

## YASKAWA AC Drive T1000A

### AC Drive for Textile Applications

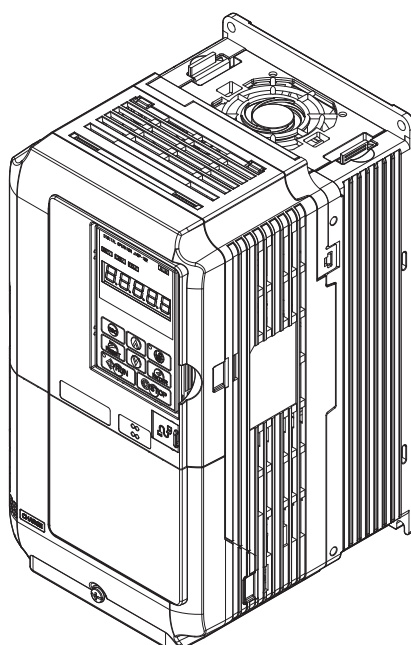
## Technical Manual

Type: CIMR-TC

Models: 200 V Class: 0.55 to 110 kW

400 V Class: 0.55 to 185 kW

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.



Receiving **1**

Mechanical Installation **2**

Electrical Installation **3**

Start-Up Programming & Operation **4**

Parameter Details **5**

Troubleshooting **6**

Periodic Inspection & Maintenance **7**

Peripheral Devices & Options **8**

Specifications **A**

Parameter List **B**

MEMOBUS/Modbus Communications **C**

Standards Compliance **D**

Quick Reference Sheet **E**

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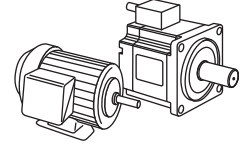
## ? Quick Reference

### Run a Motor One-Frame Larger

This drive can operate a motor one frame size larger when running variable torque loads. *Refer to C6-01: Drive Duty Mode Selection on page 162.*

### Drive a Synchronous PM Motor

T1000A can operate synchronous PM motors. *Refer to Subchart A-3: Operation with Permanent Magnet Motors on page 93.*



### Perform Auto-Tuning

Automatic tuning sets motor parameters. *Refer to Auto-Tuning on page 95.*

### Maintenance Check Using Drive Monitors

Use drive monitors to check the if fans, capacitors, and other components may require maintenance. *Refer to Performance Life Monitors Maintenance Monitors on page 350.*

### Fault Display and Troubleshooting

*Refer to Drive Alarms, Faults, and Errors on page 290 and Refer to Troubleshooting without Fault Display on page 335.*

### Standards Compliance

*Refer to European Standards on page 544 and Refer to UL Standards on page 549.*





# Table of Contents

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Quick Reference .....	3
<b>i. PREFACE &amp; GENERAL SAFETY.....</b>	<b>13</b>
<b>i.1 Preface .....</b>	<b>14</b>
Applicable Documentation .....	14
Symbols .....	14
Terms and Abbreviations .....	14
Trademarks .....	14
<b>i.2 General Safety .....</b>	<b>15</b>
Supplemental Safety Information .....	15
Safety Messages .....	16
Application Notes .....	17
Notes on Motor Operation .....	20
Applications with Specialized Motors .....	21
Drive Label Warnings .....	22
Warranty Information .....	23
<b>1. RECEIVING .....</b>	<b>25</b>
<b>1.1 Section Safety .....</b>	<b>26</b>
<b>1.2 General Description .....</b>	<b>27</b>
T1000A Model Selection .....	27
Control Mode Selection .....	28
<b>1.3 Model Number and Nameplate Check .....</b>	<b>30</b>
Nameplate .....	30
<b>1.4 Drive Models and Enclosure Types .....</b>	<b>32</b>
<b>1.5 Component Names .....</b>	<b>33</b>
IP20 Enclosure .....	33
IP00 Enclosure .....	33
Front Views .....	35
<b>2. MECHANICAL INSTALLATION.....</b>	<b>37</b>
<b>2.1 Section Safety .....</b>	<b>38</b>
<b>2.2 Mechanical Installation .....</b>	<b>40</b>
Installation Environment .....	40
Installation Orientation and Spacing .....	40
Digital Operator Remote Usage .....	42
Exterior and Mounting Dimensions .....	45
<b>3. ELECTRICAL INSTALLATION .....</b>	<b>49</b>
<b>3.1 Section Safety .....</b>	<b>50</b>
<b>3.2 Standard Connection Diagram .....</b>	<b>52</b>

<b>3.3</b>	<b>Main Circuit Configurations</b>	<b>55</b>
<b>3.4</b>	<b>Terminal Block Configuration</b>	<b>56</b>
<b>3.5</b>	<b>Terminal Cover</b>	<b>57</b>
	CIMR-T□2A0004 to 0081, 4A0002 to 0044 (IP20 Enclosure)	57
	CIMR-T□2A0110 to 0415, 4A0058 to 0362 (IP00 Enclosure)	58
<b>3.6</b>	<b>Digital Operator and Front Cover</b>	<b>59</b>
	Removing/Reattaching the Digital Operator	59
	Removing/Reattaching the Front Cover	59
<b>3.7</b>	<b>Main Circuit Wiring</b>	<b>61</b>
	Main Circuit Terminal Functions	61
	Wire Gauges and Tightening Torque	61
	Main Circuit Terminal and Motor Wiring	67
<b>3.8</b>	<b>Control Circuit Wiring</b>	<b>69</b>
	Control Circuit Connection Diagram	69
	Control Circuit Terminal Block Functions	70
	Terminal Configuration	72
	Wiring the Control Circuit Terminal	74
<b>3.9</b>	<b>Control I/O Connections</b>	<b>76</b>
	Sinking/Sourcing Mode Switch for Digital Inputs	76
	Sinking/Sourcing Mode Selection for Safe Disable Inputs	77
	Using the Photocoupler and Contact Outputs	78
	Using the Pulse Train Output	78
	Terminal A2 Input Signal Selection	79
<b>3.10</b>	<b>Connect to a PC</b>	<b>80</b>
<b>3.11</b>	<b>MEMOBUS/Modbus Termination</b>	<b>81</b>
<b>3.12</b>	<b>External Interlock</b>	<b>82</b>
	Drive Ready	82
<b>3.13</b>	<b>Wiring Checklist</b>	<b>83</b>
<b>4.</b>	<b>START-UP PROGRAMMING &amp; OPERATION</b>	<b>85</b>
<b>4.1</b>	<b>Section Safety</b>	<b>86</b>
<b>4.2</b>	<b>Using the Digital Operator</b>	<b>87</b>
	Keys and Displays	87
	Digital Text Display	88
	LED Screen Displays	88
	LO/RE LED and RUN LED Indications	89
	Menu Structure for Digital Operator	90
<b>4.3</b>	<b>The Drive and Programming Modes</b>	<b>91</b>
	Navigating the Drive and Programming Modes	91
	Changing Parameter Settings or Values	93
	Verifying Parameter Changes: Verify Menu	93
	Simplified Setup Using the Setup Group	94
	Switching Between LOCAL and REMOTE	95
<b>4.4</b>	<b>Start-Up Flowcharts</b>	<b>96</b>
	Flowchart A: Basic Start-up and Motor Tuning	96
	Subchart A-1: Simple Motor Setup Using V/f Control	97
	Subchart A-2: High Performance Operation Using OLV or CLV	98
	Subchart A-3: Operation with Permanent Magnet Motors	99
<b>4.5</b>	<b>Powering Up the Drive</b>	<b>100</b>
	Powering Up the Drive and Operation Status Display	100

<b>4.6</b>	<b>Auto-Tuning</b>	<b>101</b>
	Types of Auto-Tuning	101
	Before Auto-Tuning the Drive	104
	Auto-Tuning Interruption and Fault Codes	105
	Auto-Tuning Operation Example	105
	Parameter Settings during Induction Motor Auto-Tuning: T1	107
	Parameter Settings during PM Motor Auto-Tuning: T2	109
	Parameter Settings during Inertia and Speed Control Loop Auto-Tuning: T3	112
<b>4.7</b>	<b>No-Load Operation Test Run</b>	<b>114</b>
	No-Load Operation Test Run	114
<b>4.8</b>	<b>Test Run with Load Connected</b>	<b>115</b>
	Test Run with the Load Connected	115
<b>4.9</b>	<b>Verifying Parameter Settings and Backing Up Changes</b>	<b>116</b>
	Backing Up Parameter Values: o2-03	116
	Parameter Access Level: A1-01	116
	Password Settings: A1-04, A1-05	117
	Copy Function	117
<b>4.10</b>	<b>Test Run Checklist</b>	<b>118</b>
<b>5.</b>	<b>PARAMETER DETAILS</b>	<b>121</b>
<b>5.1</b>	<b>A: Initialization</b>	<b>122</b>
	A1: Initialization	122
	A2: User Parameters	126
<b>5.2</b>	<b>b: Application</b>	<b>127</b>
	b1: Operation Mode Selection	127
	b2: DC Injection Braking and Short Circuit Braking	134
	b3: Speed Search	137
	b4: Delay Timers	143
	b5: PID Control	143
	b6: Dwell Function	154
	b8: Energy Saving	154
	b9: Zero Servo	156
<b>5.3</b>	<b>C: Tuning</b>	<b>158</b>
	C1: Acceleration and Deceleration Times	158
	C2: S-Curve Characteristics	160
	C3: Slip Compensation	160
	C4: Torque Compensation	163
	C5: Automatic Speed Regulator (ASR)	165
	C6: Carrier Frequency	170
<b>5.4</b>	<b>d: Reference Settings</b>	<b>173</b>
	d1: Frequency Reference	173
	d2: Frequency Upper/Lower Limits	175
	d5: Torque Control	176
	d6: Field Weakening and Field Forcing	180
	d7: Offset Frequency	181
<b>5.5</b>	<b>E: Motor Parameters</b>	<b>182</b>
	E1: V/f Pattern for Motor 1	182
	E2: Motor 1 Parameters	183
	E3: V/f Pattern for Motor 2	186
	E4: Motor 2 Parameters	187
	E5: PM Motor Settings	189

<b>5.6</b>	<b>F: Option Settings</b>	<b>192</b>
	F1: PG Speed Control Card Settings	192
	F2: Analog Input Card Settings	195
	F3: Digital Input Card Settings	195
	F4: Analog Monitor Card Settings	196
	F5: Digital Output Card Settings	197
	F6: Communication Option Card	198
<b>5.7</b>	<b>H: Terminal Functions</b>	<b>200</b>
	H1: Multi-Function Digital Inputs	200
	H2: Multi-Function Digital Outputs	210
	H3: Multi-Function Analog Inputs	220
	H4: Multi-Function Analog Outputs	227
	H5: MEMOBUS/Modbus Serial Communication	229
	H6: Pulse Train Input/Output	229
<b>5.8</b>	<b>L: Protection Functions</b>	<b>232</b>
	L1: Motor Protection	232
	L2: Momentary Power Loss Ride-Thru	238
	L3: Stall Prevention	239
	L4: Speed Detection	244
	L5: Fault Restart	247
	L6: Torque Detection	248
	L7: Torque Limit	250
	L8: Drive Protection	251
<b>5.9</b>	<b>n: Special Adjustments</b>	<b>258</b>
	n1: Hunting Prevention	258
	n2: Speed Feedback Detection Control (AFR) Tuning	258
	n3: Overexcitation Deceleration	259
	n5: Feed Forward Control	261
	n6: Online Tuning	263
	n8: PM Motor Control Tuning	263
	n9: Hardware Settings	266
<b>5.10</b>	<b>o: Operator Related Settings</b>	<b>268</b>
	o1: Digital Operator Display Selection	268
	o2: Digital Operator Keypad Functions	269
	o3: Copy Function	271
	o4: Maintenance Monitor Settings	272
<b>5.11</b>	<b>S: Functions for Textile Applications</b>	<b>274</b>
	S1: Disturb Function	274
	S2: Frequency Reference Gain Settings	275
	S3: Braking Transistor and Output Voltage Gain	276
	S4: KEB Mode Selection	276
	S5: KEB Accel/Decel Settings	281
	S6: Power KEB Function	283
	S9: Synchronous Operation	285
	T: Motor Tuning	285
<b>5.12</b>	<b>U: Monitor Parameters</b>	<b>286</b>
	U1: Operation Status Monitors	286
	U2: Fault Trace	286
	U3: Fault History	286
	U4: Maintenance Monitors	286
	U5: PID Monitors	286
	U6: Operation Status Monitors	287
	U9: KEB Voltage Monitors	287

<b>6. TROUBLESHOOTING .....</b>	<b>289</b>
<b>6.1 Section Safety .....</b>	<b>290</b>
<b>6.2 Motor Performance Fine-Tuning .....</b>	<b>292</b>
Fine-Tuning V/f Control and V/f Control with PG .....	292
Fine-Tuning Open Loop Vector Control .....	293
Fine-Tuning Closed Loop Vector Control .....	294
Fine-Tuning Open Loop Vector Control for PM Motors .....	295
Fine-Tuning Advanced Open Loop Vector Control for PM Motors .....	296
Fine-Tuning Closed Loop Vector Control for PM Motors .....	296
Parameters to Minimize Motor Hunting and Oscillation .....	297
<b>6.3 Drive Alarms, Faults, and Errors .....</b>	<b>298</b>
Types of Alarms, Faults, and Errors .....	298
Alarm and Error Displays .....	299
<b>6.4 Fault Detection .....</b>	<b>303</b>
Fault Displays, Causes, and Possible Solutions .....	303
<b>6.5 Alarm Detection .....</b>	<b>320</b>
Alarm Codes, Causes, and Possible Solutions .....	320
<b>6.6 Operator Programming Errors .....</b>	<b>329</b>
oPE Codes, Causes, and Possible Solutions .....	329
Causes and Corrective Actions When the Digital Operator Goes Dark .....	333
<b>6.7 Auto-Tuning Fault Detection .....</b>	<b>334</b>
Auto-Tuning Codes, Causes, and Possible Solutions .....	334
<b>6.8 Copy Function Related Displays .....</b>	<b>338</b>
Tasks, Errors, and Troubleshooting .....	338
<b>6.9 Diagnosing and Resetting Faults .....</b>	<b>340</b>
Fault Occurs Simultaneously with Power Loss .....	340
If the Drive Still has Power After a Fault Occurs .....	340
Viewing Fault Trace Data After Fault .....	340
Fault Reset Methods .....	341
<b>6.10 Troubleshooting without Fault Display .....</b>	<b>342</b>
Common Problems .....	342
Cannot Change Parameter Settings .....	342
Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command .....	343
Motor is Too Hot .....	344
Drive Does Not Allow Selection the Desired Auto-Tuning Mode .....	345
oPE02 Error Occurs When Lowering the Motor Rated Current Setting .....	345
Motor Stalls during Acceleration or Acceleration Time is Too Long .....	345
Drive Frequency Reference Differs from the Controller Frequency Reference Command .....	346
Excessive Motor Oscillation and Erratic Rotation .....	346
Deceleration Takes Longer Than Expected with Dynamic Braking Enabled .....	346
Load Falls When Brake is Applied .....	347
Noise From Drive or Output Lines When the Drive is Powered On .....	347
Ground Fault Circuit Interrupter (GFCI) Trips During Run .....	347
Connected Machinery Vibrates When Motor Rotates .....	347
PID Output Fault .....	348
Insufficient Starting Torque .....	348
Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking) .....	348
Output Frequency is not as High as Frequency Reference .....	348
Buzzing Sound from Motor at 2 kHz .....	348
Unstable Motor Speed when Using PM .....	349
Motor Does Not Restart after Power Loss .....	349

<b>7.</b>	<b>PERIODIC INSPECTION &amp; MAINTENANCE .....</b>	<b>351</b>
7.1	Section Safety .....	352
7.2	Inspection. ....	355
	Recommended Daily Inspection .....	355
	Recommended Periodic Inspection. ....	356
7.3	Periodic Maintenance .....	358
	Replacement Parts .....	358
7.4	Cooling Fan and Circulation Fan .....	360
	Number of Fans. ....	360
	Cooling Fan Component Names .....	361
	Cooling Fan Replacement: 2A0018 to 2A0081 and 4A0007 to 4A0044 .....	362
	Cooling Fan Replacement: 2A0110 and 2A0138, 4A0058 and 4A0072 .....	364
	Cooling Fan Replacement: 4A0088 and 4A0103 .....	366
	Cooling Fan Replacement: 2A0169 to 2A0415, 4A0139 to 4A0362 .....	368
7.5	Drive Replacement .....	372
	Serviceable Parts .....	372
	Terminal Board .....	372
	Replacing the Drive .....	372
<b>8.</b>	<b>PERIPHERAL DEVICES &amp; OPTIONS .....</b>	<b>375</b>
8.1	Section Safety .....	376
8.2	Drive Options and Peripheral Devices .....	378
8.3	Connecting Peripheral Devices .....	381
8.4	Option Card Installation .....	382
	Prior to Installing the Option .....	382
	Installing the Option. ....	383
8.5	Installing Peripheral Devices .....	393
	Dynamic Braking Options .....	393
	Installing a Molded Case Circuit Breaker (MCCB) and Earth Leakage Circuit Breaker (ELCB) .....	395
	Installing a Magnetic Contactor at the Power Supply Side .....	396
	Connecting an AC or DC Reactor .....	397
	Connecting a Surge Absorber .....	397
	Connecting a Noise Filter .....	398
	Fuse/Fuse Holder .....	400
	Attachment for External Heatsink (IP00/NEMA type 1 Enclosure) .....	401
	EMC Filter Installation .....	401
	Installing a Motor Thermal Overload (oL) Relay on the Drive Output .....	401
<b>A.</b>	<b>SPECIFICATIONS .....</b>	<b>403</b>
A.1	Heavy Duty and Normal Duty Ratings .....	404
A.2	Three-Phase 200 V Class Drives .....	405
A.3	Three-Phase 400 V Class Drives .....	406
A.4	Drive Specifications .....	407
A.5	Drive Watt Loss Data .....	409
A.6	Drive Derating Data .....	411
	Rated Current Depending on Carrier Frequency .....	411
	Carrier Frequency Derating .....	412
	Temperature Derating .....	413
	Altitude Derating .....	414
<b>B.</b>	<b>PARAMETER LIST .....</b>	<b>415</b>
B.1	Understanding the Parameter Table .....	416
	Control Modes, Symbols, and Terms .....	416

<b>B.2</b>	<b>Parameter Groups</b>	<b>417</b>
<b>B.3</b>	<b>Parameter Table</b>	<b>418</b>
	A: Initialization Parameters	418
	b: Application	419
	C: Tuning	426
	d: References	431
	E: Motor Parameters	434
	F: Options	439
	H Parameters: Multi-Function Terminals	444
	L: Protection Function	457
	n: Advanced Performance Set-Up	465
	o: Operator Related Parameters	469
	S: Functions for Textile Applications	471
	T: Motor Tuning	476
	U: Monitors	480
<b>B.4</b>	<b>Parameter Defaults Determined by Control Mode (A1-02)</b>	<b>489</b>
	A1-02 (Motor 1 Control Mode) Dependent Parameters	489
	E3-01 (Motor 2 Control Mode) Dependent Parameters	492
<b>B.5</b>	<b>Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)</b>	<b>494</b>
<b>B.6</b>	<b>Parameter Defaults Determined by Motor Code (E5-01)</b>	<b>504</b>
	Yaskawa SMRA Series SPM Motor	504
	Yaskawa SSR1 Series IPM Motor (For Derated Torque)	505
	Yaskawa SST4 Series IPM Motor (For Constant Torque)	511
<b>B.7</b>	<b>Parameter Defaults Determined by Carrier Frequency Selection (C6-02)</b>	<b>517</b>
<b>B.8</b>	<b>Parameter Defaults Determined by Carrier Frequency Reduction Selection (L8-38)</b>	<b>518</b>
<b>C.</b>	<b>MEMOBUS/MODBUS COMMUNICATIONS</b>	<b>519</b>
<b>C.1</b>	<b>MEMOBUS/Modbus Configuration</b>	<b>520</b>
<b>C.2</b>	<b>Communication Specifications</b>	<b>521</b>
<b>C.3</b>	<b>Connecting to a Network</b>	<b>522</b>
	Network Cable Connection	522
	Wiring Diagram for Multiple Connection	522
	Network Termination	523
<b>C.4</b>	<b>MEMOBUS/Modbus Setup Parameters</b>	<b>524</b>
	MEMOBUS/Modbus Serial Communication	524
<b>C.5</b>	<b>Drive Operations by MEMOBUS/Modbus</b>	<b>527</b>
	Observing the Drive Operation	527
	Controlling the Drive	527
<b>C.6</b>	<b>Communications Timing</b>	<b>528</b>
	Command Messages from Master to Drive	528
	Response Messages from Drive to Master	528
<b>C.7</b>	<b>Message Format</b>	<b>529</b>
	Message Content	529
	Slave Address	529
	Function Code	529
	Data	529
	Error Check	529
<b>C.8</b>	<b>Message Examples</b>	<b>531</b>
	Reading Drive MEMOBUS/Modbus Register Contents	531
	Loopback Test	531
	Writing to Multiple Registers	532

<b>C.9</b>	<b>MEMOBUS/Modbus Data Table</b>	<b>533</b>
	Command Data	533
	Monitor Data	534
	Broadcast Messages	544
	Fault Trace Contents	544
	Alarm Register Contents	546
<b>C.10</b>	<b>Enter Command</b>	<b>547</b>
	Enter Command Types	547
	Enter Command Settings when Upgrading the Drive	547
<b>C.11</b>	<b>Communication Errors</b>	<b>548</b>
	MEMOBUS/Modbus Error Codes	548
	Slave Not Responding	548
<b>C.12</b>	<b>Self-Diagnostics</b>	<b>549</b>
<b>D.</b>	<b>STANDARDS COMPLIANCE</b>	<b>551</b>
<b>D.1</b>	<b>Section Safety</b>	<b>552</b>
<b>D.2</b>	<b>European Standards</b>	<b>554</b>
	CE Low Voltage Directive Compliance	554
	EMC Guidelines Compliance	556
<b>D.3</b>	<b>UL Standards</b>	<b>560</b>
	UL Standards Compliance	560
	Drive Motor Overload Protection	568
	Precautionary Notes on External Heatsink (IP00 Enclosure)	570
<b>D.4</b>	<b>Safe Disable Input Function</b>	<b>571</b>
	Specifications	571
	Precautions	571
	Using the Safe Disable Function	571
<b>E.</b>	<b>QUICK REFERENCE SHEET</b>	<b>575</b>
<b>E.1</b>	<b>Drive and Motor Specifications</b>	<b>576</b>
	Drive	576
	Motor	576
<b>E.2</b>	<b>Multi-Function I/O Terminal Settings Record</b>	<b>577</b>
	Multi-Function Digital Inputs (SC Common)	577
	Pulse Train Input/Analog Inputs (AC Common)	577
	Multi-Function Digital Outputs	577
	Multi-Function Photocoupler Outputs (PC Common)	577
	Monitor Outputs (AC Common)	577
<b>E.3</b>	<b>User Setting Table</b>	<b>578</b>
<b>Index</b>		<b>585</b>
<b>Revision History</b>		<b>599</b>

# Preface & General Safety

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This section provides safety messages pertinent to this product that, if not heeded, may result in fatality, personal injury, or equipment damage. Yaskawa is not responsible for the consequences of ignoring these instructions.

<b>i.1</b>	<b>PREFACE</b> .....	<b>14</b>
<b>i.2</b>	<b>GENERAL SAFETY</b> .....	<b>15</b>

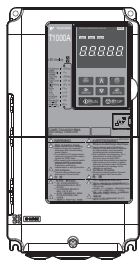
# i.1 Preface

Yaskawa manufactures products used as components in a wide variety of industrial systems and equipment. The selection and application of Yaskawa products remain the responsibility of the equipment manufacturer or end user. Yaskawa accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any Yaskawa product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All systems or equipment designed to incorporate a product manufactured by Yaskawa must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by Yaskawa must be promptly provided to the end user. Yaskawa offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the Yaskawa manual. **NO OTHER WARRANTY, EXPRESSED OR IMPLIED, IS OFFERED.** Yaskawa assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

This manual is designed to ensure correct and suitable application of T1000A-Series Drives. Read this manual before attempting to install, operate, maintain, or inspect a drive and keep it in a safe, convenient location for future reference. Be sure you understand all precautions and safety information before attempting application.

## ? Applicable Documentation

The following manuals are available for T1000A series drives:

	T1000A Series AC Drive Safety Precautions
	This guide is packaged together with the product. Covers safety precautions, model numbers, and wiring for the drive. It is meant to get the drive ready for a trial run with the application and for basic operation.
	T1000A Series AC Drive Technical Manual (this book)
	This manual includes a detailed explanation of the T1000A and instructions on usage. Always refer to the Technical Manual whenever performing any installation, wiring, troubleshooting, or operation procedures. The Technical Manual is not packaged with the T1000A. Contact a Yaskawa representative or the Yaskawa sales department directly to receive a copy of the Technical Manual.

## ? Symbols

**Note:** Indicates a supplement or precaution that does not cause drive damage.



: Indicates a term or definition used in this manual.

## ? Terms and Abbreviations



- **Drive:** Yaskawa T1000A Series Drive
- **V/f:** V/f Control
- **V/f w/PG:** V/f Control with PG
- **OLV:** Open Loop Vector Control
- **CLV:** Closed Loop Vector Control
- **OLV/PM:** Open Loop Vector Control for PM
- **AOLV/PM:** Advanced Open Loop Vector Control for PM
- **CLV/PM:** Closed Loop Vector Control for PM
- **PM motor:** Permanent Magnet Synchronous motor (an abbreviation for IPM motor or SPM motor)
- **IPM motor:** Interior Permanent Magnet Motor (such as Yaskawa’s SSR1 Series and SST4 Series motors)
- **SPM motor:** Surface mounted Permanent Magnet Motor (such as Yaskawa’s SMRA Series motors)

## ? Trademarks

- CC-Link is a trademark of CC-Link Partner Association (CLPA).
- PROFIBUS-DP is a trademark of PROFIBUS International (PI).
- MECHATROLINK-II is a trademark of MECHATROLINK Members Association (MMA).
- Other companies and product names mentioned in this manual are trademarks of those companies.

## i.2 General Safety

### ? Supplemental Safety Information

#### General Precautions

- The diagrams in this manual may be indicated without covers or safety shields to show details. Restore covers or shields before operating the drive and run the drive according to the instructions described in this manual.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
- When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representative or the nearest Yaskawa sales office and provide the manual number shown on the front cover.
- If nameplate becomes worn or damaged, order a replacement from your Yaskawa representative or the nearest Yaskawa sales office.

#### WARNING

Read and understand this manual before installing, operating or servicing this drive. The drive must be installed according to this manual and local codes.

The following conventions are used to indicate safety messages in this manual. Failure to heed these messages could result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

#### DANGER

Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.

#### WARNING

Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.

**WARNING!** will also be indicated by a bold key word embedded in the text followed by an italicized safety message.

#### CAUTION

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

**CAUTION!** will also be indicated by a bold key word embedded in the text followed by an italicized safety message.

#### NOTICE

Indicates a property damage message.

**NOTICE:** will also be indicated by a bold key word embedded in the text followed by an italicized safety message.

### ? Safety Messages

#### DANGER

**Heed the safety messages in this manual.**

Failure to comply will result in death or serious injury.

The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

#### **Electrical Shock Hazard**

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

#### WARNING

#### **Sudden Movement Hazard**

**System may start unexpectedly upon application of power, resulting in death or serious injury.**

Clear all personnel from the drive, motor and machine area before applying power. Secure covers, couplings, shaft keys and machine loads before applying power to the drive.

#### **Electrical Shock Hazard**

**Do not attempt to modify or alter the drive in any way not explained in this manual.**

Failure to comply could result in death or serious injury.

Yaskawa is not responsible for any modification of the product made by the user. This product must not be modified.

**Do not allow unqualified personnel to use equipment.**

Failure to comply could result in death or serious injury.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

#### **Fire Hazard**

**Do not use an improper voltage source.**

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

#### CAUTION

#### **Crush Hazard**

**Do not carry the drive by the front cover.**

Failure to comply may result in minor or moderate injury from the main body of the drive falling.

**NOTICE**

**Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Do not perform a withstand voltage test and megger test on any part of the drive.**

Failure to comply could result in damage to the sensitive devices within the drive.

**Do not operate damaged equipment.**

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

**When a fuse blows or if drive power has been interrupted, wait briefly before switching the power back on or operating the peripheral devices.**

Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified.

**Install adequate branch circuit short circuit protection per applicable codes.**

Failure to comply could result in damage to the drive.

The drive is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class) and 480 Vac maximum (400 V Class).

**Do not expose the drive to halogen group disinfectants.**

Failure to comply may cause damage to the electrical components in the drive.

Do not pack the drive in wooden materials that have been fumigated or sterilized.

Do not sterilize the entire package after the product is packed.

### ? Application Notes

#### ? Selection

##### Installing a Reactor

An AC or DC reactor can be used for the following:

- to suppress harmonic current.
- to smooth peak current that results from capacitor switching.
- when the power supply is above 600 kVA.
- when the drive is running from a power supply system with thyristor converters.

**Note:** A DC reactor is built in to models CIMR-T□2A0110 to 2A0415 and CIMR-T□4A0058 to 4A0362.

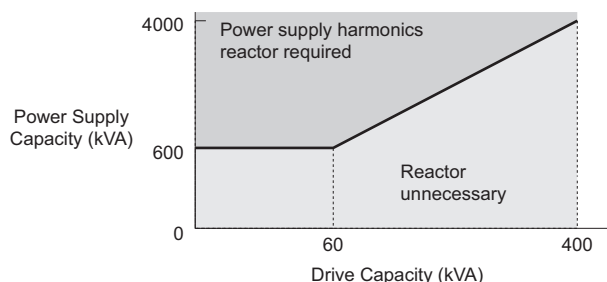


Figure i.1 Installing a Reactor

##### Drive Capacity

For specialized motors, make sure that the motor rated current is less than rated output current for the drive. When running more than one motor in parallel from a single drive, the capacity of the drive should be larger than 1.1 times of the total motor rated current.

##### Starting Torque

The overload rating for the drive determines the starting and accelerating characteristics of the motor. Expect lower torque than when running from line power. To get more starting torque, use a larger drive or increase both the motor and drive capacity.

##### Emergency Stop

When the drive faults out, the output is shut off. This, however, does not stop the motor immediately. Some type of mechanical brake may be needed if it is necessary to halt the motor faster than the Fast Stop function is able to.

##### Options

The B1, B2, +1, +2, and +3 terminals are used to connect optional devices. Connect only T1000A-compatible devices.

### ? Installation

##### Enclosure Panels

Keep the drive in a clean environment by either selecting an area free of airborne dust, lint, and oil mist, or install the drive in an enclosure panel. Be sure to leave the required space between drives to provide for cooling, and that proper measures are taken so that the ambient temperature remains within allowable limits. Keep flammable materials away from the drive. If the drive must be used in an area where it is subjected to oil mist and excessive vibration, protective designs are available. Contact Yaskawa or your Yaskawa agent for details.

##### Installation Direction

The drive should be installed upright as specified in the manual. For more information on installation, [Refer to Mechanical Installation on page 36](#).

### ? Settings

##### Upper Limits

The drive is capable of running the motor up to 400 Hz. Due to the danger of accidentally of operating at high speed, be sure to set the upper limit for the frequency. The default setting for the maximum output frequency is 50 Hz.

## DC Injection Braking

Motor overheat can result if there is too much current used during DC Injection Braking, or if the time for DC Injection Braking is too long.

## Acceleration/Deceleration Times

Acceleration and deceleration times are affected by how much torque the motor generates, the load torque, and the inertia moment. Set a longer accel/decel time when Stall Prevention is enabled. The accel/decel times are lengthened for as long as the Stall Prevention function is operating. For faster acceleration and deceleration, install one of the braking options available or increase the capacity of the drive.

## ? General Handling

### Wiring Check

Never connect the power supply lines to output terminals U/T1, V/T2, or W/T3. Doing so will destroy the drive. Be sure to perform a final check of all sequence wiring and other connections before turning the power on. Make sure there are no short circuits on the control terminals (+V, AC, etc.), as this could damage the drive.

### Selecting a Circuit Breaker or Leakage Circuit Breaker

Yaskawa recommends installing equipment for residual current monitoring/detection (RCM/RCD) to the power supply side. The RCM/RCD should be designed for use with an AC drive (e.g. Type B according to IEC/EN 60755).

Select a MCCB (Molded Case Circuit Breaker) or RCM/RCD with a rated current that is 1.5 to 2 times higher than the rated current of the drive in order to avoid nuisance trips caused by harmonics in the drive input current. Also refer to *Installing a Molded Case Circuit Breaker (MCCB) on page 386*.

### Magnetic Contactor Installation

Use a magnetic contactor (MC) to ensure that power to the drive can be completely shut off when necessary. The MC should be wired so that it opens when a fault output terminal is triggered.

Avoid switching a magnetic contactor on the power supply side more frequently than once every 30 minutes. Frequent switching can cause damage to the drive.

### Inspection and Maintenance

Capacitors in the drive take time to discharge even after the power has been shut off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

The heatsink can become quite hot during operation, and proper precautions should be taken to prevent burns. When replacing the cooling fan, shut off the power and wait at least 15 minutes to be sure that the heatsink has cooled down.

Even when the power has been shut off for a drive running a PM motor, voltage continues to be generated at the motor terminals while the motor coasts to stop. Take the precautions described below to prevent shock and injury:

- In Applications where the machine can still rotate even though the drive has fully stopped a load switch for disconnecting motor and drive should be installed to the output side of the drive.
- Do not allow an external force to rotate the motor beyond the maximum allowable speed, also when the drive has been shut off.
- Wait for at least the time specified on the warning label after opening the load switch on the output side before inspecting the drive or performing any maintenance.
- Do not open and close the load switch while the motor is running, as this can damage the drive.
- If the motor is coasting, make sure the power to the drive is turned on and the drive output has completely stopped before closing the load switch.

### Wiring

All wire ends should use ring terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

### Transporting the Drive

Never steam clean the drive.

During transport, keep the drive from coming into contact with salts, fluorine, bromine, phthalate ester, and other such harmful chemicals.

### ? Notes on Motor Operation

#### ? Using a Standard Motor

##### Low Speed Range

The cooling fan of a standard motor is usually designed to sufficiently cool the motor at the rated speed. As the self-cooling capability of such a motor reduces with the speed, applying full torque at low speed will possibly damage the motor. To prevent motor damage from overheat, reduce the load torque as the motor slows.

##### Insulation Tolerance

Consider voltage tolerance levels and insulation in applications with an input voltage of over 440 V or particularly long wiring distances. Contact Yaskawa or your Yaskawa agent for consultation.

##### High Speed Operation

Problems may occur with the motor bearings and dynamic balance of the machine when operating a motor beyond its rated speed. Contact the motor or machine manufacturer.

##### Torque Characteristics

Torque characteristics differ compared to operating the motor directly from line power. The user should have a full understanding of the load torque characteristics for the application.

##### Vibration and Shock

T1000A lets the user choose between high carrier PWM control and low carrier PWM. Selecting high carrier PWM can help reduce motor oscillation.

Take particular caution when using a variable speed drive for an application that is conventionally run from line power at a constant speed. If resonance occurs shock-absorbing rubber should be installed around the base of the motor.

##### Audible Noise

Noise created during run varies by the carrier frequency setting. When using a high carrier frequency, audible noise from the motor is comparable to the motor noise generated when running from line power. Operating above the rated r/min, however, can create unpleasant motor noise.

#### ? Using a Synchronous Motor

- Contact Yaskawa or your Yaskawa agent if you plan to use any other synchronous motor not endorsed by Yaskawa.
- A single drive is not capable of running multiple synchronous motors at the same time. Use a standard induction motor for such setups.
- At start, a synchronous motor may rotate slightly in the opposite direction of the Run command depending on parameter settings and rotor position.
- The amount of starting torque that can be generated differs by each control mode and by the type of motor being used. Set up the motor with the drive after verifying the starting torque, allowable load characteristics, impact load tolerance, and speed control range.

Contact Yaskawa or your Yaskawa agent if you plan to use a motor that does not fall within these specifications.

- In Open Loop Vector Control for PM motors, braking torque is less than 125% when running between 20% to 100% speed, even with a braking resistor. Braking torque drops to less than half when running at less than 20% speed.
- In Open Loop Vector Control for PM motors, the allowable load inertia moment is approximately 50 times higher than the motor inertia moment or less. Contact Yaskawa or your Yaskawa agent concerning applications with a larger inertia moment.
- When using a holding brake in Open Loop Vector Control for PM motors, release the brake prior to starting the motor. Failure to set the proper timing can result in speed loss. Not for use with conveyor, transport, or hoist type applications.
- To restart a coasting motor rotating at over 200 Hz while in the V/f control mode, use the Short Circuit Braking function to first bring the motor to a stop. Short Circuit Braking requires a special braking resistor. Contact Yaskawa or your Yaskawa agent for details.

Speed Search can be used to restart a coasting motor rotating slower than 200 Hz. If the motor cable is relatively long, however, the motor should instead be stopped using Short Circuit Braking, which forces the motor to stop by creating a short-circuit in the motor windings.

- If oC (Overcurrent), STo (Pull-Out Detection) or LSo (LSO Fault) occurs, adjust the motor by retrying Speed Search and using the Short Circuit Braking function on starting.

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## ? Applications with Specialized Motors

### ? Applications with Specialized Motors

#### **Multi-Pole Motor**

Because the rated current will differ from a standard motor, be sure to check the maximum current when selecting a drive. Always stop the motor before switching between the number of motor poles. If a regen overvoltage fault occurs or if overcurrent protection is triggered, the motor will coast to stop.

#### **Submersible Motor**

Because motor rated current is greater than a standard motor, select the drive capacity accordingly. Be sure to use a large enough motor cable to avoid decreasing the maximum torque level on account of voltage drop caused by a long motor cable.

#### **Explosion-Proof Motor**

Both the motor and drive need to be tested together to be certified as explosion-proof. The drive is not designed for explosion proof areas.

Furthermore, if an encoder is attached to an explosion-proof motor make sure the encoder is explosion-proof too. Use an insulating signal converter for connecting the encoder signal lines to the drives speed feedback option card.

#### **Geared Motor**

To avoid gear damage when operating at low speeds or very high speeds, make sure that both the gear and lubricant are rated for the desired speed range. Consult with the manufacturer for applications that require operation outside the rated speed range of the motor or gear box.

#### **Single-Phase Motor**


Variable speed drives are not designed for operation with single phase motors. Using capacitors to start the motor causes excessive current to flow and can damage drive components. A split-phase start or a repulsion start can end up burning out the starter coils because the internal centrifugal switch is not activated. T1000A is for use with 3-phase motors only.


#### **Motor with Brake**

Caution should be taken when using a drive to operate a motor with a built-in holding brake. If the brake is connected to the output side of the drive, it may not release at start due to low voltage levels. A separate power supply should be installed for the motor brake. Motors with a built-in brake tend to generate a fair amount of noise when running at low speeds.


### ? Drive Label Warnings

Always heed the warning information listed in *Figure i.2* in the position shown in *Figure i.3*.

**WARNING**

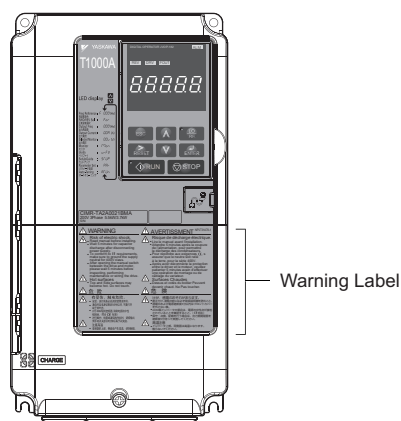


- Risk of electric shock.
- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.
- To conform to CE requirements, make sure to ground the supply neutral for 400V class.
- After opening the manual switch between the drive and motor, please wait 5 minutes before inspecting, performing maintenance or wiring the drive.

**Hot surfaces**

- Top and Side surfaces may become hot. Do not touch.

**Figure i.2 Warning Information**



**Figure i.3 Warning Information Position**

### ? Warranty Information

#### ? Restrictions

T1000A was not designed or manufactured for use in devices or systems that may directly affect or threaten human lives or health.

Customers who intend to use the product described in this manual for devices or systems relating to transportation, health care, space aviation, atomic power, electric power, or in underwater applications must first contact their Yaskawa representatives or the nearest Yaskawa sales office.

This product has been manufactured under strict quality-control guidelines. However, if this product is to be installed in any location where failure of this product could involve or result in a life-and-death situation or loss of human life or in a facility where failure may cause a serious accident or physical injury, safety devices must be installed to minimize the likelihood of any accident.

# Receiving

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This chapter explains how to inspect the drive upon receipt, and gives an overview of the different enclosure types and components.

<b>1.1</b>	<b>SECTION SAFETY .....</b>	<b>24</b>
<b>1.2</b>	<b>GENERAL DESCRIPTION .....</b>	<b>25</b>
<b>1.3</b>	<b>MODEL NUMBER AND NAMEPLATE CHECK .....</b>	<b>28</b>
<b>1.4</b>	<b>DRIVE MODELS .....</b>	<b>30</b>
<b>1.5</b>	<b>COMPONENT NAMES .....</b>	<b>31</b>

# 1.1 Section Safety

### CAUTION

**Do not carry the drive by the front cover or the terminal cover.**

Failure to comply may cause the main body of the drive to fall, resulting in minor or moderate injury.

### NOTICE

**Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**A motor connected to a PWM drive may operate at a higher temperature than a utility-fed motor and the operating speed range may reduce motor cooling capacity.**

Ensure that the motor is suitable for drive duty and/or the motor service factor is adequate to accommodate the additional heating with the intended operating conditions.

## 1.2 General Description

### ? T1000A Model Selection

**Table 1.1** gives a reference for drive selection depending on the motor power and Normal or Heavy Duty rating.

**Note:** The models and capacities in shown here are based on standard settings and operation conditions. Derating is required for higher carrier frequencies and higher ambient temperatures.

**Table 1.1 T1000A Models**

Motor Power (kW)	3-Phase 200 V Class				3-Phase 400 V Class			
	Heavy Duty Rating		Normal Duty Rating		Heavy Duty Rating		Normal Duty Rating	
	Model CIMR-T□	Rated Output Current (A)	Model CIMR-T□	Rated Output Current (A) <3>	Model CIMR-T□	Rated Output Current (A)	Model CIMR-T□	Rated Output Current (A) <3>
	2A0004	3.2 <1>	—	—	4A0002	1.8 <1>	—	—
0.75	—	—	2A0004	3.5	4A0004	3.4 <1>	4A0002	2.1
1.1	2A0006	5 <1>	2A0006	6	—	—	—	—
1.5	2A0010	8 <1>	—	—	4A0005	4.8 <1>	4A0004	4.1
2.2	2A0012	11 <1>	2A0010	9.6	4A0007	5.5 <1>	4A0005	5.4
3.0	—	—	2A0012	12	4A0009	7.2 <1>	4A0007	6.9
4.0	2A0021	17.5 <1>	—	—	4A0011	9.2 <1>	4A0009	8.8
5.5	2A0030	25 <1>	2A0021	21	4A0018	14.8 <1>	4A0011	11.1
7.5	2A0040	33 <1>	2A0030	30	4A0023	18 <1>	4A0018	17.5
11	2A0056	47 <1>	2A0040	40	4A0031	24 <1>	4A0023	23
15	2A0069	60 <1>	2A0056	56	4A0038	31 <1>	4A0031	31
18.5	2A0081	75 <1>	2A0069	69	4A0044	39 <1>	4A0038	38
22	2A0110	85 <1>	2A0081	81	4A0058	45 <1>	4A0044	44
30	2A0138	115 <1>	2A0110	110	4A0072	60 <1>	4A0058	58
37	2A0169	145 <2>	2A0138	138	4A0088	75 <1>	4A0072	72
45	2A0211	180 <2>	2A0169	169	4A0103	91 <1>	4A0088	88
55	2A0250	215 <2>	2A0211	211	4A0139	112 <2>	4A0103	103
75	2A0312	283 <2>	2A0250	250	4A0165	150 <2>	4A0139	139
90	2A0360	346 <2>	2A0312	312	4A0208	180 <2>	4A0165	165
110	2A0415	415 <2>	2A0360	360	4A0250	216 <2>	4A0208	208
	—	—	2A0415	415	—	—	—	—
132	—	—	—	—	4A0296	260 <2>	4A0250	250
160	—	—	—	—	4A0362	304 <2>	4A0296	296
185	—	—	—	—	—	—	4A0362	362

<1> These values assume the carrier frequency is not set higher than 8 kHz.

<2> These values assume the carrier frequency is not set higher than 5 kHz.

<3> These values assume the carrier frequency is set to 2 kHz.

**Note:** Current derating is required when setting the carrier frequency higher. *Refer to Carrier Frequency Derating on page 402* for details.

## 1.2 General Description

### ? Control Mode Selection

*Table 1.2* gives an overview of the T1000A control modes and their various features.

**Table 1.2 Control Modes and their Features**

Motor Type		Induction Motors, Induction Synchronous Motors		Induction Motors		Permanent Magnet Motors			Comments
Control Mode		V/f	V/f w/PG	OLV	CLV	OLV/PM	AOLV/PM	CLV/PM	–
Parameter Setting		A1-02 = 0	A1-02 = 1	A1-02 = 2	A1-02 = 3	A1-02 = 5	A1-02 = 6	A1-02 = 7	Default Setting is Open Loop Vector Control.
Basic Description		V/f control	V/f control using motor speed feedback	Open Loop Vector control	Closed Loop Vector control	Open Loop Vector control for PM motors	Open Loop Vector control for IPM motors	Closed Loop Vector control for PM motors	–
Type of Applications	Motor Type	IM	IM	IM	IM	PM	IPM	PM	–
	Multi Motor	YES	N/A	N/A	N/A	N/A	N/A	N/A	–
	Motor data unknown	YES	N/A	N/A	N/A	N/A	N/A	N/A	–
	High Speed Accuracy	N/A	YES	YES	YES	YES	YES	YES	–
	High Speed Response	N/A	N/A	YES	YES	N/A	YES	YES	–
	Zero Speed Control	N/A	N/A	N/A	YES	N/A	YES	YES	–
	Torque Control Operation	N/A	N/A	N/A	YES	N/A	YES	YES	–
	Torque Limit Operation	N/A	N/A	YES	YES	N/A	N/A	YES	–
PG Option Card		N/A	PG-B3 or PG-X3	N/A	PG-B3 or PG-X3	N/A	N/A	PG-X3	–
Control Characteristics	Speed Control Range	1:40	1:40	1:200	1:1500	1:20	1:100	1:1500	May fluctuate with characteristics and motor temperature.
	Speed Accuracy	±2 to 3%	±0.03%	±0.2%	±0.02%	±0.2%	±0.2%	±0.02%	Speed deviation when operating at constant speed. May fluctuate with characteristics and motor temperature.
	Speed Response	3 Hz (approx.)	3 Hz (approx.)	10 Hz	50 Hz	10 Hz	10 Hz	50 Hz	Max. frequency of a speed reference signal that the drive can follow. May fluctuate with characteristics and motor temperature.
	Starting Torque	150% at 3 Hz	150% at 3 Hz	200% at 0.3 Hz	200% at 0 r/min	100% at 5% speed	200% at 0 r/min	200% at 0 r/min	May fluctuate with characteristics and motor temperature. Performance may differ by capacity.

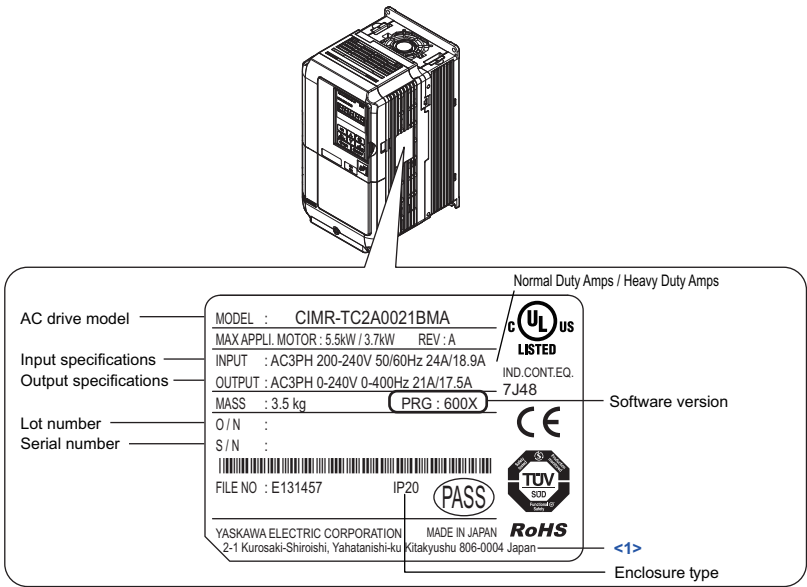
Motor Type		Induction Motors, Induction Synchronous Motors		Induction Motors		Permanent Magnet Motors			Comments
Application-Specific	Auto-Tuning	• Energy Saving Tuning • Termination resistor	• Energy Saving Tuning • Termination resistor	• Rotational • Stationary • Termination resistor	• Rotational • Stationary • Termination resistor • ASR • Inertia	• Stationary • Termination resistor	• Stationary • Termination resistor	• Stationary resistor • ASR • Inertia • Encoder Offset	Automatically adjusts parameter settings that concern electrical characteristics of the motor.
	Torque Limit	N/A	N/A	YES	YES	N/A	YES	YES	Sets the maximum torque for the motor to protect the load and connected machinery.
	Torque Control	N/A	N/A	N/A	YES	N/A	N/A	YES	Allows direct control of motor torque for tension control and other such applications.
	Zero Servo Control	N/A	N/A	N/A	YES	N/A	N/A	YES	Locks the rotor position.
	Speed Search	YES	YES	YES	–	YES	YES	YES	Bi-directional speed detection of a coasting motor to restart it without stopping.
	Energy-Saving Control	YES	YES	YES	YES	N/A	YES (IPM motors only)	YES (IPM motors only)	Saves energy by always operating the motor at its maximum efficiency.
	Feed Forward Control	N/A	N/A	N/A	YES	N/A	N/A	YES	Improves speed accuracy when the load changes by compensating effects of the system inertia.
	Kinetic Energy Buffering	YES	YES	YES	YES	YES	YES	YES	Decelerates the drive to allow it to ride through a momentary power loss and continue operation.
	Overexcitation Deceleration	YES	YES	YES	YES	N/A	N/A	N/A	Provides fast deceleration without using a braking resistor.
	Inertia Tuning, ASR Tuning	N/A	N/A	N/A	YES	N/A	N/A	YES	Provides automatic Speed Control and Feed Forward function tuning.
	Overvoltage Suppression	YES	YES	YES	YES	YES	YES	YES	Prevents overvoltage by reducing regenerative torque in application where constant speed is not required. <b>Note:</b> The drive cannot reduce regenerative torque when using the V/f Control mode. Instead try increasing the frequency level to avoid overvoltage in V/f Control.
	High Frequency Injection	N/A	N/A	N/A	N/A	N/A	YES (IPM motors only)	N/A	Greatly increases the speed control range of an IPM motor.
	Disturb Function	YES	N/A	N/A	N/A	N/A	N/A	N/A	The Disturb Function changes the frequency reference in periodic intervals.

1.3 Model Number and Nameplate Check

Please perform the following tasks after receiving the drive:

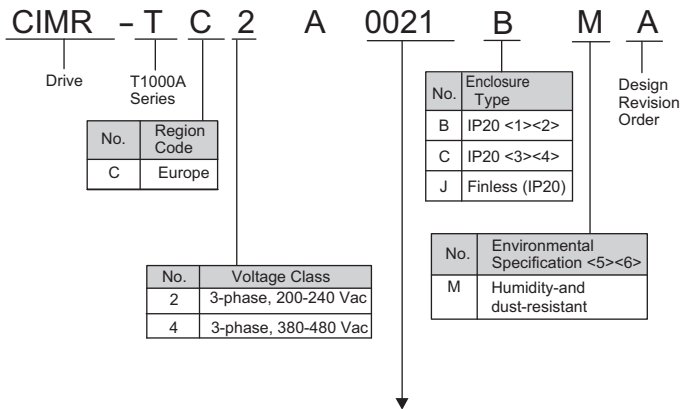
- Inspect the drive for damage.  
If the drive appears damaged upon receipt, contact the shipper immediately.
- Verify receipt of the correct model by checking the information on the nameplate.
- If you have received the wrong model or the drive does not function properly, contact your supplier.

? Nameplate



<1> The address of the head office of Yaskawa Electric Corporation (responsible for product liability) is shown on the nameplate.

Figure 1.1 Nameplate Information



? Three-Phase 200 V

Normal Duty (C6-01 = 1)		
No.	Max. Motor Capacity kW	Rated Output Current A
0004	0.75	3.5
0006	1.1	6.0
0010	2.2	9.6
0012	3.0	12
0021	5.5	21
0030	7.5	30
0040	11	40

Heavy Duty (C6-01 = 0)		
No.	Max. Motor Capacity kW	Rated Output Current A
0004	0.55	3.2
0006	1.1	5
0010	1.5	8
0012	2.2	11
0021	4.0	17.5
0030	5.5	25
0040	7.5	33

Normal Duty (C6-01 = 1)		
No.	Max. Motor Capacity kW	Rated Output Current A
0056	15	56
0069	18.5	69
0081	22	81
0110	30	110
0138	37	138
0169	45	169
0211	55	211
0250	75	250
0312	90	312
0360	110	360
0415	110	415

Heavy Duty (C6-01 = 0)		
No.	Max. Motor Capacity kW	Rated Output Current A
0056	11	47
0069	15	60
0081	18.5	75
0110	22	85
0138	30	115
0169	37	145
0211	45	180
0250	55	215
0312	75	283
0360	90	346
0415	110	415

### ? Three-Phase 400 V

Normal Duty (C6-01 = 1)		
No.	Max. Motor Capacity kW	Rated Output Current A
0002	0.75	2.1
0004	1.5	4.1
0005	2.2	5.4
0007	3.0	6.9
0009	4.0	8.8
0011	5.5	11.1
0018	7.5	17.5
0023	11	23
0031	15	31
0038	18.5	38
0044	22	44
0058	30	58
0072	37	72
0088	45	88
0103	55	103
0139	75	139
0165	90	165
0208	110	208
0250	132	250
0296	160	296
0362	185	362

Heavy Duty (C6-01 = 0)		
No.	Max. Motor Capacity kW	Rated Output Current A
0002	0.55	1.8
0004	1.1	3.4
0005	1.5	4.8
0007	2.2	5.5
0009	3.0	7.2
0011	4.0	9.2
0018	5.5	14.8
0023	7.5	18
0031	11	24
0038	15	31
0044	18.5	39
0058	22	45
0072	30	60
0088	37	75
0103	45	91
0139	55	112
0165	75	150
0208	90	180
0250	110	216
0296	132	260
0362	160	304

- <1> IP20 (code B) is available for the following drive models: CIMR-T□2A0004 through 0138, CIMR-T□4A0002 through 0103.  
 <2> These units fulfill IP20 requirements and provide wire bending space (space between terminals and cable entry point) as recommended in the IEC/EN 61800-5.  
 <3> IP20 (code C) is available for the following drive models: CIMR-T□2A0169 through 0415, CIMR-T□4A0139 through 0362.  
 <4> These units fulfill IP20 requirements, but the wire bending space provided is lower than recommended in the IEC/EN 61800-5.  
 <5> Drives with these specifications do not guarantee complete protection for the specified environmental condition.  
 <6> Contact Yaskawa for information about using drives in environments other than specified in this manual.

**Note:** 1. Refer to *Drive Models on page 30* for differences regarding enclosure protection types and component descriptions.  
 2. Use parameter C6-01 to select Heavy Duty (HD) or Normal Duty (ND) for the application. The default setting is HD.

## 1.4 Drive Models

Two types of T1000A drives are offered, heatsink cooled and finless drives.

*Table 1.3* describes drive models.

**Table 1.3 Drive Models**

Voltage Class	Heatsink Cooled Drives	Finless Drives
	2A0004B	Not Available
	2A0006B	
	2A0010B	
	2A0012B	
	2A0021B	
	2A0030B	
	2A0040B	
	2A0056B	
	2A0069B	
	2A0081B	
	2A0110B	
	2A0138B	
	2A0169C	
	2A0211C	
	2A0250C	
	2A0312C	
	2A0360C	
	2A0415C	
Three-Phase 400 V Class	4A0002B	Under Development
	4A0004B	
	4A0005B	
	4A0007B	
	4A0009B	
	4A0011B	
	4A0018B	
	4A0023B	
	4A0031B	
	4A0038B	
	4A0044B	Not Available
	4A0058B	
	4A0072B	
	4A0088B	
	4A0103B	
	4A0139C	
	4A0165C	
	4A0208C	
	4A0250C	
	4A0296C	
	4A0362C	

## 1.5 Component Names

This section gives an overview of the drive components described in this manual.

- Note:** 1. See [Using the Digital Operator on page 81](#) for a description of the operator keypad.  
2. The drive may have no cooling fans or only one cooling fan depending on the model.

### ? Heatsink Cooled Drives

#### ? Three-Phase AC200 V CIMR-T□2A0004B to 0081B

#### Three-Phase AC400 V CIMR-T□4A0002B to 0044B

Table 1.4 Exploded View of Drive Components (CIMR-T□2A0030B)

	A - Fan cover <1>
	B - Cooling fan <1>
	C - Mounting hole
	D - Heatsink
	E - Optional 24 V DC power supply connector cover
	F - Terminal board
	G - Bottom cover
	H - Rubber bushing
	I - Front cover
	J - USB port (type-B)
	K - Digital Operator
	L - Terminal cover
	M - Terminal cover screw

<1> The following drive models have a single cooling fan: CIMR-T□2A0021, CIMR-T□4A0007 to 0011. Drives CIMR-T□2A0004 to 0012 and CIMR-T□4A0002 to 0005 do not have a cooling fan or a cooling fan cover.

#### ? Three-Phase AC200 V CIMR-T□2A0110B to 0211C

#### Three-Phase AC400 V CIMR-T□4A0058B to 0165C

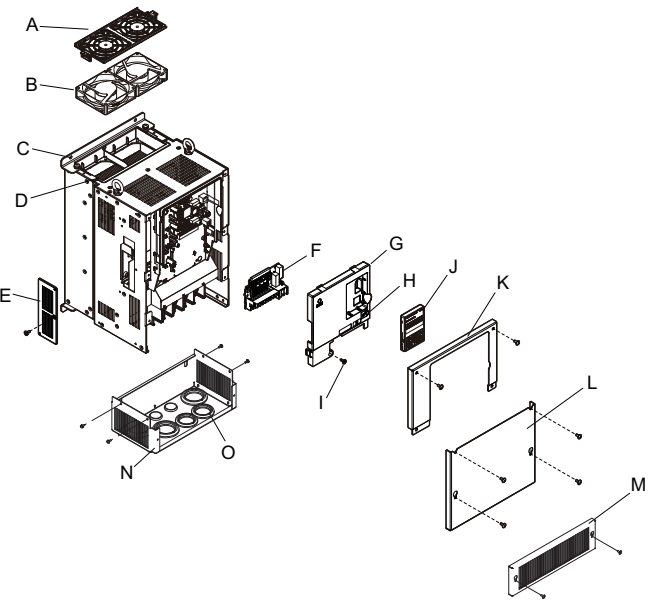
Table 1.5 Exploded View of Drive Components (CIMR-T□2A0110C)

	A - Fan cover
	B - Cooling fan
	C - Mounting hole
	D - Heatsink
	E - Optional 24 V DC power supply connector cover
	F - Terminal board
	G - Front cover
	H - USB port (type-B)
	I - Front cover screw
	J - Digital operator
	K - Drive Cover
	L - Terminal cover
	M - Bottom front cover
	N - Bottom cover
	O - Rubber bussing

1.5 Component Names

? Three-Phase AC200 V CIMR-T□2A0250C to 0415C  
Three-Phase AC400 V CIMR-T□4A0208C to 0362C

Table 1.6 Exploded View of Drive Components (CIMR-T□2A0415C)

	A - Fan cover
	B - Cooling fan
	C - Mounting hole
	D - Heatsink
	E - Optional 24 V DC power supply connector cover
	F - Terminal board
	G - Front cover
	H - USB port (type-B)
	I - Front cover screw
	J - Digital operator
	K - Drive Cover
	L - Terminal cover
	M - Bottom front cover
	N - Bottom cover
	O - Rubber bussing

? Front Views

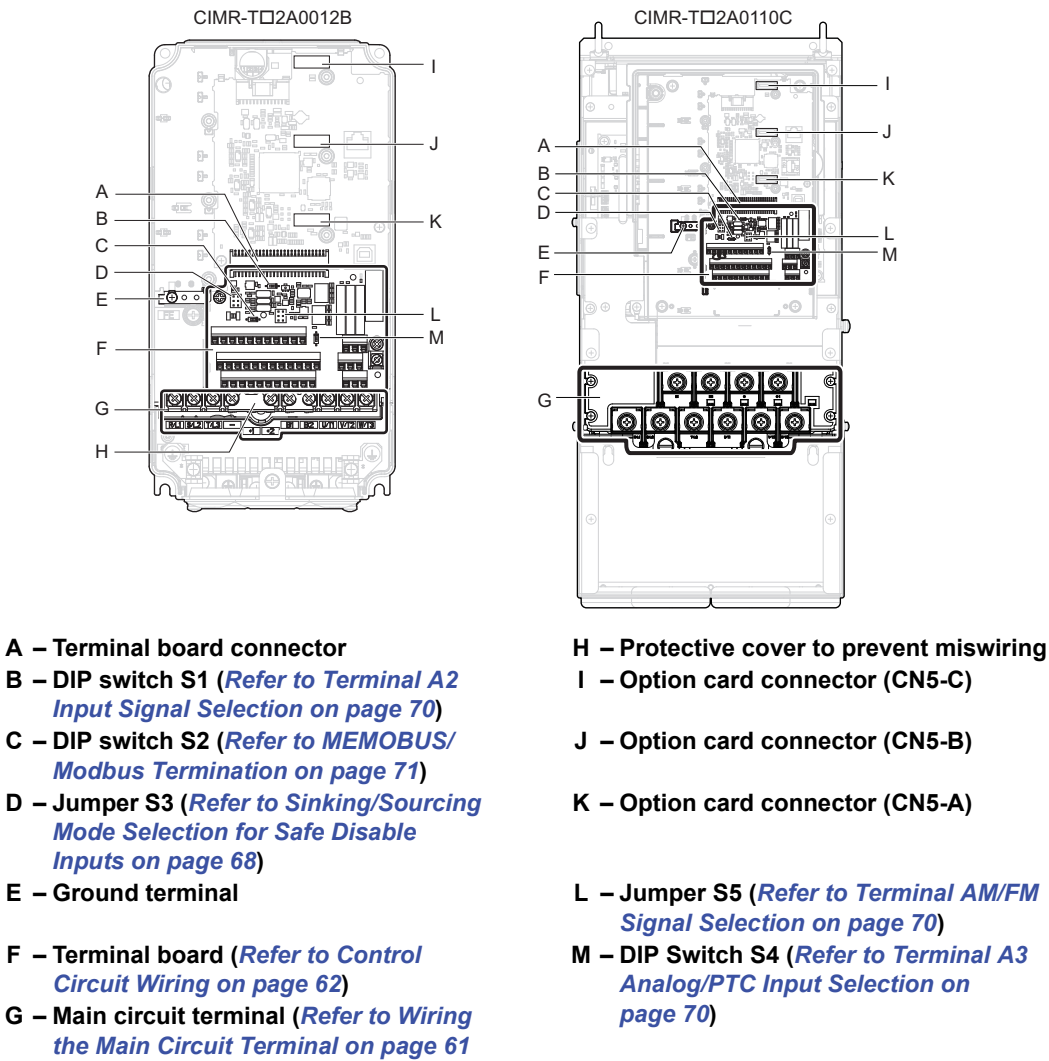


Figure 1.2 Front View of Drives

## Mechanical Installation

---

This chapter explains how to properly mount and install the drive.

<b>2.1</b>	<b>SECTION SAFETY .....</b>	<b>34</b>
<b>2.2</b>	<b>MECHANICAL INSTALLATION.....</b>	<b>36</b>

## 2.1 Section Safety

### WARNING

#### Fire Hazard

**Provide sufficient cooling when installing the drive inside an enclosed panel or cabinet.**

Failure to comply could result in overheating and fire.

When multiple drives are placed inside the same enclosure panel, install proper cooling to ensure air entering the enclosure does not exceed 50°C.

#### Crush Hazard

**If using a crane or a lifter to transport the drive, make sure that only qualified personnel are allowed operating.**

Incorrect operation may cause the drive to suddenly drop, resulting in serious injury.

**Only use a crane or a lifter appropriate for the size of the drive unit to transport and install it.**

Failure to comply could result in death or serious injury from falling equipment.

### CAUTION

#### Crush Hazard

**Do not carry the drive by the front cover or the terminal cover.**

Failure to comply may result in minor or moderate injury from the main body of the drive falling.

## NOTICE

**Equipment Hazard**

**Prevent foreign matter such as metal shavings or wire clippings from falling into the drive during drive installation and project construction.**

Failure to comply could result in damage to the drive.

Place a temporary cover over the top during installation. Be sure to remove the temporary cover before start-up, as the cover will reduce ventilation and cause the unit to overheat.

**Observe proper electrostatic discharge (ESD) procedures when handling the drive.**

Failure to comply could result in ESD damage to the drive circuitry.

**Operating the motor in the low-speed range diminishes the cooling effects, increases motor temperature, and may lead to motor damage by overheating.**

Reduce the motor torque in the low-speed range whenever using a standard blower cooled motor. If 100% torque is required continuously at low speed, consider using a special drive or vector-control motor. Select a motor that is compatible with the required load torque and operating speed range.

**The speed range for continuous operation differs according to the lubrication method and motor manufacturer.**

If the motor is to be operated at a speed higher than the rated speed, consult with the manufacturer.

Continuously operating an oil-lubricated motor in the low-speed range may result in burning.

**When the input voltage is 440 V or higher or the wiring distance is greater than 100 meters, pay special attention to the motor insulation voltage or use a drive-rated motor with reinforced insulation.**

Failure to comply could lead to motor winding failure.

**Motor vibration may increase when operating a machine in variable-speed mode, if that machine previously operated at a constant speed.**

Install vibration-proof rubber on the motor base.

**The motor may require more acceleration torque with drive operation than with a commercial power supply.**

Set a proper V/f pattern by checking the load torque characteristics of the machine to be used with the motor.

**The rated input current of submersible motors is higher than the rated input current of standard motors.**

Select an appropriate drive according to its rated output current. When the distance between the motor and drive is long, use a cable thick enough to connect the motor to the drive to prevent motor torque reduction.

**The current rating differs for a motor with variable pole pitches differs from a standard motor.**

Check the maximum current of the motor before selecting the drive capacity. Only switch motor poles when the motor is stopped. Switching between motor during run will trigger overcurrent protection circuitry or result in overvoltage from regeneration, and the motor will simply coast to stop.

**When using an explosion-proof motor, it must be subject to an explosion-proof test in conjunction with the drive.**

This is also applicable when an existing explosion-proof motor is to be operated with the drive. Since the drive itself is not explosion-proof, always install it in a safe place.

**Never lift the drive up while the cover is removed.**

This can damage the terminal board and other components.

## 2.2 Mechanical Installation

This section outlines specifications, procedures, and the environment for proper mechanical installation of the drive.

### ? Installation Environment

To help prolong the optimum performance life of the drive, install the drive in an environmental matching the specifications below.

**Table 2.1 Installation Environment**

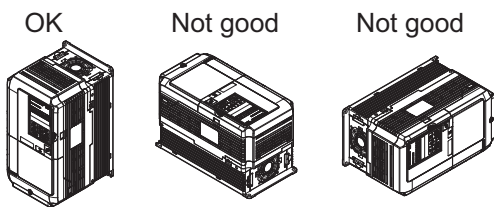
Environment	Conditions
Installation Area	Indoors
Ambient Temperature	Heatsink cooled drives: -10°C to +50°C Finless Type: IP20/IP00 enclosure: -10°C to +45°C Drive reliability improves in environments without wide temperature fluctuations. When using the drive in an enclosure panel, install a cooling fan or air conditioner in the area to ensure that the air temperature inside the enclosure does not exceed the specified levels. Do not allow ice to develop on the drive.
Humidity	95% RH or less and free of condensation
Storage Temperature	-20 to +60°C
Surrounding Area	Install the drive in an area free from: <ul style="list-style-type: none"><li>• oil mist and dust</li><li>• metal shavings, oil, water or other foreign materials</li><li>• radioactive materials</li><li>• combustible materials (e.g., wood)</li><li>• harmful gases and liquids</li><li>• excessive vibration</li><li>• chlorides</li><li>• direct sunlight</li></ul>
Altitude	1000 m, up to 3000 m with derating (for details, refer to <a href="#">Altitude Derating on page 404</a> )
Vibration	10 to 20 Hz at 9.8 m/s <sup>2</sup> 20 to 55 Hz at 5.9 m/s <sup>2</sup> (models CIMR-T□2A0004 to 2A0211 and 4A0002 to 4A0165) or, 2.0 m/s <sup>2</sup> (Models CIMR-T□2A0250 to 2A0415 and 4A0208 to 4A0362)
Orientation	Install the drive vertically to maintain maximum cooling effects.

**NOTICE:** Avoid placing drive peripheral devices, transformers, or other electronics near the drive as the noise created can lead to erroneous operation. If such devices must be used in close proximity to the drive, take proper steps to shield the drive from noise.

**NOTICE:** Prevent foreign matter such as metal shavings and wire clippings from falling into the drive during installation. Failure to comply could result in damage to the drive. Place a temporary cover over the top of the drive during installation. Remove the temporary cover before startup, as the cover will reduce ventilation and cause the drive to overheat.

### ? Installation Orientation and Spacing

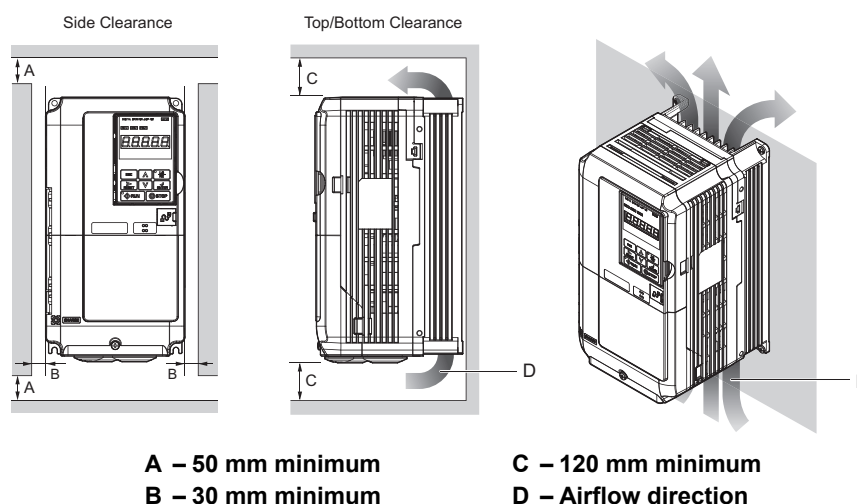
Install the drive upright as illustrated in [Figure 2.1](#) to maintain proper cooling.



**Figure 2.1 Correct Installation Orientation**

### ? Single Drive Installation

**Figure 2.2** shows the installation distance required to maintain sufficient space for airflow and wiring.



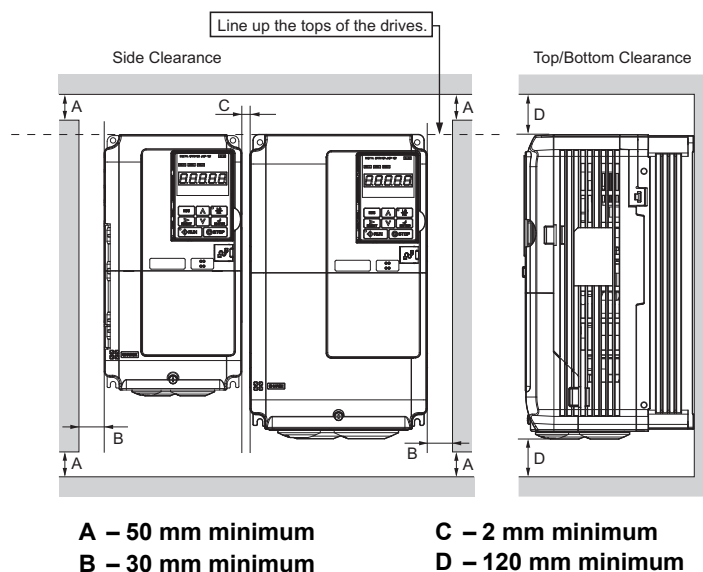
**Figure 2.2 Correct Installation Spacing**

### ? Multiple Drive Installation (Side-by-Side Installation)

Models CIMR-T□2A0004 through 0081 and 4A0002 through 0044 can take advantage of Side-by-Side installation.

When installing multiple drives into the same enclosure panel, mount the drives according to **Figure 2.2**.

When mounting drives with the minimum clearance of 2 mm according to **Figure 2.3**, derating must be considered and parameter L8-35 must be set to 1. *Refer to Temperature Derating on page 403*



**Figure 2.3 Space Between Drives (Side-by-Side Mounting)**

**Note:** When installing drives of different heights in the same enclosure panel, the tops of the drives should line up. Leave space between the top and bottom of stacked drives for easy cooling fan replacement if required.

? Digital Operator Remote Usage

? Remote Operation

The digital operator mounted on the drive can be removed and connected to the drive using an extension cable up to 3 m long. This makes it easier to operate the drive when it is installed in a location where it can not be accessed easily.

The digital operator can also be permanently mounted in a remote location like a panel door. An extension cable and an installation support set (depending on the installation type) will be required.

**Note:** Refer to *Drive Options and Peripheral Devices on page 370* for information on extension cables and installation support sets.

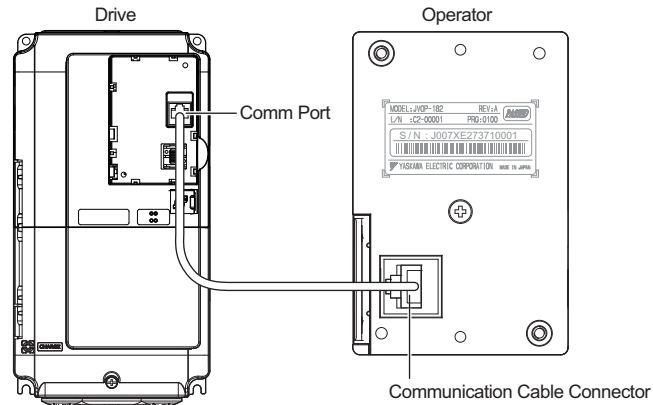


Figure 2.4 Communication Cable Connection

? Digital Operator Remote Installation

Digital Operator Dimensions

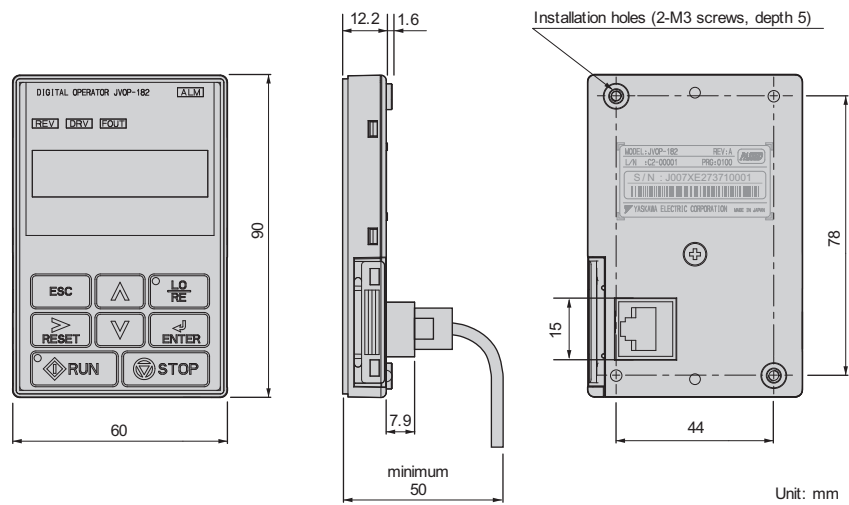


Figure 2.5 Digital Operator Dimensions

Installation Types and Required Materials

There are two ways the digital operator can be mounted to an enclosure:

- 1. External/face-mount installs the operator outside the enclosure panel
- 2. Internal/flush-mount installs the operator inside the enclosure panel

Table 2.2 Digital Operator Installation Methods and Required Tools

Installation Method	Description	Installation Support Sets	Model	Required Tools
External/Face-Mount	Simplified installation with the digital operator is mounted on the outside of the panel with two screws.	–	–	Phillips screwdriver (#1)
Internal/Flush-Mount	Encloses the digital operator in the panel. The digital operator is flush with the outside of the panel.	Installation Support Set A (for mounting with screws through holes in the panel)	EZZ020642A	Phillips screwdriver (#1, #2)
		Installation Support Set B (for use with threaded studs that are fixed to the panel)	EZZ020642B	Phillips screwdriver (#1) Wrench (7 mm)

**Note:** Prevent foreign matter such as metal shavings or wire clippings from falling into the drive during installation and project construction. Failure to comply could result in damage to the drive. Place a temporary cover over the top of the drive during installation. Remove the temporary cover before startup, as the cover will reduce ventilation and cause the drive to overheat.

External/Face-Mount

- 1. Cut an opening in the enclosure panel for the digital operator as shown in [Figure 2.7](#).
- 2. Position the digital operator so the display faces outwards, and mount it to the enclosure panel as shown in [Figure 2.6](#).

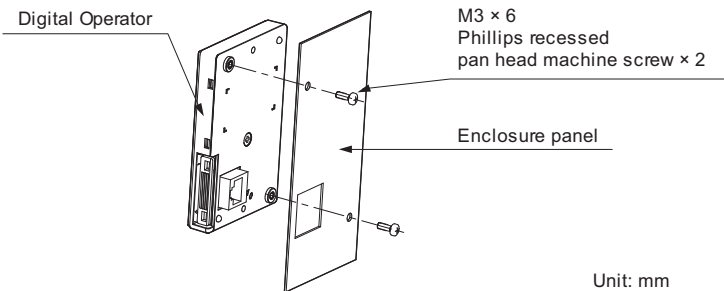


Figure 2.6 External/Face-Mount Installation

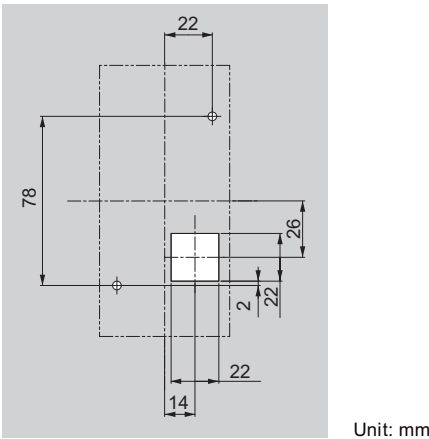


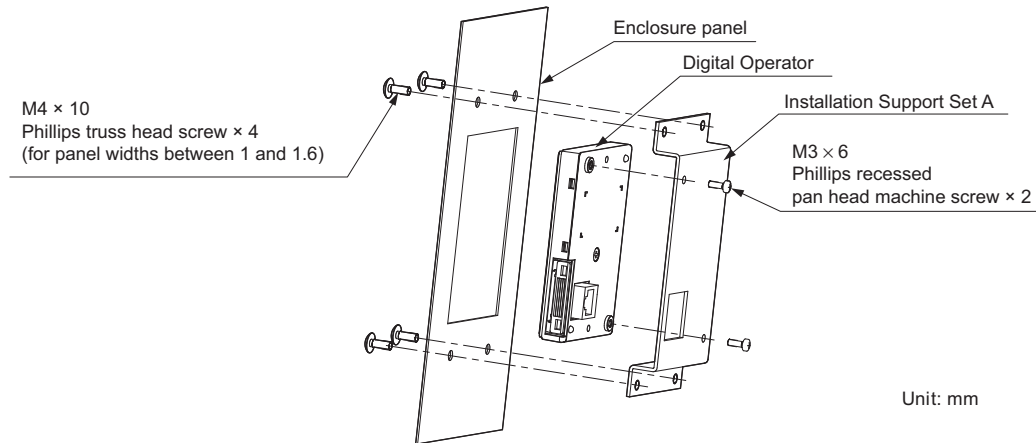
Figure 2.7 Panel Cut-Out Dimensions (External/Face-Mount Installation)

## 2.2 Mechanical Installation

### Internal/Flush-Mount

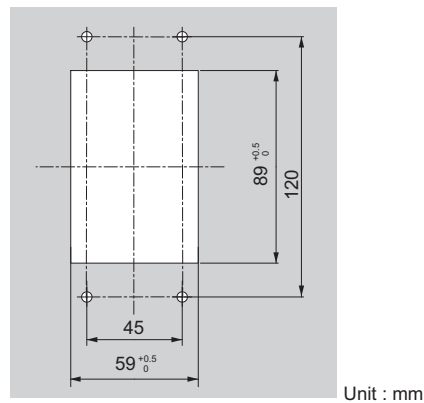
An internal flush-mount requires an installation support set that must be purchased separately. Contact your Yaskawa representative to order an installation support set and mounting hardware. [Figure 2.8](#) illustrates how to attach the Installation Support Set A.

1. Cut an opening in the enclosure panel for the digital operator as shown in [Figure 2.9](#).
2. Mount the digital operator to the installation support.
3. Mount the installation support set and digital operator to the enclosure panel.



**Figure 2.8 Internal/Flush Mount Installation**

**Note:** For environments with a significant amount of dust or other airborne debris, use a gasket between the enclosure panel and the digital operator.



**Figure 2.9 Panel Cut-Out Dimensions (Internal/Flush-Mount Installation)**

## ? Exterior and Mounting Dimensions

### ? Heatsink Cooled Drives

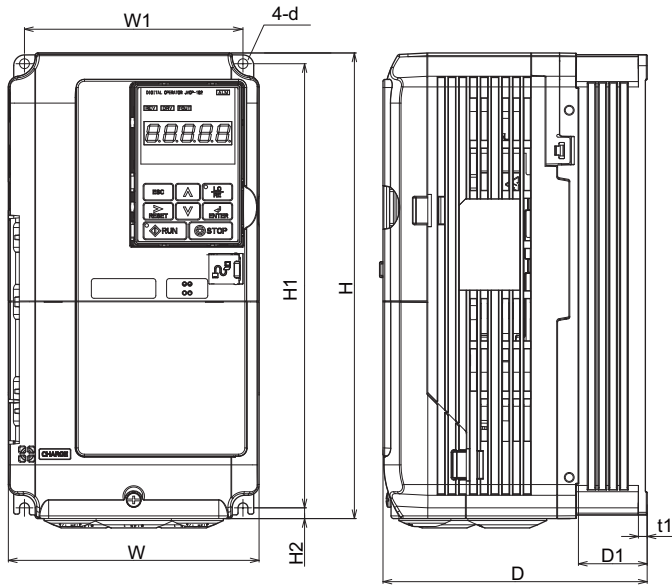


Figure 1

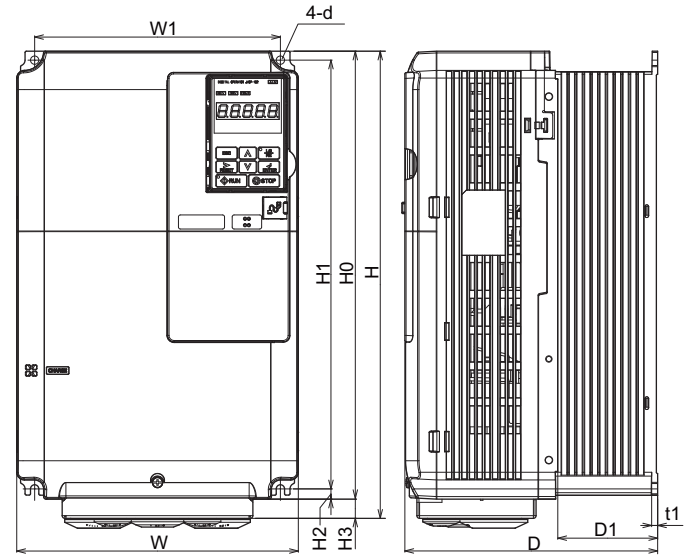


Figure 2

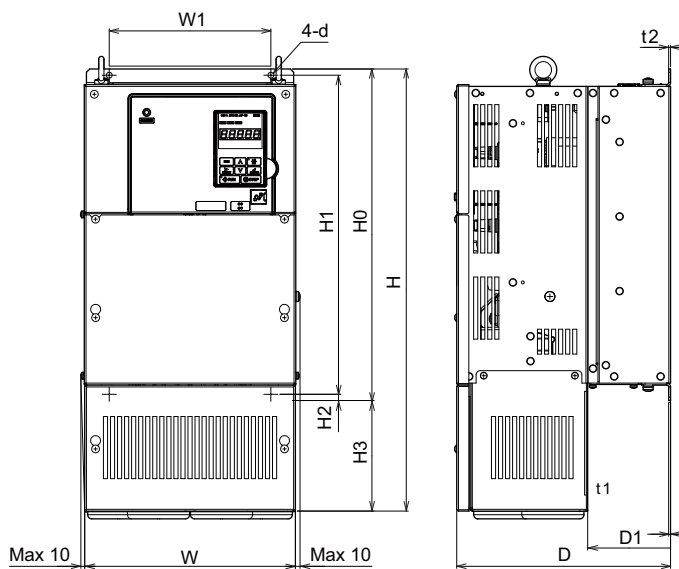


Figure 3

## 2.2 Mechanical Installation

**Table 2.3 Dimensions: 200 V Class**

Drive Model CIMR-T□2A	Dimensions (mm)													
	Figure	W	H	D	W1	H0	H1	H2	H3	D1	t1	t2	d	Weight (kg)
0004	1	140	260	147	122	—	248	6	—	38	5	—	M5	3.1
0006		140	260	147	122	—	248	6	—	38	5	—	M5	3.1
0010		140	260	147	122	—	248	6	—	38	5	—	M5	3.2
0012		140	260	147	122	—	248	6	—	38	5	—	M5	3.2
0021		140	260	164	122	—	248	6	—	55	5	—	M5	3.5
0030		140	260	167	122	—	248	6	—	55	5	—	M5	4.0
0040		140	260	167	122	—	248	6	—	55	5	—	M5	4.0
0056		180	300	187	160	—	284	8	—	75	5	—	M5	5.6
0069		220	350	197	192	—	335	8	—	78	5	—	M6	8.7
0081	2	220	365	197	192	350	335	8	15	78	5	—	M6	9.7
0110	3	254	534	258	195	400	385	7.5	134	100	2.3	2.3	M6	23
0138		279	614	258	220	450	435	7.5	164	100	2.3	2.3	M6	28
0169		329	630	283	260	550	535	7.5	80	110	2.3	2.3	M6	40
0211		329	630	283	260	550	535	7.5	80	110	2.3	2.3	M6	40
0250		456	868	330	325	705	680	12.5	163	130	3.2	3.2	M10	81
0312		456	868	330	325	705	680	12.5	163	130	3.2	3.2	M10	86
0360		504	1038	350	370	800	773	13	238	130	4.5	4.5	M12	105
0415		504	1038	350	370	800	773	13	238	130	4.5	4.5	M12	105

**Table 2.4 Dimensions: 400 V Class**

Drive Model CIMR-T□4A	Dimensions (mm)													
	Figure	W	H	D	W1	H0	H1	H2	H3	D1	t1	t2	d	Weight (kg)
0002	1	140	260	147	122	—	248	6	—	38	5	—	M5	3.2
0004		140	260	147	122	—	248	6	—	38	5	—	M5	3.2
0005		140	260	147	122	—	248	6	—	38	5	—	M5	3.2
0007		140	260	164	122	—	248	6	—	55	5	—	M5	3.4
0009		140	260	164	122	—	248	6	—	55	5	—	M5	3.5
0011		140	260	164	122	—	248	6	—	55	5	—	M5	3.5
0018		140	260	167	122	—	248	6	—	55	5	—	M5	3.9
0023		140	260	167	122	—	248	6	—	55	5	—	M5	3.9
0031		180	300	167	160	—	284	8	—	55	5	—	M5	5.4
0038		180	300	187	160	—	284	8	—	75	5	—	M5	5.7
0044		220	350	197	192	—	335	8	—	78	5	—	M6	8.3
0058	3	254	465	258	195	400	385	7.5	65	100	2.3	2.3	M6	23
0072		279	515	258	220	450	435	7.5	65	100	2.3	2.3	M6	27
0088		329	630	258	260	510	495	7.5	120	105	2.3	3.2	M6	39
0103		329	630	258	260	510	495	7.5	120	105	2.3	3.2	M6	39
0139		329	630	283	260	550	535	7.5	80	110	2.3	2.3	M6	43
0165		329	630	283	260	550	535	7.5	80	110	2.3	2.3	M6	45
0208		456	868	330	325	705	680	12.5	163	130	3.2	3.2	M10	85
0250		504	1038	350	370	800	773	13	238	130	4.5	4.5	M12	103
0296		504	1038	350	370	800	773	13	238	130	4.5	4.5	M12	109
0362		504	1038	350	370	800	773	13	238	130	4.5	4.5	M12	114

## Electrical Installation

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This chapter explains proper procedures for wiring the control circuit terminals, motor, and power supply.

<b>3.1</b>	<b>SECTION SAFETY</b>	<b>44</b>
<b>3.2</b>	<b>STANDARD CONNECTION DIAGRAM</b>	<b>46</b>
<b>3.3</b>	<b>MAIN CIRCUIT CONFIGURATIONS</b>	<b>49</b>
<b>3.4</b>	<b>TERMINAL BLOCK CONFIGURATION</b>	<b>50</b>
<b>3.5</b>	<b>TERMINAL COVER</b>	<b>51</b>
<b>3.6</b>	<b>DIGITAL OPERATOR AND FRONT COVER</b>	<b>53</b>
<b>3.7</b>	<b>MAIN CIRCUIT WIRING</b>	<b>55</b>
<b>3.8</b>	<b>CONTROL CIRCUIT WIRING</b>	<b>62</b>
<b>3.9</b>	<b>CONTROL I/O CONNECTIONS</b>	<b>68</b>
<b>3.10</b>	<b>CONNECT TO A PC</b>	<b>72</b>
<b>3.11</b>	<b>EXTERNAL INTERLOCK</b>	<b>73</b>
<b>3.12</b>	<b>WIRING CHECKLIST</b>	<b>74</b>

### 3.1 Section Safety

#### DANGER

##### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

#### WARNING

##### Electrical Shock Hazard

**Do not operate equipment with covers removed.**

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

**Always ground the motor-side grounding terminal.**

Improper equipment grounding could result in death or serious injury by contacting the motor case.

**Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.**

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

**Do not allow unqualified personnel to perform work on the drive.**

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of AC drives.

**Do not touch any terminals before the capacitors have fully discharged.**

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

##### Fire Hazard

**Tighten all terminal screws to the specified tightening torque.**

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

**Do not use improper combustible materials.**

Failure to comply could result in death or serious injury by fire.

Do not install the drive to a combustible surface. Never place combustible materials on the drive.

**Do not use an improper voltage source.**

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

**When installing a dynamic braking resistor or optional Braking Resistor Unit, perform all wiring exactly as specified in the wiring diagrams provided.**

Failure to do so can result in fire. Improper wiring may damage braking components.

**⚠ CAUTION**

**Do not carry the drive by the front cover or the terminal cover.**

Failure to comply may cause the main body of the drive to fall, resulting in minor or moderate injury.

**NOTICE**

**Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Never connect or disconnect the motor from the drive while the drive is outputting voltage.**

Improper equipment sequencing could result in damage to the drive.

**Do not use unshielded cable for control wiring.**

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive.

**Do not allow unqualified personnel to use the product.**

Failure to comply could result in damage to the drive or braking circuit.

Carefully review instruction manual TOBP C720600 00 when connecting a dynamic braking option to the drive.

**Do not modify the drive circuitry.**

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for any modification of the product made by the user. This product must not be modified.

**Check all the wiring to ensure that all connections are correct after installing the drive and connecting any other devices.**

Failure to comply could result in damage to the drive.

### 3.2 Standard Connection Diagram

Connect the drive and peripheral devices as shown in [Figure 3.1](#). It is possible to set and run the drive via the digital operator without connecting digital I/O wiring. This section does not discuss drive operation; [Refer to Start-Up Programming & Operation on page 79](#) for instructions on operating the drive.

**NOTICE:** *Inadequate wiring could result in damage to the drive. Install adequate branch circuit short circuit protection per applicable codes. The drive is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V Class) and 480 Vac maximum (400 V Class).*

**NOTICE:** *When the input voltage is 440 V or higher or the wiring distance is greater than 100 meters, pay special attention to the motor insulation voltage or use a drive duty motor. Failure to comply could lead to motor insulation breakdown.*

**NOTICE:** *Do not connect AC control circuit ground to drive enclosure. Improper drive grounding can cause control circuit malfunction.*

**NOTICE:** *The minimum load for the relay outputs M1-M2, M3-M4, M5-M6, and MA-MB-MC is 10 mA.*

**NOTICE:** *Correctly set the Sinking/sourcing mode selection jumper S3 (internal/external power supply). Failure to comply could result in damage to the drive. Refer to [Control I/O Connections on page 68](#) for details.*

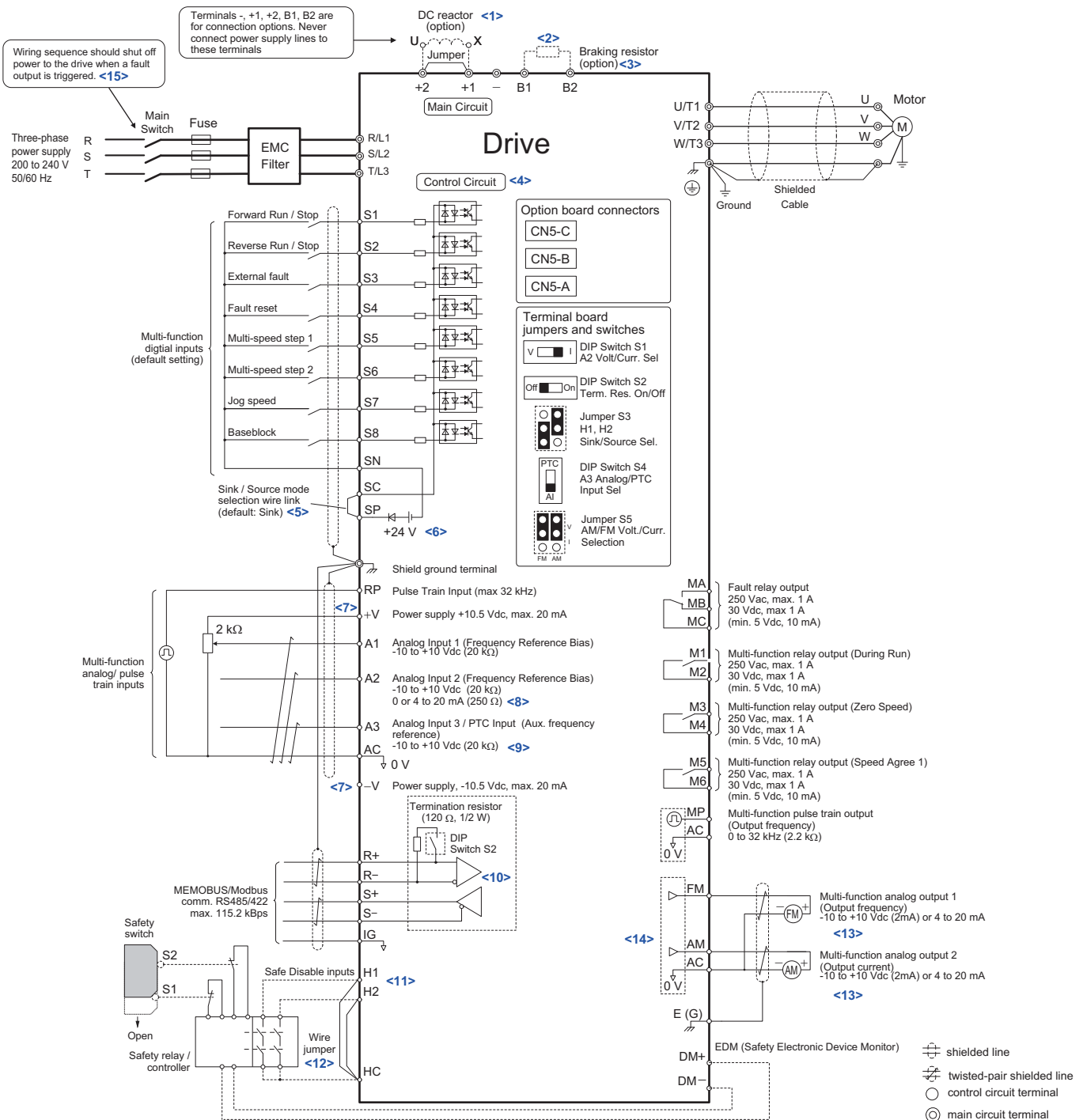


Figure 3.1 Drive Standard Connection Diagram (example: CIMR-T□2A0040)

- <1> Remove the jumper when installing a DC reactor. Models CIMR-T□2A0110 through 2A0415 and 4A0058 through 4A0362 come with a built-in DC reactor.
- <2> When using a braking resistor (ERF), make sure that braking resistor protection is enabled (L8-01 = 1). The wiring sequence should shut off the input power supply if the fault output terminal is triggered.
- <3> The drive's protection function for the internal braking transistor needs to be disabled (L8-55 = 0) if using a regen unit such as a regen converter or some type of braking option unit (and therefore not the internal braking transistor). If left enabled, a braking resistor fault (rF) may result. Make sure Stall Prevention is disabled (L3-04 = 0) whenever using a regenerative converter, a regenerative unit, a braking resistor or the Braking Resistor Unit. If left enabled, the drive may not stop within the specified deceleration time.
- <4> Supplying power to the control circuit separately from the main circuit requires a 24 V power supply (option).
- <5> This figure shows an example of a sequence input to S1 through S8 using a non-powered relay or an NPN transistor. Install the wire link between terminals SC-SP for Sink mode and SC-SN for Source mode. Leave it out for external power supply. Never short terminals SP and SN as doing so will damage the drive.
- <6> The maximum current supplied by this voltage source is 150 mA if no digital input option card DI-A3 is used.
- <7> The maximum output current capacity for the +V and -V terminals on the control circuit is 20 mA. Never short terminals +V, -V, and AC, as this can cause erroneous operation or damage the drive.
- <8> Set DIP switch S1 to select between a voltage or current input signal to terminal A2. The default setting is for current input.
- <9> Set DIP switch S4 to select between analog or PTC input for terminal A3.
- <10> Enable the termination resistor in the last drive in a MEMOBUS network by setting DIP switch S2 to the ON position.

## 3.2 Standard Connection Diagram

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- <11> Use jumper S3 to select between Sink mode, Source mode or external power supply for the Safe Disable inputs.
- <12> Disconnect the wire jumper between H1 - HC and H2 - HC when utilizing the Safe Disable input.
- <13> Monitor outputs work with devices such as analog frequency meters, ammeters, voltmeters, and wattmeters. They are not intended for use as a feedback-type of signal.
- <14> Use jumper S5 to selection between voltage or current output signals at terminal AM and FM. Set parameters H4-07 and H4-08 accordingly.
- <15> When using the automatic fault restart function while the wiring is made to shut off the power supply when a drive fault occurs, make sure the drive is set not to trigger a fault output during fault restart (L5-02=0, default). Otherwise the fault restart function can not work properly.

**WARNING!** *Sudden Movement Hazard. Do not close the wiring for the control circuit unless the multifunction input terminal parameters are properly set. Improper sequencing of run/stop circuitry could result in death or serious injury from moving equipment.*

**WARNING!** *Sudden Movement Hazard. Ensure start/stop and safety circuits are wired properly and in the correct state before energizing the drive. Failure to comply could result in death or serious injury from moving equipment. When programmed for 3-Wire control, a momentary closure on terminal S1 may cause the drive to start.*

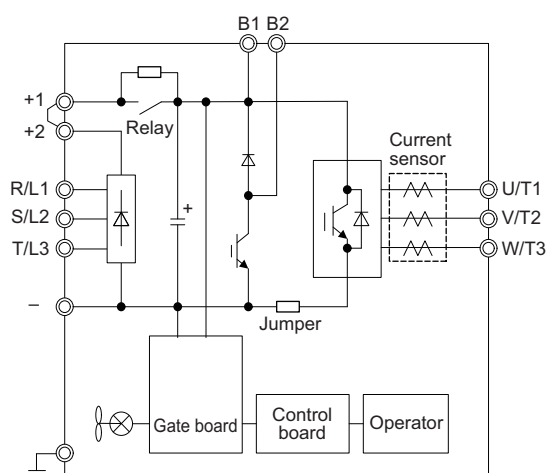
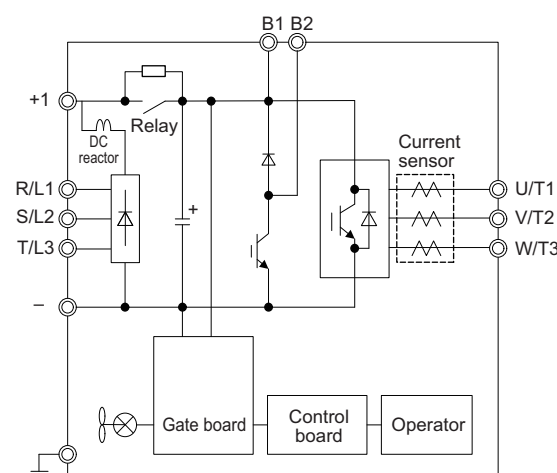
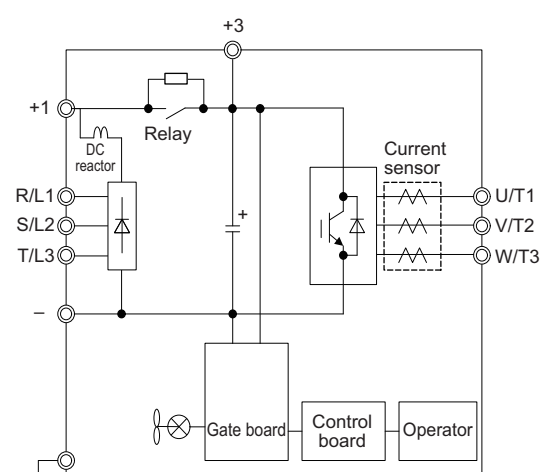
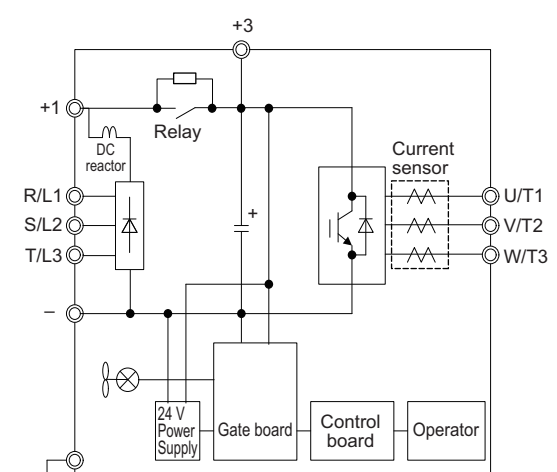
**WARNING!** *When 3-Wire sequence is used, set the drive to 3-Wire sequence before wiring the control terminals and ensure parameter b1-17 is set to 0 (drive does not accept a run command at power up (default)). If the drive is wired for 3-Wire sequence but set up for 2-Wire sequence (default) and if parameter b1-17 is set to 1 (drive accepts a Run command at power up), the motor will rotate in reverse direction at power up of the drive and may cause injury.*

### 3.3 Main Circuit Configurations

Refer to the [Table 3.1](#) when wiring the drive's main circuit. Connections may vary based on drive capacity. The DC power supply for the main circuit also provides power to the control circuit.

**NOTICE:** Do not use the negative DC bus terminal “-” as a ground terminal. This terminal is at high DC voltage potential. Improper wiring connections could damage the drive.

**Table 3.1 Drive main circuit configurations**

CIMR-T□2A0004 to 2A0081 CIMR-T□4A0002 to 4A0044	CIMR-T□2A0110, 2A0138 CIMR-T□4A0058, 4A0072
	
CIMR-T□2A0169, 2A0211 CIMR-T□4A0088 to 4A0139	CIMR-T□2A0250 to 2A0415 CIMR-T□4A0165 to 4A0362
	

# 3.4 Terminal Block Configuration

Figure 3.7 shows the different main circuit terminal arrangements for the drive capacities.

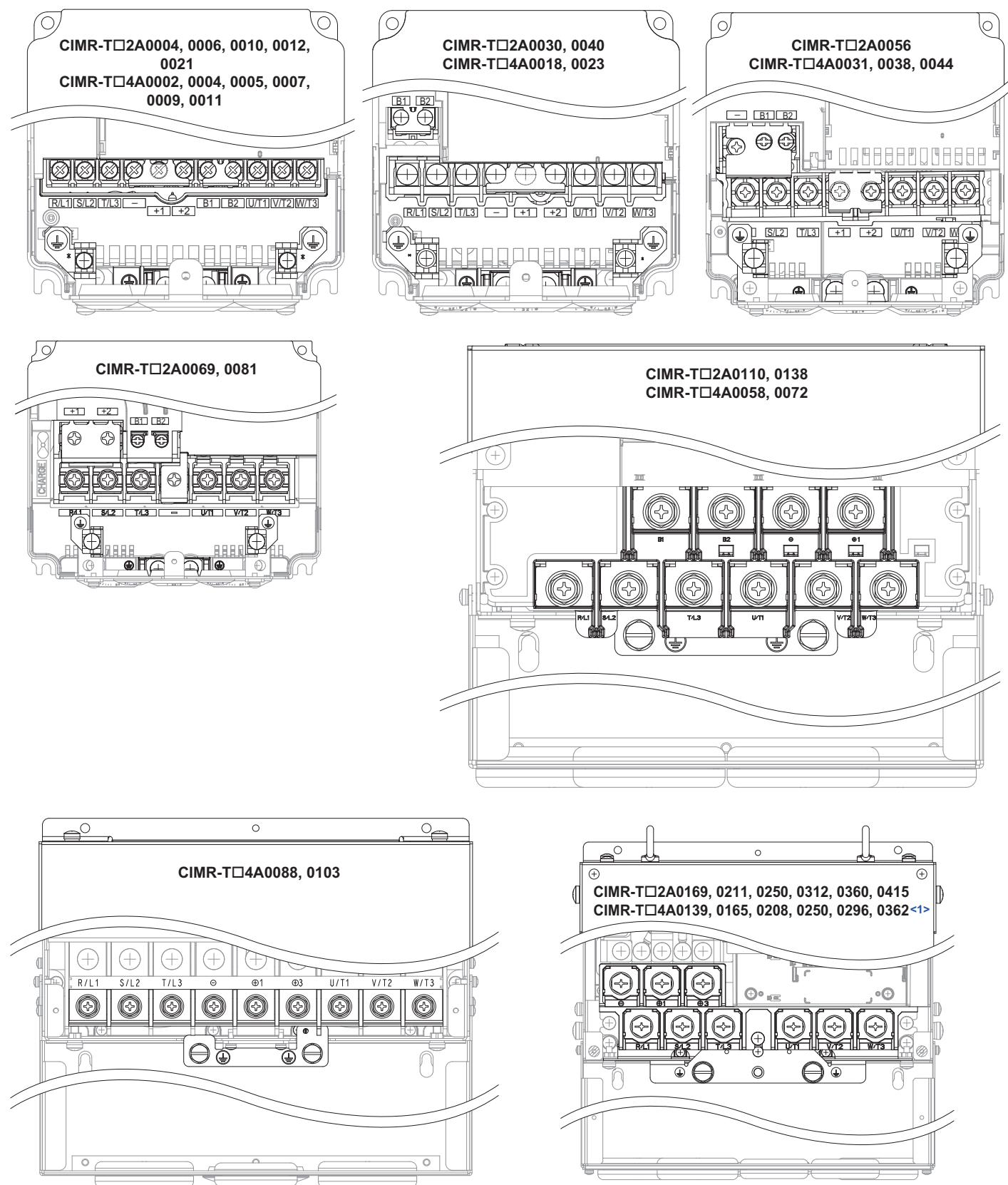


Figure 3.2 Main Circuit Terminal Block Configuration

<1> Terminal board design differs slightly for models CIMR-T□2A0250 through 2A0415 and 4A0208 through 4A0362.

## 3.5 Terminal Cover

Follow the procedure below to remove the terminal cover for wiring and to reattach the terminal cover after wiring is complete.

### ? CIMR-T□2A0004 to 0081, 4A0002 to 0044

#### ? Removing the Terminal Cover

1. Loosen the terminal cover screw.

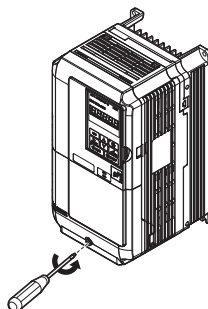


Figure 3.3 Removing the Terminal Cover

2. Push in on the hook located on the bottom of the terminal cover, and gently pull forward. This should remove the terminal cover.

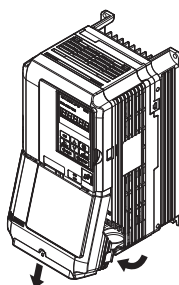


Figure 3.4 Removing the Terminal Cover

#### ? Reattaching the Terminal Cover

Power lines and signal wiring should pass through the opening provided. *Refer to Wiring the Main Circuit Terminal on page 61 and Wiring the Control Circuit Terminal on page 65 for details on wiring.*

After all wiring to the drive and other devices is complete, reattach the terminal cover.

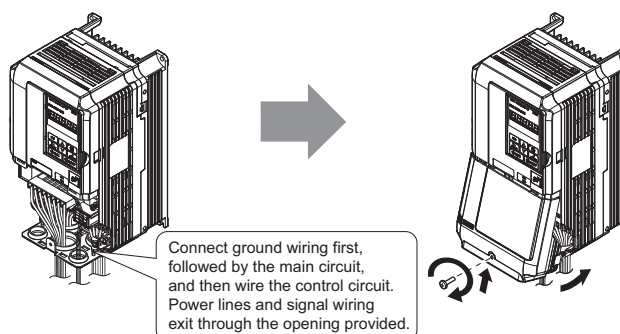


Figure 3.5 Reattaching the Terminal Cover

### ? CIMR-T□2A0110 to 0415, 4A0058 to 0362

#### ? Removing the Terminal Cover

1. Loosen the four screws on the terminal cover, then pull down on the cover.

**CAUTION!** Do not completely remove the cover screws, just loosen them. If the cover screws are removed completely, the terminal cover may fall off causing an injury. Take special care when removing/reattaching the terminal covers for larger drives.

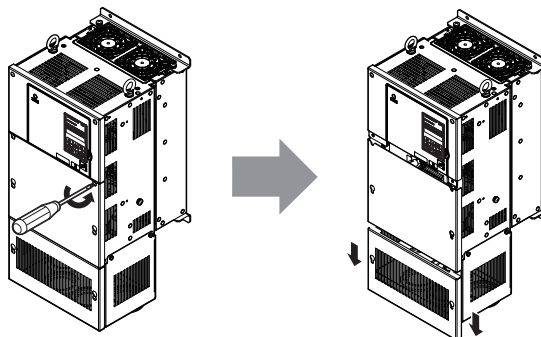


Figure 3.6 Removing the Terminal Cover

2. Pull forward on the terminal cover to free it from the drive.

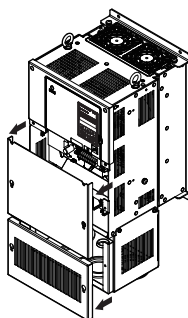


Figure 3.7 Removing the Terminal Cover

#### ? Reattaching the Terminal Cover

Once wiring to the terminal board and other devices is complete, double check all connections and finally reattach the terminal cover. *Refer to Wiring the Main Circuit Terminal on page 61 and Wiring the Control Circuit Terminal on page 65 for details on wiring.*

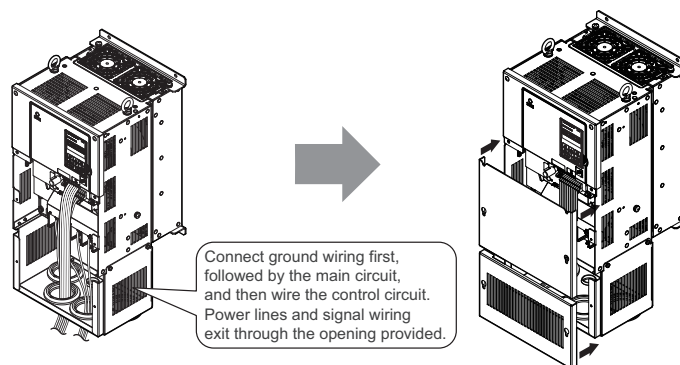


Figure 3.8 Reattaching the Terminal Cover

## 3.6 Digital Operator and Front Cover

The digital operator can be detached from the drive for remote operation, or when the front cover has to be opened to install an option card.

**NOTICE:** Be sure the digital operator has been removed prior to opening the front cover or reattaching it. Leaving the digital operator plugged into the drive when removing the front cover can result in erroneous operation caused by a poor connection. Before reattaching the operator make sure the front cover has been firmly fastened back into place.

### ? Removing/Reattaching the Digital Operator

#### ? Removing the Digital Operator

While pinching inwards on the hook located on the right side of the digital operator, pull forward and remove the operator from the drive.

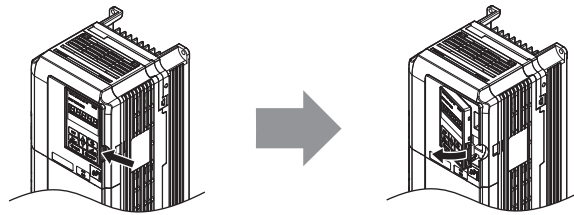


Figure 3.9 Removing the Digital Operator

#### ? Reattaching the Digital Operator

Insert the digital operator into the opening in the top cover while aligning it with the notches on the left side of the opening. Next press gently on the right side of the operator until it clicks into place.

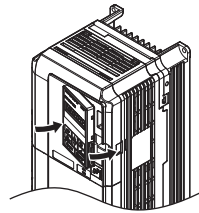


Figure 3.10 Reattaching the Digital Operator

### ? Removing/Reattaching the Front Cover

#### ? Removing the Front Cover

**2A0004 to 2A0081 and 4A0002 to 4A0044**

After removing the terminal cover and the digital operator, loosen the screw that affixes the front cover (model CIMR-T□2A0081 does not use a screw to affix the front cover). Pinch inwards on hooks found on each side of the front cover, then pull forward to remove it from the drive.

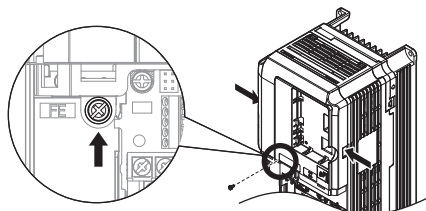


Figure 3.11 Remove the Front Cover (2A0004 to 2A0081 and 4A0002 to 4A0044)

**2A0110 to 2A0415 and 4A0058 to 4A0362**

1. Remove the terminal cover and the digital operator.
2. Loosen the installation screw on the front cover.

### 3.6 Digital Operator and Front Cover

3. Use a straight-edge screwdriver to loosen the hooks on each side of the cover that hold it in place.

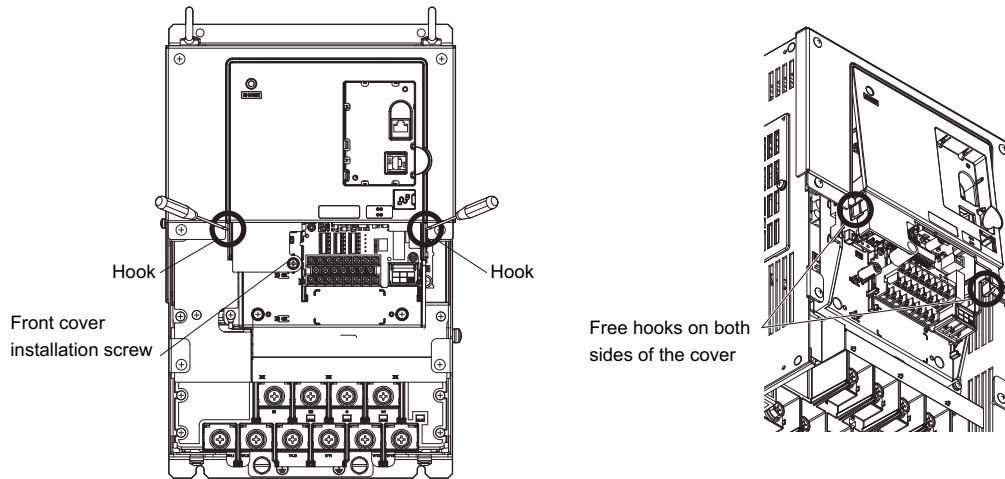


Figure 3.12 Remove the Front Cover (2A0110 to 2A0415 and 4A0058 to 4A0362)

4. First unhook the left side of the front cover, then swing the left side towards you as shown in the figure below until the cover comes off.

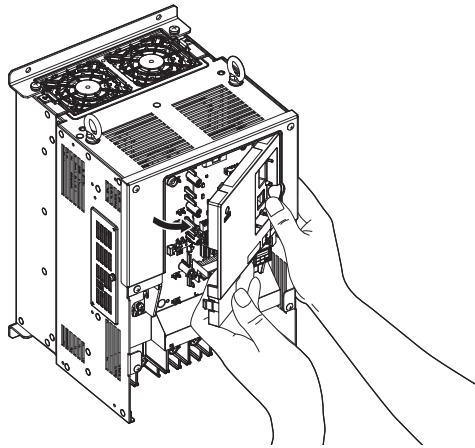


Figure 3.13 Remove the Front Cover (2A0110 to 2A0415 and 4A0058 to 4A0362)

#### ? Reattaching the Front Cover

##### 2A0004 to 2A0081 and 4A0002 to 4A0044

Reverse the instructions given in [Remove the Front Cover \(2A0004 to 2A0081 and 4A0002 to 4A0044\) on page 53](#) to reattach the front cover. Pinch inwards on the hooks found on each side of the front cover while guiding it back into the drive. Make sure it clicks firmly into place.

##### 2A0110 to 2A0415 and 4A0058 to 4A0362

1. Slide the front cover so that the hooks on the top connect to the drive.

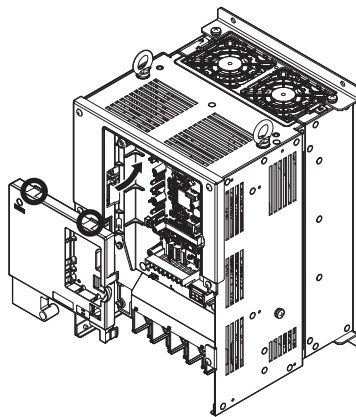


Figure 3.14 Reattach the Front Cover (2A0110 to 2A0415 and 4A0058 to 4A0362)

2. Once the hooks have connected to the drive, press firmly on the cover to make sure it locks into place.

## 3.7 Main Circuit Wiring


This section describes the functions, specifications, and procedures required to safely and properly wire the main circuit in the drive.

**NOTICE:** Do not solder the ends of wire connections to the drive. Soldered wiring connections can loosen over time. Improper wiring practices could result in drive malfunction due to loose terminal connections.

**NOTICE:** Do not switch the drive input to start or stop the motor. Frequently switching the drive on and off shortens the lifetime of the DC bus charge circuit and the DC bus capacitors, and can cause premature drive failures. For the full performance life, refrain from switching the drive on and off more than once every 30 minutes.

### ? Main Circuit Terminal Functions

Table 3.2 Main Circuit Terminal Functions

Terminal		Type			Function	Page
200 V Class	Model	2A0004 to 2A0081	2A0110 to 2A0138	2A0169 to 2A0415		
400 V Class	CIMR-T□	4A0002 to 4A0044	4A0058, 4A0072	4A0088 to 4A0362		
		Main circuit power supply input			Connects line power to the drive	47
S/L2						
T/L3						
U/T1		Drive output			Connects to the motor	47
V/T2						
W/T3						
B1		Braking resistor		not available	Available for connecting a braking resistor or a braking resistor unit option	384
B2						
+2		• DC reactor connection (+1, +2) (remove the shorting bar between +1 and +2) • DC power supply input (+1, -)	not available		For connection • of the drive to a DC power supply • of braking options • connection of a DC reactor	388
+1			DC power supply input (+1, -)	DC power supply input (+1, -)		—
—						
+3			not available			Braking transistor connection (+3, -)
		—			Grounding terminal	60

**Note:** For drives that have a built-in braking transistor (models CIMR-T□2A0004 to 2A0138 and 4A0002 to 4A0072), connect the braking resistor to the B1 terminal and the negative terminal.

### ? Wire Gauges and Tightening Torque

Select the appropriate wires and crimp terminals from [Table 3.3](#) through [Table 3.4](#).

- Note:**
- Wire gauge recommendations based on drive continuous current ratings (ND) using 75°C 600 Vac vinyl-sheathed wire assuming ambient temperature within 40°C and wiring distance less than 100 m.
  - Terminals +1, +2, +3, —, B1 and B2 are for connecting optional devices such as a DC reactor or braking resistor. Do not connect other nonspecific devices to these terminals.
- Consider the amount of voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop:  
 Line drop voltage (V) =  $\sqrt{3} \times \text{wire resistance } (\Omega/\text{km}) \times \text{wire length (m)} \times \text{motor rated current (A)} \times 10^{-3}$
  - Refer to instruction manual TOBP C720600 00 for braking unit or braking resistor unit wire gauges.
  - Use terminal +1 and the negative terminal when connecting a regenerative converter or a regen unit.
  - Use the +3 terminal and the negative terminal to connect the braking transistor unit. For drives that have a built-in braking transistor (models CIMR-T□2A0004 to 2A0138 and 4A0002 to 4A0072), connect the braking resistor to the B1 terminal and the negative terminal.
  - Refer to [UL Standards Compliance on page 549](#) for information on UL compliance.

### 3.7 Main Circuit Wiring

#### ? Three-Phase 200 V Class

Table 3.3 Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Model CIMR-T□	Terminal	Recommended Gauge mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Screw Size	Tightening Torque N·m (lb.in.)
2A0004 2A0006 2A0010	R/L1, S/L2, T/L3	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6		
	–, +1, +2	–	2.5 to 6		
	B1, B2	–	2.5 to 6		
	⊕	2.5 <I>	2.5 to 6		
2A0012	R/L1, S/L2, T/L3	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6		
	–, +1, +2	–	2.5 to 6		
	B1, B2	–	2.5 to 6		
	⊕	2.5 <I>	2.5 to 6		
2A0021	R/L1, S/L2, T/L3	4	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6		
	–, +1, +2	–	4 to 6		
	B1, B2	–	2.5 to 6		
	⊕	4 <I>	4 to 6		
2A0030	R/L1, S/L2, T/L3	6	4 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	6	4 to 16		
	–, +1, +2	–	6 to 16		
	B1, B2	–	4 to 6		
	⊕	6 <I>	6 to 10	M5	2.0 to 2.5 (17.7 to 22.1)
2A0040	R/L1, S/L2, T/L3	10	6 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	10	6 to 16		
	–, +1, +2	–	16		
	B1, B2	–	4 to 6		
	⊕	10	6 to 10	M5	2.0 to 2.5 (17.7 to 22.1)
2A0056	R/L1, S/L2, T/L3	16	16 to 25	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	16	16 to 25		
	–, +1, +2	–	16 to 25		
	B1, B2	–	6 to 10	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	10 to 16	M6	5.4 to 6.0 (47.8 to 53.1)
2A0069	R/L1, S/L2, T/L3	25	16 to 25	M8	9.9 to 11 (87.6 to 97.4)
	U/T1, V/T2, W/T3	16	16 to 25		
	–, +1, +2	–	25		
	B1, B2	–	10 to 16	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	16 to 25	M6	5.4 to 6.0 (47.8 to 53.1)
2A0081	R/L1, S/L2, T/L3	35	25 to 35	M8	9.9 to 11 (87.6 to 97.4)
	U/T1, V/T2, W/T3	25	25 to 35		
	–, +1, +2	–	25 to 35		
	B1, B2	–	16	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	16 to 25	M6	5.4 to 6.0 (47.8 to 53.1)

Model CIMR-□□	Terminal	Recommended Gauge mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Screw Size	Tightening Torque N·m (lb.in.)
2A0110	R/L1, S/L2, T/L3	35	25 to 50	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	35	25 to 50		
	-, +1	—	35 to 50		
	B1, B2	—	16 to 50		
	⊕	16	16 to 25		
2A0138	R/L1, S/L2, T/L3	50	35 to 70	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50	35 to 70		
	-, +1	—	50 to 70		
	B1, B2	—	25 to 70		
	⊕	25	25	M8	9 to 11 (79.7 to 97.4)
2A0169	R/L1, S/L2, T/L3	70	50 to 95	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70	50 to 95		
	-, +1	—	35 to 95		
	+3	—	50 to 95		
	⊕	35	25 to 35		
2A0211	R/L1, S/L2, T/L3	95	70 to 95	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95	70 to 95		
	-, +1	—	35 to 95		
	+3	—	50 to 95		
	⊕	50	25 to 50		
2A0250	R/L1, S/L2, T/L3	95 × 2P	95 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150	M10	18 to 23 (159 to 204)
	-, +1	—	70 to 150		
	+3	—	35 to 150		
	⊕	95	95 to 150	M12	32 to 40 (283 to 354)
2A0312	R/L1, S/L2, T/L3	95 × 2P	95 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150		
	-, +1	—	70 to 150		
	+3	—	70 to 150	M10	18 to 23 (159 to 204)
	⊕	95	95 to 150	M12	32 to 40 (283 to 354)
2A0360	R/L1, S/L2, T/L3	240	95 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	240	95 to 300		
	-, +1	—	125 to 300		
	+3	—	70 to 300	M10	18 to 23 (159 to 204)
	⊕	120	120 to 240	M12	32 to 40 (283 to 354)
2A0415	R/L1, S/L2, T/L3	120 × 2P	95 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300	95 to 300		
	-, +1	—	150 to 300		
	+3	—	70 to 300	M10	18 to 23 (159 to 204)
	⊕	120	120 to 240	M12	32 to 40 (283 to 354)

<1> When an EMC filter is installed, additional measures must be taken in order to comply with IEC/EN 61800-5-1. Refer to *EMC Filter Installation on page 545*.

**Note:** Refer to the related instruction manuals for the applicable wire gauges when connecting peripheral devices to terminals -, +1, +3, B1, and B2. Contact your Yaskawa representative or the nearest Yaskawa sales office directly for consultation if using a wire gauge not listed in the manual.

### 3.7 Main Circuit Wiring

#### ? Three-Phase 400 V Class

Table 3.4 Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Model CIMR-T□	Terminal	Recommended Gauge mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Screw Size	Tightening Torque N·m (lb.in.)
4A0002 4A0004	R/L1, S/L2, T/L3	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6		
	–, +1, +2	–	2.5 to 6		
	B1, B2	–	2.5 to 6		
	⊕	2.5 <I>	2.5 to 4		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6		
	–, +1, +2	–	2.5 to 6		
	B1, B2	–	2.5 to 6		
	⊕	2.5 <I>	2.5 to 6		
4A0011	R/L1, S/L2, T/L3	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6		
	–, +1, +2	–	2.5 to 6		
	B1, B2	–	2.5 to 6		
	⊕	2.5 <I>	2.5 to 6		
4A0018	R/L1, S/L2, T/L3	2.5	2.5 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	2.5	2.5 to 16		
	–, +1, +2	–	4 to 16		
	B1, B2	–	4 to 6		
	⊕	2.5 <I>	2.5 to 6	M5	2.0 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	4	2.5 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	4	2.5 to 16		
	–, +1, +2	–	4 to 16		
	B1, B2	–	4 to 6		
	⊕	4 <I>	4 to 6	M5	2.0 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	6	6 to 16	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	6	6 to 16		
	–, +1, +2	–	6 to 16		2.7 to 3.0 (23.9 to 26.6)
	B1, B2	–	6 to 10		
	⊕	6 <I>	6 to 10	M6	5.4 to 6.0 (47.8 to 53.1)
4A0038	R/L1, S/L2, T/L3	10	10 to 16	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	6	6 to 16		
	–, +1, +2	–	6 to 16		2.7 to 3.0 (23.9 to 26.6)
	B1, B2	–	6 to 10		
	⊕	10	6 to 16	M6	5.4 to 6.0 (47.8 to 53.1)
4A0044	R/L1, S/L2, T/L3	16	16 to 25	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	16	16 to 25		
	–, +1, +2	–	16 to 25		
	B1, B2	–	6 to 10	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	10 to 16	M6	5.4 to 6.0 (47.8 to 53.1)
4A0058	R/L1, S/L2, T/L3	16	10 to 16	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	16	10 to 16		
	–, +1	–	16 to 35		
	B1, B2	–	10 to 16		
	⊕	16	10 to 16		

Model CIMR-□□	Terminal	Recommended Gauge mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Screw Size	Tightening Torque N·m (lb.in.)
4A0072	R/L1, S/L2, T/L3	16	16 to 25	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	16 to 25		
	-, +1	—	25 to 35		
	B1, B2	—	16 to 25		
	⊕	16	16 to 25		
4A0088	R/L1, S/L2, T/L3	25	16 to 50	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	25 to 50		
	-, +1	—	25 to 50		
	+3	—	16 to 50		
	⊕	16	16 to 25		
4A0103	R/L1, S/L2, T/L3	35	25 to 50	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	35	25 to 50		
	-, +1	—	25 to 50		
	+3	—	25 to 50		
	⊕	16	16 to 25		
4A0139	R/L1, S/L2, T/L3	50	35 to 95	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50	35 to 95		
	-, +1	—	50 to 95		
	+3	—	25 to 95		
	⊕	25	25		
4A0165	R/L1, S/L2, T/L3	70	50 to 95	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70	70 to 95		
	-, +1	—	35 to 95		
	+3	—	50 to 95		
	⊕	35	25 to 35		
4A0208	R/L1, S/L2, T/L3	95	35 to 95	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95	35 to 95		
	-, +1	—	35 to 150		
	+3	—	25 to 70		
	⊕	50	50 to 150		
4A0250	R/L1, S/L2, T/L3	120	95 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	120	95 to 300		
	-, +1	—	70 to 300		
	+3	—	35 to 300		
	⊕	70	70 to 240		
4A0296	R/L1, S/L2, T/L3	185	95 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	185	95 to 300		
	-, +1	—	70 to 300		
	+3	—	35 to 300	M10	18 to 23 (159 to 204)
	⊕	95	95 to 240	M12	32 to 40 (283 to 354)
4A0362	R/L1, S/L2, T/L3	240	95 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	240	95 to 300		
	-, +1	—	95 to 300		
	+3	—	70 to 300	M10	18 to 23 (159 to 204)
	⊕	120	120 to 240	M12	32 to 40 (283 to 354)

<1> When an EMC filter is installed, additional measures must be taken in order to comply with IEC/EN 61800-5-1. Refer to *EMC Filter Installation on page 545*.

**Note:** Refer to the related instruction manuals for the applicable wire gauges when connecting peripheral devices to terminals -, +1, +3, B1, and B2. Contact your Yaskawa representative or the nearest Yaskawa sales office directly for consultation if using a wire gauge not listed in the manual.

? Main Circuit Terminal and Motor Wiring

This section outlines the various steps, precautions, and checkpoints for wiring the main circuit terminals and motor terminals.

**NOTICE:** When connecting the motor to the drive output terminals U/T1, V/T2, and W/T3, the phase order for the drive and motor should match. Failure to comply with proper wiring practices may cause the motor to run in reverse if the phase order is backward.

**NOTICE:** Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Failure to comply could result in damage to the drive, phase-advancing capacitors, LC/RC noise filters or ground fault circuit interrupters.

**NOTICE:** Do not connect the AC power line to the output motor terminals of the drive. Failure to comply could result in death or serious injury by fire as a result of drive damage from line voltage application to output terminals.

? Cable Length Between Drive and Motor

Voltage drop along the motor cable may cause reduced motor torque when the wiring between the drive and the motor is too long, especially at low frequency output. This can also be a problem when motors are connected in parallel with a fairly long motor cable. Drive output current will increase as the leakage current from the cable increases. An increase in leakage current may trigger an overcurrent situation and weaken the accuracy of the current detection.

Adjust the drive carrier frequency according to [Table 3.5](#). If the motor wiring distance exceeds 100 m because of the system configuration, reduce the ground currents. [Refer to C6-02: Carrier Frequency Selection on page 163.](#)

Table 3.5 Cable Length Between Drive and Motor

Cable Length	50 m or less	100 m or less	Greater than 100 m
Carrier Frequency	15 kHz or less	5 kHz or less	2 kHz or less

- Note:**
1. When setting carrier frequency in a drive running multiple motors, calculate the cable length as the total distance of wiring to all motors that are connected.
  2. The maximum cable length is 100 m when using OLV/PM (A1-02 = 5) or AOLV/PM (A1-02 = 6).

? Ground Wiring

Follow the precautions to wire the ground for one drive or a series of drives.

**WARNING! Electrical Shock Hazard.** Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire. Improper equipment grounding may cause dangerous electrical potentials on equipment chassis, which could result in death or serious injury.

**WARNING! Electrical Shock Hazard.** Be sure to ground the drive ground terminal. Improper equipment grounding could result in death or serious injury by contacting ungrounded electrical equipment.

**NOTICE:** Do not share the ground wire with other devices such as welding machines or large-current electrical equipment. Improper equipment grounding could result in drive or equipment malfunction due to electrical interference.

**NOTICE:** When using more than one drive, ground multiple drives according to instructions. Improper equipment grounding could result in abnormal operation of drive or equipment.

Refer to [Figure 3.15](#) when using multiple drives. Do not loop the ground wire.

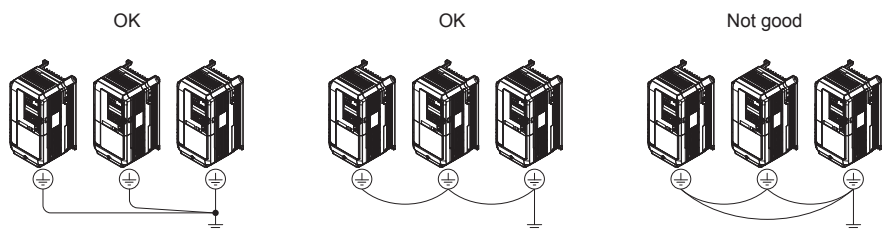


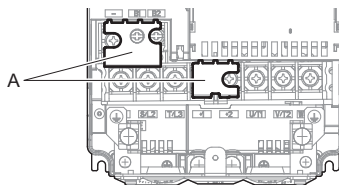
Figure 3.15 Multiple Drive Wiring

### ? Wiring the Main Circuit Terminal

**WARNING! Electrical Shock Hazard.** Shut off the power supply to the drive before wiring the main circuit terminals. Failure to comply may result in death or serious injury.

Wire the main circuit terminals after the terminal board has been properly grounded.

Models CIMR-T□2A0004 through 0081 and 4A0002 through 0044 have a cover placed over the DC bus and braking circuit terminals prior to shipment to help prevent miswiring. Cut away covers as needed for terminals using wire cutters.



A – Protective Cover

Figure 3.16 Protecting Cover to Prevent Miswiring (CIMR-T□2A0056)

### ? Main Circuit Configurations

*Refer to Main Circuit Configurations on page 49* when wiring terminals on the drive's main power circuit.

**WARNING! Fire Hazard.** The braking resistor connection terminals are B1 and B2. Do not connect braking resistors to any other terminals. Improper wiring connections could cause the braking resistor to overheat and cause death or serious injury by fire. Failure to comply may result in damage to the braking circuit or drive.

# 3.8 Control Circuit Wiring

## ? Control Circuit Connection Diagram

*Refer to Standard Connection Diagram on page 46* when wiring terminals on the drive's control circuit.

## ? Control Circuit Terminal Block Functions

Drive parameters determine which functions apply to the multi-function digital inputs (S1 to S8), multi-function digital outputs (M1 to M6), multi-function analog inputs (A1 to A3), and multi-function analog monitor output (FM, AM). The default setting is listed next to each terminal in *Figure 3.1* on page 47.

**WARNING! Sudden Movement Hazard.** Always check the operation and wiring of control circuits after being wired. Operating a drive with untested control circuits could result in death or serious injury.

## ? Input Terminals

*Table 3.6* lists the input terminals on the drive. Text in parenthesis indicates the default setting for each multi-function input.

**Table 3.6 Control Circuit Input Terminals**

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Multi-Function Digital Inputs	S1	Multi-function input 1 (Closed: Forward run, Open: Stop)	Photocoupler 24 Vdc, 8 mA Set the wire jumper between SC and SN or SC and SP to select sinking/sourcing mode and power supply. Refer to Sinking/Sourcing Mode Switch for Digital Inputs on page 68.	191
	S2	Multi-function input 2 (Closed: Reverse run, Open: Stop)		
	S3	Multi-function input 3 (External fault, N.O.)		
	S4	Multi-function input 4 (Fault reset)		
	S5	Multi-function input 5 (Multi-step speed reference 1)		
	S6	Multi-function input 6 (Multi-step speed reference 2)		
	S7	Multi-function input 7 (Jog reference)		
	S8	Multi-function input 8 (Baseblock)		
	SC	Multi-function input common	Multi-function input common	
	SP	Digital input power supply +24 Vdc	24 Vdc power supply for digital inputs, 150 mA max (if no digital input option DI-A3 is used only)	68
	SN	Digital input power supply 0 V	Never short terminals SP and SN as doing so will damage the drive.	
Safe Disable Inputs	H1	Safe Disable input 1	24 Vdc, 8 mA One or both open: Output disabled Both closed: Normal operation Internal impedance: 3.3 kΩ Off time of at least 1 ms Disconnect the wire jumpers shorting terminals H1, H2, and HC to use the Safe Disable inputs. Set the jumper S3 to select between sinking, sourcing mode, and the power supply as explained in <i>Sinking/Sourcing Mode Selection for Safe Disable Inputs</i> on page 68.	559
	H2	Safe Disable input 2		
	HC	Safe Disable function common	Safe disable function common	

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Analog Inputs / Pulse Train Input	RP	Multi-function pulse train input (Frequency reference)	Input frequency range: 0 to 32 kHz Signal Duty Cycle: 30 to 70% High level: 3.5 to 13.2 Vdc, low level: 0.0 to 0.8 Vdc Input impedance: 3 kΩ	120 220
	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)	119
	-V	Power supply for analog inputs	-10.5 Vdc (max allowable current 20 mA)	—
	A1	Multi-function analog input 1 (Frequency reference bias)	-10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ)	119 211
	A2	Multi-function analog input 2 (Frequency reference bias)	-10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) Voltage or current input must be selected by DIP switch S1 and H3-09	119 120 213
	A3	Multi-function analog input 3 (Auxiliary frequency reference) / PTC Input	-10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) Use DIP switch S4 on the terminal board to selection between analog or PTC input.	119
	AC	Frequency reference common	0 V	119
	E (G)	Ground for shielded lines and option cards	—	—

## ? Output Terminals

**Table 3.7** lists the output terminals on the drive. Text in parenthesis indicates the default setting for each multi-function output.

**Table 3.7 Control Circuit Output Terminals**

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Fault Relay	MA	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	201
	MB	N.C. output		
	MC	Fault output common		
Multi-Function Digital Output <1>	M1	Multi-function digital output (During run)	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	201
	M2			
	M3	Multi-function digital output (Zero Speed)		
	M4			
	M5	Multi-function digital output (Speed Agree 1)		
	M6			
Monitor Output	MP	Pulse train output (Output frequency)	32 kHz (max)	220
	FM	Analog monitor output 1 (Output frequency)	-10 to +10 Vdc, 0 to +10 Vdc, or 4-20 mA	218
	AM	Analog monitor output 2 (Output current)	Use jumper S5 on the terminal board to select between voltage or current output signals.	
	AC	Monitor common	0 V	—
Safety Monitor Output	DM+	Safety monitor output	Outputs status of Safe Disable function. Closed when both Safe Disable channels are closed. Up to +48 Vdc 50 mA	544
	DM-	Safety monitor output common		

<1> Refrain from assigning functions to digital outputs that involve frequent switching, as doing so may shorten relay performance life. Switching life is estimated at 200,000 times (assumes 1 A, resistive load).

? Serial Communication Terminals

Table 3.8 Control Circuit Terminals: Serial Communications

Type	No.	Signal Name	Function (Signal Level)	
MEMOBUS/Modbus Communication <I>	R+	Communications input (+)	MEMOBUS/Modbus communication: Use a RS-485 or RS-422 cable to connect the drive.	RS-485/422 MEMOBUS/Modbus communication protocol 115.2 kbps (max.)
	R-	Communications input (-)		
	S+	Communications output (+)		
	S-	Communications output (-)		
	IG	Shield ground	0 V	

<I> Enable the termination resistor in the last drive in a MEMOBUS network by setting DIP switch S2 to the ON position. For more information on the termination resistor, see [Control I/O Connections on page 68](#).

? Terminal Configuration

Control circuit terminals should be arranged as shown in [Figure 3.17](#).

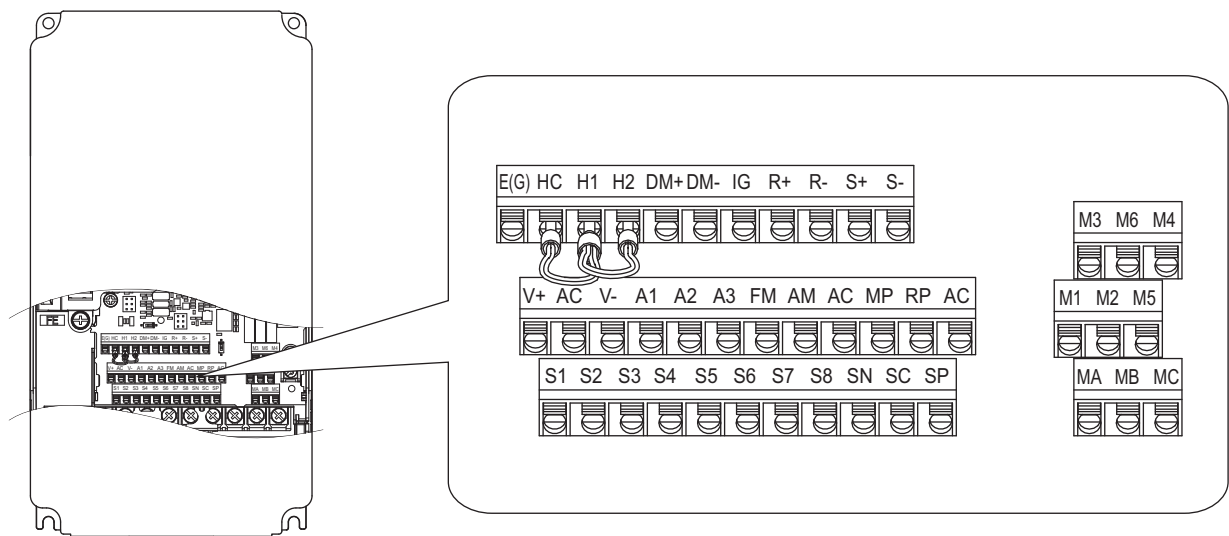


Figure 3.17 Control Circuit Terminal Arrangement

? Wire Size

Select appropriate wire type and gauges from [Table 3.9](#). For simpler and more reliable wiring, use crimp ferrules on the wire ends. Refer to [Table 3.10](#) for ferrule terminal types and sizes.

Table 3.9 Wire Gauges

Terminal	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
	Applicable wire size mm <sup>2</sup> (AWG)	Recommended wire size mm <sup>2</sup> (AWG)	Applicable wire size mm <sup>2</sup> (AWG)	Recommended wire size mm <sup>2</sup> (AWG)	
S1-S8, SC, SP, SN, RP, +V, -V, A1, A2, A3, AC, M1-M6, MA, MB, MC, MP, AM, FM, AC, S+, S-, R+, R-, IG, HC, H1, H2, DM+, DM-	Stranded wire: 0.2 to 1.0 (24 to 16) Solid wire: 0.2 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	Shielded line, etc.

### ? Ferrule-Type Wire Terminals

Prepare wire ends with insulated sleeves before connecting to the drive. See [Table 3.10](#) for dimensions. Yaskawa recommends CRIMPFOX 6, a crimping tool manufactured by PHOENIX CONTACT.

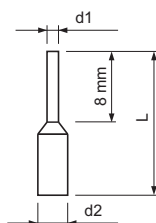


Figure 3.18 Ferrule Dimensions

Table 3.10 Ferrule Terminal Types and Sizes

Size mm <sup>2</sup> (AWG)	Type	L (mm)	d1 (mm)	d2 (mm)	Manufacturer
	AI 0.25-8YE	12.5	0.8	1.8	PHOENIX CONTACT
0.34 (22)	AI 0.34-8TQ	10.5	0.8	1.8	
0.5 (20)	AI 0.5-8WH or AI 0.5-8OG	14	1.1	2.5	

### ? Wiring the Control Circuit Terminal

This section describes the proper procedures and preparations for wiring the control terminals.

**WARNING!** *Electrical Shock Hazard. Do not remove covers or touch the circuit boards while the power is on. Failure to comply could result in death or serious injury.*

**NOTICE:** *Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, -, +1, +2) and other high-power lines. Improper wiring practices could result in drive malfunction due to electrical interference.*

**NOTICE:** *Separate wiring for digital output terminals MA, MB, MC and M1 to M6 from wiring to other control circuit lines. Improper wiring practices could result in drive or equipment malfunction or nuisance trips.*

**NOTICE:** *Use a class 2 power supply (UL standard) when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply.*

**NOTICE:** *Insulate shields with tape or shrink tubing to prevent contact with other signal lines and equipment. Improper wiring practices could result in drive or equipment malfunction due to short circuit.*

**NOTICE:** *Connect the shield of shielded cable to the appropriate ground terminal. Improper equipment grounding could result in drive or equipment malfunction or nuisance trips.*

Wire the control circuit only after terminals have been properly grounded and main circuit wiring is complete. Refer to [Figure 3.19](#) and [Figure 3.20](#) for details. Prepare the ends of the control circuit wiring as shown in [Figure 3.21](#). Refer to [Wire Size on page 64](#).

**NOTICE:** *Use shielded twisted-pair cables as indicated to prevent operating faults. Improper wiring practices could result in drive or equipment malfunction due to electrical interference.*

Connect control wires as shown in the following figure:

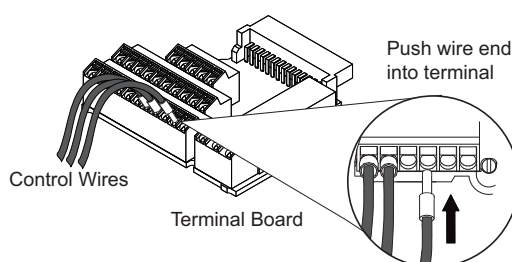
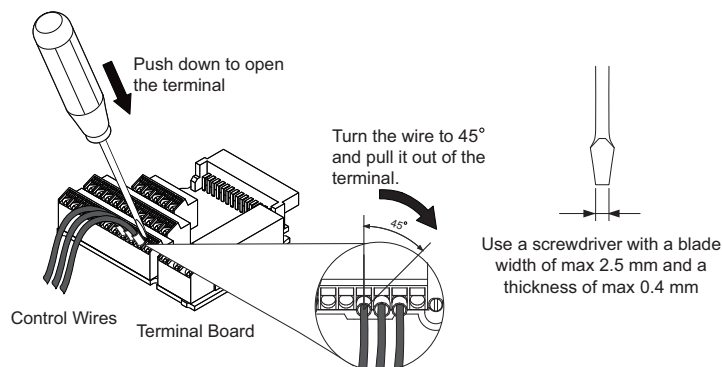


Figure 3.19 Terminal Board Wiring Guide

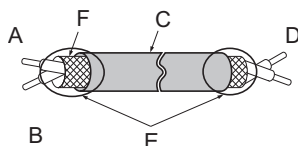
### 3.8 Control Circuit Wiring

To disconnect control wires from the terminals use the procedure described in [Figure 3.20](#). Grasp the wire where it enters the terminal with a pair of pliers, then use a straight-edge screw driver to release the terminal and pull the wire out. If it fits tightly, e.g. if ferrules are used, turn the wire for about 45° and then pull it gently out. Use this procedure to remove the wire jumper between terminals HC, H1 and H2 that is preinstalled at shipping.



**Figure 3.20 Removing Wires from the Terminal Board**

When setting the frequency by analog reference from an external potentiometer, use shielded twisted-pair wires (treating wire ends as shown in [Figure 3.21](#)) and connect the shield to the ground terminal of the drive.



- |  |   |
|--|---|
| <b>A – Drive side</b>                                  | <b>D – Control device side</b>                |
| <b>B – Connect shield to ground terminal of drive.</b> | <b>E – Shield sheath (insulate with tape)</b> |
| <b>C – Insulation</b>                                  | <b>F – Shield</b>                             |

**Figure 3.21 Preparing the Ends of Shielded Cables**

**NOTICE:** The signal lines between the drive and the operator station or peripheral equipment should not exceed 50 meters when using an analog signal from a remote source to supply the frequency reference. Failure to comply could result in poor system performance.

? Switches and Jumpers on the Terminal Board

The terminal board is equipped with several switches used to adapt the drive I/Os to the external control signals. *Figure 3.22* shows the location of these switches. Refer to *Control I/O Connections on page 68* for setting instructions.

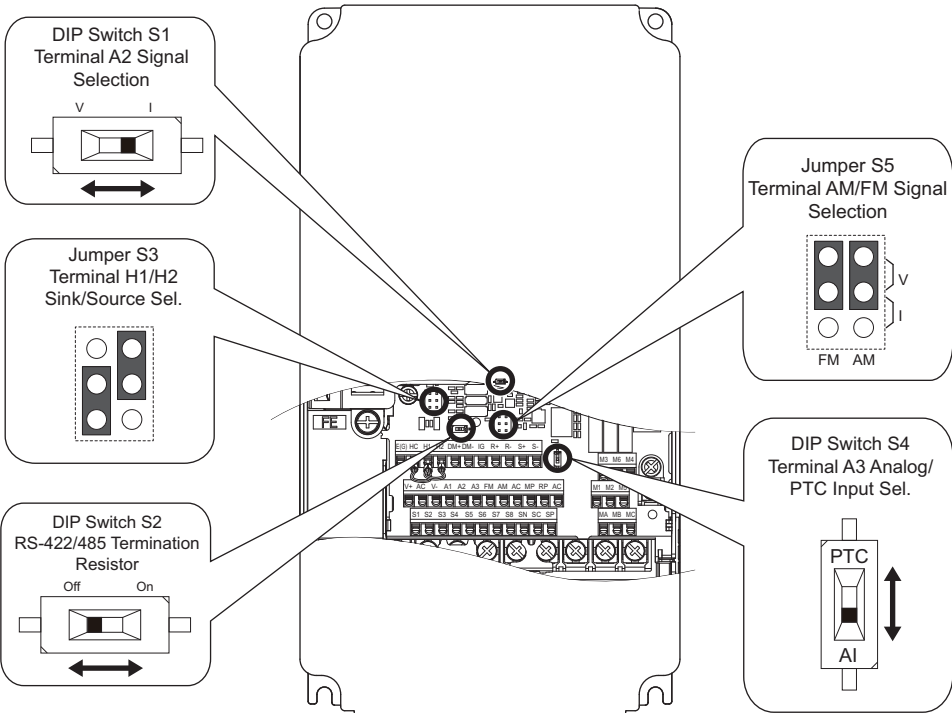


Figure 3.22 Locations of Jumpers and Switches on the Terminal Board

3.9 Control I/O Connections

? Sinking/Sourcing Mode Switch for Digital Inputs

Use the wire link between terminals SC and SP or SC and SN to select between Sink mode, Source mode or external power supply for the digital inputs S1 to S8 as shown in [Table 3.11](#) (Default: Sink mode, internal power supply).

**Note:** Never short terminals SP and SN as doing so will damage the drive.

Table 3.11 Digital Input Sink / Source / External Power Supply Selection

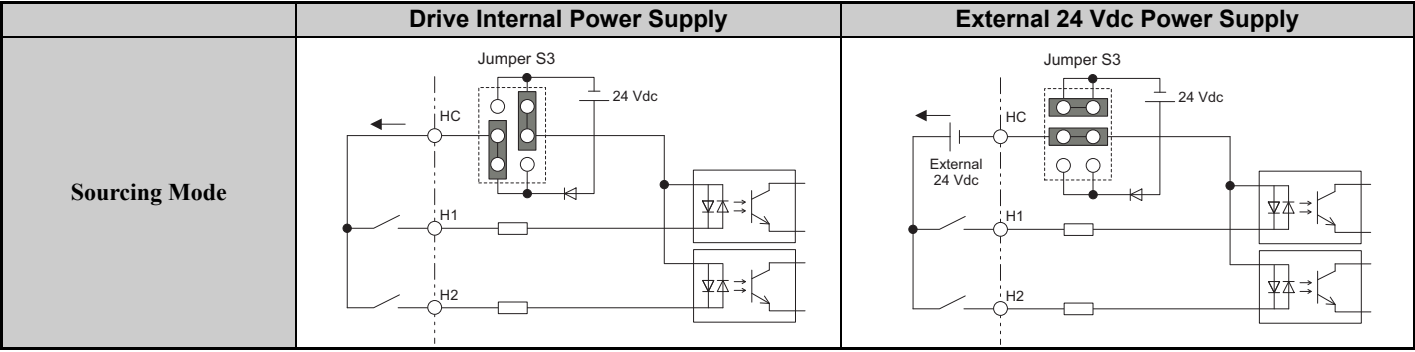
	Drive Internal Power Supply (Terminal SN and SP)	External 24 Vdc Power Supply
Sourcing Mode (PNP)		

? Sinking/Sourcing Mode Selection for Safe Disable Inputs

Use jumper S3 on the terminal board to select between Sink mode, Source mode or external power supply for the Safe Disable inputs H1 and H2 as shown in [Table 3.11](#) (Default: Source mode, internal power supply.) Refer to [Switches and Jumpers on the Terminal Board on page 67](#) for locating jumper S3.

Table 3.12 Safe Disable Input Sink / Source / External Power Supply Selection

	Drive Internal Power Supply	External 24 Vdc Power Supply
Sinking Mode		



? Using the Pulse Train Output

The pulse train output terminal MP can either supply power but can also be used with external power supply. Peripheral devices should be connected in accordance with the specifications listed below. Failure to do so can cause unexpected drive operation, and can damage the drive or connected circuits.

? Using Power from the Pulse Output Terminal (Source Mode)

The high voltage level of the pulse output terminal depends on the load impedance.

Load Impedance $R_L$ (k $\Omega$ )	Output Voltage $V_{MP}$ (V) (insulated)
1.5 k $\Omega$	5 V
4 k $\Omega$	8 V
10 k $\Omega$	10 V

**Note:** The load resistance needed in order to get a certain high level voltage  $V_{MP}$  can be calculated by:  $R_L = V_{MP} \cdot 2 / (12 - V_{MP})$

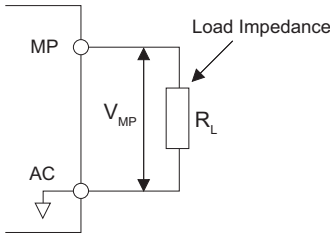


Figure 3.23 Pulse Output Connection Using Internal Voltage Supply

? Using External Power Supply (Sink Mode)

The high voltage level of the pulse output signal depends on the external voltage applied. The voltage must be between 12 and 15 Vdc. The load resistance must be adjusted so that the current is lower than 16 mA.

External Power Supply (V)	Load Impedance (k $\Omega$ )
12 to 15 Vdc $\pm 10\%$	1.0 k $\Omega$ or higher

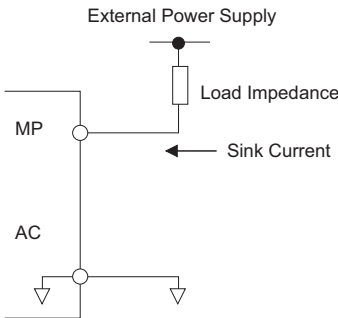


Figure 3.24 Pulse Output Connection Using External Voltage Supply

#### ? Terminal A2 Input Signal Selection

Terminal A2 can be used to input either a voltage or a current signal. Select the signal type using switch S1 as explained in [Table 3.13](#). Set parameter H3-09 accordingly as shown in [Table 3.14](#). Refer to [Switches and Jumpers on the Terminal Board on page 67](#) for locating switch S1.

**Note:** If terminals A1 and A2 are both set for frequency bias ( $H3-02 = 0$  and  $H3-10 = 0$ ), both input values will be combined to create the frequency reference.

**Table 3.13 DIP Switch S1 Settings**

Setting	Description
V (left position)	Voltage input (-10 to +10 V, or 0 to +10 V)
I (right position) (default)	Current input (4 to 20 mA or 0 to 20 mA): default setting

**Table 3.14 Parameter H3-09 Details**

No.	Parameter Name	Description	Setting Range	Default
H3-09	Terminal A2 signal level selection	Selects the signal level for terminal A2. 0: 0 to 10 Vdc 1: -10 to 10 Vdc 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2

#### ? Terminal A3 Analog/PTC Input Selection

Terminal A3 can be configured either as multi-function analog input or as PTC input for motor thermal overload protection. Use switch S4 to select the input function as described in [Table 3.15](#). Refer to [Switches and Jumpers on the Terminal Board on page 67](#) for locating switch S4.





**Table 3.15 DIP Switch S4 Settings**

Setting	Description
AI (lower position) (default)	Analog input for the function selected in parameter H3-06
PTC (upper position)	PTC input. Parameter H3-06 must be set to E (PTC input)

#### ? Terminal AM/FM Signal Selection

The signal type for terminals AM and FM can be set to either voltage or current output using jumper S5 on the terminal board as explained in [Table 3.16](#). When changing the setting of jumper S5, parameters H4-07 and H4-08 must be set accordingly. The default selection is voltage output for both terminals. Refer to [Switches and Jumpers on the Terminal Board on page 67](#) for locating jumper S5.

**Table 3.16 Jumper S5 Settings**

	Voltage Output	Current Output
		
Terminal FM		

**Table 3.17 Parameter H4-07, H4-08 Details**

No.	Parameter Name	Description	Setting Range	Default Setting
H4-07	Terminal AM signal level selection	0: 0 to 10 Vdc 1: -10 to 10 Vdc 2: 4 to 20 mA	0 to 2	0
H4-08	Terminal FM signal level selection			

## ? MEMOBUS/Modbus Termination

This drive is equipped with a built in termination resistor for the RS-422/485 communication port. DIP switch S2 enables or disabled the termination resistor as shown in [Table 3.18](#). The OFF position is the default. The termination resistor should be placed to the ON position when the drive is the last in a series of slave drives. Refer to [Switches and Jumpers on the Terminal Board on page 67](#) for locating switch S2.

**Table 3.18 MEMOBUS/Modbus Switch Settings**

S2 Position	Description
	Internal termination resistor ON
OFF	Internal termination resistor OFF (default setting)

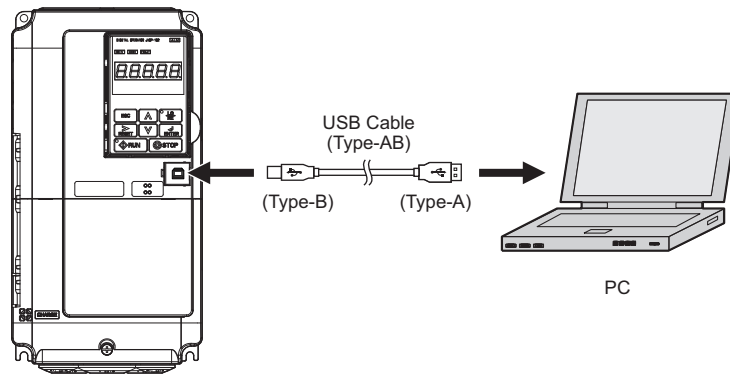
**Note:** Refer to [MEMOBUS/Modbus Communications on page 509](#) for details on MEMOBUS/Modbus.

### 3.10 Connect to a PC

This drive is equipped with a USB port (type-B).

The drive can connect to the USB port of a PC using a USB 2.0, AB type cable (sold separately). DriveWizard Plus can then be used to monitor drive performance and manage parameter settings. Contact Yaskawa for more information on DriveWizard Plus.

It is also possible to use the USB Copy Unit (JVOP-181) for connection to a PC. Remove the operator and use the RJ-45 connector when doing so.



**Figure 3.25 Connecting to a PC (USB)**

## 3.11 External Interlock

Systems that may be affected if the drive faults out should be interlocked with the drive's fault output and ready signal.

### ? Drive Ready

When the “Drive ready” signal has been set to one of the multi-function contact outputs, that output will close whenever the drive is ready to accept a Run command or is already running. Under the following conditions the Drive ready signal will switch off and remain off, even if a Run command is entered:

- when the power supply is shut off.
- during a fault.
- when there is problem with the control power supply.
- when a parameter setting error makes the drive unable to run even if a Run command has been entered.
- when a fault such as overvoltage or undervoltage is triggered as soon as the Run command is entered.
- when the drive is in the Programming mode and will not accept a Run command even when entered.

### ? Interlock Circuit Example

Two drives running a single application might interlock with the controller using the Drive ready and Fault output signals as shown below. The figure illustrates how the application would not be able to run if either drive experiences a fault or is unable to supply a Drive ready signal.

Terminal	Output Signal	Parameter Setting
MA, MB, MC	Fault	—
M1-M2	Drive Ready	H2-01 = 06

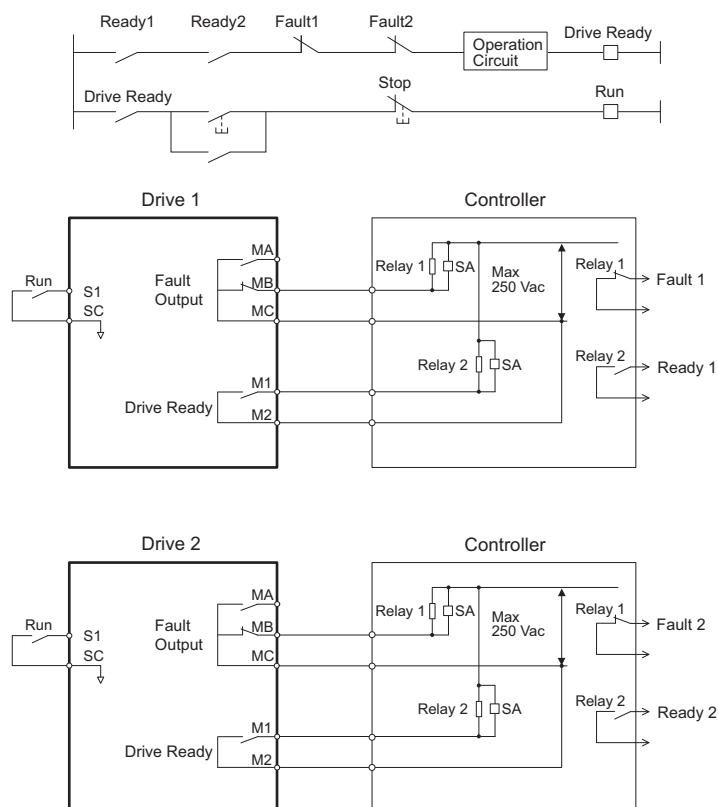
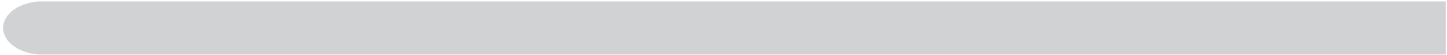


Figure 3.26 Interlock Circuit Example

## 3.12 Wiring Checklist

<input checked="" type="checkbox"/>	No.	Item	Page
<b>Drive, peripherals, option cards</b>			
<input type="checkbox"/>	1	Check drive model number to ensure receipt of correct model.	30
<input type="checkbox"/>	2	Make sure you have the correct braking resistors, DC reactors, noise filters, and other peripheral devices.	370
<input type="checkbox"/>	3	Check the option card model number.	370
<b>Installation area and physical setup</b>			
<input type="checkbox"/>	4	Ensure that the area surrounding the drive complies with specifications.	36
<b>Power supply voltage, output voltage</b>			
<input type="checkbox"/>	5	The voltage from the power supply should be within the input voltage specification range of the drive.	174
<input type="checkbox"/>	6	The voltage rating for the motor should match the drive output specifications.	28 466
<input type="checkbox"/>	7	Verify that the drive is properly sized to run the motor.	28 466
<b>Main circuit wiring</b>			
<input type="checkbox"/>	8	Confirm proper branch circuit protection as specified by national and local codes.	46
<input type="checkbox"/>	9	Properly wire the power supply to drive terminals R/L1, S/L2, and T/L3.	49
<input type="checkbox"/>	10	Properly wire the drive and motor together. The motor lines and drive output terminals R/T1, V/T2, and W/T3 should match in order to produce the desired phase order. If the phase order is incorrect, the drive will rotate in the opposite direction.	60
<input type="checkbox"/>	11	Use 600 Vac vinyl-sheathed wire for the power supply and motor lines.	55
<input type="checkbox"/>	12	Use the correct wire gauges for the main circuit. <i>Refer to Wire Gauges and Tightening Torque on page 55.</i> • When using comparatively long motor cable, calculate the amount of voltage drop. <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px 0;"> <math display="block">\text{Motor rated voltage (V)} \times 0.02 \geq \sqrt{3} \times \text{wire resistance } (\Omega/\text{km}) \times \text{cable length (m)} \times \text{motor rated current (A)} \times 10^{-3}</math> </div> • If the cable between the drive and motor exceeds 50 m, adjust the carrier frequency set to C6-02 accordingly.	55  55 60
<input type="checkbox"/>	13	Properly ground the drive. Review page 60.	60
<input type="checkbox"/>	14	Tightly fasten all terminal screws (control circuit terminals, grounding terminals). <i>Refer to Wire Gauges and Tightening Torque on page 55.</i>	55
<input type="checkbox"/>	15	Set up overload protection circuits when running multiple motors from a single drive. <div style="text-align: center; margin: 10px 0;"> </div> <p>MC1 - MCn ... magnetic contactor OL 1 - OLn ... thermal relay</p>	—
<input type="checkbox"/>	16	If using a braking resistor or dynamic braking resistor unit, install a magnetic contactor. Properly install the resistor, and ensure that overload protection shuts off the power supply.	384
<input type="checkbox"/>	17	Verify phase advancing capacitors, input noise filters, or ground fault circuit interrupters are NOT installed on the output side of the drive.	—
<b>Control circuit wiring</b>			
<input type="checkbox"/>	18	Use twisted-pair line for all drive control circuit wiring.	62
<input type="checkbox"/>	19	Ground the shields of shielded wiring to the ground terminal.	65
<input type="checkbox"/>	20	If using a 3-wire sequence, properly set parameters for multi-function contact input terminals S1 through S8, and properly wire control circuits.	—
<input type="checkbox"/>	21	Properly wire any option cards.	64
<input type="checkbox"/>	22	Check for any other wiring mistakes. Only use a multimeter to check wiring.	—

<input checked="" type="checkbox"/>	No.	Item	Page
<input type="checkbox"/>	23	Properly fasten the control circuit terminal screws in the drive. <i>Refer to Wire Gauges and Tightening Torque on page 55.</i>	55
<input type="checkbox"/>	24	Pick up all wire clippings.	—
<input type="checkbox"/>	25	Ensure that no frayed wires on the terminal block are touching other terminals or connections.	—
<input type="checkbox"/>	26	Properly separate control circuit wiring and main circuit wiring.	—
<input type="checkbox"/>	27	Analog signal line wiring should not exceed 50 m.	—
<input type="checkbox"/>	28	Safe Disable input wiring should not exceed 30 m.	—







# Start-Up Programming & Operation

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This chapter explains the functions of the digital operator and how to program the drive for initial operation.

<b>4.1</b>	<b>SECTION SAFETY</b>	<b>80</b>
<b>4.2</b>	<b>USING THE DIGITAL OPERATOR</b>	<b>81</b>
<b>4.3</b>	<b>THE DRIVE AND PROGRAMMING MODES</b>	<b>85</b>
<b>4.4</b>	<b>START-UP FLOWCHARTS</b>	<b>90</b>
<b>4.5</b>	<b>POWERING UP THE DRIVE</b>	<b>94</b>
<b>4.6</b>	<b>AUTO-TUNING</b>	<b>95</b>
<b>4.7</b>	<b>NO-LOAD OPERATION TEST RUN</b>	<b>107</b>
<b>4.8</b>	<b>TEST RUN WITH LOAD CONNECTED</b>	<b>108</b>
<b>4.9</b>	<b>VERIFYING PARAMETER SETTINGS AND BACKING UP CHANGES</b>	<b>109</b>
<b>4.10</b>	<b>TEST RUN CHECKLIST</b>	<b>111</b>

### 4.1 Section Safety

#### DANGER

##### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

#### WARNING

##### Electrical Shock Hazard

**Do not operate equipment with covers removed.**

Failure to comply could result in death or serious injury.

The diagrams in this section may include drives without covers or safety shields to illustrate details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

**A separate holding brake should be prepared by the user.**

**The holding brake should be wired so that it is activated by an external sequence when a fault occurs, the power is shut off, or an emergency switch is triggered.**

Failure to comply could result in death or serious injury.

## 4.2 Using the Digital Operator

Use the digital operator to enter run and stop commands, display data, edit parameters, as well as display fault and alarm information.

### ? Keys and Displays

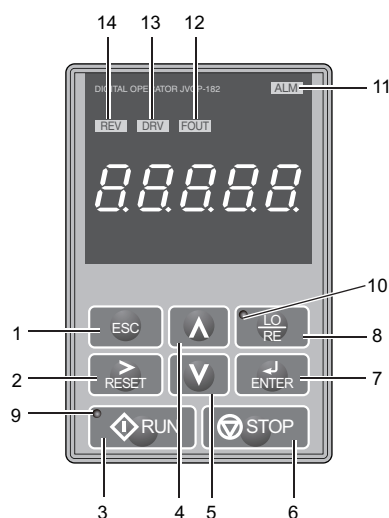


Figure 4.1 Keys and Displays on the Digital Operator

No.	Display	Name	Function
1		RESET Key	<ul style="list-style-type: none"> <li>Moves the cursor to the right.</li> <li>Resets the drive to clear a fault situation.</li> </ul>
2		RUN Key	Starts the drive in the LOCAL mode. The Run LED <ul style="list-style-type: none"> <li>is on, when the drive is operating the motor.</li> <li>flashes during deceleration to stop or when the frequency reference is 0.</li> <li>flashes quickly the drive is disabled by a DI, the drive was stopped using a fast stop DI or a run command was active during power up.</li> </ul>
3		Up Arrow Key	Scrolls up to display the next item, selects parameter numbers and increments setting values.
4		Down Arrow Key	Scrolls down to display the next item, selects parameter numbers and increments setting values.
5		STOP Key < >	Stops drive operation.
6		ENTER Key	<ul style="list-style-type: none"> <li>Enters parameter values and settings.</li> <li>Selects a menu item to move between displays.</li> </ul>
7		LO/RE Selection Key < >	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE). The LED is on when the drive is in the LOCAL mode (operation from keypad).
8		RUN Light	Lit while the drive is operating the motor. Refer to page 83 for details.
9		LO/RE Light	Lit while the operator is selected to run the drive (LOCAL mode). Refer to page 83 for details.
10		ALM LED Light	Refer to LED Screen Displays on page 82.
11		FOUT LED Light	
12		DRV LED Light	
13		REV LED Light	

<1> The STOP key has highest priority. Pressing the STOP key will always cause the drive to stop the motor, even if a Run command is active at any external Run command source. To disable the STOP key priority, set parameter o2-06 to 0.

<2> The LO/RE key can only switch between LOCAL and REMOTE when the drive is stopped. To disable the LO/RE key to prohibit switching between LOCAL and REMOTE, set parameter o2-01 to 0.

4.2 Using the Digital Operator

? Digital Text Display

Text appears on the digital operator as shown below. This section explains the meaning of text as it appears on the display screen.

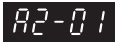

Lit	Flashing
	


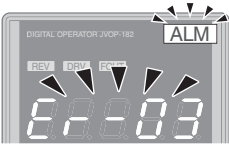
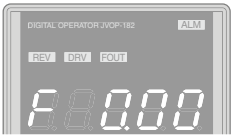
Table 4.1 Digital Text Display

Text	LED	Text	LED	Text	LED	Text	LED
0	0	9	9	I	i	R	r
1	1	A	A	J	j	S	s
2	2	B	b	K	k	T	t
3	3	C	c	L	L	U	u
4	4	D	d	M	m<1>	V	v
5	5	E	E	N	n	W	w<1>
6	6	F	F	O	o	X	none
7	7	G	G	P	p	Y	y
8	8	H	H	Q	q	Z	none

<1> Displayed in two digits.







? LED Screen Displays

Table 4.2 LED Screen Displays

Display	Lit	Flashing	Off
ALM	The drive has detected an alarm or error	<ul style="list-style-type: none"><li>When an alarm occurs</li><li>oPE detected</li><li>When a fault or error occurs during Auto-Tuning</li></ul>	Normal state (no fault or alarm)
REV	Motor is rotating in reverse	—	Motor is rotating forward
DRV	<ul style="list-style-type: none"><li>The drive is in the Drive Mode</li><li>During Auto-Tuning</li></ul>	—	<ul style="list-style-type: none"><li>The drive is in the Programming Mode</li><li>The drive will not accept a Run command</li></ul>
FOUT	When the display shows the output frequency	—	When a display other than the output frequency monitor is shown.
As illustrated in this manual			

? LO/RE LED and RUN LED Indications

Table 4.3 LO/RE LED and RUN LED Indications

LED	Lit	Flashing	Flashing Quickly <1>	Off
	When source of the Run command is assigned to the digital operator (LOCAL)	—	—	Run command to be given from a device other than the digital operator (REMOTE)
	During run	<ul style="list-style-type: none"><li>• During deceleration to stop</li><li>• When a Run command is input and frequency reference is 0 Hz</li></ul>	<ul style="list-style-type: none"><li>• While the drive is set for LOCAL, a Run command was entered to the input terminals after which the drive was then switched to REMOTE.</li><li>• A Run command was entered via the input terminals while not in the Drive Mode.</li><li>• During deceleration when a Fast Stop command was entered.</li><li>• The drive output is shut off by the Safe Disable function.</li><li>• While the drive was running in the REMOTE mode, the STOP key was pushed.</li><li>• The drive was powered up with b1-17 = 0 (default) while the Run command is active.</li></ul>	During stop
Examples				

<1> Refer to [Figure 4.2](#) for the difference between “flashing” and “flashing quickly”.

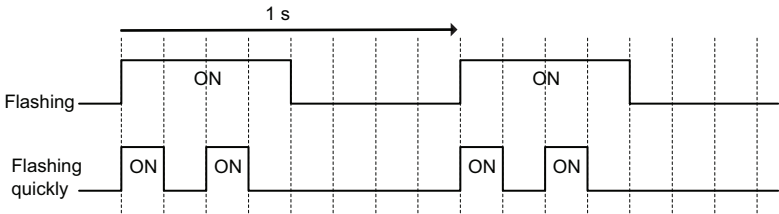


Figure 4.2 RUN LED Status and Meaning

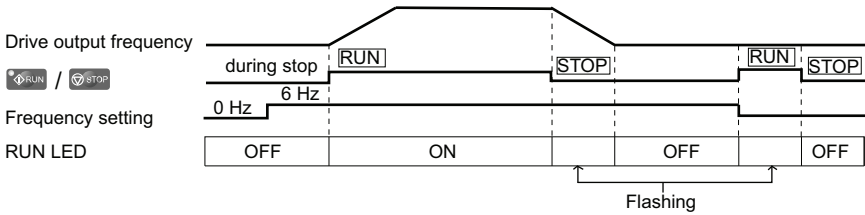
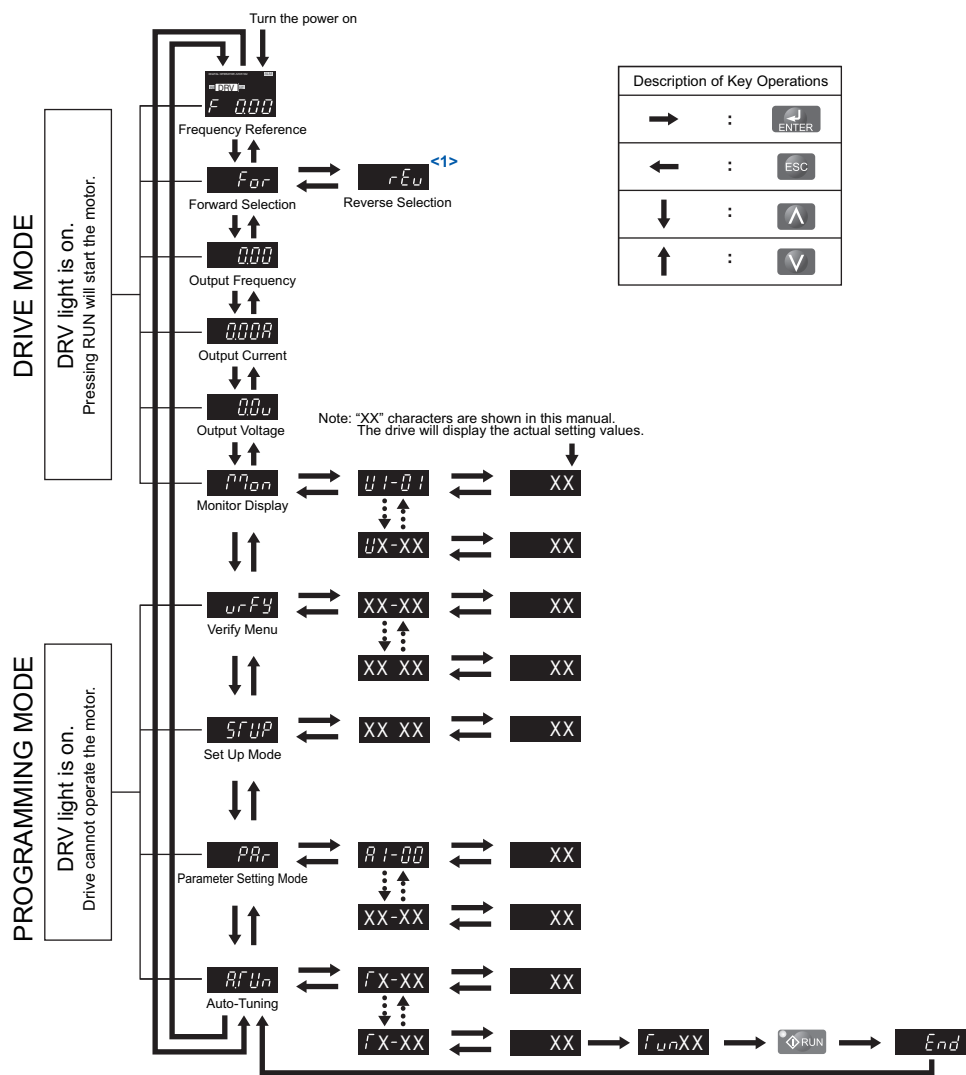


Figure 4.3 RUN LED and Drive Operation

? Menu Structure for Digital Operator



<1> Reverse can only be selected when the drive is set for LOCAL. Details on switching between forward and reverse can be found in [Navigating the Drive and Programming Modes on page 85](#).

Figure 4.4 Digital Operator Menu and Screen Structure

## 4.3 The Drive and Programming Modes

The drive has a Programming Mode to program the drive for operation, and a Drive Mode used to actually run the motor.



**Drive Mode:** In the Drive Mode, the user can start the motor and observe operation status with the monitors that are available. Parameter settings cannot be edited or changed when in the Drive Mode.













**Programming Mode:** The Programming Mode allows access to edit, adjust, and verify parameters, as well as perform Auto-Tuning. Unless set to allow a Run command, the drive will not accept a Run command when the digital operator is in the Programming Mode.

**Note:** If parameter b1-08 is set to 0 the drive will accept a Run command only in the Drive Mode. When editing parameters, the user must first exit the Programming Mode and enter the Drive Mode before starting the motor.

**Note:** To allow the drive to run the motor while in the Programming Mode, set b1-08 to 1.

### ? Navigating the Drive and Programming Modes

The drive is set to operate in Drive Mode when it is first powered up. Switch between display screens by using the  and  keys.

Mode	Contents	Operator Display	Description
Power Up	Frequency Reference (default)		This display screen allows the user to monitor and change the frequency reference while the drive is running. <i>Refer to The Drive and Programming Modes on page 85.</i> <b>Note:</b> The user can select the data displayed when the drive is first powered up with parameter o1-02.
			
Drive Mode	Forward/Reverse		This display shows the direction that has been selected when the drive is controlled by a REMOTE source. When the drive is set for LOCAL, the user can switch between FWD and REV as shown below.  <div style="text-align: center;">  </div> <p style="text-align: right; margin-right: 50px;"> <i>For</i> - Forward rotation  <i>rEv</i> - Reverse rotation </p> <b>Note:</b> For applications that should not run in reverse, set parameter b1-04 = “1” to prohibit the motor from rotating in reverse.
			
	Output Frequency Display		Displays the frequency that is output from the drive.
			
	Output Current Display		Monitors the output current of the drive.
			
	Output Voltage Reference (default)		Shows the data that selected for display by the user in parameter o1-01. The default setting displays drive output voltage (o1-01 = 106). <i>Refer to o1: Digital Operator Display Selection on page 459.</i>
			
	Monitor Display		Lists the monitor parameters (U□-□□ parameters) available in the drive.

### 4.3 The Drive and Programming Modes

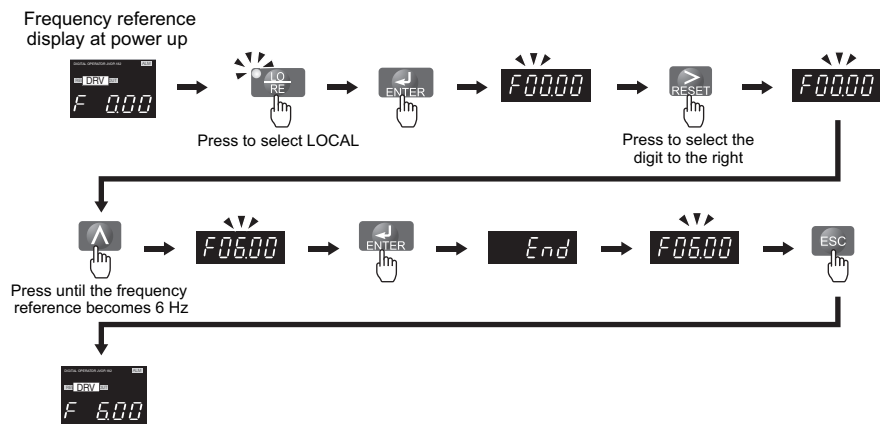
Mode	Contents	Operator Display	Description
Programming Mode			
	Verify Menu		Lists all parameters that have been edited or changed from default settings. ➔ <a href="#">Refer to Verifying Parameter Changes: Verify Menu on page 87.</a>
	Setup Group		A select list of parameters necessary to get the drive operating quickly. ➔ <a href="#">Refer to Using the Setup Group on page 88.</a>
	Parameter Setting Mode		Allows the user to access and edit all parameter settings. ➔ <a href="#">Refer to Parameter List on page 405.</a>
	Auto-Tuning Mode		Motor parameters are calculated and set automatically. ➔ <a href="#">Refer to Auto-Tuning on page 95.</a>
Drive Mode	Frequency Reference		Returns to the frequency reference display screen.

#### ? Drive Mode Details

The following actions are possible in the Drive Mode:

- Run and stop the drive
- Monitor the operation status of the drive (frequency reference, output frequency, output current, output voltage, etc.)
- View information on an alarm
- View a history of alarms that have occurred

**Figure 4.5** illustrates how to change the frequency reference from F 0.00 (0 Hz) to F 6.00 (6 Hz) while in the Drive Mode. This example assumes the drive is set to LOCAL.



**Figure 4.5** Setting the Frequency Reference while in the Drive Mode

**Note:** The drive will not accept a change to the frequency reference until the ENTER key is pressed after the frequency reference is entered. This feature prevents accidental setting of the frequency reference. To have the drive accept changes to the frequency reference as soon as changes are made without requiring the ENTER key, set o2-05 to 1.

## ? Programming Mode Details

The following actions are possible in the Programming Mode:

- **Parameter Setting Mode:** Access and edit all parameter settings
- **Verify Menu:** Check a list of parameters that have been changed from their original default values
- **Setup Group:** Access a list of commonly used parameters to simplify setup (see *Simplified Setup Using the Setup Group on page 88*)
- **Auto-Tuning Mode:** Automatically calculates and sets motor parameters to optimize drive performance

## ? Changing Parameter Settings or Values

This example explains changing C1-02 (Deceleration Time 1) from 10.0 seconds (default) to 20.0 seconds.

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	
2.	Press the  or  key until the Parameter Setting Mode screen appears.	→	
3.	Press the  key to enter the parameter menu tree.	→	
4.	Press  or  key to select the C parameter group.	→	
5.	Press  two times.	→	
6.	Press  or  key to select the parameter C1-02.	→	
7.	Press  to view the current setting value (10.0 s). Left digit flashes.	→	
8.	Press  until the desired number is selected. "1" flashes.	→	
9.	Press the  key and enter 0020.0.	→	
10.	Press  and the drive will confirm the change.	→	
11.	The display automatically returns to the screen shown in Step 4.	→	
12.	Press the  key until back at the initial display.	→	

## ? Verifying Parameter Changes: Verify Menu

The Verify Menu lists edited parameters from the Programming Mode or as a result of Auto-Tuning. The Verify Menu helps determine which settings have been changed, and is particularly useful when replacing a drive. If no settings have been changed, the Verify Menu will read *no nE*. The Verify Menu also allows users to quickly access and re-edit any parameters settings that have been changed.

**Note:** The Verify Menu will not display parameters from the A1 group (except for A1-02) and E5-01 even if those parameters have been changed from their default settings.

4.3 The Drive and Programming Modes

The following example is a continuation of the steps above. Here, parameter C1-02 is accessed using the Verify Menu, and is changed again from 10.0 s to 20.0 s.

To check the list of edited parameters:

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➔	
2.	Press  or  until the display shows the top of the Verify Menu.	➔	
3.	Press  to enter the list of parameters that have been edited from their original default settings. If parameters other than C1-02 have been changed, use the  or  key to scroll until C1-02 appears.	➔	
4.	Press the  key to access the setting value. Left digit flashes.	➔	

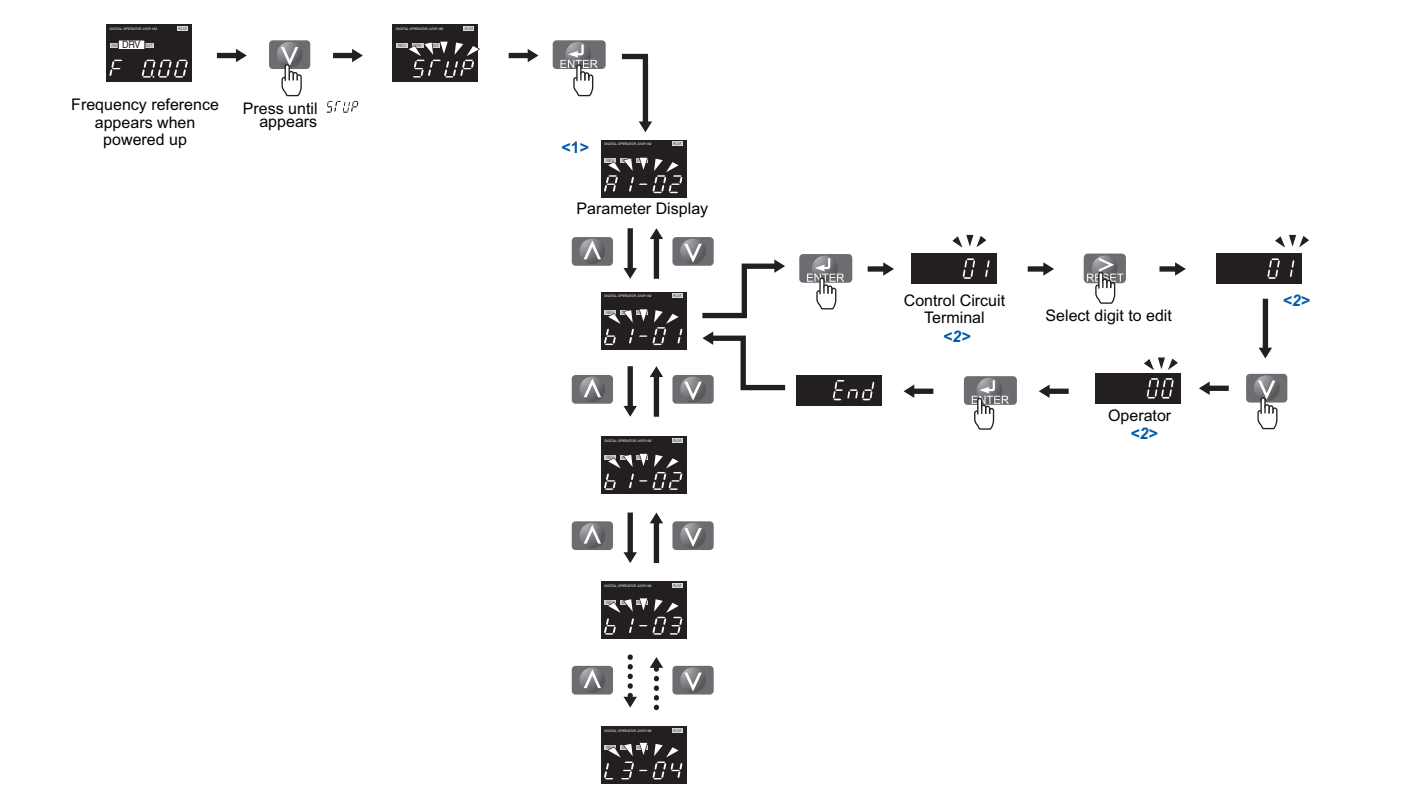
? Simplified Setup Using the Setup Group

In the Setup Group, the drive lists the basic parameters needed to set up the drive for the application. It provides a simplified way to get the application running right away by showing only the most important parameters.

? Using the Setup Group

Figure 4.6 illustrates how to enter and how to change parameters in the Setup Group.

In this example, the Setup Group is accessed to change b1-01 from 1 to 0. This changes the source of the frequency reference from the control circuit terminals to the digital operator.



<1> Use the up and down arrow keys to scroll through the Setup Group. Press the ENTER key to view or change parameter settings.  
<2> To return to the previous menu without saving changes, press the ESC key.

Figure 4.6 Setup Group Example

## ? Setup Group Parameters

**Table 4.4** lists parameters available by default in the Setup Group.

If the desired parameter is not listed in the Setup Group, go to the Programming Mode.

**Table 4.4 Setup Group Parameters**

Parameter	Name	Parameter	Name
A1-02	Control Method Selection	E1-01	Input Voltage Reference
b1-01	Frequency Reference Source 1	E1-03	V/f Pattern Selection
b1-02	Run Command Source 1	E1-04	Maximum Output Frequency
b1-03	Stop Method Selection	E1-05	Maximum Voltage
C1-01	Acceleration Time 1	E1-06	Base Frequency
C1-02	Deceleration Time 1	E1-09	Minimum Output Frequency
C6-01	Duty Selection	E1-13	Base Voltage
C6-02	Carrier Frequency Selection	E2-01	Motor Rated Current
d1-01	Frequency Reference 1	E2-04	Number of Motor Poles
d1-02	Frequency Reference 2	E2-11	Motor Rate Capacity
d1-03	Frequency Reference 3	H4-02	Terminal AM Gain Setting
d1-04	Frequency Reference 4	L1-01	Motor Protection Function Selection
d1-17	Jog Frequency Reference	L3-04	Stall Prevention Selection during Deceleration

**Note:** Parameter availability depends on the control mode set in A1-02 that is used to run the drive and motor. Consequently, some of the parameters listed above may not be accessible in certain control modes.

## ? Switching Between LOCAL and REMOTE

When the drive is set to accept the Run command from the digital operator RUN key, this is referred to as LOCAL mode. When the drive is set to accept the Run command from an external device (via the input terminals, serial communications, etc.) this is referred to as REMOTE mode.

**WARNING! Sudden Movement Hazard.** The drive may start unexpectedly if the Run command is already applied when switching from LOCAL mode to REMOTE mode when b1-07 = 1, resulting in death or serious injury. Be sure all personnel are clear of rotating machinery.

The operation can be switched between LOCAL and REMOTE either by using the LO/RE key on the digital operator or a digital input.

- Note:**
1. After selecting LOCAL, the LO/RE light will remain lit.
  2. The drive will not allow the user to switch between LOCAL and REMOTE during run.

## ? Using the LO/RE Key on the Digital Operator

Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	→
2.	Press . The LO/RE light will light up. The drive is now in LOCAL.  To set the drive for REMOTE operation, press the  key again.	→

## ? Using Input Terminals S1 through S8 to Switch between LO/RE

The user can also switch between LOCAL and REMOTE modes using one of the digital input terminals S1 through S8 (set the corresponding parameter H1-□□ to “1”).

When setting the multi-function input terminals, setting H1-□□ to 1 disables the LO/RE key on the digital operator.

**Refer to H1 Multi-Function Digital Input Selections on page 435** for a list of digital input selections.

4.4 Start-Up Flowcharts

The flowcharts in this section summarize basic steps required to start the drive. Use the flowcharts to determine the most appropriate start-up method for a given application. The charts are intended as a quick reference to help familiarize the user with start-up procedures.

Flowchart	Subchart	Objective	Page
A	–	Basic startup procedure and motor tuning	90
–	A-1	Simple motor setup using V/f mode	91
	A-2	High-performance operation using Open Loop Vector (OLV) or Closed Loop Vector (CLV) motor control	92
	A-3	Setting up the drive to run a permanent magnet (PM) motor	93

? Flowchart A: Basic Start-up and Motor Tuning

Flowchart A in [Figure 4.7](#) describes a basic start-up sequence. Use drive default parameter settings in simple applications that do not require high precision.

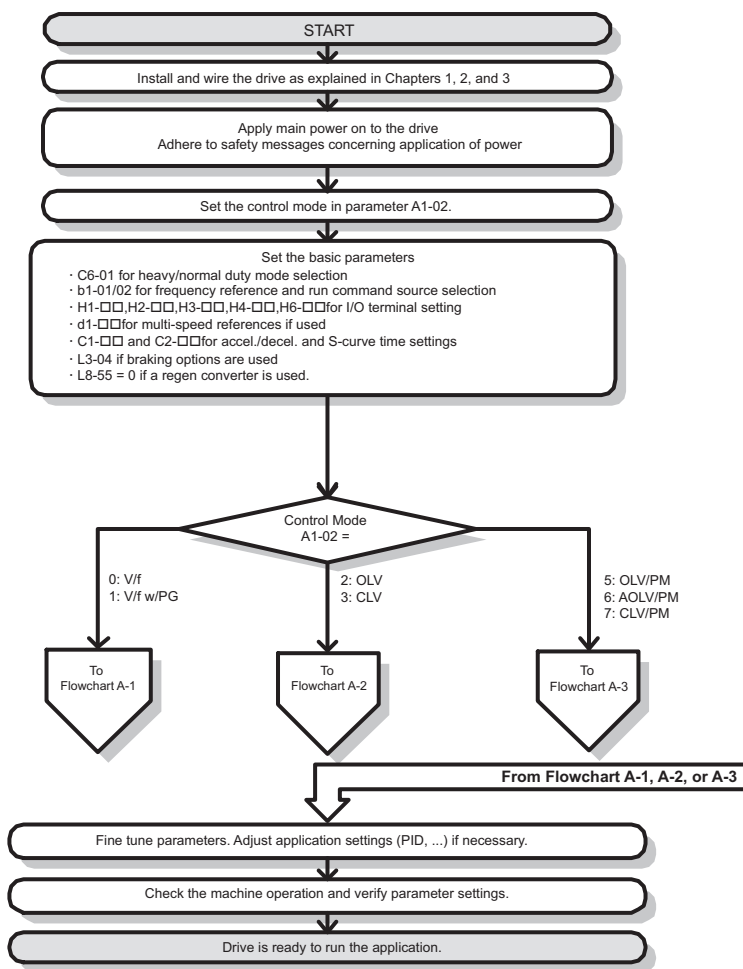


Figure 4.7 Basic Start-up

- Note:**
1. When the motor cable length has changed for more than 50 m after Auto-Tuning has been performed (e.g., after the drive has been set up and then later installed in a different location), execute Stationary Auto-Tuning for resistance between motor lines once the drive is installed in its final installation location.
  2. Auto-Tuning should be performed again after installing an AC reactor or other such components to the output side of the drive.

### ? Subchart A-1: Simple Motor Setup Using V/f Control

Flowchart A1 in [Figure 4.8](#) describes simple motor setup for V/f Control, with or without PG feedback. This procedure illustrates Energy Savings and Speed Estimation Speed Search.

**Note:** When using an induction synchronous motor, the only available selection is Stationary Auto-Tuning for line-to-line resistance.

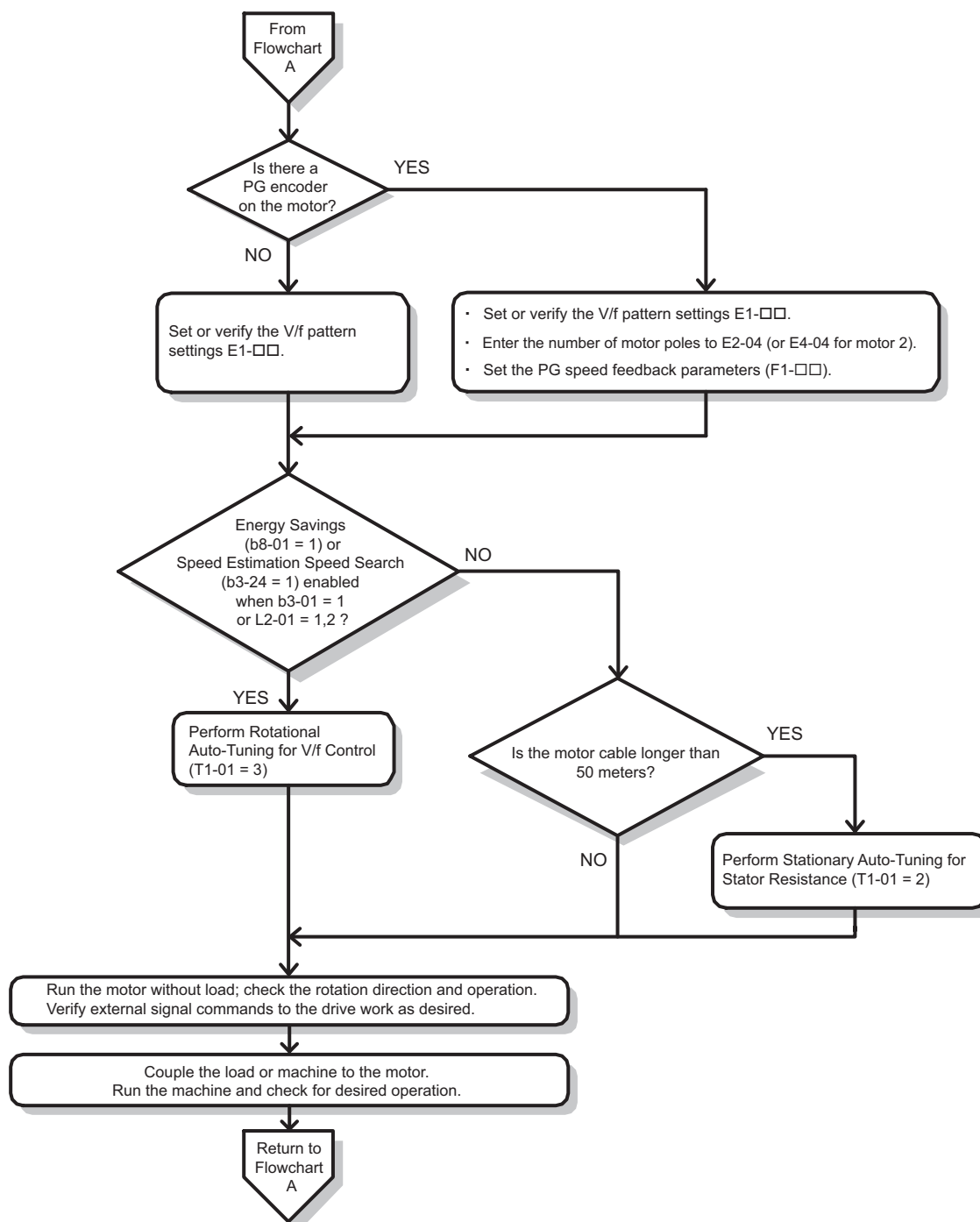
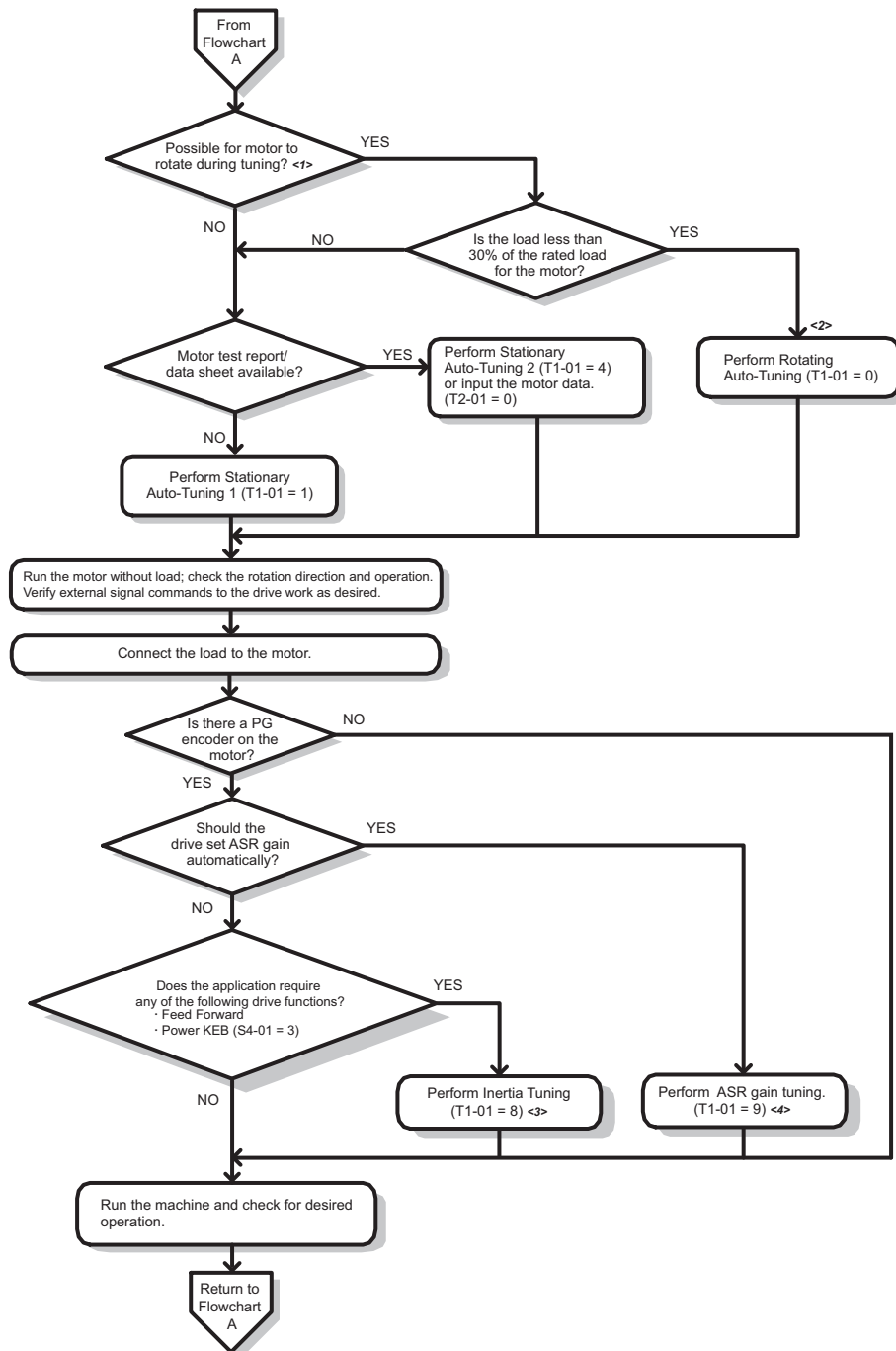


Figure 4.8 Simple Motor Setup with Energy Savings or Speed Search

### ? Subchart A-2: High Performance Operation Using OLV or CLV

Flowchart A2 in **Figure 4.9** describes the setup procedure for high-performance with Open Loop Vector Control or Closed Loop Vector Control. Appropriate for applications requiring high starting torque and torque limits.

**Note:** Although the drive sets parameters for the PG encoder during Auto-Tuning, sometimes the direction of the motor and direction of the PG get reversed. Use parameter F1-05 to switch the direction of the PG so that it matches the motor direction.



<1> The load must be decoupled from the motor to properly perform Rotational Auto-Tuning.

<2> Rotational Auto-Tuning can still be performed if the load is 30% or less, though Stationary Auto-Tuning will probably yield better control performance.

<3> Make sure the motor and load can run freely, i.e., if a brake is mounted, make sure it is released.

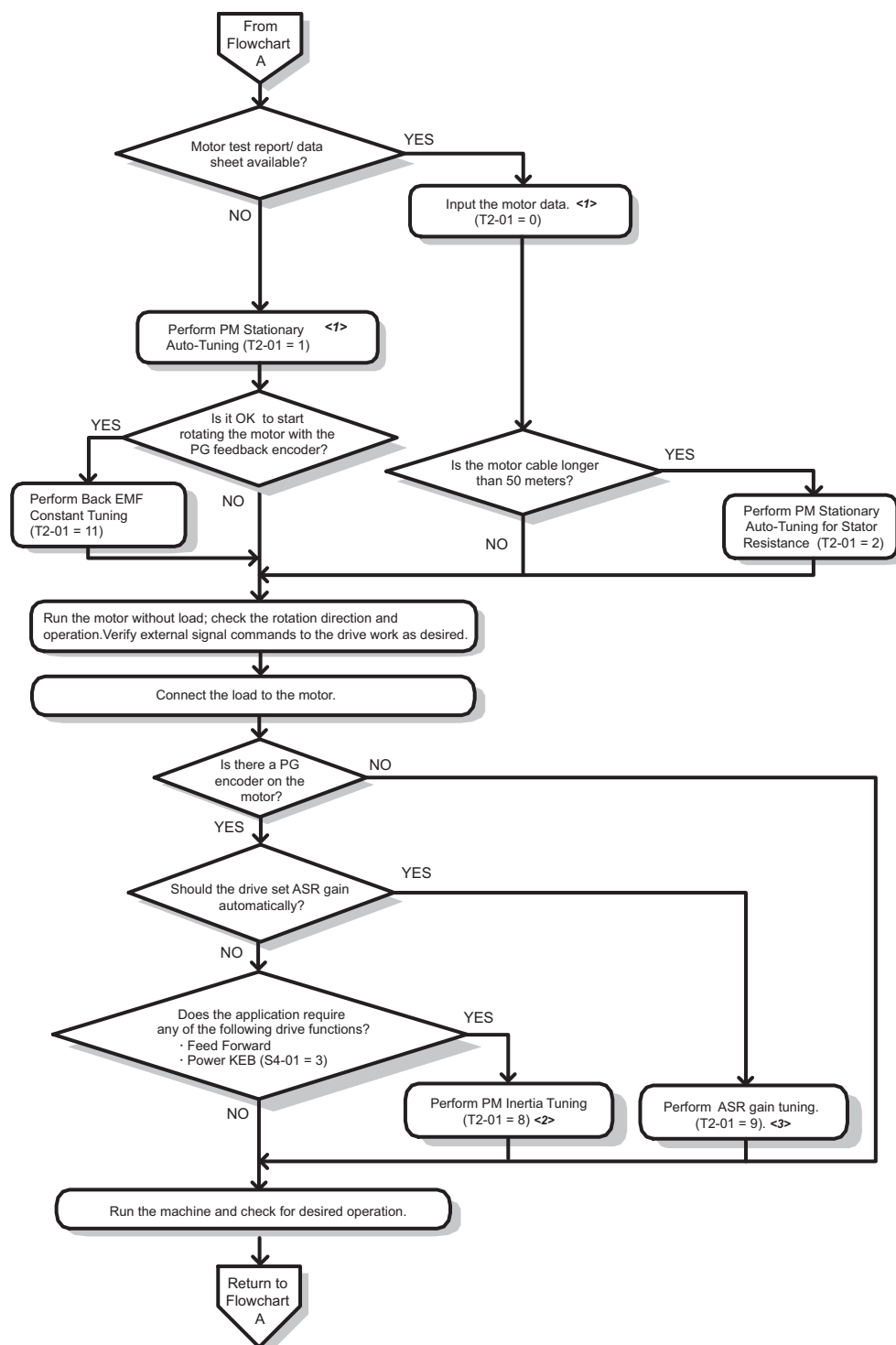
<4> ASR Gain Tuning automatically performs Inertia Tuning and sets parameters related to Feed Forward and the KEB function.

**Figure 4.9 Flowchart A2: High Performance Operation Using OLV or CLV**

### ? Subchart A-3: Operation with Permanent Magnet Motors

Flowchart A3 in [Figure 4.10](#) describes the set-up procedure for running a PM motor in Open Loop Vector Control. PM motors can be used for more energy-efficient operation in reduced or variable torque applications.

- Note:**
1. Although the drive sets parameters for the PG encoder during Auto-Tuning, sometimes the direction of the motor and direction of the PG get reversed. Use parameter F1-05 to switch the direction of the PG so that it matches the motor direction.
  2. The Z pulse must be realigned if the PG encoder is replaced. Set T2-01 to 3 to recalibrate the drive for the new encoder.



<1> A motor code can be entered as the parameter setting for E5-01 when using a Yaskawa PM motor (SMRA Series, SSR1 Series, and SST4 Series). If using a motor from another manufacturer, enter FFFF.

<2> Make sure the motor and load can run freely, i.e., if a brake is mounted, make sure it is released.

<3> ASR Gain Tuning automatically performs Inertia Tuning and sets parameters related to Feed Forward and the KEB function.

**Figure 4.10 Operation with Permanent Magnet Motors**

## 4.5 Powering Up the Drive

### ? Powering Up the Drive and Operation Status Display



#### ? Powering Up the Drive

Review the following checklist before turning the power on.

Item to Check	Description
Power supply voltage	Ensure the power supply voltage is correct: 200 V class: 3-phase 200 to 240 Vac 50/60 Hz 400 V class: 3-phase 380 to 480 Vac 50/60 Hz
	Properly wire the power supply input terminals (R/L1, S/L2, T/L3).
	Check for proper grounding of drive and motor.
Drive output terminals and motor terminals	Properly wire drive output terminals U/T1, V/T2, and W/T3 with motor terminals U, V, and W.
Control circuit terminals	Check control circuit terminal connections.
Drive control terminal status	Open all control circuit terminals (off).
Status of the load and connected machinery	Decouple the motor from the load.

#### ? Status Display

When the power supply to the drive is turned on, the digital operator lights will appear as follows:

No.	Name	Description
Normal Operation		The data display area displays the frequency reference. <b>[DRV]</b> is lit.
Fault	 External fault (example)	Data displayed varies by the type of fault. <i>Refer to Fault Displays, Causes, and Possible Solutions on page 296</i> for more information and possible solution. <b>[ALM]</b> and <b>[DRV]</b> are lit.

## 4.6 Auto-Tuning

### ? Types of Auto-Tuning

The drive offers different types of Auto-Tuning for induction motors and permanent magnet motors. The type of Auto-Tuning used differs further based on the control mode and other operating conditions. Refer to the tables below to select the type of Auto-Tuning that best suits the application. Directions on how to execute Auto-Tuning are listed in [Start-Up Flowcharts on page 90](#).

**Note:** The drive will only show Auto-Tuning parameters that are valid for the control mode that has been set to A1-03. If the control mode is for an induction motor, the Auto-Tuning parameters for PM motors will not be available. If the control mode is for a PM motor, the Auto-Tuning parameters for induction motors will not be available. Inertia Tuning and ASR Gain Tuning parameters and setting options will be visible only when the drive is set for operation with Closed Loop Vector or CLV/PM.

### ? Auto-Tuning for Induction Motors

This feature automatically sets the V/f pattern and motor parameters E1-□□ and E2-□□ (E3-□□, E4-□□ for motor 2) for an induction motor. In Closed Loop Vector, some F1-□□ parameters for speed feedback detection are also set up.

**Table 4.5 Types of Auto-Tuning for Induction Motors**

Type	Setting	Application Conditions and Benefits	Control Mode			
			V/f	V/f w/PG	OLV	CLV
	T1-01 = 0	<ul style="list-style-type: none"> <li>Motor can be decoupled from the load and rotate freely while Auto-Tuning is performed.</li> <li>Motor and load can not be decoupled but the motor load is below 30%.</li> <li>Rotational Auto-Tuning gives the most accurate results, and is therefore highly recommended if possible.</li> </ul>	N/A	N/A	YES	YES
<b>Stationary Auto-Tuning 1</b>	T1-01 = 1	<ul style="list-style-type: none"> <li>Motor and load can not be decoupled and the load is higher than 30%.</li> <li>A motor test report listing motor data is not available.</li> <li>Automatically calculates motor parameters needed for vector control.</li> </ul>	N/A	N/A	YES	YES
<b>Stationary Auto-Tuning 2</b>	T1-01 = 4	<ul style="list-style-type: none"> <li>Motor and load can not be decoupled and the load is higher than 30%.</li> <li>A motor test report is available. Once the no-load current and the rated slip have been entered, the drive calculates and sets all other motor-related parameters.</li> </ul>	N/A	N/A	YES	YES
<b>Stationary Auto-Tuning for Line-to-Line Resistance</b>	T1-01 = 2	<ul style="list-style-type: none"> <li>The drive is used in V/f Control and other Auto-Tuning selections not possible.</li> <li>Drive and motor capacities differ.</li> <li>Tunes the drive after the cable between the drive and motor has been replaced with a cable over 50 m long. Assumes Auto-Tuning has already been performed.</li> <li>Should not be used for any vector control modes unless the motor cable has changed.</li> </ul>	YES	YES	YES	YES
<b>Rotational Auto-Tuning for V/f Control</b>	T1-01 = 3	<ul style="list-style-type: none"> <li>Recommended for applications using Speed Estimation Speed Search or using the Energy Saving function in V/f Control.</li> <li>Assumes motor can rotate while Auto-Tuning is executed. Increases accuracy for certain functions like torque compensation, slip compensation, Energy Saving, and Speed Search.</li> </ul>	YES	YES	N/A	N/A

**Note:** When using an induction synchronous motor, the only available selection is Stationary Auto-Tuning for line-to-line resistance.

[Table 4.6](#) lists the data that must be entered for Auto-Tuning. Make sure this data is available before starting Auto-Tuning. The information needed is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer. Also refer to page [91](#) and [92](#) for details on Auto-Tuning process and selections.

## 4.6 Auto-Tuning

**Table 4.6 Auto-Tuning Input Data**

Input Value	Input Parameter	Unit	Tuning Type (T1-01)				
			0 Standard	1 Stationary 1	2 Line-to-Line Resistance	3 Rotational for V/f Control	4 Stationary 2
	A1-02	-	2, 3	2, 3	0, 1, 2, 3	0, 1	2, 3
Motor rated power	T1-02	kW	YES	YES	YES	YES	YES
Motor rated voltage	T1-03	Vac	YES	YES	N/A	YES	YES
Motor rated current	T1-04	A	YES	YES	YES	YES	YES
Motor rated frequency	T1-05	Hz	YES	YES	N/A	YES	YES
Number of motor poles	T1-06	-	YES	YES	N/A	YES	YES
Motor rated Speed	T1-07	r/min	YES	YES	N/A	YES	YES
PG Number of pulses per revolution	T1-08	-	YES <1>	YES <1>	N/A	N/A	YES <1>
Motor no-load current	T1-09	A	N/A	YES	N/A	N/A	YES
Motor rated Slip	T1-10	Hz	N/A	N/A	N/A	N/A	YES
Motor iron loss	T1-11	W	N/A	N/A	N/A	YES	N/A

<1> Input data is needed for CLV/PM only.

### ? Auto-Tuning for Permanent Magnet Motors

Automatically sets the V/f pattern and motor parameters E1-□□ and E5-□□ when a PM motor is used. In Closed Loop Vector Control, the Auto-Tuning process will also set some F1-□□ parameters for speed feedback detection.

**Table 4.7 Types of Auto-Tuning for Permanent Magnet Motors**

Type	Setting	Application Conditions and Benefits	Control Mode		
			OLV/PM	AOLV/PM	CLV/PM
	T2-01 = 0	<ul style="list-style-type: none"> <li>Motor does not rotate during Auto-Tuning</li> <li>Motor test report or motor data like listed in <a href="#">Table 4.8</a> are available.</li> </ul>	YES	YES	YES
PM Stationary Auto-Tuning	T2-01 = 1	<ul style="list-style-type: none"> <li>A motor test report listing motor data is not available. Drive automatically calculates and sets motor parameters.</li> </ul>	YES	YES	YES
PM Stationary Auto-Tuning for Stator Resistance	T2-01 = 2	<ul style="list-style-type: none"> <li>Useful to tune the drive when the motor data were set up manually or by motor code and the cable is longer than 50 m. Should also be performed if the cable has changed after earlier tuning.</li> </ul>	YES	YES	YES
Z Pulse Offset Tuning	T2-01 = 3	<ul style="list-style-type: none"> <li>PG encoder has been replaced. Calculates the Z pulse offset.</li> <li>Requires the motor to rotate with no or very low load.</li> </ul>	N/A	N/A	YES
Back EMF Constant Tuning	T2-01 = 11	<ul style="list-style-type: none"> <li>A motor test report listing motor data is not available. Drive automatically calculates and sets motor parameters.</li> </ul>	N/A	N/A	YES

[Table 4.8](#) lists the data that must be entered for Auto-Tuning. Make sure the data is available before starting Auto-Tuning. The information needed is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer. Also refer to page [93](#) for details on the tuning mode selection and the tuning process.

VARTSPEED  
3-PHASE PERMANENT MAGNET MOTOR

TYPE SST4- POLES E5-04

PROTECTION COOLING

kW	V	Hz	RATING	A	r/min
E5-02	E1-13			E5-03	E1-04, 06

INS. COOLANT TEMP. °C ALTITUDE m

STD MASS kg

BRG NO DRIVE END OPP END

SER NO YEAR

YASKAWA ELECTRIC CORPORATION JAPAN

r <sub>i</sub>	E5-05
L <sub>d</sub>	E5-06
L <sub>q</sub>	E5-07
K <sub>e</sub>	E5-09
Δθ	E5-11
Δθ	
K <sub>i</sub>	
K <sub>t</sub>	

**Figure 4.11 Example of Motor Nameplate**

Table 4.8 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T2-01)							
			0 Parameter Calculation			1 Stationary		2 Phase Resistance	3 Z-Pulse Offset	11 Back EMF Constant
Control Mode	A1-02	-	5, 6, 7	5	6, 7	5	6, 7	5, 6, 7	7	7
Motor Code	T2-02	-	FFFFh	FFFFh	FFFFh	-	-	-	-	-
	T2-03	-	N/A	N/A	N/A	YES	YES	N/A	N/A	N/A
Motor rated power	T2-04	kW	N/A	YES	YES	YES	YES	N/A	N/A	N/A
Motor rated voltage	T2-05	Vac	N/A	YES	YES	YES	YES	N/A	N/A	N/A
Motor rated current	T2-06	A	N/A	YES	YES	YES	YES	YES	N/A	N/A
Motor rated frequency	T2-07	Hz	N/A	YES	N/A	YES	N/A	N/A	N/A	N/A
Number of motor poles	T2-08	-	N/A	YES	YES	YES	YES	N/A	N/A	N/A
Motor rated Speed	T2-09	r/min	N/A	N/A	YES	N/A	YES	N/A	N/A	N/A
Stator 1 Phase resistance	T2-10	Ω	YES	YES	YES	N/A	N/A	N/A	N/A	N/A
d-axis inductance	T2-11	mH	YES	YES	YES	N/A	N/A	N/A	N/A	N/A
q-axis inductance	T2-12	mH	YES	YES	YES	N/A	N/A	N/A	N/A	N/A
Voltage constant <1>	T2-13	mVs/rad (el.)	YES	YES	YES	N/A	N/A	N/A	N/A	N/A
Voltage constant <1>	T2-14	mVmin (mech.)	YES	YES	YES	N/A	N/A	N/A	N/A	N/A
Tuning pull-in current	T2-15	A	N/A	N/A	N/A	YES	YES	N/A	N/A	N/A
PG Number of pulses per revolution	T2-16	-	YES <2>	N/A	YES <2>	N/A	YES <2>	N/A	N/A	N/A
Z Pulse Offset	T2-17	deg (mech.)	YES <2>	N/A	YES <2>	N/A	YES <2>	N/A	N/A	N/A

<1> Only parameter T2-13 or T2-14 has to be input. Select one and leave the other empty.

<2> Input data is needed for CLV/PM only.

## ? Inertia Tuning and Speed Control Loop Auto-Tuning

Inertia Tuning can be performed when the drive is using Closed Loop Vector control for either IM or PM motors. Inertia Tuning automatically calculates load and motor inertia, and optimizes settings related to the KEB function and Feed Forward control.

ASR Gain Auto-Tuning performs the same operation as Inertia Tuning, but also optimizes speed control loop settings.

Table 4.9 Inertia and Speed Control Loop Tuning

Type	Setting		Application Conditions and Benefits	Control Mode	
	IM Motor	PM Motor		CLV	CLV/PM
	T1-01 = 8	T2-01 = 8	Lets the motor rotate at a certain speed and applies a test signal. The response to the test signals are analyzed, and adjustments are made to parameters controlling the Feed Forward and Power KEB (S4-01 = 3).	YES	YES
ASR Gain Auto-Tuning	T1-01 = 9	T2-01 = 9	Performs the same operation as Inertia Tuning, but also adjusts the ASR gain according to the response to the test signal.	YES	YES

**Note:** Inertia Tuning and ASR Gain Auto-Tuning might not be available if gears are between the machine and the motor shaft.

Table 4.10 explains that data that must be entered in order to perform the Inertia Tuning and ASR Gain Auto-Tuning. Refer to *Auto-Tuning for Permanent Magnet Motors on page 96* for details.

Table 4.10 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01 or T2-01)	
			8 Inertia Tuning	9 ASR Gain Tuning
	A1-02	-	3, 7	3, 7
Test signal frequency	T3-01	Hz	YES	YES
Test signal Amplitude	T3-02	rad	YES	YES
Motor inertia	T3-03	kgm <sup>2</sup>	YES	YES
System response frequency	T3-04	Hz	N/A	YES

### ? Before Auto-Tuning the Drive

Check the items below before Auto-Tuning the drive.

### ? Basic Auto-Tuning Preparations

- Auto-Tuning requires the user to input data from the motor nameplate or motor test report. Make sure this data is available before Auto-Tuning the drive.
- For best performance, the drive input supply voltage must be at least equal to or greater than the motor rated voltage.  
**Note:** Better performance is possible when using a motor with a base voltage that is 20 V (40 V for 400 V class models) lower than the input supply voltage. This is particularly important when operating the motor above 90% of base speed, where high torque precision is required.
- To cancel Auto-Tuning, press the STOP key on the digital operator.
- When using a motor contactor, make sure it is closed throughout the Auto-Tuning process.
- When using Auto-Tuning for motor 2, make sure motor 2 is connected to the drive output when performing the tuning.
- [Table 4.11](#) describes digital input and output terminal operation while Auto-Tuning is executed.

**Table 4.11 Digital Input and Output Operation During Auto-Tuning**

Motor Type	Auto-Tuning Type	Digital Input	Digital Output
IM Motor	Rotational Auto-Tuning	Digital input functions are disabled.	Functions the same as during normal operation
	Stationary Auto-Tuning 1		Maintains the status at the start of Auto-Tuning
	Stationary Auto-Tuning 2		
	Stationary Auto-Tuning for Line-to-Line Resistance		Functions the same as during normal operation
	Rotational Auto-Tuning for V/f Control		Functions the same as during normal operation
PM Motor	PM Motor Parameter Settings		Digital output functions are disabled.
	PM Stationary Auto-Tuning		Maintains the status at the start of Auto-Tuning
	PM Stationary Auto-Tuning for Stator Resistance		
	Z Pulse Offset Tuning		Functions the same as during normal operation
	Back EMF Constant Tuning		Functions the same as during normal operation
IM and PM Motors	Inertia Tuning		Functions the same as during normal operation
	ASR Gain Auto-Tuning		

### ? Notes on Rotational Auto-Tuning

- To achieve optimal performance from Rotational Auto-Tuning, the load should be decoupled from the motor. Rotational Auto-Tuning is best suited for applications requiring high performance over a wide speed range.
- If motor and load can not be decoupled, reduce the load so that it is no greater than 30% of the rated load. Performing Rotational Auto-Tuning with a higher load will set motor parameters incorrectly, and can cause irregular motor rotation.
- Ensure the motor-mounted brake is fully released if installed.
- Connected machinery should be allowed to rotate the motor.

### ? Notes on Stationary Auto-Tuning

Stationary Auto-Tuning modes analyze motor characteristics by injecting current into the motor for about one minute.

**WARNING! Electrical Shock Hazard.** When executing stationary Auto-Tuning, the motor does not rotate, however, power is applied. Do not touch the motor until Auto-Tuning is completed. Failure to comply may result in injury from electrical shock.

**WARNING! Sudden Movement Hazard.** If installed, do not release the mechanical brake during stationary Auto-Tuning. Inadvertent brake release may cause damage to equipment or injury to personnel. Ensure that the mechanical brake release circuit is not controlled by the drive multi-function digital outputs.

### Stationary Auto-Tuning 1 and 2

- Perform these tuning methods when using a vector control mode but Rotational Auto-Tuning cannot be performed.
- Check the area around the motor to ensure that nothing will accidentally cause the motor to rotate during the Auto-Tuning process.
- Use Stationary Auto-Tuning 1 when the motor test report is not available. If the motor test report is available, perform Stationary Auto-Tuning 2 instead.

Stationary Auto-Tuning for Line-to-Line Resistance and PM Motor Stator Resistance

- Perform when entering motor data manually while using motor cables longer than 50 m.
- If the motor cables have been replaced with line over 50 m long after Auto-Tuning as already been performed, then execute Stationary Auto-Tuning for line-to-line resistance.

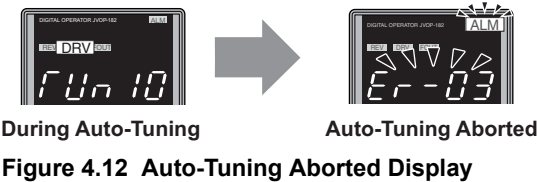
? Notes on Inertia Tuning and ASR Gain Auto-Tuning

**WARNING! Electrical Shock Hazard.** When executing Inertia Tuning or ASR Gain Auto-Tuning, voltage is applied to the motor even before it rotates. Do not touch the motor until Auto-Tuning is completed. Failure to comply may result in injury from electrical shock.

- Both tuning methods must be performed with the machine connected to the motor but without load applied.
- The motor will rotate during the Auto-Tuning process. Make sure the areas around the motor and connected machinery are clear.
- The drive will let the system rotate at a certain speed while superimposing a sine wave test signal. Make sure this tuning process does not cause any problem or malfunction in the machine before using it.
- Ensure the motor-mounted brake is fully released if installed.
- Connected machinery should be allowed to rotate the motor.

? Auto-Tuning Interruption and Fault Codes

If tuning results are abnormal or the STOP key is pressed before completion, Auto-Tuning will be interrupted and a fault code will appear on the digital operator.



? Auto-Tuning Operation Example

The following example demonstrates Rotational Auto-Tuning when using OLV (A1-02 = 2) and CLV (A1-02 = 3).

? Selecting the Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	
2.	Press the  or  key until the Auto-Tuning display appears.	→	
3.	Press  to begin setting parameters.	→	
4.	Press  to display the value for T1-01. <1>	→	
5.	Save the setting by pressing .	→	
6.	The display automatically returns to the display shown in Step 3.	→	













<1> T1-00 will appear on the display when one of the multi-function inputs has been set to switch between motor 1 and motor 2 (H1-□□ = 16).

## 4.6 Auto-Tuning

### ? Enter Data from the Motor Nameplate

After selecting the type of Auto-Tuning, enter the data required from the motor nameplate.

**Note:** These instructions continue from Step 6 in “Selecting the Type of Auto-Tuning”.

Step			Display/Result
1.	Press  to access the motor output power parameter T1-02.	→	
2.	Press  to view the default setting.	→	
3.	Press  to select the digit to edit.	→	
4.	Press  and enter the motor power nameplate data in kW.	→	
5.	Press  to save the setting.	→	
6.	The display automatically returns to the display in Step 1.	→	
7.	Repeat Steps 1 through 5 to set the following parameters: <ul style="list-style-type: none"> <li>• T1-03, Motor Rated Voltage</li> <li>• T1-04, Motor Rated Current</li> <li>• T1-05, Rated Frequency</li> <li>• T1-06, Number of Motor Poles</li> <li>• T1-07, Rated Speed</li> <li>• T1-09, Motor No-Load Current</li> </ul>	→	

**Note:** 1. For details on each setting, [Refer to Parameter Settings during Induction Motor Auto-Tuning: T1 on page 101.](#)


2. To execute Stationary Auto-Tuning for line-to-line resistance only, set parameters T1-02 and T1-04.

### ? Starting Auto-Tuning






**WARNING! Sudden Movement Hazard.** The drive and motor may start unexpectedly during Auto-Tuning, which could result in death or serious injury. Ensure the area surrounding the drive motor and load are clear before proceeding with Auto-Tuning.

**WARNING! Electrical Shock Hazard.** High voltage will be supplied to the motor when Stationary Auto-Tuning is performed even with the motor stopped, which could result in death or serious injury. Do not touch the motor until Auto-Tuning has been completed.

**NOTICE:** Rotational Auto-Tuning will not function properly if a holding brake is engaged on the load. Failure to comply could result in improper operation of the drive. Ensure the motor can freely spin before beginning Auto-Tuning.

Enter the required information from the motor nameplate. Press  to proceed to the Auto-Tuning start display.

**Note:** These instructions continue from Step 7 in “Enter Data from the Motor Nameplate”.

Step			Display/Result
1.	After entering the data listed on the motor nameplate, press  to confirm.	→	
2.	Press  to activate Auto-Tuning. <b>DRV</b> flashes. The drive begins by injecting current into the motor for about 1 min, and then starts to rotate the motor. <b>Note:</b> The first digit on the display indicates which motor is undergoing Auto-Tuning (motor 1 or motor 2). The second digit indicates the type of Auto-Tuning being performed.	→	
3.	Auto-Tuning finishes in approximately one to two minutes.	→	

## ? Parameter Settings during Induction Motor Auto-Tuning: T1

The T1-□□ parameters are used to set the Auto-Tuning input data for induction motor tuning.

**Note:** For motors that are to be operated in the field weakening range, first perform the Auto-Tuning with the base data. After Auto-Tuning is complete, change the maximum frequency E1-04 to the desired value.

### ? T1-00: Motor 1/Motor 2 Selection

Selects the motor to be tuned when motor 1/2 switching is enabled, i.e., a digital input is set for function H1-□□ = 16. This parameter is not displayed if motor 1/2 switching is disabled.

No.	Name	Setting Range	Default
T1-00	Motor 1/Motor 2 Selection	1 or 2	1

#### Setting 1: Motor 1

Auto-Tuning automatically sets parameters E1-□□ and E2-□□ for motor 1.

#### Setting 2: Motor 2

Auto-Tuning automatically sets parameters E3-□□ and E4-□□ for motor 2. Make sure that motor 2 is connected to the drive for Auto-Tuning.

### ? T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used. *Refer to Auto-Tuning for Induction Motors on page 95* for details on the different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2, 3 (V/f, V/f w/PG) 0 to 2, 4 (OLV, CLV) 8, 9 (CLV)	2 (V/f, V/f w/PG) 0 (OLV, CLV)

#### Setting 0: Rotational Auto-Tuning

#### Setting 1: Stationary Auto-Tuning 1

#### Setting 2: Stationary Auto-Tuning for Line-to-Line Resistance

#### Setting 3: Rotational Auto-Tuning for V/f Control

#### Setting 4: Stationary Auto-Tuning 2

#### Setting 8: Inertia Tuning

#### Setting 9: ASR Gain Auto-Tuning

### ? T1-02: Motor Rated Power

Sets the motor rated power according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-02	Motor Rated Power	0.03 to 650.00 kW	Determined by o2-04 and C6-01

**Note:** The maximum applicable motor capacity varies based on whether the drive is set for Normal Duty or Heavy Duty performance (C6-01). Refer to *Table A.2* and *Table A.3*.

### ? T1-03: Motor Rated Voltage

Sets the motor rated voltage according to the motor nameplate value. If the motor to be operated above its base speed, enter the voltage at base speed here.

For better control precision around rated speed when using a vector control mode, it can be helpful to enter the no-load voltage for the motor here. The motor's "no-load voltage" refers to the voltage needed to operate the motor under no-load conditions at rated speed. The no-load voltage can usually be found in the motor test report available from the manufacturer. If no data is available, enter approximately 90% of the rated voltage printed on the motor nameplate. Note that this might increase the output current reducing the overload margin.

## 4.6 Auto-Tuning

No.	Name	Setting Range	Default
T1-03 <I>	Motor Rated Voltage	0.0 to 255.5 V	200.0 V

<I> Values shown here are for 200 V class drives. Double values when using a 400 V class unit.

### ? T1-04: Motor Rated Current

Sets the motor rated current according to the motor nameplate value. For optimal performance in OLV or CLV, the motor rated current should be between 50 and 100% of the drive rated current. Enter the current at the motor base speed.

No.	Name	Setting Range	Default
T1-04	Motor Rated Current	10 to 200% of drive rated current	Depending on o2-04

### ? T1-05: Rated Frequency

Sets the motor rated frequency according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the maximum frequency to E1-04 (E3-04 for motor 2) after Auto-Tuning is complete.

No.	Name	Setting Range	Default
T1-05	Rated Frequency	0.0 to 400.0 Hz	50.0 Hz

### ? T1-06: Number of Motor Poles

Sets the number of motor poles according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-06	Number of Motor Poles	2 to 48	4

### ? T1-07: Rated Speed

Used to set the motor rated speed according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the speed at base frequency here.

No.	Name	Setting Range	Default
T1-07	Rated Speed	0 to 24000 r/min	1450 r/min

### ? T1-08: PG Number of Pulses Per Revolution

Sets the number of pulses from the PG encoder. Set the actual number of pulses for one full motor rotation.

No.	Name	Setting Range	Default
T1-08	PG Number of Pulses Per Revolution	0 to 60000 ppr	1024 ppr

**Note:** T1-08 will only be displayed in CLV.

### ? T1-09: Motor No-Load Current

Sets the no-load current for the motor.

The default setting displayed is no-load current that was automatically calculated from the output power set in T1-02 and the motor rated current set to T1-04. Enter the data listed on the motor test report. Leave this data at the default setting if the motor test report is not available.

No.	Name	Setting Range	Default
T1-09 <I>	Motor No-Load Current	0 A to [T1-04] (Max: 0 to 2999.9)	—

<I> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

### ? T1-10: Motor Rated Slip

Sets the rated slip for the motor.

The default setting displayed is the motor rated slip for a Yaskawa motor calculated from the output power set in T1-02. Enter the data listed on the motor test report.

No.	Name	Setting Range	Default
T1-10	Motor Rated Slip	0.00 to 20.00 Hz	—

### ? T1-11: Motor Iron Loss

Provides iron loss information for determining the Energy Saving coefficient. T1-11 will first display a value for the motor iron loss that the drive automatically calculated the when motor capacity was entered to T1-02. If the motor test report is available, enter the motor iron loss value listed there.

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	14 W <I>

<I> Default setting value differs depending on the motor code value and motor parameter settings.

## ? Parameter Settings during PM Motor Auto-Tuning: T2

The T2-□□ parameters are used to set the Auto-Tuning input data for PM motor tuning.

### ? T2-01: PM Motor Auto-Tuning Mode Selection

Selects the type of Auto-Tuning to be performed. *Refer to Auto-Tuning for Permanent Magnet Motors on page 96* for details on different types of Auto-Tuning.

No.	Name	Setting Range	Default
T2-01	PM Motor Auto-Tuning Mode Selection	0 to 2 (OLV/PM, AOLV/PM) 0 to 3, 8, 9, 11 (CLV/PM)	0

#### 0: PM Motor Parameter Settings

##### 1: PM Stationary Auto-Tuning

##### 2: PM Stationary Auto-Tuning for Stator Resistance

##### 3: Z-Pulse Offset Tuning

##### 8: Inertia Tuning

##### 9: ASR Gain Auto-Tuning

##### 11: Back EMF Constant Tuning

### ? T2-02: PM Motor Code Selection

If the drive is operating a Yaskawa PM motor from the SMRA, SSR1, or SST4 series, enter the motor code for the motor in parameter T2-02. This will automatically set parameters T2-03 through T2-14. If using a specialized motor or one designed by a manufacturer other than Yaskawa, set T2-02 to FFFF. Data from the motor nameplate or the motor test report will then need to be entered as prompted.

Only the designated PM motor codes may be entered. The PM motor codes accepted by the drive will differ by the control mode that has been selected. Refer to *E5: PM Motor Settings on page 181* for motor codes.

No.	Name	Setting Range	Default
T2-02	PM Motor Code Selection	0000 to FFFF	Depending on A1-02 and o2-04

## 4.6 Auto-Tuning

### ? T2-03: PM Motor Type

Selects the type of PM motor the drive will operate.

No.	Name	Setting Range	Default
T2-03	PM Motor Type	0, 1	1

0: IPM motor

1: SPM motor

### ? T2-04: PM Motor Rated Power

Specifies the motor rated power in kilowatts.

No.	Name	Setting Range	Default
T2-04	PM Motor Rated Power	0.00 to 650.00 kW	Depending on o2-04 and C6-01

### ? T2-05: PM Motor Rated Voltage

Sets the motor rated voltage.

No.	Name	Setting Range	Default
T2-05 <1>	PM Motor Rated Voltage	0.0 to 255.0 V	200.0 V

<1> The setting range and default value shown here is for a 200 V class drive. These values double when using a 400 V class unit.

### ? T2-06: PM Motor Rated Current

Enter the motor rated current in amps.

No.	Name	Setting Range	Default
T2-06	PM Motor Rated Current	10% to 200% of the drive rated current.	Depending on o2-04

### ? T2-07: PM Motor Rated Frequency

Enter the motor rated frequency in Hz.

**Note:** T2-07 will be displayed when in OLV/PM.

No.	Name	Setting Range	Default
T2-07	PM Motor Rated Frequency	0.0 to 400.0 Hz	87.5 Hz

### ? T2-08: Number of PM Motor Poles

Enter the number of motor poles.

No.	Name	Setting Range	Default
T2-08	Number of PM Motor Poles	2 to 48	6

### ? T2-09: PM Motor Rated Speed

Enter the motor rated speed in r/min.

**Note:** T2-09 will be displayed when in AOLV/PM and CLV/PM.

No.	Name	Setting Range	Default
T2-09	PM Motor Rated Speed	0 to 24000 r/min	1750 r/min

### ? T2-10: PM Motor Stator Resistance

Enter the motor stator resistance per motor phase.

No.	Name	Setting Range	Default
T2-10	PM Motor Stator Resistance	0.000 to 65.000 $\Omega$	Depending on T2-02

### ? T2-11: PM Motor d-Axis Inductance

Enter the d axis inductance per motor phase.

No.	Name	Setting Range	Default
T2-11	PM Motor d-Axis Inductance	0.00 to 600.00 mH	Depending on T2-02

### ? T2-12: PM Motor q-Axis Inductance

Enter the q axis inductance per motor phase.

No.	Name	Setting Range	Default
T2-12	PM Motor q-Axis Inductance	0.00 to 600.00 mH	Depending on T2-02

### ? T2-13: Induced Voltage Constant Unit Selection

Selects the units used for setting the induced voltage coefficient.

No.	Name	Setting Range	Default
T2-13	Induced Voltage Constant Unit Selection	0, 1	1

0: mV (r/min)

1: mV (rad/sec)

**Note:** If T2-13 is set to 0, then the drive will use E5-24 (Motor Induction Voltage Constant 2), and will automatically set E5-09 (Motor Induction Voltage Constant 1) to 0.0. If T2-13 is set to 1, then the drive will use E5-09 and will automatically set E5-25 to 0.0.

### ? T2-14: PM Motor Induced Voltage Constant (Ke)

Enter the motor induced voltage constant.

No.	Name	Setting Range	Default
T2-14	PM Motor Induced Voltage Constant (Ke)	0.1 to 2000.0	Depending on T2-02

### ? T2-15: Pull-In Current Level for PM Motor Tuning

Sets the amount of pull-in current used to tune the d-axis and q-axis inductance. Set as a percentage of the motor rated current.

No.	Name	Setting Range	Default
T2-15	Pull-In Current Level for PM Motor Tuning	0 to 120%	30%

### ? T2-16: PG Number of Pulses Per Revolution for PM Motor Tuning

Enter the number of pulses from the PG encoder per motor rotation. Set the actual number of pulses for one full motor rotation.

No.	Name	Setting Range	Default
T2-16	PG Number of Pulses Per Revolution for PM Motor Tuning	1 to 15000 ppr	1024 ppr

### ? T2-17: Encoder Z-Pulse Offset ( $\Delta\theta$ )

Sets the amount of compensation or offset in 0.1 degree units in order to fine-tune the home position. If the amount of offset needed for the Z pulse is unknown or if the PG encoder is replaced, perform Z pulse tuning.

No.	Name	Setting Range	Default
T2-17	Encoder Z-Pulse Offset ( $\Delta\theta$ )	-180.0 to 180.0 deg	0.0 deg

## ? Parameter Settings during Inertia and Speed Control Loop Auto-Tuning: T3

These tuning methods apply a sine wave test signal to the system. By the measuring the response the drive estimates the system inertia. It automatically sets parameters listed in [Table 4.12](#).

**Table 4.12 Parameters Adjusted by Inertia and Speed Loop Auto-Tuning**

Parameter	Description	T1-01 or T2-01	
		8 Inertia Tuning	9 Speed Control Loop (ASR) Tuning
	ASR Proportional Gain 1	N/A	YES
C5-17 (C5-37)	Motor Inertia	YES	YES
C5-18 (C5-38)	Motor Inertia Ratio	YES	YES
S6-02	Motor Acceleration Time for Inertia Calculations	YES	YES
S6-03	Load Inertia Ratio	YES	YES
n5-02	Motor Acceleration Time	YES	YES
n5-03	Feed Forward Control Ratio Gain	YES	YES

### ? T3-01: Inertia Tuning Frequency Reference

Sets the frequency of the test signal applied to the motor during Inertia Tuning. Although this setting rarely needs to be changed, increasing the value may be beneficial when working with high inertia loads.

No.	Name	Setting Range	Default
T3-01	Inertia Tuning Frequency Reference	0.1 to 20.0 Hz	3.0 Hz

### ? T3-02: Inertia Tuning Reference Amplitude

Enter the amplitude of the test signal applied to the motor during Inertia Tuning. Although this setting rarely needs to be changed, try decreasing the value if the load inertia is too large and causes problems during Inertia Tuning. If a fault occurs when T3-01 is set to low value, the situation may be remedied by adjusting T3-02.

No.	Name	Setting Range	Default
T3-02	Inertia Tuning Reference Amplitude	0.1 to 10.0 rad	0.5 rad

### ? T3-03: Motor Inertia

Enter the inertia of the motor. This value is used to determine the load inertia using the test signal response. The default setting is for a Yaskawa standard motor as listed in the motor inertia table.

No.	Name	Setting Range	Default
T3-03	Motor Inertia	0.0001 to 600.00 kgm <sup>2</sup>	Depending on o2-04, C6-01, and E5-01

**Note:** This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have four decimal places (0.0001 kgm<sup>2</sup>) if the drive is set for a Maximum Applicable Motor Capacity up to 37 kW (refer to [Table A.2](#) and [Table A.3](#)) and three decimal places (0.001 kgm<sup>2</sup>) if the set Maximum Applicable Motor Capacity is 37 kW to 90 kW.

### ? T3-04: ASR Response Frequency

Sets the response frequency (reciprocal of the step response time constant) of the system or the connected machine. The drive uses this value and the load inertia to fine-tune the speed control loop gain (C5-01, ASR Gain 1). Oscillation may result if the value input here is higher than the actual response frequency of the system.

No.	Name	Setting Range	Default
T3-04	ASR Response Frequency	0.1 to 50.0 Hz	10.0 Hz

# 4.7 No-Load Operation Test Run

## ? No-Load Operation Test Run

This section explains how to operate the drive with the motor decoupled from the load during a test run.

### ? Before Starting the Motor

Check the following items before operation:

- Ensure the area around the motor is safe.
- Ensure external emergency stop circuitry is working properly and other safety precautions have been taken.

### ? During Operation








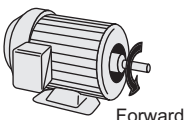




Check the following items during operation:

- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

### ? No-Load Operation Instructions

The following example illustrates a test run procedure using the digital operator.

**Note:** Before starting the motor, set the frequency reference d1-01 to 6 Hz.

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	
2.	Press the  key to select LOCAL. The LO/RE light will turn on.	→	 
3.	Press  to give the drive a Run command. RUN will light and the motor will rotate at 6 Hz.	→	 
4.	Ensure the motor is rotating in the correct direction and that no faults or alarms occur.	→	 Motor Forward
5.	If there is no error in step 4, press  to increase the frequency reference. Increase the frequency in increments of 10 Hz, verifying smooth operation at all speeds. For each frequency, check the drive output current using monitor U1-03. The current should be well below the motor rated current.	—	—
6.	The drive should operate normally. Press  to stop the motor. RUN flashes until the motor comes to a complete stop.	→	 

## 4.8 Test Run with Load Connected

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### ? Test Run with the Load Connected

After performing a no-load test run, connect the motor and proceed to run the motor and load together.

### ? Notes on Connected Machinery

- Clear the area around the motor.
- The motor should come to a complete stop without problems.
- Connect the load and machinery to the motor.
- Fasten all installation screws properly. Check that the motor and connected machinery are held in place.
- Confirm that the Fast Stop circuit or mechanical safety measures operate correctly.
- Be ready to press the STOP button in case of emergency.

### ? Checklist Before Operation

- The motor should rotate in the proper direction.
- The motor should accelerate and decelerate smoothly.

### ? Operating the Motor under Loaded Conditions

Test run the application similarly to the no-load test procedure when connecting the machinery to the motor.

- Watch monitor parameter U1-03 during operation to ensure there is no overcurrent.
- If the application permits running the load in the reverse direction, try changing motor direction and the frequency reference while watching for abnormal motor oscillation or vibration.
- Correct any problems that occur with hunting, oscillation, or other control-related issues.

## 4.9 Verifying Parameter Settings and Backing Up Changes

Use the Verify Menu to check changes to parameter settings. This function is useful to see any changes resulting from manually setting the parameters or from Auto-Tuning. *Refer to Verifying Parameter Changes: Verify Menu on page 87.*

Save the verified parameter settings. Change the access level or set a password to the drive to prevent accidental modification of parameter settings.

### ? Backing Up Parameter Values: o2-03

The following procedure saves all parameters settings to drive memory where they can later be recalled. Set o2-03 to “1” to save parameter changes. This saves all parameter settings, and then returns o2-03 to 0. The drive can now “recall” the saved parameters by performing a User Initialization (A1-03 = 1110).

No.	Parameter Name	Description	Setting Range	Default Setting
o2-03	User Parameter Default Value	Lets the user create a set of default settings for a User Initialization. 0: Saved/Not set 1: Set Defaults - Saves current parameter settings as the default values for a User Initialization. 2: Clear All - Clears the currently saved user settings. After saving the user parameter set value, the items of 1110 (User Parameter Initialize) are displayed in A1-03 (User Parameter Default Value).	0 to 2	0
A1-03	Initialize Parameters	Selects a method to initialize the parameters. 0: No Initialize 1110: User Initialization (The user must first program and store desired settings using parameter o2-03) 2220: 2-Wire Initialization (parameter initialized prior to shipment) 3330: 3-Wire Initialization 5550: oPE04 Fault reset	0 to 5550	0

### ? Parameter Access Level: A1-01



Setting the Access Level for “Operation only” (A1-01 = 0) allows the user to access parameters A1-□□ and U□-□□ only. Other parameters are not displayed.

Setting the Access Level for “User Parameters” (A1-01 = 1) allows the user to access only the parameters that have been previously saved as User Parameters. This is helpful when displaying only the relevant parameters for a specific application.

No.	Parameter Name	Description	Setting Range	Default
A1-01	Access Level Selection	Selects which parameters are accessible via the digital operator. 0: Operation only. A1-01 and A1-04 can be set and monitored, U□-□□ parameters can also be viewed. 1: User Parameters. Only those recently changed among application parameters A2-01 to A2-16 and A2-17 to A2-32 can be set and monitored. 2: Advanced Access Level. All parameters can be set and monitored.	0 to 2	2
A2-01 to A2-32	User Parameters 1 to 32	Parameters selected by the user are saved as User Parameters. This includes recently viewed parameters or parameters specifically selected for quick access. If parameter A2-33 is set to 1, recently viewed parameters will be listed between A2-17 and A2-32. Parameters A2-01 through A2-16 must be manually selected by the user. If A2-33 is set to 0, then recently viewed parameters will not be saved to the group of User Parameters. A2-□□ parameters are now available for manual programming.	b1-01 to o□-□□	—
A2-33	User Parameter Automatic Selection	0: Parameters A2-01 through A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access. The most recently changed parameter is saved to A2-17. The second most recently changed parameter is saved to A2-18.	0, 1	1

### ? Password Settings: A1-04, A1-05

The user can set a password to the drive to restrict access. The password is selected via parameter A1-05. The password must be entered to A1-04 to unlock parameter access (i.e., parameter setting A1-04 must match the value programmed into A1-05). The following parameters cannot be viewed or edited until the value entered to A1-04 correctly matches the value set to A1-05: A1-01, A1-02, A1-03, and A2-01 through A2-33.

**Note:** Parameter A1-05 is hidden from view. To display A1-05, access parameter A1-04 and simultaneously press the  key and the  key.

### ? Copy Function

Parameter settings can be copied to another drive to simplify parameter restoration or multiple drive setup. The drive supports the following copy options:

- **LED Operator (standard in all models)**

The LED operator used to operate the drive also supports copying, importing, and verifying parameter settings. *Refer to o3: Copy Function on page 262* for details.

- **LCD Operator**

The optional LCD operator also supports copying, importing, and verifying parameter settings. Refer to the manual supplied with the LCD operator for instructions.

- **USB Copy Unit and CopyUnitManager**

The copy unit is an external option connected to the drive to copy parameter settings from one drive and save those settings to another drive. Refer to the manual supplied with the USB Copy Unit for instructions.

The CopyUnitManager is a PC software tool. It allows the user to load parameter settings from the Copy Unit onto a PC, or from the PC onto a Copy Unit. This is useful when managing parameters for various drives or applications. Refer to the manual supplied with the CopyUnitManager for instructions.

- **DriveWizard Plus**

DriveWizard is a PC software tool for parameter management, monitoring, and diagnosis. DriveWizard can load, store, and copy drive parameter settings. For details, refer to Help in the DriveWizard software.

## 4.10 Test Run Checklist

Review the checklist before performing a test run. Check each item that applies.


<input checked="" type="checkbox"/>	No.	Checklist	Page
<input type="checkbox"/>	1	Thoroughly read the manual before performing a test run.	—
<input type="checkbox"/>	2	Turn the power on.	94
<input type="checkbox"/>	3	Set the voltage for the power supply to E1-01.	174
<input type="checkbox"/>	4	Select the correct duty rating (C6-01) for the application.	—

Check the items that correspond to the control mode being used.

**WARNING!** Ensure start/stop and safety circuits are wired properly and in the correct state before energizing the drive. Failure to comply could result in death or serious injury from moving equipment. When programmed for 3-Wire control, a momentary closure on terminal S1 may cause the drive to start.

<input checked="" type="checkbox"/>	No.	Checklist	Page
V/f Control (A1-02 = 0) and V/f Control with PG (A1-02 = 1)			
<input type="checkbox"/>	5	Define the V/f pattern according to the application and motor characteristics. Example: If using a motor with a rated frequency of 50.0 Hz, set E1-03 to "0".	—
<input type="checkbox"/>	6	Perform Rotational Auto-Tuning for V/f Control if using Energy Saving functions.	95
V/f Control with PG (A1-02 = 1)			
<input type="checkbox"/>	7	Setup the PG feedback parameters correctly and make sure the encoder pulse counting direction is correct.	183
<input type="checkbox"/>	8	Set the proportional gain for ASR speed control to C5-01 and the integral time to C5-02.	159
Open Loop Vector Control (A1-02 = 2) or Closed Loop Vector Control (A1-02=3)			
<input type="checkbox"/>	9	Perform Auto-Tuning as described.	101
Closed Loop Vector Control (A1-02 = 3)			
<input type="checkbox"/>	10	Set the proportional gain for ASR speed control to C5-01 and the integral time to C5-02. Perform ASR Tuning if possible.	159
Open Loop Vector Control for PM (A1-02 = 5)			
<input type="checkbox"/>	11	Perform Auto-Tuning as described.	103
Advanced Open Loop Vector Control for PM (A1-02 = 6)			
<input type="checkbox"/>	12	Perform Auto-Tuning as described.	103
<input type="checkbox"/>	13	Set the proportional gain for ASR speed control to C5-01 and the integral time to C5-02.	159
Closed Loop Vector Control for PM (A1-02 = 7)			
<input type="checkbox"/>	14	Perform Auto-Tuning as described.	103
<input type="checkbox"/>	15	Set the proportional gain for ASR speed control to C5-01 and the integral time to C5-02. Perform ASR Tuning if possible.	159
<input type="checkbox"/>	16	Set the Z pulse offset to or enter the Z manually to parameter E5-11.	103

Proceed to the following checklist after checking items 4 through 15.

<input checked="" type="checkbox"/>	No.	Checklist	Page
<input type="checkbox"/>	17	The <b>DRV</b> should light after giving a Run command.	—
<input type="checkbox"/>	18	To give a Run command and frequency reference from the digital operator, press  to set to LOCAL. The LO/RE key will light.	89
<input type="checkbox"/>	20	If the motor rotates in the opposite direction during the test run, switch two of the drive output terminals (U/T1, V/T2, W/T3) or change parameter b1-14.	94
<input type="checkbox"/>	21	Set the correct values for the motor rated current (E2-01, E4-01, E5-03) and motor protection (L1-01) to ensure motor thermal protection.	—
<input type="checkbox"/>	22	If the Run command and frequency reference are provided via the control circuit terminals, set the drive for REMOTE and be sure the LO/RE light is out.	89

## 4.10 Test Run Checklist

<input checked="" type="checkbox"/>	No.	Checklist	Page
<input type="checkbox"/>	23	If the control circuit terminals should supply the frequency reference, select the correct voltage input signal level (0 to 10 V, or -10 to 10 V) or the correct current input signal level (4 to 20 mA or 0 to 20 mA).	119
<input type="checkbox"/>	24	Set the proper voltage to terminal A1, A2 and A3 (0 to 10 V, or -10 to +10 V).	119
<input type="checkbox"/>	25	When current input is used, switch the drive's built-in DIP switch S1 from the V-side to I-side. Set the level for current signal used to H2-09 (set "2" for 4 to 20 mA, or "3" for 0 to 20 mA).	119
<input type="checkbox"/>	26	Set the proper current to terminal A2. (-10 to +10 V, 4 to 20 mA or 0 to 20 mA).	119
<input type="checkbox"/>	27	<p>If the frequency reference is supplied via one of the analog inputs, make sure the analog input produces the desired frequency reference. Make the following adjustments if the drive does not operate as expected:</p> <p>Gain adjustment: Set the maximum voltage/current signal and adjust the analog input gain (H3-03 for input A1, H3-11 for input A2, H3-07 for analog input A3) until the frequency reference value reaches the desired value.</p> <p>Bias adjustment: Set the minimum voltage/current signal and adjust the analog input bias (H3-04 for input A1, H3-12 for input A2, H3-08 for analog input A3) until the frequency reference value reaches the desired minimum value.</p>	—

## Parameter Details

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5.1	A: INITIALIZATION.....	114
5.2	B: APPLICATION.....	119
5.3	C: TUNING.....	150
5.4	D: REFERENCE SETTINGS.....	165
5.5	E: MOTOR PARAMETERS.....	174
5.6	F: OPTION SETTINGS.....	183
5.7	H: TERMINAL FUNCTIONS.....	191
5.8	L: PROTECTION FUNCTIONS.....	223
5.9	N: SPECIAL ADJUSTMENTS.....	249
5.10	O: OPERATOR RELATED SETTINGS.....	259
5.11	S: FUNCTIONS FOR TEXTILE APPLICATIONS.....	265
5.12	U: MONITOR PARAMETERS.....	278

## 5.1 A: Initialization

The initialization group contains parameters associated with initial setup of the drive. Parameters involving the display language, access levels, initialization, and password are located in this group.

### ? A1: Initialization

#### ? A1-00: Language Selection

Selects the display language for the digital operator.

**Note:** This parameter is not reset when the drive is initialized using parameter A1-03.

No.	Parameter Name	Setting Range	Default
A1-00	Language Selection	0 to 7	0

**Setting 0: English**

**Setting 1: Japanese**

**Setting 2: German**

**Setting 3: French**

**Setting 4: Italian**

**Setting 5: Spanish**

**Setting 6: Portuguese**

**Setting 7: Chinese**

#### ? A1-01: Access Level Selection

Allows or restricts access to drive parameters.

No.	Parameter Name	Setting Range	Default
A1-01	Access Level Selection	0 to 2	2

**Setting 0: Operation only**

Access is restricted to parameters A1-01, A1-04, A1-06, and all U monitor parameters.

**Setting 1: User Parameters**

Access to only a specific list of parameters set to A2-01 through A2-32. These User Parameters can be accessed using the Setup Mode of the digital operator.

**Setting 2: Advanced Access Level (A) and Setup Access Level (S)**

All parameters can be viewed and edited.

#### Notes on Parameter Access

- If the drive parameters are password protected by A1-04 and A1-05, parameters A1-00 through A1-03 and A2-01 through A2-32 cannot be modified.
- If a digital input terminal programmed for “Program lockout” (H1-□□ = 1B) is enabled, parameter values cannot be modified, even if A1-01 is set to 1 or 2.
- If parameters are changed via serial communication, then it will not be possible to edit or change parameters settings with the drive’s digital operator until an Enter command is issued to the drive from the serial communication.

#### ? A1-02: Control Method Selection

Selects the Control Method (also referred to as the “control mode”) the drive uses to operate the motor. If the drive is set up to run two motors, then A1-02 determines the control mode for motor 1.

**Note:** When changing control modes, all parameter settings depending upon the setting of A1-02 will be reset to the default.

No.	Parameter Name	Setting Range	Default
A1-02	Control Method Selection	0, 1, 2, 3, 5, 6, 7	0

## Control Modes for Induction Motors (IM)

### Setting 0: V/f Control for Induction Motors

V/f Control is for simple speed control and multiple motor applications with low demands to dynamic response or speed accuracy. This control mode should be used when the motor parameters are unknown and Auto-Tuning cannot be performed. The speed control range is 1:40.

### Setting 1: V/f Control with PG Speed Feedback

For general-purpose applications that do not require high dynamic response but high speed accuracy. This mode should be used if the motor parameters are unknown and Auto-Tuning cannot be performed. The speed control range is 1:40.

### Setting 2: Open Loop Vector Control

For general, variable-speed applications with a speed control range of 1:120 that require precise speed control, quick torque response, and high torque at low speed without using a speed feedback signal from the motor.

### Setting 3: Closed Loop Vector Control

For general, variable-speed applications that requiring precise speed control down to zero speed, fast torque response, or precise torque control. A speed feedback signal from the motor is required. The speed control range is up to 1:1500.

## Control Modes for Permanent Magnet Motors (SPM or IPM)

### Setting 5: Open Loop Vector Control for PM

Use this mode for variable torque applications and take advantage of the energy saving capabilities of a PM motor. Using this mode, the drive can control an SPM or IPM motor with a speed range of 1:20.

### Setting 6: Advanced Open Loop Vector Control for PM

This control mode can be used to operate an IPM motor for constant torque applications. Using High Frequency Injection, a speed control range as high as 1:100 is possible. Refer to [Control Mode Selection on page 26](#) for details.

### Setting 7: Closed Loop Vector Control for PM

This mode can be used for high precision control of a PM motor in constant torque or variable torque applications. The speed control range reaches 1:1500. A speed feedback signal is required.

## ? A1-03: Initialize Parameters

Resets parameters back to the original default values. After initialization, the setting for A1-03 automatically returns to 0.

No.	Parameter Name	Setting Range	Default
A1-03	Initialize Parameters	0, 1110, 2220, 3330, 5550	0

### Setting 1110: User Initialize

Drive parameters are reset to values selected by the user as User Settings. User Settings are stored when parameter o2-03 is set to “1: Set defaults”.

**Note:** A “user-initialization” resets all parameters to a user-defined set of default values that were previously saved to the drive. To clear the user-defined default values, set parameter o2-03 to 2.

### Setting 2220: 2-Wire Initialization

Resets all parameters back to their original default settings with digital inputs S1 and S2 configured as Forward run and Reverse run, respectively. For more on digital input functions, see [Setting 40, 41: Forward run, Reverse run command for 2-wire sequence on page 198](#).

### Setting 3330: 3-Wire Initialization

The drive parameters are returned to factory default values with digital inputs S1, S2, and S5 configured as Run, Stop, and Forward/Reverse respectively. Also refer to digital input functions, [Setting 0: 3-Wire Sequence on page 192](#).

### Setting 5550: oPE04 Reset

If parameters on a certain drive have been edited and then a different terminal block is installed with different settings saved in its built-in memory, an oPE04 error will appear on the display. To use the parameter settings saved to the terminal block memory, set A1-02 to 5550.

## 5.1 A: Initialization

### Notes on Parameter Initialization

The parameters shown in [Table 5.1](#) will not be reset when the drive is initialized by setting A1-03 = 2220 or 3330.

**Table 5.1 Parameters not Changed by Drive Initialization**

No.	Parameter Name
	Language Selection
A1-02	Control Method Selection
E1-03	V/f Pattern Selection
E5-01	Motor Code Selection (for PM motors)
E5-02	Motor Rated Power (for PM Motor)
E5-03	Motor Rated Current (for PM Motor)
E5-04	Number of Motor Poles (for PM Motor)
E5-05	Motor Stator Resistance (for PM Motor)
E5-06	Motor d-Axis Inductance (for PM Motor)
E5-07	Motor q-Axis Inductance (for PM Motor)
E5-09	Motor Induction Voltage Constant 1 (for PM Motor)
E5-24	Motor Induction Voltage Constant 2 (for PM Motor)
F6-□□	Communication parameter (initialized when F6-08 = 1)
L8-35	Installation Selection
o2-04	Drive/kVA Selection

### ? A1-04, A1-05: Password and Password Setting

A1-04 is for entering the password when the drive is locked. A1-05 is a hidden parameter used to set the password.

No.	Parameter Name	Setting Range	Default
A1-04	Password	0000 to 9999	0000
A1-05	Password Setting		

### How to use the Password

The user can set a password for the drive to restrict access. The password is set to A1-05 and must be entered to A1-04 to unlock parameter access. Until the correct password is entered, the following parameters cannot be viewed or edited: A1-01 through A1-03, and A2-01 through A2-32.

The instructions below demonstrate how to set a new password. Here, the password set is “1234”. An explanation follows on how to enter the password to unlock the parameters.

**Table 5.2 Setting the Password for Parameter Lock**

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	
2.	Scroll to the Parameter Setup display and press	→	
3.	Scroll to the right by pressing	→	
4.	Select the flashing digits by pressing	→	
5.	Select A1-04 by pressing	→	
6.	Press the  key while holding down  at the same time. A1-05 will appear. <b>Note:</b> Because A1-05 is hidden, it will not be displayed by simply pressing the  key.	→	
7.	Press the  key.	→	
8.	Use , , and  to enter the password.	→	




Step			Display/Result
9.	Press  to save what was entered.	→	
10.	The display automatically returns to the display shown in step 5.	→	

Table 5.3 Check to see if A1-02 is locked (continuing from step 10 above)






























Step			Display/Result
1.	Press  to display A1-02.	→	
2.	Press  to display the value set to A1-02.	→	
3.	Press  and  , making sure that the setting values cannot be changed.		
4.	Press  to return to the first display.	→	

Table 5.4 Enter the Password to Unlock Parameters (continuing from step 4 above)

Step			Display/Result
1.	Press  to enter the parameter setup display.	→	
2.	Press  to select the flashing digits as shown.	→	
3.	Press  to scroll to A1-04.	→	
4.	Enter the password “1234”.	→	
5.	Press  to save the new password.	→	
6.	Drive returns to the parameter display.	→	
7.	Press  and scroll to A1-02.	→	
8.	Press  to display the value set to A1-02. If the first “0” blinks, parameter settings are unlocked.	→	
9.	Use  and  to change the value if desired (though changing the control mode at this point is not typically done).		 OLV
10.	Press  to save the setting, or press  to return to the previous display without saving changes.	→	
11.	The display automatically returns to the parameter display.	→	

**Note:** Parameter settings can be edited after entering the correct password. Performing a 2-wire or 3-wire initialization resets the password to “0000”. Reenter the password to parameter A1-05 after drive initialization.

## 5.1 A: Initialization

### ? A2: User Parameters

#### ? A2-01 to A2-32: User Parameters 1 to 32

The user can select 32 parameters and assign them to A2-01 through A2-32. This saves time later scrolling through the parameter menu. The list of User Parameters can also track the most recently edited settings and save those parameters to this list.

No.	Parameter Name	Setting Range	Default
A2-01 to A2-32	User Parameters 1 to 32	A1-00 to 04-13	–

#### Saving User Parameters

To save specific parameters to A2-01 to A2-32, first set the access level to allow access to all parameters (A1-02 = 2). Next assign the parameter number to the User Parameters list by entering it into one of the A2-□□ parameters. If A1-01 is then set to 1, the access level can be restricted so that users can only set and refer to the specific parameters saved as User Parameters.

#### ? A2-33: User Parameter Automatic Selection

A2-33 determines whether or not parameters that have been edited are saved to the User Parameters (A2-17 to A2-32) for quick, easy access.

No.	Parameter Name	Setting Range	Default
A2-33	User Parameter Automatic Selection	0 or 1	1

#### Setting 0: Do not save list of recently viewed parameters.

To manually select the parameters listed in the User Parameter group, set A2-33 to 0.

#### Setting 1: Save history of recently viewed parameters.

By setting A2-33 to 1, all parameters that were recently edited will be automatically saved to A2-17 through A2-32. A total of 16 parameters are saved with the most recently edited parameter set to A2-17, the second most recently to A2-18, and so on. User Parameters can be accessed using the Setup Mode of the digital operator.

## 5.2 b: Application

### ? b1: Operation Mode Selection

#### ? b1-01: Frequency Reference Source 1

Use parameter b1-01 to select the frequency reference source 1 for the REMOTE mode.

- Note:**
1. If a Run command is input to the drive but the frequency reference entered is 0 or below the minimum frequency, the RUN indicator LED on the digital operator will flash.
  2. Press the LO/RE key to set the drive to LOCAL and use the operator keypad to enter the frequency reference.

No.	Parameter Name	Setting Range	Default
b1-01	Frequency Reference Source 1	0 to 4	1

#### Setting 0: Operator keypad

Using this setting, the frequency reference can be input by:

- switching between the multi-speed references in the d1-□□ parameters.
- entering the frequency reference on the operator keypad.

#### Setting 1: Terminals (analog input terminals)

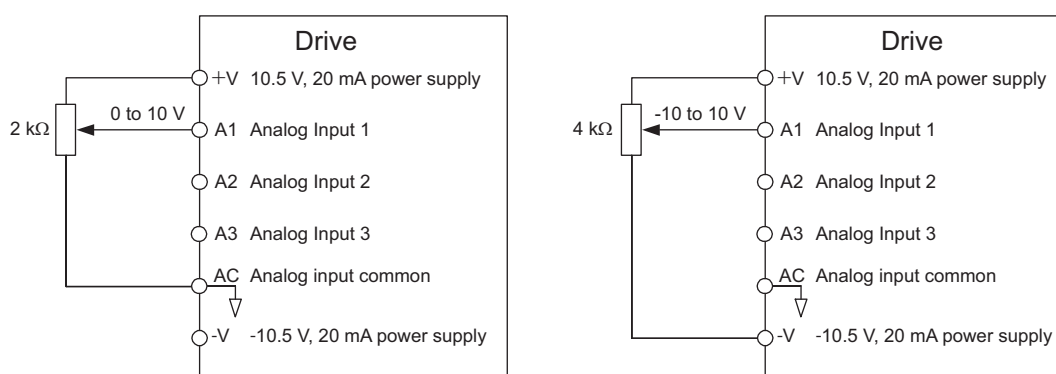
Using this setting, an analog frequency reference can be entered as a voltage or current signal from terminals A1, A2, or A3.

#### Voltage Input

Voltage input can be used at any of the three analog input terminals. Make the settings as described in [Table 5.5](#) for the input used.

**Table 5.5 Analog Input Settings for Frequency Reference Using Voltage Signals**

Terminal	Signal Level	Parameter Settings				Notes
		Signal Level Selection	Function Selection	Gain	Bias	
	0 to 10 Vdc	H3-01 = 0	H3-02 = 0	H3-03	H3-04	–
	-10 to +10 Vdc	H3-01 = 1	(Frequency Reference Bias)			
A2	0 to 10 Vdc	H3-09 = 0	H3-10 = 0	H3-11	H3-12	Make sure to set DIP switch S1 on the terminal board to “V” for voltage input.
	-10 to +10 Vdc	H3-09 = 1	(Frequency Reference Bias)			
A3	0 to 10 Vdc	H3-05 = 0	H3-06 = 0	H3-07	H3-08	Make sure to set DIP switch S4 on the terminal board to “AI”.
	-10 to +10 Vdc	H3-05 = 1	(Frequency Reference Bias)			



**Figure 5.1 Setting the Frequency Reference as a Voltage Signal at Terminal A1**

Use the wiring example shown in [Figure 5.1](#) for any other analog input terminals. When using input A2 make sure DIP switch S1 is set for voltage input.

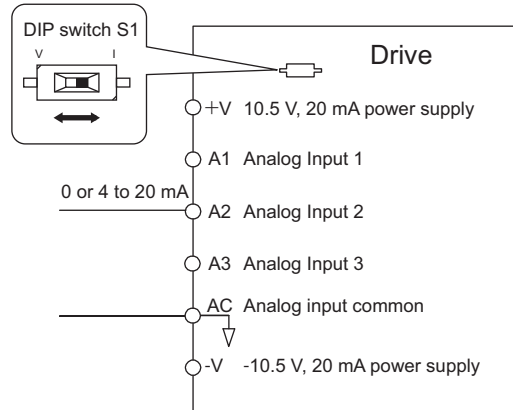
## 5.2 b: Application

### Current Input

Input terminal A2 can accept a current input signal. Refer to [Table 5.6](#) to set terminal A2 for current input.

**Table 5.6 Analog Input Settings for Frequency Reference Using a Current Signal**

Terminal	Signal Level	Parameter Settings				Notes
		Signal Level Selection	Function Selection	Gain	Bias	
	4 to 20 mA	H3-09 = 2	H3-10 = 0 (Frequency Bias)	H3-11	H3-12	Make sure to set DIP switch S1 on the terminal board to “I” for current input.
	0 to 20 mA	H3-09 = 3				



**Figure 5.2 Setting the Frequency Reference as a Current Signal to Terminal A2**

DIP switch S1 must first be set for current input.

### Switching between Main/Auxiliary Frequency References

The frequency reference input can be switched between the analog terminals A1, A2, and A3 using multi-speed inputs. Refer to [Multi-Step Speed Selection on page 165](#) for details on using this function.

### Setting 2: MEMOBUS/Modbus Communications

This setting requires that the frequency reference is entered via the RS-485/422 serial communications port (control terminals R+, R-, S+, S-). For instructions, see [MEMOBUS/Modbus Communications on page 509](#).

### Setting 3: Option card

This setting requires that the frequency reference is entered via an option board plugged into connector CN5-A on the drives control board. Consult the manual supplied with the option board for instructions on integrating the drive with the communication system.

**Note:** If the frequency reference source is set for an option PCB (b1-01 = 3), but an option board is not installed, an OPE05 Operator Programming Error will be displayed on the digital operator and the drive will not run.

### Setting 4: Pulse Train Input

If b1-01 is set to 4, the frequency reference must be provided by a pulse train signal to terminal RP. Follow the directions below to make sure the pulse signal is working properly.

### Verifying Pulse Train is Working Properly

- Make sure that b1-01 is set to 4 and H6-01 is set to 0.
- Set the pulse input scaling H6-02 to the pulse train frequency value that equals 100% of the frequency reference.
- Enter a pulse train signal to terminal RP and check if the correct frequency reference is displayed.

### ? b1-02: Run Command Source 1

Parameter b1-02 determines the Run command source 1 in the REMOTE mode.

No.	Parameter Name	Setting Range	Default
b1-02	Run Command Source 1	0 to 3	1

### Setting 0: Operator

When the b1-02 = 0, the LO/RE light will switch on and the RUN key will enter a Run command to start the drive.

### Setting 1: Control Circuit Terminal

This setting requires that the Run and Stop commands are entered from the digital input terminals. The following sequences can be used:

- 2-wire sequence 1:  
Two inputs (FWD/Stop-REV/Stop). Initializing the drive by setting A1-03 = 2220, presets the terminals S1 and S2 to these functions. This is the default setting of the drive. Also refer to [Setting 40, 41: Forward run, Reverse run command for 2-wire sequence on page 198](#).
- 2-wire sequence 2:  
Two inputs (Start/Stop-FWD/REV). Also refer to [Setting 42, 43: Run and direction command for 2-wire sequence 2 on page 198](#).
- 3-wire sequence:  
Three inputs (Start-Stop-FWD/REV). Initialize the drive by setting A1-03 = 3330 presets the terminals S1, S2, and S5 to these functions. Also refer to [Setting 0: 3-Wire Sequence on page 192](#).

### Setting 2: MEMOBUS/Modbus Communications

To issue a Run command via serial communications, set b1-02 to 2 and connect the RS-485/422 serial communication cable to control terminals R+, R-, S+, and S- on the removable terminal block. For instructions, [Refer to MEMOBUS/Modbus Communications on page 509](#).

### Setting 3: Option Card

To issue the Run command via the communication option board, set b1-02 to 3 and plug a communication option board into the CN5-A port on the control PCB. Refer to the manual supplied with the option board for instructions on integrating the drive into the communication system.

**Note:** If b1-02 is set to 3, but an option board is not installed in CN5-A, an oPE05 operator programming error will be displayed on the digital operator and the drive will not run.

### ? b1-03: Stopping Method Selection

Select how the drive stops the motor when the Run command is removed or when a Stop command is entered.

No.	Parameter Name	Setting Range	Default
b1-03	Stopping Method Selection	0 to 3	0

### Setting 0: Ramp to stop

When the Run command is removed, the drive will decelerate the motor to stop. The deceleration rate is determined by the active deceleration time. The default deceleration time is set to parameter C1-02.

When the output frequency falls below the level set in parameter b2-01, the drive will start DC injection, Zero Speed Control or Short Circuit Braking, depending on the selected control mode. Refer to [b2-01: DC Injection Braking Start Frequency on page 126](#) for details.

### Setting 1: Coast to stop

When the Run command is removed, the drive will shut off its output and the motor will coast (uncontrolled deceleration) to stop. The stopping time is determined by the inertia and the friction in the driven system.

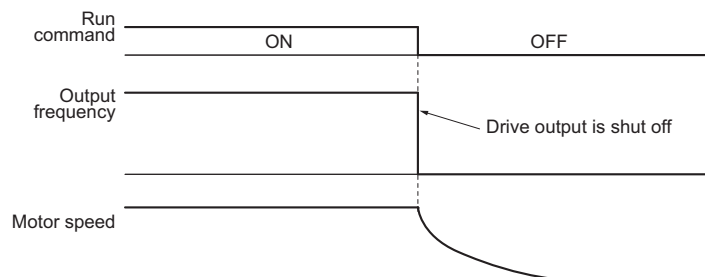


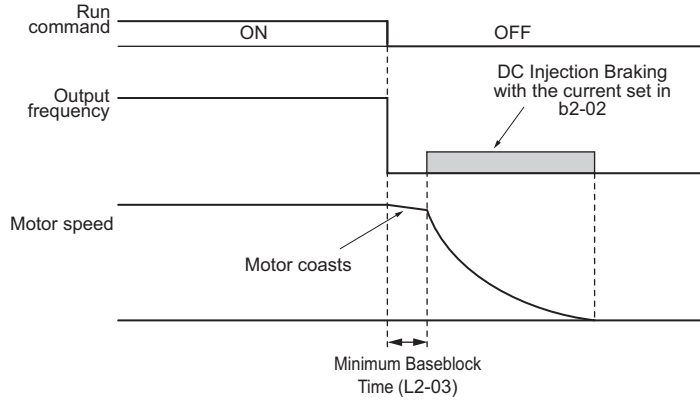
Figure 5.3 Coast to Stop

**Note:** After a stop is initiated, any subsequent Run command entered will be ignored until the minimum baseblock time (L2-03) has expired. Do not enter Run command until it has come to a complete stop. To start the motor back up before it has stopped completely, use DC Injection at start ([Refer to b2-03: DC Injection Braking Time at Start on page 128](#)) or Speed Search ([Refer to b3: Speed Search on page 129](#)).

### Setting 2: DC Injection Braking to stop

When the Run command is removed, the drive will enter baseblock (turn off its output) for the minimum baseblock time (L2-03). Once the minimum baseblock time has expired, the drive will brake the motor by injecting DC current into the motor windings. The stopping time is significantly faster than when compared with simply coasting to stop. The level of current used for DC Injection Braking is set by parameter b2-02 (default = 50%).

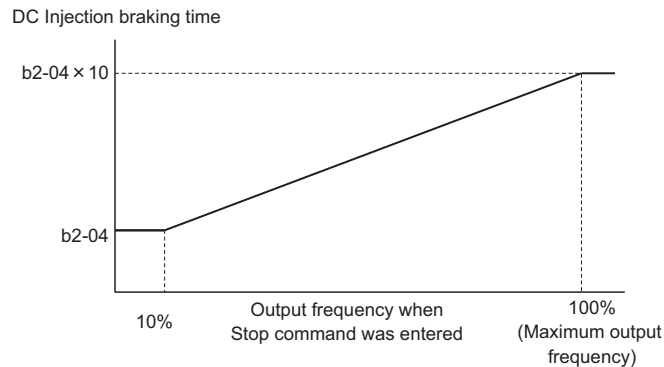
**Note:** This function is not available in CLV (A1-02 = 3) or the control modes for PM motors (A1-02 = 5, 6, 7).



**Figure 5.4 DC Injection Braking to Stop**

The time for DC Injection Braking is determined by the value set to b2-04 and by the output frequency at the time the Run command is removed. It can be calculated by:

$$\text{DC Injection brake time} = \frac{(b2-04) \times 10 \times \text{Output frequency}}{\text{Max. output frequency (E1-04)}}$$

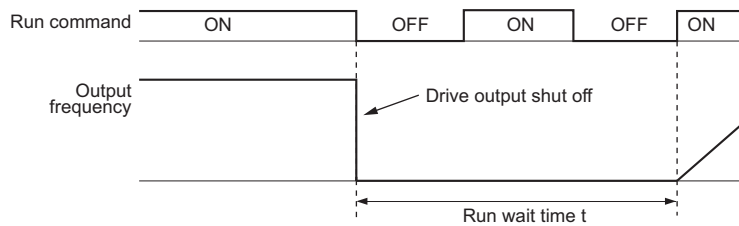


**Figure 5.5 DC Injection Braking Time Depending on Output Frequency**

**Note:** If an overcurrent (oC) fault occurs during DC Injection Braking to stop, lengthen the minimum baseblock time (L2-03) until the fault no longer occurs.

### Setting 3: Coast to Stop with Timer

When the Run command is removed, the drive will turn off its output and the motor will coast to stop. If a Run command is input before the time t (value of C1-02) has expired, the drive will not start. A Run command activated during time t must be cycled after t has expired in order to start the drive.



**Figure 5.6 Coast to Stop with Timer**

The wait time  $t$  is determined by the output frequency when the Run command is removed and by the active deceleration time.

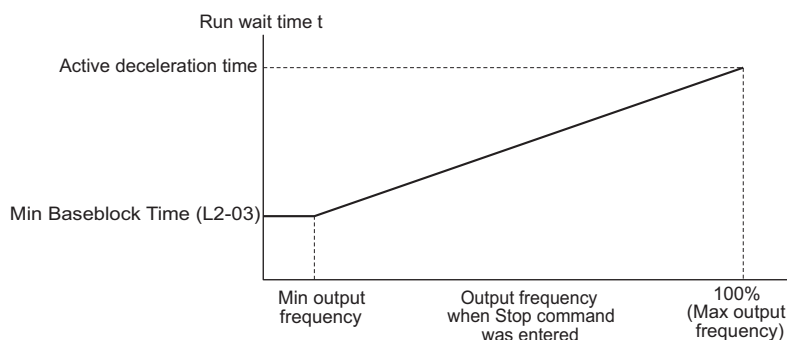


Figure 5.7 Run Wait Time Depending on Output Frequency

### ? b1-04: Reverse Operation Selection

For some applications, reverse motor rotation is not appropriate and may cause problems (e.g., air handling units, pumps, etc.). Setting parameter b1-04 to 1 instructs the drive to ignore any Reverse run commands.

No.	Parameter Name	Setting Range	Default
b1-04	Reverse Operation Selection	0 or 1	0

#### Setting 0: Reverse operation enabled

Possible to operate the motor in both forward and reverse directions.

#### Setting 1: Reverse operation disabled

Drive disregards a Reverse run command or a negative frequency reference.

### ? b1-05: Action Selection below Minimum Output Frequency (CLV and CLV/PM)

Parameter b1-05 sets the operation when the frequency reference is lower than the minimum output frequency set in parameter E1-09.

No.	Parameter Name	Setting Range	Default
b1-05	Action Selection below Minimum Output Frequency	0 to 3	0

#### Setting 0: Follow the Frequency Reference

The drive adjusts the motor speed following the speed reference, even if the frequency reference is below the setting of parameter E1-09. When the Run command is removed and the motor speed is smaller than the setting of b2-01, Zero Speed Control (not position lock) is performed for the time set in parameter b2-04 before the drive output shuts off.

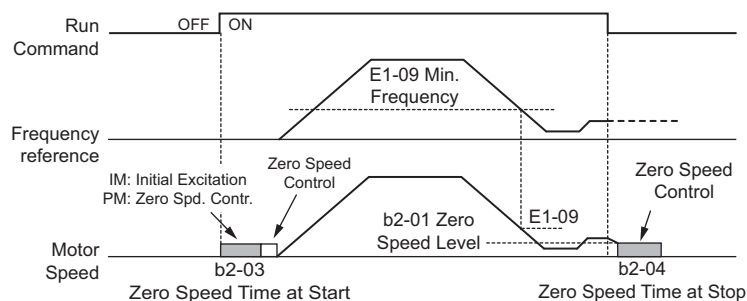


Figure 5.8 Run at the Frequency Reference

Setting 1: Coast to Stop

The motor is started first when the frequency reference exceeds the setting of parameter E1-09. Once the motor is running and the frequency reference falls below E1-09 the drive output is shut off and the motor coasts. When the motor speed falls below the zero speed level set in parameter b2-01, Zero Speed Control is activated for the time set in b2-04.

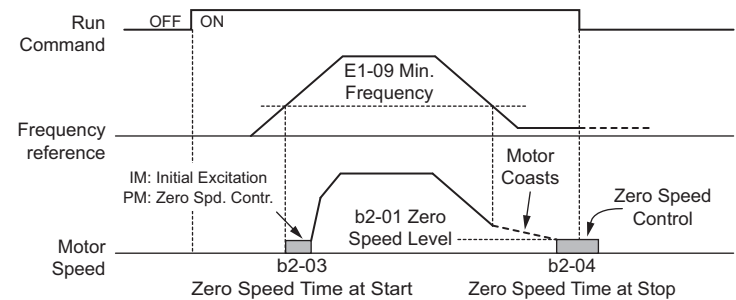


Figure 5.9 Coast to Stop

Setting 2: Run at the minimum frequency

Whenever a Run command is active and the frequency reference is smaller than the value of parameter E1-09, the drive runs the motor at the speed set in E1-09. When the Run command is removed, the drive decelerates the motor. As soon as the motor speed reaches the zero speed level set in b2-01, Zero Speed Control is activated for the time set in b2-04.

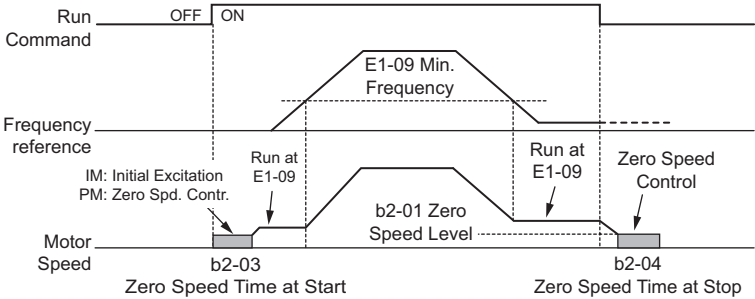


Figure 5.10 Run at the Minimum Frequency

Setting 3: Zero Speed Control

The drive applies Zero Speed Control whenever the frequency reference setting is below the value of parameter E1-09. When the Run command is removed, Zero Speed Control is activated for the time set in b2-04, even if it was already active before.

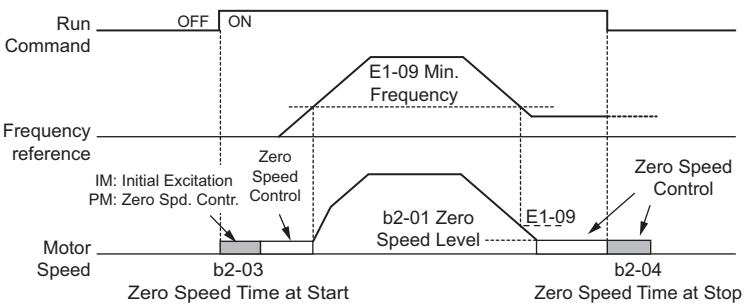


Figure 5.11 Zero Speed Control

? b1-06: Digital Input Reading

This parameter defines how the digital inputs are read.

No.	Name	Setting Range	Default
b1-06	Digital Input Reading	0 or 1	1

Setting 0: Read once

The state of a digital input is read once. If the state has changed, the input command is immediately processed. With this setting the drive responds more quickly to digital inputs, but a noisy signal could cause erroneous operation.

**Setting 1: Read twice**

The state of a digital input is read twice. Only if the state does not change during the double reading, the input command is processed. This reading process is slower but more resistant against noisy signals.

**? b1-07: LOCAL/REMOTE Run Selection**

The drive has three separate control sources that can be switched using digital inputs (H1-□□ = 1 (LOCAL/REMOTE Selection) or 2 (External reference 1/2)) or the LO/RE key on the digital operator. *Refer to Setting 1: LOCAL/REMOTE selection on page 192, Refer to Setting 2: External reference 1/2 selection on page 193 and Refer to o2-01: LO/RE (LOCAL/REMOTE) Key Function Selection on page 260* for details.

- LOCAL: Digital operator. The digital operator is used to set the frequency reference and Run command.
- REMOTE: External reference 1. The frequency reference and Run command source are set by b1-01 and b1-02.
- REMOTE: External reference 2. The frequency reference and Run command source are set by b1-15 and b1-16.

When switching from LOCAL to REMOTE, or between External reference 1 and External reference 2, the Run command may already be present at the location the source was switched to. Parameter b1-07 can be used to determine how the Run command is treated in this case.

No.	Parameter Name	Setting Range	Default
b1-07	LOCAL/REMOTE Run Selection	0 or 1	0

**Setting 0: Run command must be cycled**

When the Run command source is different in the old and new source (e.g., the old source was the terminals and the new source is serial communication), and the Run command is active at the new source as the switch over occurs, the drive will not start or will stop operation if it was running before. The Run command has to be cycled at the new source in order to start the drive again.

**Setting 1: Accept Run command at the new source**

When the Run command is active at the new source, the drive starts or continues operation if it was running before.

**WARNING!** The drive may start unexpectedly if switching control sources when b1-07 = 1. Clear all personnel away from rotating machinery and electrical connections prior to switching control sources. Failure to comply may cause death or serious injury.

**? b1-08: Run command selection while in Programming Mode**

As a safety precaution, the drive will not normally respond to a Run command input when the digital operator is being used to adjust parameters in the Programming Mode (Verify Menu, Setup Mode, Parameter Settings Mode, and Auto-Tuning Mode). If required by the application, set b1-08 to allow the drive to run while in the Programming Mode.

No.	Parameter Name	Setting Range	Default
b1-08	Run Command Selection while in Programming Mode	0 to 2	0

**Setting 0: Disabled**

A Run command is not accepted while the digital operator is in the Programming Mode.

**Setting 1: Enabled**

A Run command is accepted in any digital operator mode.

**Setting 2: Prohibit programming during run**

It is not possible to enter the Programming Mode as long as the drive output is active. The Programming Mode cannot be displayed during Run.

**? b1-14: Phase Order Selection**

Sets the phase order for drive output terminals U/T1, V/T2, and W/T3.

Switching motor phases will reverse the direction of the motor.

No.	Parameter Name	Setting Range	Default
b1-14	Phase Order Selection	0 or 1	0

**Setting 0: Standard phase order****Setting 1: Switched phase order**

## 5.2 b: Application

### ? b1-15: Frequency Reference Source 2

*Refer to b1-01: Frequency Reference Source 1 on page 119 and Refer to Setting 2: External reference 1/2 selection on page 193.* The frequency reference set to b1-15 is enabled when a multi-function digital input set to switch the Run command priority (H1-□□ = 2) closes.

No.	Parameter Name	Setting Range	Default
b1-15	Frequency Reference Source 2	0 to 4	0

### ? b1-16: Run Command Source 2

*Refer to b1-02: Run Command Source 1 on page 120 and Refer to Setting 2: External reference 1/2 selection on page 193.* The run command set to b1-16 is enabled when a multi-function digital input set to switch the Run command priority (H1-□□ = 2) closes.

No.	Parameter Name	Setting Range	Default
b1-16	Run Command Source 2	0 to 3	0

### ? b1-17: Run Command at Power Up

This parameter is used to determine whether an external Run command that is active during power up will start the drive or not.

No.	Parameter Name	Setting Range	Default
b1-17	Run Command at Power Up	0 or 1	0

#### Setting 0: Run command at power up is not issued

The Run command has to be cycled to start the drive.

**Note:** For safety reasons, the drive is initially programmed not to accept a Run command at power up (b1-17 = 0). If a Run command is issued at power up, the RUN indicator LED will flash quickly.

#### Setting 1: Run command and power up is issued

If an external Run command is active when the drive is powered up, then the drive will start to operate the motor as soon as it gets ready for operation (i.e., once the internal start up process is complete).

**WARNING! Sudden Movement Hazard.** If b1-17 is set to 1 and an external Run command is active during power up, the motor will begin rotating as soon as the power is switched on. Proper precautions must be taken to ensure that the area around the motor is safe prior to powering up the drive. Failure to comply may cause serious injury.

## ? b2: DC Injection Braking and Short Circuit Braking

These parameters determine how the DC Injection Braking, Zero Speed Control, and Short Circuit Braking features operate.

### ? b2-01: DC Injection Braking Start Frequency

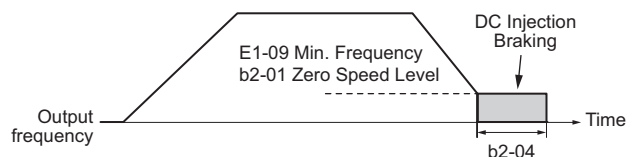
Sets the frequency to start executing DC Injection Braking, Short-Circuit Braking, and Zero Servo. Enabled when the stopping method is set for ramp to stop (b1-03 = 0).

No.	Name	Setting Range	Default
b2-01	DC Injection Braking Start Frequency	0.0 to 10.0 Hz	Determined by A1-02

The function triggered by parameter b2-01 depends on the control mode that has been selected.

#### V/f, V/f w/PG and OLV (A1-02 = 0, 1, 2)

For these control modes, parameter b2-01 sets the starting frequency for DC Injection Braking at stop. Once the output frequency falls below the setting of b2-01, DC Injection Braking is enabled for the time set in parameter b2-04.

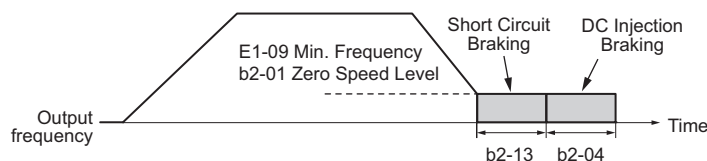


**Figure 5.12 DC Injection Braking at Stop for V/f, V/f w/PG and OLV**

**Note:** If b2-01 is set to a smaller value than parameter E1-09 (minimum frequency), then DC Injection Braking will begin as soon as the frequency falls to the value set to E1-09.

#### OLV/PM and AOLV/PM (A1-02 = 5, 6)

For these control modes, parameter b2-01 sets the starting frequency for Short-Circuit Braking at stop. Once the output frequency falls below the setting of b2-01, Short-Circuit Braking is enabled for the time set in parameter b2-13. If DC Injection Braking time is enabled at stop, then DC Injection Braking is performed for the time set in b2-04 after Short-Circuit Braking is complete.

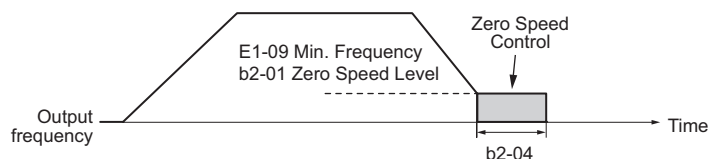


**Figure 5.13 Short-Circuit Braking at Stop in OLV/PM and AOLV/PM**

**Note:** If b2-01 is set to a smaller value than parameter E1-09 (minimum frequency), then DC Injection Braking will begin as soon as the frequency falls to the value set to E1-09.

#### CLV and CLV/PM (A1-02 = 3, 7)

For these control modes, parameter b2-01 sets the starting frequency for Zero Speed Control (not position lock) at stop. Once the output frequency falls below the setting of b2-01, Zero Speed Control is enabled for the time set in parameter b2-04 if b1-05 = 0.



**Figure 5.14 Zero Speed Control at Stop in CLV and CLV/PM**

**Note:** If b2-01 is set to lower than the minimum frequency (E1-09), then Zero Speed Control begins at the frequency set to E1-09.

### ? b2-02: DC Injection Braking Current

Sets the DC Injection Braking current as a percentage of the drive rated current. If set larger than 50%, the carrier frequency is automatically reduced to 1 kHz.

If one of the multi-function input terminals is set for DC Injection Braking 1 (H1-□□ = 59) and that terminal is activated, then the drive will use the current level set in b2-02 to perform DC Injection Braking.

If one of the multi-function input terminals is not set for DC Injection Braking 1 Command (H1-□□ = 59), DC Injection Braking can be used in OLV/PM (A1-02 = 5).

No.	Name	Setting Range	Default
b2-02	DC Injection Braking Current	0 to 100%	50%

The level of DC Injection Braking current affects the strength of the magnetic field attempting to lock the motor shaft. Increasing the current level will increase the amount of heat generated by the motor windings. This parameter should only be increased to the level necessary to hold the motor shaft.

## 5.2 b: Application

### ? b2-03: DC Injection Braking Time at Start

Sets the time of DC Injection Braking (Zero Speed Control when in CLV and CLV/PM) at start. Used to stop a coasting motor before restarting it or to apply braking torque at start. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-03	DC Injection Braking Time at Start	0.00 to 10.00 s	0.00 s

**Note:** Before starting an uncontrolled rotating motor (e.g., a fan motor driven by windmill effect), DC Injection or Speed Search should be used to either stop the motor or detect its speed before starting it. Otherwise motor stalling and other faults can occur.

### ? b2-04: DC Injection Braking Time at Stop

Sets the time of DC Injection Braking (Zero Speed Control when in CLV and CLV/PM) at stop. Used to completely stop a motor with high inertia load after ramp down. Increase the value if the motor still coasts by inertia after it should have stopped. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-04	DC Injection Braking Time at Stop	0.00 to 10.00 s	Determined by A1-02

### ? b2-08: Magnetic Flux Compensation Value

Sets the magnetic flux compensation at start as a percentage of the no-load current value (E2-03). This function allows better more flux to develop, making it easier to start machines that require high starting torque or motors with a large rotor time constant.

No.	Name	Setting Range	Default
b2-08	Magnetic Flux Compensation Value	0 to 1000%	0%

When a Run command is issued, the DC current level injected into the motor changes linearly from the level set to b2-08 to E2-03 within the time set to b2-03.

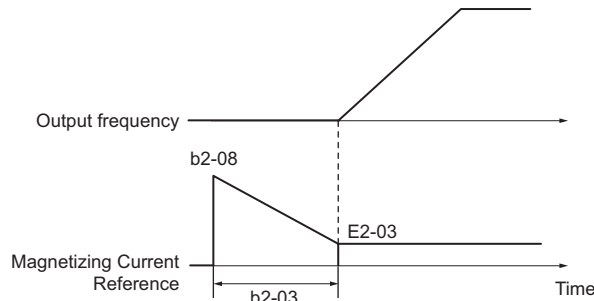


Figure 5.15 Magnetic Flux Compensation

Note that the level of the DC current injected to the motor is limited to 80% of the drive rated current or to the motor rated current, whichever value is smaller.

- Note:**
1. If b2-08 is set below 100%, it can take a relatively long time for flux to develop.
  2. If b2-08 is set to 0%, the DC current level will be the DC Injection current set to b2-02.
  3. As DC Injection can generate a fair amount of noise, b2-08 may need to be adjusted to keep noise levels acceptable.

### ? b2-10: DC Injection Braking Current 2

Set as a percentage of the drive rated current. If b2-10 is greater than 50%, the carrier frequency is automatically changed to 1 kHz. Note that the motor rated current limits the amount of current that can be used for DC Injection Braking.

If one of the multi-function input terminals is set for DC Injection Braking 2 (H1-□□ = 60) and that terminal is activated, then the drive will use the current level set in b2-10 to perform DC Injection Braking.

If one of the multi-function input terminals is not set for DC Injection Braking 2 Command (H1-□□ = 60), DC Injection Braking can be used in V/f Control, V/f Control with PG, or Open Loop Vector Control (A1-02 = 0, 1, 2).

No.	Name	Setting Range	Default
b2-10	DC Injection Braking Current 2	0 to 100%	50%

### ? b2-12: Short Circuit Brake Time at Start

Short Circuit Braking can be used in OLV/PM and AOLV/PM. By shorting all three motor phases, it produces a braking torque in the motor and can be used to stop a coasting motor before starting it again.

Parameter b2-12 sets the time for Short-Circuit Brake operation at start. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-12	Short Circuit Brake Time at Start	0.00 to 25.50 s	0.00 s

**Note:** Short Circuit Braking cannot prevent a PM motor from being rotated by an external force. To prevent the load from rotating the motor, use DC Injection.

### ? b2-13: Short Circuit Brake Time at Stop

The Short Circuit Braking described for parameter b2-12 can also be applied at the end of deceleration in order to completely stop high inertia loads. Short Circuit Braking is initiated for the time set in b2-13 when the output frequency falls below the higher of the values b1-02 and E1-09. Parameter b2-13 sets the time for Short Circuit Braking at stop. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-13	Short Circuit Brake Time at Stop	0.00 to 25.50 s	Determined by A1-02

### ? b2-18: Short Circuit Braking Current

Parameter b2-18 sets the current level for Short Circuit Braking operation as a percentage of the motor rated current. Even though a higher current level can be set using b2-18, the Short Circuit Braking current will not be higher than the drive rated current (120% for Normal Duty, 150% for Heavy Duty).

No.	Name	Setting Range	Default
b2-18	Short Circuit Braking Current	0.0 to 200.0%	100.0%

## ? b3: Speed Search

The Speed Search function allows the drive to detect the speed of a rotating motor shaft that is driven by external forces (e.g., a fan rotating by windmill effect or motor driven by load inertia). The motor operation can be directly started from the speed detected without needing to stop the machine before.

Example: When a momentary loss of power occurs, the drive output shuts off. This results in a coasting motor. When power returns, the drive can find the speed of the coasting motor and restart it directly.

For PM motors, only parameter b3-01 is needed to enable Speed Search.

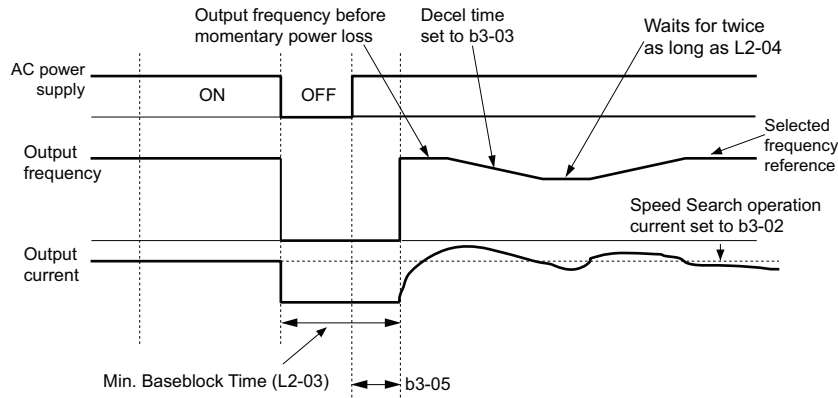
For induction motors, the drive offers two types of Speed Search than can be selected by parameter b3-24 (Speed Estimation and Current Detection). Both methods are explained below, then followed by a description of all relevant parameters.

### ? Current Detection Speed Search (b3-24 = 0)

Current Detection Speed Search is for use with IM motors. Current Detection Speed Search detects the motor speed by looking at motor current. When Speed Search is started it reduces the output frequency starting either from the maximum output frequency or the frequency reference while increasing the output voltage using the time set in parameter L2-04. As long as the current is higher than the level set in b3-02, the output frequency is lowered using the time constant b3-03. If the current falls below b3-02, the drive assumes that the output frequency and motor speed are the same and accelerates or decelerates to the frequency reference.

Be aware that sudden acceleration may occur when using this method of Speed Search with relatively light loads.

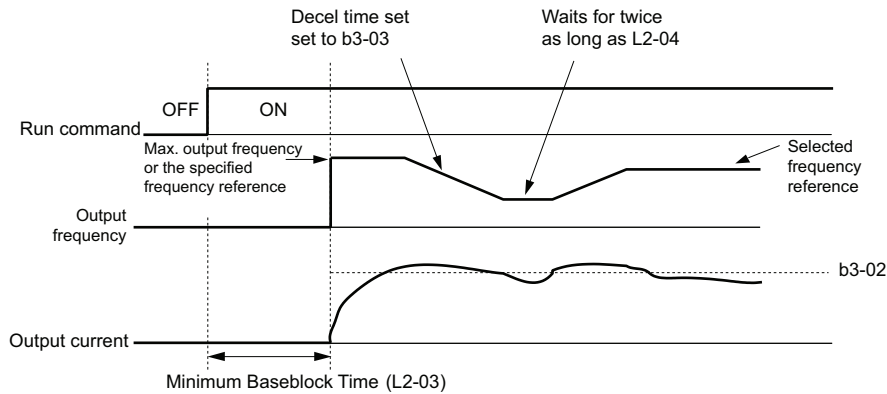
The following time chart illustrates how Current Detection Speed Search operates after a momentary power loss (L2-01 must be set to 1 or 2):



**Figure 5.16 Current Detection Speed Search after Power Loss**

**Note:** After power is restored, the drive waits until the time set to b3-05 has passed before performing Speed Search. Thereby the Speed Search may start not at the end of L2-03 but even later.

When Speed Search is applied automatically with the Run command, the drive waits for the minimum baseblock time L2-03 before Speed Search is started. If L2-03 is smaller than the time set in parameter b3-05, then b3-05 is used as the wait time.



**Figure 5.17 Current Detection Speed Search at Start or Speed Search Command by Digital Input**

### Notes on Using Current Detection Type Speed Search

- Shorten the Speed Search deceleration time set to b3-03 if an oL1 fault occurs while performing Current Detection Speed Search.
- Current Detection Speed Search is not available when using Open Loop Vector Control for PM motors.
- Increase the minimum baseblock time set to L2-03 if an overcurrent or overvoltage fault occurs when performing Speed Search after power is restored following a momentary power loss.

### ? Speed Estimation Type Speed Search (b3-24 = 1)

This method can be used for a single induction motor connected to a drive. It should not be used if the motor is one or more frame sizes smaller than the drive, at motor speeds above 200 Hz, or when using a single drive to operate more than one motor.

Speed Estimation is executed in two steps as described below.

#### Step 1: Back EMF Voltage Estimation

This method is used by Speed Search after short baseblock (e.g., a power loss where the drive's CPU kept running and the Run command was kept active). Here, the drive estimates the motor speed by analyzing the back EMF voltage. It outputs the estimated frequency and increases the voltage using the time constant set in parameter L2-04. After that, the motor is accelerated or decelerated to the frequency reference starting from the detected speed. If there is not enough residual voltage in the motor windings to perform the calculations described above, then the drive will automatically proceed to step 2.

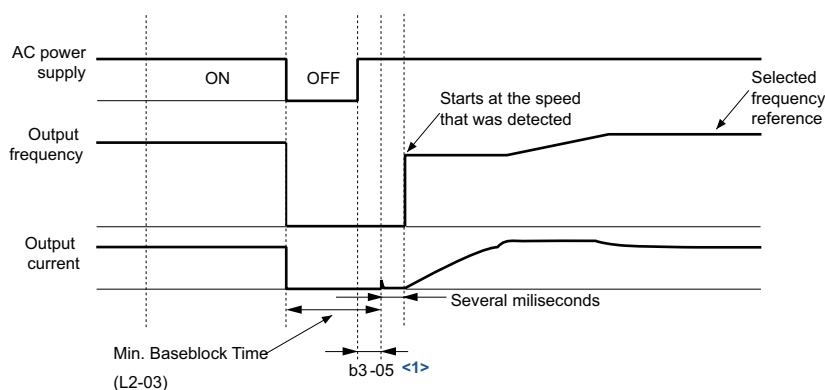


Figure 5.18 Speed Search after Baseblock

<1> Once AC power is restored, the drive will wait for at least the time set to b3-05. If the power interruption is longer than the minimum baseblock time set to L2-03, the drive will wait until the time set to b3-05 has passed after power is restored before starting Speed Search.

### Step 2: Current Injection

Current Injection is performed when there is not enough residual voltage remaining in the motor. This might occur after longer power losses, when Speed Search is applied with the Run command (b3-01 = 1), or if an External search command is used. It injects the DC current set in b3-06 to the motor and detects the speed by measuring the current feedback. The drive outputs the detected frequency and increases the voltage using the time constant set in parameter L2-04 while looking at the motor current. If the current is higher than the level in b3-02, then the output frequency is reduced. When the current falls below b3-02, the motor speed is assumed to be found and the drive starts to accelerate or decelerate to the frequency reference.

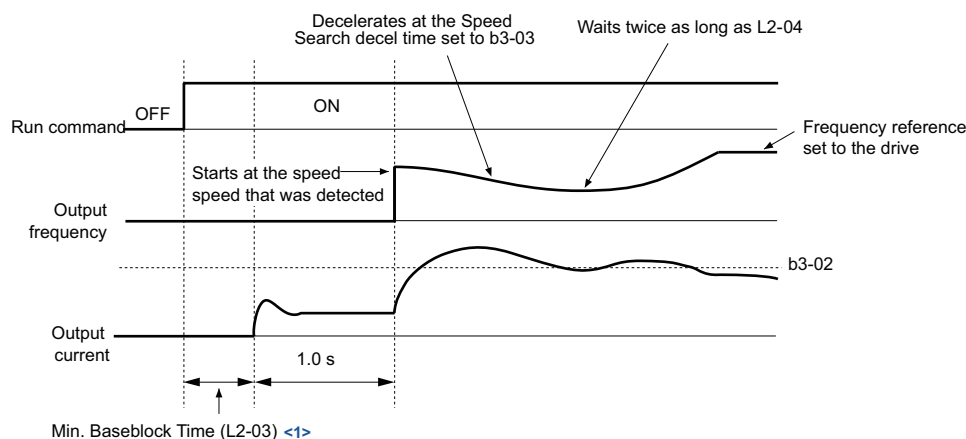


Figure 5.19 Speed Search at Start

<1> The wait time for Speed Search (b3-05) determines the lower limit.

### Notes on Using Speed Estimation Speed Search

- Rotational Auto-Tuning for V/f Control (T1-01 = 3) needs to be first performed if you plan to use Speed Estimation in V/f Control. Perform Stationary Auto-Tuning for Line-to-Line Resistance (T1-01 = 2) again if there is a change in the cable length between the drive and motor.
- Use Current Detection to search for speeds beyond 200 Hz, if the application is running multiple motors from the same drive, or if the motor is considerably smaller than the capacity of the drive.
- Speed Estimation may have trouble finding the actual speed if the motor cable is very long. Current Detection should be used in such situations.
- Use Current Detection instead of Speed Estimation when operating motors smaller than 1.5 kW. Speed Estimation can end up stopping smaller motors, as it might not be able to detect the speed or rotation direction of such small motors.
- Short Circuit Braking is recommended instead of Speed Search when using OLV/PM and AOLV/PM along with a fairly long motor cable.
- Use Short Circuit Braking instead of Speed Search if attempting to find the speed of a motor coasting faster than 200 Hz in OLV/PM and AOLV/PM.

### ? Residual Voltage Detection Speed Search

This method detects the motor speed and rotation direction by measuring the residual voltage from the rotating motor.

## 5.2 b: Application

### ? Activating of Speed Search

Speed Search can be activated as described below. Note that the Speed Search type must be selected in parameter b3-24 independent of the activation method.

1. Automatically activate Speed Search with every Run command. Here, external Speed Search commands are ignored.
2. Activate Speed Search using the digital input terminals.

The following input functions for H1-□□ can be used.

**Table 5.7 Speed Search Activation by Digital Inputs**

Setting	Description	b3-24 = 0	b3-24 = 1
	External Search Command 1	Closed: Activate Current Detection Speed Search from the maximum output frequency (E1-04).	Activate Speed Estimation Speed Search
62	External Search Command 2	Closed: Activate Current Detection Speed Search from the frequency reference.	

To activate Speed Search by a digital input, the input must always be set together with the Run command, or the Run command must be entered after the Speed Search command is given.

3. After automatic fault restart

When the number of maximum fault restarts in parameter L5-01 is set higher than 0, the drive will automatically perform Speed Search as specified by b3-24 following a fault.

4. After momentary power loss

This mode requires that the Power Loss Ride-Thru function be enabled always or at least enabled during CPU operation (L2-01 = 1 or 2). See [Refer to L2-01: Momentary Power Loss Operation Selection on page 229](#)

5. After external baseblock is released

The drive will resume the operation starting with Speed Search if the Run command is present and the output frequency is above the minimum frequency when the Baseblock command is released.

### ? b3-01: Speed Search Selection at Start

Determines if Speed Search is automatically performed when a Run command is issued or not.

No.	Parameter Name	Setting Range	Default
b3-01	Speed Search Selection at Start	0 or 1	Determined by A1-02

#### Setting 0: Disabled

When the Run command is entered, the drive starts operating at the minimum output frequency. If external Speed Search 1 or 2 is already enabled by a digital input, the drive will start operating with Speed Search.

#### Setting 1: Enabled

Speed Search is performed whenever the Run command is entered. The drive begins running the motor once Speed Search is complete.

### ? b3-02: Speed Search Deactivation Current

Sets the operating current for Speed Search as a percentage of the drive rated current. Normally there is no need to change this setting. If the drive has trouble restarting, try lowering this value.

No.	Name	Setting Range	Default
b3-02	Speed Search Deactivation Current	0 to 200%	Determined by A1-02

**Note:** When parameter A1-02 = 0 (V/f Control) the factory default setting is 120. When parameter A1-02 = 2 (Open Loop Vector) the factory default setting is 100.

### ? b3-03: Speed Search Deceleration Time

Parameter b3-03 sets the output frequency reduction ramp used by Current Detection Speed Search (b3-24 = 0) and by the Current Injection Method of Speed Estimation (b3-24 = 1). The time entered into b3-03 will be the time to decelerate from maximum frequency (E1-04) to minimum frequency (E1-09).

No.	Name	Setting Range	Default
b3-03	Speed Search Deceleration Time	0.1 to 10.0 s	2.0 s

### ? b3-04: V/f Gain During Speed Search

During Speed Search, the output voltage calculated from the V/f pattern is multiplied with the value set in parameter b3-04. Changing this setting can be useful in order to reduce the output current during Speed Search.

No.	Name	Setting Range	Default
b3-04	V/f Gain During Speed Search	10 to 100%	Determined by o2-04, C6-01

### ? b3-05: Speed Search Delay Time

In cases where an output contactor is used between the drive and the motor, the contactor must be closed before Speed Search can be performed. This parameter can be used to delay the Speed Search operation, giving the contactor enough time to close completely.

No.	Name	Setting Range	Default
b3-05	Speed Search Delay Time	0.0 to 100.0 s	0.2 s

### ? b3-06: Output Current 1 During Speed Search

Sets the current injected to the motor at the beginning of Speed Estimation Speed Search as a factor of the motor rated current set in E2-01 (E4-01 for motor 2). If the motor speed is relatively slow when the drive starts to perform Speed Search after a long period of baseblock, it may be helpful to increase the setting value. The output current during Speed Search is automatically limited by the drive rated current.

No.	Name	Setting Range	Default
b3-06	Output Current 1 during Speed Search	0.0 to 2.0	Determined by o2-04

**Note:** If Speed Estimation is not working correctly even after adjusting b3-06, try using Current Detection Speed Search instead.

### ? b3-10: Speed Search Detection Compensation Gain

This parameter sets the gain for the detected motor speed of the Speed Estimation Speed Search. The setting should be increased only if an overvoltage fault occurs when the drive restarts the motor.

No.	Name	Setting Range	Default
b3-10	Speed Search Detection Compensation Gain	1.00 to 1.20	1.05

### ? b3-14: Bi-Directional Speed Search Selection

Sets how the drive determines the motor rotation direction when performing Speed Estimation Speed Search.

No.	Parameter Name	Setting Range	Default
b3-14	Bi-Directional Speed Search Selection	0 or 1	Determined by A1-02

#### Setting 0: Disabled

The drive uses the frequency reference to determine the direction of motor rotation in order to restart the motor.

#### Setting 1: Enabled

The drive detects the motor rotation direction in order to restart the motor.

## 5.2 b: Application

### ? b3-17: Speed Search Restart Current Level

A large current can flow into the drive if there is a fairly large difference between the estimated frequency and the actual motor speed when performing Speed Estimation. This parameter sets the current level at which Speed Estimation is restarted, thus avoiding overcurrent and overvoltage problems. Set as a percentage of the drive rated current.

No.	Name	Setting Range	Default
b3-17	Speed Search Restart Current Level	0 to 200%	150%

### ? b3-18: Speed Search Restart Detection Time

Sets the time that the current must be greater than the level set in b3-17 before Speed Search can be restarted.

No.	Name	Setting Range	Default
b3-18	Speed Search Restart Detection Time	0.00 to 1.00 s	0.10 s

### ? b3-19: Number of Speed Search Restarts

Sets the number of times the drive should attempt to find the speed and restart the motor. If the number of restart attempts exceeds the value set to b3-19, the SEr fault will occur and the drive will stop.

No.	Name	Setting Range	Default
b3-19	Number of Speed Search Restarts	0 to 10	3

### ? b3-24: Speed Search Method Selection

Sets the Speed Search method used.

No.	Parameter Name	Setting Range	Default
b3-24	Speed Search Method Selection	0, 1, 3	0

#### Setting 0: Current Detection Speed Search

Speed Search begins by calculating the speed of the motor, then accelerates from the estimated speed to the speed reference. This method of Speed Search is also capable of detecting motor direction.

#### Setting 1: Speed Estimation Speed Search

Speed Search begins looking for the motor speed from either the frequency reference at the time of power loss, or from the maximum frequency reference. Here, the drive detects the speed using the current level while Speed Search is executed.

#### Setting 3: Synchronous Operation (V/f)

Speed Search detects the motor speed by measuring the residual voltage from the rotating motor and then accelerates or decelerates back to frequency reference. This method of Speed Search is also capable of detecting motor direction.

**Note:** For explanations of the Speed Search methods, see [Refer to Current Detection Speed Search \(b3-24 = 0\) on page 129](#) and [Refer to Speed Estimation Type Speed Search \(b3-24 = 1\) on page 130](#).

### ? b3-25: Speed Search Wait Time

Sets the wait time between Speed Search restarts. Increase the wait time if problems occur with overcurrent, overvoltage, or if the SEr fault occurs.

No.	Name	Setting Range	Default
b3-25	Speed Search Wait Time	0.0 to 30.0 s	0.5 s

### ? b3-27: Start Speed Search Select

Selects a condition to activate Speed Search Selection at Start (b3-01) or External Speed Search Command 1 or 2 from the multi-function input.

No.	Name	Setting Range	Default
b3-27	Start Speed Search Select	0 or 1	1

0: Triggered when a Run command is issued (normal).

1: Triggered when an external baseblock is released.

### ? b4: Delay Timers

The timer function is independent of drive operation and can be used to delay the switching of a digital output triggered by a digital input signal. An on-delay and off-delay can be separately set. The delay timer can help to get rid of chattering switch noise from sensors.

To enable the timer function, a multi-function input must be set to “Timer input” (H1-□□ = 18) and a multi-function output must be set to “Timer output” (H2-□□ = 12). One timer can be used only.

### ? b4-01, b4-02: Timer Function On-Delay, Off-Delay Time

b4-01 sets the on-delay time for switching the timer output. b4-02 sets the off-delay time for switching the timer output.

No.	Name	Setting Range	Default
b4-01	Timer Function On-Delay Time	0.0 to 3000.0 s	0.0 s
b4-02	Timer Function Off-Delay Time	0.0 to 3000.0 s	0.0 s

### ? Timer Function Operation

When the timer function input closes for longer than the value set in b4-01, the timer output switches on. When the timer function input is open for longer than the value set in b4-02, the timer output function switches off. The following diagram demonstrates the timer function operation.

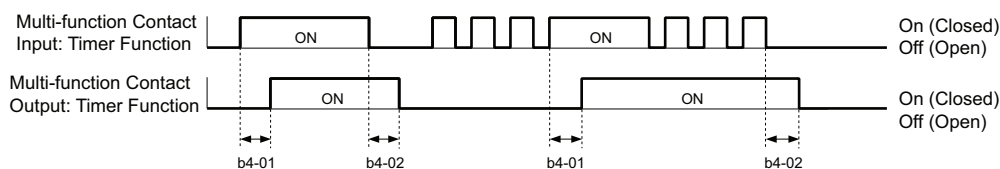


Figure 5.20 Timer Operation

### ? b5: PID Control

The drive has a built in PID (Proportional + Integral + Derivative) controller that can be used for closed loop control of system variables such as pressure, temperature, and so on. The difference between the target and the feedback value (deviation) is fed into the PID controller. The PID controller adjusts the drive output frequency in order to minimize the deviation, providing accurate control of system variables.

#### ? P Control

The output of P control is the product of the deviation and the P gain so that it follows the deviation directly and linearly. With P control, only an offset between the target and feedback remains.

#### ? I Control

The output of I control is the integral of the deviation. It minimizes the offset between target and feedback value that typically remains when pure P control is used. The integral time (I time) constant determines how fast the offset is eliminated.

### ? D Control

D control predicts the deviation signal by multiplying its derivative (slope of the deviation) with a time constant, then adds this value to the PID input. This way the D portion of a PID controller provides a braking action to the controller response and can reduce the tendency to oscillate and overshoot.

Be aware that D control tends to amplify noise on the deviation signal, which can result in control instability. D control should therefore only be used when necessary.

### ? PID Operation

To better demonstrate how PID works, the diagram below shows how the PID output changes when the PID input (deviation) jumps from 0 to a constant level.

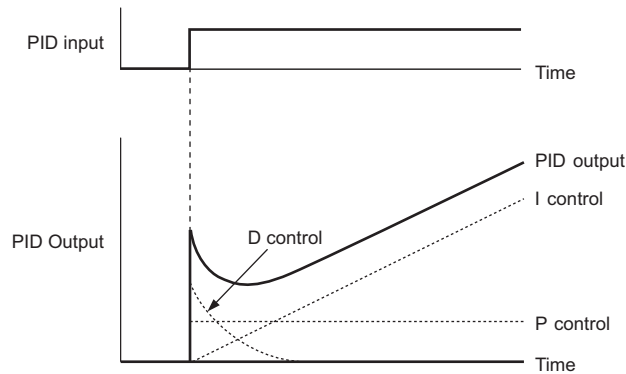


Figure 5.21 PID Operation

### ? Using PID Control

Applications for PID control are listed in the table below.

Application	Description	Sensors Used
Speed Control	Machinery speed is fed back and adjusted to meet the target value. Synchronous control is performed using speed data from other machinery as the target value	Tachometer
Pressure	Maintains constant pressure using pressure feedback.	Pressure sensor
Fluid Control	Keeps flow at a constant level by feeding back flow data.	Flow rate sensor
Temperature Control	Maintains a constant temperature by controlling a fan with a thermostat.	Thermocoupler, Thermistor

### ? PID Setpoint Input Methods

The PID setpoint input depends on the PID function setting in parameter b5-01.

If parameter b5-01 is set to 1 or 2, the frequency reference in b1-01 (or b1-15) or one of the inputs listed in [Table 5.8](#) becomes the PID setpoint.

If b5-01 is set to 3 or 4, then the PID setpoint can be input from one of the sources listed in [Table 5.8](#).

Table 5.8 PID Setpoint Sources

PID Setpoint Source	Settings
	Set H3-02 = C
	Set H3-10 = C
	Set H3-06 = C
	Set bit 1 in register 000FH to 1 and input the setpoint to register 0006H
	Set H6-01 = 2
	Set parameter b5-18 = 1 and input the PID setpoint to b5-19

**Note:** A duplicate allocation of the PID setpoint input will result in an oPE alarm.

## ? PID Feedback Input Methods

Either one feedback signal can be input for normal PID control, or two feedback signals can be input for controlling a differential process value.

### Normal PID Feedback

The PID feedback signal can be input from one of the sources listed below.

**Table 5.9 PID Feedback Sources**

PID Feedback Source	Settings
	Set H3-02 = B
	Set H3-10 = B
	Set H3-06 = B
	Set H6-01 = 1

**Note:** A duplicate allocation of the PID feedback input will result in an oPE alarm.

### Differential Feedback

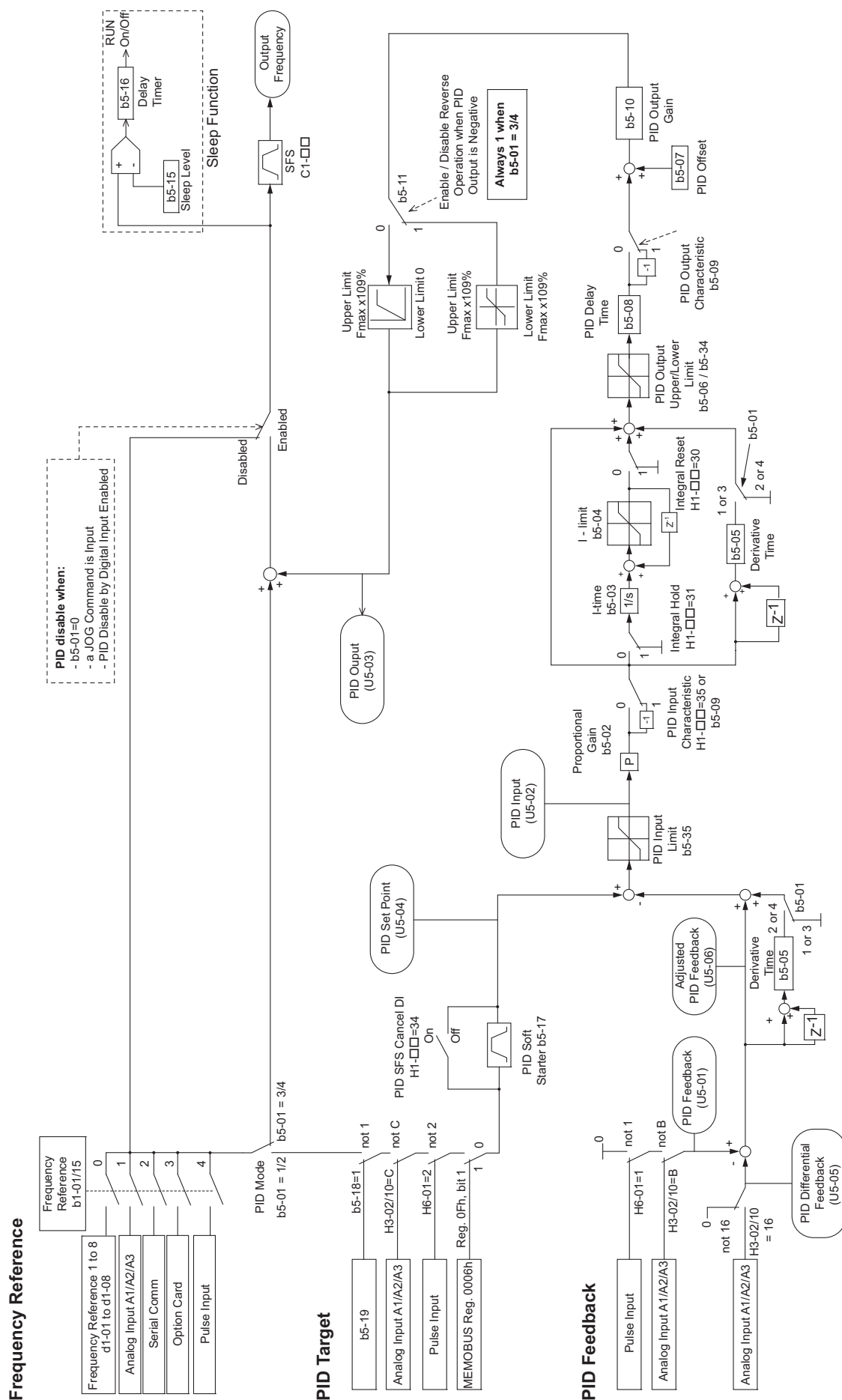
The second PID feedback signal for differential feedback can come from the sources listed below. The differential feedback function is automatically enabled when a differential feedback input is assigned.

**Table 5.10 PID Differential Feedback Sources**

PID Differential Feedback Source	Settings
	Set H3-02 = 16
	Set H3-10 = 16
	Set H3-06 = 16

**Note:** A duplicate allocation of the PID differential feedback input will result in an oPE alarm.

## ? PID Block Diagram



**Figure 5.22 PID Block Diagram**

### ? b5-01: PID Function Setting

Enables or disables the PID operation and selects the PID operation mode.

No.	Parameter Name	Setting Range	Default
b5-01	PID Function Setting	0 to 4	0

**Setting 0: PID disabled**

**Setting 1: Output frequency = PID output 1**

The PID controller is enabled and the PID output builds the frequency reference. Uses D control for the difference between the feedback and setpoint (displayed in monitor U5-02).

**Setting 2: Output frequency = PID output 2**

The PID controller is enabled and the PID output builds the frequency reference. D control is used on the feedback signal (displayed in monitor U5-06).

**Setting 3: Output frequency = frequency reference + PID output 1**

The PID controller is enabled and the PID output is added to the frequency reference. The PID input is D controlled.

**Setting 4: Output frequency = frequency reference + PID output 2**

The PID controller is enabled and the PID output is added to the frequency reference. The PID feedback is D controlled.

### ? b5-02: Proportional Gain Setting (P)

Sets the P gain that is applied to the PID input. A large value will tend to reduce the error, but may cause instability (oscillations) if set too high. A low value may allow too much offset between the setpoint and feedback.

No.	Name	Setting Range	Default
b5-02	Proportional Gain Setting (P)	0.00 to 25.00	1.00

### ? b5-03: Integral Time Setting (I)

Sets the time constant that is used to calculate the integral of the PID input. The smaller the integral time set to b5-03, the faster the offset will be eliminated. If set too short, it can cause overshoot or oscillation. To turn off the integral time, set b5-03 = 0.00.

No.	Name	Setting Range	Default
b5-03	Integral Time Setting (I)	0.0 to 360.0 s	1.0 s

### ? b5-04: Integral Limit Setting

Sets the maximum output possible from the integral block. Set as a percentage of the maximum frequency (E1-04).

No.	Name	Setting Range	Default
b5-04	Integral Limit Setting	0.0 to 100.0%	100.0%

**Note:** On some applications, especially those with rapidly varying loads, the output of the PID function may show a fair amount of oscillation. To suppress this oscillation, a limit can be applied to the integral output by programming b5-04.

### ? b5-05: Derivative Time (D)

Sets the time the drive predicts the PID input/PID feedback signal based on the derivative of the PID input/PID feedback. Longer time settings will improve the response but can cause vibrations. Shorter settings will reduce the overshoot but also reduce the controller responsiveness. D control is disabled by setting b5-05 to zero seconds.

No.	Name	Setting Range	Default
b5-05	Derivative Time (D)	0.00 to 10.00 s	0.00 s

## 5.2 b: Application

### ? b5-06: PID Output Limit

Sets the maximum output possible from the entire PID controller. Set as a percentage of the maximum frequency (E1-04).

No.	Name	Setting Range	Default
b5-06	PID Output Limit	0.0 to 100.0%	100.0%

### ? b5-07: PID Offset Adjustment

Sets the offset added to the PID controller output. Set as a percentage of the maximum frequency.

No.	Name	Setting Range	Default
b5-07	PID Offset Adjustment	-100.0 to 100.0%	0.0%

### ? b5-08: PID Primary Delay Time Constant

Sets the time constant for the filter applied to the output of the PID controller. Normally, change is not required.

No.	Name	Setting Range	Default
b5-08	PID Primary Delay Time Constant	0.00 to 10.00 s	0.00 s

**Note:** Useful when there is a fair amount of oscillation or when rigidity is low. Set to a value larger than the cycle of the resonant frequency. Increasing this time constant may reduce the responsiveness of the drive.

### ? b5-09: PID Output Level Selection

Normally a positive PID input (feedback smaller than setpoint) leads to positive PID output. Parameter b5-09 can be used to reverse the sign of the PID controller output signal.

No.	Parameter Name	Setting Range	Default
b5-09	PID Output Level Selection	0 or 1	0

#### Setting 0: Normal Output

A positive PID input causes an increase in the PID output (direct acting).

#### Setting 1: Reverse Output

A positive PID input causes a decrease in the PID output (reverse acting).

### ? b5-10: PID Output Gain Setting

Applies a gain to the PID output and can be helpful when the PID function is used to trim the frequency reference (b5-01 = 3 or 4).

No.	Name	Setting Range	Default
b5-10	PID Output Gain Setting	0.00 to 25.00	1.00

### ? b5-11: PID Output Reverse Selection

Determines whether a negative PID output reverses the direction of drive operation or not. When the PID function is used to trim the frequency reference (b5-01 = 3 or 4), this parameter has no effect and the PID output will not be limited (same as b5-11 = 1).

No.	Parameter Name	Setting Range	Default
b5-11	PID Output Reverse Selection	0 or 1	0

#### Setting 0: Reverse Disabled

Negative PID output will be limited to 0 and the drive output will be stopped.

#### Setting 1: Reverse Enabled

Negative PID output will cause the drive to run in the opposite direction.

## ? PID Feedback Loss Detection

The PID feedback loss detection function can detect broken sensors or broken sensor wiring. It should be used whenever PID control is enabled to prevent critical machine conditions (e.g., acceleration to max. frequency) caused by a feedback loss.

Feedback loss can be detected in two ways:

- **Feedback Low Detection**

Detected when the feedback falls below a certain level for longer than the specified time. This function is set up using parameters b5-12 to b5-14.

- **Feedback High Detection**

Detected when the feedback rises beyond a certain level for longer than the specified time. This function is set up using parameters b5-12, b5-36, and b5-37.

The following figure explains the working principle of feedback loss detection when the feedback signal is too low. Feedback high detection works in the same way.

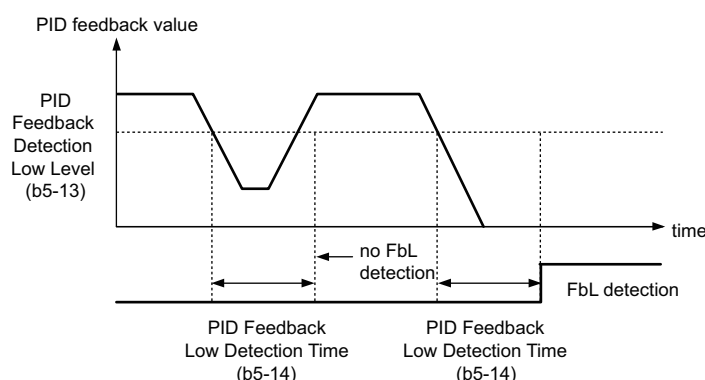


Figure 5.23 PID Feedback Loss Detection

## ? b5-12: PID Feedback Loss Detection Selection

Enables or disables the feedback loss detection and sets the operation when a feedback loss is detected.

No.	Parameter Name	Setting Range	Default
b5-12	PID Feedback Loss Detection Selection	0 to 5	0

### Setting 0: Digital Output Only

A digital output set for “PID feedback low” (H2-□□ = 3E) will be triggered if the PID feedback value is below the detection level set to b5-13 for the time set to b5-14 or longer. A digital output set for “PID feedback high” (H2-□□ = 3F) will be triggered if the PID feedback value is beyond the detection level set to b5-36 for longer than the times set to b5-37. Neither a fault nor an alarm is displayed on the digital operator. The drive will continue operation. When the feedback value leaves the loss detection range, the output is reset.

### Setting 1: Feedback Loss Alarm

If the PID feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FBL - Feedback Low” alarm will be displayed and a digital output set for “PID feedback low” (H2-□□ = 3E) will be triggered. If the PID feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FBH - Feedback High” alarm will be displayed and a digital output set for “PID feedback high” (H2-□□ = 3F) will be triggered. Both events trigger an alarm output (H1-□□ = 10). The drive will continue operation. When the feedback value leaves the loss detection range, the alarm and outputs are reset.

### Setting 2: Feedback Loss Fault

If the PID feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FbL - Feedback Low” fault will be displayed. If the PID feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FbH - Feedback High” fault will be displayed. Both events trigger a fault output (H1-□□ = E) and cause the drive to stop the motor.

## 5.2 b: Application

### Setting 3: Digital output only, even if PID is disabled by digital input

Same as b5-12 = 0. Detection is still active even if PID is disabled by a digital input (H1-□□ = 19).

### Setting 4: Feedback loss alarm, even if PID is disabled by digital input

Same as b5-12 = 1. Detection is still active even if PID is disabled by a digital input (H1-□□ = 19).

### Setting 5: Feedback loss fault, even if PID is disabled by digital input

Same as b5-12 = 2. Detection is still active even if PID is disabled by a digital input (H1-□□ = 19).

#### ? b5-13: PID Feedback Low Detection Level

Sets the feedback level used for PID feedback low detection. The PID feedback has to fall below this level for longer than the time b5-14 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-13	PID Feedback Low Detection Level	0 to 100%	0%

#### ? b5-14: PID Feedback Low Detection Time

Sets the time that the PID feedback has to fall below b5-13 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-14	PID Feedback Low Detection Time	0.0 to 25.5 s	1.0 s

#### ? b5-36: PID Feedback High Detection Level

Sets the feedback level used for PID feedback high detection. The PID feedback has to exceed this level for longer than the time b5-37 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-36	PID Feedback High Detection Level	0 to 100%	100%

#### ? b5-37: PID Feedback High Detection Time

Sets the time for that the PID feedback has to exceed b5-36 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-37	PID Feedback High Detection Time	0.0 to 25.5 s	1.0 s

#### ? PID Sleep

The PID Sleep function stops the drive when the PID output or the frequency reference falls below the PID Sleep operation level for a certain time. The drive will resume operating once the PID output or frequency reference rises above the PID Sleep operation level for the specified time. An example of PID Sleep operation appears in the figure below.

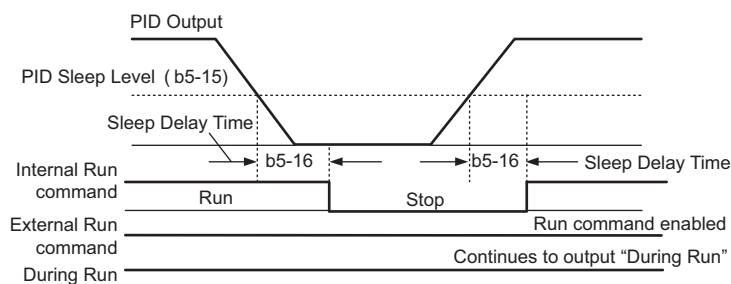


Figure 5.24 PID Sleep Operation

#### Notes on using the PID Sleep function

- The PID Sleep function is always active, even if PID control is disabled.
- The PID Sleep function stops the motor according to the stopping method in b1-03.

The parameters necessary that control the PID Sleep function are explained below.

### ? b5-15: PID Sleep Function Start Level

Sets the level that triggers PID Sleep.

The drive goes into Sleep mode if the PID output or frequency reference is smaller than b5-15 for longer than the time set in b5-16. It resumes the operation when the PID output or frequency reference is above b5-15 for longer than the time set in b5-16.

No.	Name	Setting Range	Default
b5-15	PID Sleep Function Start Level	0.0 to 400.0 Hz <I>	0.0 Hz <I>

<I> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (0.0 to 100.0%) instead of in Hz. The default setting is 0.0%.

### ? b5-16: PID Sleep Delay Time

Sets the delay time to activate or deactivate the PID Sleep function.

No.	Name	Setting Range	Default
b5-16	PID Sleep Delay Time	0.0 to 25.5 s	0.0 s

### ? b5-17: PID Accel/Decel Time

The PID acceleration/deceleration time is applied on the PID setpoint value.

As the normal acceleration times C1-□□ are applied after the PID output, they reduce the responsiveness of the system and can cause hunting or overshoot and undershoot when the setpoint changes quickly. Using the PID acceleration/deceleration time instead helps to avoid such problems.

The PID acceleration/deceleration time can be canceled using a digital input programmed for “PID SFS cancel” (H1-□□ = 34).

No.	Name	Setting Range	Default
b5-17	PID Accel/Decel Time	0.0 to 6000.0 s	0.0 s

### ? b5-18: PID Setpoint Selection

Enables or disables parameter b5-19 for PID setpoint.

No.	Parameter Name	Setting Range	Default
b5-18	PID Setpoint Selection	0 or 1	0

#### Setting 0: Disabled

Parameter b5-19 is not used as the PID setpoint.

#### Setting 1: Enabled

Parameter b5-19 is used as PID setpoint.

### ? b5-19: PID Setpoint Value

Used as the PID setpoint if parameter b5-18 = 1.

No.	Name	Setting Range	Default
b5-19	PID Setpoint Value	0.00 to 100.00%	0.00%

## 5.2 b: Application

### ? b5-20: PID Setpoint Scaling

Determines the units that the PID setpoint (b5-19) is set in and displayed. Also determines the units for monitors U5-01 and U5-04.

No.	Parameter Name	Setting Range	Default
b5-20	PID Setpoint Scaling	0 to 3	1

#### Setting 0: 0.01 Hz units

The setpoint and PID monitors are displayed in Hz with a resolution of 0.01 Hz.

#### Setting 1: 0.01% units (100% = max. output frequency)

The setpoint and PID monitors are displayed as a percentage with a resolution of 0.01%.

#### Setting 2: r/min units (set the no. of motor poles)

The setpoint and PID monitors are displayed in r/min with a resolution of 1 r/min.

#### Setting 3: User-set units (use b5-38, b5-39)

Parameters b5-38 and b5-39 determine the units and resolution used to display the values the setpoint in b5-19, and PID monitors U1-01 and U1-04.

### ? b5-34: PID Output Lower Limit

Sets the minimum possible PID controller output as a percentage of the maximum output frequency (E1-04). The lower limit is disabled when set to 0.00%

No.	Name	Setting Range	Default
b5-34	PID Output Lower Limit	-100.0 to 100.0%	0.00%

### ? b5-35: PID Input Limit

Sets the maximum allowed PID input as a percentage of the maximum output frequency (E1-04). Parameter b5-35 acts as a bipolar limit.

No.	Name	Setting Range	Default
b5-35	PID Input Limit	0 to 1000.0%	1000.0%

### ? b5-38, b5-39: PID Setpoint User Display, PID Setpoint Display Digits

When parameter b5-20 is set to 3, the parameters b5-38 and b5-39 can be used to set a user defined display for the PID setpoint (b5-19) and PID feedback monitors (U5-01, U5-04).

Parameter b5-38 determines the display value when the maximum frequency is output. Parameter b5-39 determines the number of digits. The setting value is equal to the number of decimal places.

No.	Name	Setting Range	Default
b5-38	PID Setpoint User Display	1 to 60000	Determined by b5-20
b5-39	PID Setpoint Display Digits	0 to 3	Determined by b5-20

### ? b5-40: Frequency Reference Monitor Content During PID

Sets the content of the frequency reference monitor display (U1-01) when PID control is active.

No.	Name	Setting Range	Default
b5-40	Frequency Reference Monitor Content During PID	0 or 1	0

#### Setting 0: Frequency Reference after PID

Monitor U1-01 displays the frequency reference increased or reduced for the PID output.

#### Setting 1: Frequency Reference

Monitor U1-01 displays the frequency reference value.

## ? Fine-Tuning PID

Once PID control parameters have been set, fine-tuning may be required. Follow the directions below.

**Table 5.11 PID Fine Tuning**

Goal	Tuning Procedure	Result
	<ul style="list-style-type: none"> <li>• Reduce the derivative time (b5-05)</li> <li>• increase the integral time (b5-03)</li> </ul>	
Quickly achieve stability, and some overshoot is permissible	<ul style="list-style-type: none"> <li>• Decrease the integral time (b5-03)</li> <li>• Increase the derivative time (b5-05)</li> </ul>	
Suppress long cycle oscillations (longer than the integral time setting)	<ul style="list-style-type: none"> <li>• Increase the integral time (b5-03)</li> </ul>	
Suppress short cycle oscillations	<ul style="list-style-type: none"> <li>• If oscillation cycle time is close to the derivative time, the derivative part is likely having too much influence. Reduce the derivative time (b5-05).</li> <li>• If the derivative time is set to 0.00 s and oscillations are still a problem, try reducing the proportional gain (b5-02) or try increasing the PID primary delay time (b5-08)</li> </ul>	

## ? b5-47: Reverse Operation Selection 2 by PID Output

Determines whether a negative PID output reverses the direction of drive operation. When the PID function is used to trim the frequency reference (b5-01 = 3 or 4), this parameter has no effect and the PID output will not be limited (same as b5-11 = 1).

No.	Name	Setting Range	Default
b5-47	Reverse Operation Selection 2 by PID Output	0, 1	1

### Setting 0: Reverse Disabled

Negative PID output will be limited to 0 and the drive output will be stopped.

### Setting 1: Reverse Enabled

Negative PID output will cause the drive to run in the opposite direction.

### ? b6: Dwell Function

The Dwell function is used to temporarily hold the frequency reference at a predefined value for a set time, then continue accelerating or decelerating.

If used with induction motors, the Dwell function can help prevent speed loss when starting and stopping a heavy load. If running a PM motor in V/f control, the pause in acceleration allows the PM motor rotor to align with the stator field of the motor, thus reducing the starting current.

The figure below shows how the Dwell function works.

**Note:** Using the Dwell function requires that the stopping method for the drive be set to “Ramp to stop” (b1-03 = 0).

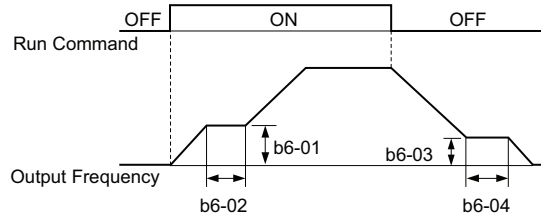


Figure 5.25 Dwell Function at Start and Stop

### ? b6-01, b6-02: Dwell Reference, Dwell Time at Start

b6-01 determines the frequency that is held or the time set in b6-02 during acceleration.

No.	Name	Setting Range	Default
b6-01	Dwell Reference at Start	0.0 to 400.0 Hz <I>	Determined by A1-02 <I>
b6-02	Dwell Time at Start	0.0 to 10.0 s	0.0 s

<I> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (0.0 to 100.0%) instead of in Hz. The default setting is 0.0%.

### ? b6-03, b6-04: Dwell Reference, Dwell Time at Stop

Parameter b6-03 determines the frequency that is held for the time set in b6-04 during deceleration.

No.	Name	Setting Range	Default
b6-03	Dwell Reference at Stop	0.0 to 400.0 Hz <I>	Determined by A1-02 <I>
b6-04	Dwell Time at Stop	0.0 to 10.0 s	0.0 s

<I> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (0.0 to 100.0%) instead of in Hz. The default setting is 0.0%.

### ? b8: Energy Saving

The Energy Saving feature improves overall system operating efficiency by operating the motor at its most efficient level.

- Note:**
1. Energy Saving is not designed for applications that experience instantaneous heavy loads or applications that rarely operate with light load conditions.
  2. As the performance of the Energy Saving function strongly depends on the accuracy of the motor data, always perform Auto-Tuning and make sure the motor data has been entered correctly before using this function.

### ? b8-01: Energy Saving Control Selection

Enables or disables the Energy Saving function.

No.	Parameter Name	Setting Range	Default
b8-01	Energy Saving Control Selection	0 or 1	Determined by A1-02

Setting 0: Disabled

Setting 1: Enabled

### ? b8-02: Energy Saving Gain (OLV, CLV)

Sets the gain level for Energy Saving. A higher value results in lower magnetization of the motor and thereby less energy consumption. However, if b8-02 is too high, the motor may stall.

No.	Name	Setting Range	Default
b8-02	Energy Saving Gain	0.0 to 10.0	Determined by A1-02

### ? b8-03: Energy Saving Control Filter Time Constant (OLV, CLV)

Parameter b8-03 sets the response time for Energy Saving. Although lowering this value allows for a quicker response, instability may result if it is too low.

No.	Name	Setting Range	Default
b8-03	Energy Saving Control Filter Time Constant	0.00 to 10.00 s	Determined by A1-02 and o2-04

### ? b8-04: Energy Saving Coefficient Value (V/f, V/f w/PG)

Parameter b8-04 is used to fine-tune Energy Saving control. The default setting depends on the capacity of the drive. Adjust this setting while viewing the output power monitor (U1-08) and running the drive with a light load.

A low setting results in less output voltage and less energy consumption, but too small a value will cause the motor to stall.

No.	Name	Setting Range	Default
b8-04	Energy Saving Coefficient Value	0.00 to 655.00	Determined by C6-01, E2-11, and o2-04

**Note:** This default value changes if the motor rated capacity set to E2-11 is changed. The Energy Saving coefficient is set automatically when Auto-Tuning for Energy Saving is performed (*Refer to Auto-Tuning on page 95*).

### ? b8-05: Power Detection Filter Time (V/f, V/f w/PG)

The Energy Saving function continuously searches out the lowest output voltage in order to achieve minimum output power. Parameter b8-05 determines how often the output power is measured in ms.

Reducing this setting will increase the response time. If the filter time is too short, the motor may become unstable with a lighter load.

No.	Name	Setting Range	Default
b8-05	Power Detection Filter Time	0 to 2000 ms	20 ms

### ? b8-06: Search Operation Voltage Limit (V/f, V/f w/PG)

Sets the voltage limit for the optimal output voltage detection of Speed Search as a percentage of the motor rated voltage. During the search operation, the drive will keep the output voltage above this level to prevent motor stalling.

**Note:** If set too low, the motor may stall with a sudden increase to the load. Disabled when b8-06 = 0. Setting this value to 0 does not disable Energy Saving.

No.	Name	Setting Range	Default
b8-06	Search Operation Voltage Limit	0 to 100%	0%

### ? b8-16: Energy Saving Parameter (Ki) for PM Motors

Coefficient to adjust torque linearity.

Set to the Ki value specified on the motor nameplate.

When E5-01 (Motor Code Selection) is set to 1□□□ or 2□□□, the automatically calculated value will be set. When the value is set automatically, it cannot be changed.

No.	Name	Setting Range	Default
b8-16	Energy Saving Parameter (Ki) for PM Motors	0.00 to 2.00	1.00

## 5.2 b: Application

### ? b8-17: Energy Saving Parameter (Kt) for PM Motors

Coefficient to adjust torque linearity.

Set to the Kt value on the motor nameplate.

When E5-01 (Motor Code Selection) is set to 1□□□ or 2□□□, the automatically calculated value will be set. When the value is set automatically, it cannot be changed.

No.	Name	Setting Range	Default
b8-17	Energy Saving Parameter (Kt) for PM Motors	0.00 to 2.00	1.00

### ? b9: Zero Servo

The Zero Servo function is a position loop that can be used in CLV and CLV/PM control modes to lock the motor at a certain position.

It must be activated using a digital input set for H1-□□ = 72. The drive will decelerate when this input is closed. Once the motor speed falls below the level set in parameter b2-01, the drive goes into the Zero Servo mode and holds the current position. When the input assigned to trigger the Zero Servo function is released and the Run command is still present, the drive reaccelerates.

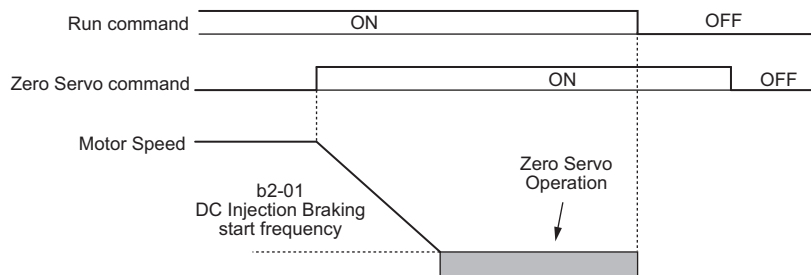


Figure 5.26 Zero Servo Operation

When Zero Servo is active, the deviation between the rotor position and the zero position is displayed in monitor U6-22 (monitor value must be divided by 4 to get the deviation in actual encoder pulses).

A digital output programmed for “Zero Servo complete” (H2-□□ = 72) is turned on when the rotor position is within the zero position, plus or minus the Zero Servo completion width set in parameter b9-02.

- Note:**
1. The Run command must remain on when using the Zero Servo function. If the Run command is switched off, then Zero Servo will no longer be able to hold the load in place.
  2. When the Zero Servo command has shut off, the Zero Servo Completion digital output width also shuts off.
  3. Avoid using Zero Servo to lock 100% load for long periods, as this can trigger a fault. If such loads need to be held in place for long periods, either make sure the current is less than 50% of the drive rated current during Zero Servo, or use a larger capacity drive.
  4. If the load rotates the motor when using CLV/PM, a dv4 fault may occur. To prevent this, either increase the Zero Servo gain (b9-01) or increase the number of pulses set to F1-19 that are required to trigger dv4.

### ? b9-01: Zero Servo Gain

Parameter b9-01 adjusts the responsiveness of the Zero Servo position loop. Increase the value if the response is too slow and the deviation from the zero position rises too high when load is applied. Decrease the value if vibrations occur during Zero Servo operation.

**Note:** Before adjusting the Zero Servo gain, make sure the ASR parameters (C5-□□) are set up properly and vibration or hunting does not occur when running with a zero speed reference.

No.	Name	Setting Range	Default
b9-01	Zero Servo Gain	0 to 100	5

**? b9-02: Zero Servo Completion Width**

Sets the output range of the Zero Servo completion signal. Enter the amount of allowable deviation from the desired position to trigger Zero Servo. An output terminal set for Zero Servo (H2-□□ = 33) will be triggered when the motor reaches the position Zero Servo position plus or minus b9-02.

No.	Name	Setting Range	Default
b9-02	Zero Servo Completion Width	0 to 16383	10

## 5.3 C: Tuning

C parameters are used to set the acceleration and deceleration characteristics, as well as S-curves. Other parameters in this group cover settings for slip compensation, torque compensation, and carrier frequency.

### ? C1: Acceleration and Deceleration Times

#### ? C1-01 to C1-08: Accel, Decel Times 1 to 4

Four different sets of acceleration and deceleration times can be set in the drive. They can be selected by digital inputs, by the motor selection, or can be switched automatically. Acceleration time parameters always set the time to accelerate from 0 Hz to the maximum output frequency (E1-04). Deceleration time parameters always set the time to decelerate from maximum output frequency to 0 Hz. C1-01 and C1-02 are the default active accel/decel settings.

No.	Parameter Name	Setting Range	Default
C1-01	Acceleration Time 1	0.0 to 6000.0 s <1>	10.0 s
C1-02	Deceleration Time 1		
C1-03	Acceleration Time 2		
C1-04	Deceleration Time 2		
C1-05	Acceleration Time 3 (Motor 2 Accel Time 1)		
C1-06	Deceleration Time 3 (Motor 2 Decel Time 1)		
C1-07	Acceleration Time 4 (Motor 2 Accel Time 2)		
C1-08	Deceleration Time 4 (Motor 2 Accel Time 2)		

<1> The setting range for the acceleration and deceleration times is determined by the accel/decel time setting units in C1-10. For example, if the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s.

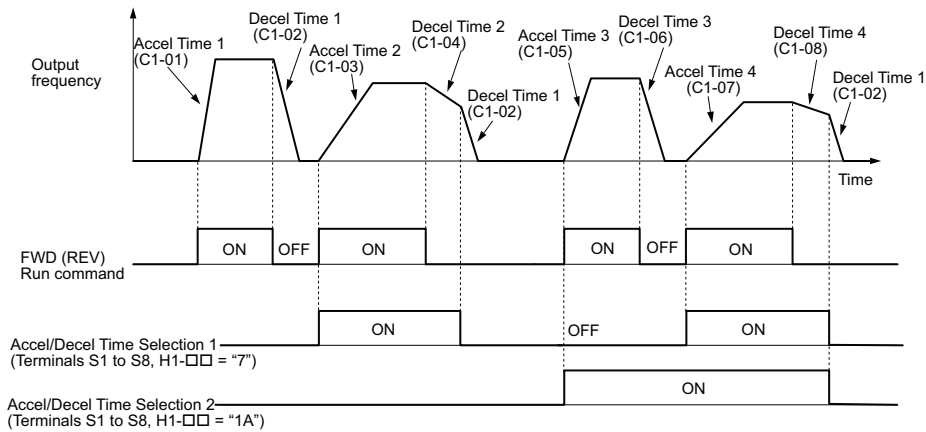
#### Switching Acceleration Times by Digital Input

Accel/decel times 1 are active by default if no input is set. The accel/decel times 2, 3, and 4 can be activated by digital inputs (H1-□□ = 7 and 1A) as explained in [Table 5.12](#).

**Table 5.12 Accel/Decel Time Selection by Digital Input**

Accel/Decel Time Sel. 1 H1-□□ = 7	Accel/Decel Time Sel. 2 H1-□□ = 1A	Active Times	
		Acceleration	Deceleration
	0	C1-01	C1-02
1	0	C1-03	C1-04
0	1	C1-05	C1-06
1	1	C1-07	C1-08

[Figure 5.27](#) shows an operation example for changing accel/decel. times. The example below requires that the stopping method be set for “Ramp to stop” (b1-03 = 0).



**Figure 5.27 Timing Diagram of Accel/Decel Time Change**

### Switching Acceleration and Deceleration Times by Motor Selection

When switching between motor 1 and 2 using a digital input (H1-□□ = 16), parameters C1-01 to C1-04 become accel/decel time 1 and 2 for motor 1, while C1-05 to C1-08 become accel/decel time 1 and 2 for motor 2. Accel/decel times 1 and 2 can be switched for each motor using a digital inputs set to H1-□□ = 7 like shown in [Table 5.13](#). It is not possible to switch between motors when using a PM motor.

**Note:** The digital input setting “Accel/Decel time 2 selection” (H1-□□ = 1A) cannot be used together with motor 1/2 switching. Trying to do so triggers an oPE03 error, indicating a contradictory multifunction input settings.

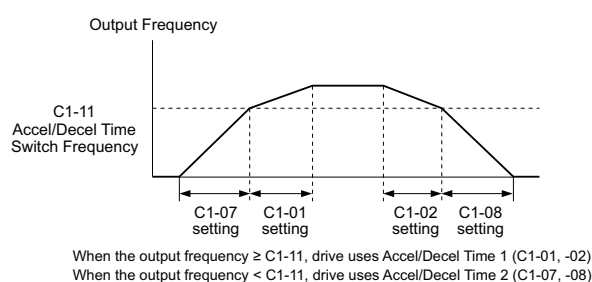
**Table 5.13 Motor Switching and Accel/Decel Time Combinations**

Accel/Decel Time 1 (H1-□□ = 7)	Motor 1 Selected (Terminal set to H1-□□ = 16 OFF)		Motor 2 Selected (Terminal set to H1-□□ = 16 ON)	
	Accel	Decel	Accel	Decel
Closed	C1-01	C1-02	C1-05	C1-06
	C1-03	C1-04	C1-07	C1-08

### Switching Accel/Decel Times by a Frequency Level

The drive can switch between different acceleration and deceleration times automatically. The drive will switch from accel/decel time 4 in C1-07 and C1-08 to the default accel/decel time in C1-01 and C1-02 (C1-05 and C1-06 for motor 2) when the output frequency exceeds the frequency level set in parameter C1-11. When it falls below this level, the accel/decel times are switched back. [Figure 5.28](#) shows an operation example.

**Note:** Acceleration and deceleration times selected by digital inputs have priority over the automatic switching by the frequency level set to C1-11. For example, if accel/decel time 2 is selected, the drive will use this time only and not switch from accel/decel time 4 to the selected one.



**Figure 5.28 Accel/Decel Time Switching Frequency**

### ? C1-11: Accel/Decel Time Switching Frequency

Sets the frequency at which the drive switches between accel/decel time settings. See [Refer to Switching Accel/Decel Times by a Frequency Level on page 151](#).

No.	Parameter Name	Setting Range	Default
C1-11	Accel/Decel Time Switching Frequency	0.0 to 400.0 Hz <I>	Determined by A1-02 <I>

<I> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (0.0 to 100.0%) instead of in Hz. The default setting is 0.0%.

**Note:** Setting C1-11 to 0.0 Hz disables this function.

### ? C1-09: Fast Stop Time

Parameter C1-09 will set a special deceleration that is used when certain faults occur or that can be operated by closing a digital input configured as H1-□□ = 15 (N.O. input) or 17 (N.C. input). The input does not have to be closed continuously, even a momentary closure will trigger the Fast Stop operation. Unlike standard deceleration, once the Fast Stop operation is initiated, the drive cannot be restarted until the deceleration is complete, the Fast Stop input is cleared, and the Run command is cycled.

A digital output programmed for “During Fast Stop” (H2-□□ = 4C) will be closed as long as Fast Stop is active.

A Fast Stop can be selected as the action the drive should take when certain faults occur, such as L8-03 (Overheat Pre-Alarm Operation Selection).

### 5.3 C: Tuning

No.	Parameter Name	Setting Range	Default
C1-09	Fast Stop Time	0.0 to 6000.0 s </>	10.0 s

<1> The setting range for the acceleration and deceleration times is determined by the accel/decel time setting units in C1-10. For example, if the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s

**NOTICE:** Rapid deceleration can trigger an overvoltage fault. When faulted, the drive output shuts off, and the motor coasts. To avoid this uncontrolled motor state and to ensure that the motor stops quickly and safely, set an appropriate Fast Stop time to C1-09.

#### ? C1-10: Accel/Decel Time Setting Units

Determines the units for the acceleration and deceleration times set to C1-01 through C1-09 using parameter C1-10.

No.	Parameter Name	Setting Range	Default
C1-10	Accel/Decel Time Setting Units	0 or 1	1

#### Setting 0: 0.01 s units

The accel/decel times are set in 0.01 s units. The setting range will be 0.00 to 600.00 s. If any of the parameters C1-01 to C1-09 is set to 600.1 seconds or more, then C1-10 cannot be set to 0.

#### Setting 1: 0.1 s units

The accel/decel times are set in 0.1 s units. The setting range will be 0.0 to 6000.0 s.

### ? C2: S-Curve Characteristics

Use S-curve characteristics to smooth acceleration and deceleration and to minimize abrupt shock to the load. Set S-curve characteristic time during acceleration/deceleration at start and acceleration/deceleration at stop. If the STo fault (Hunting Detection) occurs when starting a PM motor, try increasing the value set to C2-01.

#### ? C2-01 to C2-04: S-Curve Characteristics

C2-01 through C2-04 set separate S-curves for each section of the acceleration or deceleration.

No.	Parameter Name	Setting Range	Default
C2-01	S-Curve Characteristic at Accel Start	0.00 to 10.00 s	Determined by A1-02
C2-02	S-Curve Characteristic at Accel End		0.20 s
C2-03	S-Curve Characteristic at Decel Start		0.20 s
C2-04	S-Curve Characteristic at Decel End		0.00 s

Figure 5.29 explains how S-curves are applied.

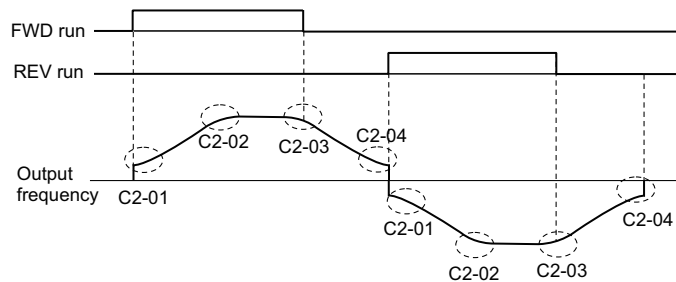


Figure 5.29 S-Curve Timing Diagram - FWD/REV Operation

Setting the S-curve will increase the acceleration and deceleration times.

$$\text{Actual accel time} = \text{accel time setting} + (C2-01 + C2-02) / 2$$

$$\text{Actual decel time} = \text{decel time setting} + (C2-03 + C2-04) / 2$$

### ? C3: Slip Compensation

The Slip Compensation function improves the speed accuracy of an induction motor. By adjusting the output frequency in accordance with the motor load, it compensates the slip and makes the motor speed equal to the frequency reference.

**Note:** Perform Auto-Tuning and make sure that the motor rated current (E2-01), the motor rated slip (E2-02), and the no-load current (E2-03) have all been set properly before making any adjustments to slip compensation parameters.

### ? C3-01: Slip Compensation Gain

This parameter sets the gain for the motor slip compensation function. Although this parameter rarely needs to be changed, adjustments might be needed under the following circumstances:

- If the motor at constant speed is slower than the frequency reference, increase C3-01.
- If the motor at constant speed is faster than the frequency reference, decrease C3-01.

No.	Parameter Name	Setting Range	Default
C3-01	Slip Compensation Gain	0.0 to 2.5	Determined by A1-02

**Note:** Default setting is 0.0 in V/f Control (A1-02 = 0), and 1.0 in Open Loop Vector Control (A1-02 = 2). In Closed Loop Vector Control, slip compensation is used correct inaccuracies that can result from temperature fluctuation in the rotor.

### ? C3-02: Slip Compensation Primary Delay Time

Adjusts the filter on the output side of the slip compensation function. Although this parameter rarely needs to be changed, adjustment may help in the following situations:

- Decrease the setting when the slip compensation response is too slow.
- Increase this setting when speed is unstable.

No.	Parameter Name	Setting Range	Default
C3-02	Slip Compensation Primary Delay Time	0 to 10000 ms	Determined by A1-02

**Note:** Default for V/f Control (A1-02 = 0) is 2000 ms. Default for Open Loop Vector Control (A1-02 = 2) is 200 ms.

### ? C3-03: Slip Compensation Limit

Sets the upper limit for the slip compensation function as a percentage of the motor rated slip (E2-02).

No.	Parameter Name	Setting Range	Default
C3-03	Slip Compensation Limit	0 to 250%	200%

The slip compensation limit is constant throughout the constant torque range (frequency reference  $\leq$  E1-06). In the constant power range (frequency reference  $>$  E1-06), it is increased based on C3-03 and the output frequency as shown in the following diagram.

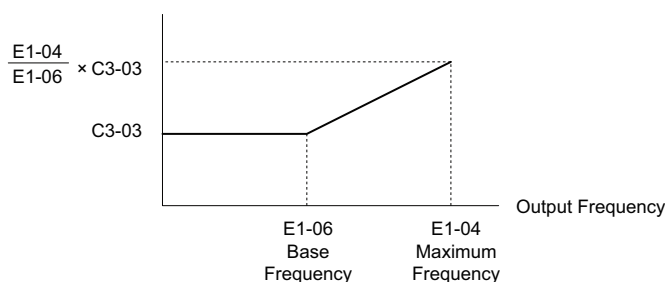


Figure 5.30 Slip Compensation Limit

### ? C3-04: Slip Compensation Selection during Regeneration

Enables or disables slip compensation during regenerative operation. When slip compensation during regeneration has been activated and a regenerative load is applied, it might be necessary to use a braking option (braking resistor, braking resistor unit, or braking unit).

Even if enabled, this function does not operate when the output frequency is too low.

No.	Parameter Name	Setting Range	Default
C3-04	Slip Compensation Selection during Regeneration	0 to 2	0

#### Setting 0: Disabled

Slip compensation is not provided. Depending on the load and mode of operation, the actual motor speed will be lower or higher than the frequency reference.

## 5.3 C: Tuning

### Setting 1: Enabled (6 Hz and above)

Slip compensation is enabled during regenerative operation. It will not be active at output frequencies below 6 Hz.

### Setting 2: Enabled (compensation provided wherever possible)

Slip compensation is enabled during regenerative operation, and at frequencies as low as 2 Hz. The drive uses the motor rated slip set in E2-02 to automatically calculate the frequency range where compensation will be disabled.

### ? C3-05: Output Voltage Limit Operation Selection

Determines if the motor flux reference is automatically reduced when output voltage reaches the saturation range.

If the input power supply voltage is low or the motor has a high voltage rating, this function can help improve the speed precision when moving heavy loads at high speeds. When this function is enabled, the reduction in flux causes a slightly higher current at high speed. Keep this in mind when selecting the drive.

No.	Parameter Name	Setting Range	Default
C3-05	Output Voltage Limit Operation Selection	0 or 1	0

### Setting 0: Disabled

### Setting 1: Enabled

### ? C3-21: Motor 2 Slip Compensation Gain

Used to improve speed accuracy for motor 2. Functions in the same way that C3-01 functions for motor 1.

Adjust this parameter only after the motor rated current (E4-01), motor rated slip (E4-02), and the motor no-load current (E4-03) have all been set.

Refer to [C3-01: Slip Compensation Gain on page 153](#) for details on adjusting this parameter.

No.	Parameter Name	Setting Range	Default
C3-21	Motor 2 Slip Compensation Gain	0.00 to 2.50	Determined by E3-01

**Note:** Default setting is 0.0 in V/f Control (E3-01 = 0). Default setting is 1.0 in Open Loop Vector Control (E3-01 = 2) and Closed Loop Vector Control (E3-01 = 3). In Closed Loop Vector Control, slip compensation gain acts as an adaptable gain.

### ? C3-22: Motor 2 Slip Compensation Primary Delay Time

Functions for motor 2 in the same way that C3-02 functions for motor 1.

Refer to [C3-02: Slip Compensation Primary Delay Time on page 153](#) for instructions on how to adjust this parameter.

No.	Parameter Name	Setting Range	Default
C3-22	Motor 2 Slip Compensation Primary Delay Time	0 to 10000 ms	Determined by E3-01

**Note:** The default for V/f Control (E3-01 = 0) is 2000 ms. The default for Open Loop Vector Control (E3-01 = 2) is 200 ms.

### ? C3-23: Motor 2 Slip Compensation Limit

Sets the upper limit for the slip compensation function as a percentage of the motor rated slip (E4-02).

No.	Parameter Name	Setting Range	Default
C3-23	Motor 2 Slip Compensation Limit	0 to 250%	200%

The slip compensation limit is constant throughout the constant torque range (frequency reference  $\leq$  E3-06). In the constant power range (frequency reference  $>$  E3-06), it is increased based on C3-23 and the output frequency as shown in [Figure 5.31](#).

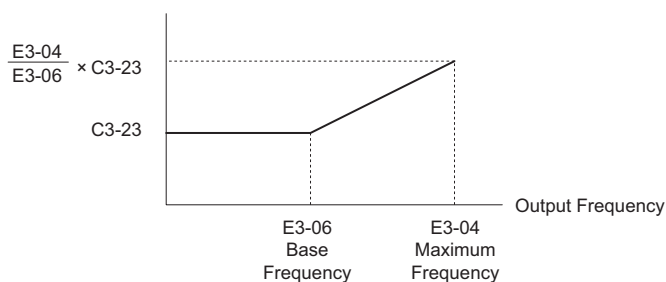


Figure 5.31 Slip Compensation Limit

### ? C3-24: Motor 2 Slip Compensation Selection during Regeneration

Functions for motor 2 in the same way that C3-04 functions for motor 1.

Refer to [C3-04: Slip Compensation Selection during Regeneration on page 153](#) for details on adjusting this parameter.

No.	Parameter Name	Setting Range	Default
C3-24	Motor 2 Slip Compensation Selection during Regeneration	0 to 2	0

**Setting 0: Disabled**

**Setting 1: Enabled (6 Hz and above)**

**Setting 2: Enabled (compensation provided wherever possible)**

### ? C4: Torque Compensation

The torque compensation function compensates for insufficient torque production at start-up or when a load is applied.

**Note:** Make sure the motor parameters and V/f pattern are set properly before setting torque compensation parameters.

### ? C4-01: Torque Compensation Gain

Sets the gain for the torque compensation function.

No.	Parameter Name	Setting Range	Default
C4-01	Torque Compensation Gain	0.00 to 2.50	Determined by A1-02

#### Torque Compensation in V/f, V/f w/PG, and OLV/PM:

The drive calculates the motor primary voltage loss using the output current and the termination resistor value (E2-05 for IM, E5-05 for PM motors) and then adjusts the output voltage to compensate insufficient torque at start or when load is applied. The effects of this voltage compensation can be increased or decreased using parameter C4-01.

#### Torque Compensation in OLV:

The drive controls the motor excitation current (d-axis current) and torque producing current (q-axis current) separately. Torque compensation affects the torque producing current only. C4-01 works as a factor of the torque reference value that builds the torque producing current reference.

#### Adjustment

Although this parameter rarely needs to be adjusted, changing the torque compensation gain in small steps of 0.05 may help in the following situations:

- Increase this setting when using a long motor cable.
- Decrease this setting when motor oscillation occurs.

Adjust C4-01 so that the output current does not exceed the drive rated current.

- Note:**
1. Refrain from adjusting torque compensation in Open Loop Vector Control, as it can have a negative effect on torque accuracy.
  2. Refrain from adjusting this parameter in OLV/PM. Too high a value can cause overcompensation, resulting in motor oscillation.

### ? C4-02: Torque Compensation Primary Delay Time

Sets the delay time used for applying torque compensation.

No.	Parameter Name	Setting Range	Default
C4-02	Torque Compensation Primary Delay Time	0 to 60000 ms	Determined by A1-02

#### Adjustment

Although C4-02 rarely needs to be changed, adjustments may help in the following situations:

- If the motor vibrates, increase C4-02.
- If the motor responds too slowly to changes in the load, decrease C4-02.

### ? C4-03: Torque Compensation at Forward Start (OLV)

Sets the amount of torque at start in the forward direction in order to improve motor performance during start with a heavy load. Compensation is applied using the time constant set in parameter C4-05. Enable this function when the load pulls the motor in reverse when starting with a Forward run command. Setting of 0.0% disables this feature.

No.	Parameter Name	Setting Range	Default
C4-03	Torque Compensation at Forward Start	0.0 to 200.0%	0.0%

### ? C4-04: Torque Compensation at Reverse Start (OLV)

Sets the amount of torque reference at start in the reverse direction in order to improve motor performance during start with heavy load. Compensation is applied using the time constant set in parameter C4-05. Enable this function if the load pulls the motor in the forward direction when starting with a Reverse run command. Setting of 0.0% disables this feature.

No.	Parameter Name	Setting Range	Default
C4-04	Torque Compensation at Reverse Start	-200.0 to 0.0%	0.0%

### ? C4-05: Torque Compensation Time Constant (OLV)

This parameter is the time constant for applying the torque compensation at start that is set to C4-03 and C4-04.

No.	Parameter Name	Setting Range	Default
C4-05	Torque Compensation Time Constant	0 to 200 ms	10 ms

### ? C4-06: Torque Compensation Primary Delay Time 2 (OLV)

This time constant is used during Speed Search or during regenerative operation. Adjust the value if an overvoltage fault occurs with sudden changes in the load or at the end of acceleration with high inertia load.

No.	Parameter Name	Setting Range	Default
C4-06	Torque Compensation Primary Delay Time 2	0 to 10000 ms	150 ms

**Note:** If C4-06 is set to a relatively large value, be sure to also increase the setting in n2-03 (AFR Time Constant 2) proportionally.

### ? C4-07: Motor 2 Torque Compensation Gain

Functions for motor 2 in the same way that C4-01 functions for motor 1.

Refer to [C3-01: Slip Compensation Gain on page 153](#) for details on adjusting this parameter.

No.	Parameter Name	Setting Range	Default
C4-07	Motor 2 Torque Compensation Gain	0.00 to 2.50	1.00

## ? C5: Automatic Speed Regulator (ASR)

The ASR is used for controlling the motor speed in V/f w/PG, CLV, AOLV/PM, and CLV/PM control modes. It adjusts the output frequency (V/f w/PG) or torque reference (CLV, AOLV/PM, CLV/PM) in order to minimize the difference between frequency reference and actual motor speed.

The figures below illustrates how ASR works.

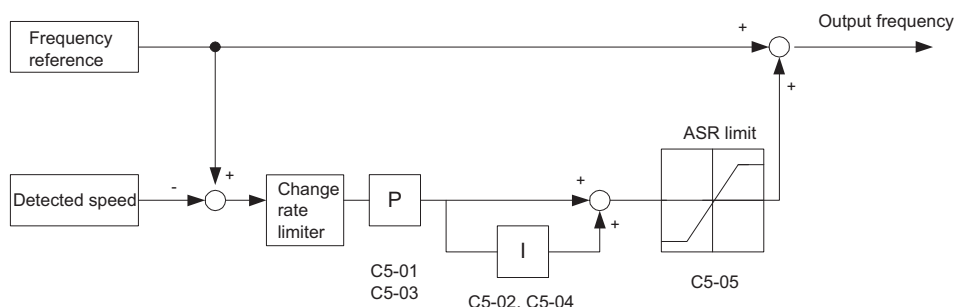


Figure 5.32 Speed Control Block Diagram for V/f Control with PG

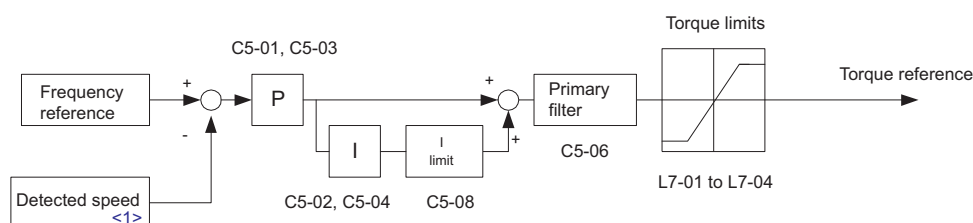


Figure 5.33 Speed Control Block Diagram for CLV, AOLV/PM and CLV/PM

<1> Advanced Open Loop Vector Control for PM motors estimates the speed using the motor model and does not require an encoder feedback signal.

## ? Adjusting the ASR Parameters

Before adjusting ASR parameters make sure all motor data have been set up correctly or Auto-Tuning has been performed.

Analog output signals should be used to monitor the frequency reference after softstarter (U1-16) and the motor speed (U1-05) when adjusting the ASR. Refer to [H4: Multi-Function Analog Outputs on page 218](#) for details on setting up analog output functions.

Generally when tuning the ASR, first optimize the ASR gain, then adjust the integral time settings. Always make adjustments with the load connected to the motor.

### Adjusting the ASR Parameters in V/f Control with PG

In V/f Control with PG, the ASR settings change between two sets of parameters depending on the motor speed as described in [C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2 on page 159](#).

Perform the following steps for adjusting ASR parameters:

1. Run the motor at minimum speed and increase ASR gain 2 (C5-03) as much as possible without oscillation.
2. Run the motor at minimum speed and decrease ASR integral time 2 (C5-04) as much as possible without oscillation.
3. Check the output current monitor to make sure that the output current is less than 50% of the drive rated current. If the value is higher than 50%, decrease C5-03 and increase C5-04.
4. Run the motor at maximum speed and increase ASR gain 1 (C5-01) as much as possible without oscillations.
5. Run the motor at maximum speed and decrease ASR integral time 1 (C5-02) as much as possible without oscillations.
6. If higher speed precision and faster response during acceleration or deceleration is required, enable integral control during accel/decel by setting parameter C5-12 to 1. Change the speed and make sure no over/undershoot occurs.

### 5.3 C: Tuning

#### Adjusting the ASR Parameters in CLV, AOLV/PM, and CLV/PM

In CLV, AOLV/PM, and CLV/PM the drive is pre-set to use ASR settings C5-01/02 over the whole speed range. If required by the application, a second set of ASR parameters (C5-03/04) can be automatically activated depending on the motor speed or by using a digital input. Also refer to **C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2 on page 159**.

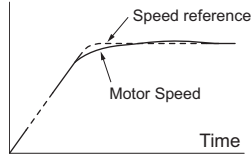
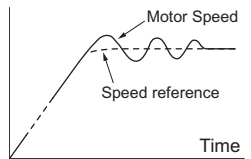
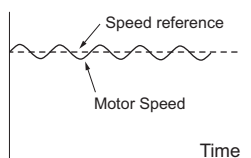
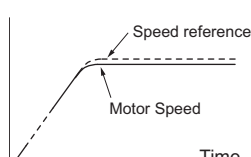
Perform the following steps for adjusting ASR parameters:

1. Run the motor at zero speed and increase the ASR gain (C5-01) as much as possible without oscillation.
2. Run the motor at zero speed and decrease the ASR integral time (C5-02) as much as possible without oscillation.
3. Run at the normal operating speed. Check for over/undershoot when changing speed and for any oscillation.
4. Should problems occur in step 3, increase the integral time and reduce the gain.  
Alternatively, use different ASR settings for high and low speed. Set the values from step 1 and 2 to parameters C5-03 and C5-04, then set an ASR switching frequency in parameter C5-07. Run the motor at a speed higher than C5-07 and repeat step 3 while adjusting C5-01 and C5-02.

#### Solving Problems During ASR Setup

Use **Table 5.14** when making adjustments to ASR. Though the parameters listed below are for motor 1, the same changes can be made to the corresponding motor 2 parameters when running a second motor.

**Table 5.14 ASR Setup Problems and Corrective Actions**

Problem		Possible Solutions
Slow response to speed changes or speed deviation lasts for too long		<ul style="list-style-type: none"> <li>• Increase the ASR gain.</li> <li>• Decrease the integral time.</li> </ul>
Overshoot or undershoot at the end of acceleration or deceleration		<ul style="list-style-type: none"> <li>• Decrease the ASR gain.</li> <li>• Increase the integral time.</li> </ul>
Vibration and oscillation occur at constant speed		<ul style="list-style-type: none"> <li>• Decrease the ASR gain.</li> <li>• Increase the integral time.</li> <li>• Increase the ASR delay time (C5-06).</li> </ul>
The motor slip is not fully compensated when running in V/f Control with PG		<ul style="list-style-type: none"> <li>• Check the pulse number set to F1-01 and the gear ratio in F1-12 and F1-13.</li> <li>• Make sure the pulse signal from the encoder is set up properly.</li> <li>• Check monitor U6-04 and check if the ASR is working at its output limit (setting of C5-05). If so, increase C5-05.</li> </ul>
Integral operation is enabled in V/f Control with PG (C5-15 = 1) and over/undershoot occurs when changing speed.	-	<ul style="list-style-type: none"> <li>• Decrease the ASR gain.</li> <li>• Increase the integral time.</li> <li>• If the problem persists, reduce the ASR output limit set in C5-05.</li> </ul>
Oscillation at low speed and response is too slow at high speed (or vice versa)	-	<ul style="list-style-type: none"> <li>• V/f control: Use C5-01/02 and C5-03/04 to set up different ASR settings at minimum and maximum speed.</li> <li>• CLV, AOLV/PM, CLV/PM: Use C5-01, C5-02 and C5-03, C5-04 to define optimal ASR settings for high and low speed. Use C5-07 to define a switching frequency.</li> </ul>

### ? C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2

These parameters can be used to adjust the responsiveness of the ASR.

**Note:** C5-01 is automatically set when ASR Tuning is performed (T1-01 = 9 or T2-01 = 9).

No.	Parameter Name	Setting Range	Default
C5-01	ASR Proportional Gain 1	0.00 to 300.00 <I>	Determined by A1-02
C5-02	ASR Integral Time 1	0.000 to 10.000 s	Determined by A1-02
C5-03	ASR Proportional Gain 2	0.00 to 300.00 <I>	Determined by A1-02
C5-04	ASR Integral Time 2	0.000 to 10.000 s	Determined by A1-02

<I> The setting range is 1.00 to 300.0 in CLV, AOLV/PM, and CLV/PM.

These parameter settings will function differently depending on the control mode.

#### V/f Control with PG

Parameters C5-01 and C5-02 determine the ASR characteristics at maximum speed, whereas C5-03 and C5-04 determine the characteristics at minimum speed.

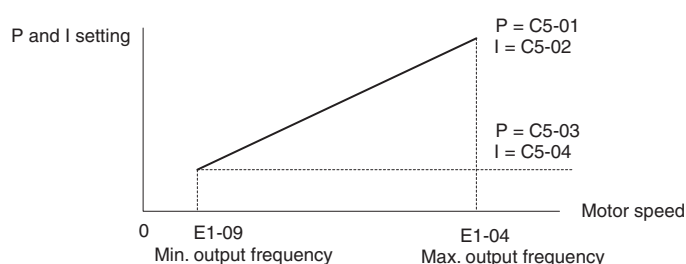


Figure 5.34 ASR Gain and Integral Time in V/fw/PG

#### CLV, AOLV/PM, and CLV/PM

In these control modes, parameters C5-03 and C5-04 define the ASR gain and integral time at zero speed. The settings in C5-01 and C5-02 are used at speeds above the setting in C5-07. C5-07 is set to 0 as the default so that C5-01 and C5-02 are used over the entire speed range. Also refer to [C5-07: ASR Gain Switching Frequency on page 160](#).

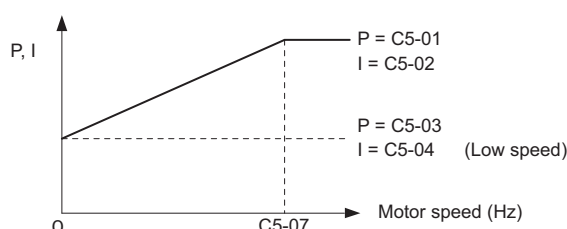


Figure 5.35 Low-speed and High-speed Gain Settings

The gain set in C5-03 can also be activated with a digital input programmed to “ASR gain switch” (H1-□□ = 77). When the terminal is open, the drive uses the ASR gain level set by the pattern in the figure above. When the terminal closes, C5-03 is used. The integral time set to C5-02 is used to change linearly between these settings.

The ASR gain switch command from a multi-function input terminal overrides the switching frequency set to C5-07.

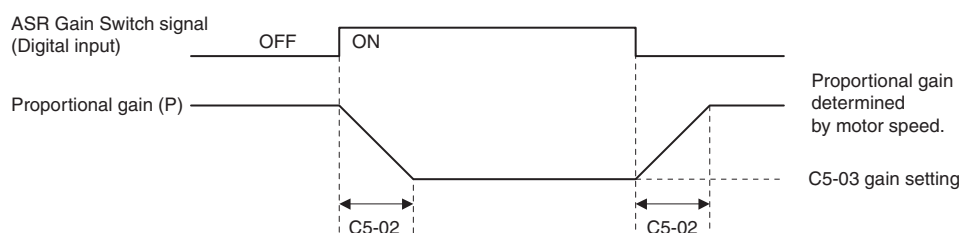


Figure 5.36 ASR Proportional Gain Switch

## 5.3 C: Tuning

### ASR Gain Tuning (C5-01, C5-03)

The higher this setting, the faster is the speed response. Too high of a setting can lead to oscillation. In general, this setting should be increased with larger loads in order to minimize the speed deviation.

### ASR Integral Time Tuning (C5-02, C5-04)

Determines how fast a continuous speed deviation problem is eliminated. Too long of an integral time makes the speed control less responsive, while a too short of an integral time can cause oscillation.

#### ? C5-05: ASR Limit

Sets the ASR output limit as a percentage of the maximum output frequency (E1-04). If the motor rated slip is high, the setting might need to be increased to provide proper motor speed control. Use the ASR output monitor U6-04 to determine if ASR is working at the limit set in C5-05. If so, make sure the PG pulses (F1-01), PG gear teeth (F1-12, F1-13), and the PG signal are set correctly before making further changes to C5-05.

No.	Parameter Name	Setting Range	Default
C5-05	ASR Limit	0.0 to 20.0%	5.0%

#### ? C5-06: ASR Primary Delay Time Constant

This parameter sets the filter time constant for the time from the speed loop to the torque command output.

Increase this setting gradually in increments of 0.01 for loads with low rigidity, or when oscillation is a problem.

**Note:** This parameter rarely requires adjustment.

No.	Parameter Name	Setting Range	Default
C5-06	ASR Primary Delay Time Constant	0.000 to 0.500 s	Determined by A1-02

#### ? C5-07: ASR Gain Switching Frequency

Sets the frequency where the drive should switch between ASR proportional gain 1 and 2 (C5-01, C5-03) as well as between integral time 1 and 2 (C5-02, C5-04).

No.	Parameter Name	Setting Range	Default
C5-07	ASR Gain Switching Frequency	0.0 to 400.0 Hz <1>	Determined by A1-02

<1> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (0.0 to 100.0%) instead of in Hz. The default setting is 0.0%.

**Note:** A multi-function input set for the ASR gain switch (H1-□□ = 77) takes priority over the ASR gain switching frequency.

Switching the proportional gain and integral time in the low or high speed range can help stabilize operation and avoid resonance problems. A good switching point is about 80% of the frequency where oscillation occurs, or at 80% of the target speed. Refer to [C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2 on page 159](#).

#### ? C5-08: ASR Integral Limit

Sets the upper limit for ASR as a percentage of the rated load.

No.	Parameter Name	Setting Range	Default
C5-08	ASR Integral Limit	0 to 400%	400%

#### ? C5-11: Regenerative ASR Limit

Sets an upper limit for frequency compensation when using ASR. The value is set as a percentage of the maximum output frequency.

No.	Parameter Name	Setting Range	Default
C5-11	Regenerative ASR Limit	0.0% to 20.0%	0.0%

### ? C5-12: Integral Operation during Accel/Decel (V/f w/PG)

Enables integral operation during acceleration and deceleration. Integral operation should be used when driving a heavy load or a high inertia load, but can cause problems with overshoot at the end of acceleration and deceleration. Refer to [ASR Setup Problems and Corrective Actions on page 158](#) to solve such problems.

No.	Parameter Name	Setting Range	Default
C5-12	Integral Operation during Accel/Decel	0, 1	0

#### Setting 0: Disabled

Integral operation occurs only during constant speed and not during acceleration or deceleration.

#### Setting 1: Enabled

Integral operation is always enabled.

### ? C5-17, C5-18: Motor Inertia, Load Inertia Ratio

C5-17 and C5-18 determine the ratio of the machine inertia and the inertia of the motor being used.

These parameters are set automatically when Inertia Tuning and ASR Tuning are performed in CLV and CLV/PM control modes. [Refer to Auto-Tuning on page 95](#) for details on Auto-Tuning or enter the data manually.

No.	Parameter Name	Setting Range	Default
C5-17	Motor Inertia	0.0001 to 600.00 kgm <sup>2</sup>	Determined by C6-01, E5-01 and o2-04
C5-18	Load Inertia Ratio	0.0 to 6000.0	1.0

### ? C5-21, C5-23 / C5-22, C5-24: Motor 2 ASR Proportional Gain 1, 2 / Integral Time 1, 2

These parameters function for motor 2 in the same way that C5-01 through C5-04 function for motor 1. For more details, see [C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2 on page 159](#).

No.	Parameter Name	Setting Range	Default
C5-21	Motor 2 ASR Proportional Gain 1	0.00 to 300.00 <1>	Determined by E3-01
C5-22	Motor 2 ASR Integral Time 1	0.000 to 10.000 s	Determined by E3-01
C5-23	Motor 2 ASR Proportional Gain 2	0.00 to 300.00 <1>	Determined by E3-01
C5-24	Motor 2 ASR Integral Time 2	0.000 to 10.000 s	Determined by E3-01

<1> The setting range is 1.00 to 300.00 in CLV.

### ? C5-25: Motor 2 ASR Limit

Functions for motor 2 in the same way that C5-05 functions for motor 1. Sets the ASR output limit for motor 2 as a percentage of the maximum output frequency (E4-04). For more details, see [C5-05: ASR Limit on page 160](#).

No.	Parameter Name	Setting Range	Default
C5-25	Motor 2 ASR Limit	0.0 to 20.0%	5.0%

### ? C5-26: Motor 2 ASR Primary Delay Time Constant

Functions for motor 2 in the same way that C5-06 functions for motor 1.

Sets the filter time constant for the time from the speed loop to the torque command output. For more details, see [C5-06: ASR Primary Delay Time Constant on page 160](#).

**Note:** This parameter rarely requires adjustment.

No.	Parameter Name	Setting Range	Default
C5-26	Motor 2 ASR Primary Delay Time Constant	0.000 to 0.500 s	0.004 s

## 5.3 C: Tuning

### ? C5-27: Motor 2 ASR Gain Switching Frequency

Functions for motor 2 in the same way that C5-07 functions for motor 1.

Sets the frequency for motor 2 to change ASR proportional gain 1 and 2 (C5-21, C5-23) as well as the integral time 1 and 2 (C5-22, C5-24). For more details, see [C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2 on page 159](#).

No.	Parameter Name	Setting Range	Default
C5-27	Motor 2 ASR Gain Switching Frequency	0.0 to 400.0 Hz	0.0 Hz

**Note:** A multi-function input set for the ASR gain switch (H1-□□ = 77) takes priority over the ASR gain switching frequency.

### ? C5-28: Motor 2 ASR Integral Limit

Functions for motor 2 in the same way that C5-08 functions for motor 1.

Sets the upper limit for ASR as a percentage of the rated load.

No.	Parameter Name	Setting Range	Default
C5-28	Motor 2 ASR Integral Limit	0 to 400%	400%

### ? C5-32: Integral Operation during Accel/Decel for Motor 2

Functions for motor 2 in the same way that C5-12 functions for motor 1.

Enables integral operation during acceleration and deceleration. For more details, see [C5-12: Integral Operation during Accel/Decel \(V/f w/PG\) on page 161](#).

No.	Parameter Name	Setting Range	Default
C5-32	Integral Operation during Accel/Decel for Motor 2	0, 1	0

#### Setting 0: Disabled

Integral operation occurs only during constant speed and not during acceleration or deceleration.

#### Setting 1: Enabled

Integral operation is always enabled.

### ? C5-37, C5-38: Motor 2 Inertia, Motor 2 Load Inertia Ratio

These parameters function for motor 2 in the same way that C5-17 and C5-18 function for motor 1.

These parameters are set automatically when Inertia Tuning and ASR Tuning are performed for motor 2 in CLV and CLV/PM control modes. [Refer to Auto-Tuning on page 95](#) for details on Auto-Tuning or enter the data manually.

No.	Parameter Name	Setting Range	Default
C5-37	Motor 2 Inertia	0.0001 to 600.00 kgm <sup>2</sup>	Determined by C6-01 and o2-04
C5-38	Motor 2 Load Inertia Ratio	0.0 to 6000.0	1.0

## ? C6: Carrier Frequency

### ? C6-01: Drive Duty Mode Selection

The drive has two different “duty modes” to select from based on the load characteristics. The drive rated current, overload capacity, and maximum output frequency will change depending upon the duty mode selection. Use parameter C6-01 to select Heavy Duty (HD) or Normal Duty (ND) for the application. The default setting is ND. [Refer to Heavy Duty and Normal Duty Ratings on page 394](#) for details about the rated current.

No.	Parameter Name	Setting Range	Default
C6-01	Duty Mode Selection	0 or 1	0 (HD)

Table 5.15 Differences between Heavy and Normal Duty

Characteristics	Heavy Duty Rating (HD)	Normal Duty Rating (ND)
	0	Normal Duty Rating (ND)
Performance		
	Use Heavy Duty Rating for applications requiring a high overload tolerance with constant load torque.	Use Normal Duty Rating for applications in which the torque requirements drop along with the speed.
	150% of drive rated Heavy Duty current for 60 s	120% of drive rated Normal Duty current for 60 s
Stall Prevention during Acceleration (L3-02)	150%	120%
Stall Prevention during Run (L3-06)	150%	120%
Default Carrier Frequency	2 kHz	2 kHz

**Note:** By changing the Duty Mode selection, the maximum size motor the drive can run changes, and the E2-□□ parameters are automatically set to appropriate values (E4-□□ for motor 2). Parameters settings determined by motor capacity are recalculated automatically when the Duty Mode selection is changed. This includes b8-04, L2-03, n5-02, S6-02, C5-17, and C5-37.

## ? C6-02: Carrier Frequency Selection

Parameter C6-02 sets the switching frequency of the drive's output transistors. Changes to the switching frequency helps lower audible noise and also reduces leakage current.

**Note:** Increasing the carrier frequency above the default value automatically lowers the drive's current rating. [Refer to Rated Current Depending on Carrier Frequency on page 401.](#)

No.	Parameter Name	Setting Range	Default
C6-02	Carrier Frequency Selection	1 to 6, F	Determined by A1-02, o2-04. Reset when C6-01 is changed.

**Note:** The default setting for the carrier frequency differs based on the type of motor and the Duty Mode selection. The default is 2 kHz when the drive is set for Heavy Duty performance and Normal Duty performance. When using a PM motor, the default carrier frequency is 5.0 Hz.

### Settings:

C6-02	Carrier Frequency	C6-02	Carrier Frequency
1	2.0 kHz	5	12.5 kHz (10.0 kHz)
2	5.0 kHz (4.0 kHz)	6	15.0 kHz (12.0 kHz)
3	8.0 kHz (6.0 kHz)	F	User defined (C6-03 to C6-05)
4	10.0 kHz (8.0 kHz)		

**Note:** The value in parenthesis indicates the carrier frequency for AOLV/PM.

### Guidelines for Carrier Frequency Parameter Setup

Symptom	Remedy
Speed and torque are unstable at low speeds	Lower the carrier frequency.
Noise from the drive affects peripheral devices	
Excessive leakage current from the drive	
Wiring between the drive and motor is too long <1>	
Audible motor noise is too loud	Increase the carrier frequency or use Swing PWM. <2>

<1> The carrier frequency may need to be lowered if the motor cable is too long. Refer to the table below.

<2> Increasing the carrier frequency is fine when the drive is set for Normal Duty, but remember that the drive rated current falls when the carrier frequency is increased.

### 5.3 C: Tuning

Wiring Distance	Up to 50 m	Up to 100 m	Greater than 100 m
Recommended setting value for C6-02	1 to 6, F (up to 15 kHz)	1 to 2 (up to 5 kHz)	1 (up to 2 kHz)

**Note:** The maximum cable length is 100 m when using OLV/PM (A1-02 = 5) or AOLV/PM (A1-02 = 6).

#### ? C6-03, C6-04, C6-05: Carrier Frequency Upper Limit, Lower Limit, Proportional Gain

Use these parameters to set a user defined or a variable carrier frequency. To set the upper and lower limits and the carrier frequency proportional gain, first set C6-02 to F.

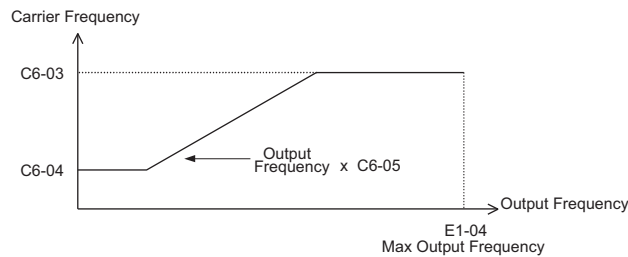
No.	Parameter Name	Setting Range	Default
C6-03	Carrier Frequency Upper Limit	1.0 to 15.0 kHz	Determined by C6-02
C6-04	Carrier Frequency Lower Limit (V/f Control only)	1.0 to 15.0 kHz	
C6-05	Carrier Frequency Proportional Gain (V/f Control only)	0 to 99	

#### Setting a Fixed User Defined Carrier Frequency

A carrier frequency between the fixed selectable values can be entered in parameter C6-03 when C6-02 is set to F. In V/f Control, parameter C6-04 must also be adjusted to the same value as C6-03.

#### Setting a Variable Carrier Frequency (V/f Control)

In V/f Control, the carrier frequency can be set up to change linearly with the output frequency. To do this, set the upper and lower limits for the carrier frequency and the carrier frequency proportional gain (C6-03, C6-04, C6-05) as shown in [Figure 5.37](#).



**Figure 5.37 Carrier Frequency Changes Relative to Output Frequency**

- Note:**
1. C6-03 takes priority when the carrier frequency proportional gain C6-05 > 27 and C6-03 < C6-04.
  2. When C6-05 is set lower than 7, C6-04 is disabled and the carrier frequency will be fixed to the value set in C6-03.

#### ? C6-06 PWM Method

Determines how the drive should perform pulse width modulation. Enabled only when parameter C6-02 is set to F.

No.	Parameter Name	Setting Range	Default
C6-06	PWM Method	0 to 2	2 when C6-02 = 1 0 for all other C6-02 settings

**0: 2-phase/3-phase conversion**

**1: 2-phase modulation**

**2: 3-phase modulation**

#### ? C6-09: Carrier Frequency during Rotational Auto-Tuning

C6-09 determines what the carrier frequency should be while Rotational Auto-Tuning is performed.

This parameter rarely requires adjustment, but can be helpful solving problems with overcurrent when Auto-Tuning a high frequency motor or a low impedance motor. In such cases, first set C6-03 to high value, then set C6-09 = 1.

No.	Parameter Name	Setting Range	Default
C6-09	Carrier Frequency during Rotational Auto-Tuning	0, 1	0

**Setting 0: 5 kHz**

**Setting 1: Same value set to C6-03**

## 5.4 d: Reference Settings

The figure below gives an overview of the reference input, selections, and priorities.

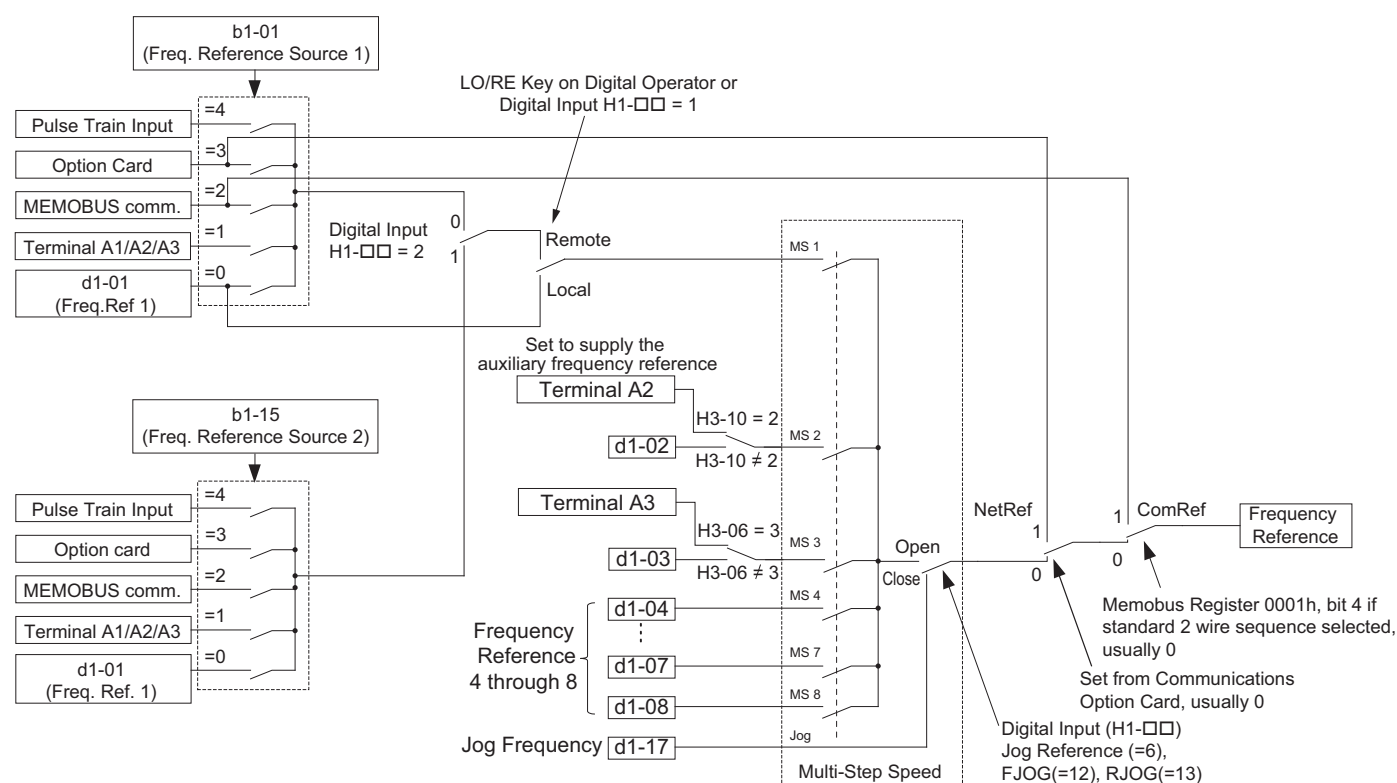


Figure 5.38 Frequency Reference Setting Hierarchy

### ? d1: Frequency Reference

#### ? d1-01 to d1-08, d1-17: Frequency Reference 1 to 8 and Jog Frequency Reference

Up to 9 preset frequency references (including the Jog reference) can be programmed in the drive. The drive lets the user switch between these frequency references during run by using the digital input terminals. The drive uses the acceleration and deceleration times that have been selected when switching between each frequency reference.

The Jog frequency must be selected by a separate digital input and overrides all other frequency references.

The multi-speed references 1, 2, and 3 can be provided by analog inputs.

No.	Parameter Name	Setting Range	Default
d1-01 to d1-08	Frequency Reference 1 to 8	0.00 to 400.00 Hz <1> <2>	0.00 Hz <2>
d1-17	Jog Frequency Reference	0.00 to 400.00 Hz <1> <2>	6.00 Hz <2>

<1> The upper limit is determined by the maximum output frequency (E1-04) and upper limit for the frequency reference (d2-01).

<2> Setting units are determined by parameter o1-03. The default is "Hz" (o1-03 = 0) in V/f, V/f w/PG, OLV, CLV, and OLV/PM control modes. The default for AOLV/PM and CLV/PM control modes expresses the frequency reference as a percentage (o1-03 = 1).

### Multi-Step Speed Selection

To use several speed references for a multi-step speed sequence, set the H1-□□ parameters to 3, 4, and 5. To assign the Jog reference to a digital input, set H1-□□ to 6.

Notes on using analog inputs as Multi-Speed 1, 2, and 3:

#### • Multi-Step Speed 1

When setting terminal A1's analog input to Multi-Step Speed 1, set b1-01 to 1, and when setting d1-01 (Frequency Reference 1) to Multi-Step Speed 1, set b1-01 to 0.

## 5.4 d: Reference Settings

### • Multi-Step Speed 2

When setting terminal A2's analog input to Multi-Step Speed 2, set H3-10 (Terminal A2 Function Selection) to 2 (Auxiliary frequency reference 1). When setting d1-02 (Frequency Reference 2) to Multi-Step Speed 2, set H3-10 to 1F (Through mode).

### • Multi-Step Speed 3

When setting terminal A3's analog input to Multi-Step Speed 3, set H3-06 (Terminal A3 Function Selection) to 3 (Auxiliary frequency reference 2). When setting d1-03 (Frequency Reference 3) to Multi-Step Speed 3, set H3-06 to 1F (Through mode).

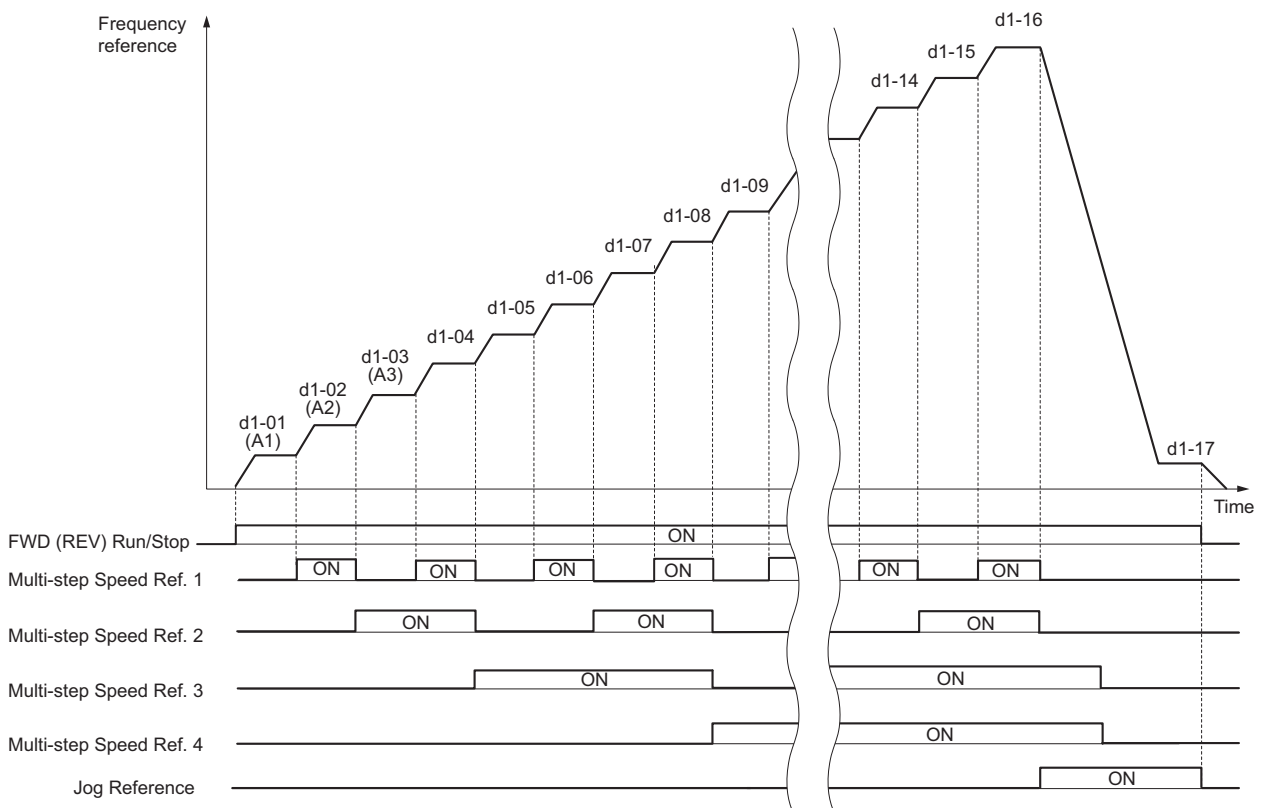
When inputting 0 to 10 V to terminal A3's analog input, set H3-09 to 0, and DIP switch S1 on the control circuit terminal board to V (voltage).

The different speed references can be selected as shown in [Table 5.16](#). [Figure 5.39](#) illustrates the multi-step speed selection.

**Table 5.16 Multi-Step Speed Reference and Terminal Switch Combinations**

Reference	Multi-Step Speed 1 H1-□□=3	Multi-Step Speed 2 H1-□□=4	Multi-Step Speed 3 H1-□□=5	Jog Reference H1-□□=6
	OFF	OFF	OFF	OFF
Frequency Reference 2 (d1-02 or input terminal A1, A2, A3)	ON	OFF	OFF	OFF
Frequency Reference 3 (d1-03 or input terminal A1, A2, A3)	OFF	ON	OFF	OFF
Frequency Reference 4 (d1-04)	ON	ON	OFF	OFF
Frequency Reference 5 (d1-05)	OFF	OFF	ON	OFF
Frequency Reference 6 (d1-06)	ON	OFF	ON	OFF
Frequency Reference 7 (d1-07)	OFF	ON	ON	OFF
Frequency Reference 8 (d1-08)	ON	ON	ON	OFF
Jog Frequency Reference (d1-17) <1>	—	—	—	ON

<1> The Jog frequency overrides whatever frequency reference is being used.



**Figure 5.39 Preset Reference Timing Diagram**

### ? d2: Frequency Upper/Lower Limits

By entering upper or lower frequency limits, the user can keep motor speed from going above or below levels that may cause resonance or equipment damage.

#### ? d2-01: Frequency Reference Upper Limit

Sets the upper limit for the frequency reference value that is input from frequency reference source 1 (b1-01). The limit applies to any source selected in parameter b1-01. The value is set as a percentage of the maximum output frequency.

Even if the frequency reference is set to a higher value, the drive internal frequency reference will not exceed this value.

No.	Parameter Name	Setting Range	Default
d2-01	Frequency Reference Upper Limit	0.0 to 110.0%	100.0%

#### ? d2-02: Frequency Reference Lower Limit

Sets the upper limit for the frequency reference value that is input from frequency reference source 1 (b1-01). The limit applies to any source selected in parameter b1-01. The value is set as a percentage of the maximum output frequency.

If a lower reference than this value is entered, the drive will run at the limit set to d2-02. If the drive is started with a lower reference than d2-02, it will accelerate up to d2-02.

No.	Parameter Name	Setting Range	Default
d2-02	Frequency Reference Lower Limit	0.0 to 110.0%	0.0%

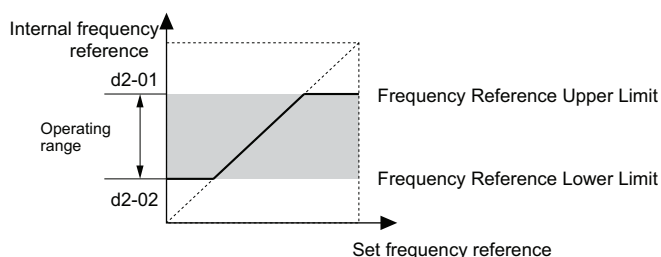


Figure 5.40 Frequency Reference: Upper and Lower Limits

#### ? d2-03: Master Speed Reference Lower Limit

This parameter is used to set a lower limit level for the main frequency reference (this setting does not affect the lower limit level for the jog frequency reference, multi-step speed frequency reference, or auxiliary frequency). The drive will use the frequency reference set to d2-03 if a frequency reference below the main frequency reference is entered.

Set as a percentage of the maximum output frequency.

**Note:** When lower limits are set to both the frequency reference (d2-02 or d2-05) and the main frequency reference (d2-03), the drive uses the greater of those two values as the lower limit.

No.	Parameter Name	Setting Range	Default
d2-03	Master Speed Reference Lower Limit	0.0 to 110.0%	0.0%

#### ? d2-04: Frequency Reference 2 Upper Limit

Sets the upper limit for the frequency reference value that is input from frequency reference source 2 (b1-15). The limit applies to any source selected in parameter b1-15. The value is set as a percentage of the maximum output frequency.

Even if the frequency reference is set to a higher value, the drive internal frequency reference will not exceed this value.

No.	Parameter Name	Setting Range	Default
d2-04	Frequency Reference 2 Upper Limit	0.0 to 110.0%	100.0%

## 5.4 d: Reference Settings

### ? d2-05: Frequency Reference 2 Lower Limit

Sets the upper limit for the frequency reference value that is input from frequency reference source 2 (b1-15). The limit applies to any source selected in parameter b1-15. The value is set as a percentage of the maximum output frequency.

If a lower reference than this value is input, the drive will run at the d2-05 level. If the drive is started with a lower reference than d2-05, it will accelerate up to d2-05.

No.	Parameter Name	Setting Range	Default
d2-05	Frequency Reference 2 Lower Limit	0.0 to 110.0%	0.0%

### ? d5: Torque Control

Torque Control is available for CLV and CLV/PM (A1-02 = 3, 7). It allows to define a setpoint for the torque produced by the motor.

#### ? Torque Control Operation

Torque control can be enabled either by setting parameter d5-01 to 1 or by a digital input (H1-□□ = 71). [Figure 5.41](#) illustrates the working principle.

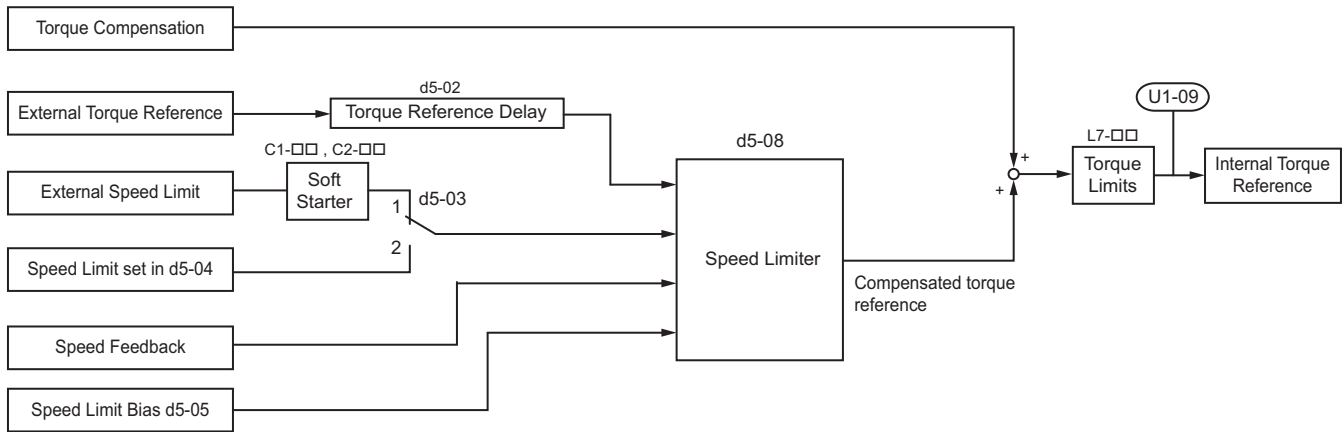


Figure 5.41 Torque Control Block Diagram

The externally input torque reference is used as the target value for the motor output torque. If the motor torque reference and the load torque are not in balance when in Torque Control, the motor accelerates or decelerates. An operation beyond the speed limit is prevented by compensating the external torque reference value if the motor speed reaches the limit. The compensation value is calculated using the speed limit, speed feedback, and the speed limit bias.

If an external torque compensation value is input, it is added to the speed limit compensated torque reference value. The value calculated is limited by the L7-□□ settings, and is then used as the internal torque reference, which can be monitored in U1-09. The L7-□□ settings have highest priority, i.e., the motor cannot be operated with a higher torque than the L7-□□ settings, even if the external torque reference value is increased.

### ? Setting the Torque Reference, Speed Limit, and Torque Compensation Values

#### Torque Control Reference Sources

Input values for Torque Control can be set like explained in [Table 5.17](#).

Table 5.17 Torque Control Input Value Selection

Input Value	Signal Source	Settings	Remarks
	Analog inputs A1/A2/A3	H3-02, H3-10, or H3-06 = 13 <1>	Make sure the signal level settings for the input terminal selected match the signal used. Refer to <a href="#">H3: Multi-Function Analog Inputs on page 211</a> for details on adjusting analog input signals.
	Analog Option Card	<ul style="list-style-type: none"> <li>F2-01 = 0</li> <li>H3-02, H3-10, or H3-06 = 13 &lt;1&gt;</li> </ul>	The F3-□□ settings become effective for the option board input terminals. Make sure the signal level settings for the input terminal selected match the signal used. Refer to <a href="#">H3: Multi-Function Analog Inputs on page 211</a> for details on adjusting analog input signals.
	MEMOBUS Register 0004h	<ul style="list-style-type: none"> <li>b1-01 = 2</li> <li>Set Register 000Fh, Bit 2 = 1 to enable Torque reference from register 0004h</li> </ul>	—
	Communication Option Card	<ul style="list-style-type: none"> <li>b1-01 = 3</li> <li>F6-06 = 1</li> </ul> Refer to the option card manual for details about setting the torque reference value.	—
Speed Limit	Signal selected as frequency reference source	d5-03 = 1 The speed limit is taken from the input selected as frequency reference source in parameter b1-01 or b1-15. <1>	The settings in C1-□□ for accel/decel times and in C2-□□ for S-curves are applied to the speed limit value.
	Parameter d5-04	d5-03 = 2	—
Torque Compensation	Analog inputs A1/A2/A3	H3-02, H3-10, or H3-06 = 14 <1>	Make sure the signal level settings for the input terminal selected match the signal used. Refer to <a href="#">H3: Multi-Function Analog Inputs on page 211</a> for details on adjusting analog input signals.
	Analog Option Card	<ul style="list-style-type: none"> <li>F2-01 = 0</li> <li>H3-02, H3-10, or H3-06 = 14 &lt;1&gt;</li> </ul>	The H3-□□ settings become effective for the option board input terminals. Make sure the signal level settings for the input terminal selected match the signal used.
	MEMOBUS Register 0005h	<ul style="list-style-type: none"> <li>b1-01 = 2</li> <li>Set Register 000Fh, bit 3 = 1 to enable the torque compensation setting by register 0005h</li> </ul>	—
	Communication Option Card	b1-01 = 3 Refer to the option card manual for details about setting the torque reference value.	—

<1> Sets analog input terminals A1, A2, and A3 to supply the speed limit, torque reference, or torque compensation. An operator programming error oPE07 (Multi-Function Analog Input Selection Error) will occur if two analog inputs are set for the same function.

### Input Value Polarity

The polarity of the torque reference determines the direction of the torque output from the motor, and is not determined by the direction of the Run command (i.e., forward or reverse). The polarity of the torque reference depends on the following:

Positive torque reference: Drive's internal torque reference is for forward operation (rotating counter-clockwise when looking down the motor shaft from the load side).

Negative torque reference: Drive's internal torque reference is for reverse operation (rotating clockwise when looking down the motor shaft from the load side).

When using an analog signal to set the frequency reference, the following situations will create a negative input signal:

- Negative voltage reference input
- Positive voltage reference input but using a negative value for the analog input bias
- Positive voltage reference input with an input terminal set to "External torque reference polarity inversion" (H1-□□ = 78) is closed

The sign for the torque reference (positive or negative) can also be set using MEMOBUS/Modbus or a communications option card.

### ? Speed Limitation and Speed Limit Bias

The speed limit setting is read from the input selected in parameter d5-03. A bias can be added to this speed limit using parameter d5-05 while parameter b5-08 determines how the speed limit bias is applied. [Table 5.18](#) explains the relation between these settings.

**Table 5.18 Speed Limit, Speed Bias and Speed Limit Priority Selection**

	Operating Conditions							
Run Command	Forward	Reverse	Forward	Reverse	Forward	Reverse	Forward	Reverse
Torque Reference Direction	Positive (Forward)	Positive (Reverse)	Negative (Reverse)	Negative (Forward)	Negative (Reverse)	Negative (Forward)	Positive (Forward)	Positive (Reverse)
Speed Limit Direction	Positive (Forward)	Negative (Forward)	Negative (Reverse)	Positive (Reverse)	Positive (Forward)	Negative (Forward)	Negative (Reverse)	Positive (Reverse)
Normal Operation Direction	Forward		Reverse		Forward		Reverse	
Generated Torque (d5-08 = 0) </>								
Generated Torque (d5-08 = 1) </>								
Application Example	Winder				Unwinder			

<1> The value of delta n in the drawings depends on the ASR setting in parameters C5-□□.

### ? Indicating Operation at the Speed Limit

A digital output can be programmed to close when the drives is operating at or beyond the speed limit (H2-□□ = 32). Use this output to notify a PLC or some other control device of abnormal operating conditions.

### ? Switching Between Torque and Speed Control

A digital output can be used to switch Torque Control and Speed Control (H1-□□ = 71). When switching from Speed Control to Torque Control, the torque limit becomes the torque reference and the speed reference becomes the speed limit. This change is reversed when switching back to Speed Control.

If required by the application, a delay time can be set up using parameter d5-06. The reference values (torque reference/speed limit in Torque Control or speed reference/torque limit in Speed Control) are held during this switch delay time. Be sure to change the reference values from the controller within this delay time.

- Note:**
- 1. The switching delay time d5-06 is not applied when the Stop command is entered. Here the operation switches immediately to speed control and the drive decelerates to stop at the torque limit.
  - 2. Set d5-01 to 0 when switching between Torque Control and Speed Control. An oPE15 alarm will be triggered if parameter d5-01 is set to 1 while H1-□□ is set to 71 at the same time.

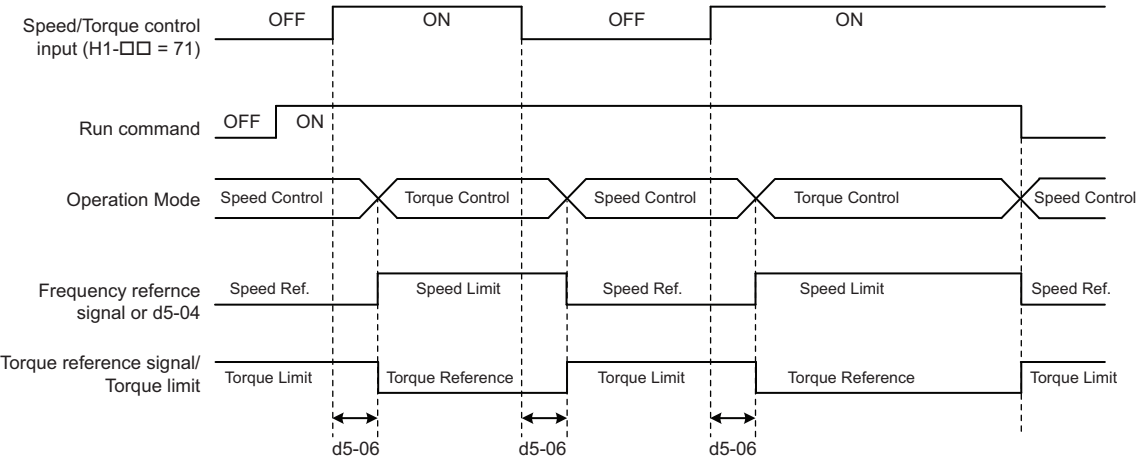


Figure 5.42 Speed/Torque Control Switching Time

? **d5-01: Torque Control Selection**

No.	Parameter Name	Setting Range	Default
d5-01	Torque Control Selection	0 or 1	0

**Setting 0: Disabled**

Speed Control will be active. Also use this setting when H1-□□ = 71 (Speed/Torque Control Switch).

**Setting 1: Enabled**

Torque Control is always enabled.

? **d5-02: Torque Reference Delay Time**

A filter with the time constant set in parameter d5-02 can be applied to the torque reference signal in order to eliminate oscillation that results from an unstable torque reference signal. A higher filter time will stabilize control, but also reduce the responsiveness.

No.	Parameter Name	Setting Range	Default
d5-02	Torque Reference Delay Time	0 to 1000 ms	Determined by A1-02

? **d5-03: Speed Limit Selection**

Parameter d5-03 determines how the speed limit is set.

No.	Parameter Name	Setting Range	Default
d5-03	Speed Limit Selection	1, 2	1

**Setting 1: Frequency Reference Input**

The frequency reference value at the active reference source (digital operator, External reference 1 or External reference 2) will be used as speed limit. Note that in this case all settings for accel/decel times (C1-01 to C1-08) and S-curves (C2-01 to C2-04) will apply for the speed limit.

**Setting 2: Parameter d5-04**

The speed limit is set by parameter d5-04.

## 5.4 d: Reference Settings

### ? d5-04: Speed Limit

Sets the speed limit during torque control if parameter d5-03 is set to 2. Refer to *Speed Limitation and Speed Limit Bias on page 170*.

No.	Parameter Name	Setting Range	Default
d5-04	Speed Limit	-120 to 120%	0%

### ? d5-05: Speed Limit Bias

Using d5-05 a bias can be applied to the speed limit value. The bias is set as a percentage of the maximum output frequency. Refer to *Speed Limitation and Speed Limit Bias on page 170*.

No.	Parameter Name	Setting Range	Default
d5-05	Speed Limit Bias	0 to 120%	10%

### ? d5-06: Speed/Torque Control Switchover Time

Sets the delay time for switching from Speed Control to Torque Control and vice versa.

No.	Parameter Name	Setting Range	Default
d5-06	Speed/Torque Control Switchover Time	0 to 1000 ms	0 ms

### ? d5-08: Unidirectional Speed Limit Bias

Parameter d5-08 selects how the speed limit bias is applied.

No.	Parameter Name	Setting Range	Default
d5-08	Unidirectional Speed Limit Bias	0 or 1	1

#### Setting 0: Disabled

The speed limit bias is applied in both directions, the speed limit and the opposite direction.

#### Setting 1: Enabled

The speed limit bias is applied in the opposite direction of the speed limit only.

## ? d6: Field Weakening and Field Forcing

### Field Weakening

The Field Weakening function reduces the output voltage to a pre-defined level in order to reduce the energy consumption of the motor. It can be activated using a digital input programmed for H1-□□ = 63. Field Weakening should only be used with a known and unchanging light load condition. Use the Energy Saving function (b8-□□ parameters) when Energy Saving for various different load conditions is required.

### Field Forcing

The Field Forcing function compensates the delaying influence of the motor time constant when changing the excitation current reference. Field Forcing can improve the motor responsiveness. It is ineffective during DC Injection Braking.

### ? d6-01: Field Weakening Level

Sets the level to what the output voltage is reduced when Field Weakening is activated. Set as percentage of the drive maximum output voltage.

No.	Parameter Name	Setting Range	Default
d6-01	Field Weakening Level	0 to 100%	80%

### ? d6-02: Field Weakening Frequency Limit

Sets the minimum output frequency for that field weakening can be activated. For frequencies below d6-02, Field Weakening cannot be activated.

No.	Parameter Name	Setting Range	Default
d6-02	Field Weakening Frequency Limit	0 to 400.0 Hz	0.0 Hz

? **d6-03: Field Forcing Selection**

Enables or disables the Field Forcing function.

No.	Parameter Name	Setting Range	Default
d6-03	Field Forcing Selection	0 or 1	0

Setting 0: Disabled

Setting 1: Enabled

? **d6-06: Field Forcing Limit**

Sets the maximum level to what the Field Forcing function can boost the excitation current reference. The value is set as a percentage of the motor no load current.

No.	Parameter Name	Setting Range	Default
d6-06	Field Forcing Limit	100 to 400%	400%

**Note:** Adjustment is not normally required.

? **d7: Offset Frequency**

? **d7-01 to d7-03: Offset Frequency 1 to 3**

Three different offset values can be added to the frequency reference. The value is set as a percentage of the maximum output frequency. They can be selected using digital inputs programmed for Offset frequency 1, 2, and 3 (H1-□□ = 44, 45, 46). The selected offset values are added together if multiple inputs are closed at the same time.

**Note:** This function can be used to replace the “Trim Control” function (H1-□□ = 1C, 1D) of earlier Yaskawa drives.

No.	Parameter Name	Setting Range	Default
d7-01	Offset Frequency 1	-100.0 to 100.0%	0%
d7-02	Offset Frequency 2	-100.0 to 100.0%	0%
d7-03	Offset Frequency 3	-100.0 to 100.0%	0%

Figure 5.43 illustrates the Offset frequency function.

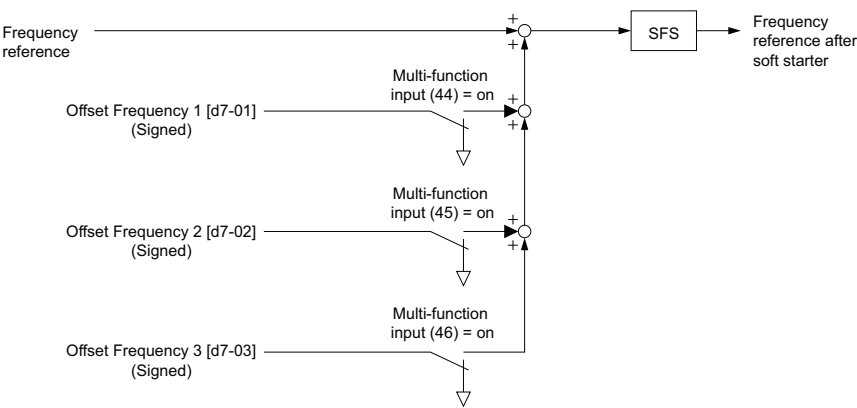


Figure 5.43 Offset Frequency Operation

## 5.5 E: Motor Parameters

E parameters cover V/f pattern and motor data settings.

### ? E1: V/f Pattern for Motor 1

#### ? E1-01: Input Voltage Setting

Set the input voltage parameter to the nominal voltage of the AC power supply. This parameter adjusts the levels of some protective features of the drive (overvoltage, Stall Prevention, etc.).

**NOTICE:** Set parameter E1-01 to match the input voltage of the drive. Drive input voltage (not motor voltage) must be set in E1-01 for the protective features to function properly. Failure to set the correct drive input voltage will result in improper drive operation.

No.	Parameter Name	Setting Range	Default
E1-01 <I>	Input Voltage Setting	155 to 255 V	200 V

<I> The setting range and default value shown here are for 200 V class drives. Double this for 400 V class units.

#### E1-01 Related Values

The input voltage setting when using a 400 V class drive will change the undervoltage detection level for Uv1 and the KEB function as follows:

Voltage	Setting Value of E1-01	(Approximate Values)		
		Uv Detection Level (L2-05)	KEB Target Voltage (S4-11)	ov Suppression / Stall Prevention Level (L3-17)
200 V Class	All settings	190 V	260 V	375 V
400 V Class	setting ≥ 400 V	380 V	500 V	750 V
	setting < 400 V	350 V	460 V	750 V

**Note:** The braking transistor operation levels are valid for the drive internal braking transistor. If an external CDBR braking chopper is used, refer to the instruction manual of that unit.

### ? V/f Pattern Settings (E1-03)

The drive utilizes a set V/f pattern to determine the appropriate output voltage level for each relative to the frequency reference.

One custom V/f pattern can be set up by programming parameters E1-04 through E1-13.

#### ? E1-03: V/f Pattern Selection

This parameter can only be set to F.

No.	Parameter Name	Setting Range	Default
E1-03	V/f Pattern Selection	F	F

### ? V/f Pattern Settings E1-04 to E1-13

Using parameters E1-04 through E1-13, the user can either monitor the V/f pattern values if set up a custom V/f pattern as shown in [Figure 5.44](#) for an example custom V/f pattern.

**Note:** Certain E1-□□ parameters might not be visible depending on the selected control mode. [Refer to Parameter Table on page 408](#) for details.

No.	Parameter Name	Setting Range	Default
E1-04	Maximum Output Frequency	40.0 to 400.0 Hz <I>	<I> <I>
E1-05	Maximum Voltage	0.0 to 255.0 V <I>	<I> <I>
E1-06	Base Frequency	0.0 to [E1-04]	<I> <I>
E1-07	Middle Output Frequency	0.0 to [E1-04]	<I>
E1-08	Middle Output Frequency Voltage	0.0 to 255.0 V <I>	<I> <I>
E1-09	Minimum Output Frequency	0.0 to [E1-04]	<I> <I>

No.	Parameter Name	Setting Range	Default
E1-10	Minimum Output Frequency Voltage	0.0 to 255.0 V <4>	<2> <4>
E1-11	Middle Output Frequency 2	0.0 to [E1-04]	0.0 Hz <6>
E1-12	Middle Output Frequency Voltage 2	0.0 to 255.0 V <4>	0.0 V <4> <5> <6>
E1-13	Base Voltage	0.0 to 255.0 V <4>	0.0 V <4> <5> <7>

<1> When using PM motors, the setting range is determined by the motor code set to E5-01.

<2> Default setting is determined by the control mode.

<3> When using PM motors, the default setting is determined by the motor code set to E5-01.

<4> Values shown here are for 200 V class drives. Double values when using a 400 V class unit.

<5> The drive changes these settings when Auto-Tuning is performed (Rotational Auto-Tuning, Stationary Auto-Tuning 1, 2).

<6> Parameter ignored when E1-11 and E1-12 are set to 0.0.

<7> When Auto-Tuning is performed, E1-05 and E1-13 will be set to the same value.

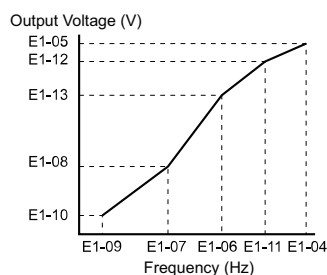


Figure 5.44 V/f Pattern

- Note:**
1. The following condition must be true when setting up the V/f pattern:  $E1-09 \leq E1-07 < E1-06 \leq E1-11 \leq E1-04$
  2. To make the V/f pattern a straight line below E1-06, set  $E1-09 = E1-07$ . In this case the E1-08 setting is disregarded.
  3. E1-03 is unaffected when the parameters are initialized using parameter A1-03, but the settings for E1-04 through E1-13 are returned to their default values.
  4. Parameters E1-11, E1-12, and E1-13 should only be used to fine-tune the V/f pattern in the constant output range. These parameters rarely need to be changed.

## ? E2: Motor 1 Parameters

These parameters contain the motor data needed for motor 1. They are set automatically when Auto-Tuning is performed (this includes Rotational Auto-Tuning, Stationary Auto-Tuning 1 and 2). If Auto-Tuning cannot be performed, then refer to [Auto-Tuning Fault Detection on page 327](#).

**Note:** As the motor parameters for a PM motor are set up in the E5-□□ parameters, parameters for induction motors (E2-□□) are hidden when a PM motor control mode is selected for motor 1 (i.e., parameter A1-02 is set to 5, 6, or 7).

### ? E2-01: Motor Rated Current

Set E2-01 to the full load amps (FLA) stamped on the motor nameplate. This value is used for motor protection and to calculate torque limits. If Auto-Tuning completes successfully, the value entered to T1-04 will automatically be saved to E2-01.

No.	Parameter Name	Setting Range	Default
E2-01	Motor Rated Current	10% to 200% of the drive rated current.	Determined by C6-01 and 2-04

- Note:**
1. This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.
  2. If the motor rated current in E2-01 is set lower than the motor no-load current in E2-03, than a parameter setting error will occur (oPE02). E2-03 must be set correctly to prevent this error.

## 5.5 E: Motor Parameters

### ? E2-02: Motor Rated Slip

Sets the motor rated slip in Hz. The setting in E2-02 is used for motor protection and to calculate torque limits. This value is automatically set during Auto-Tuning (Rotational Auto-Tuning, Stationary Auto-Tuning 1 and 2).

No.	Parameter Name	Setting Range	Default
E2-02	Motor Rated Slip	0.00 to 20.00 Hz	Determined by C6-01 and o2-04

If Auto-Tuning cannot be performed, calculate the motor rated slip using the information written on the motor nameplate and the formula below:

$$E2-02 = f - (n \times p)/120$$

(f: rated frequency (Hz), n: rated motor speed (r/min), p: number of motor poles)

### ? E2-03: Motor No-Load Current

Set the no-load current for the motor in amperes when operating at the rated frequency and the no-load voltage. The drive sets E2-03 during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning 1, 2). The motor no-load current listed in the motor test report can also be entered to E2-03 manually. Contact the motor manufacturer to receive a copy of the motor test report.

No.	Parameter Name	Setting Range	Default
E2-03	Motor No-Load Current	0 to [E2-01] (unit: 0.01 A)	Determined by C6-01 and o2-04

**Note:** This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01.

The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

### ? E2-04: Number of Motor Poles

Set the number of motor poles to E2-04. If Auto-Tuning completes successfully, the value entered to T1-06 will automatically be saved to E2-04.

No.	Parameter Name	Setting Range	Default
E2-04	Number of Motor Poles	2 to 48	4

### ? E2-05: Motor Line-to-Line Resistance

Sets the line-to-line resistance of the motor stator winding. If Auto-Tuning completes successfully, this value is automatically calculated. Remember that this value must be entered as line-to-line and not for each motor phase.

If Auto-Tuning is not possible, then contact the motor manufacturer to find out the line-to-line resistance or measure it manually. When using the manufacturer motor test report, calculate E2-05 by the formulas below.

- E-type insulation: Multiply 0.92 times the resistance value ( $\Omega$ ) listed on the test report at 75°C.
- B-type insulation: Multiply 0.92 times the resistance value ( $\Omega$ ) listed on the test report at 75°C.
- F-type insulation: Multiply 0.87 times the resistance value ( $\Omega$ ) listed on the test report at 115°C.

No.	Parameter Name	Setting Range	Default
E2-05	Motor Line-to-Line Resistance	0.000 to 65.000 $\Omega$	Determined by C6-01 and o2-04

### ? E2-06: Motor Leakage Inductance

Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. This value is automatically set during Auto-Tuning (Rotational Auto-Tuning, Stationary Auto-Tuning 1, 2).

No.	Parameter Name	Setting Range	Default
E2-06	Motor Leakage Inductance	0.0 to 40.0%	Determined by C6-01 and o2-04

### ? E2-07: Motor Iron-Core Saturation Coefficient 1

Sets the motor iron saturation coefficient at 50% of the magnetic flux. If Rotational Auto-Tuning completes successfully, then this value is automatically calculated and set to E2-07. This coefficient is used when operating with constant output.

No.	Parameter Name	Setting Range	Default
E2-07	Motor Iron-Core Saturation Coefficient 1	0.00 to 0.50	0.50

### ? E2-08: Motor Iron-Core Saturation Coefficient 2

Sets the motor iron saturation coefficient at 75% of the magnetic flux. If Rotational Auto-Tuning completes successfully, then this value is automatically and set to E2-08. This coefficient is used when operating with constant output.

No.	Parameter Name	Setting Range	Default
E2-08	Motor Iron-Core Saturation Coefficient 2	E2-07 to 0.75	0.75

### ? E2-09: Motor Mechanical Loss

This parameter sets to the motor mechanical loss as a percentage of motor rated power (kW) capacity.

Adjust this setting in the following circumstances:

- When there is a large amount of torque loss due to motor bearing friction.

The setting for the mechanical loss is added to the torque.

No.	Parameter Name	Setting Range	Default
E2-09	Motor Mechanical Loss	0.0 to 10.0%	0.0%

### ? E2-10: Motor Iron Loss for Torque Compensation

This parameter sets the motor iron loss in watts.

No.	Parameter Name	Setting Range	Default
E2-10	Motor Iron Loss for Torque Compensation	0 to 65535 W	Determined by C6-01 and o2-04

### ? E2-11: Motor Rated Power

This parameter sets the motor rated power in kW. If Auto-Tuning completes successfully, the value entered to T1-02 will automatically be saved to E2-11.

No.	Parameter Name	Setting Range	Default
E2-11	Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04

**Note:** The maximum applicable motor capacity varies based on whether the drive is set for Normal Duty or Heavy Duty performance (C6-01). For more information, refer to [Model Number and Nameplate Check on page 28](#).

### ? Setting Motor Parameters Manually

Follow the instructions below when setting motor-related parameters manually instead of using the Auto-Tuning feature. Refer to the motor test report included with the motor to make sure the correct data is entered into the drive.

#### Setting the Motor Rated Current

Enter the motor rated current listed on the nameplate of the motor to E2-01.

#### Setting the Motor Rated Slip

Use the base speed listed on the motor nameplate to calculate the rated slip. Refer to the formula below, then enter that value to E2-02.

Motor rated slip = rated frequency [Hz] – base speed [r/min] × (no. of motor poles) / 120

## 5.5 E: Motor Parameters

### Setting the No-Load Current

Enter the no-load current at rated frequency and rated voltage to E2-03. The no-load current is not usually listed on the nameplate. Contact the motor manufacturer if the data cannot be found.

The default setting of the no-load current is for performance with a 4-pole Yaskawa motor.

### Setting the Number of Motor Poles

Only required in V/f Control with PG and Closed Loop Vector Control. Enter the number of motor poles as indicated on motor nameplate.

### Setting the Line-to-Line Resistance

E2-05 is normally set during Auto-Tuning. If Auto-Tuning cannot be performed, contact the manufacturer of the motor to find out what the correct resistance is between motor lines. The motor test report can also be used to calculate this value:

- E-type insulation: Multiply 0.92 times the resistance value ( $\Omega$ ) listed on the test report at 75°C.
- B-type insulation: Multiply 0.92 times the resistance value ( $\Omega$ ) listed on the test report at 75°C.
- F-type insulation: Multiply 0.87 times the resistance value ( $\Omega$ ) listed on the test report at 115°C.

### Setting the Motor Leakage Inductance

The motor leakage inductance set to E2-06 determines the amount of voltage drop relative to the motor rated voltage. This value should be entered particularly for motors with a low degree of inductance, such as high-speed motors. As this information is not listed on the motor nameplate, contact the motor manufacturer to find out the correct value for the motor leakage inductance.

### Setting the Motor Iron-Core Saturation Coefficient 1, 2

E2-07 and E2-08 are set when Auto-Tuning is performed.

### Setting the Motor Mechanical Loss

The drive only requires this information when using Closed Loop Vector Control. The drive compensates for the degree of mechanical loss with torque compensation. Although E2-09 rarely needs to be changed, adjustment may benefit the following circumstances:

- When there is a large amount of torque loss due to motor bearing friction.

### Setting the Motor Iron Loss for Torque Compensation

This value only needs to be set when using V/f Control. Enter this value in watts to E2-10. The drive uses this setting to improve the precision of torque compensation.

## ? E3: V/f Pattern for Motor 2

These parameters set the V/f pattern used for motor 2. *Refer to Setting 16: Motor 2 selection on page 196* for details on switching motors.

**Note:** As the function for switching between two motors cannot be used with a PM motor, the E3-□□ parameters will be hidden when a PM motor control mode is selected (A1-02 = 5, 6, or 7).

## ? E3-01: Motor 2 Control Mode Selection

Selects the control mode for motor 2. A control mode for PM motors cannot be selected for motor 2.

- Note:**
1. E3-01 dependant parameters are reset to the default settings when E3-01 is changed.
  2. Protection from motor overload (oL1) is determined by L1-01, just as it is for motor 1.

No.	Parameter Name	Setting Range	Default
E3-01	Motor 2 Control Mode Selection	0 to 3	0

### Setting 0: V/f Control

### Setting 1: V/f Control with PG

### Setting 2: Open Loop Vector Control

### Setting 3: Closed Loop Vector Control

**Note:** Protection from motor overload (oL1) is determined by L1-01, just as it is for motor 1.

### ? E3-04 to E3-13

Parameters E3-04 through E3-13 set up the V/f pattern used for motor 2 as shown in *Figure 5.45*.

**Note:** Certain E3-□□ parameters might not be visible depending on the control mode. *Refer to Parameter Table on page 408.*

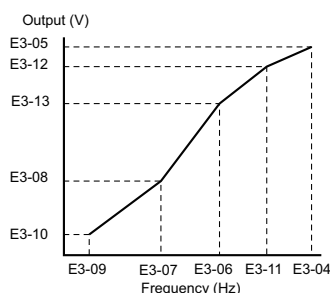
No.	Parameter Name	Setting Range	Default
E3-04	Motor 2 Max Output Frequency	40.0 to 400.0 Hz	<2>
E3-05	Motor 2 Max Voltage	0.0 to 255.0 V <1>	<1> <2>
E3-06	Motor 2 Base Frequency	0.0 to [E3-04]	<2>
E3-07	Motor 2 Mid Output Frequency	0.0 to [E3-04]	<2>
E3-08	Motor 2 Mid Output Frequency Voltage	0.0 to 255.0 V <1>	<1> <2>
E3-09	Motor 2 Minimum Output Frequency	0.0 to [E3-04]	<2>
E3-10	Motor 2 Minimum Output Frequency Voltage	0.0 to 255.0 V <1>	<1> <2>
E3-11	Motor 2 Mid Output Frequency 2	0.0 to [E3-04]	0.0 Hz <4>
E3-12	Motor 2 Mid Output Frequency Voltage 2	0.0 to 255.0 V <1>	0.0 V <1> <3> <4>
E3-13	Motor 2 Base Voltage	0.0 to 255.0 V <1>	0.0 V <1> <3>

<1> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<2> Default setting is determined by the control mode selected for motor 2 (E3-01).

<3> The drive sets this value when Auto-Tuning is performed (Rotational Auto-Tuning and Stationary Auto-Tuning 1, 2).

<4> Parameter ignored when E3-11 and E3-12 are set to 0.0.



**Figure 5.45 V/f Pattern for Motor 2**

- Note:**
1. The following conditions must be true when setting up the V/f pattern:  $E3-09 \leq E3-07 < E3-06 \leq E3-11 \leq E3-04$
  2. To make the V/f pattern a straight line at a frequency lower than E3-06, set  $E3-09 = E3-07$ . With this setting, E3-08 is disregarded.
  3. Parameters E3-04 through E3-13 are reset to their default values when the drive is initialized.
  4. E3-11, E3-12, and E3-13 rarely need to be changed, and should only be used to fine-tune the V/f pattern in the constant output range.

### ? E4: Motor 2 Parameters

E4 parameters contain the motor data for motor 2. These parameters are usually set automatically during the Auto-Tuning process (Rotational Auto-Tuning, Stationary Auto-Tuning 1 and 2). If Auto-Tuning cannot be performed, then refer to *Auto-Tuning Fault Detection on page 327*.

**Note:** As the function for switching between two motors cannot be used with a PM motor, the E5-□□ parameters will be hidden when a PM motor control mode is selected (A1-02 = 5, 6, or 7).

#### ? E4-01: Motor 2 Rated Current

Set E4-01 to the full load amps (FLA) stamped on the nameplate of motor 2. This value is used for motor protection and to calculate torque limits. If Auto-Tuning completes successfully, the value entered to T1-04 will automatically be saved to E4-01.

No.	Parameter Name	Setting Range	Default
E4-01	Motor 2 Rated Current	10 to 200% of the drive rated current.	Determined by C6-01 and o2-04

- Note:**
1. This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to *Table A.2* and *Table A.3*) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.
  2. If the motor rated current in E4-01 is set lower than the motor no-load current in E4-03, then a parameter setting error will occur (oPE02). E4-03 must be set correctly to prevent this error.

## 5.5 E: Motor Parameters

### ? E4-02: Motor 2 Rated Slip

This parameter sets the motor 2 rated slip frequency. Slip compensation is based on this value. The drive calculates this value automatically during Auto-Tuning (Rotational Auto-Tuning and Stationary Auto-Tuning 1, 2).

For information on calculating the motor rated slip, refer to [E2-02: Motor Rated Slip on page 176](#).

No.	Parameter Name	Setting Range	Default
E4-02	Motor 2 Rated Slip	0.00 to 20.00 Hz	Determined by C6-01 and o2-04

### ? E4-03: Motor 2 Rated No-Load Current

Set the no-load current for motor 2 in amperes when operating at the rated frequency and the no-load voltage. The drive sets E2-03 during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning 1, 2). The motor no-load current listed in the motor test report can also be entered to E2-03 manually. Contact the motor manufacturer to receive a copy of the motor test report.

No.	Parameter Name	Setting Range	Default
E4-03	Motor 2 Rated No-Load Current	0 to [E4-01]	Determined by C6-01 and o2-04

**Note:** This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#).) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

### ? E4-04: Motor 2 Motor Poles

Set the pole number of motor 2 to E4-04. If Auto-Tuning completes successfully, the entered value to T1-06 will be automatically saved to E4-04.

No.	Parameter Name	Setting Range	Default
E4-04	Motor 2 Motor Poles	2 to 48	4

### ? E4-05: Motor 2 Line-to-Line Resistance

Sets the line-to-line resistance for the motor 2 stator winding. If Auto-Tuning completes successfully, this value is automatically calculated. Remember this value must be entered as line-to-line and not for each motor phase. [Refer to E2-05: Motor Line-to-Line Resistance on page 176](#) to manually enter this parameter setting.

No.	Parameter Name	Setting Range	Default
E4-05	Motor 2 Line-to-Line Resistance	0.000 to 65.000 $\Omega$	Determined by C6-01 and o2-04

### ? E4-06: Motor 2 Leakage Inductance

Sets the voltage drop due to motor leakage inductance as a percentage of rated voltage of motor 2. This value is automatically set during Auto-Tuning (Rotational Auto-Tuning and Stationary Auto-Tuning 1, 2).

No.	Parameter Name	Setting Range	Default
E4-06	Motor 2 Leakage Inductance	0.0 to 40.0%	Determined by C6-01 and o2-04

### ? E4-10: Motor 2 Iron Loss

Sets the motor 2 iron loss in watts.

No.	Parameter Name	Setting Range	Default
E4-10	Motor 2 Iron Loss	0 to 65535 W	Determined by C6-01 and o2-04

### ? E4-11: Motor 2 Rated Power

Sets the motor 2 rated power. If Auto-Tuning completes successfully, the value entered to T1-02 will automatically be saved to E4-11.

No.	Parameter Name	Setting Range	Default
E4-11	Motor 2 Rated Power	0.00 to 650.00 kW	Determined by C6-01 and o2-04

**Note:** The maximum applicable motor capacity varies based on whether the drive is set for Normal Duty or Heavy Duty performance (C6-01). For more information, refer to [Model Number and Nameplate Check on page 28](#).

## ? E5: PM Motor Settings

These parameters set the motor data of a PM motor.

When Yaskawa motors are used, entering the motor code written on the motor nameplate will set up the E5-□□ parameters.

For all other PM motors, Auto-Tuning can be performed. If motor data is known, it can also be entered manually.

- Note:**
1. E5-□□ parameters are visible only when a PM motor control mode is selected (A1-02 = 5, 6, or 7).
  2. E5-□□ parameters are not reset when the drive is initialized using parameter A1-03.

### ? E5-01: Motor Code Selection

When Yaskawa motors are used, set the motor code for the PM motor being used. Depending on the motor code entered, the drive automatically sets several parameters to appropriate values. [Refer to Parameter Defaults Determined by Motor Code \(E5-01\) on page 493](#) for details on the supported motor codes and their parameter settings.

Setting parameter E5-01 to FFFF will allow to set the motor data manually using the E5-□□ parameters.

No.	Parameter Name	Setting Range	Default
E5-01	Motor Code Selection	0000 to FFFF	Determined by A1-02, C6-01 and o2-04

- Note:**
1. If E5-01 was set a value besides FFFF and is then changed to FFFF, the value of parameters E5-02 through E5-24 will not change.
  2. If using a different motor other than Yaskawa's SMRA, SSR1, or SST4 series, then E5-01 should be set to FFFF.
  3. The default setting is below:
    - OLV/PM, AOLV/PM: Yaskawa SSR1 Series (1750 r/min)
    - CLV/PM: Yaskawa SSR4 Series (1750 r/min)
  4. Some selections may not be available depending on the motor code that has been selected.
  5. If an alarm or hunting occurs even though a motor code is used, enter the value indicated on the name plate. For details, refer to [Auto-Tuning for Permanent Magnet Motors on page 96](#).

### ? E5-02: Motor Rated Power

Sets the rated power of the motor. Determined by the value set to T2-04 during Stationary Auto-Tuning for PM motors or by entering the motor code to E5-01.

No.	Parameter Name	Setting Range	Default
E5-02	Motor Rated Power	0.10 to 650.00 kW	Determined by E5-01

### ? E5-03: Motor Rated Current

Sets the motor rated current in amps. This parameter is automatically set when the value is entered to T2-06 during the Auto-Tuning process.

No.	Parameter Name	Setting Range	Default
E5-03	Motor Rated Current	10 to 200% of drive rated current	Determined by E5-01

- Note:** This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

## 5.5 E: Motor Parameters

### ? E5-04: Number of Motor Poles

Sets the number of motor poles. This parameter is automatically set when the value is entered to T2-08 during the Auto-Tuning process.

No.	Parameter Name	Setting Range	Default
E5-04	Number of Motor Poles	2 to 48	Determined by E5-01

### ? E5-05: Motor Stator Resistance (r1)

Set the resistance for one motor phase. When measuring the resistance manually, make sure not to enter the line-to-line resistance into E5-05.

No.	Parameter Name	Setting Range	Default
E5-05	Motor Stator Resistance	0.000 to 65.000 $\Omega$	Determined by E5-01

### ? E5-06: Motor d-Axis Inductance (Ld)

Sets the d-axis inductance in 0.01 mH units. This parameter is set during the Auto-Tuning process.

No.	Parameter Name	Setting Range	Default
E5-06	Motor d-Axis Inductance	0.00 to 300.00 mH	Determined by E5-01

### ? E5-07: Motor q-Axis Inductance (Lq)

Sets the q-axis inductance in 0.01 mH units. This parameter is set during the Auto-Tuning process.

No.	Parameter Name	Setting Range	Default
E5-07	Motor q-Axis Inductance	0.00 to 600.00 mH	Determined by E5-01

### ? E5-09: Motor Induction Voltage Constant 1 (Ke)

Set the induced peak voltage per phase in units of 0.1 mV/(rad/s) [electrical angle]. Set this parameter when using an SSR1 series IPM motor with derated torque or an SST4 series IPM motor with constant torque.

When E5-01 is set to FFFF, use either E5-09 or E5-24 for setting the voltage constant. This parameter is set during Parameter Auto-Tuning for PM motors.

No.	Parameter Name	Setting Range	Default
E5-09	Motor Induction Voltage Constant 1	0.0 to 2000.0 mV/(rad/s)	Determined by E5-01

**Note:** Ensure that E5-24 = 0 when setting parameter E5-09. An alarm will be triggered, however, if both E5-09 and E5-24 are set 0, or if neither parameter is set to 0. When E5-01 = FFFF, then E5-09 = 0.0.

### ? E5-11 Encoder Z-Pulse Offset ( $\Delta\theta$ )

Sets the offset between the rotor magnetic axis and the Z-pulse of the encoder connected. This parameter is set during Parameter Auto-Tuning for PM motors and during Z Pulse Tuning.

No.	Parameter Name	Setting Range	Default
E5-11	Encoder Z-Pulse Offset	-180.0 to 180.0 deg	0.0 deg

### ? E5-24: Motor Induction Voltage Constant 2 (Ke)

Set the induced phase-to-phase rms voltage in units of 0.1 mV/(r/min) [mechanical angle]. Set this parameter when using an SMRA Series SPM Motor.

When E5-01 is set to FFFF, use either E5-09 or E5-24 for setting the voltage constant. This parameter is set during Parameter Auto-Tuning for PM motors.

No.	Parameter Name	Setting Range	Default
E5-24	Motor Induction Voltage Constant 2	0.0 to 6500.0 mV/(r/min)	Determined by E5-01

**Note:** Ensure that E5-09 = 0 when setting parameter E5-24. An alarm will be triggered, however, if both E5-09 and E5-24 are set 0, or if neither parameter is set to 0. When E5-01 = FFFF, then E5-09 = 0.0.

## 5.6 F: Option Settings

### ? F1: PG Speed Control Card Settings

Yaskawa offers two motor encoder PG option cards: PG-B3 and PG-X3. When using only one PG option card, use the CN5-C port. For two PG option cards, use ports CN5-C and CN5-B. When one of the multi-function input terminals has been programmed to act as a switch between two motors (H1-□□ = 16), then the card connected to port CN5-C is to be used for motor 1 while the card connected to CN5-B is for motor 2.

*Table 5.19* lists the parameters that must be set for each option card port.

**Table 5.19 Option Card Ports and Corresponding Parameters**

Port	Parameters
	F1-02 to F1-04, F1-08 to F1-11, F1-14
	F1-01, F1-05, F1-06, F1-12, F1-13, F1-18 to F1-21
	F1-31 to F1-37

### ? F1-01, F1-31: PG 1 and PG 2 Pulses Per Revolution

Sets the number encoder number of pulses per revolution.

No.	Parameter Name	Option Port	Setting Range	Default
F1-01	PG 1 Pulses Per Revolution	CN5-C	0 to 60000 ppr <1>	1024 ppr
F1-31	PG 2 Pulses Per Revolution	CN5-B	0 to 60000 ppr	1024 ppr

<1> The setting range is 0 to 15000 ppr in PM motor control modes.

### ? F1-02, F1-14: PG Open (PGo) Circuit Operation Selection, Detection Time

A PGo fault is triggered if the drive receives no pulse signal for longer than the time set in F1-14. The stopping method when PGo occurs should be set to parameter F1-02.

No.	Parameter Name	Option Port	Setting Range	Default
F1-02	Operation Selection at PG Open Circuit (PGo)	CN5-B, CN5-C	0 to 3	1
F1-14	PG Open-Circuit Detection Time	CN5-B, CN5-C	0.0 to 10.0 s	2.0 s

#### Parameter F1-02 Settings:

**Setting 0: Ramp to stop (uses the deceleration time set to C1-02)**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop (uses the Fast Stop time set to C1-09)**

**Setting 3: Alarm only**

**Note:** Due to potential damage to motor and machinery, the “Alarm only” setting should be used only under special circumstances.

### ? F1-03, F1-08, F1-09: Overspeed (oS) Operation Selection, Detection Level, Delay Time

An overspeed error (oS) is triggered when the speed feedback exceeds the value set in F1-08 for longer than the time set in F1-09. The stopping method when an overspeed fault occurs can be selected in parameter F1-03.

No.	Parameter Name	Option Port	Setting Range	Default
F1-03	Operation Selection at Overspeed (oS)	CN5-B, CN5-C	0 to 3	1
F1-08	Overspeed Detection Level	CN5-B, CN5-C	0 to 120%	115%
F1-09	Overspeed Detection Delay Time	CN5-B, CN5-C	0.0 to 2.0 s	Determined by A1-02

#### Parameter F1-03 Settings:

**Setting 0: Ramp to stop (uses the deceleration time set to C1-02)**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop (uses the Fast Stop time set to C1-09)**

**Setting 3: Alarm only**

**Note:** Due to potential damage to motor and machinery, the “Alarm only” setting should be used only under special circumstances.

## 5.6 F: Option Settings

### ? F1-04, F1-10, F1-11: Operation at Speed Deviation (dEv), Detection Level, Delay Time

A speed deviation error (dEv) is triggered when the difference between the frequency reference and the speed feedback exceeds the value set in F1-10 for longer than the time set in F1-1. The stopping method when a speed deviation fault occurs can be selected in parameter F1-04.

No.	Parameter Name	Option Port	Setting Range	Default
F1-04	Operation Selection at Deviation (dEv)	CN5-B, CN5-C	0 to 3	3
F1-10	Excessive Speed Deviation Detection Level	CN5-B, CN5-C	0 to 50%	10%
F1-11	Excessive Speed Deviation Detection Delay Time	CN5-B, CN5-C	0.0 to 10.0 s	0.5 s

#### Settings for Parameter F1-04:

**Setting 0: Ramp to stop (uses the deceleration time set to C1-02)**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop (uses the Fast Stop time set to C1-09)**

**Setting 3: Alarm only (drive continues operating while “dEv” flashes on the screen)**

### ? F1-05, F1-32: PG 1, PG 2 Rotation Selection

Determines the direction indicated by the pulses from the PG feedback encoder for motor 1 and motor 2.

See PG option card instruction manual for details on how to set the direction for the PG encoder and the motor.

No.	Parameter Name	Option Port	Setting Range	Default
F1-05	PG 1 Rotation Selection	CN5-C	0, 1	Determined by A1-02
F1-32	PG 2 Rotation Selection	CN5-B	0, 1	0

**Setting 0: A pulse leads with Forward run command.**

**Setting 1: B pulse leads with Forward run command.**

### ? F1-06, F1-35: PG 1, PG 2 Division Rate for PG Pulse Monitor

Sets the ratio between the pulse input and the pulse output of a PG option card as a three digit number, where the first digit (n) sets the numerator and the second and third digit (m) set the denominator as shown below:

$$f_{\text{Pulse Input}} = f_{\text{Pulse Output}} \cdot \frac{(1 + n)}{m}$$

Example: To have a ratio of 1/32 between the PG card pulse input and output, set F1-06 = 032.

No.	Parameter Name	Option Port	Setting Range	Default
F1-06	PG 1 Division Rate for PG Pulse Monitor	CN5-C	1 to 132 (1 to $\frac{1}{32}$ )	1
F1-35	PG 2 Division Rate for PG Pulse Monitor	CN5-B	1 to 132 (1 to $\frac{1}{32}$ )	1

### ? F1-12, F1-13, F1-33, F1-34: PG 1, PG 2 Gear Teeth 1, 2 (V/f w/PG only)

Sets the gear ratio between the motor shaft and the PG encoder. F1-12 and F1-33 set the number of gear teeth on the motor side, while F1-13 and F1-34 set the number of gear teeth for the load side. The drive uses the formula below to calculate the motor speed.

$$r/\text{min} = \frac{\text{Input pulses from PG} \times 60}{\text{Pulses per Rev (F1-01/31)}} \cdot \frac{\text{Load-side PG gear teeth (F1-12/33)}}{\text{Motor-side PG gear teeth (F1-13/34)}}$$

No.	Parameter Name	Option Port	Setting Range	Default
F1-12	PG 1 Gear Teeth 1	CN5-C	0 to 1000	0
F1-13	PG 1 Gear Teeth 2	CN5-C	0 to 1000	0
F1-33	PG 2 Gear Teeth 1	CN5-B	0 to 1000	0
F1-34	PG 2 Gear Teeth 2	CN5-B	0 to 1000	0

**Note:** A gear ratio of 1 will be used if any of these parameters is set to 0.

### ? F1-18: dv3 Detection Selection (CLV/PM)

A dv3 situation is detected when the torque reference and speed reference are in opposite directions while the difference between the actual motor speed and the speed reference is greater than 30%. Parameter F1-18 sets the number of times such a situation must occur before a dv3 fault is triggered. Setting F1-18 to 0 disables dv3 detection.

No.	Parameter Name	Option Port	Setting Range	Default
F1-18	dv3 Detection Selection	CN5-B, CN5-C	0 to 10	10

**Note:** A common cause for a dv3 fault is the incorrect setting of E5-11. Make sure the correct Z pulse offset has been entered to E5-11.

### ? F1-19: dv4 Detection Selection (CLV/PM)

A dv4 fault is triggered when there is a motor speed deviation opposite to the frequency reference and larger than the number of pulses set in F1-19. Setting F1-19 to 0 disables dv4 detection.

No.	Parameter Name	Option Port	Setting Range	Default
F1-19	dv4 Detection Selection	CN5-B, CN5-C	0 to 5000	128

**Note:** 1. A common cause for a dv4 fault is the incorrect setting of E5-11. Make sure the correct Z pulse offset is set to E5-11.  
2. Set F1-19 to 0 for applications where the direction of the load is the opposite of the speed reference.

### ? F1-20, F1-36: PG Option Card Disconnect Detection

Sets whether the drive detects a fault or not when a PG-X3 card is disconnected.

No.	Parameter Name	Option Port	Setting Range	Default
F1-20	PG Option Card Disconnection Detection 1	CN5-C	0, 1	1
F1-36	PG Option Card Disconnection Detection 2	CN5-B	0, 1	1

**Setting 0: Disabled**

**Setting 1: Enabled**

### ? F1-21, F1-37: PG 1, PG 2 Signal Selection (V/f w/PG only)

Determines whether the signal to the PG option card is single track or two track.

No.	Parameter Name	Option Port	Setting Range	Default
F1-21	PG 1 Signal Selection	CN5-C	0, 1	0
F1-37	PG 2 Signal Selection	CN5-B	0, 1	0

**Setting 0: Single track (A track only)**

**Setting 1: Two track (tracks A and B)**

### ? F1-30: PG Option Card Port for Motor 2 Selection

Specifies the drive port for the PG option card used for motor 2. This parameter should be set when switching between motor 1 and motor 2, where both motors supply a speed feedback signal to the drive. If the same PG card is being used for feedback signals from both motors, then set F1-30 to 0. If each motor has its own PG card connected to the drive, then set F1-30 to 1.

**Note:** It is not possible to switch between motors when using a PM motor.

No.	Parameter Name	Setting Range	Default
F1-30	PG Option Card Port for Motor 2 Selection	0, 1	1

**Setting 0: CN5-C**

**Setting 1: CN5-B**

### ? F2: Analog Input Card Settings

These parameters are used to setup the drive for operation with the analog input option card AI-A3. This section describes parameters that govern operation with an input option card. Refer to the instruction manual packaged with the option card for specific details on installation, wiring, input signal level selection, and parameter setup.

#### ? F2-01: Analog Input Option Card Operation Selection

Determines how the input terminals on the AI-A3 option card are to be used.

No.	Parameter Name	Setting Range	Default
F2-01	Analog Input Option Card Operation Selection	0, 1	0

#### Setting 0: Separate functions for each terminal (V1, V2, V3 replace terminals A1, A2, A3)

Apply this setting to replace the drive terminals A1, A2, and A3 by the option board terminals V1, V2, and V3. Functions, gain, and bias levels for an analog reference supplied by AI-A3 are set using the H3-□□ parameters as described in [H3-03, H3-04: Terminal A1 Gain and Bias Settings on page 212](#).

**Note:** Parameter setting error oPE05 will occur if option card terminals are set for separate input functions (F2-01 = 0) while b1-01 = 3.

#### Setting 1: Combine input terminal values to create frequency reference

With this setting, all three input signals on the AI-A3 option card are added together to create the frequency reference. When the option card is the source of the frequency reference for the drive, parameter b1-01 must be set to 3. Gain and bias settings for the frequency reference supplied from AI-A3 can be set using parameters F2-02 and F2-03.

#### ? F2-02, F2-03: Analog Input Option Card Gain, Bias

Parameter F2-02 sets the gain and parameter F2-03 sets the bias for the AI-A3 input signal when the card is used in the combined input signals mode (F2-01 = 1). Both gain and bias are set as a percentage of the maximum output frequency.

No.	Parameter Name	Setting Range	Default
F2-02	Analog Input Option Card Gain	-999.9 to 999.9%	100.0%
F2-03	Analog Input Option Card Bias	-999.9 to 999.9%	0.0%

**Note:** Enabled only when F2-01 = 1.

### ? F3: Digital Input Card Settings

These parameters set up the drive for operation with the option card DI-A3. This section describes parameters that govern operation with a digital input option card. Refer to the instruction manual packaged with the option card for specific details on installation, wiring, input signal level selection, and parameter setup.

#### ? F3-01: Digital Input Option Card Input Selection

Determines the type of input for digital option card DI-A3 when o1-03 is set to 0 or 1.

No.	Parameter Name	Setting Range	Default
F3-01	Digital Input Option Card Input Selection	0 to 7	0

#### Setting 0: BCD, 1% units

#### Setting 1: BCD, 0.1% units

#### Setting 2: BCD, 0.01% units

#### Setting 3: BCD, 1 Hz units

#### Setting 4: BCD, 0.1 Hz units

#### Setting 5: BCD, 0.01 Hz units

#### Setting 6: BCD, special setting (5 digit input), 0.02 Hz units

#### Setting 7: Binary

The value set to F3-03 determines the setting range and units as follows:

F3-03 = 0: 100%/255 (-255 to +255)

F3-03 = 1: 100%/4095 (-4095 to +4095)

F3-03 = 2: 100%/30000 (-33000 to +33000)

**Note:** BCD input when o1-03 = 2 or 3. Units are determined by o1-03.

### ? F3-03: Digital Input Option DI-A3 Data Length Selection

Determines the number of bits for the option card input that sets the frequency reference.

No.	Parameter Name	Setting Range	Default
F3-03	Digital Input Option DI-A3 Data Length Selection	0 to 2	2

Setting 0: 8 bit

Setting 1: 12 bit

Setting 2: 16 bit

### ? F4: Analog Monitor Card Settings

These parameters set up the drive for operation with the analog output option card AO-A3. This section describes parameters that govern operation with an analog output option card. Refer to the instruction manual packaged with the option card for specific details on installation, wiring, input signal level selection, and parameter setup.

#### ? F4-01, F4-03: Terminal V1, V2 Monitor Selection

Selects the data to output from analog terminal V1. Enter the final three digits of U□-□□ to determine which monitor data is output from the option card. Some monitors are only available in certain control modes.

No.	Parameter Name	Setting Range	Default
F4-01	Terminal V1 Monitor Selection	000 to 999	102
F4-03	Terminal V2 Monitor Selection	000 to 999	103

#### ? F4-02, F4-04, F4-05, F4-06: Terminal V1, V2 Monitor Gain and Bias

Parameters F4-02 and F4-04 determine the gain, while parameters F4-05 and F4-06 set the bias. These parameters are set as a percentage of the output signal from V1 and V2 where 100% equals 10 V output. The terminal output voltage is limited to 10 V.

No.	Parameter Name	Setting Range	Default
F4-02	Terminal V1 Monitor Gain	-999.9 to 999.9%	100.0%
F4-04	Terminal V2 Monitor Gain	-999.9 to 999.9%	50.0%
F4-05	Terminal V1 Monitor Bias	-999.9 to 999.9%	0.0%
F4-06	Terminal V2 Monitor Bias	-999.9 to 999.9%	0.0%

#### Using Gain and Bias to Adjust Output Signal Level

It is possible to calibrate the meter when the drive is stopped. Follow the procedure below.

##### Terminal V1

1. Use the digital operator to display the monitor gain for terminal V1 (F4-02). Make sure that the voltage output is 100% of the monitor level selection for terminal V1 (F4-01).
2. Adjust the setting to parameter F4-02 accordingly while watching the read out of the meter connected to terminal V1.
3. Use the digital operator to display the monitor bias for terminal V1 (F4-05). Make sure that the voltage output is 0% of the monitor level selection for terminal V1 (F4-01).
4. Adjust the setting to parameter F4-05 accordingly while watching the read out of the meter connected to terminal V1.

##### Terminal V2

1. Use the digital operator to display the monitor gain for terminal V2 (F4-04). Make sure that the voltage output is 100% of the monitor level selection for terminal V2 (F4-03).
2. Adjust the setting to parameter F4-04 accordingly while watching the read out of the meter connected to terminal V2.
3. Use the digital operator to display the monitor bias for terminal V2 (F4-06). Make sure that the voltage output is 0% of the monitor level selection for terminal V2 (F4-03).
4. Adjust the setting to parameter F4-06 accordingly while watching the read out of the meter connected to terminal V2.

## 5.6 F: Option Settings

### ? F4-07, F4-08: Terminal V1, V2 Signal Level

Sets the output signal level for terminals V1 and V2.

No.	Parameter Name	Setting Range	Default
F4-07	Terminal V1 Signal Level	0, 1	0
F4-08	Terminal V2 Signal Level	0, 1	0

**Setting 0: 0 to 10 V**

**Setting 1: -10 to 10 V**

### ? F5: Digital Output Card Settings

These parameters set up the drive for operation with the digital output option card DO-A3. This section describes parameters that govern operation with a digital output option card. Refer to the instruction manual packaged with the option card for specific details on installation, wiring, input signal level selection, and parameter setup.

### ? F5-01 through F5-08: Digital Output Option Card Terminal Function Selection

When F5-09 = 2, the parameters listed in the table below are used to assign functions to the output terminals on the option card.

No.	Name	Setting Range	Default
F5-01	Terminal P1-PC Output Selection	0 to 161	0: During run
F5-02	Terminal P2-PC Output Selection	0 to 161	1: Zero speed
F5-03	Terminal P3-PC Output Selection	0 to 161	2: Speed agree
F5-04	Terminal P4-PC Output Selection	0 to 161	4: Frequency detection 1
F5-05	Terminal P5-PC Output Selection	0 to 161	6: Drive ready
F5-06	Terminal P6-PC Output Selection	0 to 161	37: During frequency output
F5-07	Terminal M1-M2 Output Selection	0 to 161	F: Not used
F5-08	Terminal M3-M4 Output Selection	0 to 161	F: Not used

### ? F5-09: DO-A3 Output Mode Selection

Determines how the DO-A3 option card is to work with the drive.

No.	Parameter Name	Setting Range	Default
F5-09	DO-A3 Output Mode Selection	0 to 2	0

**Setting 0: Separate output functions for each of 8 terminals**

**Setting 1: Binary output**

**Setting 2: Output functions assigned by F5-01 through F5-08**

## ? F6: Communication Option Card

These parameters are to configure communication option cards and communication fault detection methods.

Some parameters apply to all communication option cards, while some parameters are used only for certain network options.

Parameter	Communication Protocol		
	CC-Link	MECHATROLINK-II	PROFIBUS-DP
F6-01 to F6-03	○	○	○
F6-04	○	–	–
F6-06 to F6-08	○	○	○
F6-10 to F6-14	○	–	–
F6-20, F6-21	–	○	–
F6-22	–	○	–
F6-23 to F6-26	–	○	–
F6-30 to F6-32	–	–	○

### ? F6-01: Communications Error Operation Selection

Determines drive operation if a communication error occurs.

No.	Parameter Name	Setting Range	Default
F6-01	Communications Error Operation Selection	0 to 3	1

**Setting 0: Ramp to stop (uses the deceleration time set to C1-02)**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop (uses the Fast Stop time set to C1-09)**

**Setting 3: Alarm only (continue operation)**

### ? F6-02: External Fault from Comm. Option Detection Selection

Determines the detection method of an external fault initiated by a communication option (EF0).

No.	Parameter Name	Setting Range	Default
F6-02	External Fault from Comm. Option Detection Selection	0 or 1	0

**Setting 0: Always detected**

**Setting 1: Detection during run only**

### ? F6-03: External Fault from Comm. Option Operation Selection

Determines the operation when an external fault is initiated by a communication option (EF0).

No.	Parameter Name	Setting Range	Default
F6-03	External Fault from Comm. Option Operation Selection	0 to 3	1

**Setting 0: Ramp to stop**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop**

**Setting 3: Alarm only (continue operation)**

## 5.6 F: Option Settings

### ? F6-06: Torque Reference / Torque Limit Selection from Comm. Option

Used to select if torque reference and torque limit values are assigned to the drive from the network.

No.	Parameter Name	Setting Range	Default
F6-06	Torque Reference / Torque Limit Selection from Comm. Option	0, 1	0

**Setting 0: Enabled**

**Setting 1: Disabled**

### ? F6-07: Multi-Step Speed Enable/Disable Selection when NetRef/ComRef is Selected

Selects how multi-step speed inputs are treated when the NetRef command is set.

No.	Parameter Name	Setting Range	Default
F6-07	Multi-Step Speed Enable/Disable Selection when NetRef/ComRef is Selected	0, 1	0

**Setting 0: Multi-step speed operation disabled**

If the NetRef command is selected, multi-step speed input frequency references are disabled.

**Setting 1: Multi-step speed operation enabled**

Even if the NetRef command is selected, multi-step speed inputs are still active and can override the frequency reference from the communications option.

### ? F6-08: Reset Communication Parameters

Determines whether communication-related parameters (F6-□□) are reset when the drive is initialized using parameter A1-03.

No.	Parameter Name	Setting Range	Default
F6-08	Reset Communication Parameters	0, 1	0

**Setting 0: Do not reset parameters F6-□□ when the drive is initialized with A1-03**

**Setting 1: Reset F6-□□ when the drive is initialized with A1-03**

**Note:** F6-08 is not reset when the drive is initialized.

### ? CC-Link Parameters

Parameters F6-04, F6-10, F6-11, and F6-14 set up the drive to operate on a CC-Link network.

For details on parameter settings, refer to the YASKAWA AC Drive 1000-Series Option CC-Link Installation Manual and Technical Manual.

### ? MECHATROLINK-II Parameters

Parameters F6-20 through F6-26 set up the drive to operate on a MECHATROLINK-II network.

For details on parameter settings, refer to the YASKAWA AC Drive 1000-Series Option MECHATROLINK-II Installation Manual and Technical Manual.

### ? PROFIBUS-DP Parameters

Parameters F6-30 through F6-32 set up the drive to operate on a PROFIBUS-DP network.

For details on parameter settings, refer to the YASKAWA AC Drive 1000-Series Option PROFIBUS-DP Installation Manual and Technical Manual.

## 5.7 H: Terminal Functions

H parameters are used to assign functions to the external terminals.

### ? H1: Multi-Function Digital Inputs

#### ? H1-01 to H1-08: Functions for Terminals S1 to S8

These parameters assign functions to the multi-function digital inputs. The various functions and their settings are listed below in [Table 5.20](#).

No.	Parameter Name	Setting Range	Default
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	1 to 7E	40 (F) <I>: Forward Run Command (2-wire sequence)
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	1 to 7E	41 (F) <I>: Reverse Run Command (2-wire sequence)
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	0 to 7E	24: External Fault
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	0 to 7E	14: Fault Reset
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	0 to 7E	3 (0) <I>: Multi-Step Speed Reference 1
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	0 to 7E	4 (3) <I>: Multi-Step Speed Reference 2
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	0 to 7E	6 (4) <I>: Jog Reference Selection
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	0 to 7E	8: Baseblock Command (N.O.)

<I> Number appearing in parenthesis is the default value after performing a 3-Wire initialization.

**Table 5.20 Multi-Function Digital Input Terminal Settings**

Setting	Function	Page	Setting	Function	Page
	3-wire sequence	<a href="#">192</a>	31	PID integral hold	<a href="#">197</a>
1	Local/remote selection	<a href="#">192</a>	34	PID soft starter cancel	<a href="#">197</a>
2	External reference 1/2 selection	<a href="#">193</a>	35	PID input level selection	<a href="#">198</a>
3	Multi-Step Speed Reference 1	<a href="#">193</a>	40	Forward run command (2-wire sequence)	<a href="#">198</a>
4	Multi-Step Speed Reference 2			Reverse run command (2-wire sequence)	
	Multi-Step Speed Reference 3			Run command (2-wire sequence 2)	
6	Jog reference selection	<a href="#">193</a>	43	FWD/REV command (2-wire sequence 2)	<a href="#">198</a>
	Accel/decel time selection 1	<a href="#">193</a>	44	Offset frequency 1	
8	Baseblock command (N.O.)	<a href="#">193</a>	45	Offset frequency 2	
	Baseblock Command (N.C.)		46	Offset frequency 3	<a href="#">198</a>
	Accel/decel ramp hold	<a href="#">193</a>	50	Disturb Function Cancel	
B	Drive overheat alarm (OH2)	<a href="#">193</a>	51	Synchronous Accel/Decel	<a href="#">198</a>
C	Analog terminal input selection	<a href="#">194</a>	53	Energy Saving On/Off	<a href="#">198</a>
D	PG encoder disable	<a href="#">194</a>	59	DC Injection Braking 1	<a href="#">199</a>
E	ASR integral reset	<a href="#">194</a>	60	DC Injection Braking 2	<a href="#">199</a>
F	Through mode	<a href="#">194</a>	61	External Speed Search command 1	<a href="#">199</a>
10	Up command	<a href="#">194</a>	62	External Speed Search command 2	<a href="#">199</a>
11	Down command			Field Weakening	<a href="#">199</a>
12	Forward jog		65	KEB (N.C.)	<a href="#">200</a>
13	Reverse jog	<a href="#">195</a>		KEB (N.O.)	
	Fault reset	<a href="#">195</a>	67	Communications test mode	<a href="#">200</a>
15	Fast Stop (N.O.)	<a href="#">195</a>	6A	Drive enabled	<a href="#">200</a>
16	Motor 2 selection	<a href="#">196</a>	71	Speed/Torque Control switch	<a href="#">200</a>
17	Fast Stop (N.C.)	<a href="#">195</a>	72	Zero Servo	<a href="#">200</a>
18	Timer function input	<a href="#">196</a>	77	ASR gain switch	<a href="#">200</a>
19	PID disable	<a href="#">196</a>	78	External torque reference polarity inversion	<a href="#">200</a>
1A	Accel/decel time selection 2	<a href="#">197</a>	7C	Short Circuit Braking (N.O.)	<a href="#">200</a>
1B	Program lockout	<a href="#">197</a>	7D	Short Circuit Braking (N.C.)	
	External fault	<a href="#">197</a>	7E	Forward/reverse detection (V/f control with simple PG)	<a href="#">200</a>
30	PID integral reset	<a href="#">197</a>	—	—	—

### Setting 0: 3-Wire Sequence

When one of the digital inputs is programmed for 3-wire control, that input becomes a forward/reverse directional input, S1 becomes the Run command input, and S2 becomes the Stop command input.

The drive will start the motor when the input S1 set for the Run command is closed for longer than 2 ms. The drive will stop the operation when the Stop input S2 is released for a brief moment. Whenever the input programmed for 3 wire sequence is open, the drive will be set for forward direction. If the input is closed, the drive is set for reverse direction.

**Note:** When 3-wire sequence is selected, the Run and Stop commands must be input via S1 and S2.

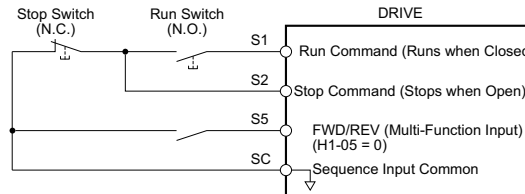


Figure 5.46 3-Wire Sequence Wiring Diagram

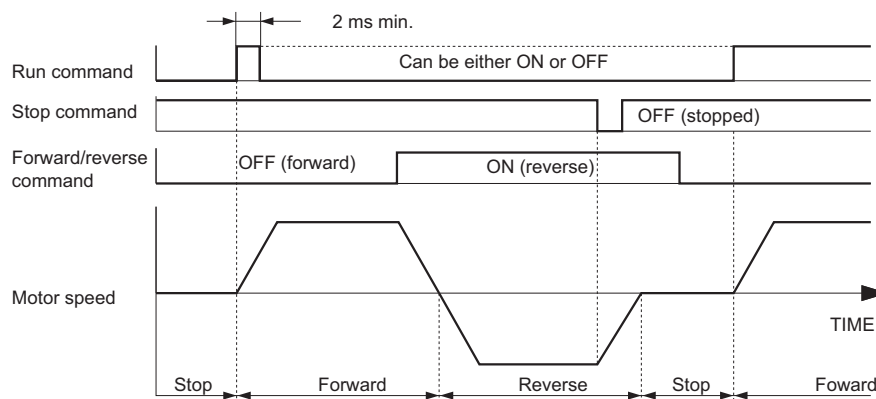


Figure 5.47 3-Wire Sequence

- Note:**
1. The Run command must be closed for more than 2 ms.
  2. If the Run command is active at power up and b1-17 = 0 (Run command at power up not accepted), the Run LED will flash to indicate that protective functions are operating. If required by the application, set b1-17 to 1 to have the Run command issued automatically as soon as the drive is powered up.

**WARNING!** Sudden Movement Hazard. Ensure start/stop and safety circuits are wired properly and in the correct state before energizing the drive. Failure to comply could result in death or serious injury from moving equipment.

**WARNING!** The drive may start unexpectedly in reverse direction after power up if it is wired for 3-wire sequence but set up for 2-wire sequence (default). Make sure b1-17 is set to "0" (drive does not accept a Run command active at power up). When initializing the drive use 3-wire initialization. Failure to comply could result in death or serious injury from moving equipment.

### Setting 1: LOCAL/REMOTE selection

This setting allows the input terminal to determine if the drive will run in LOCAL mode or REMOTE mode.

Status	Description
Open	REMOTE: Frequency reference and Run command are input from the external reference that has been selected. If a digital input set to H1-□□ = 2 is active, they will be read from external reference source 2 (b1-15 and b1-16). Otherwise they will be read from external reference source 1 (b1-01 and b1-02).
Closed	LOCAL: Frequency reference and Run command are input from the digital operator.

- Note:**
1. If one of the multi-function input terminals is set to for LOCAL/REMOTE, then the LO/RE key on the operator will be disabled.
  2. When the drive is set to LOCAL, the LO/RE LED will light.
  3. The default setting of the drive is not to allow switching between LOCAL and REMOTE during run. To allow the drive to switch between LOCAL and REMOTE during run, [Refer to b1-07: LOCAL/REMOTE Run Selection on page 125.](#)

**Setting 2: External reference 1/2 selection**

This function can be used to switch the Run command and frequency reference source between External reference 1 and 2 if the drive is in the REMOTE mode.

Status	Description
Open	External reference 1 is used (defined by parameters b1-01 and b1-02)
Closed	External reference 2 is used (defined by parameters b1-15 and b1-16)

**Note:** With default settings the drive is not to allow switching between External reference 1 and 2 during run. *Refer to b1-07: LOCAL/REMOTE Run Selection on page 125* if this feature is required by the application.

**Setting 3 to 5: Multi-Step Speed Reference 1 to 3**

Used to switch multi-step speed frequency references d1-01 to d1-08 by digital inputs. *Refer to d1-01 to d1-08, d1-17: Frequency Reference 1 to 8 and Jog Frequency Reference on page 165* for details.

**Setting 6: Jog reference selection**

The Jog frequency set in parameter d1-17 becomes the frequency reference when the input terminal closes. Refer to *d1: Frequency Reference on page 165* for details.

**Setting 7: Accel/decel time selection 1**

Used to switch between accel/decel times 1 (C1-01 and C1-02) and 2 (C1-03 and C1-04). *Refer to C1-01 to C1-08: Accel, Decel Times 1 to 4 on page 150* for details.

**Setting 8, 9: Baseblock command (N.O., N.C.)**

When the drive receives a Baseblock command, the output transistor stop switching and the motor coasts to stop. During this time, the alarm “bb” will flash on the digital operator to indicate baseblock. When baseblock ends and a Run command is active, the drive performs Speed Search to get the motor running again.

Digital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 8 (N.C.)	Baseblock (Interrupt output)	Normal operation
Setting 9 (N.O.)	Normal operation	Baseblock (Interrupt output)

**NOTICE:** If using baseblock in hoist applications, make sure the brake closes when the drive output is cut off by a Baseblock command triggered via one of the input terminals. Failure to do so will result in the motor suddenly coasting when the Baseblock command is entered, causing the load to slip.

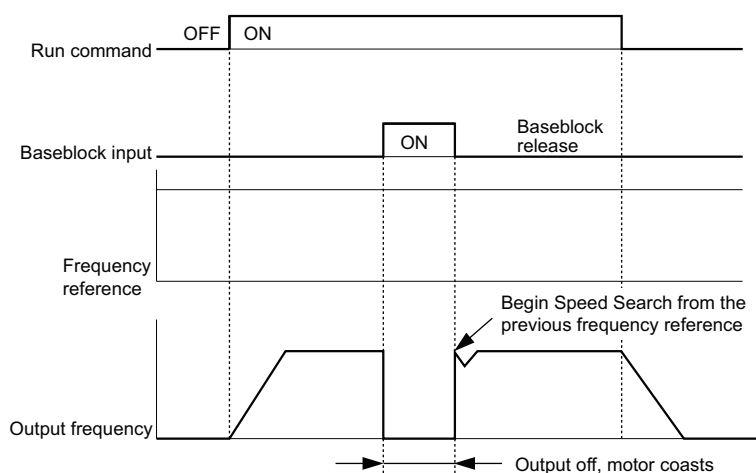


Figure 5.48 Baseblock Operation During Run

**Setting A: Accel/decel ramp hold**

When the digital input programmed for the Accel/decel ramp hold function closes, the drive will lock (“hold”) the output frequency. Acceleration or deceleration will resume once the input is opened again.

**Setting B: Drive overhear alarm (oH2)**

Triggers an oH2 alarm when the contact closes. Because this is an alarm, drive operation is not affected.

## 5.7 H: Terminal Functions

### Setting C: Analog terminal input selection (terminal A1, A2, A3)

When closed, the terminals specified in H3-14 are enabled. When open, the drive disregards the input signal to the analog terminals.

### Setting D: PG encoder disable

When closed the drive disregards PG feedback from the motor when using V/f Control with PG. When the terminal is opened again, the drive resumes using PG feedback to control motor speed.

### Setting E: ASR integral reset

Switches between PI control or simply P control by resetting the integral value. As long as the terminal is closed, integral operation is disabled and the drive uses P control. When the terminal opens, PI control resumes.

### Setting F: Through mode

Select this setting when using the terminal in a pass-through mode. When set to F, an input does not trigger any function in the drive. Setting F, however, still allows the input status to be read out by a PLC via a communication option or MEMOBUS/Modbus communications.

### Setting 10, 11: Up, Down command

Using the Up/Down function allows the frequency reference to be set by two push buttons. One digital input must be programmed as the Up input (H1-□□ = 10) to increase the frequency reference, and the other one must be programmed as the Down input (H1-□□ = 11) to decrease the frequency reference.

The Up/Down function has priority over the frequency references from the digital operator, the analog inputs, and the pulse input (b1-01 = 0, 1, 4). If the Up/Down function is used, then references provided by these sources will be disregarded.

The inputs operate as shown in the table below.

Status		Drive Operation
Up (10)	Down (11)	
Open	Open	Hold current frequency reference
Closed	Open	Increase frequency reference
Open	Closed	Decrease frequency reference
Closed	Closed	Hold current frequency reference

- Note:**
1. An oPE03 alarm will occur when only one of the functions Up/Down is programmed for a digital input.
  2. An oPE03 alarm will occur if the Up/Down function is assigned to the terminals while another input is programmed for the Accel/decel ramp hold function. For more information on alarms, [Refer to Multi-Function Input Selection Error on page 322](#).
  3. The Up/Down function can only be used for External reference 1. Consider this when using Up/Down and the external reference switching command (H1-□□ = 2).

### Using the Up/Down Function with Frequency Reference Limits

The upper frequency reference limit is determined by parameter d2-01.

The value for the lower frequency reference limit depends on the setting of parameter d4-10, and can be set by an analog input or parameter d2-02. When a Run command is applied, the lower limits work as follows:

- If the lower limit is set by d2-02 only, the drive will accelerate to this limit as soon as a Run command is entered.
- If the lower limit is determined by an analog input only, the drive will accelerate to the limit as long as the Run command and an Up or Down command are active. It will not start running if only the Run command is on.
- If the lower limit is set by both an analog input and d2-02, and the analog limit is higher than the d2-02 value, then the drive will accelerate to the d2-02 value when a Run command is input. Once the d2-02 value is reached, it will continue acceleration to the analog limit only if an Up or Down command is set.

**Figure 5.49** shows an Up/Down function example with a lower frequency reference limit set by d2-02, and the frequency reference hold function both enabled and disabled.

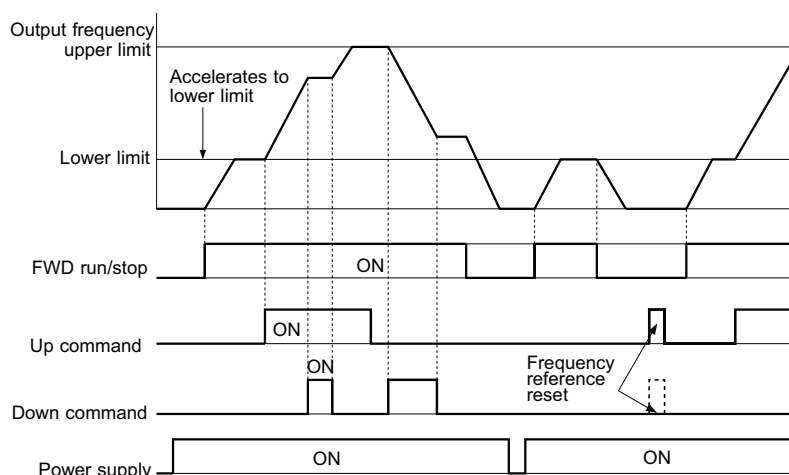


Figure 5.49 Up/Down Command Operation

**Setting 12, 13: Forward Jog, Reverse Jog**

Digital inputs programmed as Forward Jog (H1-□□ = 12) and Reverse Jog (H1-□□ = 13) will be Jog inputs that do not require a Run command. Closing the terminal set for Forward Jog input will cause the drive to ramp to the Jog frequency reference (d1-17) in the forward direction. The Reverse Jog will cause the same action in the reverse direction. The Forward Jog and Reverse Jog command can be set independently.

**Note:** The Forward Jog and Reverse Jog commands override all other frequency references. However, if the drive is set to prohibit reverse rotation (b1-04 = 1), then activating Reverse Jog will have no effect. If both the Forward Jog and Reverse Jog are input simultaneously for 500 ms or more, an alarm will occur and the drive will ramp to stop.

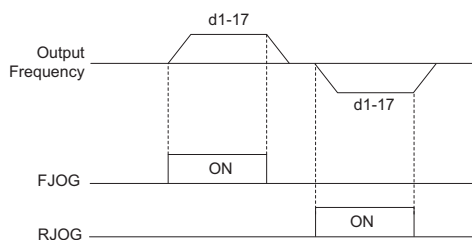


Figure 5.50 FJOG/RJOG Operation

**Setting 14: Fault reset**

Whenever the drive detects a fault condition, the fault output contact will close and the drive's output will shut off. The motor then coasts to stop (specific stopping methods can be selected for some faults such as L1-04 for motor overload). Once the Run command is removed, the fault can be cleared by either the RESET key on the digital operator or by closing a digital input configured as a Fault Reset (H1-□□ = 14).

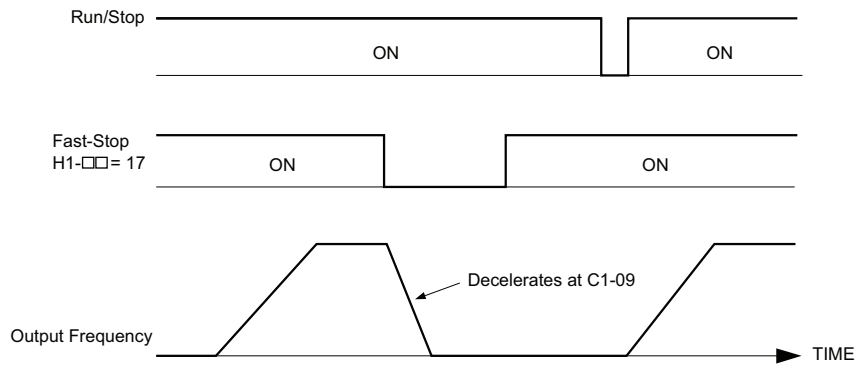
**Note:** Fault Reset commands are ignored as long as the Run command is present. To reset a fault, first remove the Run command.

**Setting 15, 17: Fast Stop (N.O., N.C.)**

The Fast Stop function operates much like an emergency stop input to the drive. If a Fast Stop command is input while the drive is running, the drive will decelerate to a stop by the deceleration time set to C1-09 (*Refer to C1-09: Fast Stop Time on page 151*). The drive can only be restarted after it has come to a complete stop, the Fast Stop input is off, and the Run command has been switched off.

- To trigger the Fast Stop function with a N.O. switch, set H1-□□ = 15.
- To trigger the Fast Stop function with a N.C. switch, set H1-□□ = 17.

*Figure 5.51* shows an operation example of Fast Stop.



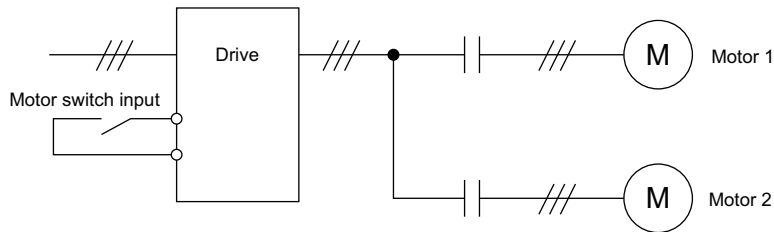
**Figure 5.51 Fast Stop Sequence**

**NOTICE:** Rapid deceleration can trigger an overvoltage fault. When faulted, the drive output shuts off, and the motor coasts. To avoid this uncontrolled motor state and to ensure that the motor stops quickly and safely, set an appropriate Fast Stop time to C1-09.

### Setting 16: Motor 2 selection

The drive has the capability to control two induction motors independently. A second motor may be selected using a multi-function digital input as shown in [Figure 5.52](#).

**Note:** The motor switching function is not available when using a PM motor.



**Figure 5.52 Motor Selection**

When switching between motor 1 and motor 2, the parameters used to control those motors also change. Below, [Table 5.21](#) lists the parameters that correspond to each motor.

**Table 5.21 Parameters for Switching Between Two Motors**

No.	Setting 16 Open (Motor 1)	⇒	Setting 16 Closed (Motor 2)
C1-□□: Acceleration/Deceleration Time	C1-01 to C1-04	⇒	C1-05 to C1-08
C3-□□: Motor Slip Compensation	C3-01 to C3-04	⇒	C3-21 to C3-24
C4-□□: Motor Torque Compensation	C4-01	⇒	C4-07
C5-□□: Speed Control (ASR)	C5-01 to C5-08, C5-12, C5-17, C5-18	⇒	C5-21 to C5-28, C5-32, C5-37, C5-38
E1-□□, E3-□□: V/f Pattern E2-□□, E4-□□: Motor Parameters	E1-□□, E2-□□	⇒	E3-□□ to E4-□□
F1-□□ (PG Constant)	F1-01 to F1-21	⇒	F1-02 to F1-04, F1-08 to F1-11, F1-14, F1-31 to F1-37

- Note:**
1. When using 2 motors, the motor overload protection selection (oL1) set to L1-01 applies to both motor 1 and motor 2.
  2. It is not possible to switch between motor 1 and motor 2 during run. Doing so will trigger the “rUn” alarm.
  3. There is a 500 ms delay when switching between motors equipped with a PG encoder for feedback.
  4. It is not possible to switch between motors when using a PM motor.

If a digital output is programmed for “Motor 2 selection” (H1-01, H1-02, or H1-03 = 1C), motor will be selected when the output is closed.

### Setting 18: Timer function input

This setting configures a digital input terminal as the input for the timer function. Use this setting combination with the timer function output (H2-□□ = 12). [Refer to b4: Delay Timers on page 135](#) for details.

### Setting 19: PID disable

When the PID function has been enabled by parameter b5-01, it can be indefinitely disabled by closing a digital input. When the input is released, the drive resumes PID operation. Also refer to [PID Block Diagram on page 138](#).

**Setting 1A: Accel/decel time selection 2**

Used to select accel/decel times 1 to 4 in combination with the Accel/decel time selection 1 command. *Refer to C1-01 to C1-08: Accel, Decel Times 1 to 4 on page 150* for details.

**Setting 1B: Program lockout**

When an input is programmed for Program Lockout, parameters values cannot be changed as long as this input is open (it is still possible to view and monitor parameter settings).

**Setting 20 to 2F: External fault**

By using the External fault command, the drive can be stopped when problems occur with external devices.

To use the External fault command, set one of the multi-function digital inputs to any value between 20 to 2F. The digital operator will display EF□ where □ is the number of the terminal to which the external fault signal is assigned.

For example, if an external fault signal is input to terminal S3, “EF3” will be displayed.

Select the value to be set in H1-□□ from a combination of any of the following three conditions:

- Signal input level from peripheral devices (N.O., N.C.)
- External fault detection method
- Operation after external fault detection

The following table shows the relationship between the conditions and the value set to H1-□□:

Setting	Terminal Status <1>		Detection Conditions <2>		Stopping Method			
	N.O.	N.C.	Always Detected	Detected during Run only	Ramp to Stop (fault)	Coast to Stop (fault)	Fast Stop (fault)	Alarm Only (continue running)
20	O		O		O			
21		O	O		O			
22	O			O	O			
23		O		O	O			
24	O		O			O		
25		O	O			O		
26	O			O		O		
27		O		O		O		
28	O		O				O	
29		O	O				O	
2A	O			O			O	
2B		O		O			O	
2C	O		O					O
2D		O	O					O
2E	O			O				O
2F		O		O				O

<1> Determine the terminal status for each fault, i.e., whether the terminal is normally open or normally closed.

<2> Determine whether detection for each fault should be enabled only during run or always detected.

**Setting 30: PID integral reset**

By configuring one of the digital inputs for PID integral reset (H1-□□ = 30), the value of the integral component in PID control will be reset to 0 whenever the terminal is closed. *Refer to PID Block Diagram on page 138* for more details.

**Setting 31: PID integral hold**

By configuring a digital input for Integral Hold (H1-0□ = 31), the value of the integral component of the PID control is locked as long as the input is active. The PID controller resumes integral operation from the hold value as soon as the integral hold input is released. *Refer to PID Block Diagram on page 138* for more information on this function.

**Setting 34: PID soft starter cancel**

A digital input configured as a PID soft starter cancel input (H1-0□ = 34) can be used to enable or disable the PID soft starter and thereby canceling the PID accel/decel time (b5-17). *Refer to PID Block Diagram on page 138*.

## 5.7 H: Terminal Functions

### Setting 35: PID input level selection

Allows an input terminal to switch the sign of the PID input. *Refer to PID Block Diagram on page 138* for details.

### Setting 40, 41: Forward run, Reverse run command for 2-wire sequence

Configures the drive for a 2-wire sequence.

When an input terminal set to 40 closes, the drive operates in the forward direction. When an input set for 41 closes, the drive will operate in reverse. Closing both inputs at the same time will result in an external fault.

- Note:**
1. This function cannot be used simultaneously with settings 42 and 43.
  2. The same functions are assigned to terminals S1 and S2 when the drive is initialized for 2-wire sequence.

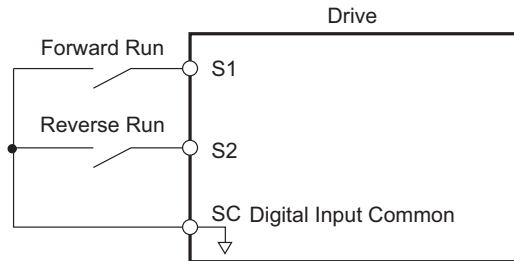


Figure 5.53 Example Wiring Diagram for 2-Wire Sequence

### Setting 42, 43: Run and direction command for 2-wire sequence 2

Sets the drive for 2-wire sequence 2.

When an input terminal programmed for 42 is closed, the drive will operate in the direction selected. When the input opens, the drive will stop. The input programmed for 43 selects the direction. If it is open, forward direction is selected. If it is closed, reverse direction is selected.

- Note:** This function cannot be used simultaneously with settings 40 and 41.

### Setting 44, 45, 46: Offset frequency 1, 2, 3

These inputs can be used to add offset frequencies d7-01, d7-02, and d7-03 to the frequency reference. *Refer to d7-01 to d7-03: Offset Frequency 1 to 3 on page 173* for details.

### Setting 50: Disturb Function Cancel

When enabled, a terminal set to "50" cancels the Disturb function. The Disturb waveform is generated as long as the terminal remains open. For more information, refer to *S1: Disturb Function on page 265*.

### Setting 51: Synchronous Accel/Decel

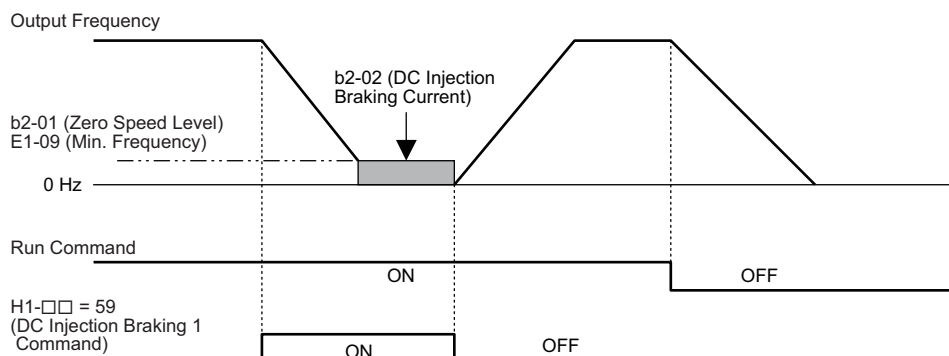
If this input is enabled the drive uses the accel/decel time setting as the time to accel/decel to the set frequency reference (not maximum frequency). In this way, motors in a line system can be accelerated or decelerated synchronously.

### Setting 53: Energy Saving On/Off

This terminal can enable and disable the Energy Saving feature in the drive, regardless of what parameter b8-01 is set to. For description of Energy Saving, see *b8: Energy Saving on page 146*.

### Setting 59: DC Injection Braking 1

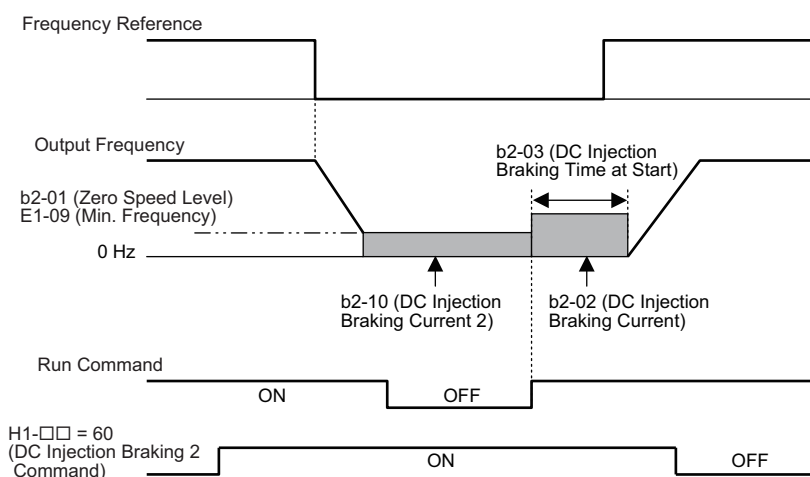
When this function is activated, the drive performs DC Injection Braking for as long as the input terminal is closed. The drive uses the DC Injection Braking current level set in parameter b2-02. A Run command is not required to activate this function. If the DC Injection 1 command is entered during run, the drive will perform DC Injection Braking.



**Note:** If b2-01 is set to a smaller value than parameter E1-09 (minimum frequency), then DC Injection Braking will begin as soon as the frequency falls to the value set to E1-09.

### Setting 60: DC Injection Braking 2

This function can be used to warm up the motor before starting it, and to keep the motor warm when stopped. The DC Injection 2 command can be activated using a digital input (H1-□□ = 60). A Run command is not necessary to use this function.



- Note:**
1. If a Run command is input while DC Injection 2 is active, then DC Injection 1 will be performed for the time set in b2-03. Acceleration will not start until the time set in b2-03 has passed.
  2. If the frequency reference is kept at zero after a Run command has been entered and the time b2-03 has passed, then the drive will continue to perform DC Injection 2 until the digital input is released.
  3. A Run command has priority over the DC Injection 2 command.
  4. If b2-01 is set to a smaller value than parameter E1-09 (minimum frequency), then DC Injection Braking will begin as soon as the frequency falls to the value set to E1-09.

### Setting 61, 62: External Speed Search command 1, 2

These input functions can be used to enable Speed Search even if parameter b3-01 = 0 (no Speed Search at start). See [Refer to Activating of Speed Search on page 132](#) for details on how to use the input signals. [Refer to b3: Speed Search on page 129](#) for more about Speed Search.

**Note:** Operator error oPE03 will result if both Speed Search 1 and Speed Search 2 are set to the input terminals at the same time.

### Setting 63: Field Weakening

Enabled in V/f Control. When closed, Field Weakening is performed. For details, see [d6: Field Weakening and Field Forcing on page 172](#).

## 5.7 H: Terminal Functions

### Setting 65, 66: KEB (N.C.), (N.O.)

A digital input programmed for this function can be used to activate the KEB 1 function and detect power supply return. If KEB is activated, the drive uses the method selected in parameter S4-01 to perform KEB.

**Note:** These inputs have no effect when setting S4-01 = 0.

Digital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 65 (N.C.)	KEB Deceleration	Normal operation
Setting 66 (N.O.)	Normal operation	KEB Deceleration

### Setting 67: Communication test mode

The drive has a built-in function for self-diagnosing serial communications operation. The test involves wiring the send and receive terminals of the RS-485/422 port together. The drive transmits data and then confirms that the communications are received normally. [Refer to Self-Diagnostics on page 539](#) for details on how to use this function.

### Setting 6A: Drive enable

A digital input configured as a “Drive enable” (H1-□□ = 6A) will prevent the drive from executing a Run command until the input is closed. When the input is open, the digital operator will display “dnE” to indicate that the drive is disabled.

If a Run command is enabled before the terminal set for “Drive enable” closes, then the drive will not run until the Run command is cycled (i.e., a new Run command is required). If the input is opened while the drive is running, the drive will stop according to the stop method set to b1-03 ([Refer to b1-03: Stopping Method Selection on page 121](#)).

### Setting 71: Speed/Torque Control switch

Switches the drive between Torque Control and Speed Control. Torque Control is enabled when the terminal is closed, and Speed Control is enabled when the terminal is open. Note that parameter d5-01 must be set to 0 when using this function. See [d5: Torque Control on page 168](#) and [Switching Between Torque and Speed Control on page 170](#).

### Setting 72: Zero Servo

Used to activate the Zero Servo function that can be used to lock the rotor at a certain position. Refer to [b9: Zero Servo on page 148](#) for details.

### Setting 77: ASR gain switch

Switches the ASR gain between the values set to C5-01 and C5-03. The gain set to C5-03 is enabled when the terminal is closed, and C5-01 is enabled when the terminal opens again. See [C5-01, C5-03 / C5-02, C5-04: ASR Proportional Gain 1, 2 / ASR Integral Time 1, 2 on page 159](#) for a more detailed description.

### Setting 78: External torque reference polarity inversion

Reverses the direction of the torque reference when the terminal closes. Refer to [d5: Torque Control on page 168](#) and [Setting the Torque Reference, Speed Limit, and Torque Compensation Values on page 168](#) for details.

### Setting 7C, 7D: Short Circuit Braking (N.O., N.C.) (OLV/PM, AOLV/PM)

An input programmed for this function can be used to activate Short Circuit Braking in Open Loop Vector control modes for PM motors. By linking all three phases of a PM motor, Short Circuit Braking creates a braking torque that can be used to stop a rotating motor or prevent a motor from coasting due to external forces. Parameter b2-18 can be used to limit the current during Short Circuit Braking.

Digital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 7C (N.O.)	Normal operation	Short Circuit Braking
Setting 7D (N.C.)	Short-Circuit Braking	Normal operation

### Setting 7E: Forward/reverse detection (for V/f Control with Simple PG Feedback)

When a digital input is programmed for this function, the input determines the motor rotation direction for V/f Control with Simple PG feedback (A1-02 = 0 and H6-01 = 3). If the input is open, the speed feedback signal is considered to be forward. If the input is closed, it is considered to be in reverse. [Refer to H6: Pulse Train Input/Output on page 220](#).

## ? H2: Multi-Function Digital Outputs

### ? H2-01 to H2-03: Terminal M1-M2, M3-M4, and M5-M6 Function Selection

The drive has three multi-function output terminals. [Table 5.22](#) lists the functions available for these terminals using H2-01, H2-02, and H2-03.

No.	Parameter Name	Setting Range	Default
H2-01	Terminal M1-M2 Function Selection	0 to 161	0: During run
H2-02	Terminal M3-M4 Function Selection	0 to 161	1: Zero Speed
H2-03	Terminal M5-M6 Function Selection	0 to 161	2: Speed agree 1

**Table 5.22 Multi-Function Digital Output Terminal Settings**

Setting	Function	Page	Setting	Function	Page
	During run	<a href="#">202</a>	1C	Motor 2 selection	<a href="#">208</a>
1	Zero Speed	<a href="#">202</a>	1D	During regeneration	<a href="#">208</a>
2	Speed agree 1	<a href="#">202</a>	1E	Restart enabled	<a href="#">208</a>
3	User-set speed agree 1	<a href="#">203</a>	1F	Motor overload alarm (oL1)	<a href="#">208</a>
4	Frequency detection 1	<a href="#">203</a>	20	Drive overheat pre-alarm (oH)	<a href="#">208</a>
5	Frequency detection 2	<a href="#">204</a>	2F	Maintenance period	<a href="#">208</a>
6	Drive ready	<a href="#">204</a>	30	During torque limit	<a href="#">209</a>
7	DC bus undervoltage	<a href="#">204</a>	31	During speed limit	<a href="#">209</a>
8	During baseblock (N.O.)	<a href="#">204</a>	32	During speed limit in Torque Control	<a href="#">209</a>
9	Frequency reference source	<a href="#">204</a>	33	Zero Servo complete	<a href="#">209</a>
A	Run command source	<a href="#">205</a>	37	During frequency output	<a href="#">209</a>
B	Torque detection 1 (N.O.)	<a href="#">205</a>	38	Drive enabled	<a href="#">209</a>
C	Frequency reference loss	<a href="#">205</a>	39	Watt hour pulse output	<a href="#">209</a>
D	Braking resistor fault	<a href="#">205</a>	3C	LOCAL/REMOTE Status	<a href="#">210</a>
E	Fault	<a href="#">205</a>	3D	During Speed Search	<a href="#">210</a>
F	Through mode	<a href="#">205</a>	3E	PID feedback low	<a href="#">210</a>
10	Minor fault	<a href="#">205</a>	3F	PID feedback high	<a href="#">210</a>
11	Fault reset command active	<a href="#">205</a>	4A	During KEB operation	<a href="#">210</a>
12	Timer output	<a href="#">205</a>	4B	During Short Circuit Braking	<a href="#">210</a>
13	Speed agree 2	<a href="#">206</a>	4C	During Fast Stop	<a href="#">210</a>
14	User-set speed agree 2	<a href="#">206</a>	4E <1>	Braking transistor fault (rr)	<a href="#">210</a>
15	Frequency detection 3	<a href="#">207</a>	4F <1>	Braking resistor overheat (rH)	<a href="#">210</a>
16	Frequency detection 4	<a href="#">207</a>	50	Disturb Function Up	<a href="#">210</a>
17	Torque detection 1 (N.C.)	<a href="#">205</a>	51	Disturb Function Enabled/Disabled	<a href="#">210</a>
18	Torque detection 2 (N.O.)			Uv during KEB	<a href="#">210</a>
19	Torque detection 2 (N.C.)	<a href="#">205</a>	60	Internal cooling fan alarm	<a href="#">210</a>
1A	During reverse	<a href="#">208</a>	61	Rotor Position Detection Completed	<a href="#">210</a>
1B	During baseblock (N.C.)	<a href="#">208</a>	100 to 161	Functions 0 to 61 with inverse output	<a href="#">211</a>

<1> This function is not available in models CIMR-T□2A0169 to 2A0415 and 4A0088 to 4A0362.

## 5.7 H: Terminal Functions

### Setting 0: During Run

Output closes when the drive is outputting a voltage.

Status	Description
Open	Drive is stopped.
Closed	A Run command is input or the drive is during deceleration or during DC injection.

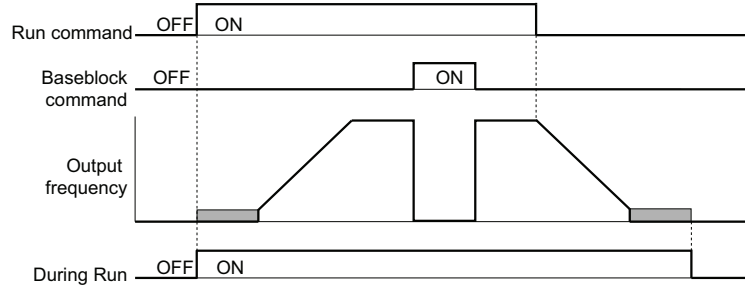


Figure 5.54 During Run Time Chart

### Setting 1: Zero Speed

Terminal closes whenever the output frequency or motor speed (CLV, CLV/PM) falls below the minimum output frequency set to E1-09 or b2-01.

Status	Description
Open	Output frequency is above the minimum output frequency set to E1-09 or b2-01
Closed	Output frequency is less than the minimum output frequency set to E1-09 or b2-01

**Note:** When using CLV or CLV/PM control modes, the zero speed level is defined by b2-01. In all other control modes, the zero speed level is the minimum output frequency set to E1-09.

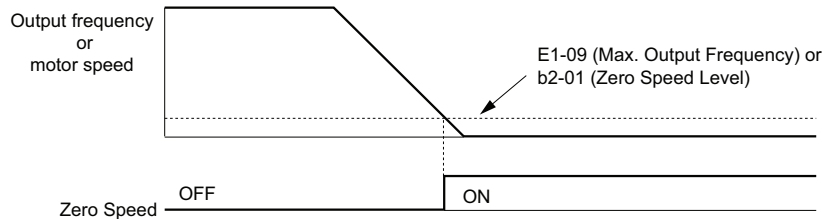


Figure 5.55 Zero-Speed Time Chart

### Setting 2: Speed agree 1 ( $f_{ref}/f_{out}$ Agree 1)

Closes whenever the actual output frequency or motor speed (CLV, CLV/PM) is within the Speed Agree Width (L4-02) of the current frequency reference regardless of the direction.

Status	Description
Open	Output frequency or motor speed does not match the frequency reference while the drive is running.
Closed	Output frequency or motor speed is within the range of frequency reference $\pm L4-02$ .

**Note:** Detection works in both directions, forward and reverse.

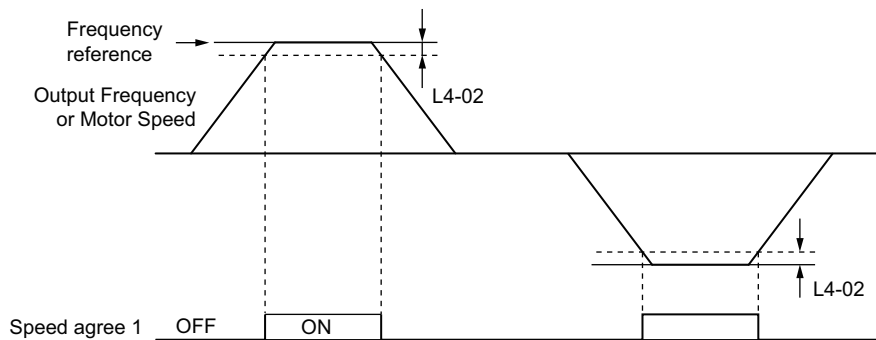


Figure 5.56 Speed Agree 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 235 for more details.

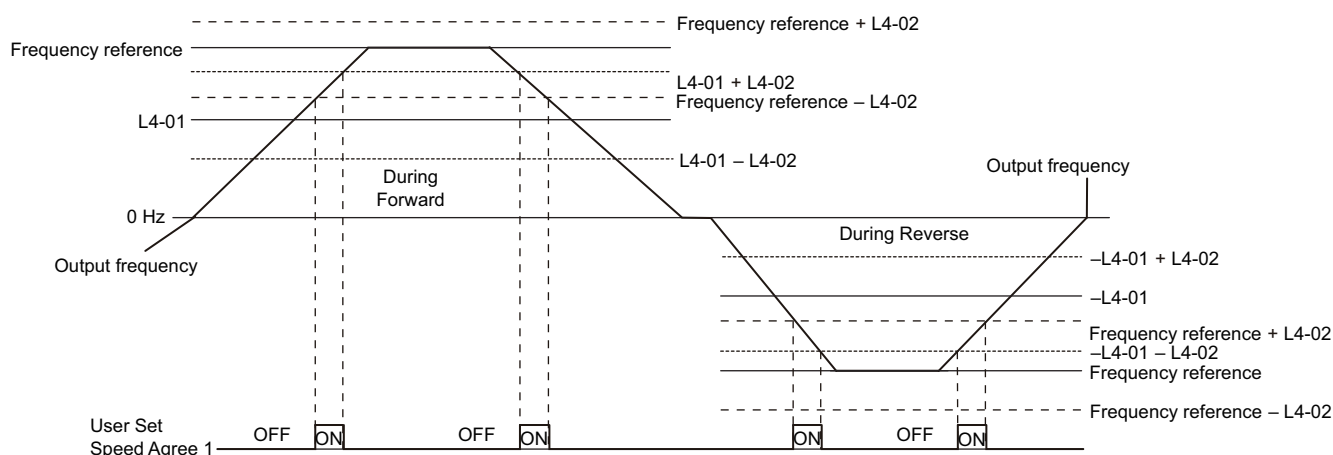
**Setting 3: User-set speed agree 1 ( $f_{ref}/f_{set}$  Agree 1)**

Output terminal closes when both conditions below are met.

- The output frequency (or the motor speed when using CLV or CLV/PM) is within the range of the speed agreement detection level (L4-01) plus or minus the speed agreement detection width (L4-02).
- The output frequency (or the motor speed when using CLV or CLV/PM) is within the range of the frequency reference plus or minus the speed agreement detection width (L4-02).

Status	Description
Open	One of the following conditions is true: <ul style="list-style-type: none"> <li>• Output frequency or motor speed is not within the range of <math>L4-01 \pm L4-02</math></li> <li>• Output frequency or motor speed is not within the range of the frequency reference <math>\pm L4-02</math></li> </ul>
Closed	Both of the following conditions are true: <ul style="list-style-type: none"> <li>• Output frequency or motor speed is within the range of <math>L4-01 \pm L4-02</math></li> <li>• Output frequency or motor speed is within the range of the frequency reference <math>\pm L4-02</math></li> </ul>

**Note:** Frequency detection works in both forward and reverse. The value of L4-01 is used as the detection level for both directions.



**Figure 5.57 User Set Speed Agree 1 Time Chart**

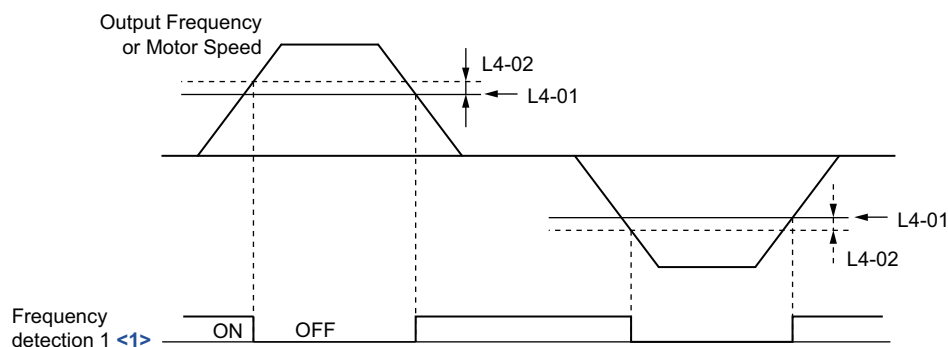
*Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 235 for more instructions.*

**Setting 4: Frequency Detection 1**

Output opens when the output frequency or motor speed (CLV, CLV/PM) rises above the detection level set in L4-01 plus the detection width set in L4-02. The terminal remains open until the output frequency or motor speed falls below the level set in L4-01.

Status	Description
Open	Output frequency or motor speed exceeded $L4-01 + L4-02$ .
Closed	Output frequency or motor speed is below $L4-01$ or has not exceeded $L4-01 + L4-02$ .

**Note:** Frequency detection works in both forward and reverse. The value of L4-01 is used as the detection level for both directions.



**Figure 5.58 Frequency Detection 1 Time Chart**

<1> This is the time chart when L4-07 (Speed Agree Detection Selection) is set to 1 (detection always enabled). The default setting for L4-07 is 0 (no detection during baseblock). When L4-07 = 0, the terminal opens during baseblock.

*Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 235 for more details.*

## 5.7 H: Terminal Functions

### Setting 5: Frequency Detection 2

Output closes whenever the output frequency or motor speed (CLV, CLV/PM) is above the detection level set in L4-01. The terminal remains closed until the output frequency or motor speed falls below L4-01 minus the setting of L4-02.

Status	Description
Open	Output frequency or motor speed is below L4-01 minus L4-02 or has not exceeded L4-01.
Closed	Output frequency or motor speed exceeded L4-01.

**Note:** Frequency detection works in both forward and reverse. The value of L4-01 is used as the detection level for both directions.

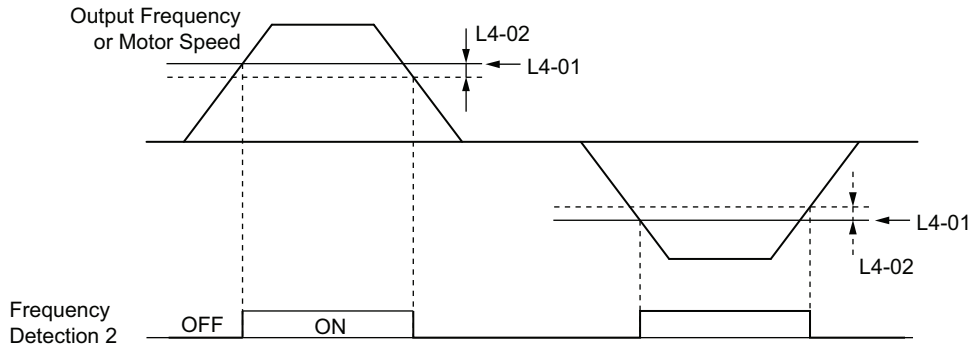


Figure 5.59 Frequency Detection 2 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 235 for more details.

### Setting 6: Drive ready

Output closes whenever the drive is ready to operate the motor. The terminal will not close under the conditions listed below, and any Run commands will be disregarded.

- When the power is shut off
- During a fault
- When the drive's internal power supply has malfunctioned
- When a parameter setting error makes it impossible to run
- Although stopped, an overvoltage or undervoltage situation occurs
- While editing a parameter in the Programming Mode (when b1-08 = 0)

### Setting 7: DC bus undervoltage

Output closes whenever the DC bus voltage or control circuit power supply drops below the trip level set in L2-05. A fault in the DC bus circuit will also cause the terminal to set for "DC bus undervoltage" to close.

Status	Description
Open	DC bus voltage is above the level set to L2-05
Closed	DC bus voltage has fallen below the trip level set to L2-05.

### Setting 8: During baseblock (N.O.)

Output closes to indicate that the drive is in a baseblock state. While in baseblock, output transistors do not switch and no main circuit voltage is output.

Status	Description
Open	Drive is not in a baseblock state.
Closed	Baseblock is being executed.

### Setting 9: Frequency reference source

A digital output programmed for this function shows the frequency reference source that is currently selected.

Status	Description
Open	Frequency reference is provided from External reference 1 (b1-01) or External reference 2 (b1-15)
Closed	Frequency reference is being sourced from the digital operator.

**Setting A: Run command source**

A digital output programmed for this function shows the Run command source that is currently selected.

Status	Description
Open	Run command is provided from External reference 1 (b1-02) or 2 (b1-16).
Closed	Run command is being sourced from the digital operator.

**Setting B, 17, 18, 19: Torque detection 1 (N.O., N.C.), Torque detection 2 (N.O., N.C.)**

These digital output functions can be used to signal an overtorque or undertorque situation to an external device.

Set up the torque detection levels and select the output function from the table below. *Refer to L6: Torque Detection on page 239* for details.

Setting	Status	Description
B	Closed	Torque detection 1 (N.O.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.
17	Open	Torque detection 1 (N.C.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.
18	Closed	Torque detection 2 (N.O.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-05 for longer than the time specified in parameter L6-06.
19	Open	Torque detection 2 (N.C.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-05 for longer than the time specified in parameter L6-06.

**Setting C: Frequency reference loss**

An output set for this function will be closed if frequency reference loss is detected. *Refer to L4-05: Frequency Reference Loss Detection Selection on page 236* for details.

**Setting D: Braking resistor fault**

An output programmed for this function will close when the dynamic braking resistor (DB) overheats or the braking transistor is in a fault condition.

**Setting E: Fault**

The digital output will close whenever the drive experiences a fault (this excludes faults CPF00 and CPF01).

**Setting F: Through mode**

Select this setting when using the terminal in a pass-through mode. When set to F, an output does not trigger any function in the drive. Setting F, however, still allows the output status to be read by a PLC via a communication option or MEMOBUS/Modbus communications.

**Setting 10: Minor fault**

Output closes when a minor fault condition is present.

**Setting 11: Fault reset command active**

Output closes whenever there is an attempt to reset a fault situation from the control circuit terminals, via serial communications, or using a communications option card.

**Setting 12: Timer output**

This setting configures a digital output terminal as output for the timer function. *Refer to b4: Delay Timers on page 135* for details.

## 5.7 H: Terminal Functions

### Setting 13: Speed agree 2 ( $f_{ref}/f_{out}$ agree 2)

Closes whenever the actual output frequency or motor speed (CLV, CLV/PM) is within the speed agree width (L4-04) of the current frequency reference, regardless of the direction.

Status	Description
Open	Output frequency or motor speed does not match the frequency reference while the drive is running.
Closed	Output frequency or motor speed is within the range of frequency reference $\pm L4-04$ .

**Note:** Detection works in both forward and reverse.

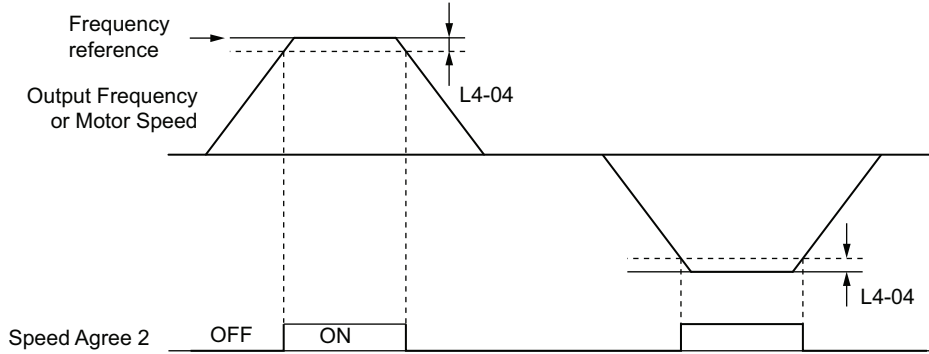


Figure 5.60 Speed Agree 2 Time Chart

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 236 for more details.

### Setting 14: User-set speed agree 2 ( $f_{ref}/f_{set}$ agree 2)

Output terminal closes when both conditions below are met.

- The output frequency (or the motor speed when using CLV or CLV/PM) is within the range of the speed agreement detection level (L4-03) plus or minus the speed agreement detection width (L4-04).
- The output frequency (or the motor speed when using CLV or CLV/PM) is within the range of the frequency reference plus or minus the speed agreement detection width (L4-04).

Status	Description
Open	One of the following conditions is true: <ul style="list-style-type: none"> <li>• Output frequency or motor speed is not within the range of <math>L4-03 \pm L4-04</math></li> <li>• Output frequency or motor speed is not within the range of the frequency reference <math>\pm L4-04</math></li> </ul>
Closed	Both of the following conditions are true: <ul style="list-style-type: none"> <li>• Output frequency or motor speed is within the range of <math>L4-03 \pm L4-04</math></li> <li>• Output frequency or motor speed is within the range of the frequency reference <math>\pm L4-04</math></li> </ul>

**Note:** As the detection level L4-03 is a signed value, detection works in the specified direction only.

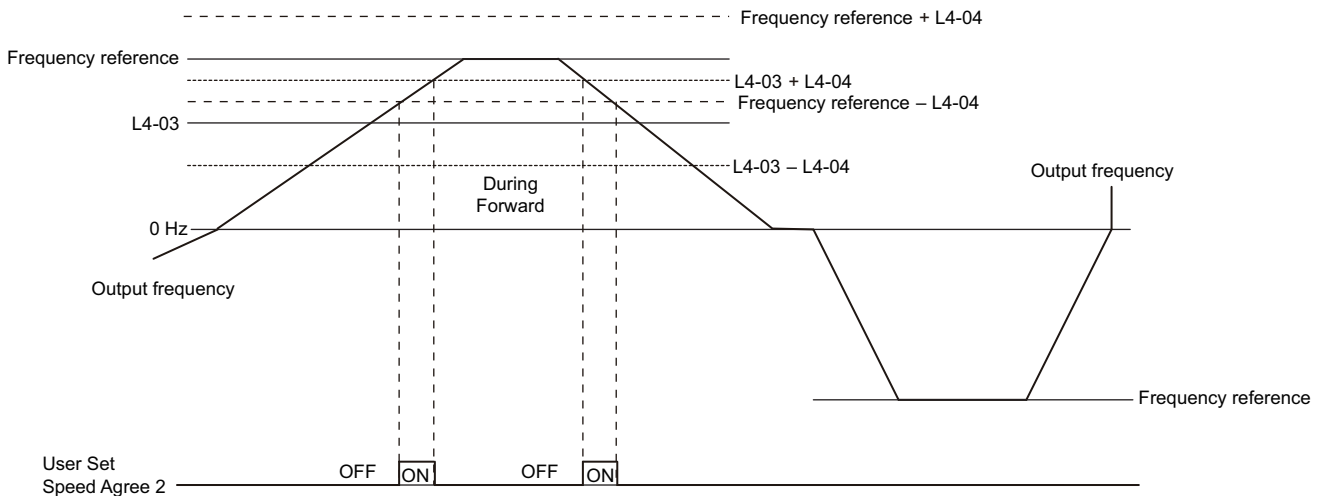


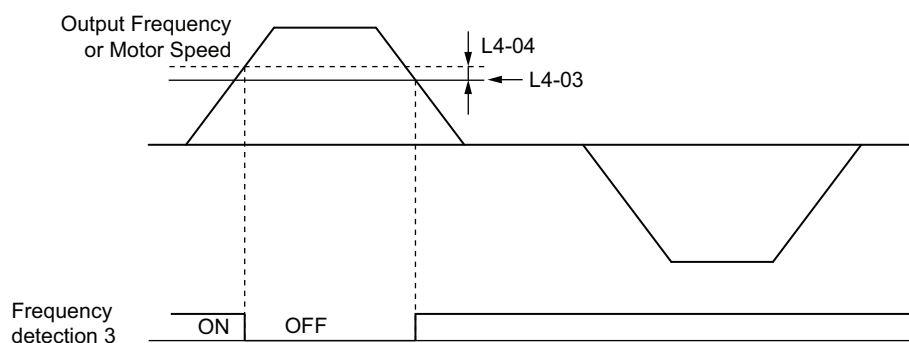
Figure 5.61 User Set Speed Agree 2 Example with a Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 236 for more details.

**Setting 15: Frequency detection 3**

Output opens when the output frequency or motor speed (CLV, CLV/PM) rises above the detection level set in L4-03 plus the detection with set in L4-04. The terminal remains open until the output frequency or motor speed falls below the level set in L4-03. As the detection level L4-03 is a signed value, the detection works in the specified direction only.

Status	Description
Open	Output frequency or motor speed exceeded L4-03 plus L4-04.
Closed	Output frequency or motor speed is below L4-03 or has not exceeded L4-03 plus L4-04 yet.



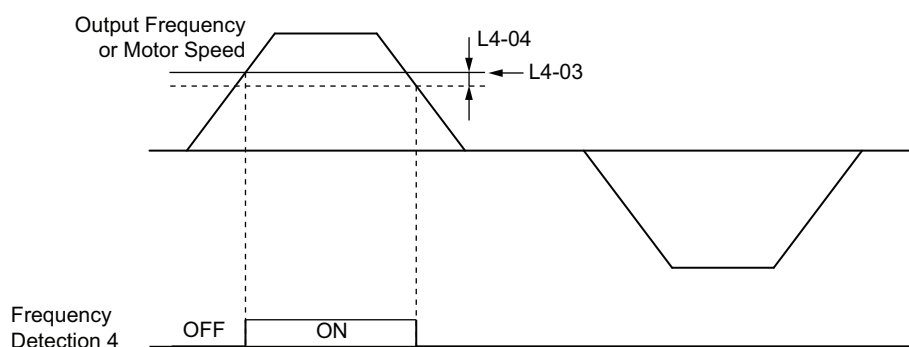
**Figure 5.62 Frequency Detection 3 Example with a Positive L3-04 Value**

*Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 236 for more details.*

**Setting 16: Frequency detection 4**

Output closes whenever the output frequency or motor speed (CLV, CLV/PM) is above the detection level set in L4-03. The terminal remains closed until the output frequency or motor speed falls below L4-03 minus the setting of L4-04. As the detection level L4-03 is a signed value, frequency detection works in the specified direction only.

Status	Description
Open	Output frequency or motor speed is below L4-03 minus L4-04 or has not exceeded L4-03 yet.
Closed	Output frequency or motor speed exceeded L4-03.



**Figure 5.63 Frequency Detection 4 Example with Positive L3-04 Value**

*Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 236 for more details.*

## 5.7 H: Terminal Functions

### Setting 1A: During reverse

A digital output set for “During reverse” will close whenever the drive is running the motor in the reverse direction.

Status	Description
Open	Motor is being driven in the forward direction or stopped.
Closed	Motor is being driven in reverse.

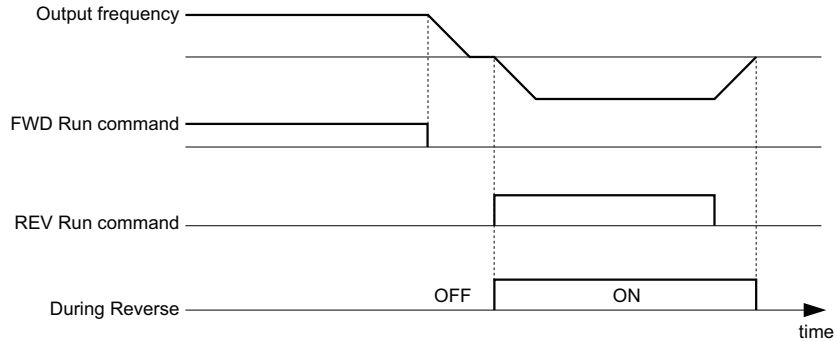


Figure 5.64 Reverse Direction Output Example Time Chart

### Setting 1B: During baseblock (N.C.)

Output opens to indicate that the drive is in a baseblock state. While Baseblock is executed, output transistors do not switch and no main circuit voltage is output.

Status	Description
Open	Baseblock is being executed.
Closed	Drive is not in a baseblock state.

### Setting 1C: Motor 2 selection

Indicates which motor is selected when another output terminal is set up to switch drive operation between two motors (H1-□□ = 16). [Refer to Setting 16: Motor 2 selection on page 196](#) for details on switching motors.

Status	Description
Open	Motor 1 is selected.
Closed	Motor 2 is selected.

### Setting 1D: During regeneration

Terminal closes when the motor is driven in the regenerative mode.

### Setting 1E: Restart enabled

An output set for “Restart enabled” closes once the drive begins attempting to restart after a fault has occurred.

The fault restart function allows the drive to automatically clear a fault. The terminal set to 1E will close after the fault is cleared and the drive has begun attempting to restart. If the drive cannot successfully restart within the number of attempts permitted by L5-01, then a fault will be triggered and the terminal set to 1E will open. [Refer to L5: Fault Restart on page 238](#) for details on automatic restart.

### Setting 1F: Motor overload alarm (oL1)

An output programmed for this function will close when the motor overload level estimated by the oL1 fault detection exceeds 10% of the oL1 detection level. [Refer to L1-01: Motor Overload Protection Selection on page 223](#).

### Setting 20: Drive overhear pre-alarm (oH)

Output closes whenever the drive heatsink temperature reaches the level specified by parameter L8-02. [Refer to L8-02: Overheat Alarm Level on page 242](#) for details on drive overheat detection.

### Setting 2F: Maintenance period

Output closes when the cooling fan, DC bus capacitors, or DC bus pre-charge relay may require maintenance as determined by the estimated performance life span of those components. Components performance life is displayed as a percentage on the digital operator screen. [Refer to Periodic Maintenance on page 350](#).

**Setting 30: During torque limit**

Output closes when the motor is operating at the torque limit specified by the L7-□□ parameters or an analog input. This setting can only be used in OLV, CLV, AOLV/PM and CLV/PM control modes. *Refer to L7-01 to L7-04: Torque Limits on page 241* for details.

**Setting 31: During speed limit**

Output closes when the speed limit has been reached. This function can be used in CLV and CLV/PM control modes.

Status	Description
Open	The conditions described below are not present.
Closed	<ol style="list-style-type: none"> <li>1. The frequency reference has reached the upper limit set in d2-01.</li> <li>2. The frequency reference has fallen to the lower limit set in d2-02 or d2-03.</li> <li>3. Parameter b1-05 is set to 1, 2, or 3, and the frequency reference has fallen below the minimum output frequency (E1-09).</li> </ol>

**Setting 32: During speed limit in Torque Control**

The motor torque and load torque are not in balance, causing the motor to accelerate. An output terminal set to 32 closes when the motor reaches the speed limit. Refer to *d5: Torque Control on page 168* and *Indicating Operation at the Speed Limit on page 170* for details.

**Setting 33: Zero Servo complete**

Output closes when Zero Servo is enabled and the load is locked into position within the allowable deviation (b9-02). For how Zero Servo operates, see *b9: Zero Servo on page 148*.

**Setting 37: During frequency output**

Output closes when the drive is outputting a frequency.

Status	Description
Open	Drive is stopped or one of the following functions is being performed: baseblock, DC Injection Braking, Short Circuit Braking.
Closed	Drive is outputting frequency.

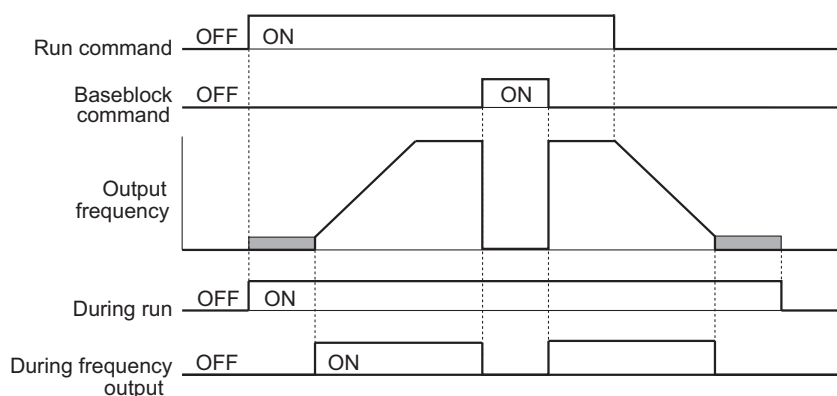


Figure 5.65 During Frequency Output Time Chart

**Setting 38: Drive enable**

A digital output set for “Drive enable” will reflect the status of a digital input configured as a “Drive enable” input (H1-□□ = 6A). If that digital input closes, then the digital output set for “Drive enable” will also close.

**Setting 39: Watt hour pulse output**

Outputs a pulse to indicate the watt hours. *Refer to H2-06: Watt Hour Output Unit Selection on page 211* for details.

## 5.7 H: Terminal Functions

### Setting 3C: LOCAL/REMOTE status

Output terminal closes while the drive is set for LOCAL and opens when in REMOTE.

Status	Description
Open	REMOTE: The external reference that has been selected (either b1-01 and b1-02 or b1-15 and b1-16) is used as frequency reference and Run command source
Closed	LOCAL: The digital operator is used as frequency reference and Run command source

### Setting 3D: During Speed Search

Output terminal closes while Speed Search is being performed. *Refer to b3: Speed Search on page 129* for details.

### Setting 3E: PID feedback low

Output terminal closes when a PID feedback loss (FbL) is detected. The feedback is considered to be lost if it falls below the level set to b5-13 for longer than the time set to b5-14. *Refer to PID Feedback Loss Detection on page 141* for details.

### Setting 3F: PID feedback high

Output terminal closes when an excessive PID feedback (FbH) is detected. The feedback is considered to be lost if it rises beyond the level set to b5-36 for longer than the time set to b5-37. *Refer to PID Feedback Loss Detection on page 141* for details.

### Setting 4A: During KEB operation

The output terminal is closed during KEB deceleration, during the reacceleration wait time in S4-12 and when reaccelerating with the time set in S5-05. The output will open when the previous frequency reference is reached or when the drive reaccelerates with the acceleration time set in C1. *Refer to KEB Function Description on page 267* for a KEB function description.

### Setting 4B: During Short Circuit Braking

Output terminal closes while Short Circuit Braking is being executed.

### Setting 4C: During Fast Stop

Output terminal closes when a Fast Stop is being executed. *Setting 15, 17: Fast Stop (N.O., N.C.) on page 195.*

### Setting 4E: Braking transistor fault (rr)

Output closes if the drive's internal braking transistor reaches the overheat level.

### Setting 4F: Braking resistor overheat (rH)

The braking resistor may overheat due to motor regeneration or too short of a deceleration time setting. The output terminal closes when the braking resistor exceeds the overheat level.

### Setting 50: Disturb Function Up

Output terminal closes if the motor accelerates when the Disturb waveform is being output. For more information, see *S1: Disturb Function on page 265*.

### Setting 51: Disturb Function Enabled/Disabled

Indicates that the Disturb function is activated by closing whenever the Disturb waveform is output. For more information, see *S1: Disturb Function on page 265*.

### Setting 52: Uv during KEB

Terminal closes if the DC bus voltage falls below the level set to L2-05 during KEB.

### Setting 60: Internal cooling fan alarm

Output closes when the drive's internal cooling fan has failed.

### Setting 61: Rotor position detection complete

After the Run command is given, the output terminal signals that the drive has detected the rotor position (PM motors).

### Setting 100 to 161: Functions 0 to 61 with inverse output

These settings have the same function as settings 0 to 92 but with inverse output. Set as 1□□, where the “1” indicates inverse output and the last two digits specify the setting number of the function.

Examples:

- For inverse output of “8: During baseblock”, set 108.
- For inverse output of “4A: During KEB” set 14A.

### ? H2-06: Watt Hour Output Unit Selection

When one of the multi-function terminals is set to output the number of watt hours (H2-01, H2-02, or H2-03 = 39), parameter H2-06 determines the units for the output signal.

This output function provides a watt hour meter or a PLC input by a 200 ms pulse signal. H2-06 determines the frequency that pulses are issued to keep track of the kWh for the drive.

No.	Parameter Name	Setting Range	Default
H2-06	Watt Hour Output Unit Selection	0: 0.1 kWh units 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units	0

- Note:**
1. A negative power output (i.e., regeneration) does not subtract from the total watt hours.
  2. The drive keeps track of the watt hours as long as the control circuit has power. The value is reset when the power supply is shut off.

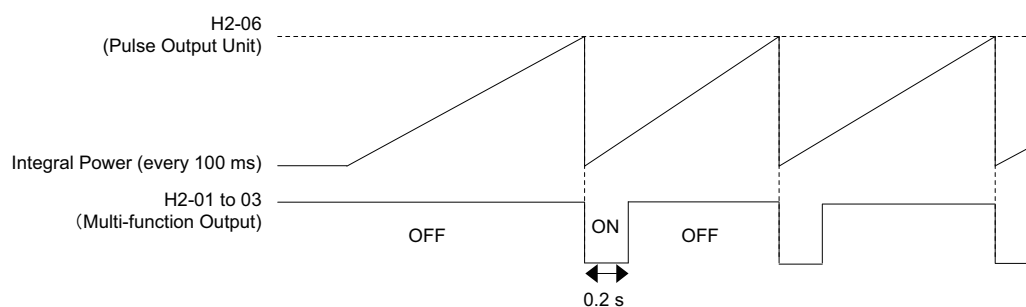


Figure 5.66 Watt Hour Output Example

### ? H3: Multi-Function Analog Inputs

The drive is equipped with three multi-function analog input terminals: A1, A2, and A3. See [Table 5.23](#) for a listing of the functions that can be set to these terminals.

### ? H3-01: Terminal A1 Signal Level Selection

Selects the input signal level for analog input A1.

No.	Name	Setting Range	Default
H3-01	Terminal A1 Signal Level Selection	0, 1	0

#### Setting 0: 0 to 10 Vdc

The input level is 0 to 10 Vdc. The minimum input level is limited to 0%, so that a negative input signal due to gain and bias settings will be simply read as 0%.

#### Setting 1: -10 to 10 Vdc

The input level is -10 to 10 Vdc. If the resulting voltage is negative after being adjusted by gain and bias settings, then the motor will rotate in reverse.

### ? H3-02: Terminal A1 Function Selection

Selects the input signal level for analog input A3. See [Refer to Multi-Function Analog Input Terminal Settings on page 215](#) for instructions on how to adjust the signal level.

No.	Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 41	0

### ? H3-03, H3-04: Terminal A1 Gain and Bias Settings

Parameter H3-03 sets the level of the selected input value that is equal to 10 Vdc input at terminal A1 (gain).

Parameter H3-04 sets the level of the selected input value that is equal to 0 V input at terminal A1 (bias).

Both can be used to adjust the characteristics of the analog input signal to terminal A1.

No.	Name	Setting Range	Default
H3-03	Terminal A1 Gain Setting	-999.9 to 999.9%	100.0%
H3-04	Terminal A1 Bias Setting	-999.9 to 999.9%	0.0%

#### Setting Examples

- Gain H3-03 = 200%, bias H3-04 = 0, terminal A1 as frequency reference input (H3-02 = 0):

An input 10 Vdc will be equivalent to a 200% frequency reference and 5 Vdc will be equivalent to a 100% frequency reference. Since the drive output is limited by the maximum frequency parameter (E1-04), the frequency reference will be equal to E1-04 above 5 Vdc.

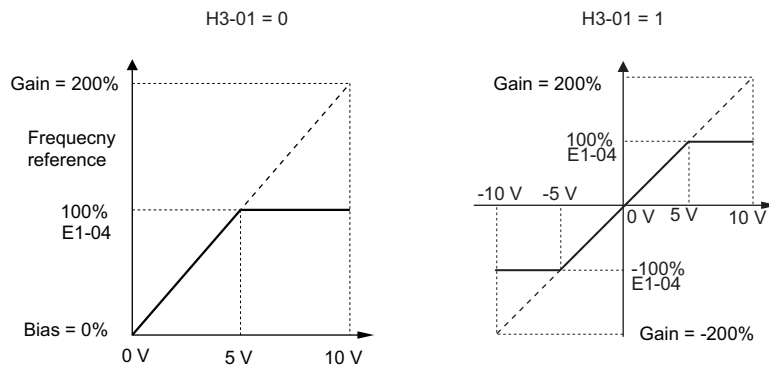


Figure 5.67 Frequency Reference Setting by Analog Input with Increased Gain

- Gain H3-03 = 100%, bias H3-04 = -25%, terminal A1 as frequency reference input:

An input of 0 Vdc will be equivalent to a -25% frequency reference.

When parameter H3-01 = 0, the frequency reference is 0% between 0 and 2 Vdc input.

When parameter H3-01 = 1, the motor will rotate in reverse between -10 and 2 Vdc input.

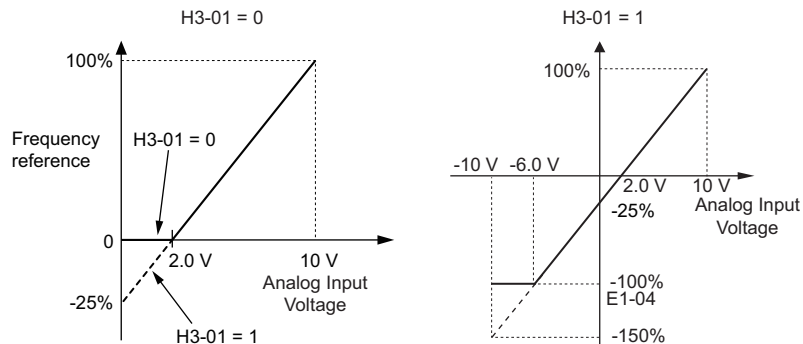


Figure 5.68 Frequency Reference Setting by Analog Input with Negative Bias

### ? H3-05: Terminal A3 Signal Level Selection

Determines the function assigned to analog input terminal A3.

No.	Name	Setting Range	Default
H3-05	Terminal A3 Signal Level Selection	0, 1	0

#### Setting 0: 0 to 10 Vdc

The input level is 0 to 10 Vdc. See the explanation provided for H3-01. *Refer to Setting 0: 0 to 10 Vdc on page 211.*

#### Setting 1: -10 V to 10 Vdc

The input level is -10 to 10 Vdc. See the explanation provided for H3-01. *Refer to Setting 1: -10 to 10 Vdc on page 211.*

### ? H3-06: Terminal A3 Function Selection

Determines the function assigned to analog input terminal A3. *Refer to Multi-Function Analog Input Terminal Settings on page 215* for a list of functions and descriptions.

When analog input A3 is used as PTC input set H3-06 = E and make sure switch S4 on the terminal board is set for PTC input. Also refer to *Terminal A3 Analog/PTC Input Selection on page 70*.

No.	Name	Setting Range	Default
H3-06	Terminal A3 Function Selection	0 to 41	2

### ? H3-07, H3-08: Terminal A3 Gain and Bias Setting

Parameter H3-07 sets the level of the selected input value that is equal to 10 Vdc input at terminal A3 (gain).

Parameter H3-08 sets the level of the selected input value that is equal to 0 V input at terminal A3 (bias).

No.	Name	Setting Range	Default
H3-07	Terminal A3 Gain Setting	-999.9 to 999.9%	100.0%
H3-08	Terminal A3 Bias Setting	-999.9 to 999.9%	0.0%

### ? H3-09: Terminal A2 Signal Level Selection

Selects the input signal level for analog input A2. Be sure to also set DIP switch S1 on the terminal board accordingly for a voltage input or current input.

No.	Name	Setting Range	Default
H3-09	Terminal A2 Signal Level Selection	0 to 3	2

#### Setting 0: 0 to 10 Vdc

The input level is 0 to 10 Vdc. *Refer to Setting 0: 0 to 10 Vdc on page 211*

#### Setting 1: -10 to 10 Vdc

The input level is -10 to 10 Vdc. *Refer to Setting 1: -10 to 10 Vdc on page 211.*

#### Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

#### Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

### ? H3-10: Terminal A2 Function Selection

Determines the function assigned to analog input terminal A2. *Refer to Multi-Function Analog Input Terminal Settings on page 215* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-10	Terminal A2 Function Selection	0 to 41	0

## 5.7 H: Terminal Functions

### ? H3-11, H3-12: Terminal A2 Gain and Bias Setting

Parameter H3-11 sets the level of the input value selected that is equal to 10 Vdc input or 20 mA input to terminal A2.

Parameter H3-12 sets the level of the input value selected that is equal to 0 V, 4 mA or 0 mA input at terminal A2.

Both can be used to adjust the characteristics of the analog input signal to terminal A2. The setting works in the same way as parameters H3-03 and H3-04 for analog input A1.

No.	Name	Setting Range	Default
H3-11	Terminal A2 Gain Setting	-999.9 to 999.9%	100.0%
H3-12	Terminal A2 Bias Setting	-999.9 to 999.9%	0.0%

### ? H3-13: Analog Input Filter Time Constant

Parameter H3-13 sets the time constant for a first order filter that will be applied to the analog inputs.

An analog input filter can be used to prevent erratic drive control when a “noisy” analog reference is used. The drive operation becomes more stable the longer the time programmed, but it becomes less responsive to rapidly changing analog signals.

No.	Name	Setting Range	Default
H3-13	Analog Input Filter Time Constant	0.00 to 2.00 s	0.03 s

### ? H3-14: Analog Input Terminal Enable Selection

When one of the multi-function digital input parameters is set for “Analog input enable” (H1-□□ = C), the value set to H3-14 determines which analog input terminals are enabled and which terminals are disabled when the input is closed. All analog input terminals will be enabled all of the time if H1-□□ is not set to C.

No.	Name	Setting Range	Default
H3-14	Analog Input Terminal Enable Selection	1 to 7	7

**Setting 1: A1 only enabled**

**Setting 2: A2 only enabled**

**Setting 3: A1 and A2 only enabled**

**Setting 4: A3 only enabled**

**Setting 5: A1 and A3 only enabled**

**Setting 6: A2 and A3 only enabled**

**Setting 7: All analog input terminals enabled**

### ? H3-16 to H3-18 Terminal A1/A2/A3 Offset

Parameters H3-16 to H3-18 set the offset level of the selected input value to terminal A1, A2 or A3 that is equal to 0 Vdc input. These parameters rarely need adjustment.

No.	Name	Setting Range	Default
H3-16	Terminal A1 Offset	-500 to 500	0
H3-17	Terminal A2 Offset	-500 to 500	0
H3-18	Terminal A3 Offset	-500 to 500	0

## ? Multi-Function Analog Input Terminal Settings

See [Table 5.23](#) for information on how H3-02, H3-10, and H3-06 determine functions for terminals A1, A2, and A3.

**Note:** The scaling of all input functions depends on the gain and bias settings for the analog inputs. Set these to appropriate values when selecting and adjusting analog input functions.

**Table 5.23 Multi-Function Analog Input Terminal Settings**

Setting	Function	Page	Setting	Function	Page
	Frequency bias	<a href="#">215</a>	D	Frequency bias	<a href="#">217</a>
1	Frequency gain	<a href="#">215</a>	E	Motor temperature (PTC input)	<a href="#">217</a>
2	Auxiliary frequency reference 1	<a href="#">215</a>	F	Through mode	<a href="#">217</a>
3	Auxiliary frequency reference 2	<a href="#">215</a>	10	Forward torque limit	<a href="#">217</a>
4	Output voltage bias	<a href="#">215</a>	11	Reverse Torque Limit	
	Accel/decel time gain	<a href="#">216</a>	12	Regenerative torque limit	
	DC Injection Braking current	<a href="#">216</a>	13	Torque limit using torque reference/speed limit	<a href="#">217</a>
7	Torque detection level	<a href="#">216</a>	14	Torque compensation	<a href="#">217</a>
8	Stall Prevention level during run	<a href="#">216</a>	15	General torque limit	<a href="#">217</a>
9	Output frequency lower limit level	<a href="#">216</a>	16	Differential PID feedback	<a href="#">217</a>
B	PID feedback	<a href="#">216</a>	1F	Through mode	<a href="#">217</a>
C	PID setpoint	<a href="#">217</a>	41	Output voltage gain	<a href="#">218</a>

### Setting 0: Frequency bias

The input value of an analog input set to this function will be added to the analog frequency reference value. When the frequency reference is supplied by a different source other than the analog inputs, this function will have no effect. Use this setting also when only one of the analog inputs is used to supply the frequency reference.

By default, analog inputs A1 and A2 are set for this function. Using A1 and A2 at the same time increases the frequency reference by the total of all inputs.

Example: If the analog frequency reference from analog input terminal A1 is 50% and a bias of 20% is applied by analog input terminal A2, the resulting frequency reference will be 70% of the maximum output frequency.

### Setting 1: Frequency gain

The input value of an analog input set to this function will be multiplied with the analog frequency reference value.

Example: If the analog frequency reference from analog input terminal A1 is 80% and a gain of 50% is applied from analog input terminal A2, the resulting frequency reference will be 40% of the maximum output frequency.

### Setting 2: Auxiliary reference 1

Sets the auxiliary frequency reference 1 when multi-step speed operation is selected. [Refer to Multi-Step Speed Selection on page 165](#) for details.

### Setting 3: Auxiliary reference 2

Sets the auxiliary frequency reference 2 when multi-step speed operation is selected. [Refer to Multi-Step Speed Selection on page 165](#) for details.

### Setting 4: Output voltage bias

Voltage bias boosts the output voltage of the V/f curve as a percentage of the maximum output voltage set to E1-05 (200 V for 200 V class drives, 400 V for the 400 V class). Available only when using V/f Control.

## 5.7 H: Terminal Functions

### Setting 5: Accel/decel time gain

Adjusts the gain level for the acceleration and deceleration times set to parameters C1-01 through C1-08.

The acceleration time used by the drive is calculated by multiplying the this gain level to C1-□□ as follows:

$$C1-□□ \times \text{Accel/decel time gain} = \text{Drive accel/decel time}$$

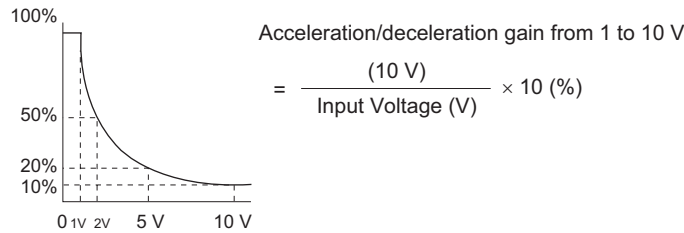


Figure 5.69 Accel/Decel Time Gain with Analog Input Terminal

### Setting 6: DC Injection Braking current

The current level used for DC Injection Braking. Set as a percentage of the maximum output current using.

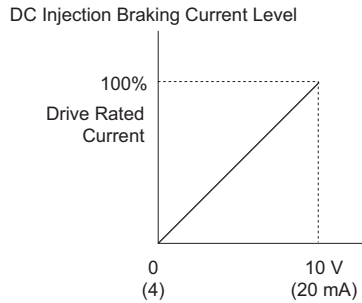


Figure 5.70 DC Injection Braking Current Using an Analog Input Terminal

### Setting 7: Torque Detection level

Using this setting, the overtorque/undertorque detection level for torque detection 1 (L6-01) can be set by an analog input. The analog input will replace the level set to L6-02. An analog input of 100% (10 V or 20 mA) will set a torque detection level equal to 100% drive rated current / motor rated torque. Adjust the analog input gain if higher detection level settings are required. [Refer to L6: Torque Detection on page 239](#) for details on torque detection.

### Setting 8: Stall Prevention level

This setting allows an analog input signal to adjust the Stall Prevention level. [Figure 5.71](#) shows the setting characteristics. The drive will use either the Stall Prevention level set to L3-06 or the level coming from the analog input terminal that has been selected, whichever value is lower.

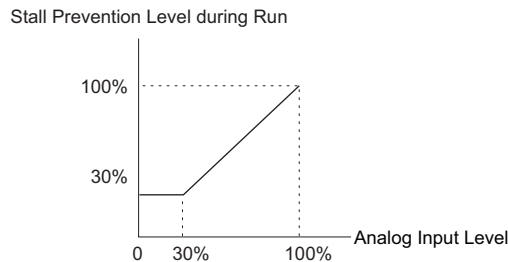


Figure 5.71 Stall Prevention During Run Using an Analog Input Terminal

### Setting 9: Output frequency lower limit level

The user can adjust the lower limit of the output frequency using an analog input signal.

### Setting B: PID feedback

An input set for this function supplies the PID feedback value. This setting requires PID operation to be enabled in b5-01. [Refer to PID Feedback Input Methods on page 137.](#)

**Setting C: PID setpoint**

An input set for this function supplies the PID setpoint value, and the frequency reference selected in parameter b1-01 is no longer the PID setpoint. PID operation to be enabled in b5-01 to use this setting. *Refer to [PID Setpoint Input Methods on page 136](#).*

**Setting D: Frequency bias**

The input value of an analog input set to this function will be added to the frequency reference. This function can be used with any frequency reference source.

**Setting E: Motor temperature**

In addition to motor overload fault detection oL1, it is possible to use a PTC (Positive Temperature Coefficient) thermistor for motor insulation protection. Connect the PTC to analog input terminal A3, and set switch S4 on the terminal board to PTC. Refer to *[Terminal A3 Analog/PTC Input Selection on page 70](#)* for details on setting S4. Refer to *[Motor Protection Using a Positive Temperature Coefficient \(PTC\) on page 227](#)* for further explanation.

**Setting F, 1F: Through mode**

When set to F or 1F, an input does not affect any drive function, but the input level can still be read out by a PLC via a communication option or MEMOBUS/Modbus communications.

**Setting 10, 11, 12, 15: Forward, Reverse, Regenerative, General torque limit (OLV, CLV, AOLV/PM, CLV/PM)**

These functions can be used to set a torque limit using analog inputs for different operating conditions. Refer to *[L7: Torque Limit on page 241](#)* for details.

**Setting 13: Torque Limit Using Torque Reference/Speed Limit**

When using Torque Control, an analog input programmed to this function can set the torque reference (when in Torque Control) or the torque limit (when in Speed Control). Refer to *[Setting the Torque Reference, Speed Limit, and Torque Compensation Values on page 168](#)* for details.

**Setting 14: Torque compensation**

Used to set a torque compensation value when using Torque Control. Refer to *[Setting the Torque Reference, Speed Limit, and Torque Compensation Values on page 168](#)* for details.

**Setting 16: Differential PID Feedback**

If an analog value is set for this function, the PID controller is set for differential feedback. The subtraction of the PID feedback input value and the differential feedback input value builds the feedback value that is used to calculate the PID input. *Refer to [PID Feedback Input Methods on page 137](#).*

Setting 41: Output Voltage Gain

Adjust the output voltage gain using the analog input signal.

An input signal of 0 V or 4 mA equals 2% output voltage gain, and an input signal of 10 V or 20 mA equals 200% output voltage gain.

**Note:** MEMOBUS register 03H will be disabled if an input terminal has been set to determine the output voltage gain level (H3-□□ = 41).

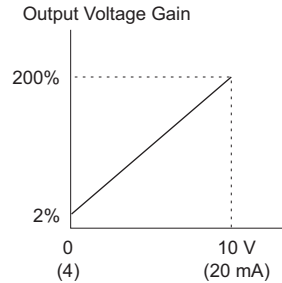


Figure 5.72 Output Voltage Gain Using an Analog Input Terminal

When the output voltage gain function is disabled (S3-03 = 0), the output voltage will be 100%. When the S3-03 = 1 (enabled), the output voltage gain will be affected in accordance with the output voltage gain time setting in parameter S3-04.

Example of How to Set the Gain Level

When S3-04 = 0.5, changing the output voltage gain from 100% to 200% takes 0.5 s for the actual output voltage gain to reach 200%.

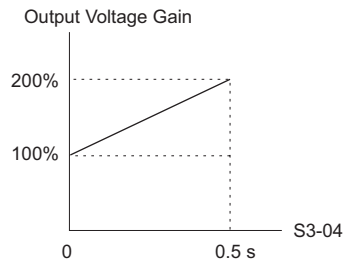


Figure 5.73 Example of How to Set the Output Voltage Gain

? H4: Multi-Function Analog Outputs

These parameters assign functions to analog output terminals FM and AM for monitoring a specific aspect of drive performance.

? H4-01, H4-04: Multi-Function Analog Output Terminal FM, AM Monitor Selection

Sets the desired drive monitor parameter U□-□□ to output as an analog value via terminal FM and AM. *Refer to U: Monitors on page 470* for a list of all monitors. The “Analog Output Level” column indicates if a monitor can be used for analog output.

Example: Enter “103” for U1-03.

No.	Name	Setting Range	Default
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	000 to 999	102
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	000 to 999	103

A setting of 031 or 000 applies no drive monitor to the analog output. With this setting, terminal functions as well as FM and AM output levels can be set by a PLC via a communication option or MEMOBUS/Modbus (through mode).

? **H4-02, H4-03: Multi-Function Analog Output Terminal FM Gain and Bias**  
**H4-05, H4-06: Multi-Function Analog Output Terminal AM Gain and Bias**

Parameter H4-02 and H4-05 set the terminal FM and AM output signal level when the value of the selected monitor is at 100%. Parameter H4-03 and H4-06 set the terminal FM and AM output signal level when the value of the selected monitor is at 0%. Both are set as a percentage, where 100% equals 10 Vdc or 20 mA analog output and 0% equals 0 V or 4 mA. The output voltage of both terminals is limited to +/-10 Vdc.

The output signal range can be selected between 0 to +10 Vdc, -10 to +10 Vdc, or 4 to 20 mA using parameter H4-07 and H4-08. *Figure 5.74* illustrates how gain and bias settings work.

No.	Name	Setting Range	Default
H4-02	Multi-Function Analog Output Terminal FM Gain	-999.9 to 999.9%	100.0%
H4-03	Multi-Function Analog Output Terminal FM Bias	-999.9 to 999.9%	0.0%
H4-05	Multi-Function Analog Output Terminal AM Gain	-999.9 to 999.9%	50.0%
H4-06	Multi-Function Analog Output Terminal AM Bias	-999.9 to 999.9%	0.0%

### Using Gain and Bias to Adjust Output Signal Level

It is possible to calibrate the meter when the drive is stopped. Follow the procedure below.

#### Terminal FM

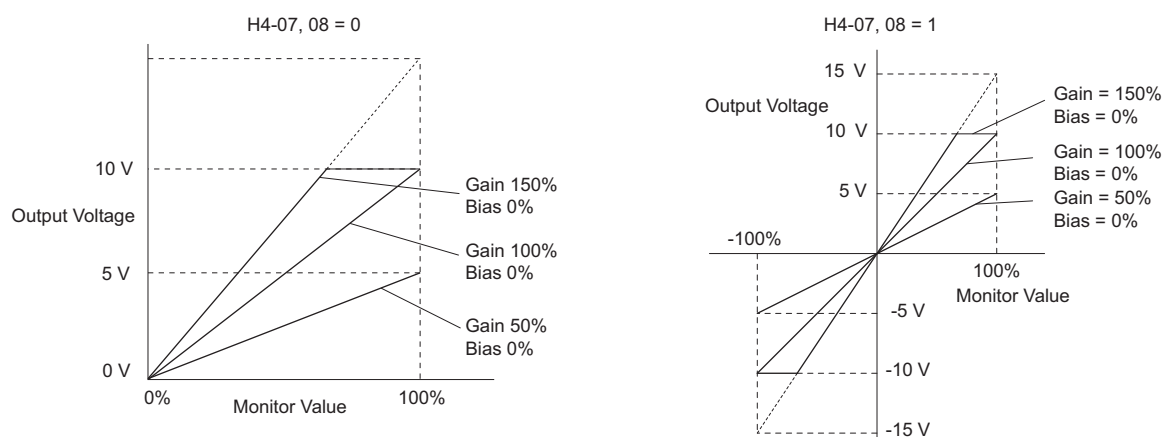
1. Use the digital operator to display the monitor gain for terminal FM (H4-02). Make sure that the voltage output is 100% of the monitor level selection for terminal FM (H4-01).
2. Adjust the setting to parameter H4-02 accordingly while watching the read out of the meter connected to terminal FM.
3. Use the digital operator to display the monitor bias for terminal FM (H4-03). Make sure that the voltage output is 0% of the monitor level selection for terminal FM (H4-01).
4. Adjust the setting to parameter H4-03 accordingly while watching the read out of the meter connected to terminal FM.

#### Terminal AM

1. Use the digital operator to display the monitor gain for terminal AM (H4-05). Make sure that the voltage output is 100% of the monitor level selection for terminal AM (H4-04).
2. Adjust the setting to parameter H4-05 accordingly while watching the read out of the meter connected to terminal AM.
3. Use the digital operator to display the monitor bias for terminal AM (H4-06). Make sure that the voltage output is 0% of the monitor level selection for terminal AM (H4-04).
4. Adjust the setting to parameter H4-06 accordingly while watching the read out of the meter connected to terminal AM.

Example 1: To have an output signal of 5 V at terminal FM when the monitored value is at 100%, set H4-02 to 50%.

Example 2: To have an output signal of 10 V at terminal FM when the monitored value is at 76.7%, set H4-02 to 150%.



**Figure 5.74 Analog Output Gain and Bias Setting Example 1 and 2**

Example 3: To have an output signal of 3 V at terminal FM when the monitored value is at 0%, set H4-03 to 30%.

## 5.7 H: Terminal Functions

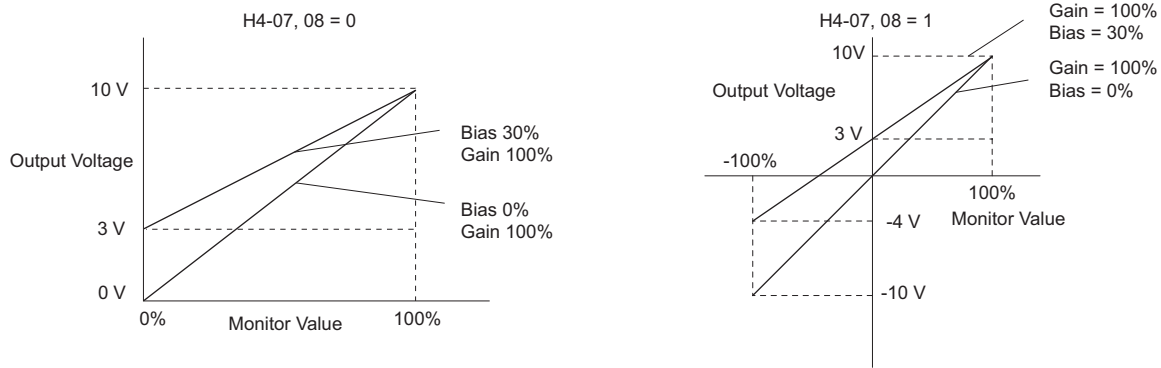


Figure 5.75 Analog Output Gain and Bias Setting Example 3

### ? H4-07, H4-08: Multi-Function Analog Output Terminal FM, AM Signal Level Selection

Sets the voltage output level of U parameter (monitor parameter) data to terminal FM and terminal AM using parameters H4-07 and H4-08.

When changing the setting of these parameters make sure jumper S5 on the terminal board is set accordingly. Refer to [Terminal AM/FM Signal Selection on page 70](#) for details on setting S5.

No.	Name	Setting Range	Default
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	0 to 2	0
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	0 to 2	0

**Setting 0: 0 to 10 V**

**Setting 1: -10 V to 10 V**

**Setting 2: 4 to 20 mA**

### ? H5: MEMOBUS/Modbus Serial Communication

Through the drives built in RS-422/485 port (terminals R+, R-, S+, S-), serial communication is possible using programmable logic controllers (PLCs) or similar devices running the MEMOBUS/Modbus protocol.

The H5-□□ parameters are used to set up the drive for MEMOBUS/Modbus Communications. [Refer to MEMOBUS/Modbus Serial Communication on page 514](#) for detailed descriptions of the H5-□□ parameters.

### ? H6: Pulse Train Input/Output

A one track pulse train signal with a maximum frequency of 32 kHz can be input to the drive at terminal RP. This pulse train signal can be used as the frequency reference, for PID functions, or as the speed feedback signal in V/f Control.

The pulse output monitor terminal MP can output drive monitor values as a pulse train signal with a maximum frequency of 32 kHz. It can be used in sinking or sourcing mode. [Refer to Using the Pulse Train Output on page 69](#) for details.

Use parameters H6-□□ to set the scale and other aspects of the pulse input terminal RP and pulse output terminal MP.

### ? H6-01: Pulse Train Input Terminal RP Function Selection

Selects the function of pulse train input terminal RP.

No.	Name	Setting Range	Default
H6-01	Pulse Train Input Terminal RP Function Selection	0 to 3	0

**Setting 0: Frequency reference**

If the pulse input is set for this function and the frequency reference source is set to pulse input (b1-01, b1-15 = 4), the drive reads the frequency value from terminal RP.

**Setting 1: PID feedback value**

Using this setting, the feedback value for PID control can be supplied as a pulse signal at terminal RP. See [Refer to b5: PID Control on page 135](#) for details on PID control.

### Setting 2: PID setpoint value

Using this setting, the setpoint value for PID control can be supplied as a pulse signal at terminal RP. See [Refer to b5: PID Control on page 135](#) for details on PID control.

### Setting 3: Speed feedback (V/f Control with Simple Speed Feedback)

This setting can be used in V/f control to increase the speed control precision by using a motor speed feedback signal. The drive reads the speed feedback from terminal RP, compares it to the frequency reference and compensates the motor slip using a speed regulator (ASR, setup in the C5-□□ parameters) like shown in [Figure 5.71](#). Because input terminal RP is incapable of detecting motor direction, a separate way of determining motor direction still needs to be set up:

#### 1. Using a Digital Input

If a digital input programmed for “Forward/reverse detection” (H1-□□ = 7E) is closed, the drive assumes reverse rotation. If open, then the drive assumes that the motor is rotating forwards.

#### 2. Using the Frequency Reference Direction

If no digital input is set to “Forward/reverse detection” (H1-□□ = 7E), the drive uses the direction of the frequency reference as the direction for the speed feedback detected at the pulse input.

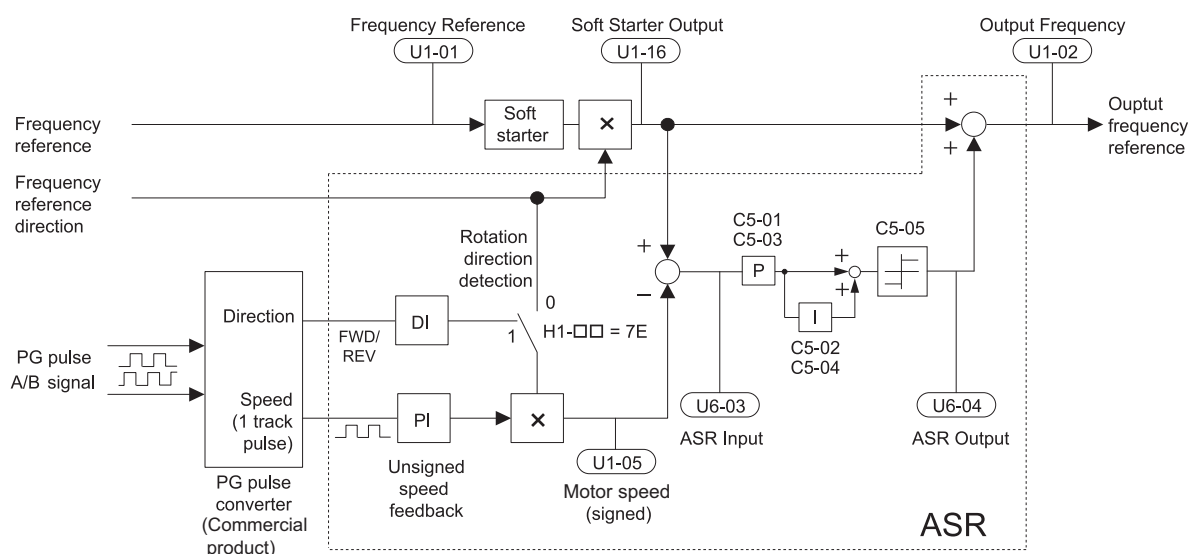


Figure 5.76 Speed Control with ASR in V/f with Simple Speed Feedback

### Enabling V/f Control with Simple Speed Feedback:

1. Set the drive to V/f Control (A1-02 = 0).
2. Connect the motor speed pulse signal to the pulse input RP, set H6-01 = 3, and set the pulse signal frequency that is equal to the maximum speed to H6-02 (pulse input scaling). Make sure the pulse input bias (H6-04) is 0% and the gain (H6-03) is 100%.
3. Decide the signal used for detecting the direction. If a digital input is used, set H1-□□ = 7E.
4. Use the ASR gain and integral time parameters described in [C5: Automatic Speed Regulator \(ASR\) on page 157](#) for adjusting the responsiveness.

**Note:** 1. C5 parameters will appear when using V/f Control (A1-02 = 0) and when the pulse input RP function is set for simple PG feedback in V/f Control (H6-01 = 3).  
2. If running two motors from the same drive, note that the V/f Control with simple PG feedback can be used for motor 1 only.

### ? H6-02: Pulse Train Input Scaling

This parameter sets the pulse signal frequency that is equal to 100% of the input value selected in parameter H6-01.

No.	Name	Setting Range	Default
H6-02	Pulse Train Input Scaling	100 to 32000 Hz	1440 Hz

### ? H6-03: Pulse Train Input Gain

Sets the level of the input value selected in H6-01 when a pulse train signal with the frequency set in H6-02 is input to terminal RP.

No.	Name	Setting Range	Default
H6-03	Pulse Train Input Gain	0.0 to 1000.0%	100.0%

## 5.7 H: Terminal Functions

### ? H6-04: Pulse Train Input Bias

Sets the level of the input value selected in H6-01 when no signal (0 Hz) is input to terminal RP.

No.	Name	Setting Range	Default
H6-04	Pulse Train Input Bias	-100.0 to 100.0%	0.0%

### ? H6-05: Pulse Train Input Filter Time

Sets the pulse train input filter time constant in seconds.

No.	Name	Setting Range	Default
H6-05	Pulse Train Input Filter Time	0.00 to 2.00 s	0.10 s

### ? H6-06: Pulse Train Monitor Selection

Selects the monitor to output as a pulse train signal via terminal MP. Indicate which monitor to output entering the three digits in U□-□□. *Refer to U: Monitors on page 470* for a complete list of monitors. Monitors that can be selected by H6-06 appear in the table below.

No.	Name	Setting Range	Default
H6-06	Pulse Train Monitor Selection	000 <1>, 031 <1>, 101, 102, 105, 116, 501, 502	102

<1> Set this value as 000 when using the terminal in the pass-through mode.

### ? H6-07: Pulse Train Monitor Scaling

Pulse train monitor scaling sets the output frequency at terminal MP when the specified monitor item is at 100%. Set H6-06 to 102 and H6-07 to 0 to make the pulse train monitor output synchronous to the output frequency.

No.	Name	Setting Range	Default
H6-07	Pulse Train Monitor Scaling	0 to 32000 Hz	1440 Hz

### ? H6-08: Pulse Train Input Minimum Frequency

Sets the minimum output frequency that can be detected by the pulse train input. Decreasing this setting reduces the time the drive needs to react to changes in the input signal.

- If the pulse input frequency falls below this level, the pulse input value will be 0.
- Enabled when H6-01 = 0, 1, or 2.
- When simple speed feedback in V/f Control is set as the function for terminal RP (H6-01 = 3), the minimum frequency becomes the detection time for PG disconnect (F1-14).

No.	Name	Setting Range	Default
H6-08	Pulse Train Input Minimum Frequency	0.1 to 1000.0 Hz	0.5 Hz

## 5.8 L: Protection Functions

### ? L1: Motor Protection

#### ? L1-01: Motor Overload Protection Selection

The drive has an electronic overload protection function that estimates the motor overload level based on output current, output frequency, thermal motor characteristics, and time. An oL1 fault will be triggered when motor overload is detected and drive output will be shut off.

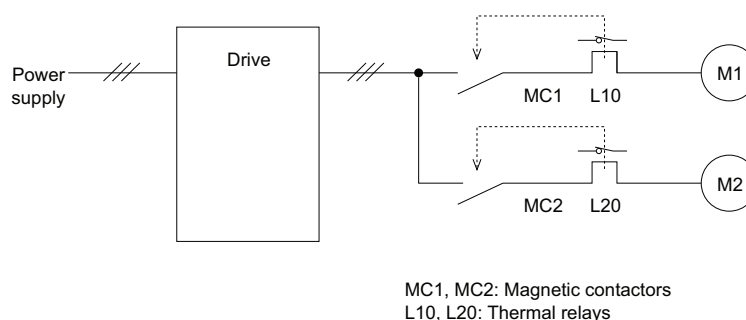
L1-01 sets the overload protection function characteristics according to the motor being used.

No.	Name	Setting Range	Default
L1-01	Motor Overload Protection Selection	0 to 6	Determined by A1-02

- Note:**
1. When the motor protection function is enabled (L1-01 ≠ 0), an oL1 alarm can be output through one of the multi-function outputs by setting H2-01 to 1F. The output will close when the motor overload level reaches 90% of the oL1 detection level.
  2. Select a method to protect the motor from overheat by setting L1-01 between 1 and 6 when running a single motor from the drive. An external thermal relay is not needed.

#### Setting 0: Disabled (motor overload protection is not provided)

This setting should be used if no motor overheat protection is desired or if multiple motors are connected to a single drive. In this case it is recommended that you install a thermal relay for each motor as shown in [Figure 5.77](#)



**Figure 5.77 Example of Protection Circuit Design for Multiple Motors**

**NOTICE:** Thermal protection cannot be provided when running multi-motors simultaneously with the same drive, or when using motors with a current rating that is relatively high when compared with other standard motors (such as a submersible motor). Failure to comply could result in motor damage. Disable the electronic overload protection of the drive (L1-01 = "0: Disabled") and protect each motor with individual motor thermal overloads.

#### Setting 1: General-purpose motor (standard self-cooled)

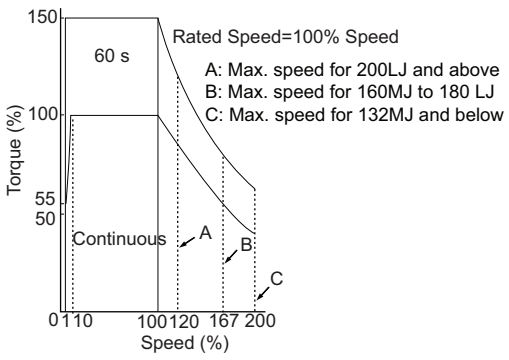
Because the motor is self-cooled, the overload tolerance drops when the motor speed is lowered. The drive appropriately adjusts the electrothermal trigger point according to the motor overload characteristics, protecting the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
<p>Rated Speed=100% Speed</p> <p>A: Max. speed for 200LJ and above B: Max. speed for 160MJ to 180 LJ C: Max. speed for 132MJ and below</p>	<p>Motor designed to operate from line power.</p> <p>Motor cooling is most effective when running at rated base frequency (check the motor nameplate or specifications).</p>	<p>Continuous operation at less than line power frequency with 100% load can trigger motor overload protection (oL1). A fault is output and the motor will coast to stop.</p>

## 5.8 L: Protection Functions

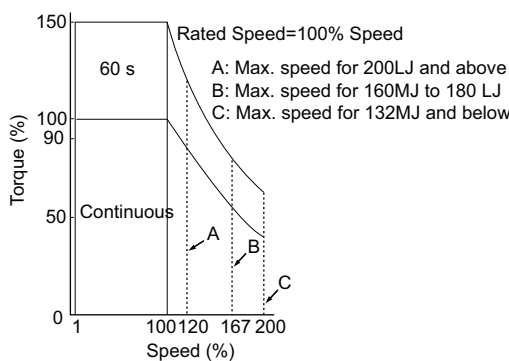
### Setting 2: Drive dedicated motor (speed range for constant torque: 1:10)

Use this setting when operating a drive duty motor that allows constant torque in a speed range of 1:10. The drive will allow the motor to run with 100% load from 10% up to 100% speed. Running at slower speeds with full load can trigger an overload fault.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor is designed to effectively cool itself even at low speeds.	Continuous operation with 100% load from 5 Hz to 50 Hz.

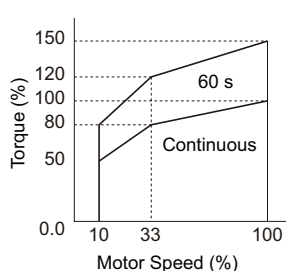
### Setting 3: Vector motor (speed range for constant torque: 1:100)

Use this setting when operating a drive-dedicated motor that allows constant torque in a speed range of 1:100. This motor type is allowed to run with 100% load from 1% up to 100% speed. Running slower speeds with full load can trigger an overload fault.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor is designed to effectively cool itself at ultra-low speeds.	Continuous operation with 100% load from 0.5 Hz to 50 Hz.

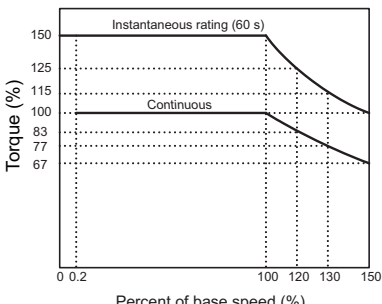
### Setting 4: PM derated torque motor

This setting is for operating a PM motor. PM motors for derated torque have a self-cooling design, so the overload tolerance drops as the motor slows. Electronic thermal overload is triggered in accordance with the motor overload characteristics, providing overheat protection across the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor is designed to produce 100% torque at base speed. Built with effective cooling capabilities.	Reaching 100% when operating at below the base frequency will cause a motor overload fault (oL1). The drive fault output closes and the motor coasts to stop.

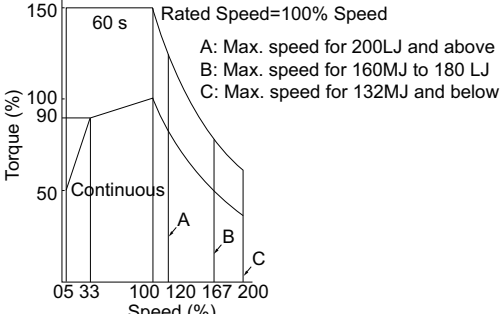
**Setting 5: Constant torque PM motors (constant torque range of 1:500)**

Sets protection characteristics needed when driving a PM with constant torque. These motors allow for a speed control from 0.2% to 100% when operating with 100% load. Slower speeds with 100% load will trigger overload.

Overload Tolerance	Cooling Ability	Overload Characteristics
	<p>Motor is designed to effectively cool itself at ultra-low speeds (about 0.2% of base speed).</p>	<p>Continuous operation with 100% load from 0.2% to 100% of base speed.</p>

**Setting 6: General-purpose motor (50 Hz)**

Because the motor (50 Hz) is self-cooled, the overload tolerance drops when the motor speed is lowered. The drive appropriately adjusts the electrothermal trigger point according to the motor overload characteristics, protecting the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
	<p>Motor designed to operate from line power.</p> <p>Motor cooling is most effective when running at rated base frequency (check the motor nameplate or specifications).</p>	<p>Continuous operation at less than line power frequency with 100% load can trigger motor overload protection (oL1). A fault is output and the motor will coast to stop.</p>

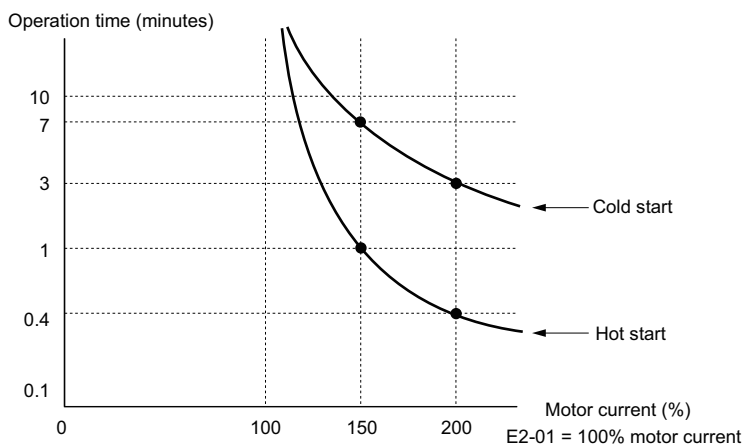
? **L1-02: Motor Overload Protection Time**

Sets the time it takes the drive to detect motor overload due to overload. This setting rarely requires adjustment, but should correlate with the motor overload tolerance protection time for performing a hot start.

No.	Name	Setting Range	Default
L1-02	Motor Overload Protection Time	0.1 to 5.0 minutes	1.0 minutes

Defaulted to operate with an allowance of 150% overload operation for one minute in a hot start.

- **Figure 5.78** shows an example of the electrothermal protection operation time using a general-purpose motor operating at 50 Hz with L1-02 set to one minute.
- During normal operation, motor overload protection operates in the area between a cold start and a hot start.
- Cold start: Motor protection operation time in response to an overload situation that was suddenly reached when starting a stationary motor.
  - Hot start: Motor protection operation time in response to an overload situation that occurred during sustained operation at rated current.



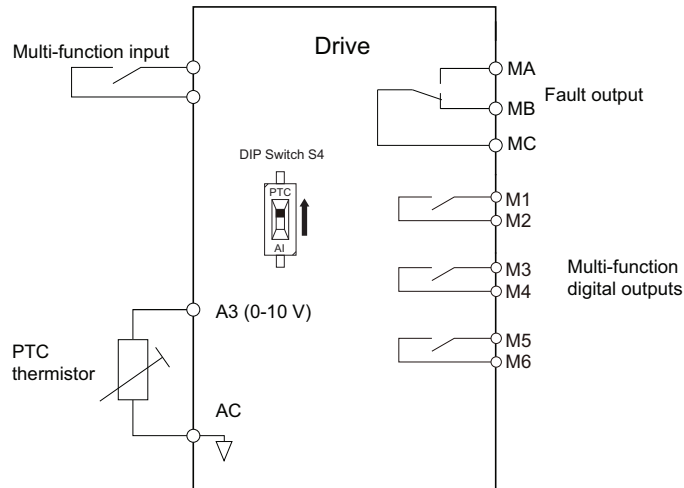
**Figure 5.78 Motor Protection Operation Time**

### ? Motor Protection Using a Positive Temperature Coefficient (PTC)

A motor PTC can be connected to an analog input of the drive. This input is used by the drive for motor overload protection.

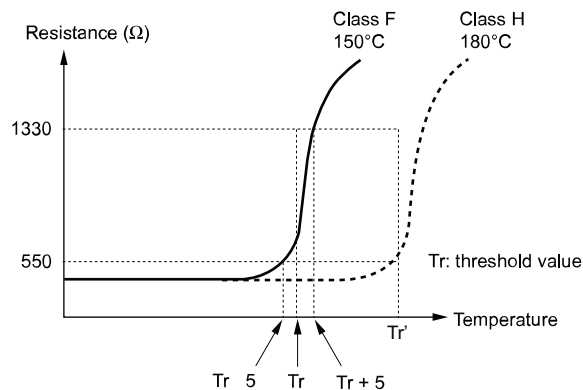
When the PTC input signal reaches the motor overload alarm level, an oH3 alarm will be triggered and the drive will continue operation as selected in L1-03. When the PTC input signal reaches the overload fault level, an oH4 fault will be triggered, a fault signal will be output, and the drive will stop the motor using the stop method determined in L1-04.

Connect the PTC between terminals AC and A3 and set jumper S4 on the terminal board to “PTC” like shown in [Figure 5.79](#). Set parameter H3-05 to 0 and parameter H3-06 to E.



**Figure 5.79 Connection of a Motor PTC**

The PTC must have the following characteristics for one motor phase. The drives motor overload detection expects 3 of these PTCs to be connected in series.



**Figure 5.80 Motor PTC Characteristics**

Overheat detection using a PTC can be set up by parameters L1-03, L1-04, and L1-05 as explained below.

## 5.8 L: Protection Functions

### ? L1-03: Motor Overheat Alarm Operation Selection (PTC input)

Sets the drive operation when the PTC input signal reaches the motor overheat alarm level (oH3).

No.	Name	Setting Range	Default
L1-03	Motor Overheat Alarm Operation Selection (PTC input)	0 to 3	3

#### Setting 0: Ramp to stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

#### Setting 1: Coast to stop

The drive output is switched off and the motor coasts to stop.

#### Setting 2: Fast Stop

The drive stops the motor using the Fast Stop time set in parameter C1-09.

#### Setting 3: Alarm only

The operation is continued and an oH3 alarm is displayed on the digital operator.

### ? L1-04: Motor Overheat Fault Operation Selection (PTC input)

Sets the drive operation when the PTC input signal reaches the motor overheat fault level (oH4).

No.	Name	Setting Range	Default
L1-04	Motor Overheat Fault Operation Selection (PTC input)	0 to 2	1

#### Setting 0: Ramp to stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

#### Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to stop.

#### Setting 2: Fast Stop

The drive stops the motor using the Fast Stop time set in parameter C1-09.

### ? L1-05: Motor Temperature Input Filter Time (PTC input)

Used to set a filter on the PTC input signal in order to prevent a motor overheat fault from being mistakenly detected.

No.	Name	Setting Range	Default
L1-05	Motor Temperature Input Filter Time (PTC input)	0.00 to 10.00 s	0.20 s

### ? L1-13: Continuous Electrothermal Operation Selection

Determines whether or not to hold the current value of the electrothermal motor protection (L1-01) when the power supply is interrupted.

No.	Name	Setting Range	Default
L1-13	Continuous Electrothermal Operation Selection	0 or 1	1

#### Setting 0: Disabled

#### Setting 1: Enabled

## ? L2: Momentary Power Loss Ride-Thru

### ? L2-01: Momentary Power Loss Operation Selection

When a momentary power loss occurs (DC bus voltage falls below the level set in L2-05), the drive can be set to automatically return to the operation it was performing when the power went out based on certain conditions.

No.	Name	Setting Range	Default
L2-01	Momentary Power Loss Operation Selection	0 to 2	0

#### Setting 0: Disabled (default)

If power is not restored within 15 ms, a Uv1 fault will result and the drive will stop the motor. The motor coasts to stop.

#### Setting 1: Recover within L2-02

When a momentary power loss occurs, the drive output will be shut off. Should the power return within the time set to parameter L2-02, the drive will perform Speed Search and attempt to resume operation. If power is not restored within the time set by L2-02 (i.e., DC bus voltage level remains below Uv1 detection level L2-05), then a Uv1 fault is triggered.

#### Setting 2: Recover as long as CPU has power

When a momentary power loss occurs, the drive output will be shut off. Should the power return as long as the drive control circuit has power, the drive will attempt to perform Speed Search and resume the operation. A Uv1 fault is not triggered.

**Note:** It is not necessary to set this parameter to a value greater than 0 when using the KEB function. The KEB function is enabled by setting S4-01 to a value greater than 0.

### ? L2-02: Momentary Power Loss Ride-Thru Time

Sets the maximum time allowed to ride through a power loss. If power loss operation exceeds this time, the drive will attempt to accelerate back to frequency reference. This parameter is valid when L2-01 = 1 or S4-01 = 2.

**Note:** 1. The amount of time the drive is capable of recovering after a power loss is determined by the capacity of the drive. Drive capacity determines the upper limit for L2-02.

No.	Name	Setting Range	Default
L2-02	Momentary Power Loss Ride-Thru Time	0.0 to 25.5 s	Determined by C6-01 and o2-04

### ? L2-03: Momentary Power Loss Minimum Baseblock Time

Sets the minimum baseblock time when power is restored following a momentary power loss. This determines the time the drive waits for the residual voltage in the motor to dissipate. Increase this setting if overcurrent or overvoltage occurs at the beginning of Speed Search, after a power loss, or during DC Injection Braking.

No.	Name	Setting Range	Default
L2-03	Momentary Power Loss Minimum Baseblock Time	0.1 to 5.0 s	Determined by C6-01 and o2-04

### ? L2-04: Momentary Power Loss Voltage Recovery Ramp Time

Sets the time for the drive to restore the output voltage to the level specified by the V/f pattern after Speed Search. The setting value determines the time for the voltage to go from 0 V to the maximum voltage.

No.	Name	Setting Range	Default
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	0.0 to 5.0 s	Determined by C6-01 and o2-04

### ? L2-05: Undervoltage Detection Level (Uv)

Determines the voltage at which a UV1 fault is triggered (when the drive is running and L2-01 = 0) or when a UV alarm is triggered (when the drive is not running or L2-01 is set > 0, or when the KEB function is active).

No.	Name	Setting Range	Default
L2-05 <1>	Undervoltage Detection Level	150 to 250 Vdc	190 V <2>

<1> Values are for 200 V class drives and must be doubled for 400 V class drives.

<2> The default setting for 400 V class drives will vary depending on if the drive input voltage is over or under 400 V.

- Note:**
1. When setting L2-05 below the default value, an AC reactor option should be installed to the input side of the power supply to prevent damage to drive circuitry.
  2. This parameter has no effect on triggering the KEB function, even when S4-01 is set > 0. Use S4-03 to set KEB Start Voltage Level.

### ? L3: Stall Prevention

When the load is too high or acceleration and deceleration times are too short, the motor may be unable to keep up with the frequency reference, resulting in excessive slip. During acceleration, this usually causes an overcurrent (oC), drive overload (oL2), or motor overload (oL1). During deceleration, it can cause excessive regenerative power to flow back into the DC bus capacitors, eventually causing the drive to fault out from overvoltage (oV). The drive can prevent the motor from stalling and still reach the desired speed without the user needing to change the acceleration or deceleration time settings. The Stall Prevention function can be set separately for acceleration, operating at constant speeds, and deceleration.

#### ? L3-01: Stall Prevention Selection during Acceleration

Stall Prevention during acceleration prevents tripping with overcurrent (oC), motor overload (oL1), or drive overload (oL2) faults common when accelerating with heavy loads.

No.	Name	Setting Range	Default
L3-01	Stall Prevention Selection during Acceleration	0 to 2 <1>	1

<1> Setting 2 is not available for PM OLV.

#### Setting 0: Disabled

No Stall Prevention is provided. If the acceleration time is too short, the drive may not be able to get the motor up to speed fast enough, thus tripping an overload fault.

#### Setting 1: Enabled

Enables Stall Prevention during acceleration. Operation varies, depending on the control mode.

- V/f Control, V/f Control with PG, and Open Loop Vector Control:

The drive stops accelerating if the output current exceeds the Stall Prevention level set in L3-02. Acceleration will resume again once the output current falls 15% below the level set in L3-02.

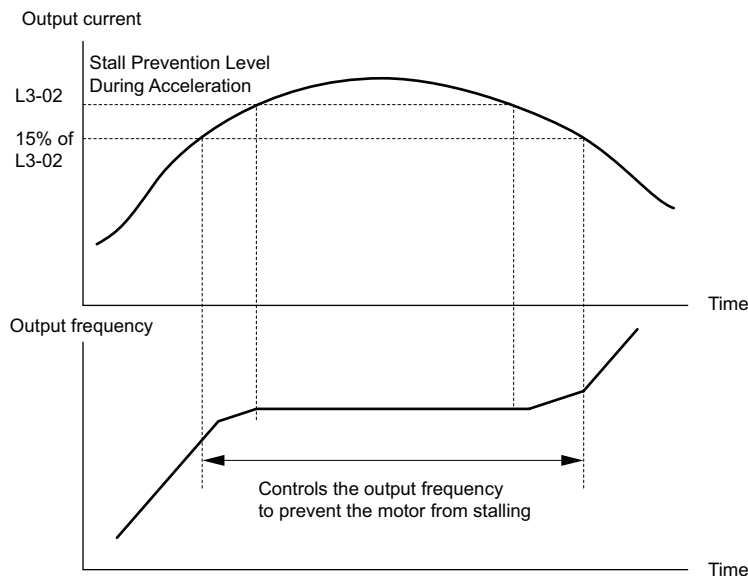


Figure 5.81 Stall Prevention During Acceleration for Induction Motors

- Open Loop Vector Control for PM:

Acceleration is stopped when the output current reaches the level set in parameter L3-02. Once the time set in parameter L3-27 passes, the drive decelerates using the deceleration time set in L3-22 (*Refer to L3-22: Deceleration Time at Stall Prevention during Acceleration on page 232*). Once the output current falls 5% below the level set in L3-02, the drive stop decelerating and starts to accelerate again.

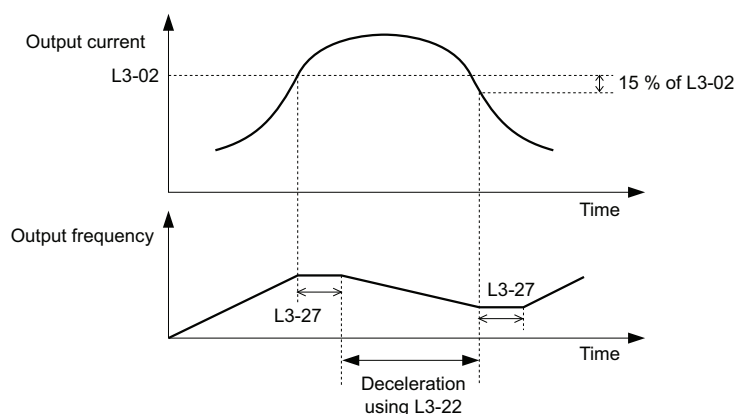


Figure 5.82 Stall Prevention During Acceleration for Permanent Magnet Motors

### Setting 2: Intelligent Stall Prevention

When L3-02 = 2, the drive will disregard the selected acceleration time and try to accelerate in the minimum time. The acceleration rate is adjusted so that the current does not exceed the value set in parameter L3-02.

#### ? L3-02: Stall Prevention Level during Acceleration

Sets the output current level at which the Stall Prevention during acceleration is activated.

No.	Name	Setting Range	Default
L3-02	Stall Prevention Level during Acceleration	0 to 150% <I>	<I>

<I> The upper limit and default value is determined by the duty rating and the carrier frequency derating selection (C6-01 and L8-38 respectively).

- If stalling occurs with L3-02 set to its default value when using a motor that is relatively small compared to the drive, try lowering L3-02.
- When operating the motor in the constant power range, also set parameter L3-03.

#### ? L3-03: Stall Prevention Limit during Acceleration

The Stall Prevention level is automatically reduced when the motor is operated in the constant power range. L3-03 sets the lower limit for this reduction as a percentage of the drive rated current.

No.	Name	Setting Range	Default
L3-03	Stall Prevention Limit during Acceleration	0 to 100%	50%

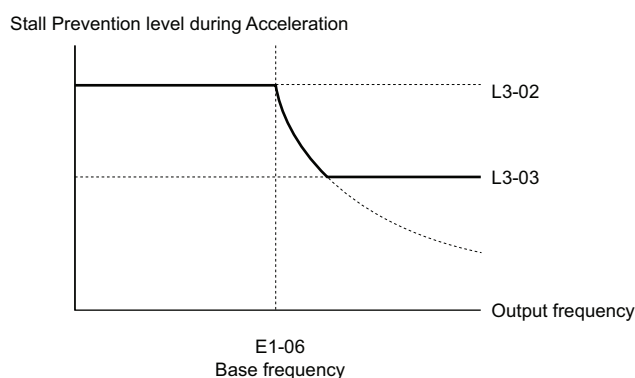


Figure 5.83 Stall Prevention Level and Limit During Acceleration

### ? L3-22: Deceleration Time at Stall Prevention during Acceleration

Sets the brief deceleration time used when stalling occurs while accelerating a PM motor. When set to 0, this function is disabled and the drive will decelerate at the selected deceleration time when stalling occurs.

The function is effective only in Open Loop Vector Control for PM motors and if parameter L3-01 is set to 1.

No.	Name	Setting Range	Default
L3-22	Deceleration Time at Stall Prevention During Acceleration	0.0 to 6000.0 s	0.0 s

### ? L3-04: Stall Prevention Selection during Deceleration

Stall Prevention during deceleration can control the deceleration based on the DC bus voltage and prevent an overvoltage fault caused by high inertia or rapid deceleration.

No.	Name	Setting Range	Default
L3-04	Stall Prevention Selection During Deceleration	0 to 5 <I>	1

<I> Settings 3 through 5 are not available in OLV/PM. Settings 2 through 5 are not available in AOLV/PM and CLV/PM.

#### Setting 0: Disabled

When this setting is used, the drive decelerates according to the set deceleration time. With high inertia loads or rapid deceleration, an overvoltage (ov) fault may occur. In this case use braking options or switch to another L3-04 selection.

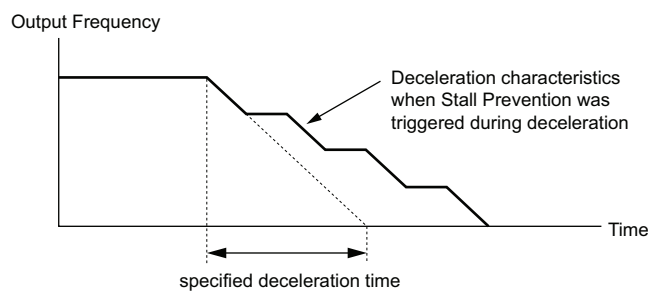
#### Setting 1: General-purpose Stall Prevention

With this setting the drive tries to decelerate within the set deceleration time. When the DC bus voltage exceeds the Stall Prevention level, the drive pauses deceleration. Deceleration continues as soon as the DC bus voltage drops below that level. Stall Prevention may be triggered repeatedly to avoid an overvoltage fault. The DC bus voltage level for Stall Prevention depends on the input voltage setting E1-01.

Drive Input Voltage	Stall Prevention Level during Deceleration
200 V Class	377 Vdc
400 V Class	754 Vdc

- Note:**
1. This setting should not be used in combination with a Dynamic Braking Resistor or other braking options. If Stall Prevention during deceleration is enabled, it will be triggered before the braking resistor option can operate.
  2. This method may lengthen the total deceleration time compared to the set value. If this is not appropriate for the application consider using a braking option.

*Figure 5.84* illustrates the function of Stall Prevention during deceleration.



**Figure 5.84 Stall Prevention During Deceleration**

### Setting 2: Intelligent Stall Prevention

With this setting, the drive adjusts the deceleration rate so that the DC bus voltage is kept at the level set in parameter L3-17. This way the shortest possible deceleration time is achieved while the motor is protected from stalling. The deceleration time that has been selected is disregarded, but the achievable deceleration time cannot be smaller than 1/10 of the set deceleration time.

This function uses the following parameters to calculate the deceleration rate:

- DC Bus Adjustment Gain (S6-04)
- Accel/Decel Calculation Gain (S6-05)
- Motor Acceleration Time (S6-02)
- Load Inertia Ratio (S6-03)
- Additional DC Bus Capacitors (L3-26)
- DC Bus Capacity (S6-01)

For descriptions regarding the S6 parameters refer to section *S6: Power KEB Function on page 275*.

**Note:** As the deceleration time is not constant, Intelligent Stall Prevention should not be used in applications where stopping accuracy is a concern. Use braking options instead.

### Setting 3: Stall Prevention with braking option

Enables the Stall Prevention function while using a braking resistor. Overvoltage problems in the DC bus can occur if Stall Prevention during deceleration is disabled (L3-04) in OLV and a braking option is installed. Set L3-04 to 3 to remedy this situation.

### Setting 4: Overexcitation Deceleration 1

Overexcitation Deceleration 1 (increasing the motor flux) is faster than deceleration with no Stall Prevention (L3-04 = 0). Refer to *Overexcitation Deceleration (induction motors) on page 250* for details.

### Setting 5: Overexcitation Deceleration 2

Overexcitation Deceleration 2 slows down the motor while trying to maintain the DC bus voltage at the level set in parameter L3-17. By doing this, the achievable deceleration time can even be shorter than with Overexcitation Deceleration 1. Refer to *Overexcitation Deceleration (induction motors) on page 250* for details.

### ? L3-05: Stall Prevention Selection during Run

Stall Prevention during run can prevent a motor from stalling by automatically reducing the speed when a transient overload occurs while the motor is running at constant speed.

This parameter determines how Stall Prevention works during run.

No.	Name	Setting Range	Default
L3-05	Stall Prevention Selection During Run	0 to 2	1

- Note:**
1. This function is available in V/f, V/f w/PG, and OLV/PM.
  2. When output frequency is 6 Hz or less, Stall Prevention during run is disabled regardless of the setting in L3-05 and L3-06.

### Setting 0: Disabled

Drive runs at the set frequency reference. A heavy load may cause the motor to stall and trip the drive with an oC or oL fault.

### Setting 1: Decelerate using C1-02

If the current exceeds the Stall Prevention level set in parameter L3-06, then the drive will decelerate at decel time 1 (C1-02). Once the current level drops below the value of L3-06 minus 2% for 100 ms, the drive accelerates back to the frequency reference at the active acceleration time.

### Setting 2: Decelerate using C1-04

Same as setting 1 except the drive decelerates at decel time 2 (C1-04).

### ? L3-06: Stall Prevention Level during Run

Sets the current level to trigger Stall Prevention during run. Depending on the setting of parameter L3-23, the level is automatically reduced in the constant power range (speed beyond base speed). The value is set as a percentage of the drive rated output current.

The Stall Prevention level can be adjusted using an analog input. Refer to *Multi-Function Analog Input Terminal Settings on page 215* for details.

No.	Name	Setting Range	Default
L3-06	Stall Prevention Level During Run	30 to 150% </>	</>

</> The upper limit and default for this setting is determined by C6-01 and L8-38.

### ? L3-23: Automatic Reduction Selection for Stall Prevention during Run

This function reduces the Stall Prevention during run level in the constant power range.

No.	Name	Setting Range	Default
L3-23	Automatic Reduction Selection for Stall Prevention During Run	0 or 1	0

#### Setting 0: Disabled

The level set in L3-06 is used throughout the entire speed range.

#### Setting 1: Enabled

The Stall Prevention level during run is reduced in the constant power range. The lower limit will be 40% of L3-06.

### ? Overvoltage Suppression Function

This function suppresses overvoltage faults by decreasing the regenerative torque limit and slightly increasing the output frequency when the DC bus voltage rises. It can be used to drive loads with cyclic regenerative operation, such as a punch press or other applications that involve repetitive crank movements.

The overvoltage suppression function controls the output frequency (in V/f Control and other control modes that do not rely on motor feedback) or the regen torque limit (in closed-loop setups) in order to keep the DC bus voltage at the value set to L3-17.

- Note:**
1. The motor speed will exceed the frequency reference when overvoltage suppression is triggered. Consequently, overvoltage suppression is not appropriate in applications that require a perfect match between the frequency reference and the motor speed.
  2. Disable overvoltage suppression when using a braking resistor.
  3. Overvoltage may still occur if there is a sudden increase to a regenerative load.
  4. This function is enabled only when operating just below the maximum frequency. Overvoltage suppression does not increase the output frequency beyond the maximum frequency. If this is required by the application, increase the maximum frequency and change the base frequency setting.

### ? L3-11: Overvoltage Suppression Function Selection

Enables or disables the overvoltage suppression function.

No.	Name	Setting Range	Default
L3-11	Overvoltage Suppression Function Selection	0 or 1	0

#### Setting 0: Disabled

The regenerative torque limit and the output frequency are not adjusted. A regenerative load may trip the drive with an overvoltage fault. Use this setting if braking options are installed.

#### Setting 1: Enabled

When the DC bus voltage rises due to regenerative load, an overvoltage fault is prevented by decreasing the regenerative torque limit and increasing the output frequency.

### ? L3-17: Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention

Sets the target DC bus voltage target level used by the overvoltage suppression function (L3-11 = 1) or Intelligent Stall Prevention during deceleration (L3-04 = 2).

No.	Name	Setting Range	Default
L3-17	Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention	150 to 400 Vdc <1>	375 Vdc <1> <2>

<1> Values are for 200 V class drives and must be doubled for 400 V class drives.

<2> This value is initialized when E1-01 is changed.

### ? L3-26: Additional DC Bus Capacitors

Sets the capacity of any additional DC bus capacitors that have been installed.

This data is used in the Power KEB, Intelligent Stall Prevention and Overvoltage Suppression functions. This setting needs to be adjusted only if external capacity is connected to the drive's DC bus and one of these functions is used.

The resulting DC bus capacity, used by the drive will be L3-26 + S6-01.

No.	Name	Setting Range	Default
L3-26	Additional DC Bus Capacitors	0 to 65000 µF	0 µF

### ? L3-27: Stall Prevention Detection Time

Sets a delay time from when the Stall Prevention level is reached and the actual Stall Prevention function is activated.

No.	Name	Setting Range	Default
L3-27	Stall Prevention Detection Time	0 to 5000 ms	50 ms

## ? L4: Speed Detection

These parameters set up the speed agree and speed detection functions which can be assigned to the multi-function output terminals.

A speed agree situation can be detected by the motor speed when using Closed Loop Vector Control and Closed Loop Vector Control for PM motors.

### ? L4-01, L4-02: Speed Agreement Detection Level and Detection Width

Parameter L4-01 sets the detection level for the digital output functions “Speed agree 1,” “User-set speed agree 1,” “Frequency detection 1,” and “Frequency detection 2.”

Parameter L4-02 sets the hysteresis level for these functions. *Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and M5-M6 Function Selection on page 201*, Settings 2, 3, 4, and 5.

No.	Name	Setting Range	Default
L4-01	Speed Agreement Detection Level	0.0 to 400.0 Hz <1>	Determined by A1-02 <1>
L4-02	Speed Agreement Detection Width	0.0 to 20.0 Hz <2>	Determined by A1-02 <2>

<1> The setting range depends on the control mode selected for the drive. The setting range is 0.0 to 100.0% in AOLV/PM and CLV/PM.

<2> The setting range depends on the control mode selected for the drive. The setting range is 0.0 to 40.0% in AOLV/PM and CLV/PM.

## 5.8 L: Protection Functions

### ? L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-)

Parameter L4-03 sets the detection level for the digital output functions “Speed agree 2,” “User-set speed agree 2,” “Frequency detection 3,” and “Frequency detection 4.”

Parameter L4-04 sets the hysteresis level for these functions. *Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and M5-M6 Function Selection on page 201*, Settings 13, 14, 15, and 16.

No.	Name	Setting Range	Default
L4-03	Speed Agreement Detection Level (+/-)	-400.0 to 400.0 Hz <1>	0.0 Hz
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0 Hz <2>	Determined by A1-02

<1> The setting range depends on the control mode selected for the drive. The setting range is -100.0 to 100.0% in AOLV/PM and CLV/PM.

<2> The setting range depends on the control mode selected for the drive. The setting range is 0.0 to 40.0% in AOLV/PM and CLV/PM.

### ? L4-05: Frequency Reference Loss Detection Selection

The drive can detect a loss of an analog frequency reference from input A1, A2, or A3. Frequency reference loss is detected when the frequency reference drops below 10% of the reference before or below 5% of the maximum output frequency within 400 ms.

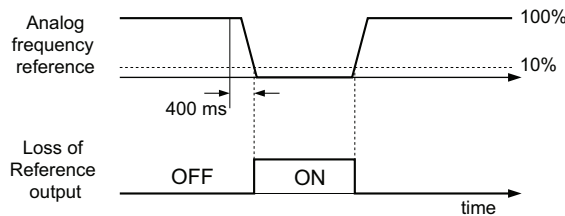


Figure 5.85 Loss of Reference Function

To have a digital output trigger when frequency reference loss occurs, set H2-01, H2-02, or H2-03 to C. *Refer to Setting C: Frequency reference loss on page 205* for details on setting the output function.

Parameter L4-05 selects the operation when a frequency reference loss is detected.

No.	Name	Setting Range	Default
L4-05	Frequency Reference Loss Detection Selection	0 or 1	0

#### Setting 0: Stop

Drive follows the frequency reference (which is no longer present) and simply stops the motor.

#### Setting 1: Continue operation with reduced frequency reference

The drive will continue operation at the frequency reference value set in parameter L4-06. When the external frequency reference value is restored, the operation is continued with the frequency reference.

### ? L4-06: Frequency Reference at Reference Loss

Sets the frequency reference level the drive runs with when L4-05 = 1 and a reference loss was detected. The value is set as a percentage of the frequency reference when the loss was detected.

No.	Name	Setting Range	Default
L4-06	Frequency Reference at Reference Loss	0.0 to 100.0%	80.0%

### ? L4-07: Speed Agreement Detection Selection

Determines when frequency detection is activated.

No.	Name	Setting Range	Default
L4-07	Speed Agreement Detection Selection	0 or 1	0

**Setting 0: During run only (no detection while drive output is shut off)**

**Setting 1: Detection always enabled**

### ? L4-08: Frequency Agree Condition Selection

Sets whether a frequency agree situation should be determined by the soft-starter output frequency or by the estimated speed of the motor.

No.	Name	Setting Range	Default
L4-08	Frequency Agree Condition Selection	0, 1	1

**Setting 0: Use the soft starter output frequency to determine frequency agree**

**Setting 1: Use the motor speed to determine frequency agree**

The setting of L4-08 affects the other drive functions listed below.

- Conditions for overtorque/undertorque detection 1 and 2 (L6-01, L6-04) become so that both fault and alarm detection for overtorque 1 and 2 (oL3, oL4) are possible only during speed agree.
- Frequency agree detection is possible with the following settings for the multi-function output terminals.

Setting	Function
2	Speed Agree 1
3	User-set Speed Agree 1
4	Frequency Detection 1
5	Frequency Detection 2
13	Speed Agree 2
14	User-set Speed Agree 2
15	Frequency Detection 3
16	Frequency Detection 4

- MEMOBUS Monitor Data

Register No.	Contents
002CH	Drive Status 2
	bit2 Speed Agree
	bit3 User Speed Agree
	bit4 Frequency Detection 1
	bit5 Frequency Detection 2
004BH	Drive Status (U1-12)
	bit4 During Speed Agree

- Monitor Parameter

No.	Name	Description
U1-12	Drive Status	The 5th digit from the right indicates whether speed agree has been reached or not.

### ? L5: Fault Restart

After a fault has occurred, this function attempts to automatically restart the motor and continue operation instead of stopping.

The drive can be set up to perform a self-diagnostic check and resume the operation after a fault has occurred. If the self-check is successful and the cause of the fault has disappeared, the drive restarts by first performing Speed Search (Refer to b3: Speed Search on page 129 for details).

- Note:**
1. The wiring sequence should remove the Forward/Reverse command when a fault is triggered and output is shut off.
  2. With the Forward/Reverse command removed, the drive can perform a self-diagnostic check and attempt to reset the fault automatically.

**DANGER!** Never use the fault restart function in hoist-type applications.

The drive can attempt to restart itself following the faults listed below.

Fault	Name	Fault	Name
GF	Ground Fault	oL4	Overtorque 2
LF	Output Open Phase	ov	DC Bus Overvoltage
oC	Overcurrent	PF	Input Phase Loss
oH1	Drive Overheat	rH	Braking Resistor Fault
oL1	Motor Overload	rr	Braking Transistor Fault
oL2	Drive Overload	Uv1	DC Bus Undervoltage <1>
oL3	Overtorque 1	STo	Pull-Out Detection

<1> When L2-01 is set to 1 or 2 (continue operation during momentary power loss)

Use parameters L5-01 to L5-05 to set up automatic fault restart.

To output a signal during fault restart, set H2-01, H2-02, or H2-03 to 1E.

### ? L5-01: Number of Auto Restart Attempts

Sets the number of times that the drive may attempt to restart itself.

The method of incrementing the restart counter is determined by the setting of parameter L5-05. When the counter reaches the number set in L5-01, the operation stops and the fault has to be reset manually after correcting the cause.

The restart counter is incremented at each restart attempt, regardless of whether the attempt was successful. When the counter reaches the number set in L5-01, the operation stops and the fault has to be reset manually after correcting the cause.

The number of fault restarts is reset back to zero when:

- The drive operates normally for ten minutes following a fault restart.
- A fault is cleared manually after protective functions are triggered.
- The power supply is cycled.

No.	Name	Setting Range	Default
L5-01	Number of Auto Restart Attempts	0 to 10 Times	0 Time

### ? L5-02: Auto Restart Fault Output Operation Selection

Determines if a fault output is triggered (H2-□□ = E) when the drive attempts to restart.

No.	Name	Setting Range	Default
L5-02	Auto Restart Fault Output Operation Selection	0 or 1	0

**Setting 0: No fault output**

**Setting 1: Fault output is set**

### ? L5-04: Fault Reset Interval Time

Determines the amount of time to wait between restart attempts when parameter L5-05 is set to 1.

No.	Name	Setting Range	Default
L5-04	Fault Reset Interval Time	0.5 to 600.0 s	10.0 s

## ? L5-05: Fault Reset Operation Selection

No.	Name	Setting Range	Default
L5-05	Fault Reset Operation Selection	0 or 1	0

### Setting 0: Count successful restarts

The drive will continuously attempt to restart. If it restarts successfully, the restart counter is increased. This operation is repeated each time a fault occurs until the counter reaches the value set in L5-01.

### Setting 1: Count restart attempts

The drive will try to restart using the time interval set in parameter L5-04. A record is kept of the number of attempts to restart to the drive, regardless of whether or not those attempts were successful. When the number of attempted restarts exceeds the value set to L5-01, the drive gives up trying to restart.

## ? L6: Torque Detection

The drive provides two independent torque detection functions that trigger an alarm or fault signal. Make sure an overtorque alarm will be displayed when necessary in applications that may be damaged from excessive torque. They are set up using the L6-□□ parameters. To indicate the underload or overload condition to an external device, digital outputs should be programmed as shown below.

**Note:** The drive can notify the user that an overtorque situation has been reached. This is particularly useful in applications where overtorque can damage connected machinery. Use the torque detection for this purpose. Use undertorque detection to discover application problems.

H2-01, H2-02, H2-03 Setting	Description
B	Torque detection 1, N.O. (output closes when overload or underload is detected)
17	Torque detection 1, N.C. (output opens when overload or underload is detected)
18	Torque detection 2, N.O. (output close when overload or underload is detected)
19	Torque detection 2, N.C. (output opens when overload or underload is detected)

Figure 5.86 and Figure 5.87 show the function of overtorque and undertorque detection.

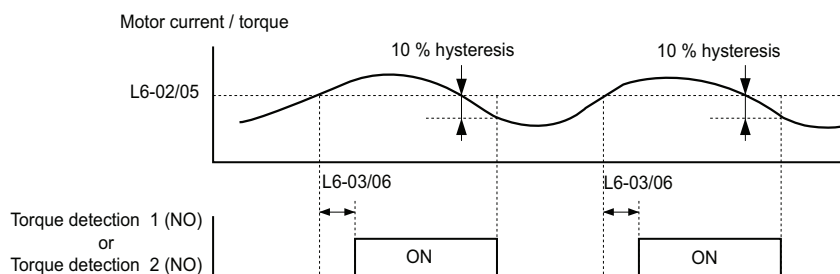


Figure 5.86 Overtorque Detection Operation

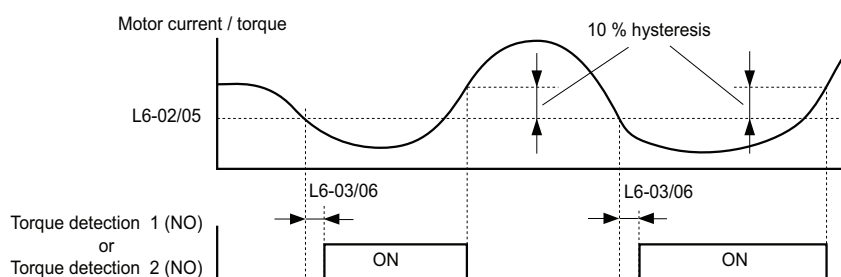


Figure 5.87 Undertorque Detection Operation

- Note:**
1. The torque detection function uses a hysteresis of 10% of the drive rated output current and motor rated torque.
  2. In V/f, V/f w/PG and OLV/PM, the level is set as a percentage of the drive rated output current. In OLV, CLV, AOLV/PM and CLV/PM, it is set as a percentage of the motor rated torque.

An analog input signal can be used to set the detection level of torque detection 1 (L6-01). *Refer to Multi-Function Analog Input Terminal Settings on page 215* for details on assigning a function to an analog input.

**? L6-01, L6-04: Torque Detection Selection 1, 2**

The torque detection function is triggered when the current or torque exceeds the levels set in L6-02 and L6-05 for longer than the time set in L6-03 and L6-06. L6-01 and L6-04 select the conditions for detection and the operation that follows.

No.	Name	Setting Range	Default
L6-01	Torque Detection Selection 1	0 to 8	0
L6-04	Torque Detection Selection 2	0 to 8	0

**Setting 0: Disabled****Setting 1: oL3, oL4 at Speed Agree - Alarm**

Overtorque detection is active only when the output speed is equal to the frequency reference, i.e., no detection during acceleration and deceleration. The operation continues after detection and an oL3/oL4 alarm is triggered.

**Setting 2: oL3, oL4 at Run - Alarm**

Overtorque detection works as long as the Run command is active. The operation continues after detection and an oL3 or oL4 alarm is triggered.

**Setting 3: oL3, oL4 at Speed Agree - Fault**

Overtorque detection is active only when the output speed is equal to the frequency reference, i.e., no detection during acceleration and deceleration. The operation is stopped and an oL3 or oL4 fault is triggered.

**Setting 4: oL3, oL4 at Run - Fault**

Overtorque detection works as long as a Run command is active. Operation stops and an oL3 or oL4 fault is triggered.

**Setting 5: UL3, UL4 at Speed Agree - Alarm**

Undertorque detection is active only when the output speed is equal to the frequency reference, i.e., no detection during acceleration and deceleration. The operation continues after detection and a UL3 or UL4 alarm is triggered.

**Setting 6: UL3, UL4 at Run - Alarm**

Undertorque detection works as long as the Run command is active. The operation continues after detection and a UL3 or UL4 alarm is triggered.

**Setting 7: UL3, UL4 at Speed Agree - Fault**

Undertorque detection is active only when the output speed is equal to the frequency reference, i.e., no detection during acceleration and deceleration. The operation is stopped and a UL3 or UL4 fault is triggered.

**Setting 8: UL3, UL4 at Run - Fault**

Undertorque detection works as long as a Run command is active. Operation stops and a UL3 or UL4 fault is triggered.

**? L6-02, L6-05: Torque Detection Level 1, 2**

These parameters set the detection levels for the torque detection functions 1 and 2. The setting for torque detection is set as a percentage of either the drive rated current or of the motor rated torque, depending on the control mode. In V/f Control, V/f with PG Control, and OLV/PM, L6-02 and L6-05 are set as a percentage of the drive rated current. In all other control modes (OLV, CLV, AOLV/PM) torque detection is set as a percentage of the motor rated torque.

No.	Name	Setting Range	Default
L6-02	Torque Detection Level 1	0 to 300%	150%
L6-05	Torque Detection Level 2	0 to 300%	150%

**Note:** The torque detection level 1 (L6-02) can also be supplied by an analog input terminal set to H3-□□ = 7. Here, the analog value has priority and the setting in L6-02 is disregarded. Torque detection level 2 (L6-05) cannot be set by an analog input.

**? L6-03, L6-06: Torque Detection Time 1, 2**

These parameters determine the time required to trigger an alarm or fault after exceeding the levels in L6-02 and L6-05.

No.	Name	Setting Range	Default
L6-03	Torque Detection Time 1	0.0 to 10.0 s	0.1 s
L6-06	Torque Detection Time 2	0.0 to 10.0 s	0.1 s

## ? L7: Torque Limit

The torque limit function can be used to limit the torque in each of the four quadrants individually and thereby protect the machinery. It can be used in OLV, CLV, AOV/PM, and CLV/PM control modes. The limit can be either set by parameters or by analog inputs. A digital output programmed for “During torque limit” (H2-01, H2-02, H2-03 = 30) can be switched when the drive is operating at the torque limit.

### ? Setting Torque Limits

The torque limits are defined by parameters L7-01 to L7-04 for each of the four operation quadrants. Analog inputs can also be used to either define a general limit for all operation conditions (H3-02, H3-06, H3-10 = 15) or for setting separate limits for each operation condition (H3-02, H3-06, H3-10 = 10, 11, or 12). *Figure 5.88* shows which of the limit settings is applied in each quadrant.

If two limit values are defined for the same operation conditions, the drive will use the lower value.

**Note:** The maximum output torque is ultimately limited by the drive output current (max. 150% of drive rated current in HD, 120% in ND). Output torque will not exceed the limit set for the drive rated current, even if the torque limits are set to higher values.

Example: If parameter L7-01 = 130%, L7-02 to L7-04 = 200%, and a general torque limit of 150% is set by an analog input (H2-02, H2-06, H2-10 = 15), then the torque limit in quadrant 1 will be 130%, but 150% in all other quadrants.

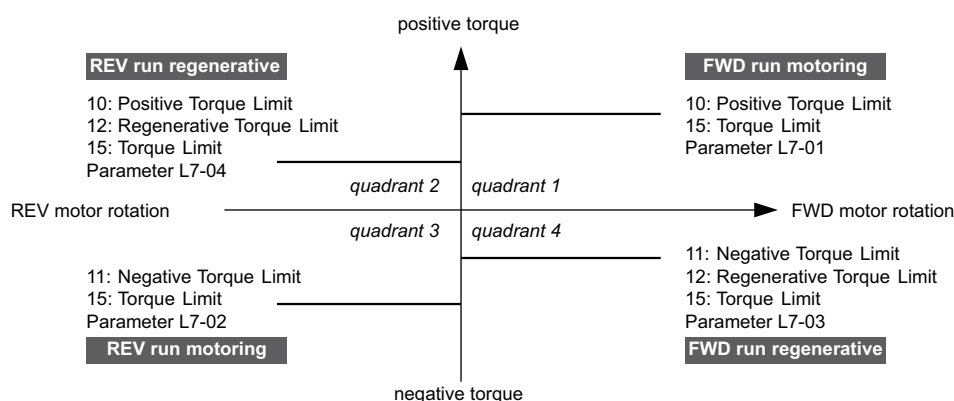


Figure 5.88 Torque Limit Parameters and Analog Input Settings

### ? L7-01 to L7-04: Torque Limits

These parameters set the torque limits in each operation mode. The value is set as a percentage of the motor rated torque.

No.	Name	Setting Range	Default
L7-01	Forward Torque Limit	0 to 300%	200%
L7-02	Reverse Torque Limit	0 to 300%	200%
L7-03	Forward Regenerative Torque Limit	0 to 300%	200%
L7-04	Reverse Regenerative Torque Limit	0 to 300%	200%

**Note:** If the multi-function analog input (H3-02, H3-06, or H3-10) is programmed for “10: Forward torque limit”, “11: Reverse torque limit”, “12: Regenerative torque limit”, or “15: General torque limit”, the drive uses the lower value in L7-01 through L7-04, or analog input torque limit.

### ? L7-06: Torque Limit Integral Time Constant

Sets the integral time constant for the torque limit function. Decrease this setting for faster torque limit response. Increase it if oscillation occur when operating at the torque limit.

No.	Name	Setting Range	Default
L7-06	Torque Limit Integral Time Constant	5 to 10000 ms	200 ms

## 5.8 L: Protection Functions

### ? L7-07: Torque Limit Control Method Selection during Accel/Decel

Selects the function of torque limit during acceleration and deceleration.

No.	Name	Setting Range	Default
L7-07	Torque Limit Control Method Selection during Accel/Decel	0 or 1	0

#### Setting 0: Proportional control

The torque limit function works with P control during accel and decel, and switches to I control at constant speed. Use this setting when accelerating or decelerating to the desired speed has priority over the torque limit during speed changes.

#### Setting 1: Integral control

The torque limit function always uses I control. Use this setting when a highly accurate torque limit is required, even during speed changes. Using this function may increase the acceleration time, or may prevent the motor speed from reaching the frequency reference if the torque limit is reached first.

### ? L7-16: Torque Limit Process at Start

Assigns a time filter to allow the torque limit to build at start.

No.	Name	Setting Range	Default
L7-16	Torque Limit Process at Start	0 to 1	1

#### Setting 0: Disabled

Torque limit is created at start without a delay time. Disable L7-16 to maximize response time when the application requires sudden acceleration or deceleration at start.

#### Setting 1: Enabled

A time filter is added to allow the torque limit to build at start.

## ? L8: Drive Protection

### ? L8-01: Internal Dynamic Braking Resistor Protection Selection (ERF type)

This parameter selects the dynamic braking resistor protection when using an optional heatsink mounted braking resistor (ERF type, 3% ED).

No.	Name	Setting Range	Default
L8-01	Internal Dynamic Braking Resistor Protection Selection (ERF type)	0 or 1	1

#### Setting 0: Disabled

Disables braking resistor protection. Use this setting for any braking option other than the Yaskawa ERF type resistor.

#### Setting 1: Enabled

Enables protection for ERF type resistors.

### ? L8-02: Overheat Alarm Level

Sets the overheat alarm (oH) detection level.

The drive will output an alarm when the heatsink temperature exceeds the alarm level set in parameter L8-02. If the operation when this alarm occurs is set for continued operation (L8-03 = 4) and the temperature reaches the overheat fault level, the drive will trigger an oH1 fault and stop operation.

When an output terminal is set for the oH pre-alarm (H2-□□ = 20), the switch will close when the heatsink temperature rises above L8-02.

No.	Name	Setting Range	Default
L8-02	Overheat Alarm Level	50 to 150 °C	Determined by C6-01 and o2-04

### ? L8-03: Overheat Pre-Alarm Operation Selection

Sets the operation when an overheat pre-alarm is detected.

No.	Name	Setting Range	Default
L8-03	Overheat Pre-Alarm Operation Selection	0 to 3	3

#### Setting 0: Ramp to stop

If an overheat alarm occurs, the drive decelerates to stop using the deceleration time currently selected. If a digital output is programmed for “fault” (H2-□□ = E), this output will be triggered.

#### Setting 1: Coast to stop

If heatsink overheat (oH) occurs, the drive switches off the output and the motor coasts to stop. If a digital output is programmed for “fault” (H2-□□ = E), this output will be triggered.

#### Setting 2: Fast Stop

If an overheat alarm occurs, the drive decelerates to stop using the Fast Stop time (C1-09). If a digital output is programmed for “fault” (H2-□□ = E), this output will be triggered.

#### Setting 3: Alarm only

If an overheat alarm occurs, an alarm is output and the drive continues operation.

### ? L8-05: Input Phase Loss Protection Selection

Enables or disables the input phase loss detection.

No.	Name	Setting Range	Default
L8-05	Input Phase Loss Protection Selection	0, 1, 4	1

#### Setting 0: Disabled

#### Setting 1: Enabled (software detection only)

#### Setting 4: Enabled (both software and hardware detection)

Enables input phase loss detection. As detection is performed by measuring the DC bus ripple, a phase loss fault (PF) can also be triggered by a power supply voltage imbalance or main circuit capacitor deterioration. Detection is disabled if:

- The drive is decelerating.
- No Run command is active.
- Output current is less than or equal to 30% of the drive rated current.

### ? L8-07: Output Phase Loss Protection Selection

Enables or disables the output phase loss detection, which is triggered when the output current falls below 5% of the drive rated current.

- Note:**
1. Output phase loss detection can mistakenly be triggered if the motor rated current is very small compared to the drive rating. Disable this parameter in such cases.
  2. Output phase loss detection is not possible when the drive is running a PM motor with light load.

No.	Name	Setting Range	Default
L8-07	Output Phase Loss Protection Selection	0 to 2	0

#### Setting 0: Disabled

#### Setting 1: Fault when one phase is lost

An output phase loss fault (LF) is triggered when one output phase is lost. The output shuts off and the motor coasts to stop.

#### Setting 2: Fault when two phases are lost

An output phase loss fault (LF) is triggered when two output phases are lost. The output shuts off and the motor coasts to stop.

## 5.8 L: Protection Functions

### ? L8-09: Output Ground Fault Detection Selection

Enables or disables the output ground fault detection.

No.	Name	Setting Range	Default
L8-09	Output Ground Fault Detection Selection	0 or 1	1

#### Setting 0: Disabled

Ground faults are not detected.

#### Setting 1: Enabled

A ground fault (GF) is triggered when high leakage current or a ground short circuit occurs in one or two output phases.

### ? L8-10: Heatsink Cooling Fan Operation Selection

Selects the heatsink cooling fan operation.

No.	Name	Setting Range	Default
L8-10	Heatsink Cooling Fan Operation Selection	0 or 1	0

#### Setting 0: Run with timer

The fan is switched on when a Run command is active. It is switched off with the delay set in parameter L8-11 after the Run command has been released. Using this setting extends the fan lifetime.

#### Setting 1: Run always

The fan runs whenever power is supplied to the drive.

### ? L8-11: Heatsink Cooling Fan Off-Delay Time

Sets the cooling fan switch off-delay time if parameter L8-10 is set to 0.

No.	Name	Setting Range	Default
L8-11	Heatsink Cooling Fan Off-Delay Time	0 to 300 s	60 s

### ? L8-12: Ambient Temperature Setting

If the temperature where the drive is mounted is above the specified values, the drive rated current must be reduced for optimal performance life. By setting the ambient temperature to parameter L8-12 and adjusting the installation method setting in L8-35, the drive rating automatically adapts to safe values.

No.	Name	Setting Range	Default
L8-12	Ambient Temperature Setting	-10 to 50°C	40°C

### ? L8-15: oL2 Characteristics Selection at Low Speeds

Selects whether the drive overload capability (oL fault detection level) is reduced at low speeds in order to prevent premature output transistor failures.

**Note:** Contact Yaskawa for consultation first before disabling this setting.

No.	Name	Setting Range	Default
L8-15	oL2 Characteristics Selection at Low Speed	0 or 1	1

#### Setting 0: Protection disabled at low speed

The overload protection level is not reduced. Frequently operating the drive with high output current at low speed can lead to premature drive faults.

#### Setting 1: protection enabled at low speed

The overload protection level (oL2 fault detection level) is automatically reduced at speeds below 6 Hz.

### ? L8-18: Software Current Limit Selection

The Software Current Limit (CLA) is a drive protection function that prevents main circuit transistor failures caused by high current. Parameter L8-18 enables or disables this function.

**Note:** This setting should not be changed unless absolutely necessary. For proper drive protection and operation leave the Software CLA function enabled.

No.	Name	Setting Range	Default
L8-18	Software Current Limit Selection	0 or 1	0

#### Setting 0: Software CLA disabled

The drive may trip on an oC fault if the load is too heavy or the acceleration is too short.

#### Setting 1: Software CLA enabled

When the soft CLA current level is reached, the drive reduces the output voltage in order to reduce the current. If the current level drops below the Software CLA level, then normal operation will continue.

### ? L8-27: Overcurrent Detection Gain

Adjusts the overcurrent detection level when running in OLV/PM, AOLV/PM, or CLV/PM. A setting of 100% is equal to the motor rated current. When the drive rated current is considerably higher than the motor rated current, use this parameter to decrease the overcurrent level in order to prevent motor demagnetization by too high current.

Overcurrent detection will use whichever value is the lowest: the overcurrent level for the drive, or the motor rated current multiplied by L8-27.

No.	Name	Setting Range	Default
L8-27	Overcurrent Detection Gain	0.0 to 300.0%	300.0%

### ? L8-29: Current Unbalance Detection (LF2)

Enables or disables output current imbalance detection when running in OLV/PM, AOLV/PM, or CLV/PM. Current unbalance can heat up a PM motor and lead to demagnetization of the magnets. The current imbalance detection function prevents such motor damage by monitoring output current and triggering the LF2 fault when current unbalance occurs.

No.	Name	Setting Range	Default
L8-29	Current Unbalance Detection (LF2)	0 or 1	1

#### Setting 0: Disabled

No current unbalance protection is provided to the motor.

#### Setting 1: Enabled

The LF2 fault is triggered if an output current imbalance is detected. Drive output shuts off and the motor coasts to stop.

### ? L8-32 Main Contactor and Cooling Fan Power Supply Failure Selection

Determines drive operation when a FAn fault occurs.

No.	Name	Setting Range	Default
L8-32	Main Contactor and Cooling Fan Power Supply Failure Selection	0 to 3	1

#### Setting 0: Ramp to stop

The drive stops the motor using the deceleration time<sup>1</sup> set in parameter C1-02.

#### Setting 1: Coast to stop

The drive output is switched off and the motor coasts to stop.

#### Setting 2: Fast stop

The drive stops the motor using the Fast stop time set in parameter C1-09.

#### Setting 3: Alarm only

The operation is continued and a FAn alarm is displayed on the digital operator.

**Note:** FAn is detected as an error when setting 0 to 2 is selected. It is detected as an alarm when setting 3 is selected.

## 5.8 L: Protection Functions

### ? L8-35: Installation Method Selection

Selects the type of installation for the drive and changes the drive overload (oL2) limits accordingly.

- Note:**
1. This parameter is not reset when the drive is initialized.
  2. The value is preset to the appropriate value when the drive is shipped. Change the value only when using Side-by-Side installation or when mounting a standard drive with the heatsink outside the cabinet.

No.	Name	Setting Range	Default
L8-35	Installation Method Selection	0 to 3	Determined by o2-04

#### Setting 0: IP20 enclosure drive

For an IP20 enclosure drive installed with at a minimum of 30 mm space to the next drive or a cabinet wall.

#### Setting 1: Side-by-Side mounting

For drives mounted according to Yaskawa's Side-by-Side specifications (requires 2 mm between drives).

#### Setting 2: NEMA Type 1

For drives compliant with NEMA Type 1 enclosure specifications.

#### Setting 3: Finless model or external heatsink Installation

For finless drives or a standard drive mounted with the heatsink outside the cabinet or enclosure panel.

### ? L8-38: Carrier Frequency Reduction Selection

Lets the drive reduce the carrier frequency when the output current exceeds a certain level. This temporarily increases the overload capability (oL2 detection), allowing the drive to run through transient load peaks without tripping.

L8-38 selects the operation of the carrier frequency reduction function.

- Note:** This function cannot be used in Advanced Open Loop Vector for PM motors.

No.	Name	Setting Range	Default
L8-38	Carrier Frequency Reduction Selection	0 to 2	Determined by A1-02 and o2-04

#### Setting 0: Disabled

No carrier frequency reduction at high current.

#### Setting 1: Enabled for output frequencies below 6 Hz

The carrier frequency is reduced at speeds below 6 Hz when the current exceeds 100% of the drive rated current. The drive returns to its normal carrier frequency when the current falls below 88% or the output frequency exceeds 7 Hz.

#### Setting 2: Enabled for entire frequency range

The carrier frequency is reduced at the following speeds:

- Below 6 Hz when the current exceeds 100% of the drive rated current.
- Above 7 Hz when the current exceeds 112% of the drive rated current.

The drive uses the delay time set in parameter L8-40 and a hysteresis of 12% when switching the carrier frequency back to the set value.

### ? L8-40: Carrier Frequency Reduction Off-Delay Time

Sets a hold time before returning to the original carrier frequency setting after the carrier frequency has been temporarily derated as determined by L8-38. The carrier frequency reduction function is disabled if this value is 0.00 s.

No.	Name	Setting Range	Default
L8-40	Carrier Frequency Reduction Off-Delay Time	0.00 to 2.00 s	Determined by A1-02

### ? L8-41: High Current Alarm Selection

Triggers a high current alarm (HCA) when the output current rises too much.

No.	Name	Setting Range	Default
L8-41	High Current Alarm Selection	0 or 1	0

#### Setting 0: Disabled

No alarm is detected.

#### Setting 1: Enabled

An alarm is triggered when the output current exceeds 150% of the drive rated current. A digital output set for an alarm (H2-□□ = 10) will close.

### ? L8-46: AVR Function Selection

Enables or disabled the AVR function. If enabled AVR adjusts the PWM to have the output voltage at the desired level even if the DC bus voltage changes.

No.	Name	Setting Range	Default
L8-46	AVR Function Selection	0, 1	1

#### Setting 0: Disabled

#### Setting 1: Enabled

### ? L8-55: Internal Braking Transistor Protection

Enables or disables protection for the internal braking transistor.

No.	Name	Setting Range	Default
L8-55	Internal Braking Transistor Protection	0 or 1	1

#### Setting 0: Disabled

Braking transistor protection should be disabled whenever the internal braking transistor is not used. This includes,

- when using a regen converter such as DC5.
- when using a regen unit such as RC5.
- when using external braking transistor options like CDBR units.
- when the drive is used in common DC bus applications and the internal braking chopper is not installed.

Enabling this L8-55 under such conditions can incorrectly trigger a braking transistor fault (rF).

#### Setting 1: Enabled

The following models come with a built-in braking transistor:

- CIMR-T□2A0004 to 2A0138
- CIMR-T□4A0002 to 4A0072

Enable L8-55 when connecting a braking resistor or a braking resistor unit to the drive built-in braking transistor.

### ? L8-93: Pull-Out Detection Time at Low Speed

Sets the amount of time until baseblock is executed once pull-out has been detected at low speed. A setting of 0.0 s essentially disables this parameters.

No.	Name	Setting Range	Default
L8-93	Pull-Out Detection Time at Low Speed	0.0 to 10.0 s	1.0 s

## 5.8 L: Protection Functions

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### ? L8-94: Pull-Out Detection Level at Low Speed

Determines the detection level of pull-out at low speed. The value is set as a percentage of the maximum frequency.

No.	Name	Setting Range	Default
L8-94	Pull-Out Detection Level at Low Speed	0 to 10%	3%

### ? L8-95: Average Pull-Out Frequency at Low Speed

Sets the average number of times pull-out can occur at low speed.

No.	Name	Setting Range	Default
L8-95	Average Pull-Out Frequency at Low Speed	1 to 50 Times	10 Times

## 5.9 n: Special Adjustments

These parameters handle a variety of specialized adjustments and functions, including Hunting Prevention, AFR Control, Overexcitation Deceleration, resistance between motor lines, and PM motor control functions.

### ? n1: Hunting Prevention

Hunting Prevention keeps the drive from hunting as a result of low inertia and operating with light load. Hunting often occurs with a high carrier frequency and an output frequency below 30 Hz.

#### ? n1-01: Hunting Prevention Selection

Enables or disables the Hunting Prevention function.

**Note:** This function is available only when using V/f Control. Hunting Prevention should be disabled when drive response is more important than suppressing motor oscillation. This function can also be disabled without any problems in applications with high inertia loads or relatively heavy loads.

No.	Name	Setting Range	Default
n1-01	Hunting Prevention Selection	0 or 1	1

**Setting 0: Disabled**

**Setting 1: Enabled**

#### ? n1-02: Hunting Prevention Gain Setting

Sets the gain for the Hunting Prevention Function.

No.	Name	Setting Range	Default
n1-02	Hunting Prevention Gain Setting	0.00 to 2.50	1.00

Normally, n1-02 does not need to be changed, but adjustment may help under the following conditions:

- If the motor vibrates while lightly loaded and n1-01 = 1, increase the gain by 0.1 until vibration ceases.
- If the motor stalls while n1-01 = 1, decrease the gain by 0.1 until the stalling ceases.

#### ? n1-03: Hunting Prevention Time Constant

Determines how responsive the Hunting Prevention function is (affects the primary delay time for Hunting Prevention).

No.	Name	Setting Range	Default
n1-03	Hunting Prevention Time Constant	0 to 500 ms	Determined by o2-04

Normally, n1-03 does not need to be changed, but adjustment may help under the following conditions:

- Increase this value for applications with a large load inertia. A higher setting leads to slower response, though, which can result in oscillation at lower frequencies.
- Lower this setting if oscillation occurs at low speed.

#### ? n1-05: Hunting Prevention Gain while in Reverse

This parameter is the same as n1-02, except that it is used when rotating in reverse. See the explanation for n1-02.

**Note:** When set to 0 ms, n1-02 is enabled even when the drive is operating in reverse.

No.	Name	Setting Range	Default
n1-05	Hunting Prevention Gain while in Reverse	0.00 to 2.50	0.00

### ? n2: Speed Feedback Detection Control (AFR) Tuning

These parameters are used to achieve speed stability when a load is suddenly applied or removed.

**Note:** Before making changes to the AFR parameters, make sure all motor parameters are set properly or perform Auto-Tuning.

### ? n2-01: Speed Feedback Detection Control (AFR) Gain

Sets the internal speed feedback detection control gain in the AFR.

No.	Name	Setting Range	Default
n2-01	Speed Feedback Detection Control (AFR) Gain	0.00 to 10.00	1.00

Normally there is no need to adjust n2-01 from the default setting. Make adjustments in the following cases:

- If hunting occurs, increase the setting value in steps of 0.05 while checking the response.
- If response is low, decrease the setting value in steps of 0.05 while checking the response.

### ? n2-02, n2-03: Speed Feedback Detection Control (AFR) Time Constant 1, 2

Parameter n2-02 sets the time constant normally used by AFR.

Parameter n2-03 sets the time constant during Speed Search or regenerative operation.

No.	Name	Setting Range	Default
n2-02	Speed Feedback Detection Control (AFR) Time Constant 1	0 to 2000 ms	50 ms
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2	0 to 2000 ms	750 ms

**Note:** Parameter n2-02 cannot be set higher than n2-03 or an oPE08 error will result.

These parameters rarely need to be changed. Adjust settings only under the following conditions:

- If hunting occurs, increase n2-02. If response is low, decrease it.
- Increase n2-03 if overvoltage occurs with high inertia loads at the end of acceleration or with sudden load changes.
- If setting n2-02 to a higher value, also increase C4-02 (Torque Compensation Delay Time Constant 1) proportionally.
- If setting n2-02 to a higher value, also increase C4-06 (Torque Compensation Delay Time Constant 2) proportionally.

## ? n3: Overexcitation Deceleration

### ? Overexcitation Deceleration (induction motors)

Overexcitation Deceleration increases the flux during deceleration and allows shorter deceleration time settings without the use of a braking resistor. Enabled by setting L3-04 to 4 or 5. See [L3-04: Stall Prevention Selection during Deceleration on page 232](#).

#### Notes on Overexcitation Deceleration

- As regenerative energy is mainly dissipated as heat in the motor, the motor temperature will rise if Overexcitation Deceleration is applied frequently. In such cases, make sure the motor temperature does not exceed the maximum allowable value or consider using a braking resistor option instead.
- During Overexcitation Deceleration 2, Hunting Prevention in V/f Control and torque limits in Open Loop Vector Control are disabled.
- Do not use Overexcitation Deceleration in combination with a braking resistor option.
- Overexcitation Deceleration can be used in Open and Closed Loop Vector Control, but it lowers the accuracy of Torque Control, and thereby the braking efficiency. It can be most efficiently used in a V/f Control.
- Overexcitation Deceleration cannot be used with PM motors.

#### Parameter Adjustments

- Use parameters n3-13 through n3-23 for adjusting Overexcitation Deceleration.
- When repetitive or long Overexcitation Deceleration results in motor overheating, lower the overexcitation gain (n3-13) and reduce the overslip suppression current level (n3-21).
- During Overexcitation Deceleration 1 (L3-04 = 4), the drive decelerates at the active deceleration time (C1-02, C1-04, C1-06, or C1-08). Make sure to set this time so that no overvoltage (ov) fault occurs.
- During Overexcitation Deceleration 2 (L3-04 = 5), the drive decelerates using the active deceleration time while adjusting the deceleration rate in order to keep the DC bus voltage at the level set in L3-17. The actual stopping time will be longer or shorter than the set deceleration time, depending on the motor characteristics and the load inertia. If overvoltage occurs (ov), try increasing the deceleration time.
- When a Run command is entered during Overexcitation Deceleration, overexcitation operation is cancelled and the drive will reaccelerate to the specified speed.

### ? n3-13: Overexcitation Deceleration Gain

Multiplies a gain to the V/f pattern output value during Overexcitation Deceleration, thereby determining the level of overexcitation. The drive returns to the normal V/f value after the motor has stopped or when it is accelerating to the frequency reference.

No.	Name	Setting Range	Default
n3-13	Overexcitation Deceleration Gain	1.00 to 1.40	1.10

The optimum setting for n3-13 depends on the motor flux saturation characteristics.

- Increase the gain gradually by 1.25 to 1.30 to improve the braking power of Overexcitation Deceleration.
- If flux saturation characteristics cause overcurrent, try lowering n3-13. A high setting sometimes causes overcurrent (oC), motor overload (oL1), or drive overload (oL2). Lowering n3-21 can also help remedy these problems.

### ? n3-14: High Frequency Injection during Overexcitation Deceleration

Enables High Frequency Injection while Overexcitation Deceleration is executed. Injecting high frequency into the motor increases loss, which in turn shortens deceleration time. This function tends to increase audible noise from the motor, and might not be desirable in environments where motor noise is a concern.

No.	Name	Setting Range	Default
n3-14	High Frequency Injection During Overexcitation Deceleration	0 or 1	0

**Setting 0: Disabled**

**Setting 1: Enabled**

### ? n3-21: Overslip Suppression Current Level

If the motor current exceeds the value set to n3-21 during Overexcitation Deceleration due to flux saturation, the drive will automatically reduce the overexcitation gain. Parameter n3-21 is set as a percentage of the drive rated current.

This parameter should be set to a relatively low value to optimize deceleration. If overcurrent, oL1, or oL2 occur during Overexcitation Deceleration, reduce the overslip suppression current level.

No.	Name	Setting Range	Default
n3-21	Overslip Suppression Current Level	0 to 150%	100%

### ? n3-23: Overexcitation Operation Selection

Limit the Overexcitation Deceleration operation selected in parameter L3-04 to forward only or reverse only.

No.	Name	Setting Range	Default
n3-23	Overexcitation Operation Selection	0 to 2	0

**Setting 0: Overexcitation Operation as Selected in L3-04 in Forward and Reverse Direction**

**Setting 1: Overexcitation Operation as Selected in L3-04 in Forward Direction Only**

**Setting 2: Overexcitation Operation as Selected in L3-04 in Reverse Direction Only**

? n5: Feed Forward Control

Enabling Feed Forward can improve the drives responsiveness to speed reference changes in applications where a high speed control proportional gain setting (ASR gain, C5-01, C5-03) would lead to problems with overshoot, undershoot, or oscillation. **Figure 5.89** gives an example of overshoot reduction by Feed Forward. Parameters related to this function and the function principle are illustrated in **Figure 5.90**. Feed Forward can only be used in Closed Loop Vector Control for induction or PM motors (A1-02 = 4 or 7), or in Advanced Open Loop Vector Control for PM motors (A1-02 = 6).

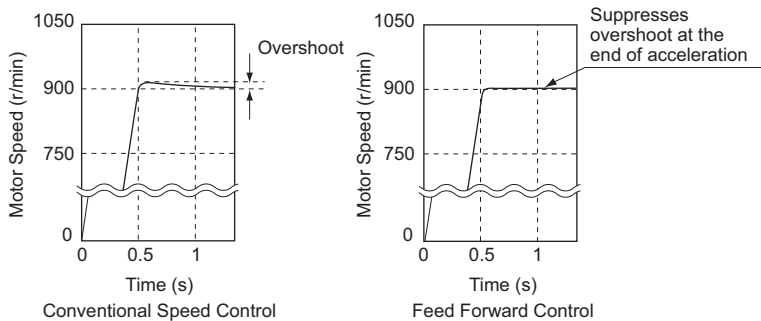


Figure 5.89 Overshoot Suppression by Feed Forward Control

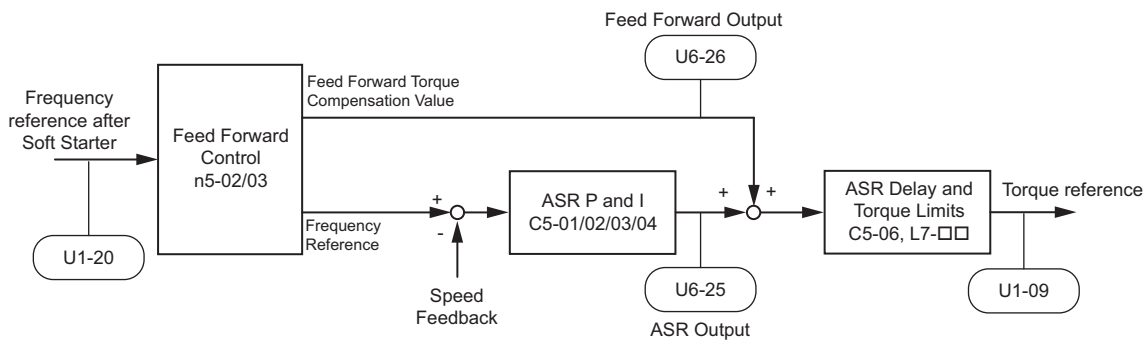


Figure 5.90 Feed Forward Control

- Note:**
- 1. Feed Forward can only be used in CLV, AOLV/PM, and CLV/PM control modes.
  - 2. Prior to using Feed Forward, always perform Auto-Tuning or set the correct motor data manually. Also perform ASR Auto-Tuning to set the speed loop gain (C5-01), or adjust it manually. Fine-tune the other speed control loop parameters (C5-□□) if required.
  - 3. If not restricted by the application, use Inertia Auto Tuning (T1-01 = 8) to have the drive automatically optimize Feed Forward parameters. If Inertia Auto Tuning cannot be performed, parameters related to Feed Forward should be set manually.

? n5-01: Feed Forward Control Selection

Enables to disables the Feed Forward function.

No.	Name	Setting Range	Default
n5-01	Feed Forward Control Selection	0 or 1	0

Setting 0: Disabled

Setting 1: Enabled

? n5-02: Motor Acceleration Time

Sets the time required to accelerate the motor from a full stop up to the rated speed at the rated torque.

No.	Parameter Name	Setting Range	Default
n5-02	Motor Acceleration Time	0.001 to 10.000 s	Determined by C6-01, E5-01 and o2-04

This value can be set automatically by Inertia Auto-Tuning. If Inertia Auto-Tuning cannot be performed, use one of the methods below to determine the setting value for this parameter.

### Calculation

The motor acceleration time can be calculated by,

$n5-02 = \frac{2\pi \cdot J_{\text{Motor}} \cdot n_{\text{rated}}}{60 \cdot T_{\text{rated}}}$	Where: <ul style="list-style-type: none"> <li>• <math>J_{\text{Motor}}</math> is the motor inertia in <math>\text{kg}\cdot\text{m}^2</math>.</li> <li>• <math>n_{\text{rated}}</math> is the rated speed of the motor in r/min</li> <li>• <math>T_{\text{rated}}</math> is the rated torque of the motor in N·m.</li> </ul>
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or

$n5-02 = \frac{4\pi \cdot J_{\text{Motor}} \cdot f_{\text{rated}}}{p \cdot T_{\text{rated}}}$	Where: <ul style="list-style-type: none"> <li>• <math>J_{\text{Motor}}</math> is the motor inertia in <math>\text{kg}\cdot\text{m}^2</math>.</li> <li>• <math>f_{\text{rated}}</math> is the rated frequency of the motor in Hz.</li> <li>• <math>p</math> is the number of motor poles (not pole pairs!).</li> <li>• <math>T_{\text{rated}}</math> is the rated torque of the motor in N·m.</li> </ul>
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### Measuring Acceleration Time

Take the following steps when measuring the motor acceleration time.

1. Decouple motor and load.
2. Make sure Auto-Tuning has been performed or that the correct motor data has been entered manually.
3. Make sure that the speed loop (ASR) has been set up properly.
4. Set the acceleration time to zero.
5. Set the forward torque limit in parameter L7-01 to 100%.
6. Set the frequency reference equal to the motor rated speed.
7. While monitoring the motor speed in U1-05, start the motor in the forward direction and measure the time it takes to reach the rated speed.
8. Reverse the parameter settings above and set the measured time to parameter n5-02.

### ? n5-03: Feed Forward Control Gain

Parameter n5-03 sets the inertia ratio of the load connected to the motor.

No.	Parameter Name	Setting Range	Default
n5-03	Feed Forward Control Gain	0.00 or 100.00	1.00

This value can be set automatically by Inertia Auto-Tuning. If Inertia Auto Tuning cannot be performed, determine the value for parameter n5-03 using the following steps.

1. Setup parameter n5-02 correctly.
2. Couple motor and load.
3. Set the acceleration time C1-01 to 0.
4. Set the torque limits in the L7-□□ parameters to a value that will easily be reached during the test ( $T_{\text{Lim\_Test}}$ ).
5. Set the frequency reference equal to a value in the upper speed range of the machine ( $f_{\text{ref\_Test}}$ ).
6. While monitoring the motor speed in U1-05, start the motor in the forward direction and measure the time it takes to reach the set speed ( $t_{\text{accel}}$ ).
7. Reverse the parameter settings above and calculate the set value for parameter n5-03 using the formula below.

$n5-03 = \frac{t_{\text{accel}} \cdot T_{\text{Lim\_Test}} \cdot f_{\text{rated}}}{n5-02 \cdot f_{\text{ref\_Test}} \cdot 100} - 1$	Where: <ul style="list-style-type: none"> <li>• <math>t_{\text{accel}}</math> is the measured acceleration time in s.</li> <li>• <math>f_{\text{rated}}</math> is the rated frequency of the motor in Hz.</li> <li>• <math>T_{\text{Lim\_Test}}</math> is torque limit setting during the test in %.</li> <li>• <math>f_{\text{ref\_Test}}</math> is the frequency reference during the test in Hz.</li> </ul>
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## 5.9 n: Special Adjustments

### ? n6: Online Tuning

Online Tuning prevents loss from insufficient torque and diminished speed control accuracy due to fluctuating motor temperature.

#### ? n6-05: Online Tuning Gain

Sets the compensation gain for the voltage correction in the Online Tuning function (n6-01 = 2). Normally there is no need to adjust n6-05, but increase the set value in steps of 0.1 if an overload fault occurs during voltage correction.

No.	Name	Setting Range	Default
n6-05	Online Tuning Gain	0.10 to 5.00	1.00

### ? n8: PM Motor Control Tuning

These parameters are available in the vector control modes for permanent magnet motors and can be used to adjust the control performance.

#### ? n8-01: Initial Rotor Position Estimation Current

The initial rotor position estimation current is the current used to detect the initial position of the rotor. The value is set as a percentage of the motor rated current (E5-03), using setting units of 1%. This parameter rarely needs to be changed. If the motor nameplate lists an Si value, enter that value here.

**Note:** Parameter n8-01 is available only when in AOLV/PM or CLV/PM control mode.

No.	Name	Setting Range	Default
n8-01	Initial Rotor Position Estimation Current	0 to 100%	50%

#### ? n8-02: Pole Attraction Current

Sets the current applied to pull the rotor into position after the initial rotor position estimations are complete. The value is set as a percentage of the motor rated current. Increase this setting in order to increase the starting torque.

**Note:** This parameter is available only when using AOLV/PM control mode.

No.	Name	Setting Range	Default
n8-02	Pole Attraction Current	0 to 150%	80%

#### ? n8-35: Initial Rotor Position Detection Selection

Selects how the rotor position is detected at start.

- Note:**
1. This parameter is available only when using AOLV/PM or CLV/PM control mode.
  2. In CLV/PM, the drive performs a magnetic pole search the first time it starts the motor. After that, rotor position is calculated from the PG encoder signal and saved until the drive is switched off. Parameter n8-35 determines how this initial pole search operates.
  3. High Frequency Injection and pulse injection for rotor position detection (n8-35 = 1 or 2) can be used with IPM motors only. When using a SPM motor, select the pull in method to find the initial position of the rotor (n8-35 = 0).

No.	Name	Setting Range	Default
n8-35	Initial Rotor Position Detection Selection	0 to 2	1

#### Setting 0: Pull in

Starts the rotor using pull-in current.

#### Setting 1: High Frequency Injection

High frequency is injected in order to detect the rotor position. Some noise may be generated from the motor at start.

#### Setting 2: Pulse injection

A pulse signal is injected into the motor in order to detect the rotor position.

### ? n8-45: Speed Feedback Detection Control Gain

Sets the gain for internal speed feedback detection control. Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:

- Increase this setting if motor oscillation or hunting occurs.
- Decrease this setting in increments of 0.05 to decrease drive responsiveness.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-45	Speed Feedback Detection Control Gain	0.00 to 10.00	0.80

### ? n8-47: Pull-In Current Compensation Time Constant

Sets the time constant for the actual current and the pull-in current to match one another.

Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:

- Increase this setting when it takes too long for the reference value of the pull-in current to match the target value.
- Decrease this setting if motor oscillation occurs.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-47	Pull-In Current Compensation Time Constant	0.0 to 100.0 s	5.0 s

### ? n8-48: Pull-In Current

Sets the d-axis current during no-load operation at a constant speed. Set as a percentage of the motor rated current.

- Increase this setting when hunting occurs or the motor speed is unstable while running at a constant speed.
- If there is too much current when driving a light load at a constant speed, then slightly increasing this value.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-48	Pull-In Current	20 to 200%	30%

### ? n8-49: d-Axis Current for High Efficiency Control

Sets the d-axis current reference when running with high load at constant speed. When using an IPM motor, setting this parameter will increase the efficiency by using the motors reluctance torque and thereby reduce the energy consumption. This parameter should be set to 0 when using an SPM motor.

Although this setting seldom needs to be changed, please note the following:

- If motor operation is unstable when driving heavy loads, try lowering this setting.
- If motor parameters (E5-□□) have been changed, this value will be reset to 0 and will need to be readjusted.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-49	d Axis Current for High Efficiency Control	-200.0 to 0.0%	Determined by E5-01

### ? n8-51: Acceleration/Deceleration Pull-In Current

Sets the pull-in current during acceleration and deceleration as a percentage of the motor rated current (E5-03).

Adjustments to this setting may help in the following situations:

- Increase this setting when a large amount of starting torque is required.
- Lower this setting if there is excessive current during acceleration.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-51	Acceleration/Deceleration Pull-In Current	0 to 200%	50%

## 5.9 n: Special Adjustments

### ? n8-54: Voltage Error Compensation Time Constant

Sets the time constant for voltage error compensation. Make changes to this parameter under the following conditions:

- Adjust the value when hunting occurs at low speed.
- Increase the value in steps of 0.1 when hunting occurs with sudden load changes. Try to disable the compensation by setting n8-54 = 0 if increasing n8-54 does not help.
- Increase the value when oscillations occur at start.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-54	Voltage Error Compensation Time Constant	0.00 to 10.00	1.00

### ? n8-55: Load Inertia

Sets the ratio between motor inertia and the inertia of the connected machinery. If this value is set too low, the motor may not start very smoothly, and the STo fault (Motor Step-Out) may occur.

For large inertia loads or to improve speed control response, increase this setting from 0. Oscillations may occur if this value is set too high with low inertia load.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-55	Load Inertia	0 to 3	0

#### Setting 0: Below 1:10

The inertia ratio between the motor and the load is just less than 1:10.

#### Setting 1: Between 1:10 and 1:30

The inertia ratio between the motor and the load is between 1:10 and 1:30. Set n8-55 to 1 if an STo fault occurs as a result of impact load or sudden acceleration/deceleration when n8-55 = 0.

#### Setting 2: Between 1:30 and 1:50

The inertia ratio between the motor and the load is between 1:30 and 1:50. Set n8-55 to 2 if an STo fault occurs as a result of impact load or sudden acceleration/deceleration when n8-55 = 1.

#### Setting 3: Beyond 1:50

The inertia ratio between the motor and the load is higher than 1:50. Set n8-55 to 3 if an STo fault occurs as a result of impact load or sudden acceleration/deceleration when n8-55 = 2.

### ? n8-57: High Frequency Injection

Detects motor speed by injecting a high frequency into the motor.

**Note:** This parameter is available only when using AOLV/PM control mode.

No.	Name	Setting Range	Default
n8-57	High Frequency Injection	0 or 1	0

#### Setting 0: Disabled

Disable n8-57 with SPM motors. The speed control range will be limited to approximately 1:20.

#### Setting 1: Enabled

Enabling n8-57 with IPM motors allows precise speed detection in a speed control range of approximately 1:100.

- Note:**
1. Be aware that using this function will generate some audible noise in the motor up to a certain speed.
  2. Set E1-09 to 0.0 when using zero speed control.

### ? n8-62: Output Voltage Limit

Sets the output voltage limit to prevent voltage saturation. This parameter rarely requires adjustment. Never set this value higher than the actual input voltage.

**Note:** This parameter is available in OLV/PM, AOLV/PM, and CLV/PM.

No.	Name	Setting Range	Default
n8-62 <1>	Output Voltage Limit	0.0 to 230.0 Vac	200 Vac

<1> Values shown here are for 200 V class drives. Double values when using a 400 V class unit.

### ? n8-65: Speed Feedback Detection Control Gain during ov Suppression

Sets the gain for internal speed feedback detection control when overvoltage suppression is active. Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:

- Increase this setting if motor oscillation or hunting occurs when OV suppression is active.
- Decrease this setting in increments of 0.05 to decrease the drive responsiveness during OV suppression.

**Note:** This parameter is available only when using OLV/PM control mode.

No.	Name	Setting Range	Default
n8-65	Speed Feedback Detection Control Gain during ov Suppression (OLV/PM)	0.00 to 10.00	1.50

### ? n8-69: Speed Calculation Gain

Sets the proportional gain for phase lock loop (PLL) control of an extended observer.

There is normally no need to change this parameter from the default value.

**Note:** This parameter is available in AOLV/PM only.

No.	Name	Setting Range	Default
n8-69	Speed Calculation Gain	0.00 to 20.00	1.00

### ? n8-84: Polarity Judge Current

Sets the current to determine polarity for the initial polarity calculation as a percentage of the motor rated current (E5-03).

**Note:** This parameter is available when in AOLV/PM or CLV/PM control mode.

The drive determines motor polarity at motor start when using AOLV/PM (A1-02 = 6), and at power up when using CLV/PM (A1-02 = 7).

The integrated current deviation during judging polarity (U6-57) has been provided to check if the initial polarity estimation is correct or not.

If an “Si” value is listed on the nameplate for a Yaskawa motor, n8-84 should be set to “Si” value × 2.

No.	Name	Setting Range	Default
n8-84	Polarity Judge Current	0 to 150%	100%

## ? n9: Hardware Settings

Using these parameters, the drive output voltage can be adjusted.

### ? n9-10: AVR Time Constant

Sets the delay time constant that is used to adjust the output voltage when the DC bus voltage changes.

No.	Name	Setting Range	Default
n9-10	AVR Time Constant	0.0 to 100.0 ms	1.0 ms

### ? n9-12: On-Delay Compensation Time

Sets the time value used for IGBT On-delay compensation.

No.	Name	Setting Range	Default
n9-12	On-Delay Compensation Time	0.00 to 20.00 μs	Determined by o2-04

## 5.9 n: Special Adjustments

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### ? n9-62: On-Delay Compensation Derating Start Frequency

Sets the frequency at which the drive begins to compensate the output voltage for the IGBT On-Delay.

No.	Name	Setting Range	Default
n9-62	On-Delay Compensation Derating Start Frequency	0.0 to [E1-04] Hz	60.0 Hz

### ? n9-63: On-Delay Compensation Disable Frequency

When operating a high-speed motor at low speeds, n9-62 sets the frequency at which the drive stops compensating the switching delay in the DC bus.

No.	Name	Setting Range	Default
n9-63	On-Delay Compensation Disable Frequency	0.0 to [E1-04] Hz	120.0 Hz

## 5.10 o: Operator Related Settings

These parameters are for controlling the various functions, features, and display of the digital operator.

### ? o1: Digital Operator Display Selection

These parameters determine how data appears on the operator display.

#### ? o1-01: Drive Mode Unit Monitor Selection

When the drive is powered up, the monitor selected in parameter o1-02 appears first on the display. If o1-02 is set to 5, o1-01 can be used to change the content of this monitor.

When using an LED operator, pressing the up arrow key will display the following data: speed reference → rotational direction → output speed → output current → o1-01 selection.

Parameter o1-01 lets the user select the content of the last monitor in this sequence. There is no effect like this on an LCD operator.

No.	Name	Setting Range	Default
o1-01	Drive Mode Unit Monitor Selection	104 to 905 U1-04 (Control Mode) to U9-05 (Motor Residual Voltage (Synchronous Operation)) <f>	106 (U1-06)

<1> U2-□□ and U3-□□ parameters cannot be selected.

#### ? o1-02: User Monitor Selection after Power Up

Selects which monitor parameter is displayed upon power up. This is done by entering the 1□□ part of U1-□□. Certain monitors are not available in some control modes. *Refer to U: Monitor Parameters on page 278* for a list of monitors.

No.	Name	Setting Range	Default
o1-02	User Monitor Selection after Power Up	1 to 5	1

**Setting 1: Frequency reference (U1-01)**

**Setting 2: Motor direction**

**Setting 3: Output frequency (U1-02)**

**Setting 4: Output current (U1-03)**

**Setting 5: User-selected monitor (set by o1-01)**

#### ? o1-03: Digital Operator Display Selection

Sets the units used to display the frequency reference and output frequency. Set o1-03 to 3 for user-set units, then set parameters o1-10 and o1-11.

No.	Name	Setting Range	Default
o1-03	Digital Operator Display Selection	0 to 3	Determined by A1-02

**Setting 0: 0.01 Hz units**

**Setting 1: 0.01% units (100% = max. output frequency)**

**Setting 2: r/min units (calculated by the max output frequency and the no. of motor poles)**

**Setting 3: User-set units (use o1-10, o1-11)**

Set the value use for the maximum frequency reference to o1-10. The placement of the decimal point in this number should be set to o1-11.

For example, to have the maximum output frequency displayed as “100.00”, set the o1-10 = 1000 and o1-11 = 2 (i.e., 1000 with 2 decimal points).

**Note:** 1. Parameter o1-03 allows the programmer to change the units used in the following parameters and monitors:

- U1-01: frequency reference
- U1-02: output frequency
- U1-05: motor speed
- U1-16: output frequency after softstarter (accel/decel ramp generator)
- d1-01 to d1-17: frequency references

2. Setting o1-03 to 2 requires that the number of motor poles be entered to E2-04, E4-04, and E5-04.

## 5.10 o: Operator Related Settings

### ? o1-04: V/f Pattern Display Unit

Determines the units used for the frequency reference when setting parameters that create the V/f pattern: E1-04, E1-06, E1-09, E1-11, and E2-04. For motor 2, this includes parameters E3-04, E3-06, E3-07, E3-09, and E3-11.

Enabled only in vector control modes (CLV, AOLV/PM, CLV/PM).

No.	Name	Setting Range	Default
o1-04	V/f Pattern Display Unit	0 or 1	Determined by A1-04

**Setting 0: Hertz**

**Setting 1: r/min**

**Note:** For motor 2, o1-04 can only be set to 0 for Hertz.

### ? o1-10: User-Set Display Units Maximum Value

Determines the display value that is equal to the maximum output frequency.

No.	Name	Setting Range	Default
o1-10	User-Set Display Units Maximum Value	1 to 60000	Determined by o1-03

### ? o1-11: User-Set Display Units Decimal Display

Determines how many decimal points should be used to set and display the frequency reference.

No.	Name	Setting Range	Default
o1-11	User-Set Display Units Decimal Display	0 to 3	Determined by o1-03

**Setting 0: No decimal point**

**Setting 1: One decimal point**

**Setting 2: Two decimal points**

**Setting 3: Three decimal points**

## ? o2: Digital Operator Keypad Functions

These parameters determine the functions assigned to the operator keys.

### ? o2-01: LO/RE (LOCAL/REMOTE) Key Function Selection

Parameter o2-01 determines whether the LO/RE key on the digital operator will be enabled or not for switching between LOCAL and REMOTE.

No.	Name	Setting Range	Default
o2-01	LO/RE Key Function Selection	0 or 1	1

**Setting 0: Disabled**

The LO/RE key is disabled.

**Setting 1: Enabled**

The LO/RE switches between LOCAL and REMOTE operation. Switching is possible during stop only. When LOCAL is selected, the LED indicator on the LO/RE key will light up.

**WARNING! Sudden Movement Hazard.** The drive may start unexpectedly if the Run command is already applied when switching from LOCAL mode to REMOTE mode when b1-07 = 1, resulting in death or serious injury. Check all mechanical or electrical connections thoroughly before making any setting changes to o2-01 and b1-07. [Table 5.24](#) lists the setting combinations for o2-01 and b1-07.

**Table 5.24 LO/RE Key and b1-07**

o2-01	b1-07	Switch from LOCAL to REMOTE	Switch from REMOTE to LOCAL
0	0	Not possible	Not possible
	1	Not possible	Not possible

o2-01	b1-07	Switch from LOCAL to REMOTE	Switch from REMOTE to LOCAL
1	0	Will not run until a new Run command is entered.	Run not possible
	1	If a Run command is entered, the drive will start running as soon as the LO/RE key is pushed to change from LOCAL to REMOTE.	Run not possible

### ? o2-02: STOP Key Function Selection

Determines if the STOP key on the digital operator can still be used to stop drive operation when the drive is being controlled from a remote source (i.e., not from digital operator).

No.	Name	Setting Range	Default
o2-02	STOP Key Function Selection	0 or 1	1

**Setting 0: Disabled**

**Setting 1: Enabled**

The STOP key can be used to terminate drive operation, even if the Run command source is not assigned to the digital operator. If the drive is stopped by pressing the STOP key, the Run command must be cycled to restart the drive.

### ? o2-03: User Parameter Default Value

Once drive parameters are set up completely, the values set can be saved as user-set default values using parameter o2-03. Once this has been done, the “Initialize Parameters” parameter (A1-03) will offer the choice of “1110: User Initialize”. Choosing A1-03 = “1110: User Initialize” will reset all parameters to the values saved as user-set defaults. *Refer to A1-03: Initialize Parameters on page 115* for details on drive initialization.

No.	Name	Setting Range	Default
o2-03	User Parameter Default Value	0 to 2	0

**Setting 0: No change (awaiting command)**

**Setting 1: Set User Initialize values**

The current parameter settings are saved as user-set default for a later User Initialize. Once o2-03 is set to 1 and the ENTER key is pressed, the values are saved and the display returns to 0.

**Setting 2: Clear User Initialize Values**

All user-set defaults for “User Initialize” are cleared. Once o2-03 is set to 2 and the ENTER key is pressed, the values are erased and the display returns to 0.

### ? o2-04: Drive Model Selection

This parameter must be set when replacing the control board or the terminal board for any reason. For information on the drive model selection, see *Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01) on page 483*.

**NOTICE:** Drive performance will suffer if the correct drive capacity is not set to o2-04, and protective functions will fail to operate properly.

No.	Name	Setting Range	Default
o2-04	Drive Model Selection	-	Determined by drive capacity

**Note:** Change settings only when necessary.

### ? o2-05: Frequency Reference Setting Method Selection

Determines if the ENTER key must be pressed after changing the frequency reference using the digital operator while in the Drive Mode.

No.	Name	Setting Range	Default
o2-05	Frequency Reference Setting Method Selection	0 or 1	0

## 5.10 o: Operator Related Settings

### Setting 0: ENTER key required

Every time the frequency reference is changed using the digital operator, the ENTER key must be pressed for the drive to accept the change.

### Setting 1: ENTER key not required

The output frequency changes immediately when the reference is changed by the up or down arrow keys on the digital operator. The ENTER key does not need to be pressed. The frequency reference is saved for 5 s after it is changed.

### ? o2-06: Operation Selection when Digital Operator is Disconnected

Determines if the drive will stop when the digital operator is removed in LOCAL mode or when b1-02 or b1-16 is set to 0. When the operator is reconnected, the display will indicate that it was disconnected.

No.	Name	Setting Range	Default
o2-06	Digital Operator Disconnection Operation	0 or 1	0

### Setting 0: Continue operation

The operation is continued.

### Setting 1: Trigger a fault

The operation is stopped and an “oPr” fault is triggered. The motor coasts to stop.

### ? o2-07: Motor Direction at Power Up when Using Operator

Determines the direction the motor will rotate after the drive is powered up and the Run command is given from the digital operator.

**Note:** This parameter is effective only when the Run command is set to be given from the digital operator (b1-02, b1-16 = 0).

No.	Name	Setting Range	Default
o2-07	Motor Direction at Power Up when Using Operator	0 or 1	0

### Setting 0: Forward

### Setting 1: Reverse

## ? o3: Copy Function

These parameters control the digital operator's Copy function. The Copy function lets the user store all parameter settings into the memory of the digital operator, and easily transfer those settings to other drives (requires that the other drives be the same model, capacity, and have the same control mode setting). See [Copy Function Related Displays on page 331](#) for a description of errors and displays.

### ? o3-01 Copy Function Selection

Setting o3-01 will instruct the drive to Read, Write, or Verify parameters settings.

No.	Name	Setting Range	Default
o3-01	Copy Function Selection	0 to 3	0

### Setting 0: Copy Select (no function)

### Setting 1: INV → OP READ

All parameters are copied from the drive to the digital operator.

**Note:** The copy protection for the digital operator is enabled by default. To unlock copy protection, set o3-01 = 1.

### Setting 2: OP → INV WRITE

All parameters are copied from the digital operator to the drive.

### Setting 3: OP ↔ INV VERIFY

Parameters in the drive are compared with the parameter settings saved on the digital operator to see if they match.

### ? o3-02 Copy Allowed Selection

Restricts or allows the use of the Copy function.

No.	Name	Setting Range	Default
o3-02	Copy Allowed Selection	0 or 1	0

**Setting 0: Disabled**

**Setting 1: Enabled**

## ? o4: Maintenance Monitor Settings

### ? o4-01: Cumulative Operation Time Setting

Parameter o4-01 sets the cumulative operation time of the drive. The user can also manually set this parameter to begin keeping track of operation time from some desired value. Total operation time can be viewed in monitor U4-01.

**Note:** The value in o4-01 is set in 10 h units. For example, a setting of 30 will set the cumulative operation time counter to 300 h. 300 h will also be displayed in monitor U4-01.

No.	Name	Setting Range	Default
o4-01	Cumulative Operation Time Setting	0 to 9999	0

### ? o4-02: Cumulative Operation Time Selection

Selects the conditions for how the drive keeps track of its total operation time. This time log can be viewed in U4-01.

No.	Name	Setting Range	Default
o4-02	Cumulative Operation Time Selection	0 or 1	0

#### Setting 0: Power on time

The drive logs the time it is connected to a power supply, regardless if the motor is running or not.

#### Setting 1: Run time

The drive logs the time that the output is active. This includes whenever the Run command is active (even if the motor is not rotating) and when there is voltage output.

### ? o4-03: Cooling Fan Operation Time Setting

Sets the value for how long the cooling fan has been operating. This value can be viewed in monitor U4-03. Parameter o4-03 also sets the base value used for the cooling fan maintenance, which is displayed in U4-04. Be sure to reset this parameter back to 0 if the cooling fan is replaced.

- Note:**
1. The value in o4-03 increases after every 10 hours of use. A setting of 30 will set the cooling fan operation time counter to 300 h. "300" will be displayed in monitor U4-03.
  2. The cooling fan may require maintenance at an earlier date in harsher environments.

No.	Name	Setting Range	Default
o4-03	Cooling Fan Operation Time Setting	0 to 9999	0

### ? o4-05: Capacitor Maintenance Setting

Sets value of the maintenance monitor for the DC bus capacitors displayed in U4-05 as a percentage of the total expected performance life. This value should be reset to 0 when the DC bus capacitors have been replaced.

**Note:** The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-05	Capacitor Maintenance Setting	0 to 150%	0%

## 5.10 o: Operator Related Settings

### ? o4-07: DC Bus Pre-Charge Relay Maintenance Setting

Sets the value of the softcharge bypass relay maintenance time displayed in U4-06 as a percentage of the total expected performance life. This value should be reset to 0 when the bypass relay has been replaced.

**Note:** The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-07	DC Bus Pre-charge Relay Maintenance Setting	0 to 150%	0%

### ? o4-09: IGBT Maintenance Setting

Sets the value of the IGBT maintenance time displayed in U4-07 as a percentage of the total expected performance life. This value should be reset to 0 when the IGBTs have been replaced.

**Note:** The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-09	IGBT Maintenance Setting	0 to 150%	0%

### ? o4-11: U2, U3 Initialization

When the drive is initialized, the fault trace and fault history monitors (U2-□□ and U3-□□) are not reset. Parameter o4-11 can be used to reset them.

No.	Name	Setting Range	Default
o4-11	U2, U3 Initialization	0 or 1	0

#### Setting 0: No action

The drive keeps the record already saved concerning fault trace and fault history.

#### Setting 1: Reset fault data

Resets the data for the U2-□□ and U3-□□ monitors. Once o4-11 is set to 1 and the ENTER key is pressed, fault data is erased and the display returns to 0.

### ? o4-12: kWh Monitor Initialization

The kWh monitors U4-10 and U4-11 are not initialized when power is shut off or the drive is initialized. Use o4-12 to manually reset them.

No.	Name	Setting Range	Default
o4-12	kWh Monitor Initialization	0 or 1	0

#### Setting 0: No Action

The kWh data are kept as they are.

#### Setting 1: Reset kWh Data

Resets the kWh counter. The monitors U4-10 and U4-11 will display “0” after they are initialized. Once o4-12 is set to 1 and the ENTER key is pressed, kWh data is erased and the display returns to 0.

### ? o4-13: Number of Run Commands Counter Initialization

The Run command counter displayed in U4-02 is not reset when the power is cycled or the drive is initialized. Use o4-13 to reset U4-02.

No.	Name	Setting Range	Default
o4-13	Number of Run Commands Counter Initialization	0 or 1	0

#### Setting 0: No Action

The Run command data are kept as they are.

#### Setting 1: Number of Run Commands Counter

Resets the Run command counter. The monitor U4-02 will show 0. Once o4-13 is set to 1 and the ENTER key is pressed, the counter value is erased and the display returns to 0.

## 5.11 S: Functions for Textile Applications

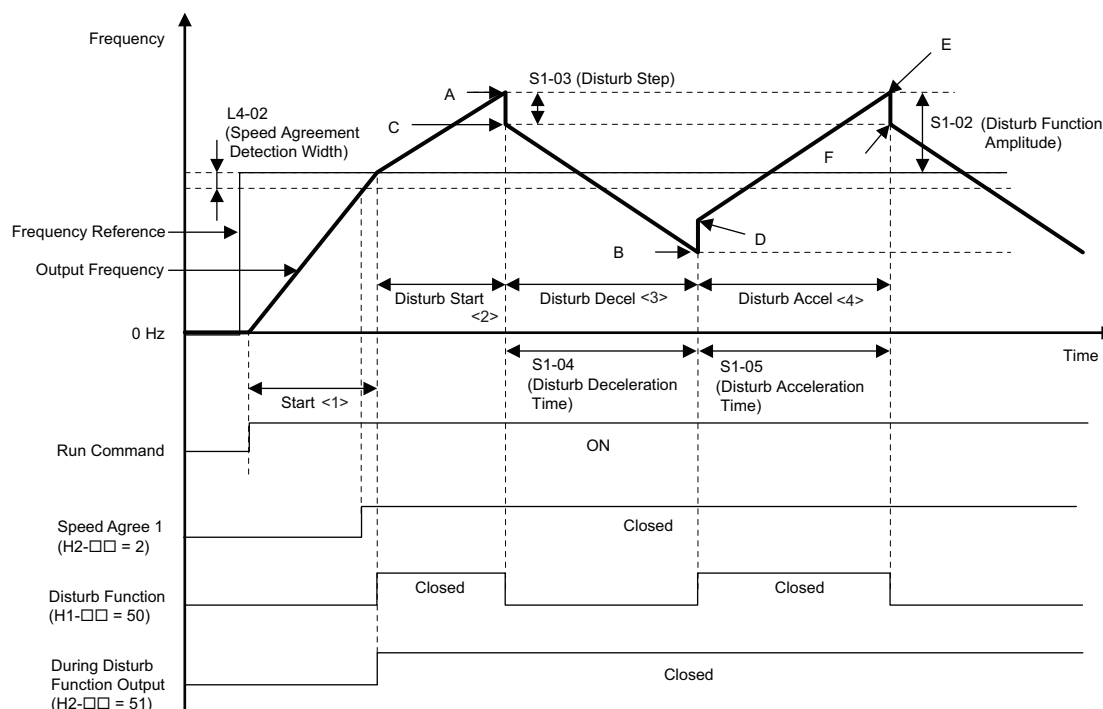
These parameters are designed specifically for textile applications. They are used to set and adjust the Disturb function, gain levels for the frequency reference, braking transistor characteristics, and certain aspects of the KEB function.

### ? S1: Disturb Function

The S1 parameter group determines how the Disturb function operates.

#### ? Disturb Function

The Disturb function changes the frequency reference in periodic intervals. These changes in the frequency reference make it possible to wind the line more evenly. Below **Figure 5.91** shows how the Disturb function operates.



- <1> Once the Run command is entered, the drive speeds up to the frequency reference within the specified acceleration time (using the Accel times 1 through 4). If triggered, the Disturb waveform is generated.
- <2> When the conditions to trigger the Disturb waveform arise, the drive outputs the Disturb waveform from the soft-starter output up to the Disturb frequency (point A) within the Disturb acceleration time set to S1-05. The drive then immediately decelerates to point C as specified by the Disturb step (S1-03).
- <3> The drive slows from point C to point B within the Disturb deceleration time set to S1-04, then immediately accelerates up to point D as specified by the Disturb step (S1-03).
- <4> The drive accelerates from point D up to point E within the acceleration time set to S1-05, then immediately decelerates to point F as specified by the Disturb step (S1-03).

**Figure 5.91 Disturb Function Operation**

- Note:**
1. The top of the Disturb frequency indicated by point A is limited to the maximum output frequency set to E1-04.
  2. The bottom of the Disturb frequency indicated by point B is limited to the minimum frequency reference.

#### Conditions for Activation of the Disturb Function

- The Disturb function must be enabled (S1-01 = 1 or 2).
- The Disturb function amplitude (S1-02), the Disturb deceleration time (S1-04), and the Disturb acceleration time (S1-05) must be set to a value greater than zero.
- The Disturb function cannot be executed during KEB.
- The Disturb function cannot be executed when power loss has been detected.
- A multi-function input terminal set for the Disturb command (H1-□□ = 50) must be open.
- The drive must use V/f Control to run the motor (A1-02 = 0).

#### Conditions that Stop the Disturb Function

Any one of the conditions below will stop the Disturb function.

- The multi-function input terminal set to activate the Disturb command (H1-□□ = 50) closes.
- KEB is triggered.
- The drive detects power loss.

## 5.11 S: Functions for Textile Applications

### ? S1-01: Disturb Function Selection

Enables or disables the Disturb function. If enabled, the Disturb waveform is generated when the frequency reference and output frequency match (referred to as "speed agree").

No.	Name	Setting Range	Default
S1-01	Disturb Function Selection	0 to 2	0

**Setting 0: Disabled**

**Setting 1: Enabled**

**Setting 2: Enabled, Outputs the Disturb Waveform During Accel/Decel**

### ? S1-02: Disturb Function Amplitude

Sets the amplitude of the Disturb waveform as a percentage of the frequency reference.

No.	Name	Setting Range	Default
S1-02	Disturb Function Amplitude	0.0 to 20.0%	0.0%

### ? S1-03: Disturb Step

Sets the step applied at the end of disturb acceleration or deceleration as a percentage of the Disturb amplitude in S1-02.

No.	Name	Setting Range	Default
S1-03	Disturb Step	0 to 50%	0%

### ? S1-04: Disturb Deceleration Time

Sets the deceleration time for the Disturb function.

No.	Name	Setting Range	Default
S1-04	Disturb Deceleration Time	0.0 to 120.0 s	0.0 s

### ? S1-05: Disturb Acceleration Time

Sets the acceleration time for the Disturb function.

No.	Name	Setting Range	Default
S1-05	Disturb Acceleration Time	0.0 to 120.0 s	0.0 s

## ? S2: Frequency Reference Gain Settings

Independent of the frequency reference source selected, this function applies a gain to the frequency reference value. A gain change ramp can be used in order to avoid speed steps when the gain value in S2-02 is modified.

### ? S2-01: Frequency Reference Gain

Determines how much to reduce or amplify the frequency reference. Note that the frequency reference cannot exceed the upper limit set to d2-01, regardless of how high S2-01 is set.

No.	Name	Setting Range	Default
S2-01	Frequency Reference Gain	0.0 to 1000.0%	100.0%

### ? S2-02: Frequency Reference Gain Change Ramp

Determines the time the drive uses to change the frequency reference gain from 0.0% to the value assigned to S2-01.

No.	Name	Setting Range	Default
S2-02	Frequency Reference Gain Change Ramp	0.0 to 600.0 s	0.0 s

## ? S3: Braking Transistor and Output Voltage Gain

### ? S3-01: Braking Transistor Operation Selection

Determines when the drive built-in braking transistor is enabled.

No.	Name	Setting Range	Default
S3-01	Braking Transistor Operation Selection	0, 1	0

**Setting 0: During run only**

**Setting 1: Always enabled**

### ? S3-02: Braking Transistor Operation Voltage Level

Sets the voltage level that triggers the drive built-in braking transistor.

No.	Name	Setting Range	Default
S3-02	Braking Transistor Operation Voltage Level	300 to 400 Vdc	394 Vdc

**Note:** This value is for 200 V drives. Double this setting when using a 400 V class drive.

### ? S3-03: Output Voltage Gain Selection

Enables and disables the output voltage gain setting in parameter H3-□□ = 41 (Output Voltage Gain) or in MEMOBUS register 03H.

No.	Name	Setting Range	Default
S3-03	Output Voltage Gain Selection	0, 1	0

**Setting 0: Disable**

**Setting 1: Enable**

### ? S3-04: Output Voltage Gain Change Time

Sets the drive uses to change the output voltage gain set in parameter H3-□□ = 41 (Output Voltage Gain) or in MEMOBUS register 03H.

No.	Name	Setting Range	Default
S3-04	Output Voltage Gain Change Time	0.0 to 10.0 s	0.5 s

## ? S4: KEB Mode Selection

S4 parameters define the conditions for how the KEB function operates.

### ? KEB Function Description

Short for Kinetic Energy Backup, the KEB function helps the drive through power loss. Once power loss is detected, KEB quickly decelerates the motor, using regenerative energy to maintain voltage levels in the DC bus. This keeps the drive running through a momentary loss in power. Once power is restored, the drive will reaccelerate to the frequency reference or continue to decelerate to a complete stop (depending on the S4-14 setting).

There are three ways that KEB can be performed. Parameter S4-01 determines which method is used. *Refer to S4-01: KEB Mode Selection on page 270.*

#### Conditions that Trigger KEB

When KEB is enabled (i.e., S4-01 is not set to 0), it will be triggered by any one of the following conditions:

- A multi-function input terminal set for KEB is activated (H1-□□ = 65 or 66).  
**Note:** Be sure to wire this input accurately when enabling it, or the drive may go into KEB even when the power is not lost. KEB 1 will decelerate to zero using the ramp times set in the S5 group. KEB 2 will start deceleration and will trip with a UV1 fault once the L2-02 time has elapsed.
- Voltage in the DC bus has fallen below the level that trips KEB (set in S4-03).
- Voltage fluctuation in the DC bus exceeded the level that trips KEB (set to S4-04).

## 5.11 S: Functions for Textile Applications

- Phase loss was detected as defined by the phase loss detection level (S4-08) and the detection time (S4-10).
- AC Input supply is lost, and is detected by hardware detection circuit (enabled as default by S4-15).
- The 1 phase loss of the power supply is detected by measuring the ripple of the DC bus voltage. The detection is tuned with parameters S4-08 (KEB 1 phase loss detection level), S4-09 (KEB 1 phase loss sampling time) and S4-10 (KEB 1 Phase Loss Detection Intervals), see [Figure 5.92](#) for details.

The DC bus ripple is defined as:  $V_{DC\ max} - V_{DC\ min}$ . It is measured within the time period of S4-09 with a scan time between 100 and 250  $\mu\text{sec}$ , depending on the carrier frequency.

When the measured DC bus ripple is bigger than the value set in S4-08 for the time  $S4-09 \times S4-10$ , phase loss is detected and the KEB function is started.

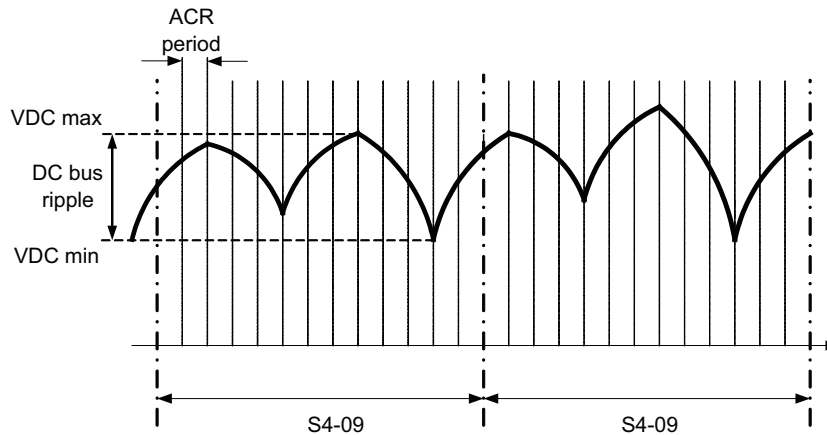


Figure 5.92 One Phase Loss Detection

### Conditions that Stop KEB

While KEB is being executed, any one of the following conditions will stop the KEB process.

- All the conditions that trigger KEB are no longer present, the minimum time for KEB (S4-13) has passed, and the DC bus voltage is greater than the level required for KEB to complete (S4-06) for longer than the time set in S4-07.

**Note:** KEB cannot complete until the time set to S4-07 has passed, even if all other conditions to stop KEB have been met.

- Once power is restored, the input terminal set for KEB ( $H1-\square\square = 65$  or  $66$ ) that triggered KEB is released.

**Note:** When an input terminal is programmed to trigger KEB, the operation of KEB depends on the opening and closing of that terminal. Other conditions are not relevant in this case.

- KEB 2 is being used and deceleration took longer than L2-02. In this case, KEB 2 will be stopped and the drive will trip with a UV1 fault.

**Note:** When triggering KEB by  $dV/dt$  detection only, be sure that S4-03 and S4-13 are accurately set. Otherwise, KEB operation might end before the supply power has been restored. Set  $S4-11 < S4-03 < 1.35 \times E1-01$ .

### DC Bus Voltage Control (KEB 1), Power KEB (KEB 3)

Below [Figure 5.93](#) demonstrates how KEB 1 and KEB 3 operate.

The KEB function is triggered when one of the previously explained conditions becomes true. The KEB function starts by immediately applying a frequency gain in order to bring the motor into a regenerative state, then quickly decelerates the motor.

The deceleration is performed for at least the time set in parameter S4-13. The drive controls the deceleration so that the energy needed to keep the DC bus voltage at the level set in S4-11 is fed from the rotating system back into the drive. KEB 1 ( $S4-01 = 1$ ) uses the deceleration times set in S5-01 and S5-02 as a base, and adjusts the deceleration rate depending on the DC bus voltage. KEB 3 ( $S4-01 = 3$ ) uses motor and machine inertia data only to calculate the optimal deceleration rate. The deceleration time settings have no effect during KEB 3.

The KEB function ends as described above. If KEB has not been triggered by single phase loss detection and the output frequency is greater than S4-14, the drive will hold the output frequency for the time set in parameter S4-12, then accelerate back to the frequency reference. The acceleration time is defined by parameter S5-05. If S5-05 is set to 0, then the drive uses the acceleration times set in C1-01, C1-03, C1-05, and C1-07.

- Note:**
1. Make sure that the Run command remains enabled during power loss. If the Run command is released, then the drive will not be able to accelerate back up to the frequency reference once power is restored. Removing the Run command during Power KEB will bring the drive ramping down to zero with standard ramp time.
  2. When Power KEB has been started by digital input H1-□□ = 65/66, and the power loss detection relay has failed (input stays on) while S4-11 is set below 1.35, the drive will reaccelerate without waiting for the time set in S4-12. The ramp time will not be S5-05 or the standard ramp, but will be calculated by the drive.
  3. When the supply power is restored during Power KEB and the drive is set to reaccelerate to the frequency reference in effect before KEB, a small step in the output frequency might occur at the end of KEB deceleration and before the S4-12 time starts.

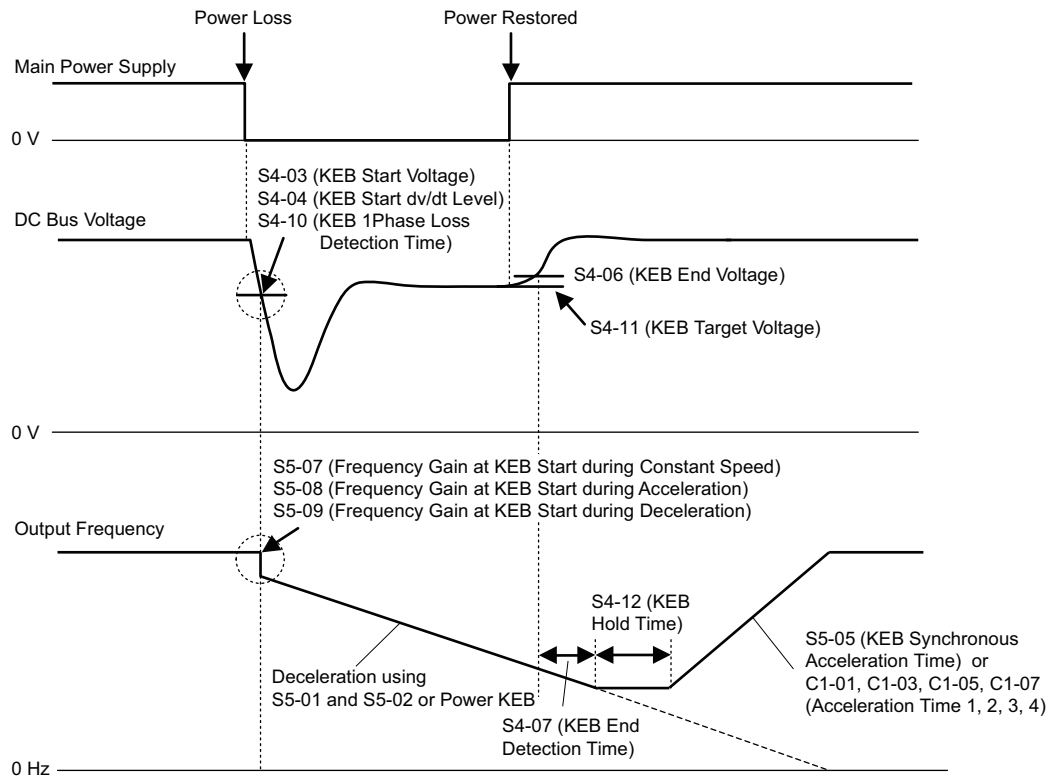


Figure 5.93 KEB Function when S4-01 = 1 or 3

### Synchronous Accel/Decel (KEB 2)

Synchronous KEB can be used when multiple drives have to be decelerated during power loss while keeping the speed ratio between the drives constant.

KEB 2 begins when one of the conditions that triggers the KEB function becomes true. To have multiple drives remain in sync with one another while accelerating and decelerating during KEB 2, Yaskawa recommends setting a multi-function input to "KEB" (H1-□□ = 65 or 66) to activate the synchronous accel/decel provided by KEB 2.

KEB 2 decelerates the drive using the deceleration time set in S5-01 and S5-02. This deceleration time is referred as the time needed to decelerate from the active frequency reference to stop.

When the power returns the drive accelerates back to the frequency reference using the time set in S5-05. This acceleration time is referred as the time needed to accelerate from the current output frequency to the frequency reference.

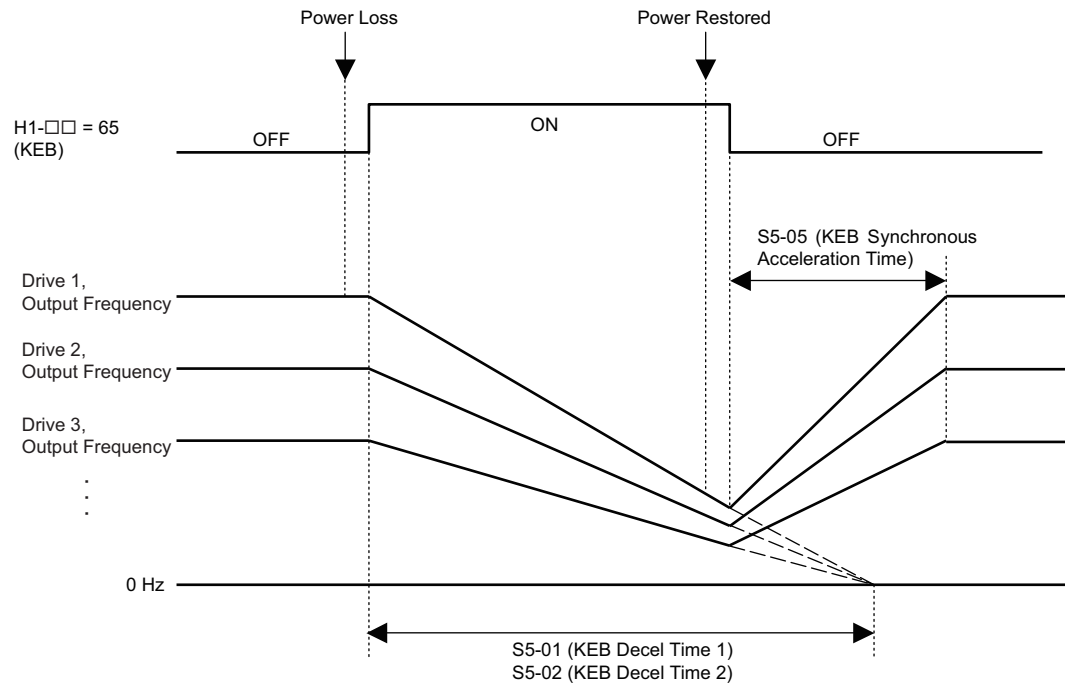


Figure 5.94 S4-01 = 2 (Synchronous accel/decel (KEB 2))

Figure 5.95 shows a wiring diagram when assigning an input terminal to trigger KEB (H1-□□ = 65 or 66).

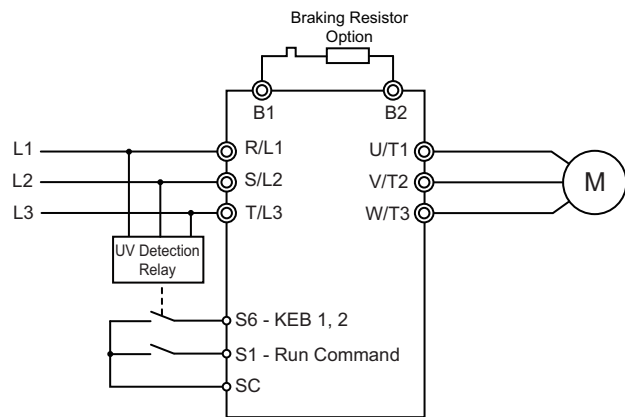


Figure 5.95 KEB Terminal Wiring Example

- Note:**
1. Make sure that the Run command remains enabled during power loss. If the Run command is released, then the drive will not be able to accelerate back up to the frequency reference once power is restored.
  2. A braking resistor option is needed when using the synchronous accel/decel feature offered by KEB 2 (S4-01 = 1) while S5-10 is set to 0.

? **S4-01: KEB Mode Selection**

Determines which of the three types of KEB to use.

To have the drive perform KEB itself (i.e., using its own independent deceleration rate), then use KEB 1 or KEB 3 by setting S4-01 to either 1 or 3.

For drives running on a line system in a textile application, it may be beneficial to synchronize the deceleration rate for all drives on the line. Use KEB 2 (S4-01 = 2) to have all drive decelerate together.

No.	Name	Setting Range	Default
S4-01	KEB Mode Selection	0 to 3	0

**Setting 0: KEB Disabled**

Drive will not use KEB when power loss occurs.

**Setting 1: DC Bus Voltage Control (KEB 1)**

When KEB is triggered, the drive observes the DC bus voltage and holds the frequency if the voltage rises. The deceleration rate is adjusted in accordance with the KEB decel times set to S5-01 and S5-02. This selection is recommended when a braking resistor option is not installed.

**Note:** A braking resistor option must be installed when using KEB in a line system in which synchronous accel/decel is required. Frequency hold should also be disabled when decelerating during KEB (S5-10 = 0) in such applications.

**Setting 2: Synchronous Accel/Decel (KEB 2)**

KEB decelerates the motor according to the times set in S5-01 and S5-02, regardless of the DC bus voltage level. A braking resistor should be used to prevent problems with overvoltage.

**Setting 3: Power KEB (KEB 3)**

Using inertia data of the machine the drive calculates the optimal deceleration rate in order to keep the DC bus voltage at the target level set in parameter S4-11.

**? S4-02: KEB Start/End Voltage Setting Mode**

Determines how the KEB start and end voltage in parameters S4-03 and S4-06 are set.

No.	Name	Setting Range	Default
S4-02	KEB Start/End Voltage	0, 1	0

**Setting 0: Set as a Percentage of E1-01 × 1.414**

**Setting 1: Set as a Percentage of the DC Bus Voltage Before KEB was Triggered**

**? S4-03: KEB Start Voltage**

Determines the voltage level in the DC bus that will trigger KEB. Sets the minimum operation time for KEB once it is triggered. The setting value depends on the selection in parameter S4-02. A setting of 200.0% essentially disables S4-03.

No.	Name	Setting Range	Default
S4-03	KEB Start Voltage	0.0 to 200.0%	200.0%

**? S4-04: KEB Start dv/dt Level**

Sets the level of voltage fluctuation in the DC bus that triggers KEB. If set to 0, this parameter will not trigger KEB.

No.	Name	Setting Range	Default
S4-04	KEB Start dv/dt Level	0 to 10000 Vdc/s	0 Vdc/s

**? S4-05: KEB Start dv/dt Filter**

Sets the time required for the voltage fluctuation level defined in S4-04 to trigger KEB.

No.	Name	Setting Range	Default
S4-05	KEB Start dv/dt Filter	0 to 50 ms	20 ms

**? S4-06: KEB End Voltage**

Sets the DC bus voltage level at that the drive assumes the power supply has returned. If this level is exceeded for longer than S4-07 the drive starts reaccelerating to the set frequency reference. The setting value depends on the selection in parameter S4-02.

No.	Name	Setting Range	Default
S4-06	KEB End Voltage	0.0 to 200.0%	200.0%

**Note:** 1. This parameter is disregarded by the drive if an input terminal is set for KEB (H1-□□ = 65 or 66).  
2. S4-06 must be set to higher value than S4-11.

## 5.11 S: Functions for Textile Applications

### ? S4-07: KEB End Detection Time

Sets the time for that the DC bus voltage must exceed the level set in S4-06 in order to end the KEB function and reaccelerate to the set frequency reference.

No.	Name	Setting Range	Default
S4-07	KEB End Detection Time	0 to 2000 ms	0 ms

**Note:** This parameter is disregarded by the drive if an input terminal is set for KEB (H1-□□ = 65 or 66).

### ? S4-08: KEB 1 Phase Loss Detection Level

Defines the DC bus voltage ripple that indicates a one phase loss on input side, thus triggering the KEB function. A setting of 0 V will keep the KEB function from being triggered when one phase loss occurs.

No.	Name	Setting Range	Default
S4-08	KEB 1 Phase Loss Detection Level	0 to 800 V <1>	0 V

<1> This value is for 200 V drives. Double this setting when using a 400 V class drive.

### ? S4-09: KEB 1 Phase Loss Sampling Time

Sets the sampling time used to detect one input phase loss.

No.	Name	Setting Range	Default
S4-09	KEB 1 Phase Loss Sampling Time	0 to 3000 ms	0 ms

### ? S4-10: KEB 1 Phase Loss Detection Time

Sets the time that the ripple in the DC bus voltage must exceed the level set in S4-08 to trigger one phase loss detection.

No.	Name	Setting Range	Default
S4-10	KEB 1 Phase Loss Detection Time	0 to 10 ms	10 ms

### ? S4-11: KEB Target Voltage

When KEB 1 or KEB 3 has been selected, the drive attempts to keep the DC bus voltage at the target voltage defined in S4-11 multiplied by E1-01.

No.	Name	Setting Range	Default
S4-11	KEB Target Voltage	0.80 to 1.50	1.35

- Note:**
1. This parameter is disabled when KEB 2 is enabled.
  2. S4-06 must be set to higher value than S4-11.

### ? S4-12: KEB Hold Time

Once KEB is complete, S4-12 sets the time to hold the frequency reference before reacceleration.

No.	Name	Setting Range	Default
S4-12	KEB Hold Time	0.0 to 10.0 s	0.0 s

### ? S4-13: KEB Minimum Operation Time

Sets the minimum period of time the KEB must operate for once it has been triggered. Even if the conditions that triggered KEB may no longer be present, KEB will still continue until the time set to S4-13 has passed.

No.	Name	Setting Range	Default
S4-13	KEB Minimum Operation Time	0 to 2000 ms	50 ms

### ? S4-14: KEB Reacceleration Prohibit Frequency

Sets the frequency level to prohibit re-acceleration after the power returned. If the drive output frequency fell below S4-14 during KEB operation the drive will decelerate the motor to stop, even if the power returns. This parameter will have no effect when KEB has been triggered by One Phase Loss Detection. The drive will always decelerate to a stop in this case.

A setting of 0.0 essentially disables this parameter.

No.	Name	Setting Range	Default
S4-14	KEB Reacceleration Prohibit Frequency	0.0 to 100.0%	0.0%

### ? S4-15: KEB Supply Loss Detection Selection

This parameter can be used to trigger KEB operation when the hardware detection circuit detects that the AC supply voltage has been lost.

No.	Name	Setting Range	Default
S4-15	KEB Supply Loss Detection Selection	0, 1	1

**Setting 0: Disabled**

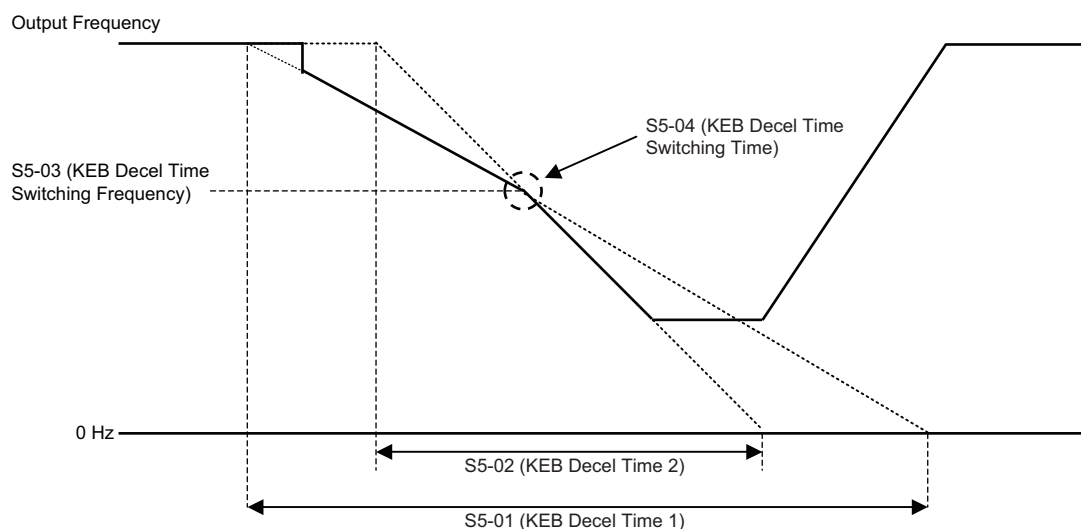
**Setting 1: Enabled**

## ? S5: KEB Accel/Decel Settings

S5 parameters govern settings for acceleration, deceleration and initial frequency step.

### ? KEB Decel Time Switching

The KEB 1 and KEB 2 functions can be used with an automatic switch over between two deceleration times. After the KEB function starts, the drive decelerates the motor according to KEB Decel Time 1 (S5-01). When the output frequency reaches the switching level set to S5-03 it changes the deceleration time over to KEB Decel Time 2 (S5-02) within the time set in S5-04.



**Figure 5.96 KEB Decel Time Switching**

No.	Name	Setting Range	Default
S5-01	KEB Decel Time 1	0.0 to 200.0 sec	0.0 sec
S5-02	KEB Decel Time 2	0.0 to 200.0 sec	0.0 sec
S5-03	KEB Decel Time Switching Frequency	0.0 to 100.0%	0.0%
S5-04	KEB Decel Time Switching Time	0.0 to 10.0 sec	0.0 sec

- Note:**
1. S5-01 is enabled as long as the output frequency is greater than S5-03. When the output frequency is less than or equal to S5-03, the drive uses the deceleration time set to S5-02.
  2. S5-03 is set as a percentage of the output frequency just before the KEB function is triggered. It determines the point at which the drive switches between deceleration times while the KEB function is executed.

## 5.11 S: Functions for Textile Applications

### ? S5-05: KEB Synchronous Acceleration Time

Sets time to accelerate from the frequency after KEB to the set frequency reference. This setting can be used to let multiple drives accelerate synchronously back to the set speed after power loss. Used in all KEB modes.

When the supply power is lost a second time while reaccelerating with S5-05, KEB deceleration will start again and the output frequency where this second power loss occurred will be stored by the drive. When restoring the supply again, the drive will reaccelerate with the S5-05 time to the stored output frequency and continue reacceleration to the frequency reference with the standard ramp time.

No.	Name	Setting Range	Default
S5-05	KEB Synchronous Acceleration Time	0.0 to 200.0 s	0.0 s

**Note:** If S5-05 is set to 0.0, the drive will use the normal acceleration times (C1-01, C1-03, C1-05, C1-07) to accelerate back up to speed once power is restored.

### ? S5-06: S-Curve at KEB Deceleration Start

Sets the S-curve time when KEB begins deceleration. Increase this setting if overvoltage trouble occurs.

Decreases if undervoltage occurs right after power loss deceleration.

No.	Name	Setting Range	Default
S5-06	S-Curve at KEB Deceleration Start	0.00 to 2.50 s	0.20 s

### ? S5-07: Frequency Gain at KEB Start during Constant Speed

Sets the output frequency reduction step applied when power loss is detected during constant speed operation.

Percent of frequency reduction = (slip frequency just before KEB)  $\times$  S5-07  $\times$  2

Increases if Uv is detected right after power loss deceleration.

No.	Name	Setting Range	Default
S5-07	Frequency Gain at KEB Start during Constant Speed	0 to 300%	100%

### ? S5-08: Frequency Gain at KEB Start during Acceleration

Sets the output frequency reduction step applied when power loss is detected during acceleration.

Percent of frequency reduction = (slip frequency just before KEB)  $\times$  S5-08  $\times$  2

No.	Name	Setting Range	Default
S5-08	Frequency Gain at KEB Start during Acceleration	0 to 300%	100%

### ? S5-09: Frequency Gain at KEB Start during Deceleration

Sets the output frequency reduction step applied when power loss is detected during deceleration.

Percent of frequency reduction = (slip frequency just before KEB)  $\times$  S5-09  $\times$  2

No.	Name	Setting Range	Default
S5-09	Frequency Gain at KEB Start during Deceleration	0 to 300%	100%

### ? S5-10: Synchronous Deceleration ov Prevention

Enables or disables overvoltage prevention during synchronous KEB operation (S4-01 = 2). If S5-10 is enabled the drive will temporary halt the deceleration if the DC bus voltage rises too high in order to avoid overvoltage trips.

No.	Name	Setting Range	Default
S5-10	Synchronous Deceleration ov Prevention	0, 1	0

**Setting 0: Disabled (requires a braking option)**

**Setting 1: Enabled**

### ? S5-11: KEB Frequency Reduction Step Lower Limit

Sets the lower limit for the frequency reduction step at the start of KEB operation. The lower limit is calculated as Minimum Frequency Reduction = Motor rated slip (E2-02) × S5-11

When the Frequency Reduction Step (as calculated by the drive from the slip before KEB and S5-07, S5-08 or S5-09) is lower than S5-11, the Minimum Frequency Reduction will be used.

**Note:** When using one of the control modes for a PM motor, S5-11 will disabled, regardless of what value it has been set to.

No.	Name	Setting Range	Default
S5-11	KEB Frequency Reduction Step Lower Limit	0 to 500%	20%

### ? S6: Power KEB Function

S6 parameters determine how the Power KEB type of KEB operates. Power KEB is enabled when S4-01 is set to 3. It uses machine inertia data for determining the deceleration rate needed to keep the DC bus voltage level at the value set in parameter S4-11.

#### ? S6-01: DC Bus Capacity

Enter the size of any external capacitors that have been added to the drive to S6-01.

The resulting DC bus capacity used by the drive will be L3-26 + S6-01.

No.	Name	Setting Range	Default
S6-01	DC Bus Capacity	0 to 65000 μF	Determined by drive capacity

#### ? S6-02: Motor Acceleration Time

Enter the time required for the motor the drive is running to accelerate from zero up to the maximum frequency at the rated torque. If setting in parameter E2-11 is changed by the user or by performing Auto-Tuning, then S6-02 will automatically be set to the motor acceleration time of a standard Yaskawa 4-pole motor.

No.	Name	Setting Range	Default
S6-02	Motor Acceleration Time	0.001 to 10.000 s	Determined by o2-04, E2-11, and E5-01

The motor acceleration time can be calculated using the formula below.

$$S6-02 = \frac{2\pi \times J \times Nr}{60 \times T_{100}}$$

$$J : \frac{GD^2}{4} \text{ [Kgm}^2\text{]}, P : \text{Rated output [kW]}, Nr : \text{Rated speed [r/min]}, T_{100} : \text{Rated torque [Nm]}$$

Use the following formula to find the rated torque.

$$T_{100} = \frac{60 \times P \times 10^3}{2\pi \times Nr}$$

## 5.11 S: Functions for Textile Applications

### ? S6-03: Load/Inertia Ratio

Enter the ratio between the inertia of the load and the inertia of the motor the drive is running. This parameter also adjusts the functions, Stall Prevention during deceleration (L3-04 = 2), and overvoltage suppression (L3-11 = 1).

No.	Name	Setting Range	Default
S6-03	Load/Inertia Ratio	0.0 to 1000.0	1, 0

If S6-03 is set to the wrong value, a large current ripple may appear during Power KEB and during overvoltage suppression. Problems may occur with overvoltage or undervoltage in the DC bus, and overcurrent.

The load/inertia ratio can be calculated using the following formula:

$$\text{Load inertia ratio} = \frac{\text{Machine inertia (excluding motor)}}{\text{Rotor inertia}}$$

An inertia setting that is too high might have an effect, even when the drive manages to decelerate to a complete stop. The deceleration rate might be not fast enough at the end of deceleration to keep the DC bus stable.

Adjust S6-03 while measuring the DC Bus Voltage.

### ? S6-04: DC Bus Adjustment Gain

Sets the gain to keep the voltage in the DC bus at the target level. If overvoltage or undervoltage is a problem at the start of Power KEB, gradually increasing S6-04 in increments of 0.1 may help.

No.	Name	Setting Range	Default
S6-04	DC Bus Adjustment Gain	0.00 to 5.00	Determined by A1-02

#### DC Bus Gain Adjustment for Power KEB and Intelligent Stall Prevention

- If overvoltage or undervoltage is a problem at the start of Power KEB or when the “intelligent” method of Stall Prevention during deceleration (L3-04 = 2) is performed, then gradually increasing S6-04 in increments of 0.1.
- Setting S6-04 too high can result in a large speed or current ripple.

#### DC Bus Gain Adjustment for Overvoltage Suppression

- For sudden increases in a regenerative load resulting in overvoltage, trying gradually increasing S6-04 in increments of 0.1.
- Setting S6-04 too high can result in a large speed or current ripple.

### ? S6-05: Accel/Decel Calculation Gain

Sets the gain used to calculate the acceleration and deceleration rates used for Power KEB, overvoltage suppression, and “intelligent” method of Stall Prevention during deceleration (L3-04 = 2).

No.	Name	Setting Range	Default
S6-05	Accel/Decel Calculation Gain	0.00 to 200.00	1.00

#### Adjusting Calculation Gain for Power KEB and Intelligent Stall Prevention

- If speed or current ripple is a problem at the start of Power KEB or when the “intelligent” method of Stall Prevention during deceleration (L3-04 = 2) is performed, then gradually reduce S6-05 in steps of 0.05
- For problems with overvoltage or overcurrent, reduce the value set to S6-05.
- If the calculation gain set to S6-05 is too low, the drive may be sluggish in suppressing DC bus voltage, and deceleration times may take longer than is optimal.

#### Adjusting Calculation Gain for Overvoltage Suppression

- If the overvoltage suppression function is enabled (L3-11 = 1) but cannot handle the amount of regenerative energy coming back from the motor, try gradually increasing S6-05 in increments of 0.1.
- If speed ripple is a problem while the overvoltage suppression function is enabled (L3-11 = 1), try gradually decreasing S6-05 in steps of 0.05.

### ? S6-06: ASR Primary Delay Time Constant 2

Sets the filter time constant in seconds for the time from the speed loop to the torque reference output when the Power KEB Ride-Thru is enabled (S4-01 = 3). If oscillation occurs during Power KEB Ride-Thru, then gradually increase this setting in increments of 0.01 s.

No.	Name	Setting Range	Default
S6-06	ASR Primary Delay Time Constant 2	0.000 to 0.500 s	0.000 s

### ? S6-07: Torque Limit Delay Time

Sets the filter time constant in seconds for the torque limit value to return to set value when the Power KEB Ride-Thru is enabled (S4-01 = 3). If oscillation occurs during Power KEB Ride-Thru, then gradually increase this setting in increments of 0.010 s.

No.	Name	Setting Range	Default
S6-07	Torque Limit Delay Time	0.000 to 1.000 s	Determined by A1-02

## ? S9: Synchronous Operation

### ? S9-03: Speed Detection Change Rate Limit

Assigns a limit to how much the motor speed detection may fluctuate each millisecond.

No.	Name	Setting Range	Default
S9-03	Speed Detection Change Rate Limit	0.00 to 5.00 Hz	0.01 Hz

### ? S9-06: Speed Detection Width After Coasting

Sets the motor speed detection width as soon as the motor is done coasting.

Once the motor is done coasting, the drive will apply the motor speed detection value if the value detected is less than S9-06 plus the previous value.

No.	Name	Setting Range	Default
S9-06	Speed Detection Width After Coasting	0.00 to 1.00 Hz	0.20 Hz

## ? T: Motor Tuning

Auto-Tuning automatically sets and tunes parameters required for optimal motor performance.

*Refer to Auto-Tuning on page 95* for details on Auto-Tuning parameters.

# 5.12 U: Monitor Parameters

Monitor parameters let the user view various aspects of drive performance using the digital operator display. Some monitors can be output from terminals FM and AM by assigning the specific monitor parameter number (U□-□□) to H4-01 and H4-04. *Refer to H4-01, H4-04: Multi-Function Analog Output Terminal FM, AM Monitor Selection on page 218* for details on assigning functions to an analog output.

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### ? U1: Operation Status Monitors

Status monitors display drive status data such as output frequency and output current. Refer to *U1: Operation Status Monitors on page 470* for a complete list of U1-□□ monitors and descriptions.

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### ? U2: Fault Trace

These monitor parameters are used to view the status of various drive aspects when a fault occurs.

This information is helpful for finding out why a fault occurred. Refer to *U2: Fault Trace on page 472* for a complete list of U2-□□ monitors and descriptions.

U2-□□ monitors are not reset when the drive is initialized. *Refer to o4-11: U2, U3 Initialization on page 264* for instructions on how to reset these monitor values.

**Note:** Fault trace (i.e., the fault history) is not kept when CPF00, CPF01, Uv1, Uv2 occur.

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### ? U3: Fault History

These parameters display faults that have occurred during operation as well as the drive operation time when those faults occurred. Refer to *U3: Fault History on page 473* for a complete list of U3-□□ monitors and descriptions.

U3-□□ monitors are not reset when the drive is initialized. *Refer to o4-11: U2, U3 Initialization on page 264* for instructions on how to reset these monitor values.

**Note:** Fault trace (i.e., the fault history) is not kept when CPF00, CPF01, Uv1, Uv2 occur.

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### ? U4: Maintenance Monitors

Maintenance monitors show:

- Runtime data of the drive and cooling fans, and number of Run commands issued
- Maintenance data and replacement information for various drive components
- kWh data
- Highest peak current that has occurred and output frequency at the time the peak current occurred
- Motor overload status information
- Detailed information about the present Run command and frequency reference source selection

*Refer to U4: Maintenance Monitors on page 474* for a complete list of U4-□□ monitors and descriptions.

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### ? U5: PID Monitors

These monitors display various aspects of PID control. *Refer to PID Block Diagram on page 138* for details on how these monitors display PID data.

*U5: PID Monitors on page 476* has a complete list of U5-□□ monitors and descriptions.

## ? U6: Operation Status Monitors

Control monitors show:

- Reference data for the output voltage and vector control
- Data on PM motor rotor synchronization, forward phase compensation, and flux positioning
- Pulse data from the PG motor encoder
- Pulse data for Zero Servo control
- ASR and Feed Forward control monitors

Refer to [Figure 5.32](#) on page 157 and [Figure 5.33](#) on page 157 for details and an illustration showing where monitors are located in the ASR block.

- The offset value added to the frequency reference by the frequency offset function. [Refer to Setting 44, 45, 46: Offset frequency 1, 2, 3 on page 198.](#)

Refer to [U6: Operation Status Monitors on page 476](#) for a complete list of U6-□□ monitors and descriptions.

## ? U9: KEB Voltage Monitors

These parameters allow the user to monitor the voltage levels used for KEB function start and end. For more information on the U9 monitor parameter monitors, see [U9: KEB Voltage Monitors on page 478](#).



# Troubleshooting

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This chapter provides descriptions of the drive faults, alarms, errors, related displays, and guidance for troubleshooting. This chapter can also serve as a reference guide for tuning the drive during a trial run.

<b>6.1</b>	<b>SECTION SAFETY</b> .....	<b>282</b>
<b>6.2</b>	<b>MOTOR PERFORMANCE FINE-TUNING</b> .....	<b>284</b>
<b>6.3</b>	<b>DRIVE ALARMS, FAULTS, AND ERRORS</b> .....	<b>290</b>
<b>6.4</b>	<b>FAULT DETECTION</b> .....	<b>296</b>
<b>6.5</b>	<b>ALARM DETECTION</b> .....	<b>313</b>
<b>6.6</b>	<b>OPERATOR PROGRAMMING ERRORS</b> .....	<b>322</b>
<b>6.7</b>	<b>AUTO-TUNING FAULT DETECTION</b> .....	<b>327</b>
<b>6.8</b>	<b>COPY FUNCTION RELATED DISPLAYS</b> .....	<b>331</b>
<b>6.9</b>	<b>DIAGNOSING AND RESETTING FAULTS</b> .....	<b>333</b>
<b>6.10</b>	<b>TROUBLESHOOTING WITHOUT FAULT DISPLAY</b> .....	<b>335</b>

## 6.1 Section Safety

### DANGER

#### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

### WARNING

#### Electrical Shock Hazard

**Do not operate equipment with covers removed.**

Failure to comply could result in death or serious injury.

The diagrams in this section may illustrate drives without covers or safety shields to display details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

**Always ground the motor-side grounding terminal.**

Improper equipment grounding could result in death or serious injury by contacting the motor case.

**Do not touch terminals before the capacitors have fully discharged.**

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the drive input power is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**Do not allow unqualified personnel to perform work on the drive.**

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

**Do not perform work on the drive while wearing loose clothing, jewelry, or without eye protection.**

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

#### Fire Hazard

**Tighten all terminal screws to the specified tightening torque.**

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

**Do not use an improper voltage source.**

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming drive input power before applying power.

**⚠ WARNING****Do not use improper combustible materials.**

Failure to comply could result in death or serious injury by fire.

Attach the drive to metal or other noncombustible material.

**NOTICE****Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Never connect or disconnect the motor from the drive while the drive is outputting voltage.**

Improper equipment sequencing could result in damage to the drive.

**Do not use unshielded cable for control wiring.**

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

**Do not allow unqualified personnel to use the product.**

Failure to comply could result in damage to the drive or braking circuit.

Carefully review instruction manual TOBP C720600 00 when connecting a dynamic braking option to the drive.

**Do not modify the drive circuitry.**

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for modification of the product made by the user.

**Check all the wiring after installing the drive and connecting other devices to ensure that all connections are correct.**

Failure to comply could result in damage to the drive.

## 6.2 Motor Performance Fine-Tuning

This section offers helpful information for counteracting oscillation, hunting, or other problems that occur while performing a trial run. Refer to the section below that corresponds to the motor control method used.

**Note:** This section describes parameters that are commonly edited and may be set incorrectly. Consult Yaskawa for more information on detailed settings and fine-tuning the drive.

### ? Fine-Tuning V/f Control and V/f Control with PG

**Table 6.1 Parameters for Fine-Tuning Performance in V/f and V/f w/PG**

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
Motor hunting and oscillation at speeds between 10 and 40 Hz	Hunting Prevention Gain (n1-02)	<ul style="list-style-type: none"> <li>If insufficient motor torque relative to the size of the load causes hunting, reduce the setting.</li> <li>When motor hunting and oscillation occur with a light load, increase the setting.</li> <li>Lower this setting if hunting occurs when using a motor with a relatively low inductance, such as a high-frequency motor or a motor with a larger frame size.</li> </ul>	1.00	0.10 to 2.00
<ul style="list-style-type: none"> <li>Motor noise</li> <li>Motor hunting and oscillation at speeds up to 40 Hz</li> </ul>	Carrier Frequency Selection (C6-02)	<ul style="list-style-type: none"> <li>If the motor noise is too loud, increase the carrier frequency.</li> <li>When motor hunting and oscillation occur at speeds up to 40 Hz, lower the carrier frequency.</li> <li>The default setting for the carrier frequency depends on the drive capacity (o2-04) and the Duty Selection (C6-01).</li> </ul>	1 (2 kHz)	1 to max. setting
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	Torque Compensation Primary Delay Time (C4-02)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, decrease the setting.</li> <li>If motor hunting and oscillation occur, increase the setting.</li> </ul>	200 ms <1>	100 to 1000 ms
<ul style="list-style-type: none"> <li>Poor motor torque at speeds below 10 Hz</li> <li>Motor hunting and oscillation</li> </ul>	Torque Compensation Gain (C4-01)	<ul style="list-style-type: none"> <li>If motor torque is insufficient at speeds below 10 Hz, increase the setting.</li> <li>If motor hunting and oscillation with a relatively light load, decrease the setting.</li> </ul>	1.00	0.50 to 1.50
<ul style="list-style-type: none"> <li>Poor motor torque at low speeds</li> <li>Motor instability at motor start</li> </ul>	Mid Output Voltage A (E1-08) Minimum Output Voltage (E1-10)	<ul style="list-style-type: none"> <li>If torque is insufficient at speeds below 10 Hz, increase the setting.</li> <li>If motor instability occurs at motor start, decrease the setting.</li> <li><b>Note:</b> The recommended setting value is for 200 V class drives. Double this value when using a 400 V class drive.</li> </ul>	E1-08: 15.0 V E1-10: 9.0 V <2>	Default setting ±5 V
Poor speed precision (V/f control)	Slip Compensation Gain (C3-01)	After setting the motor-rated current (E2-01), motor-rated slip (E2-02), and motor no-load current (E2-03), adjust the slip compensation gain (C3-01).	0.0 (no slip compensation)	0.5 to 1.5
Poor speed precision (V/f control with PG)	ASR Proportional Gain 1 (C5-01) ASR Integral Time 1 (C5-02) <3> <4>	Adjust the ASR proportional gain 1 (C5-01) and the ASR integral time 1 (C5-02).	C5-01: 0.20 C5-02: 0.200 s	Proportional gain = 0.10 to 1.00 Integral time = 0.100 to 2.000 s

<1> Default setting value is dependent on parameter A1-02, Control Method Selection, and o2-04, Drive Model Selection.

<2> Default settings change when the Control Method is changed (A1-02).

<3> ASR in V/f Control with PG only controls the output frequency, and therefore does not allow the high gain settings possible when using Close Loop Vector control.

<4> Refer to **C5: Automatic Speed Regulator (ASR) on page 157** for details on Automatic Speed Regulator (ASR).

## ? Fine-Tuning Open Loop Vector Control

**Table 6.2 Parameters for Fine-Tuning Performance in OLV**

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
<ul style="list-style-type: none"> <li>Poor motor torque and speed response</li> <li>Motor hunting and oscillation at speeds between 10 and 40 Hz</li> </ul>	AFR Gain (n2-01)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, gradually decrease the setting by 0.05.</li> <li>If motor hunting and oscillation occur, gradually increase the setting by 0.05.</li> </ul>	1.00	0.50 to 2.00
<ul style="list-style-type: none"> <li>Poor motor torque and speed response</li> <li>Motor hunting and oscillation at speeds between 10 and 40 Hz</li> </ul>	AFR Time Constant 1 (n2-02)	<ul style="list-style-type: none"> <li>To improve motor torque speed response, gradually reduce this setting by 10 ms and check the performance.</li> <li>If motor hunting and oscillation occur as a result of load inertia, gradually increase the setting by 50 ms and check the performance.</li> <li><b>Note:</b> Ensure that <math>n2-02 \leq n2-03</math>. When changing n2-02, set C4-02 (Torque Compensation Primary Delay Time Constant 1) accordingly.</li> </ul>	50 ms	50 to 2000 ms
Overvoltage trips when accelerating, decelerating, or during sudden speed or load changes.	AFR Time Constant 2 (n2-03)	<ul style="list-style-type: none"> <li>If overvoltage occur, gradually increase this setting by 50 ms and check the performance.</li> <li>If response is slow, gradually reduce this setting by 10 ms and check the performance.</li> <li><b>Note:</b> Ensure that <math>n2-02 \leq n2-03</math>. When making adjustments to n2-03, increase the value of C4-06 (Torque Compensation Primary Delay Time 2) proportionally.</li> </ul>	750 ms	750 to 2000 ms
	Torque Compensation Primary Delay Time Constant 2 (C4-06)	<ul style="list-style-type: none"> <li>If overvoltage trips occur, gradually increase this setting by 10 ms and check the performance.</li> <li>If response is slow, gradually reduce this setting by 2 ms and check the performance.</li> <li><b>Note:</b> Ensure that <math>C4-02 \leq C4-06</math>. When changing C4-06 (Torque Compensation Primary Delay Time Constant 2), increase the value of n2-03 proportionally.</li> </ul>	150 ms	150 to 750 ms
<ul style="list-style-type: none"> <li>Poor motor torque and speed response</li> <li>Motor hunting and oscillation</li> </ul>	Torque Compensation Primary Delay Time Constant 1 (C4-02)	<ul style="list-style-type: none"> <li>To improve motor torque speed response, gradually reduce this setting by 2 ms and check the performance.</li> <li>If motor hunting and oscillation occur, gradually increase this setting by 10 ms.</li> <li><b>Note:</b> Ensure that <math>C4-02 \leq C4-06</math>. When making adjustments to C4-02, increase the AFR time constant 1 (n2-02) proportionally.</li> </ul>	20 ms <=>	20 to 100 ms <=>
Poor speed response and stability	Slip Compensation Primary Delay Time Constant (C3-02)	<ul style="list-style-type: none"> <li>If response is slow, gradually decrease the setting by 10 ms.</li> <li>If speed is unstable, gradually increase the setting by 10 ms.</li> </ul>	200 ms <=>	100 to 500 ms
Poor speed precision	Slip Compensation Gain (C3-01)	<ul style="list-style-type: none"> <li>If speed is too slow, gradually increase the setting by 0.1 ms.</li> <li>If speed is too fast, gradually decrease the setting by 0.1 ms.</li> </ul>	1.0 <=>	0.5 to 1.5
Poor speed precision during regenerative operation	Slip Compensation Selection During Regeneration (C3-04)	Enable slip compensation during regeneration by setting parameter C3-04 = 1.	0	1
<ul style="list-style-type: none"> <li>Motor noise</li> <li>Motor hunting and oscillation occur at speeds below 10 Hz</li> </ul>	Carrier Frequency Selection (C6-02)	<ul style="list-style-type: none"> <li>If there is too much motor noise, the carrier frequency is too low.</li> <li>If motor hunting and oscillation occur at low speeds, reduce the carrier frequency.</li> <li><b>Note:</b> The default setting for the carrier frequency depends on the drive capacity (o2-04) and Duty Selection (C6-01).</li> </ul>	1 (2 kHz)	0 to max. setting

## 6.2 Motor Performance Fine-Tuning

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
<ul style="list-style-type: none"> <li>Poor motor torque at low speeds</li> <li>Poor speed response</li> <li>Motor instability at start</li> </ul>	Mid Output Voltage A (E1-08) Minimum Output Voltage (E1-10)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, increase the setting.</li> <li>If the motor exhibits excessive instability at start-up, reduce the setting.</li> <li><b>Note:</b> The default value is for 200 V class units. Double this value when using a 400 V class drive. When working with a relatively light load, increasing this value too much can result in overtorque.</li> </ul>	E1-08: 11.0 V <2> E1-10: 2.0 V <2>	Default setting ±2 V

<1> Default setting value is dependent on parameter A1-02, Control Method Selection, and o2-04, Drive Model Selection.

<2> Default settings change when the Control Method is changed (A1-02).

When using OLV, leave the torque compensation gain (C4-01) at its default setting of 1.00.

## ? Fine-Tuning Closed Loop Vector Control

**Table 6.3 Parameters for Fine-Tuning the Performance in CLV**

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	ASR Proportional Gain 1 (C5-01) ASR Proportional Gain 2 (C5-03) <1>	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, gradually increase the ASR gain setting by 5.</li> <li>If motor hunting and oscillation occur, decrease the setting.</li> <li>Parameter C5-03 needs to be adjusted only if C5-05 &gt; 0.</li> <li>Perform ASR Auto-Tuning if possible</li> </ul>	20.00	10.00 to 50.00
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	High-speed: ASR Integral Time 1 (C5-02) Low-speed: ASR Integral Time 2 (C5-04) <1>	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, decrease the setting.</li> <li>If motor hunting and oscillation occur, increase the setting.</li> <li>Parameter C5-04 needs to be adjusted only if C5-05 &gt; 0.</li> </ul>	0.500 s	0.300 to 1.000 s
Trouble maintaining the ASR proportional gain or the integral time at the low or high end of the speed range	ASR Gain Switching Frequency (C5-07) <1>	Have the drive switch between two different ASR proportional gain and integral time settings based on the output frequency.	0.0 Hz	0.0 to max output frequency
Motor hunting and oscillation	ASR Primary Delay Time Constant (C5-06) <1>	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, gradually decrease the setting by 0.01.</li> <li>If the load is less rigid and subject to oscillation, increase this setting.</li> </ul>	0.004 s	0.004 to 0.020 s
<ul style="list-style-type: none"> <li>Motor noise</li> <li>Control motor hunting and oscillation occur at speeds below 3 Hz.</li> </ul>	Carrier Frequency Selection (C6-02)	<ul style="list-style-type: none"> <li>If there is too much motor noise, the carrier frequency is too low.</li> <li>If motor hunting and oscillation occur at low speeds, reduce the carrier frequency.</li> <li><b>Note:</b> The default setting for the carrier frequency depends on the drive capacity (o2-04) and Drive Duty Selection (C6-01).</li> </ul>	1	2.0 kHz to the max. setting
Overshoot or undershoot when the speed changes with high inertia load.	Feed Forward Control (n5-01) Inertia Tuning (T1-01 = 8)	<ul style="list-style-type: none"> <li>Enable Feed Forward by setting parameter n5-01 = 1 and perform Inertia Tuning. If Inertia Tuning is not possible, set parameters C5-17, C5-18, and n5-03 manually.</li> </ul>	0	1

<1> Refer to *C5: Automatic Speed Regulator (ASR) on page 157* for details on Automatic Speed Regulator (ASR).

## ? Fine-Tuning Open Loop Vector Control for PM Motors

Table 6.4 Parameters for Fine-Tuning Performance in OLV/PM

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
Motor performance not as desired	Motor parameters (E1-□□, E5-□□)	<ul style="list-style-type: none"> <li>Check the settings for base and maximum frequency in the E1-□□ parameters</li> <li>Check E5-□□ parameters and make sure all motor data has been set correctly. Be careful not to enter line to line data where single-phase data is required, and vice versa.</li> <li>Perform Auto-Tuning.</li> </ul>	-	-
Poor motor torque and speed response	Load Inertia Ratio (n8-55)	Adjust parameter n8-55 to meet the load inertia ratio of the machine.	0	Close to the actual load inertia ratio
	Speed Feedback Detection Gain (n8-45)	Decrease the speed feedback detection gain (n8-45).	0.8	Decrease in decrements of 0.05
	Torque Compensation (C4-01)	Enable torque compensation. <b>Note:</b> Setting this value too high can cause overcompensation and motor oscillation.	0	1
Oscillation at start or the motor stalls	Pull-In Current during Accel/Decel (n8-51)	Increase the pull-in current set in n8-51	50%	Increase in steps of 5%
	DC Injection Braking Current (b2-02), DC Injection Time at Start (b2-03)	Use DC Injection Braking at start to align the rotor. Be aware that this operation can cause a short reverse rotation at start.	b2-02 = 50% b2-03 = 0.0 s	b2-03 = 0.5 s Increase b2-02 if needed
	Load Inertia Ratio (n8-55)	Increase the load inertia ratio. <b>Note:</b> Setting this value too high can cause overcompensation and motor oscillation.	0	Close to the actual load inertia ratio
Stalling or oscillation occur when load is applied during constant speed	Pull-In Current Compensation Time Constant (n8-47)	Decrease n8-47 if hunting occurs during constant speed	5.0 s	Reduce in increments of 0.2 s
	Pull-In Current (n8-48)	Increase the pull-in current in n8-48.	30%	Increase in increments of 5%
	Load Inertia Ratio (n8-55)	Increase the load inertia ratio.	0	Close to the actual load inertia ratio
Hunting or oscillation occur	Speed feedback Detection Gain (n8-45)	Increase the speed feedback detection gain in n8-45.	0.8	Increase in increments 0.05
STO fault trips even if the load is not too high	Induced Voltage Constant (E5-09 or E5-24)	<ul style="list-style-type: none"> <li>Check and adjust the induced voltage constant.</li> <li>Check the motor name plate, the data sheet or contact the motor manufacturer for getting data.</li> </ul>	dep. on drive capacity and motor code	Refer to the motor data sheet or the nameplate.
Stalling or STO occurs at high speed as the output voltage becomes saturated.	Output Voltage Limit (n8-62)	Set the value of the input voltage to parameter n8-62. Never set the value higher than the actual input voltage.	200 Vac or 400 Vac	Set the value lower than the actual input voltage.

When using OLV/PM, leave the torque compensation gain (C4-01) of its default setting of 1.00. Enable the slip compensation selection during regeneration (C3-04 = 1) if speed precision is not possible during the regeneration.

### ? Fine-Tuning Advanced Open Loop Vector Control for PM Motors

**Table 6.5 Parameters for Fine-Tuning Performance in AOLV/PM**

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	High-speed: ASR Proportional Gain 1 (C5-01) Low-speed: ASR Proportional Gain 2 (C5-03)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, gradually increase the setting by 5.</li> <li>If motor hunting and oscillation occur, decrease the setting.</li> <li>Parameter C5-03 needs to be adjusted only if C5-05 &gt; 0.</li> </ul>	10.00	5.00 to 30.00 <1>
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	High-speed: ASR Integral Time 1 (C5-02) Low-speed: ASR Integral Time 2 (C5-04)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, decrease the setting.</li> <li>If motor hunting and oscillation occur, increase the setting.</li> <li>Parameter C5-03 needs to be adjusted only if C5-05 &gt; 0</li> </ul>	0.500 s	0.300 to 1.000 s <1>
Trouble maintaining the ASR proportional gain or the integral time at the low or high end of the speed range	ASR Gain Switching Frequency (C5-07)	Have the drive switch between two different ASR proportional gain and integral time settings based on the output frequency.	0.0%	0.0 to Max r/min
Motor hunting and oscillation	ASR Primary Delay Time Constant (C5-06)	If the load is less rigid and subject to oscillation, increase this setting.	0.010 s	0.016 to 0.035 s <1>
Motor stalling makes normal operation impossible	Motor parameters (E1-□□, E5-□□)	Check the motor parameter settings.	-	-

<1> Optimal settings will differ between no-load and loaded operation.

### ? Fine-Tuning Closed Loop Vector Control for PM Motors

**Table 6.6 Parameters for Fine-Tuning Performance in CLV/PM**

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	High-speed: ASR Proportional Gain 1 (C5-01) Low-speed: ASR Proportional Gain 2 (C5-03)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, gradually increase the setting by 5.</li> <li>If motor hunting and oscillation occur, decrease the setting.</li> <li>Perform ASR Gain Auto-Tuning if possible</li> </ul>	20.00	10.00 to 50.00 <1>
<ul style="list-style-type: none"> <li>Poor torque or speed response</li> <li>Motor hunting and oscillation</li> </ul>	High-speed: ASR Integral Time 1 (C5-02) Low-speed: ASR Integral Time 2 (C5-04)	<ul style="list-style-type: none"> <li>If motor torque and speed response are too slow, decrease the setting.</li> <li>If motor hunting and oscillation occur, increase the setting.</li> </ul>	0.500 s	0.300 to 1.000 s <1>
ASR proportional gain or the integral time at the low or high end of the speed range	ASR Gain Switching Frequency (C5-07)	Have the drive switch between two different ASR proportional gain and integral time settings based on the output frequency.	0.0%	0.0 to Max r/min
Motor hunting and oscillation	ASR Primary Delay Time Constant (C5-06)	If the load is less rigid and subject to oscillation, increase this setting.	0.016 s	0.004 to 0.020 s <1>
Motor stall makes normal operation impossible	Motor parameters (E1-□□, E5-□□)	Check the motor parameter settings.	-	-
Overshoot or undershoot at speed changes with high inertia load.	Feed Forward Control (n5-01) Inertia Auto-Tuning (T2-01 = 8)	Enable Feed Forward Control by setting parameter n5-01 = 1 and perform Inertia Auto-Tuning. If Auto-Tuning cannot be performed set parameters C5-17, C5-18 and n5-03 manually.	0	1

<1> Optimal settings will differ between no-load and loaded operation.

## ? Parameters to Minimize Motor Hunting and Oscillation

In addition to the parameters discussed on page 284 through 288, the following parameters indirectly affect motor hunting and oscillation.

**Table 6.7 Parameters that Affect Control Performance in Applications**

Name (Parameter No.)	Application
<b>Dwell Function (b6-01 through b6-04)</b>	Prevents motor speed loss by maintaining the output frequency when working with heavy loads or when there is powerful backlash on the machine side.
<b>Accel/Decel Time (C1-01 through C1-11)</b>	Adjusting accel and decel times will affect the torque presented to the motor during acceleration or deceleration.
<b>S-Curve Characteristics (C2-01 through C2-04)</b>	Prevents shock at the beginning and end of acceleration and deceleration.
<b>Analog Filter Time Constant (H3-13)</b>	Prevents fluctuation in the analog input signal due to noise.
<b>Stall Prevention (L3-01 through L3-06, L3-11)</b>	<ul style="list-style-type: none"> <li>Prevents motor speed loss and overvoltage. Used when the load is too heavy and also during sudden acceleration/deceleration.</li> <li>Adjustment is not normally required because Stall Prevention is enabled as a default. Disable Stall Prevention during deceleration (L3-04 = "0") when using a braking resistor.</li> </ul>
<b>Torque Limits (L7-01 through L7-04, L7-06, L7-07)</b>	<ul style="list-style-type: none"> <li>Sets the maximum torque for Open Loop Vector Control.</li> <li>Ensure that the drive capacity is greater than the motor capacity when increasing this setting. Be careful when reducing this value because motor speed loss may occur with heavy loads.</li> </ul>
<b>Feed Forward Control (n5-01 through n5-03)</b>	Used to increase response for acceleration/deceleration or to reduce overshooting when there is low machine rigidity and the gain of the speed controller (ASR) cannot be increased. The inertia ratio between the load and motor and the acceleration time of the motor running alone must be set.

## 6.3 Drive Alarms, Faults, and Errors

### ? Types of Alarms, Faults, and Errors

Check the digital operator for information about possible faults if the drive or motor fails to operate. *Refer to Using the Digital Operator on page 81.*

If problems occur that are not covered in this manual, contact the nearest Yaskawa representative with the following information:

- Drive model
- Software version
- Date of purchase
- Description of the problem

**Table 6.8** contains descriptions of the various types of alarms, faults, and errors that may occur while operating the drive.

**Table 6.8 Types of Alarms, Faults, and Errors**

Type	Drive Response
<b>Faults</b>	<p>When the drive detects a fault:</p> <ul style="list-style-type: none"> <li>• The digital operator displays text that indicates the specific fault and the ALM indicator LED remains lit until the fault is reset.</li> <li>• The fault interrupts drive output and the motor coasts to a stop.</li> <li>• Some faults allow the user to select how the drive should stop when the fault occurs.</li> <li>• Fault output terminals MA-MC will close, and MB-MC will open.</li> </ul> <p>The drive will remain inoperable until that fault has been cleared. <i>Refer to Fault Reset Methods on page 334.</i></p>
<b>Minor Faults and Alarms</b>	<p>When the drive detects an alarm or a minor fault:</p> <ul style="list-style-type: none"> <li>• The digital operator displays text that indicates the specific alarm or minor fault, and the ALM indicator LED flashes.</li> <li>• The drive generally continues running the motor, although some alarms allow the user to select a stopping method when the alarm occurs.</li> <li>• One of the multi-function contact outputs closes if set to be tripped by a minor fault (H2- □□ = 10), but not by an alarm.</li> <li>• The digital operator displays text indicating a specific alarm and ALM indicator LED flashes.</li> </ul> <p>To reset the a minor fault or alarm, remove whatever is causing the problem.</p>
<b>Operation Errors</b>	<p>When parameter settings conflict with one another or do not match hardware settings (such as with an option card), it results in an operation error. When the drive detects an operation error:</p> <ul style="list-style-type: none"> <li>• The digital operator displays text that indicates the specific error.</li> <li>• Multi-function contact outputs do not operate.</li> </ul> <p>The drive will not operate the motor until the error has been reset. Correct the settings that caused the operation error to clear the error.</p>
<b>Tuning Errors</b>	<p>Tuning errors occur while performing Auto-Tuning. When the drive detects a tuning error:</p> <ul style="list-style-type: none"> <li>• The digital operator displays text indicating the specific error.</li> <li>• Multi-function contact outputs do not operate.</li> <li>• Motor coasts to stop.</li> </ul> <p>Remove the cause of the error and repeat the Auto-Tuning process.</p>
<b>Copy Function Errors</b>	<p>These are the types of errors that can occur when using the optional digital operator or the USB Copy Unit to copy, read, or verify parameter settings.</p> <ul style="list-style-type: none"> <li>• The digital operator displays text indicating the specific error.</li> <li>• Multi-function contact outputs do not operate.</li> </ul> <p>Pressing any key on the operator will clear the fault. Find out what is causing the problem (such as model incompatibility) and try again.</p>

## ? Alarm and Error Displays

### ? Faults

**Table 6.9** gives an overview of possible fault codes. As conditions such as overvoltage can trip both a fault and an alarm, it is important to distinguish between faults and alarms in order to find the right corrective action.

When the drive detects a fault, the ALM indicator LEDs lights and the fault code appears on the display. The drive fault contact MA-MB-MC will be triggered. If the ALM LED blinks and the code appearing on the operator screen is flashes, then an alarm has been detected. See *Minor Faults and Alarms on page 292* for a list of alarm codes.

**Table 6.9 Fault Displays**

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
boL	boL	Braking Transistor Overload Fault	296
bUS	bUS	Option Communication Error	296
CE	CE	MEMOBUS/Modbus Communication Error	296
CF	CF	Control Fault	296
CPF00, CPF01 <I>	CPF00, CPF01	Control Circuit Error	297
CPF02	CPF02	A/D Conversion Error	297
CPF03	CPF03	Control Board Connection Error	297
CPF06	CPF06	EEPROM Memory Data Error	297
CPF07, CPF08	CPF07, CPF08	Terminal Board Connection Error	297
CPF20, CPF21 <I>	CPF20, CPF21	Control Circuit Error	297
CPF22	CPF22	Hybrid IC Error	298
CPF23	CPF23	Control Board Connection Error	298
CPF24	CPF24	Drive Unit Signal Fault	298
CPF25	CPF25	Terminal Board Not Connected	298
CPF26 to CPF35	CPF26 to CPF35	Control Circuit Error	298
dEv	dEv	Excessive Speed Deviation (for Control Mode with PG)	298
dv1	dv1	Z Pulse Fall Detection	298
dv2	dv2	Z Pulse Noise Fault Detection	299
dv3	dv3	Inversion Detection	299
dv4	dv4	Inversion Prevention Detection	299
dv7	dv7	Initial Polarity Estimation Timeout	299
E5	E5	MECHATROLINK Watchdog Timer Error	299
EF0	EF0	Option Card External Fault	300

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
oFA12 to oFA17	oFA12 to oFA17	Option Card Connection Error (CN5-A)	303
oFA30 to oFA43	oFA30 to oFA43	Option Card Connection Error (CN5-A)	303
oFb00	oFb00	Option Card Connection Error (CN5-B)	303
oFb01	oFb01	Option Card Fault (CN5-B)	304
oFb02	oFb02	Option Card Fault (CN5-B)	304
oFb03, oFb11	oFb03, oFb11	Option Card Error (CN5-B)	304
oFb12 to oFb17	oFb12 to oFb17	Option Card Connection Error (CN5-B)	304
oFC00	oFC00	Option Card Connection Error (CN5-C)	304
oFC01	oFC01	Option Card Fault (CN5-C)	304
oFC02	oFC02	Option Card Fault (CN5-C)	304
oFC12 to oFC17	oFC12 to oFC17	Option Card Connection Error (CN5-C)	305
oH	oH	Heatsink Overheat	305
oH1	oH1	Heatsink Overheat	305
oH3	oH3	Motor Overheat 1 (PTC input)	305
oH4	oH4	Motor Overheat 2 (PTC input)	306
oL1	oL1	Motor Overload	306
oL2	oL2	Drive Overload	307
oL3	oL3	Overtorque Detection 1	307
oL4	oL4	Overtorque Detection 2	307
oPr	oPr	Operator Connection Fault	307
oS	oS	Overspeed	308
ov	ov	Overvoltage	308

### 6.3 Drive Alarms, Faults, and Errors

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
$EF1$ to $EF8$	EF1 to EF8	External Fault (input terminal S1 to S8)	<a href="#">300</a>
$Err$	Err	EEPROM Write Error	<a href="#">300</a>
$FAn$	FAn	Internal Fan Fault	<a href="#">300</a>
$FbH$	FbH	Excessive PID Feedback	<a href="#">301</a>
$FbL$	FbL	PID Feedback Loss	<a href="#">301</a>
$GF$	GF	Ground Fault	<a href="#">301</a>
$LF$	LF	Output Phase Loss	<a href="#">301</a>
$LF2$	LF2	Current Imbalance	<a href="#">302</a>
$LSo$	LSo	LSo Fault	<a href="#">302</a>
$nSE$	nSE	Node Setup Error	<a href="#">302</a>
$oC$	oC	Overcurrent	<a href="#">302</a>
$oFA00$	oFA00	Option Card Connection Error (CN5-A)	<a href="#">303</a>
$oFA01$	oFA01	Option Card Fault (CN5-A)	<a href="#">303</a>
$oFA03$ to $oFA06$	oFA03 to oFA06	Option Card Error (CN5-A)	<a href="#">303</a>
$oFA10$ , $oFA11$	oFA10, oFA11	Option Card Error (CN5-A)	<a href="#">303</a>

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
$PF$	PF	Input Phase Loss	<a href="#">309</a>
$PGo$	PGo	PG Disconnect (for Control Mode with PG)	<a href="#">309</a>
$PGoH$	PGoH	PG Hardware Fault	<a href="#">309</a>
$rF$	rF	Braking Resistor Fault	<a href="#">309</a>
$rH$	rH	Dynamic Braking Resistor	<a href="#">309</a>
$rr$	rr	Dynamic Braking Transistor	<a href="#">310</a>
$SC$	SC	Output Short-Circuit or IGBT Fault	<a href="#">310</a>
$SEr$	SEr	Too Many Speed Search Restarts	<a href="#">310</a>
$STo$	STo	Pull-Out Detection	<a href="#">310</a>
$SvE$	SvE	Zero-Servo Fault	<a href="#">310</a>
$UL3$	UL3	Undertorque Detection 1	<a href="#">311</a>
$UL4$	UL4	Undertorque Detection 2	<a href="#">311</a>
$Uv1$	Uv1	Undervoltage	<a href="#">311</a>
$Uv2$	Uv2	Control Power Supply Undervoltage	<a href="#">311</a>
$Uv3$	Uv3	Soft Charge Circuit Fault	<a href="#">312</a>
$voF$	voF	Output Voltage Detection Fault	<a href="#">312</a>
—	—	—	—

<1> Displays  $CPF00$  or  $CPF20$  if a control circuit error occurs while the drive is starting up.  
 Displays  $CPF01$  or  $CPF21$  if a control circuit error occurs mid-operation.

#### ? Minor Faults and Alarms

**Table 6.10** give an overview of possible alarm codes. As conditions such as overvoltage can trip both a fault and alarm, it is important to distinguish between faults and alarms in order to find the right corrective action.

If an alarm is detected, the ALM LED will blink and the alarm code display flashes. The majority of alarms will trigger a digital output programmed for alarm output (H2-□□ = 10). If the ALM LED lights without blinking, this means that a fault has been detected (not an alarm). Information on fault codes can be found in [Faults on page 291](#).

**Table 6.10 Minor Fault and Alarm Displays**

Digital Operator Display		Name	Minor Fault Output (H2-□□ = 10)	Page
LED Operator	LCD Operator			
$AEr$	AEr	Station Address Setting Error (CC-Link, MECHATROLINK)	YES	<a href="#">313</a>
$bb$	bb	Drive Baseblock	No output	<a href="#">313</a>
$boL$	boL	Braking Transistor Overload Fault	YES	<a href="#">313</a>
$bUS$	bUS	Option Card Communications Error	YES	<a href="#">313</a>
$CALL$	CALL	Serial Communication Transmission Error	YES	<a href="#">314</a>
$CE$	CE	MEMOBUS/Modbus Communication Error	YES	<a href="#">314</a>
$CrST$	CrST	Cannot Reset	YES	<a href="#">314</a>
$CyC$	CyC	MECHATROLINK Comm. Cycle Setting Error	YES	<a href="#">314</a>
$dEv$	dEv	Excessive Speed Deviation (for Control Mode with PG)	YES	<a href="#">315</a>

Digital Operator Display		Name	Minor Fault Output (H2-□□ = 10)	Page
LED Operator	LCD Operator			
<i>dnE</i>	dnE	Drive Disabled	YES	315
<i>E5</i>	E5	MECHATROLINK Watchdog Timer Error	YES	299
<i>EF</i>	EF	Run Command Input Error	YES	315
<i>EF0</i>	EF0	Option Card External Fault	YES	315
<i>EF1 to EF8</i>	EF1 to EF8	External Fault (input terminal S1 to S8)	YES	315
<i>FAn</i>	FAn	Internal Fan Fault	YES	316
<i>FbH</i>	FbH	Excessive PID Feedback	YES	316
<i>FbL</i>	FbL	PID Feedback Loss	YES	316
<i>Hbb</i>	Hbb	Safe Disable Signal Input	YES	316
<i>HbbF</i>	HbbF	Safe Disable Signal Input	YES	316
<i>HCA</i>	HCA	Current Alarm	YES	317
<i>LT-1</i>	LT-1	Cooling Fan Maintenance Time	No output <1>	317
<i>LT-2</i>	LT-2	Capacitor Maintenance Time	No output <1>	317
<i>LT-3</i>	LT-3	Soft Charge Bypass Relay Maintenance Time	No output <1>	317
<i>LT-4</i>	LT-4	IGBT Maintenance Time (50%)	No output <1>	317
<i>oH</i>	oH	Heatsink Overheat	YES	318
<i>oH2</i>	oH2	Drive Overheat	YES	318
<i>oH3</i>	oH3	Motor Overheat	YES	318
<i>oL3</i>	oL3	Overtorque 1	YES	318
<i>oL4</i>	oL4	Overtorque 2	YES	318
<i>oS</i>	oS	Overspeed	YES	319
<i>ov</i>	ov	Overvoltage	YES	319
<i>PASS</i>	PASS	MEMOBUS/Modbus Test Mode Complete	No output	319
<i>PF</i>	PF	Input Phase Loss	YES	319
<i>PGo</i>	PGo	PG Disconnect (for Control Mode with PG)	YES	320
<i>PGoH</i>	PGoH	PG Hardware Fault (when using PG-X3)	YES	320
<i>rUn</i>	rUn	During Run 2, Motor Switch Command Input	YES	320
<i>SE</i>	SE	MEMOBUS/Modbus Test Mode Fault	YES	320
<i>TrPC</i>	TrPC	IGBT Maintenance Time (90%)	YES	320
<i>UL3</i>	UL3	Undertorque 1	YES	320
<i>UL4</i>	UL4	Undertorque 2	YES	320
<i>Uv</i>	Uv	Undervoltage	YES <2>	321
<i>voF</i>	voF	Output Voltage Detection Fault	YES	321

&lt;1&gt; Output when H2-□□ = 2F.

&lt;2&gt; An alarm output will not be triggered when KEB is being performed.

## ? Operation Errors

Table 6.11 Operation Error Displays

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
$\alpha P E 0 1$	oPE01	Drive Unit Setting Error	<a href="#">322</a>
$\alpha P E 0 2$	oPE02	Parameter Setting Range Error	<a href="#">322</a>
$\alpha P E 0 3$	oPE03	Multi-Function Input Setting Error	<a href="#">322</a>
$\alpha P E 0 4$	oPE04	Terminal Board Mismatch Error	<a href="#">323</a>
$\alpha P E 0 5$	oPE05	Run Command Selection Error	<a href="#">323</a>
$\alpha P E 0 6$	oPE06	Control Method Selection Error	<a href="#">323</a>
$\alpha P E 0 7$	oPE07	Multi-Function Analog Input Selection Error	<a href="#">324</a>
$\alpha P E 0 8$	oPE08	Parameter Selection Error	<a href="#">324</a>

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
$\alpha P E 0 9$	oPE09	PID Control Selection Error	<a href="#">324</a>
$\alpha P E 1 0$	oPE10	V/f Data Setting Error	<a href="#">325</a>
$\alpha P E 1 1$	oPE11	Carrier Frequency Setting Error	<a href="#">325</a>
$\alpha P E 1 3$	oPE13	Pulse Train Monitor Selection Error	<a href="#">325</a>
$\alpha P E 1 4$	oPE14	Application Selection Error	<a href="#">325</a>
$\alpha P E 1 5$	oPE15	Torque Control Setting Error	<a href="#">325</a>
$\alpha P E 1 6$	oPE16	Energy Saving Constants Error	<a href="#">326</a>
$\alpha P E 1 8$	oPE18	Online Tuning Parameter Setting Error	<a href="#">326</a>

## ? Auto-Tuning Errors

Table 6.12 Auto-Tuning Error Displays

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
$E n d 1$	End1	Excessive V/f Setting	<a href="#">327</a>
$E n d 2$	End2	Motor Iron Core Saturation Coefficient Error	<a href="#">327</a>
$E n d 3$	End3	Rated Current Setting Alarm	<a href="#">327</a>
$E n d 4$	End4	Adjusted Slip Value Fell Below Lower Limit	<a href="#">327</a>
$E n d 5$	End5	Resistance Between Lines Error	<a href="#">327</a>
$E n d 6$	End6	Leakage Inductance Alarm	<a href="#">327</a>
$E n d 7$	End7	No-Load Current Alarm	<a href="#">328</a>
$E r - 0 1$	Er-01	Motor Data Error	<a href="#">328</a>
$E r - 0 2$	Er-02	Alarm	<a href="#">328</a>
$E r - 0 3$	Er-03	STOP button Input	<a href="#">328</a>
$E r - 0 4$	Er-04	Line-to-Line Resistance Error	<a href="#">328</a>
$E r - 0 5$	Er-05	No-Load Current Error	<a href="#">328</a>
$E r - 0 8$	Er-08	Rated Slip Error	<a href="#">329</a>

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
$E r - 0 9$	Er-09	Acceleration Error	<a href="#">329</a>
$E r - 1 0$	Er-10	Motor Direction Error	<a href="#">329</a>
$E r - 1 1$	Er-11	Motor Speed Error	<a href="#">329</a>
$E r - 1 2$	Er-12	Current Detection Error	<a href="#">329</a>
$E r - 1 3$	Er-13	Leakage Inductance Error	<a href="#">329</a>
$E r - 1 4$	Er-14	Motor Speed Error 2	<a href="#">330</a>
$E r - 1 5$	Er-15	Torque Saturation Error	<a href="#">330</a>
$E r - 1 6$	Er-16	Inertia ID Error	<a href="#">330</a>
$E r - 1 7$	Er-17	Reverse Prohibited Error	<a href="#">330</a>
$E r - 1 8$	Er-18	Induction Voltage Error	<a href="#">330</a>
$E r - 1 9$	Er-19	PM Inductance Error	<a href="#">330</a>
$E r - 2 0$	Er-20	Stator Resistance Error	<a href="#">330</a>
$E r - 2 1$	Er-21	Z Pulse Correction Error	<a href="#">330</a>

## ? Errors and Displays When Using the Copy Function

Table 6.13 Copy Errors

Digital Operator Display		Name	Page
LED Operator	LCD Operator		
<i>CoPY</i>	CoPy	Writing parameter settings (flashing)	<a href="#">331</a>
<i>CPEr</i>	CPeR	Control mode of the drive does not match	<a href="#">331</a>
<i>CPyE</i>	CPyE	Error writing data	<a href="#">331</a>
<i>CSEr</i>	CSEr	Error occurred in the copy function	<a href="#">331</a>
<i>dFPS</i>	dFPS	Drive models do not match.	<a href="#">331</a>
<i>End</i>	End	Task completed	<a href="#">331</a>
<i>iFEr</i>	iFEr	Communication error	<a href="#">331</a>
<i>ndAT</i>	ndAT	Model, voltage class, capacity, and/or control mode differ	<a href="#">332</a>
<i>rdEr</i>	rdEr	Error reading data	<a href="#">332</a>
<i>rEAd</i>	rEAd	Reading parameter settings (flashing)	<a href="#">332</a>
<i>vAEr</i>	vAEr	Voltage class and/or drive capacity does not match	<a href="#">332</a>
<i>vFyE</i>	vFyE	Parameter settings in the drive and those saved to the copy function are not the same	<a href="#">332</a>
<i>vrFy</i>	vrFy	Comparing parameter settings (flashing)	<a href="#">332</a>

## 6.4 Fault Detection

### ? Fault Displays, Causes, and Possible Solutions

Faults are detected for drive protection, and cause the drive to stop. When a fault occurs, the fault output terminal MA-MB-MC is triggered. Faults have to be cleared manually after removing the cause to start running the drive again.

**Table 6.14 Detailed Fault Displays, Causes, and Possible Solutions**

Digital Operator Display		Fault Name
boL	boL	Braking Transistor Overload Fault
		The braking transistor has reached its overload level.
Cause		Possible Solution
The wrong braking resistor is installed.		Select the optimal braking resistor.
Digital Operator Display		Fault Name
buS	bUS	Option Communication Error
		• After establishing initial communication, the connection was lost.
		• Only detected when the run command frequency reference is assigned to an option card.
Cause		Possible Solution
No signal received from the PLC.		• Check for faulty wiring.
Faulty communications wiring or a short circuit exists.		• Correct the wiring.
		• Check for disconnected cables and short circuits. Repair as needed.
A communications data error occurred due to noise.		• Check the various options available to minimize the effects of noise.
		• Take steps to counteract noise in the control circuit, main circuit, and ground wiring.
		• Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if necessary.
		• Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side.
		• Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive power supply input.
The option card is damaged.		Replace the option card if there are no problems with the wiring and the error continues to occur.
The option card is not properly connected to the drive.		• The connector pins on the option card are not properly lined up with the connector pins on the drive.
		• Reinstall the option card.
Digital Operator Display		Fault Name
CE	CE	MEMOBUS/Modbus Communication Error
		Control data was not received for the CE detection time set to H5-09.
Cause		Possible Solution
Faulty communications wiring or a short circuit exists.		• Check for faulty wiring.
		• Correct the wiring.
		• Check for disconnected cables and short circuits. Repair as needed.
Communication data error occurred due to noise.		• Check the various options available to minimize the effects of noise.
		• Take steps to counteract noise in the control circuit, main circuit, and ground wiring.
		• Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side.
		• Ensure that other equipment such as switches or relays do not cause noise and use surge suppressors if required.
		• Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive power supply input.
Digital Operator Display		Fault Name
CF	CF	Control Fault
		A torque limit was reached continuously for three seconds or longer while ramping to stop in Open Loop Vector Control.
Cause		Possible Solution
Motor parameters are not set properly.		Check the motor parameter settings and repeat Auto-Tuning.
Torque limit is too low.		Set the torque limit to the most appropriate setting (L7-01 through L7-04).
Load inertia is too big.		• Adjust the deceleration time (C1-02, -04, -06, -08).
		• Set the frequency to the minimum value and interrupt the Run command when the drive finishes decelerating.


Digital Operator Display		Fault Name
CPF00 or CPF01 <I>	CPF00 or CPF01	Control Circuit Error
Cause		Possible Solution
There is a self diagnostic error in control circuit.		<ul style="list-style-type: none"> <li>• Cycle power to the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
Connector on the operator is damaged.		<ul style="list-style-type: none"> <li>• Replace the operator.</li> </ul>
Digital Operator Display		Fault Name
CPF02	CPF02	A/D Conversion Error
		An A/D conversion error or control circuit error occurred.
Cause		Possible Solution
Control circuit is damaged.		<ul style="list-style-type: none"> <li>• Cycle power to the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
Digital Operator Display		Fault Name
CPF03	CPF03	Control Board Connection Error
		Connection error between the control board and the drive
Cause		Possible Solution
There is a connection error.		<ul style="list-style-type: none"> <li>• Turn the power off and check the connection between the control board and the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive.</li> </ul>
Drive fails to operate properly due to noise interference.		<ul style="list-style-type: none"> <li>• Check the various options available to minimize the effects of noise.</li> <li>• Take steps to counteract noise in the control circuit, main circuit, and ground wiring.</li> <li>• Use only recommended cables or other shielded line. Ground the shield on the controller side or on the drive input power side.</li> <li>• Ensure that other equipment such as switches or relays do not cause noise and use surge suppressors if required.</li> <li>• Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive power supply input.</li> </ul>
Digital Operator Display		Fault Name
CPF06	CPF06	EEPROM Memory Data Error
		There is an error in the data saved to EEPROM.
Cause		Possible Solution
There is an error in EEPROM control circuit.		<ul style="list-style-type: none"> <li>• Turn the power off and check the connection between the control board and the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
The power supply was switched off when parameters were being saved to the drive.		Reinitialize the drive (A1-03 = 2220 or 3330).
Digital Operator Display		Fault Name
CPF07	CPF07	Terminal Board Connection Error
CPF08	CPF08	
Cause		Possible Solution
There is a fault connection between the terminal board and control board.		<ul style="list-style-type: none"> <li>• Turn the power off and reconnect the control circuit terminal board.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
Digital Operator Display		Fault Name
CPF20 or CPF21 <I>	CPF20 and CPF21	Control Circuit Error
Cause		Possible Solution
Hardware is damaged.		<ul style="list-style-type: none"> <li>• Cycle power to the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>

## 6.4 Fault Detection

Digital Operator Display		Fault Name
$\overline{CPF22}$	CPF22	Powerboard Failure
Cause		Possible Solution
An A/D conversion error occurred in the power board circuit.		<ul style="list-style-type: none"> <li>• Cycle power to the drive. <i>Refer to Diagnosing and Resetting Faults on page 333.</i></li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
Digital Operator Display		Fault Name
$\overline{CPF23}$	CPF23	Control Board Connection Error
Cause		Connection error between the control board and the drive
Cause		Possible Solution
Hardware is damaged.		<ul style="list-style-type: none"> <li>• Turn the power off and check the connection between the control board and the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
Digital Operator Display		Fault Name
$\overline{CPF24}$	CPF24	Drive Unit Signal Fault
Cause		The drive capacity cannot be detected correctly (drive capacity is checked when the drive is powered up).
Cause		Possible Solution
Hardware is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Fault Name
$\overline{CPF25}$	CPF25	Terminal Board Not Connected
Cause		Terminal board is not connected properly.
Cause		Possible Solution
Terminal board is not connected properly.		Make sure the terminal board is properly connected to the drive, then switch the power on.
Digital Operator Display		Fault Name
$\overline{CPF26}$ to $\overline{CPF35}$	CPF26 to CPF35	Control Circuit Error
Cause		CPU error
Cause		Possible Solution
Hardware is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Fault Name
$\overline{dEv}$	dEv	Speed Deviation (for Control Mode with PG)
Cause		The deviation between the speed reference and speed feedback is greater than the setting in F1-10 for longer than the time set to F1-11.
Cause		Possible Solution
Load is too heavy.		Reduce the load.
Acceleration and deceleration times are set too short.		Increase the acceleration and deceleration times (C1-01 through C1-08).
The load is locked up.		Check the machine.
Parameters are not set appropriately.		Check the settings of parameters F1-10 and F1-11.
Incorrect speed feedback scaling if terminal RP is used as speed feedback input in V/f control.		<ul style="list-style-type: none"> <li>• Set H6-02 to the same value as the speed feedback signal frequency when the motor runs at maximum speed.</li> <li>• Adjust the speed feedback signal using parameters H6-03 through H6-05.</li> <li>• Make sure the speed feedback signal frequency does not exceed the maximum input frequency of terminal RP.</li> </ul>
Motor brake engaged.		Ensure the motor brake releases properly.
Digital Operator Display		Fault Name
$\overline{dv1}$	dv1	Z Pulse Fault
Cause		The motor turned one full rotation without the Z pulse being detected.
Cause		Possible Solution
PG encoder is not connected, not wired properly, or is damaged.		<ul style="list-style-type: none"> <li>• Make sure the PG encoder is properly connected and all shielded lines are properly grounded.</li> <li>• If the problem continues after cycling power, then replace either the PG option card or the PG encoder itself.</li> </ul>

Digital Operator Display		Fault Name
d <sub>u</sub> 2	dv2	Z Pulse Noise Fault Detection
		The Z pulse is out of phase by more than 5 degrees for the number of times specified in parameter F1-17.
Cause		Possible Solution
Noise interference along the PG cable.		Separate the PG cable lines from the source of the noise (very possibly drive output wiring).
PG cable is not wired properly.		Rewire the PG encoder and make sure all shielded lines are properly grounded.
PG option card or the PG encoder is damaged.		If the problem continues after cycling power, then replace either the PG option card or the PG encoder itself.
Digital Operator Display		Fault Name
d <sub>u</sub> 3	dv3	Inversion Detection
		The torque reference and acceleration are in opposite directions from one another (one is in reverse and the other is forward) while at the same time the speed reference and actual motor speed differ by over 30% for the number of pulses set to F1-18.
Cause		Possible Solution
The Z pulse offset is not set properly to E5-11.		Set the value for Δθ to E5-11 as specified on the motor nameplate. Replacing the PG encoder or changing the application so that the motor rotates in reverse instead requires readjustment of the Z pulse offset.
An external force on the load side has caused the motor to move.		<ul style="list-style-type: none"><li>• Make sure the motor is rotating in the right direction.</li><li>• Look for any problems on the load side that might be causing the motor to rotate in the opposite direction.</li></ul>
Noise interference along the PG cable affecting the A or B pulse.		Rewire the PG encoder and make sure all lines including shielded line are properly connected.
PG encoder is disconnected, not wired properly, or the PG option card or PG itself is damaged.		
Rotational direction for the PG encoder set to F1-05 is the opposite of the order of the motor lines.		Make sure motor lines for each phase (U, V, W) are connected properly.
Digital Operator Display		Fault Name
d <sub>u</sub> 4	dv4	Inversion Prevention Detection
		Pulses indicate that the motor is rotating in the opposite direction of the speed reference. Set the number of pulses to trigger inverse detection to F1-19. <b>Note:</b> Disable inverse detection in applications where the motor may rotate in the opposite direction of the speed reference. Setting F1-19 to 0 disables this feature.
Cause		Possible Solution
The Z pulse offset is not set properly to E5-11.		<ul style="list-style-type: none"><li>• Set the value for Δθ to E5-11 as specified on the motor nameplate.</li><li>• If the problem continues after cycling power, then replace either the PG option card or the PG encoder itself. Replacing the PG encoder or changing the application so that the motor rotates in reverse instead requires readjustment of the Z-pulse offset.</li></ul>
Noise interference along the PG cable affecting the A or B pulse.		<ul style="list-style-type: none"><li>• Make sure the motor is rotating in the correct direction.</li><li>• Look for any problems on the load side that might be causing the motor to rotate in the opposite direction.</li></ul>
PG encoder is disconnected, not wired properly, or the PG option card or PG itself is damaged.		<ul style="list-style-type: none"><li>• Rewire the PG encoder and make sure all lines including shielded line are properly connected.</li><li>• If the problem continues after cycling power, then replace either the PG option card or the PG encoder itself.</li></ul>
Digital Operator Display		Fault Name
d <sub>u</sub> 7	dv7	Initial Polarity Estimation Timeout
		Drive was unable to detect polarity within the specified time.
Cause		Possible Solution
Disconnection in the motor coil winding.		Measure the motor line-to-line resistance and replace the motor if the motor coil winding is disconnected.
Loose output terminals.		Check for loose terminals. Apply the tightening torque specified in the Technical manual or Quick Start Guide to fasten the terminals.
Digital Operator Display		Fault Name
E5	E5	MECHATROLINK Watchdog Timer Error
		The watchdog has timed out.
Cause		Possible Solution
Data has not been received from the PLC, triggering the watchdog timer.		Execute DISCONNECT or ALM_CLR, then issue a CONNECT command or SYNC_SET command and proceed to phase 3.

## 6.4 Fault Detection

Digital Operator Display		Fault Name
EF0	EF0	Option Card External Fault
		An external fault condition is present.
Cause		Possible Solution
An external fault was received from the PLC with other than F6-03 = 3 “alarm only” (the drive continued to run after external fault).		<ul style="list-style-type: none"><li>Remove the cause of the external fault.</li><li>Remove the external fault input from the PLC.</li></ul>
Problem with the PLC program.		Check the PLC program and correct problems.
Digital Operator Display		Fault Name
EF1	EF1	External Fault (input terminal S1)
		External fault at multi-function input terminal S1.
EF2	EF2	External Fault (input terminal S2)
		External fault at multi-function input terminal S2.
EF3	EF3	External Fault (input terminal S3)
		External fault at multi-function input terminal S3.
EF4	EF4	External Fault (input terminal S4)
		External fault at multi-function input terminal S4.
EF5	EF5	External Fault (input terminal S5)
		External fault at multi-function input terminal S5.
EF6	EF6	External Fault (input terminal S6)
		External fault at multi-function input terminal S6.
EF7	EF7	External Fault (input terminal S7)
		External fault at multi-function input terminal S7
EF8	EF8	External Fault (input terminal S8)
		External fault at multi-function input terminal S8
Cause		Possible Solution
An external device has tripped an alarm function.		Remove the cause of the external fault and reset the fault.
Wiring is incorrect.		<ul style="list-style-type: none"><li>Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-□□ = 20 to 2B).</li><li>Reconnect the signal line.</li></ul>
Incorrect setting of multi-function contact inputs.		<ul style="list-style-type: none"><li>Check if the any unused terminals are set for H1-□□ = 20 to 2B (External Fault).</li><li>Change the terminal settings.</li></ul>
Digital Operator Display		Fault Name
Err	Err	EEPROM Write Error
		Data cannot be written to the EEPROM.
Cause		Possible Solution
Noise has corrupted data while writing to the EEPROM.		<ul style="list-style-type: none"><li>Press the  button.</li><li>Correct the parameter setting.</li><li>Cycle power to the drive. <i>Refer to Diagnosing and Resetting Faults on page 333.</i></li><li>Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
Hardware problem.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Fault Name
FAn	FAn	Internal Fan Fault
		Fan or magnetic contactor failed.
Cause		Possible Solution
Internal cooling fan has malfunctioned (models 2A0360, 2A0415, 4A0362).		Cycle power to the drive and see if the fault is still present. Check if the fan is operating or not. Verify the cumulative operation time of the fan using monitor U4-03, and the fan maintenance timer in U4-04. If the cooling fan has passed its expected performance life or is damaged in some way, follow the instructions in this manual to replace it.
Fault detected in the internal cooling fan or magnetic contactor to the power supply (models 2A0250 to 2A0415, 4A0165).		Cycle power to the drive and see if the fault is still present. If the fault still occurs, either replace the control circuit board or the entire unit. For instructions on replacing the power board, contact the Yaskawa sales office directly or your nearest Yaskawa representative.

Digital Operator Display		Fault Name
FbH	FbH	Excessive PID Feedback
		PID feedback input is greater than the level set b5-36 for longer than the time set to b5-37. To enable fault detection, set b5-12 = 2 or 5.
Cause		Possible Solution
Parameters are not set appropriately.		Check the settings of parameters b5-36 and b5-37.
Wiring for PID feedback is incorrect.		Correct the wiring.
There is a problem with the feedback sensor.		<ul style="list-style-type: none"><li>• Check the sensor on the control side.</li><li>• Replace the sensor if damaged.</li></ul>
Digital Operator Display		Fault Name
FbL	FbL	PID Feedback Loss
		This fault occurs when PID feedback loss detection is programmed to trigger a fault (b5-12 = 2 or 5) and the PID feedback level is below the detection level set to b5-13 for longer than the time set to b5-14.
Cause		Possible Solution
Parameters are not set appropriately.		Check the settings of parameters b5-13 and b5-14.
Wiring for PID feedback is incorrect.		Correct the wiring.
There is a problem with the feedback sensor.		Check the sensor on the controller side. If damaged, replace the sensor.
Digital Operator Display		Fault Name
GF	GF	Ground Fault
		<ul style="list-style-type: none"><li>• A current short to ground exceeded 50% of rated current on the output side of the drive.</li><li>• Setting L8-09 to 1 enables ground fault detection.</li></ul>
Cause		Possible Solution
Motor insulation is damaged.		<ul style="list-style-type: none"><li>• Check the insulation resistance of the motor.</li><li>• Replace the motor.</li></ul>
A damaged motor cable is creating a short circuit.		<ul style="list-style-type: none"><li>• Check the motor cable.</li><li>• Remove the short circuit and turn the power back on.</li></ul>
The leakage current at the drive output is too high.		<ul style="list-style-type: none"><li>• Check the resistance between the cable and the ground terminal ⊕.</li><li>• Replace the cable.</li></ul>
The drive started to run during a current offset fault or while coasting to a stop.		<ul style="list-style-type: none"><li>• Reduce the carrier frequency.</li><li>• Reduce the amount of stray capacitance.</li></ul>
The drive started to run during a current offset fault or while coasting to a stop.		<ul style="list-style-type: none"><li>• The value set exceeds the allowable setting range while the drive automatically adjusts the current offset (this happens only when attempting to restart a PM motor that is coasting to stop).</li><li>• Enable Speed Search at start (b3-01 = 1).</li><li>• Perform Speed Search 1 or 2 (H1-□□ = 61 or 62) via one of the external terminals.</li></ul> <p><b>Note:</b> Speed Search 1 and 2 are the same when using PM OLV.</p>
Hardware problem.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Fault Name
LF	LF	Output Phase Loss
		<ul style="list-style-type: none"><li>• Phase loss on the output side of the drive.</li><li>• Phase Loss Detection is enabled when L8-07 is set to 1 or 2.</li></ul>
Cause		Possible Solution
The output cable is disconnected.		<ul style="list-style-type: none"><li>• Check for wiring errors and ensure the output cable is connected properly.</li><li>• Correct the wiring.</li></ul>
The motor winding is damaged.		<ul style="list-style-type: none"><li>• Check the resistance between motor lines.</li><li>• Replace the motor if the winding is damaged.</li></ul>
The output terminal is loose.		Apply the tightening torque specified in this manual to fasten the terminals. <i>Refer to Wire Size on page 64.</i>
The rated current of the motor being used is less than 5% of the drive rated current.		Check the drive and motor capacities.
An output transistor is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
A single-phase motor is being used.		The drive cannot operate a single phase motor.

## 6.4 Fault Detection

Digital Operator Display		Fault Name
LF2	LF2	Output current imbalance
		One or more of the phases in the output current is lost.
Cause		Possible Solution
Phase loss has occurred on the output side of the drive.		<ul style="list-style-type: none"><li>• Check for faulty wiring or poor connections on the output side of the drive.</li><li>• Correct the wiring.</li></ul>
Terminal wires on the output side of the drive are loose.		Apply the tightening torque specified in this manual to fasten the terminals. <i>Refer to Wire Size on page 64.</i>
The output circuit is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Motor impedance or motor phases are uneven.		<ul style="list-style-type: none"><li>• Measure the line-to-line resistance for each motor phase. Ensure all values are the same.</li><li>• Replace the motor.</li></ul>
Digital Operator Display		Fault Name
LS0	LS0	LSo Fault <>
		Pull-out was detected while operating at low speed.
Cause		Possible Solution
The incorrect motor code has been entered.		Enter the correct motor code for the PM motor being used into E5-01. For special-purpose motors, enter the correct data to all E5 parameters according to the test report provided for the motor.
The load is too heavy.		<ul style="list-style-type: none"><li>• Reduce the load.</li><li>• Replace the drive with a larger model.</li></ul>
The drive incorrectly detected the position of the motor poles.		<ul style="list-style-type: none"><li>• Make sure some external force is not rotating the motor at start.</li><li>• Enable Speed Search Selection at start. (b3-01 = 1)</li><li>• If the value displayed in U6-57 is lower than 819, then set the polarity judge current (n8-84) higher than the default value.</li></ul>
Values set to parameters L8-93, L8-94, and L8-95 are incorrect.		<ul style="list-style-type: none"><li>• Increase the value set to L8-93.</li><li>• Increase the value set to L8-94.</li><li>• Increase the value set to L8-95.</li></ul>
Digital Operator Display		Fault Name
nSE	nSE	Node Setup Error
Cause		Possible Solution
The node setup terminal closed during run.		Stop the drive when using the node setup function.
A run command was issued while the node setup function was active.		
Digital Operator Display		Fault Name
oC	oC	Overcurrent
		Drive sensors have detected an output current greater than the specified overcurrent level.
Cause		Possible Solution
The motor has been damaged due to overheating or the motor insulation is damaged.		<ul style="list-style-type: none"><li>• Check the insulation resistance.</li><li>• Replace the motor.</li></ul>
One of the motor cables has shorted out or there is a grounding problem.		<ul style="list-style-type: none"><li>• Check the motor cables.</li><li>• Remove the short circuit and power the drive back up.</li><li>• Check the resistance between the motor cables and the ground terminal ⊕.</li><li>• Replace damaged cables.</li></ul>
The load is too heavy.		<ul style="list-style-type: none"><li>• Measure the current flowing into the motor.</li><li>• Replace the drive with a larger capacity unit if the current value exceeds the rated current of the drive.</li><li>• Determine if there is sudden fluctuation in the current level.</li><li>• Reduce the load to avoid sudden changes in the current level or switch to a larger drive.</li></ul>
The acceleration or deceleration times are too short.		Calculate the torque needed during acceleration relative to the load inertia and the specified acceleration time. If the right amount of torque cannot be set, make the following changes: <ul style="list-style-type: none"><li>• Increase the acceleration time (C1-01, -03, -05, -07)</li><li>• Increase the S-curve characteristics (C2-01 through C2-04)</li><li>• Increase the capacity of the drive.</li></ul>
The drive is attempting to operate a specialized motor or a motor larger than the maximum size allowed.		<ul style="list-style-type: none"><li>• Check the motor capacity.</li><li>• Ensure that the rated capacity of the drive is greater than or equal to the capacity rating found on the motor nameplate.</li></ul>
Magnetic contactor (MC) on the output side of the drive has turned on or off.		Set up the operation sequence so that the MC is not tripped while the drive is outputting current.

V/f setting is not operating as expected.	<ul style="list-style-type: none"> <li>• Check the ratios between the voltage and frequency.</li> <li>• Set parameter E1-04 through E1-10 appropriately (E3-04 through E3-10 for motor 2).</li> <li>• Lower the voltage if it is too high relative to the frequency.</li> </ul>	
Excessive torque compensation.	<ul style="list-style-type: none"> <li>• Check the amount of torque compensation.</li> <li>• Reduce the torque compensation gain (C4-01) until there is no speed loss and less current.</li> </ul>	
Drive fails to operate properly due to noise interference.	<ul style="list-style-type: none"> <li>• Review the possible solutions provided for handling noise interference.</li> <li>• Review the section on handling noise interference and check the control circuit lines, main circuit lines, and ground wiring.</li> </ul>	
Overexcitation gain is set too high.	<ul style="list-style-type: none"> <li>• Check if fault occurs simultaneously to overexcitation function operation.</li> <li>• Consider motor flux saturation and reduce the value of n3-13 (Overexcitation Deceleration Gain).</li> </ul>	
Run command applied while motor was coasting.	<ul style="list-style-type: none"> <li>• Enable Speed Search at start (b3-01 = 1).</li> <li>• Program the Speed Search command input through one of the multi-function contact input terminals (H1-□□ = 61 or 62).</li> </ul>	
The wrong motor code has been entered for PM Open Loop Vector (Yaskawa motors only) or the motor data are wrong.	<ul style="list-style-type: none"> <li>• Enter the correct motor code to E5-01.</li> <li>• If a non-Yaskawa PM motor is used, enter "FFFF" to E5-01. Set the correct motor data to the E5-□□ parameters or perform Auto-Tuning.</li> </ul>	
The motor control method and motor do not match.	<ul style="list-style-type: none"> <li>• Check which motor control method the drive is set to (A1-02).</li> <li>• For IM motors, set A1-02 = "0", "1", "2", or "3".</li> <li>• For PM motors, set A1-02 = "5", "6" or "7".</li> </ul>	
The drives rated output current is too small.	Use a larger drive.	
Digital Operator Display		Fault Name
<i>oFR00</i>	oFA00	Option Card Connection Error at Option Port CN5-A
Cause		Possible Solution
The option card installed into port CN5-A is incompatible with the drive.		Check if the drive supports the option card that shall be installed. Contact Yaskawa for assistance.
A PG option card is connected to option port CN5-A		PG option cards are supported by option ports CN5-B and CN5-C only. Place the PG option card into the correct option port.
Digital Operator Display		Fault Name
<i>oFR01</i>	oFA01	Option Card Fault at Option Port CN5-A
Cause		Possible Solution
The option board connection to port CN5-A is faulty.		<ul style="list-style-type: none"> <li>• Turn the power off and reconnect the option card.</li> <li>• Check if the option card is properly plugged into the option port. Make sure the card is fixed properly.</li> <li>• If the option is not a communication option card, try to use the card in another option port. If it works there, replace the drive. If the error persists (oFb01 or oFC01 occur), replace the option board.</li> </ul>
Digital Operator Display		Fault Name
<i>oFR03</i> to <i>oFR06</i>	oFA03 to oFA06	Option card error occurred at option port CN5-A
<i>oFR10</i> , <i>oFR11</i>	oFA10, oFA11	
<i>oFR12</i> to <i>oFR17</i>	oFA12 to oFA17	Option Card Connection Error (CN5-A)
<i>oFR30</i> to <i>oFR43</i>	oFA30 to oFA43	Comm. Option Card Connection Error (CN5-A)
Cause		Possible Solution
Option card or hardware is damaged.		<ul style="list-style-type: none"> <li>• Cycle power to the drive.</li> <li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li> </ul>
Digital Operator Display		Fault Name
<i>oFb00</i>	oFb00	Option Card Fault at Option Port CN5-B
Cause		Possible Solution
The option card installed into port CN5-B is incompatible with the drive.		Check if the drive supports the option card that you are attempting to install. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-B.		Communication option cards are supported by option port CN5-A only. More than one comm. option cannot be installed.

## 6.4 Fault Detection

Digital Operator Display		Fault Name
oFb01	oFb01	Option Card Fault at Option Port CN5-B
		Option not properly connected
Cause		Possible Solution
The option board connection to port CN5-B is faulty.		<ul style="list-style-type: none"><li>• Turn the power off and reconnect the option card.</li><li>• Check if the option card is properly plugged into the option port. Make sure the card is fixed properly.</li><li>• Try to use the card in another option port (in case of a PG option use port CN5-C). If option card still doesn't work there, replace the drive. If the error persists (oFA01 or oFC01 occur), replace the option board.</li></ul>
Digital Operator Display		Fault Name
oFb02	oFb02	Option Card Fault at Option Port CN5-B
		Same type of option card already connected
Cause		Possible Solution
An option card of the same type is already installed in option port CN5-A.		Two ports cannot use the same type of option card. The exception is when PG option cards are used.
An input option card is already installed in option port CN5-A.		Make sure that a comm. option, a digital input option, or an analog input option is installed. Two ports cannot use the same type of option card.
Digital Operator Display		Fault Name
oFb03 to oFb11 oFb12 to oFb17	oFb03 to oFb11 oFb12 to oFb17	Option card error occurred at Option Port CN5-B
Cause		Possible Solution
Option card or hardware is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive.</li><li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
Digital Operator Display		Fault Name
oFC00	oFC00	Option Card Connection Error at Option Port CN5-C
		Option compatibility error
Cause		Possible Solution
The option card installed into port CN5-C is incompatible with the drive.		Check if the drive supports the option card you are attempting to instal. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-C.		Communication option cards are supported by option port CN5-A only. More than one comm. option cannot be installed.
Digital Operator Display		Fault Name
oFC01	oFC01	Option Card Fault at Option Port CN5-C
		Option not properly connected
Cause		Possible Solution
The option board connection to port CN5-C is faulty.		<ul style="list-style-type: none"><li>• Turn the power off and reconnect the option card.</li><li>• Check if the option card is properly plugged into the option port. Make sure the card is fixed properly.</li><li>• Try to use the card in another option port (in case of a PG option use port CN5-B). If it works there, replace the drive. If the error persists (oFA01 or oFb01 occur), replace the option board.</li></ul>
Digital Operator Display		Fault Name
oFC02	oFC02	Option Card Fault at Option Port CN5-C
		Same type of option card already connected
Cause		Possible Solution
An option card of the same type is already installed in option port CN5-A or CN5-B.		Two ports cannot use the same type of option card. The exception is when PG option cards are used.
An input option card is already installed in option port CN5-A or CN5-B.		Make sure that a comm. option, a digital input option, or an analog input option is installed. Two ports cannot use the same type of option card.
Three PG option cards are installed.		A single PG option card can be connected to CN5-B and to CN5-C. Remove any PG option card from CN5-A.

Digital Operator Display		Fault Name
oFC03 to oFC11	oFC03 to oFC11	Option card error occurred at option port CN5-C
oFC12 to oFC17	oFC12 to oFC17	
Cause		Possible Solution
Option card or hardware is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive.</li><li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
Digital Operator Display		Fault Name
oH	oH	Heatsink Overheat
		The temperature of the heatsink exceeded the overheat pre-alarm level set to L8-02. Default value for L8-02 is determined by drive capacity (o2-04).
Cause		Possible Solution
Surrounding temperature is too high.		<ul style="list-style-type: none"><li>• Check the temperature surrounding the drive. Verify temperature is within drive specifications.</li><li>• Improve the air circulation within the enclosure panel.</li><li>• Install a fan or air conditioner to cool the surrounding area.</li><li>• Remove anything near the drive that might be producing excessive heat.</li></ul>
Load is too heavy.		<ul style="list-style-type: none"><li>• Measure the output current.</li><li>• Decrease the load.</li><li>• Lower the carrier frequency (C6-02).</li></ul>
Internal cooling fan is stopped.		<ul style="list-style-type: none"><li>• Replace the cooling fan. <i>Refer to Cooling Fan Component Names on page 353.</i></li><li>• After replacing the drive, reset the cooling fan maintenance parameter (o4-03 = 0).</li></ul>
Digital Operator Display		Fault Name
oH1	oH1	Overheat 1 (Heatsink Overheat)
		The temperature of the heatsink exceeded the drive overheat level. The overheat level is determined by drive capacity (o2-04).
Cause		Possible Solution
Surrounding temperature is too high.		<ul style="list-style-type: none"><li>• Check the temperature surrounding the drive.</li><li>• Improve the air circulation within the enclosure panel.</li><li>• Install a fan or air conditioner to cool the surrounding area.</li><li>• Remove anything near the drive that might be producing excessive heat.</li></ul>
Load is too heavy.		<ul style="list-style-type: none"><li>• Measure the output current.</li><li>• Lower the carrier frequency (C6-02).</li><li>• Reduce the load.</li></ul>
Internal cooling fan is stopped.		<ul style="list-style-type: none"><li>• Replace the cooling fan. <i>Refer to Cooling Fan Component Names on page 353.</i></li><li>• After replacing the drive, reset the cooling fan maintenance parameter (o4-03 = 0).</li></ul>
Digital Operator Display		Fault Name
oH3	oH3	Motor Overheat Alarm (PTC Input)
		<ul style="list-style-type: none"><li>• The motor overheat signal to analog input terminal A1, A2, or A3 exceeded the alarm detection level.</li><li>• Detection requires multi-function analog input H3-02, H3-06, or H3-10 be set to “E”.</li></ul>
		Possible Solution
Motor has overheated		<ul style="list-style-type: none"><li>• Check the size of the load, the accel/decel times, and the cycle times.</li><li>• Decrease the load.</li><li>• Increase the acceleration and deceleration times (C1-01 through C1-08).</li><li>• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10.</li><li>• Be careful not to lower E1-08 and E1-10 too much, as this reduces load tolerance at low speeds.</li><li>• Check the motor rated current.</li><li>• Enter the motor rated current as indicated on the motor nameplate (E2-01).</li><li>• Ensure the motor cooling system is operating normally.</li><li>• Repair or replace the motor cooling system.</li></ul>

## 6.4 Fault Detection

Digital Operator Display		Fault Name
oH4	oH4	Motor Overheat Fault (PTC Input)
		<ul style="list-style-type: none"><li>• The motor overheat signal to analog input terminal A1, A2, or A3 exceeded the fault detection level.</li><li>• Detection requires that multi-function analog input H3-02, H3-06, or H3-10 = “E”.</li></ul>
Cause		Possible Solution
Motor has overheated.		<ul style="list-style-type: none"><li>• Check the size of the load, the accel/decel times, and the cycle times.</li><li>• Decrease the load.</li><li>• Increase the acceleration and deceleration times (C1-01 through C1-08).</li></ul>
		<ul style="list-style-type: none"><li>• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. Be careful not to lower E1-08 and E1-10 too much because this reduces load tolerance at low speeds.</li></ul>
		<ul style="list-style-type: none"><li>• Check the motor rated current.</li><li>• Enter the motor rated current as indicated on the motor nameplate (E2-01).</li><li>• Ensure the motor cooling system is operating normally.</li><li>• Repair or replace the motor cooling system.</li></ul>
Digital Operator Display		Fault Name
oL1	oL1	Motor Overload
		The electronic motor overload protection tripped.
Cause		Possible Solution
Load is too heavy.		Reduce the load.
Cycle times are too short during acceleration and deceleration.		Increase the acceleration and deceleration times (C1-01 through C1-08).
A general purpose motor is driven below the rated speed with too high load.		<ul style="list-style-type: none"><li>• Reduce the load.</li><li>• Increase the speed.</li><li>• If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.</li></ul>
The output voltage is too high.		Adjust the user-set V/f patterns (E1-04 through E1-10). Parameters E1-08 and E1-10 may need to be reduced. Be careful not to lower E1-08 and E1-10 too much because this reduces load tolerance at low speeds.
The wrong motor rated current is set to E2-01.		<ul style="list-style-type: none"><li>• Check the motor-rated current.</li><li>• Enter the value written on the motor nameplate to parameter E2-01.</li></ul>
The base frequency is set incorrectly.		<ul style="list-style-type: none"><li>• Check the rated frequency indicated on the motor nameplate.</li><li>• Enter the rated frequency to E1-06 (Base Frequency).</li></ul>
Multiple motors are running off the same drive.		Disable the motor protection function (L1-01 = 0) and install a thermal relay to each motor.
The electrical thermal protection characteristics and motor overload characteristics do not match.		<ul style="list-style-type: none"><li>• Check the motor characteristics.</li><li>• Correct the type of motor protection that has been selected (L1-01).</li><li>• Install an external thermal relay.</li></ul>
The electrical thermal relay is operating at the wrong level.		<ul style="list-style-type: none"><li>• Check the current rating listed on the motor nameplate.</li><li>• Check the value set for the motor rated current (E2-01).</li></ul>
Motor overheated by overexcitation operation.		<ul style="list-style-type: none"><li>• Overexcitation increases the motor losses and the motor temperature. If applied too long, motor damage can occur. Prevent excessive overexcitation operation or apply proper cooling to the motor.</li><li>• Reduce the excitation deceleration gain (n3-13).</li><li>• Set L3-04 (Stall Prevention during Deceleration) to a value other than 4.</li></ul>
Speed Search related parameters are set incorrectly.		<ul style="list-style-type: none"><li>• Check values set to Speed Search related parameters.</li><li>• Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively).</li><li>• After Auto-Tuning, enable Speed Estimation Speed Search (b3-24 = 1).</li></ul>
Output current fluctuation due to input phase loss		Check the power supply for phase loss.

Digital Operator Display		Fault Name
oL2	oL2	Drive Overload
		The thermal sensor of the drive triggered overload protection.
Cause		Possible Solution
Load is too heavy.		Reduce the load.
Acceleration or deceleration times are too short.		Increase the settings for the acceleration and deceleration times (C1-01 through C1-08).
The output voltage is too high.		<ul style="list-style-type: none"><li>Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10.</li><li>Be careful not to lower E1-08 and E1-10 excessively because this reduces load tolerance at low speeds.</li></ul>
Drive capacity is too small.		Replace the drive with a larger model.
Overload occurred when operating at low speeds.		<ul style="list-style-type: none"><li>Reduce the load when operating at low speeds.</li><li>Replace the drive with a model that is one frame size larger.</li><li>Lower the carrier frequency (C6-02).</li></ul>
Excessive torque compensation.		Reduce the torque compensation gain (C4-01) until there is no speed loss but less current.
Speed Search related parameters are set incorrectly.		<ul style="list-style-type: none"><li>Check the settings for all Speed Search related parameters.</li><li>Adjust the current used during Speed Search and the Speed Search deceleration time (b3-03 and b3-02 respectively).</li><li>After Auto-Tuning the drive, enable the Speed Estimation Speed Search (b3-24 = 1).</li></ul>
Output current fluctuation due to input phase loss		Check the power supply for phase loss.
Digital Operator Display		Fault Name
oL3	oL3	Overtorque Detection 1
		The current has exceeded the value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause		Possible Solution
Parameter settings are not appropriate for the load.		Check the settings of parameters L6-02 and L6-03.
Fault on the machine side (e.g., machine is locked up).		Check the status of the load. Remove the cause of the fault.
Digital Operator Display		Fault Name
oL4	oL4	Overtorque Detection 2
		The current has exceeded the value set for Overtorque Detection 2 (L6-05) for longer than the allowable time (L6-06).
Cause		Possible Solution
Parameter settings are not appropriate for the load.		Check the settings of parameters L6-05 and L6-06.
Digital Operator Display		Fault Name
oPr	oPr	External Digital Operator Connection Fault
		<ul style="list-style-type: none"><li>The external operator has been disconnected from the drive.</li></ul> <b>Note:</b> An oPr fault will occur when all of the following conditions are true:
		<ul style="list-style-type: none"><li>Output is interrupted when the operator is disconnected (o2-06 = 1).</li><li>The Run command is assigned to the operator (b1-02 = 0 and LOCAL has been selected).</li></ul>
Cause		Possible Solution
External operator is not properly connected to the drive.		<ul style="list-style-type: none"><li>Check the connection between the operator and the drive.</li><li>Replace the cable if damaged.</li><li>Turn off the drive input power and disconnect the operator. Next reconnect the operator and turn the drive input power back on.</li></ul>

## 6.4 Fault Detection

Digital Operator Display		Fault Name
o5	oS	Overspeed
		The motor speed feedback exceeded the F1-08 setting.
Cause		Possible Solution
Overshoot is occurring.		<ul style="list-style-type: none"><li>Reduce the settings for C5-01 (Speed Control Proportional Gain 1) and increase C5-02 (Speed Control Integral Time 1).</li><li>If using a Closed Loop Vector mode, enable Feed Forward and perform Inertia Auto-Tuning.</li></ul>
Incorrect speed feedback scaling if terminal RP is used as speed feedback input in V/f control.		<ul style="list-style-type: none"><li>Set H6-02 to the value of the speed feedback signal frequency when the motor runs at the maximum speed.</li><li>Adjust the input signal using parameters H6-03 through H6-05.</li></ul>
Incorrect number of PG pulses has been set.		<ul style="list-style-type: none"><li>Check and correct parameter F1-01.</li></ul>
Inappropriate parameter settings.		Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).
Digital Operator Display		Fault Name
ou	ov	Overvoltage
		Voltage in the DC bus has exceeded the overvoltage detection level. <ul style="list-style-type: none"><li>For 200 V class: approximately 410 V</li><li>For 400 V class: approximately 820 V</li></ul>
Cause		Possible Solution
Deceleration time is too short and regenerative energy is flowing from the motor into the drive.		<ul style="list-style-type: none"><li>Increase the deceleration time (C1-02, C1-04, C1-06, C1-08).</li><li>Install a braking resistor or a dynamic braking resistor unit.</li><li>Enable stall prevention during deceleration (L3-04 = 1). Stall Prevention is enabled as the default setting.</li></ul>
Fast acceleration time causes the motor to overshoot the speed reference.		<ul style="list-style-type: none"><li>Check if sudden drive acceleration triggers an overvoltage alarm.</li><li>Increase the acceleration time.</li><li>Use longer S-curve acceleration and deceleration times.</li><li>Enable the Overvoltage Suppression function (L3-11 = 1).</li><li>Lengthen the S-curve at acceleration end.</li></ul>
Excessive braking load.		The braking torque was too high, causing regenerative energy to charge the DC bus. Reduce the braking torque, use a braking option, or lengthen decel time.
Surge voltage entering from the drive input power.		Install a DC reactor. <b>Note:</b> Voltage surge can result from a thyristor convertor and phase advancing capacitor using the same input power supply.
Ground fault in the output circuit causing the DC bus capacitor to overcharge.		<ul style="list-style-type: none"><li>Check the motor wiring for ground faults.</li><li>Correct grounding shorts and turn the power back on.</li></ul>
Improper Setting of Speed Search related parameters. (Includes Speed Search after a momentary power loss and after a fault restart.)		<ul style="list-style-type: none"><li>Check the settings for Speed Search-related parameters.</li><li>Enable Speed Search restart function (b3-19 greater than or equal to 1 to 10).</li><li>Adjust the current level during Speed Search and the deceleration time (b3-02 and b3-03 respectively).</li><li>Perform Stationary Auto-Tuning for line-to-line resistance and then enable Speed Estimation Speed Search (b3-24 = 1).</li></ul>
Drive input power voltage is too high.		<ul style="list-style-type: none"><li>Check the voltage.</li><li>Lower drive input power voltage within the limits listed in the specifications.</li></ul>
The braking transistor is wired incorrectly.		<ul style="list-style-type: none"><li>Check braking transistor wiring for errors.</li><li>Properly rewire the braking resistor device.</li></ul>
PG cable is disconnected.		Reconnect the cable.
PG cable wiring is wrong.		Correct the wiring.
Noise interference along the PG encoder wiring.		Separate the wiring from the source of the noise (often the output lines from the drive).
Drive fails to operate properly due to noise interference.		<ul style="list-style-type: none"><li>Review the list of possible solutions provided for controlling noise.</li><li>Review the section on handling noise interference and check the control circuit lines, main circuit lines, and ground wiring.</li></ul>
Load inertia has been set incorrectly.		<ul style="list-style-type: none"><li>Check the load inertia settings when using KEB, overvoltage suppression, or Stall Prevention during deceleration.</li><li>Adjust the load inertia ratio in S6-03 to better match the load.</li></ul>
Braking function is being used in OLV/PM.		Connect a braking resistor.
Motor hunting occurs.		<ul style="list-style-type: none"><li>Adjust the parameters that control hunting.</li><li>Set the gain for Hunting Prevention (n1-02).</li><li>Adjust the AFR time constant 1, 2 (n2-02 and n2-03).</li><li>Adjust the speed feedback detection suppression gain for PM motors (n8-45) and the time constant for pull-in current (n8-47).</li></ul>

Digital Operator Display		Fault Name
$P\bar{F}$	PF	Input Phase Loss
		Drive input power has an open phase or has a large imbalance of voltage between phases. Detected when L8-05 = 1 or 4 (enabled).
Cause		Possible Solution
There is phase loss in the drive input power while the drive is running.		<ul style="list-style-type: none"><li>• Check for wiring errors in the main circuit drive input power.</li><li>• Correct the wiring.</li></ul>
A Run command is entered while an alarm PF has been triggered.		Remove the cause of the fault.
There is loose wiring in the drive input power terminals.		<ul style="list-style-type: none"><li>• Ensure the terminals are tightened properly.</li><li>• Apply the tightening torque as specified in this manual. <i>Refer to Wire Gauges and Tightening Torque on page 55</i></li></ul>
There is excessive fluctuation in the drive input power voltage.		<ul style="list-style-type: none"><li>• Check the voltage from the drive input power.</li><li>• Review the possible solutions for stabilizing the drive input power.</li></ul>
There is poor balance between voltage phases.		<ul style="list-style-type: none"><li>• Stabilize drive input power or disable phase loss detection.</li></ul>
The main circuit capacitors are worn.		<ul style="list-style-type: none"><li>• Check the maintenance time for the capacitors (U4-05).</li><li>• Replace the capacitor if U4-05 is greater than 90%. For instructions on replacing the capacitor, contact Yaskawa or your nearest sales representative.</li></ul>
		Check for anything problems with the drive input power. If drive input power appears normal but the alarm continues to occur, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Fault Name
$P\bar{G}\bar{O}$	PGO	PG Disconnect (for any control modes using a PG option card)
		No PG pulses are received for longer than the time set to F1-14.
Cause		Possible Solution
PG cable is disconnected.		Reconnect the cable.
PG cable wiring is wrong.		Correct the wiring.
PG has no power.		Check the power line to the PG encoder.
PG encoder brake is clamped shut.		Ensure the motor brake releases properly.
Digital Operator Display		Fault Name
$P\bar{G}\bar{O}H$	PGoH	PG Hardware Fault
		PG cable is not connected properly.
Cause		Possible Solution
PG cable is disconnected.		Reconnect the cable.
Digital Operator Display		Fault Name
$r\bar{F}$	rF	Braking Resistor Fault
		The resistance of the braking resistor being used is too low.
Cause		Possible Solution
The proper braking resistor option has not been installed.		Select the braking resistor option so that fits to the drives braking transistor specification.
Regenerative converter, regenerative unit, or braking unit is being used.		Disable the braking transistor protection selection (set L8-55 to 1).
Digital Operator Display		Fault Name
$r\bar{H}$	rH	Braking Resistor Overheat
		Braking resistor protection was triggered.
		Fault detection is enabled when L8-01 = 1 (disabled as a default).
Cause		Possible Solution
Deceleration time is too short and excessive regenerative energy is flowing back into the drive.		<ul style="list-style-type: none"><li>• Check the load, deceleration time, and speed.</li><li>• Reduce the load inertia.</li><li>• Increase the deceleration times (C1-02, C1-04, C1-06, C1-08, C1-09).</li><li>• Replace the braking option with a larger device that can handle the power that is discharged.</li></ul>
Excessive braking inertia.		Recalculate braking load and braking power. Reduce the braking load by adjusting braking resistor settings.
The braking operation duty cycle is too high.		Check the braking operation duty cycle. Braking resistor protection for ERF-type braking resistors (L8-01 = 1) allows a braking duty cycle of maximum 3%.
The proper braking resistor has not been installed.		<ul style="list-style-type: none"><li>• Check the specifications and conditions for the braking resistor device.</li><li>• Select the optimal braking resistor.</li></ul>
<b>Note:</b> The magnitude of the braking load trips the braking resistor overheat alarm, NOT the surface temperature. Using the braking resistor more frequently than it is rated for trips the alarm even when the braking resistor surface is not very hot.		

## 6.4 Fault Detection

Digital Operator Display		Fault Name
rr	rr	Dynamic Braking Transistor
		The built-in dynamic braking transistor failed.
Cause		Possible Solution
The braking transistor is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive and check if the fault reoccurs. <i>Refer to Diagnosing and Resetting Faults on page 333.</i></li><li>• Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
The control circuit is damaged.		
Digital Operator Display		Fault Name
SC	SC	Output Short-Circuit or IGBT Fault
		The drive has detected an output short, a grounding fault, or an IGBT malfunction.
Cause		Possible Solution
Motor has been damaged from overheat or the motor insulation has been weakened.		Check the motor insulation resistance and replace the motor if continuity is detected.
The cable is damaged and is coming into contact with something causing a short-circuit.		Check the motor power cable and repair any short-circuits.
Hardware fault		A short-circuit or grounding fault on the drive output side has damaged the output transistors. Make sure drive output is not shorted as follows: B1 $\longleftrightarrow$ U, V, W $\ominus \longleftrightarrow$ U, V, W The above short-circuit will damage the output transistors. Contact your Yaskawa representative or our sales offices for assistance.
Digital Operator Display		Fault Name
SEr	SEr	Too Many Speed Search Restarts
		The number of Speed Search restarts exceeded the number set to b3-19.
Cause		Possible Solution
Speed Search parameters are set to the wrong values.		<ul style="list-style-type: none"><li>• Reduce the detection compensation gain during Speed Search (b3-10).</li><li>• Increase the current level when attempting Speed Search (b3-17).</li><li>• Increase the detection time during Speed Search (b3-18).</li><li>• Repeat Auto-Tuning.</li></ul>
The motor is coasting in the opposite direction of the Run command.		Enable Bi-Directional Speed Search (b3-14 = 1).
Digital Operator Display		Fault Name
STo	STo	Motor Pull Out or Step Out Detection
		Motor pull out or step out has occurred. Motor has exceeded its pull-out torque.
Cause		Possible Solution
The wrong motor code is set (Yaskawa motors only).		<ul style="list-style-type: none"><li>• Enter the correct motor code for the PM being used into E5-01.</li><li>• For special-purpose motors, enter the correct data to all E5 parameters according to the test report provided for the motor.</li></ul>
Load is too heavy.		<ul style="list-style-type: none"><li>• Increase the load inertia for PM motor (n8-55).</li><li>• Increase the pull-in current during accel/decel (n8-51).</li><li>• Reduce the load.</li><li>• Increase the motor or drive capacity.</li></ul>
Load inertia is too heavy.		Increase the load inertia for PM motor (n8-55).
Acceleration and deceleration times are too short.		<ul style="list-style-type: none"><li>• Increase the acceleration and deceleration times (C1-01 through C1-08).</li><li>• Increase the S-curve acceleration and deceleration times (C2-01).</li></ul>
Speed response is too slow.		Increase the load inertia for PM motor (n8-55).
Digital Operator Display		Fault Name
SvE	SvE	Zero Servo Fault
		Position deviation during zero servo.
Cause		Possible Solution
Torque limit is set too low.		Set the torque limit to an appropriate value using parameters L7-01 to L7-04.
Excessive load torque.		Reduce the amount of load torque.
Noise interference along PG encoder wiring.		Check the PG signal for noise interference.

Digital Operator Display		Fault Name
UL3	UL3	Undertorque Detection 1
		The current has fallen below the minimum value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause		Possible Solution
Parameter settings are not appropriate for the load.		Check the settings of parameters L6-02 and L6-03.
There is a fault on the machine side.		Check the load for any problems.
Digital Operator Display		Fault Name
UL4	UL4	Undertorque Detection 2
		The current has fallen below the minimum value set for torque detection (L6-05) for longer than the allowable time (L6-06).
Cause		Possible Solution
Parameter settings are not appropriate for the load.		Check the settings of parameters L6-05 and L6-06.
There is a fault on the machine side.		Check the load for any problems.
Digital Operator Display		Fault Name
Uv1	Uv1	DC Bus Undervoltage
		One of the following conditions occurred while the drive was running: <ul style="list-style-type: none"><li>• Voltage in the DC bus fell below the undervoltage detection level (L2-05)</li><li>• For 200 V class: approximately 190 V</li><li>• For 400 V class: approximately 380 V (350 V when E1-01 is less than 400) In normal operation, the fault is output only if L2-01 = 0 or L2-01 = 1 and the DC bus voltage has fallen below the level set to L2-05 for longer than the time set to L2-02. During KEB deceleration, a fault is output when the DC bus voltage falls below 300 Vdc.</li></ul>
Cause		Possible Solution
Input power phase loss.		<ul style="list-style-type: none"><li>• The main circuit drive input power is wired incorrectly.</li><li>• Correct the wiring.</li></ul>
One of the drive input power wiring terminals is loose.		<ul style="list-style-type: none"><li>• Ensure there are no loose terminals.</li><li>• Apply the tightening torque specified in this manual to fasten the terminals. <i>Refer to Wire Gauges and Tightening Torque on page 55</i></li></ul>
There is a problem with the voltage from the drive input power.		<ul style="list-style-type: none"><li>• Check the voltage.</li><li>• Correct the voltage to be within the range listed in drive input power specifications.</li><li>• If there is no problem with the power supply to the main circuit, check for problems with the main circuit magnetic contactor.</li></ul>
The power has been interrupted.		Correct the drive input power.
The main circuit capacitors are worn.		<ul style="list-style-type: none"><li>• Check the maintenance time for the capacitors (U4-05).</li><li>• Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
The relay or contactor on the soft-charge bypass circuit is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive and see if the fault reoccurs.</li><li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li><li>• Check monitor U4-06 for the performance life of the soft-charge bypass.</li><li>• Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
KEB deceleration was not successful.		Check the settings in parameter groups S4, S5 and S6.
Digital Operator Display		Fault Name
Uv2	Uv2	Control Power Supply Voltage Fault
		Voltage is too low for the control drive input power.
Cause		Possible Solution
L2-02 was changed from its default value without installing a Momentary Power Loss Ride-Thru unit in models CIMR-T□2A0004 to 2A0056 and CIMR-T□4A0002 to 4A0031.		Correct the setting to L2-02 or install an optional Momentary Power Loss Ride-Thru unit.
Control power supply wiring is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive. Check if the fault reoccurs.</li><li>• If the problem continues, replace the control board, the entire drive, or the control power supply.</li></ul>
Internal circuitry is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive. Check if the fault reoccurs.</li><li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>

## 6.4 Fault Detection

Digital Operator Display		Fault Name
Uv3	Uv3	Undervoltage 3 (Soft-Charge Bypass Circuit Fault)
		The soft-charge bypass circuit has failed.
Cause		Possible Solution
The relay or contactor on the soft-charge bypass circuit is damaged.		<ul style="list-style-type: none"><li>• Cycle power to the drive and see if the fault reoccurs.</li><li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li><li>• Check monitor U4-06 for the performance life of the soft-charge bypass.</li><li>• Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
Digital Operator Display		Fault Name
voF	voF	Output Voltage Detection Fault
		Problem detected with the voltage on the output side of the drive.
Cause		Possible Solution
Hardware is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

<1> Displays  $\overline{PPF00}$  or  $\overline{PPF20}$  if a control circuit error occurs while the drive is starting up.

Displays  $\overline{PPF01}$  or  $\overline{PPF21}$  if a control circuit error occurs mid-operation.

<2> This function prevents continuous operation in reverse when using high frequency injection (n8-57 = 1) in the Advanced Open Loop Vector Control mode for PM motors (A1-02 = 6) with a motor for which no motor code has been entered (it does not simply prevent reverse operation). To quickly detect undesirable reverse operation, set L8-93, L8-94, and L8-95 to low values within range of erroneous detection.

## 6.5 Alarm Detection

### ? Alarm Codes, Causes, and Possible Solutions

Alarms are drive protection functions that do not necessarily cause the drive to stop. Once the cause of an alarm is removed, the drive will return to the same status it was before the alarm occurred.

When an alarm has been triggered, the ALM light on the digital operator display blinks and the alarm code display flashes. If a multi-function output is set for an alarm (H2-□□ = 10), that output terminal will be triggered.

**Note:** If a multi-function output is set to close when an alarm occurs (H2-□□ = 10), it will also close when maintenance periods are reached, triggering alarms LT-1 through LT-4 (triggered only if H2-□□ = 2F).

**Table 6.15 Alarm Codes, Causes, and Possible Solutions**

Digital Operator Display		Minor Fault Name
REr	AEr	Station Address Setting Error (CC-Link, MECHATROLINK)
		Option card node address is outside the acceptable setting range.
Cause		Possible Solutions
Station number is set outside the possible setting range.		<ul style="list-style-type: none"><li>Set parameter F6-10 to the proper value if a CC-Link option card is used.</li><li>Set parameter F6-20 to the proper value if a MECHATROLINK option card is used.</li></ul>
Digital Operator Display		Minor Fault Name
bb	bb	Baseblock
		Drive output interrupted as indicated by an external baseblock signal.
Cause		Possible Solutions
External baseblock signal was entered via one of the multi-function input terminals (S1 to S8).		Check external sequence and baseblock signal input timing.
Digital Operator Display		Minor Fault Name
boL	boL	Braking Transistor Overload Fault
		The braking transistor in the drive has been overloaded.
Cause		Possible Solutions
The proper braking resistor has not been installed.		Select the optimal braking resistor.
Digital Operator Display		Minor Fault Name
bUS	bUS	Option Communication Error
		<ul style="list-style-type: none"><li>After initial communication was established, the connection was lost.</li><li>Assign a Run command frequency reference to the option card.</li></ul>
Cause		Possible Solutions
Connection is broken or master controller stopped communicating.		<ul style="list-style-type: none"><li>Check for faulty wiring.</li><li>Correct the wiring.</li><li>Check for disconnected cables and short circuits. Repair as needed.</li></ul>
Option card is damaged.		If there are no problems with the wiring and the fault continues to occur, replace the option card.
The option card is not properly connected to the drive.		<ul style="list-style-type: none"><li>The connector pins on the option card are not properly lined up with the connector pins on the drive.</li><li>Reinstall the option card.</li></ul>
A data error occurred due to noise.		<ul style="list-style-type: none"><li>Check options available to minimize the effects of noise.</li><li>Take steps to counteract noise in the control circuit wiring, main circuit lines and ground wiring.</li><li>Try to reduce noise on the controller side.</li><li>Use surge absorbers on magnetic contactors or other equipment causing the disturbance.</li><li>Use recommended cables or some other type of shielded line. Ground the shield to the controller side or on the input power side.</li><li>All wiring for comm. devices should be separated from drive input power lines. Install an EMC noise filter to the drive input power.</li></ul>

## 6.5 Alarm Detection

Digital Operator Display		Minor Fault Name
CALL	CALL	Serial Communication Transmission Error
		Communication has not yet been established.
Cause		Possible Solutions
Communications wiring is faulty, there is a short circuit, or something is not connected properly.		<ul style="list-style-type: none"><li>• Check for wiring errors.</li><li>• Correct the wiring.</li><li>• Check for disconnected cables and short circuits. Repair as needed.</li></ul>
Programming error on the master side.		Check communications at start-up and correct programming errors.
Communications circuitry is damaged.		<ul style="list-style-type: none"><li>• Perform a self-diagnostics check.</li><li>• If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
Termination resistor setting is incorrect.		A termination resistor must be installed at both ends of a communication line. Slave drives must have the internal termination resistor switch set correctly. Place DIP switch S2 to the ON position.
Digital Operator Display		Minor Fault Name
CE	CE	MEMOBUS/Modbus Communication Error
		Control data was not received correctly for two seconds.
Cause		Possible Solutions
A data error occurred due to noise.		<ul style="list-style-type: none"><li>• Check options available to minimize the effects of noise.</li><li>• Take steps to counteract noise in the control circuit wiring, main circuit lines, and ground wiring.</li><li>• Reduce noise on the controller side.</li><li>• Use surge absorbers for the magnetic contactors or other components that may be causing the disturbance.</li><li>• Use only recommended shielded line. Ground the shield on the controller side or on the drive input power side.</li><li>• Separate all wiring for comm. devices from drive input power lines. Install an EMC noise filter to the drive input power supply.</li></ul>
Communication protocol is incompatible.		<ul style="list-style-type: none"><li>• Check the H5 parameter settings as well as the protocol setting in the controller.</li><li>• Ensure settings are compatible.</li></ul>
The CE detection time (H5-09) is set shorter than the time required for a communication cycle to take place.		<ul style="list-style-type: none"><li>• Check the PLC.</li><li>• Change the software settings in the PLC.</li><li>• Set a longer CE detection time (H5-09).</li></ul>
Incompatible PLC software settings or there is a hardware problem.		<ul style="list-style-type: none"><li>• Check the PLC.</li><li>• Remove the cause of the error on the controller side.</li></ul>
Communications cable is disconnected or damaged.		<ul style="list-style-type: none"><li>• Check the connector to make sure the cable has a signal.</li><li>• Replace the communications cable.</li></ul>
Digital Operator Display		Minor Fault Name
CrST	CrST	Fault Reset with Run Command Enabled
		Fault Reset Attempt with Run Command
Cause		Possible Solutions
Attempted to reset a fault with the Run command still enabled.		<ul style="list-style-type: none"><li>• Ensure that a Run command cannot be entered from the external terminals or option card during fault reset.</li><li>• Turn off the Run command.</li></ul>
Digital Operator Display		Minor Fault Name
CyC	CyC	MECHATROLINK Comm. Cycle Setting Error
		Comm. Cycle Setting Error was detected.
Cause		Possible Solutions
The controller is using a comm. cycle beyond the allowable setting range for the MECHATROLINK option.		Set the comm. cycle for the upper controller within the allowable setting range for the MECHATROLINK option.

Digital Operator Display		Minor Fault Name
dEv	dEv	Speed Deviation (when using a PG option card)
		The deviation between the speed reference and speed feedback is greater than the setting in F1-10 for longer than the time in F1-11.
Cause		Possible Solutions
Load is too heavy.		Reduce the load.
Acceleration and deceleration times are set too short.		Increase the acceleration and deceleration times (C1-01 through C1-08).
The load is locked up.		Check the machine.
Parameter settings are inappropriate.		Check the settings of parameters F1-10 and F1-11.
Incorrect speed feedback scaling if terminal RP is used as speed feedback input in V/f Control.		<ul style="list-style-type: none"><li>Set H6-02 to value of the speed feedback signal frequency when the motor runs at the maximum speed.</li><li>Adjust the speed feedback signal using parameters H6-03 through H6-05.</li><li>Make sure the speed feedback signal frequency does not exceed the maximum input frequency of terminal RP.</li></ul>
The motor brake engaged.		Ensure the brake releases properly.
Digital Operator Display		Minor Fault Name
dnE	dnE	Drive Disabled
Cause		Possible Solutions
“Drive Enable” is set to a multi-function contact input (H1-□□ = 6A) and that signal was switched off.		Check the operation sequence.
Digital Operator Display		Minor Fault Name
EF	EF	Forward/Reverse Run Command Input Error
		Both forward run and reverse run closed simultaneously for over 0.5 s.
Cause		Possible Solutions
Sequence error		Check the forward and reverse command sequence and correct the problem. <b>Note:</b> When minor fault EF detected, motor ramps to stop.
Digital Operator Display		Minor Fault Name
EF0	EF0	Option Card External Fault
		An external fault condition is present.
Cause		Possible Solutions
An external fault was received from the PLC with F6-03 = 3 (causing the drive to continue running when an external fault occurs).		<ul style="list-style-type: none"><li>Remove the cause of the external fault.</li><li>Remove the external fault input from the PLC.</li></ul>
There is a problem with the PLC program.		Check the PLC program and correct problems.
Digital Operator Display		Minor Fault Name
EF1	EF1	External fault (input terminal S1)
		External fault at multi-function input terminal S1.
EF2	EF2	External fault (input terminal S2)
		External fault at multi-function input terminal S2.
EF3	EF3	External fault (input terminal S3)
		External fault at multi-function input terminal S3.
EF4	EF4	External fault (input terminal S4)
		External fault at multi-function input terminal S4.
EF5	EF5	External fault (input terminal S5)
		External fault at multi-function input terminal S5.
EF6	EF6	External fault (input terminal S6)
		External fault at multi-function input terminal S6.
EF7	EF7	External fault (input terminal S7)
		External fault at multi-function input terminal S7.
EF8	EF8	External fault (input terminal S8)
		External fault at multi-function input terminal S8.

## 6.5 Alarm Detection

Cause		Possible Solutions
An external device has tripped an alarm function.		Remove the cause of the external fault and reset the multi-function input value.
Wiring is incorrect.		<ul style="list-style-type: none"> <li>Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-□□ = 2C to 2F).</li> <li>Reconnect the signal line.</li> </ul>
Multi-function contact inputs are set incorrectly.		<ul style="list-style-type: none"> <li>Check if the unused terminals have been set for H1-□□ = 2C to 2F (External Fault).</li> <li>Change the terminal settings.</li> </ul>
Digital Operator Display		Minor Fault Name
$FAn$	FAn	Internal Fan Fault
		Fan or magnetic contactor failed.
Cause		Possible Solution
Internal cooling fan has malfunctioned (models 2A0360, 2A0415, 4A0362).		Cycle power to the drive and see if the fault is still present. Check if the fan is operating or not. Verify the cumulative operation time of the fan using monitor U4-03, and the fan maintenance timer in U4-04. If the cooling fan has passed its expected performance life or is damaged in some way, follow the instructions in this manual to replace it.
Fault detected in the internal cooling fan or magnetic contactor to the power supply (models 2A0250 to 2A0415, 4A0165).		Cycle power to the drive and see if the fault is still present. If the fault still occurs, either replace the control circuit board or the entire unit. For instructions on replacing the power board, contact the Yaskawa sales office directly or your nearest Yaskawa representative.
Digital Operator Display		Minor Fault Name
$FbH$	FbH	Excessive PID Feedback
		The PID feedback input is higher than the level set in b5-36 for longer than the time set in b5-37, and b5-12 is set to 1 or 4.
Cause		Possible Solutions
Parameters settings for b5-36 and b5-37 are incorrect.		Check parameters b5-36 and b5-37.
PID feedback wiring is faulty.		Correct the wiring.
Feedback sensor has malfunctioned.		Check the sensor and replace it if damaged.
Feedback input circuit is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Minor Fault Name
$FbL$	FbL	PID Feedback Loss
		The PID feedback input is lower than the level set in b5-13 for longer than the time set in b5-14.
Cause		Possible Solutions
Parameters settings for b5-13 and b5-14 are incorrect.		Check parameters b5-13 and b5-14.
PID feedback wiring is faulty.		Correct the wiring.
Feedback sensor has malfunctioned.		Check the sensor and replace it if damaged.
Feedback input circuit is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Minor Fault Name
$Hbb$	Hbb	Safe Disable Signal Input
		Both Safe Disable Input channels are open.
Cause		Possible Solutions
Both Safe Disable Inputs H1 and H2 are open.		<ul style="list-style-type: none"> <li>Check signal status at the input terminals H1 and H2.</li> <li>Check the Sink/Source Selection for the digital inputs.</li> <li>If the Safe Disable function is not utilized, check if the terminals H1-HC, and H2-HC are linked.</li> </ul>
Internally, both Safe Disable channels are broken.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Minor Fault Name
$HbbF$	HbbF	Safe Disable Signal Input
		One Safe Disable channel is open while the other one is closed.
Cause		Possible Solutions
The signals to the Safe Disable inputs are wrong or the wiring is incorrect.		Check signal status at the input terminals H1 and H2. If the Safe Disable function is not utilized, the terminals H1-HC, and H2-HC must be linked.
One of the Safe Disable channels is faulty.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

Digital Operator Display		Minor Fault Name
H <sub>CA</sub>	HCA	Current Alarm
		Drive current exceeded overcurrent warning level (150% of the rated current).
Cause		Possible Solutions
Load is too heavy.		Either reduce the load for applications with repetitive operation (repetitive stops and starts, etc.), or replace the drive.
Acceleration and deceleration times are too short.		<ul style="list-style-type: none"><li>• Calculate the torque required during acceleration and for the inertia moment.</li><li>• If the torque level is not right for the load, take the following steps:</li><li>• Increase the acceleration and deceleration times (C1-01 through C1-08).</li><li>• Increase the capacity of the drive.</li></ul>
A special-purpose motor is being used, or the drive is attempting to run a motor greater than the maximum allowable capacity.		<ul style="list-style-type: none"><li>• Check the motor capacity.</li><li>• Use a motor appropriate for the drive. Ensure the motor is within the allowable capacity range.</li></ul>
The current level increased due to Speed Search after a momentary power loss or while attempting to perform a fault restart.		The alarm will appear only briefly. There is no need to take action to prevent the alarm from occurring in such instances.
Digital Operator Display		Minor Fault Name
LT-1	LT-1	Cooling Fan Maintenance Time
		The cooling fan has reached its expected maintenance period and may need to be replaced. <b>Note:</b> An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
Cause		Possible Solutions
The cooling fan has reached 90% of its expected performance life.		Replace the cooling fan and reset the Maintenance Monitor by setting o4-03 to 0.
Digital Operator Display		Minor Fault Name
LT-2	LT-2	Capacitor Maintenance Time
		The main circuit and control circuit capacitors are nearing the end of their expected performance life. <b>Note:</b> An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
Cause		Possible Solutions
The main circuit and control circuit capacitors have reached 90% of their expected performance life.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Minor Fault Name
LT-3	LT-3	Soft Charge Bypass Relay Maintenance Time
		The DC bus soft charge relay is nearing the end of its expected performance life. <b>Note:</b> An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
Cause		Possible Solutions
The DC bus soft charge relay has reached 90% of their expected performance life.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Minor Fault Name
LT-4	LT-4	IGBT Maintenance Time (50%)
		IGBTs have reached 50% of their expected performance life. <b>Note:</b> An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
Cause		Possible Solutions
IGBTs have reached 50% of their expected performance life.		Check the load, carrier frequency, and output frequency.

## 6.5 Alarm Detection

Digital Operator Display		Minor Fault Name
oH	oH	Heatsink Overheat
		The temperature of the heatsink exceeded the overheat pre-alarm level set to L8-02 (90-100°C). Default value for L8-02 is determined by drive capacity (o2-04).
Cause		Possible Solutions
Surrounding temperature is too high		<ul style="list-style-type: none"><li>• Check the surrounding temperature.</li><li>• Improve the air circulation within the enclosure panel.</li><li>• Install a fan or air conditioner to cool surrounding area.</li><li>• Remove anything near drive that may cause extra heat.</li></ul>
Internal cooling fan has stopped.		<ul style="list-style-type: none"><li>• Replace the cooling fan. <i>Refer to Cooling Fan Component Names on page 353.</i></li><li>• After replacing the drive, reset the cooling fan maintenance parameter to (o4-03 = “0”).</li></ul>
Airflow around the drive is restricted.		<ul style="list-style-type: none"><li>• Provide proper installation space around the drive as indicated in the manual. <i>Refer to Installation Orientation and Spacing on page 36.</i></li><li>• Allow for the specified space and ensure that there is sufficient circulation around the control panel.</li><li>• Check for dust or foreign materials clogging cooling fan.</li><li>• Clear debris caught in the fan that restricts air circulation.</li></ul>
Digital Operator Display		Minor Fault Name
oH2	oH2	Drive Overheat Warning
		“Drive Overheat Warning” was input to a multi-function input terminal, S1 through S8 (H1-□□= B)
Cause		Possible Solutions
An external device triggered an overheat warning in the drive.		<ul style="list-style-type: none"><li>• Search for the device that tripped the overheat warning.</li><li>• Solving the problem will clear the warning.</li></ul>
Digital Operator Display		Minor Fault Name
oH3	oH3	Motor Overheat
		The motor overheat signal entered to a multi-function analog input terminal exceeded the alarm level (H3-02, H3-06 or H3-10 = E).
Cause		Possible Solutions
Motor thermostat wiring is fault (PTC input).		Repair the PTC input wiring.
There is a fault on the machine side (e.g., the machine is locked up).		<ul style="list-style-type: none"><li>• Check the status of the machine.</li><li>• Remove the cause of the fault.</li></ul>
Motor has overheated.		<ul style="list-style-type: none"><li>• Check the load size, accel/decel times, and cycle times.</li><li>• Decrease the load.</li><li>• Increase accel and decel times (C1-01 to C1-08).</li><li>• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10.</li><li>• <b>Note:</b> Do not lower E1-08 and E1-10 excessively, because this reduces load tolerance at low speeds.</li><li>• Check the motor-rated current.</li><li>• Enter motor-rated current on motor nameplate (E2-01).</li><li>• Ensure the motor cooling system is operating normally.</li><li>• Repair or replace the motor cooling system.</li></ul>
Digital Operator Display		Minor Fault Name
oL3	oL3	Overtorque 1
		Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) was greater than L6-02 for longer than the time set in L6-03.
Cause		Possible Solutions
Inappropriate parameter settings.		Check parameters L6-02 and L6-03.
There is a fault on the machine side (e.g., the machine is locked up).		<ul style="list-style-type: none"><li>• Check the status of the machine.</li><li>• Remove the cause of the fault.</li></ul>
Digital Operator Display		Minor Fault Name
oL4	oL4	Overtorque 2
		Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) was greater than L6-05 for longer than the time set in L6-06.
Cause		Possible Solutions
Parameter settings are not appropriate.		Check parameters L6-05 and L6-06.
There is a fault on the machine side (e.g., the machine is locked up).		<ul style="list-style-type: none"><li>• Check the status of the machine being used.</li><li>• Remove the cause of the fault.</li></ul>

Digital Operator Display		Minor Fault Name
o <sub>S</sub>	oS	Overspeed
		The motor speed feedback exceeded the F1-08 setting.
Cause		Possible Solutions
Overshoot is occurring.		<ul style="list-style-type: none"><li>Reduce the settings for C5-01 (Speed Control Proportional Gain 1) and increase C5-02 (Speed Control Integral Time 1).</li><li>If using a Closed Loop Vector mode enable Feed Forward Control and perform Inertia Auto-Tuning.</li></ul>
Incorrect speed feedback scaling if terminal RP is used as speed feedback input in V/f control		<ul style="list-style-type: none"><li>Set H6-02 to value of the speed feedback signal frequency when the motor runs at the maximum speed.</li><li>Adjust the input signal using parameters H6-03 through H6-05.</li></ul>
Incorrect PG pulse number has been set		Check and correct parameter F1-01.
Inappropriate parameter settings.		Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).
Digital Operator Display		Minor Fault Name
o <sub>V</sub>	oV	DC Bus Overvoltage
		The DC bus voltage exceeded the trip point. For 200 V class: approximately 410 V For 400 V class: approximately 820 V
Cause		Possible Solutions
Surge voltage present in the drive input power.		<ul style="list-style-type: none"><li>Install a DC reactor or an AC reactor.</li><li>Voltage surge can result from a thyristor convertor and a phase advancing capacitor operating on the same drive input power system.</li></ul>
The motor is short-circuited.		<ul style="list-style-type: none"><li>Check the motor power cable, relay terminals and motor terminal box for short circuits.</li><li>Correct grounding shorts and turn the power back on.</li></ul>
Ground current has over-charged the main circuit capacitors via the drive input power.		
Noise interference causes the drive to operate incorrectly.		<ul style="list-style-type: none"><li>Review possible solutions for handling noise interference.</li><li>Review section on handling noise interference and check control circuit lines, main circuit lines and ground wiring.</li><li>If the magnetic contactor is identified as a source of noise, install a surge protector to the MC coil.</li></ul>
		Set number of fault restarts (L5-01) to a value other than 0.
PG cable is disconnected.		Reconnect the cable.
PG cable wiring is wrong.		Correct the wiring.
Noise interference along PG encoder wiring.		Separate PG wiring from the source of the noise (often output wiring from the drive).
Digital Operator Display		Minor Fault Name
PASS	PASS	MEMOBUS/Modbus Comm. Test Mode Complete
Cause		Possible Solutions
MEMOBUS/Modbus test has finished normally.		This verifies that the test was successful.
Digital Operator Display		Minor Fault Name
P <sub>F</sub>	PF	Input Phase Loss
		Drive input power has an open phase or has a large imbalance of voltage between phases. Detected when L8-05 = 4 (enabled).
Cause		Possible Solution
There is phase loss in the drive input power while the drive is stopped.		<ul style="list-style-type: none"><li>Check for wiring errors in the main circuit drive input power.</li><li>Correct the wiring.</li></ul>
There is loose wiring in the drive input power terminals.		<ul style="list-style-type: none"><li>Ensure the terminals are tightened properly.</li><li>Apply the tightening torque as specified in this manual. <i>Refer to Wire Gauges and Tightening Torque on page 55</i></li></ul>
There is excessive fluctuation in the drive input power voltage.		<ul style="list-style-type: none"><li>Check the voltage from the drive input power.</li><li>Review the possible solutions for stabilizing the drive input power.</li></ul>
There is poor balance between voltage phases.		<ul style="list-style-type: none"><li>Stabilize drive input power or disable phase loss detection.</li></ul>
The main circuit capacitors are worn.		<ul style="list-style-type: none"><li>Check the maintenance time for the capacitors (U4-05).</li><li>Replace the capacitor if U4-05 is greater than 90%. For instructions on replacing the capacitor, contact Yaskawa or your nearest sales representative.</li></ul>
		Check for anything problems with the drive input power. If drive input power appears normal but the alarm continues to occur, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

## 6.5 Alarm Detection

Digital Operator Display		Minor Fault Name
PGo	PGo	PG Disconnect (for Control Mode with PG)
		Detected when no PG pulses are received for a time longer than setting in F1-14.
Cause		Possible Solutions
PG cable is disconnected.		Reconnect the cable.
PG cable wiring is wrong.		Correct the wiring.
PG encoder does not have enough power.		Make sure the correct power supply is properly connected to the PG encoder.
Brake is holding the PG.		Ensure the brake releases properly
Digital Operator Display		Minor Fault Name
PGoH	PGoH	PG Hardware Fault (detected when using a PG-X3 option card)
		PG cable has become disconnected.
Cause		Possible Solutions
PG cable is disconnected.		Reconnect the cable.
Digital Operator Display		Minor Fault Name
rUn	rUn	Motor Switch during Run
		A command to switch motors was entered during run.
Cause		Possible Solutions
A motor switch command was entered during run.		Change the operation pattern so that the motor switch command is entered while the drive is stopped.
Digital Operator Display		Minor Fault Name
SE	SE	MEMOBUS/Modbus Communication Test Mode Error <b>Note:</b> This alarm will not trigger a multi-function output terminal that is set for alarm output (H2-□□ = 10).
Cause		Possible Solutions
A digital input set to 67H (MEMOBUS/Modbus test) was closed while the drive was running.		Stop the drive and run the test again.
Digital Operator Display		Minor Fault Name
TrPC	TrPC	IGBT Maintenance Time (90%)
		IGBTs have reached 90% of their expected performance life.
Cause		Possible Solutions
IGBTs have reached 90% of their expected performance life.		Replace the drive.
Digital Operator Display		Minor Fault Name
UL3	UL3	Undertorque Detection 1
		Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) less than L6-02 for longer than L6-03 time.
Cause		Possible Solutions
Inappropriate parameter settings.		Check parameters L6-02 and L6-03.
Load has dropped or decreased significantly.		Check for broken parts in the transmission system.
Digital Operator Display		Minor Fault Name
UL4	UL4	Undertorque Detection 2
		Drive output current (or torque in OLV, CLV, AOLV/PM, CLV/PM) less than L6-05 for longer than L6-06 time.
Cause		Possible Solutions
Inappropriate parameter settings.		Check parameters L6-05 and L6-06.
The load has dropped or decreased significantly.		Check for broken parts in the transmission system.

Digital Operator Display		Minor Fault Name
Uu	Uv	Undervoltage
		One of the following conditions was true : <ul style="list-style-type: none"><li>• DC bus voltage dropped below the level specified in L2-05.</li><li>• Contactor to suppress inrush current in the drive was opened.</li><li>• Low voltage in the control drive input power. This alarm outputs only if L2-01 is not 0 and DC bus voltage is under L2-05.</li></ul> <b>Note:</b> The alarm output (H2-□□ = 10) will not be triggered when the drive is in KEB deceleration.
Cause		Possible Solutions
Phase loss in the drive input power.		Check for wiring errors in the main circuit drive input power. Correct the wiring.
Loose wiring in the drive input power terminals.		<ul style="list-style-type: none"><li>• Ensure the terminals have been properly tightened.</li><li>• Apply the tightening torque to the terminals as specified. <i>Refer to Wire Gauges and Tightening Torque on page 55</i></li></ul>
There is a problem with the drive input power voltage.		<ul style="list-style-type: none"><li>• Check the voltage.</li><li>• Lower the voltage of the drive input power so that it is within the limits listed in the specifications.</li></ul>
Drive internal circuitry is worn.		<ul style="list-style-type: none"><li>• Check the maintenance time for the capacitors (U4-05).</li><li>• Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
The drive input power transformer is too small and voltage drops when the power is switched on.		<ul style="list-style-type: none"><li>• Check for an alarm when the magnetic contactor, line breaker, and leakage breaker are closed.</li><li>• Check the capacity of the drive input power transformer.</li></ul>
Air inside the drive is too hot.		Check the temperature inside the drive.
The CHARGE light is broken or disconnected.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
KEB is being performed.		KEB can be triggered unintentionally. Check settings in the S4 group and the Power Loss Detection Relay when using such a device (H1-□□ = 65/66).
Digital Operator Display		Minor Fault Name
uoF	voF	Output Voltage Detection Fault
		There is a problem with the output voltage.
Cause		Possible Solutions
Hardware is damaged.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

## 6.6 Operator Programming Errors

### ? oPE Codes, Causes, and Possible Solutions

An Operator Programming Error (oPE) occurs when a contradictory parameter is set or an individual parameter is set to an inappropriate value.

The drive will not operate until the parameter or parameters causing the problem are set correctly. An oPE, however, does not trigger an alarm or fault output. If an oPE occurs, investigate the cause and [Refer to oPE Codes, Causes, and Possible Solutions on page 322](#) for the appropriate action. When an oPE appears on the operator display, press the ENTER button to view U1-18 and see the parameter that is causing the oPE error (U1-18).

**Table 6.16 oPE Codes, Causes, and Possible Solutions**

Digital Operator Display		Error Name
oPE01	oPE01	Drive Capacity Setting Fault
		Drive capacity and the value set to o2-04 do not match.
Cause		Possible Solutions
The drive model selection (o2-04) and the actual capacity of the drive are not the same.		Correct the value set to o2-04.
Digital Operator Display		Error Name
oPE02	oPE02	Parameter Range Setting Error
		Use U1-18 to find parameters set outside the range.
Cause		Possible Solutions
Parameters were set outside the possible setting range.		Set parameters to the proper values.
Note: When multiple errors occur at the same time, other errors are given precedence over oPE02.		
Digital Operator Display		Error Name
oPE03	oPE03	Multi-Function Input Selection Error
		A contradictory setting is assigned to multi-function contact inputs H1-01 to H1-08.
Cause		Possible Solutions
• The same function is assigned to two multi-function inputs. • Excludes “Not used” and “External Fault.”		• Ensure all multi-function inputs are assigned to different functions. • Re-enter the multi-function settings to ensure this does not occur.
The Up command was set but the Down command was not, or vice versa (settings 10 vs. 11).		Correctly set functions that need to be enabled in combination with other functions.
• Run/Stop command for a 2-wire sequence was set (H1-□□ = 42), but Forward/Reverse command (H1-□□ = 43) was not. • “Drive Enable” is set to multi-function input S1 or S2 (H1-01 = 6A or H1-02 = 6A).		Correctly set functions that need to be enabled in combination with other functions.
Two of the following functions are set at the same time: • Up/Down Command (10 vs. 11) • Hold Accel/Decel Stop (A) • Offset Frequency 1, 2, 3 Calculations (44, 45, 46)		• Check if contradictory settings have been assigned to the multi-function input terminals at the same time. • Correct setting errors.
The Up/Down command (10, 11) is enabled at the same time as PID control (b5-01).		Disable control PID (b5-01 = 0) or disable the Up/Down command.
Settings for N.C. and N.O. input for the following functions were selected at the same time: • External Search Command 1 and External Search Command 2 (61 vs. 62) • Fast Stop N.O. and Fast Stop N.C. (15 vs. 17) • FWD Run Command (or REV) and FWD/REV Run Command (2-wire) (40, 41 vs. 42, 43) • External DB Command and Drive Enable (60 vs. 6A) • Synchronous Accel/Decel and Up/Down Command (or Accel/decel ramp hold) (51 vs. 10, 11, A) • DC Injection Braking 2 and Short Circuit Braking (N.O. or N.C.) (60 vs. 7C, 7D)		Check for contradictory settings assigned to the multi-function input terminals at the same time. Correct setting errors.

One of the following settings was entered while H1-□□ = 2 (External Reference 1/2): <ul style="list-style-type: none"><li>• b1-15 = 4 (Pulse Train Input) but the pulse train input selection is not set for the frequency reference (H6-01 &gt; 0)</li><li>• b1-15 or b1-16 set to 3 but no option card is connected</li><li>• Although b1-15 = 1 (Analog Input) and H3-02 or H3-10 are set to 0 (Frequency Bias)</li></ul>		Correct the settings for the multi-function input terminal parameters.
H2-□□ = 38 (Drive Enabled) but H1-□□ is not set to 6A (Drive Enable).		
H1-□□ = 7E (Direction Detection) although H6-01 is not set to 3 (for V/f Control with PG using terminal RP as speed feedback input).		
The following functions are set at the same time: <ul style="list-style-type: none"><li>• H1-□□=10 or 11 (Up/Down Command)</li><li>• H1-□□=50 (Disturb Function Cancel), or S1-01=1 or 2 (Disturb Function Selection enabled)</li></ul>		Check for contradictory settings assigned to the multi-function input terminals and the parameter at the same time. Correct setting errors.
The following functions are set at the same time: <ul style="list-style-type: none"><li>• b2-04 (DC Injection Braking Time at Stop) &gt; 0</li><li>• b2-13 (Short Circuit Brake Time at Stop) &gt; 0</li></ul>		Correct the parameter settings.
Digital Operator Display		Error Name
oPE04	oPE04	Initialization required.
Cause		Possible Solutions
The drive, control board, or terminal board has been replaced and the parameter settings between the control board and the terminal board no longer match.		To load the parameter settings to the drive that are stored in the terminal board, set A1-03 to 5550. Initialize parameters after drive replacement by setting A1-03 to 2220 or 3330.
Digital Operator Display		Error Name
oPE05	oPE05	Run Command/Frequency Reference Source Selection Error
Cause		Possible Solutions
Frequency reference is assigned to an option card (b1-01 = 3) but an input option card is not connected to the drive.		Reconnect the input option card to the drive.
The Run command is assigned to an option card (b1-02 = 3) but an input option card is not connected to the drive.		
Frequency reference is assigned to the pulse train input (b1-01 = 4), but terminal RP is not set for frequency reference input (H6-01 > 0)		Set H6-01 to “0”.
Although the digital card input is set for BCD special for a 5 digit input (F3-01 = 6), the data length is set for 8 bit or 12 bit (F3-03 = 0, 1).		Set the input data for 16 bit (F3-03 = 2).
The following values have been set while an AI-A3 option card is installed: <ul style="list-style-type: none"><li>• The source of frequency reference setting is assigned to an option card (b1-01 = 3).</li><li>• The action for the analog card is set for separate terminal input (F2-01 = 0).</li></ul>		Make sure parameters are set properly.
Digital Operator Display		Error Name
oPE06	oPE06	Control Method Selection Error
		Correct the setting for the control method.
Cause		Possible Solutions
A control mode has been selected that requires a PG option card to be installed, but no PG encoder is installed (A1-02 = 1, 3, or 7).		<ul style="list-style-type: none"><li>• Connect a PG option card.</li><li>• Correct the value set to A1-02.</li></ul>

## 6.6 Operator Programming Errors

Digital Operator Display		Error Name
oPE07	oPE07	Multi-Function Analog Input Selection Error
		A contradictory setting is assigned to multi-function analog inputs H3-02, H3-06, or H3-10 and PID functions conflict.
Cause		Possible Solutions
At least two analog input terminals are set to the same function (i.e., at least two of these parameters has the same setting: H3-02, H3-06, or H3-10).		Change the settings to H3-02, H3-06, and H3-10 so that functions no longer conflict. <b>Note:</b> Both 0 (frequency reference bias) and F or 1F (Through mode) can be set to H3-02, H3-06, and H3-10 at the same time.
The following simultaneous contradictory settings: <ul style="list-style-type: none"><li>• H3-02, H3-06, or H3-10 = B (PID Feedback) while H6-01 (Pulse Train Input) = 1 (PID Feedback)</li><li>• H3-02, H3-06, or H3-10 = C (PID Target Value) while H6-01 = 2 (pulse train input sets the PID target value)</li><li>• H3-02, H3-06, or H3-10 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value)</li><li>• H6-01 = 2 (PID target) while b5-18 = 1 (enables b5-19 as the target PID value)</li></ul>		Disable one of the PID selections.
Digital Operator Display		Error Name
oPE08	oPE08	Parameter Selection Error
		A function has been set that cannot be used in the motor control method selected.
Cause		Possible Solutions
Attempted to use a function available only in Open Loop Vector Control though the drive is set for V/f control.		Check the motor control method and the functions available.
In Open Loop Vector Control, n2-02 is greater than n2-03		Correct parameter settings so that n2-02 is less than n2-03.
In Open Loop Vector Control, C4-02 is greater than C4-06		Correct parameter settings so that C4-02 is less than C4-06.
The Disturb waveform function can only be used when running V/f Control.		If using the Disturb function make sure the drive is set for V/f Control (A1-02 = 0).
In OLV/PM, parameters E5-02 to E5-07 are set to 0.		<ul style="list-style-type: none"><li>• Set the correct motor code in accordance with the motor being used (E5-01).</li><li>• When using a special-purpose motor, set E5-□□ in accordance with the test report provided.</li></ul>
E5-09 and E5-24 are both equal to 0, or neither equals 0 in the control mode for PM.		Set E5-09 or E5-24 to the correct value, and set the other to “0”.
The following functions are set at the same time: <ul style="list-style-type: none"><li>• L8-05 (Input Phase Loss Protection Selection) = 4 (Enabled (both software and hardware detection))</li><li>• S4-15 (KEB Supply Loss Detection Selection) = 1 (Enabled)</li></ul>		Correct the parameter settings.
In AOLV/PM High Frequency Injection is disabled (n8-57 = 0) and the minimum frequency (E1-09) is set lower than 1/20 of the base frequency setting.		Correct the parameter settings.
<b>Note:</b> Use U1-18 to find which parameters are set outside the specified setting range. Other errors are given precedence over oPE08 when multiple errors occur at the same time.		
Digital Operator Display		Error Name
oPE09	oPE09	PID Control Selection Fault
		PID control function selection is incorrect. Requires that PID control is enabled (b5-01 = 1 to 4).
Cause		Possible Solutions
The following simultaneous contradictory settings have occurred: <ul style="list-style-type: none"><li>• b5-15 not 0.0 (PID Sleep Function Operation Level)</li><li>• The stopping method is set to either DC Injection Braking or coast to stop with a timer (b1-03 = 2 or 3).</li></ul>		<ul style="list-style-type: none"><li>• Set b5-15 to another value besides 0.</li><li>• Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).</li></ul>
The following functions are set at the same time: <ul style="list-style-type: none"><li>• b5-01 = 1 or 2 (PID output becomes output frequency reference)</li><li>• b5-11 = 1 (Rotation direction reverses with negative PID output)</li><li>• d2-02 (Frequency Reference Lower Limit) ≠ 0 or d2-05 (Frequency Reference 2 Lower Limit) ≠ 5 when H1-□□ = 2 (External reference 1/2 selection)</li></ul>		Correct the parameter settings.
PID control is set to b5-01 = 3 or 4, but d2-02 (Frequency Reference Lower Limit) ≠ 0 or d2-05 (Frequency Reference 2 Lower Limit) ≠ 5.		Correct the parameter settings.

Digital Operator Display		Error Name
oPE 10	oPE10	V/f Data Setting Error
		The following setting errors have occurred where: <ul style="list-style-type: none"><li>E1-04 is greater than or equal to E1-11, E1-11 is greater than or equal to E1-06, E1-06 is greater than or equal to E1-07, E1-07 is greater than or equal to E1-09.</li><li>E3-04 is greater than or equal to E3-11, E3-11 is greater than or equal to E3-06, E3-06 is greater than or equal to E3-07, E3-07 is greater than or equal to E3-09.</li></ul>
Cause		Possible Solutions
—		Correct the settings for E1-04, E1-06, E1-07, E1-09, and E1-11 (for motor 2, correct E3-04, E3-06, E3-07, E3-09, and E3-11).
Digital Operator Display		Error Name
oPE 11	oPE11	Carrier Frequency Setting Error
		Correct the setting for the carrier frequency.
Cause		Possible Solutions
The following simultaneous contradictory settings: C6-05 is greater than 6 and C6-04 is greater than C6-03 (carrier frequency lower limit is greater than the upper limit). If C6-05 is less than or equal to 6, the drive operates at C6-03.		Correct the parameter settings.
Upper and lower limits between C6-02 and C6-05 contradict each other.		
Digital Operator Display		Error Name
oPE 13	oPE13	Pulse Monitor Selection Error
		Incorrect setting of monitor selection for pulse train (H6-06).
Cause		Possible Solutions
Scaling for the pulse train monitor is set to 0 (H6-07 = 0) while H6-06 is not set to 101, 102, 105, or 116.		Change scaling for the pulse train monitor or set H6-06 to 101, 102, 105, or 116.
Digital Operator Display		Error Name
oPE 14	oPE14	Application Selection Error
		A conflicting function was selected.
Cause		Possible Solutions
The following functions are set at the same time: <ul style="list-style-type: none"><li>L3-11 (Overvoltage Suppression Function Selection) = 1 (Enabled)</li><li>S1-01 (Disturb Function Selection) ≠ 0 (Disabled)</li></ul>		Correct the parameter settings.
The following functions are set at the same time: <ul style="list-style-type: none"><li>b3-24 (Speed Search Method Selection) = 3 (Synchronous Operation)</li><li>b1-14 (Phase Order Selection) = 1 (Switch phase order)</li></ul>		Correct the parameter settings.
The following functions are set at the same time: <ul style="list-style-type: none"><li>H1-□□ = 53 (Energy Saving On/Off) or b8-01 (Energy Saving Control Selection) = 1 (Enabled)</li><li>S3-03 (Output Voltage Gain Selection) = 1 (Enabled)</li></ul>		Correct the parameter settings.
Digital Operator Display		Error Name
oPE 15	oPE15	Torque Control Setting Error
		Parameters settings that are not allowed in combination with Torque Control have been set.
Cause		Possible Solutions
Either Torque Control is enabled by d5-01 = 1, the or Speed/Torque Control switch is assigned to a digital input H1-□□ = 71, while at the same time: <ul style="list-style-type: none"><li>Feed Forward is enabled (n5-01 = 1), or</li><li>Intelligent Stall Prevention or Overexcitation Deceleration 2 is enabled (L3-04 = 2 or 5), or</li><li>A digital input is set for KEB (H1-□□ = 65 or 66)</li></ul>		Correct the parameter settings.
The following functions are set at the same time: <ul style="list-style-type: none"><li>S4-01 (KEB Mode Selection) ≠ 0 (KEB disabled)</li><li>d5-01 (Torque Control Selection) = 1 (Torque Control), or H1-□□ = 71 (Speed/Torque Control Switch)</li></ul>		Correct the parameter settings.

## 6.6 Operator Programming Errors

Digital Operator Display		Error Name
oPE 16	oPE16	Energy Savings Constants Error
Cause		Possible Solutions
In AOLV/PM the automatically calculated energy saving coefficients are out of the allowable range.		Check and correct the motor data in E5 parameters.
Digital Operator Display		Error Name
oPE 18	oPE18	Online Tuning Parameter Setting Error
Cause		Parameters that control Online Tuning are not set correctly.
Possible Solutions		Make sure E2-02, E2-03, and E2-06 are set the correct values.
One of the following setting errors has occurred while Online Tuning is enabled in OLV (A1-02 = 2):		
<ul style="list-style-type: none"> <li>E2-02 has been set below 30% of the original default value</li> <li>E2-06 has been set below 50% of the original default value</li> <li>E2-03 = 0</li> </ul>		

### ? Causes and Corrective Actions When the Digital Operator Goes Dark

**Table 6.17 Causes and Corrective Actions When the Digital Operator Goes Dark**

Cause	Possible Solutions
A short-circuit between +V, -V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
Overload in the control circuit terminal	Check the resistance and wiring for the frequency setting potentiometer, etc. (Check that the current for terminals +V and -V is 20 mA or less.)
The short-circuit bar between +1 and +2 terminals in the main circuit has been removed.	Attach the short-circuit bar.
P terminal and N terminal of the Braking Unit are connected in reverse.	<ul style="list-style-type: none"> <li>Check the wiring for the Braking Unit, including cables connected to the Braking Unit and relay terminals.</li> <li>Replace the drive.</li> </ul>
Control power circuit failure	Charge indicator is lit: <ul style="list-style-type: none"> <li>Replace the Digital Operator.</li> <li>Replace the board or the drive.</li> </ul> Charge indicator is not lit: <ul style="list-style-type: none"> <li>Check the input power supply voltage.</li> <li>Replace the drive.</li> </ul>
Malfunction occurred in the control power circuit.	Turn OFF the power, wait for 5 minutes, and turn ON the power again.
Digital Operator contact failure	Turn OFF the power and remove the Digital Operator. Replace the Digital Operator.

## 6.7 Auto-Tuning Fault Detection

Auto-Tuning faults are shown below. When the following faults are detected, the fault is displayed on the digital operator and the motor coasts to a stop. Auto-Tuning faults do not trigger an multi-function terminal set for fault or alarm output.

An End□ error indicates that although Auto-Tuning has completely successful, there is some discrepancy in the calculations the drive made. If an End□ error occurs, check for what might be causing the error using the table below, and perform Auto-Tuning again once the problem has been taken care of. If there appears to be no problem despite the End□ error being displayed, go ahead and start the application.

### ? Auto-Tuning Codes, Causes, and Possible Solutions

**Table 6.18 Auto-Tuning Codes, Causes, and Possible Solutions**

Digital Operator Display		Error Name
$\text{End1}$	End1	Excessive V/f Setting (detected only during Rotational Auto-Tuning, and displayed after Auto-Tuning is complete)
Cause		Possible Solutions
The torque reference exceeded 20% during Auto-Tuning.		<ul style="list-style-type: none"><li>• Before Auto-Tuning the drive, verify the information written on the motor nameplate and enter that data to T1-03 through T1-05.</li><li>• Enter proper information to parameters T1-03 to T1-05 and repeat Auto-Tuning.</li><li>• If possible, disconnect the motor from the load and perform Auto-Tuning. If the load cannot be uncoupled, simply use the Auto-Tuning results as they are.</li></ul>
The results from Auto-Tuning the no-load current exceeded 80%.		
Digital Operator Display		Error Name
$\text{End2}$	End2	Motor Iron-Core Saturation Coefficient (detected only during Rotational Auto-Tuning and displayed after Auto-Tuning is complete)
Cause		Possible Solutions
Motor data entered during Auto-Tuning was incorrect.		<ul style="list-style-type: none"><li>• Make sure the data entered to the T1 parameters match the information written on the motor nameplate.</li><li>• Restart Auto-Tuning and enter the correct information.</li></ul>
Results from Auto-Tuning are outside the parameter setting range, assigning the iron-core saturation coefficient (E2-07, E2-08) a temporary value.		
Digital Operator Display		Error Name
$\text{End3}$	End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete)
Cause		Possible Solutions
The correct current rating printed on the nameplate was not entered into T1-04.		<ul style="list-style-type: none"><li>• Check the setting of parameter T1-04.</li><li>• Check the motor data and repeat Auto-Tuning.</li></ul>
Digital Operator Display		
$\text{End4}$	End4	Adjusted Slip Calculation Error
Cause		Possible Solutions
The slip that was calculated is outside the allowable range.		<ul style="list-style-type: none"><li>• Make sure the data entered for Auto-Tuning is correct.</li><li>• Execute Rotational Auto-Tuning instead. If not possible, try Stationary Auto-Tuning 2.</li></ul>
Digital Operator Display		
$\text{End5}$	End5	Resistance Tuning Error
Cause		Possible Solutions
The resistance value that was calculated is outside the allowable range.		<ul style="list-style-type: none"><li>• Double check the data that was entered for the Auto-Tuning process.</li><li>• Check the motor and motor cable connection for faults.</li></ul>
Digital Operator Display		
$\text{End6}$	End6	Leakage Inductance Alarm
Cause		Possible Solutions
The leakage inductance value that was calculated is outside the allowable range.		Double check the data that was entered for the Auto-Tuning process.

## 6.7 Auto-Tuning Fault Detection

Digital Operator Display		Error Name
End7	End7	No-Load Current Alarm
Cause		Possible Solutions
The entered no-load current value was outside the allowable range.		Check and correct faulty motor wiring.
Auto-Tuning results were less than 5% of the motor rated current.		Double check the data that was entered for the Auto-Tuning process.
Digital Operator Display		Error Name
Er-01	Er-01	Motor Data Error
Cause		Possible Solutions
Motor data or data entered during Auto-Tuning was incorrect.		<ul style="list-style-type: none"><li>• Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning.</li><li>• Start Auto-Tuning over again and enter the correct information.</li></ul>
Motor output power and motor-rated current settings (T1-02 and T1-04) do not match.		<ul style="list-style-type: none"><li>• Check the drive and motor capacities.</li><li>• Correct the settings of parameters T1-02 and T1-04.</li></ul>
The setting of parameter T1-04 is smaller than 0.3 A.		Correct the settings of parameter T1-04.
Motor rated current and detected no-load current are not consistent with another.		<ul style="list-style-type: none"><li>• Check the motor rated current and no-load current.</li><li>• Correct the settings of parameters T1-04 and E2-03.</li></ul>
Base frequency and motor rated speed (T1-05 and T1-07) do not match.		<ul style="list-style-type: none"><li>• Set T1-05 and T1-07 to the correct value.</li><li>• Check if the correct pole number was entered to T1-06.</li></ul>
Digital Operator Display		Error Name
Er-02	Er-02	Minor Fault
Cause		Possible Solutions
An alarm was triggered during Auto-Tuning.		Exit the Auto-Tuning menu, check the alarm code, remove the alarm cause, and repeat Auto-Tuning.
Digital Operator Display		Error Name
Er-03	Er-03	STOP Button Input
Cause		Possible Solutions
Auto-Tuning canceled by pressing STOP button.		Auto-Tuning did not complete properly and will have to be performed again.
Digital Operator Display		Error Name
Er-04	Er-04	Line-to-Line Resistance Error
Cause		Possible Solutions
Motor data entered during Auto-Tuning was incorrect.		<ul style="list-style-type: none"><li>• Make sure the data entered to the T1 parameters match the information written on the motor nameplate.</li><li>• Restart Auto-Tuning and enter the correct information.</li></ul>
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.		Check and correct faulty motor wiring.
Motor cable or cable connection faulty.		
Digital Operator Display		Error Name
Er-05	Er-05	No-Load Current Error
Cause		Possible Solutions
Motor data entered during Auto-Tuning was incorrect.		<ul style="list-style-type: none"><li>• Make sure the data entered to the T1 parameters match the information written on the motor nameplate.</li><li>• Restart Auto-Tuning and enter the correct information.</li></ul>
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.		<ul style="list-style-type: none"><li>• Check and correct faulty motor wiring.</li><li>• Perform Rotational Auto-Tuning.</li></ul>
The load during Rotational Auto-tuning was too high.		<ul style="list-style-type: none"><li>• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%.</li><li>• If a mechanical brake is installed, make sure it is fully lifted during tuning.</li></ul>

Digital Operator Display		Error Name
Er-08	Er-08	Rated Slip Error
Cause		Possible Solutions
Motor data entered during Auto-Tuning was incorrect.		<ul style="list-style-type: none"><li>Make sure the data entered to the T1 parameters match the information written on the motor nameplate.</li><li>Restart Auto-Tuning and enter the correct information.</li></ul>
Drive-calculated values outside parameter setting range or the tuning process took too long.		<ul style="list-style-type: none"><li>Check and correct faulty motor wiring.</li><li>Perform Rotational Auto-Tuning.</li></ul>
The load during rotational Auto-tuning was too high.		<ul style="list-style-type: none"><li>Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%.</li><li>If a mechanical brake is installed, make sure it is fully lifted during tuning.</li></ul>
Digital Operator Display		Error Name
Er-09	Er-09	Acceleration Error
Cause		Possible Solutions
The motor did not accelerate for the specified acceleration time.		<ul style="list-style-type: none"><li>Increase the acceleration time (C1-01).</li><li>Check if it is possible to disconnect the machine from the motor.</li></ul>
Torque limit when motoring is too low (L7-01 and L7-02).		<ul style="list-style-type: none"><li>Check the settings of parameters L7-01 and L7-02.</li><li>Increase the setting.</li></ul>
The load during Rotational Auto-Tuning was too high.		<ul style="list-style-type: none"><li>Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%.</li><li>If a mechanical brake is installed, make sure it is fully lifted during tuning.</li></ul>
Digital Operator Display		Error Name
Er-10	Er-10	Motor Direction Error
Cause		Possible Solutions
The encoder signal lines are not properly connected to the drive.		Check and correct wiring to the PG encoder.
Motor and PG direction are opposite.		Check the motor speed monitor U1-05 while turning the motor manually in forward direction. If the sign displayed is negative, change the setting of parameter F1-05.
The load pulled the motor in the opposite direction of the speed reference and the torque exceeded 100%.		Uncouple the motor from the load and repeat Auto-Tuning.
Digital Operator Display		Error Name
Er-11	Er-11	Motor Speed Fault
Cause		Possible Solutions
Torque reference is too high.		<ul style="list-style-type: none"><li>Increase the acceleration time (C1-01).</li><li>Disconnect the machine from the motor, if possible.</li></ul>
Digital Operator Display		Error Name
Er-12	Er-12	Current Detection Error
Cause		Possible Solutions
One of the motor phases is missing: (U/T1, V/T2, W/T3).		Check motor wiring and correct any problems.
Current exceeded the current rating of the drive.		<ul style="list-style-type: none"><li>Check the motor wiring for a short between motor lines.</li><li>If a magnetic contactor is used between motors, make sure it is closed.</li><li>Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.</li></ul>
The current is too low.		
Attempted Auto-Tuning without motor connected to the drive.		Connect the motor and perform Auto-Tuning.
Current detection signal error.		Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Digital Operator Display		Error Name
Er-13	Er-13	Leakage Inductance Error
Cause		Possible Solutions
Drive was unable to complete tuning for leakage inductance within 300 seconds.		<ul style="list-style-type: none"><li>Check all wiring and correct any mistakes.</li><li>Double check the motor rated current value that was entered to T1-04 for Auto-Tuning.</li><li>Check the motor rated current value written on the motor nameplate and enter the correct value.</li></ul>

## 6.7 Auto-Tuning Fault Detection

Digital Operator Display		Error Name
Er - 14	Er-14	Motor Speed Error 2
Cause		Possible Solutions
The motor speed exceeded twice the amplitude of speed reference during Inertia Tuning.		Reduce the ASR gain set to C5-01.
Digital Operator Display		Error Name
Er - 15	Er-15	Torque Saturation Error
Cause		Possible Solutions
The output torque reached the torque limit set in L7-01 through L7-04 during Inertia Tuning.		<ul style="list-style-type: none"> <li>• Increase the torque limits in L7-01 through L7-04 (but keep them within reasonable limits).</li> <li>• First try reducing the test signal amplitude in T3-01 and repeat the tuning. If necessary, then try reducing the test signal frequency (T3-02) and repeat the tuning.</li> </ul>
Digital Operator Display		Error Name
Er - 16	Er-16	Inertia Detection Error
Cause		Possible Solutions
The inertia identified by the drive was abnormally small or abnormally large during Inertia Tuning.		<ul style="list-style-type: none"> <li>• First try reducing the test signal amplitude in T3-01 and repeat the tuning. If necessary, then try reducing the test signal frequency (T3-02) and repeat the tuning.</li> <li>• Check the basic motor inertia value entered to T3-03.</li> </ul>
Digital Operator Display		Error Name
Er - 17	Er-17	Reverse Prohibited Error
Cause		Possible Solutions
Drive is prohibited from rotating the motor in reverse while attempting to perform Inertia Tuning.		<ul style="list-style-type: none"> <li>• Inertia Auto-Tuning cannot be performed if the drive is restricted from rotating in reverse.</li> <li>• Assuming it is acceptable for the application to rotate in reverse, set b1-04 to 0 and then execute Inertia Tuning.</li> </ul>
Digital Operator Display		Error Name
Er - 18	Er-18	Induction Voltage Error
Cause		Possible Solutions
The induced voltage constant exceeds the allowable setting range.		Double check the data that was entered to the T2-□□ parameters, and perform Auto-Tuning again.
Digital Operator Display		Error Name
Er - 19	Er-19	PM Inductance Error
Cause		Possible Solutions
The induced inductance values set to E5-08 or E5-09 exceed the allowable range.		Double check the data that was entered to the T2-□□ parameters, and perform Auto-Tuning again.
Digital Operator Display		Error Name
Er - 20	Er-20	Stator Resistance Error
Cause		Possible Solutions
Stator resistance tuning attempted to set a value to E5-06 that is outside the allowable setting range.		Double check the data that was entered to the T2-□□ parameters, and perform Auto-Tuning again.
Digital Operator Display		Error Name
Er - 21	Er-21	Z Pulse Correction Error
Cause		Possible Solutions
Motor was coasting when Auto-Tuning was performed.		Make sure the motor has stopped completely. Repeat Auto-Tuning.
Either the motor or the PG encoder on the motor is not properly wired.		Check the wiring for the motor and the PG encoder. Repeat Auto-Tuning.
The direction for the PG encoder is set incorrectly, or the number of pulses set for the PG encoder is wrong.		Check the direction and number of pulses set for the PG encoder. Repeat Auto-Tuning.
PG encoder is damaged.		Check the signal output from the PG encoder attached to the motor. Replace the PG if damaged.

## 6.8 Copy Function Related Displays

### ? Tasks, Errors, and Troubleshooting

The table below lists the messages and errors that may appear when using the Copy function.

When executing the tasks offered by the Copy function, the operator will indicate the task being performed. When an error occurs, a code appears on the operator to indicate the error. Note that errors related to the Copy function do not trigger a multi-function output terminal that has been set up to close when a fault or alarm occurs. To clear an error, simply press any key on the operator and the error display will disappear.

**Table 6.19** lists the corrective action that can be taken when an error occurs.

- Note:**
1. Whenever using the copy function, the drive should be fully stopped.
  2. The drive will not accept a Run command while the Copy function is being executed.
  3. Parameters can only be saved to a drive when the voltage class, capacity, control mode, and software version match.

**Table 6.19 Copy Function Task and Error Displays**

Digital Operator Display		Task
<code>CoPy</code>	CoPy	Writing Parameter Settings (flashing)
<b>Cause</b>		<b>Possible Solutions</b>
Parameters are being written to the drive.		Not an error.
Digital Operator Display		Task
<code>CPEr</code>	CPEr	Control Mode Mismatch
<b>Cause</b>		<b>Possible Solutions</b>
Control mode of the parameters to be loaded onto the drive and the control mode already set to the drive don't match.		Check the control mode for the parameters that are to be loaded onto the drive and the control mode set to the drive those parameters will be written to. Set the same control mode using parameter A1-02 and try again.
Digital Operator Display		Task
<code>CPyE</code>	CPyE	Error Writing Data
<b>Cause</b>		<b>Possible Solutions</b>
Failed writing parameters.		Try writing parameters again.
Digital Operator Display		Task
<code>CSEr</code>	CSEr	Copy Unit Error
<b>Cause</b>		<b>Possible Solutions</b>
Hardware fault		Replace the operator or the USB Copy Unit.
Digital Operator Display		Task
<code>dFPS</code>	dFPS	Drive Model Mismatch
<b>Cause</b>		<b>Possible Solutions</b>
The drive from which the parameter were copied and the drive you are attempting to write to are not the same model. <ul style="list-style-type: none"> <li>• The drive the parameters were copied from is a different model drive.</li> <li>• The drive you attempting to write to is a different model.</li> </ul>		Check the model number of the drive that the parameters were copied from and the model of the drive you are attempting to write those parameters to. Make sure the drive from which the parameter are copied and the drive to be written to have the same model numbers and software versions.
Digital Operator Display		Task
<code>End</code>	End	Task Complete
<b>Cause</b>		<b>Possible Solutions</b>
Finished reading, writing, or verifying parameters.		Not an error.
Digital Operator Display		Task
<code>iFEr</code>	iFEr	Communication Error
<b>Cause</b>		<b>Possible Solutions</b>
A communication error occurred between the drive and the operator or the USB copy unit.		Check the cable connection.
A non-compatible cable is being used to connect the USB Copy Unit and the drive.		Use the cable originally packaged with the USB Copy Unit.

## 6.8 Copy Function Related Displays

Digital Operator Display		Task
ndAT	ndAT	Model, Voltage Class, Capacity Mismatch
Cause		Possible Solutions
The drive the parameters were copied from and the drive you are attempting to write to have different electrical specifications, a different capacity, is set to a different control mode, or is a different model number.		Make sure model numbers and specifications are the same for both drives.
The device being used to write the parameters is blank and does not have any parameters saved on it.		Making sure all connections are correct, and copy the parameter settings onto the USB Copy Unit or the operator.
Digital Operator Display		Task
rdEr	rdEr	Error Reading Data
Cause		Possible Solutions
Failed while attempting to read parameter settings from the drive.		Press and hold the READ key on the USB Copy Unit for at least one second to have the unit read parameters from the drive.
Digital Operator Display		Task
rEAd	rEAd	Reading Parameter Settings (flashing)
Cause		Possible Solutions
Displayed while the parameter settings are being read onto the USB Copy Unit.		Not an error.
Digital Operator Display		Task
vAEr	vAEr	Voltage Class, Capacity Mismatch
Cause		Possible Solutions
The drive the parameters were copied from and the drive you performing the Verify mode on have different electrical specifications or are a different capacity.		Make sure electrical specifications and capacities are the same for both drives.
Digital Operator Display		Task
vFyE	vFyE	Parameter settings in the drive and those saved to the copy function are not the same
Cause		Possible Solutions
Indicates that parameter settings that have been Read and loaded onto the Copy Unit or Digital Operator are different.		To have parameters be the same, either write the parameters save on the USB Copy Unit or LCD digital operator onto the drive, or Read the parameter settings on the drive onto the USB Copy Unit.
Digital Operator Display		Task
vrFy	vrFy	Comparing Parameter Settings (flashing)
Cause		Possible Solutions
The Verify mode has confirmed that parameters settings on the drive and parameters read to the copy device are identical.		Not an error.

## 6.9 Diagnosing and Resetting Faults

When a fault occurs and the drive stops, follow the instructions below to remove whatever conditions triggered the fault, then restart the drive.

### ? Fault Occurs Simultaneously with Power Loss

**WARNING! Electrical Shock Hazard.** Ensure there are no short circuits between the main circuit terminals (R/L1, S/L2, and T/L3) or between the ground and main circuit terminals before restarting the drive. Failure to comply may result in serious injury or death and will cause damage to equipment.

1. Turn on the drive input power.
2. Use monitor parameters U2-□□ to display data on the operating status of the drive just before the fault occurred.
3. Remove the cause of the fault and reset.















**Note:** 1. To find out what faults were triggered, check the fault history in U2-02. Information on drive status when the fault occurred such as the frequency, current, and voltage can be found in U2-03 through U2-20. *Refer to Viewing Fault Trace Data After Fault on page 333* for information on how to view fault data.

2. When the fault continues to be displayed after cycling power, remove the cause of the fault and reset.

### ? If the Drive Still has Power After a Fault Occurs



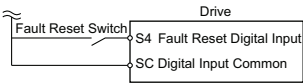
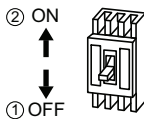
1. Look at the digital operator for information on the fault that occurred.
2. *Refer to Fault Displays, Causes, and Possible Solutions on page 296*
3. Reset the fault. *Refer to Fault Reset Methods on page 334.*

### ? Viewing Fault Trace Data After Fault

	Step		Display/Result
1.	Turn on the drive input power. The first screen displays.	→	
2.	Press  until the monitor screen is displayed.	→	
3.	Press  to display the parameter setting screen.	→	
4.	Press  and  until U2-02 (Fault History) is displayed.	→	
5.	Press  to view the most recent fault (oC in this example).	→	
6.	Press  to go back to the U2-02 display.	→	
7.	Press  to view drive status information when fault occurred. Parameters U2-03 through U2-20 help determine the cause of a fault. Parameters to be monitored differ depending on the control mode.	→	

? Fault Reset Methods

When a fault occurs, the cause of the fault must be removed and the drive must be restarted. The table below lists the different ways to restart the drive.

After the Fault Occurs	Procedure	
Fix the cause of the fault, restart the drive, and reset the fault	With the fault displayed on the digital operator screen, press  on the digital operator.	
Resetting via Fault Reset Digital Input S4	Close then open the fault signal digital input via terminal S4. S4 is set for “Fault Reset” as default (H1-04 = 14).	
If the above methods do not reset the fault, turn off the drive main power supply. Reapply power after the digital operator display is out.		

**Note:** If the Run command is present, the drive will disregard any attempts to reset the fault. The Run command must first be removed before a fault situation can be cleared.

## 6.10 Troubleshooting without Fault Display

This section describes troubleshooting problems that do not trip an alarm or fault.

The following symptoms indicate that the drive is not set correctly for proper performance with the motor. Refer to *Motor Performance Fine-Tuning on page 284* for guidance on troubleshooting.

- Motor hunting and oscillation
- Poor motor torque
- Poor speed precision
- Poor motor torque and speed response
- Motor noise



### ? Common Problems

Common Problems		Page
Cannot Change Parameter Settings		335
Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command	Motor Does Not Rotate	336
	Motor Rotates in the Opposite Direction from the Run Command	337
	Motor Rotates in One Direction Only	337
Motor is Too Hot		337
Drive Does Not Allow Selection of Rotational Auto-Tuning		338
oPE02 Error Occurs When Lowering the Motor Rated Current Setting		338
Motor Stalls During Acceleration or With Large Loads		338
Drive Frequency Reference Differs from the Controller Frequency Reference Command		339
Excessive Motor Oscillation and Erratic Rotation		339
Deceleration Takes Longer Than Expected with Dynamic Braking Enabled		339
Load Falls When Brake is Applied (Hoist-Type Applications)		340
Noise From Drive or Output Lines When the Drive is Powered On		340
Ground Fault Circuit Interrupter (GFCI) Trips During Run		340
Connected Machinery Vibrates When Motor Rotates	Unexpected Noise from Connected Machinery	340
	Oscillation or Hunting	340
PID Output Fault		341
Insufficient Starting Torque		341
Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking)		341
Output Frequency is not as High as Frequency Reference		341
Buzzing Sound from Motor at 2 kHz		341
Unstable Motor Speed when Using PM or IPM		342
Motor Does Not Restart after Power Loss		342

### ? Cannot Change Parameter Settings



Cause	Possible Solutions
The drive is running the motor (i.e., the Run command is present).	<ul style="list-style-type: none"> <li>• Stop the drive and switch over to the Programming Mode.</li> <li>• Most parameters cannot be edited during run.</li> </ul>
The Access Level is set to restrict access to parameter settings.	<ul style="list-style-type: none"> <li>• Set the Access Level to allow parameters to be edited (A1-01 = 2).</li> </ul>
The operator is not in the Parameter Setup Mode (the screen will display “PAR”).	<ul style="list-style-type: none"> <li>• See what mode the operator is currently set for.</li> <li>• Parameters cannot be edited when in the Setup Mode (“STUP”). Switch modes so that “PAR” appears on the screen. Refer to <i>The Drive and Programming Modes on page 85</i>.</li> </ul>
A multi-function contact input terminal is set to allow or restrict parameter editing (H1-01 through H1-08 = 1B).	<ul style="list-style-type: none"> <li>• When the terminal is open, parameters cannot be edited.</li> <li>• Turn on the multi-function contact input set to 1B.</li> </ul>




## 6.10 Troubleshooting without Fault Display

Cause	Possible Solutions
The wrong password was entered.	<ul style="list-style-type: none"> <li>If the password entered to A1-04 does not match the password saved to A1-05, then drive settings cannot be changed.</li> <li>Reset the password.</li> </ul> <p>If you cannot remember the password:</p> <ul style="list-style-type: none"> <li>Scroll to A1-04. Press the  button and press  at the same time. Parameter A1-05 will appear.</li> <li>Set a new password to parameter A1-05.</li> </ul>
Undervoltage was detected.	<ul style="list-style-type: none"> <li>Check the drive input power voltage by looking at the DC bus voltage (U1-07).</li> <li>Check all main circuit wiring.</li> </ul>

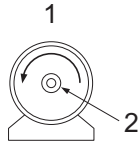
### ? Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command

#### ? Motor Does Not Rotate

Cause	Possible Solutions
The drive is not in the Drive Mode.	<ul style="list-style-type: none"> <li>Check if the DRV light on the digital operator is lit.</li> <li>Enter the Drive Mode to begin operating the motor. <i>Refer to The Drive and Programming Modes on page 85.</i></li> </ul>
The  button was pushed.	<p>Stop the drive and check if the correct frequency reference source is selected. If the operator keypad shall be the source, the LO/RE button LED must be on. If the source is REMOTE, it must be off. Take the following steps to solve the problem:</p> <ul style="list-style-type: none"> <li>Push the  button.</li> <li>If o2-01 is set to 0, then the LO/RE button will be disabled.</li> </ul>
Auto-Tuning has just completed.	<ul style="list-style-type: none"> <li>When Auto-Tuning completes, the drive is switched back to the Programming Mode. The Run command will not be accepted unless the drive is in the Drive Mode.</li> <li>Use the digital operator to enter the Drive Mode. <i>Refer to The Drive and Programming Modes on page 85.</i></li> </ul>
A Fast Stop was executed and has not yet been reset.	Reset the Fast Stop command.
Settings are incorrect for the source that provides the Run command.	<p>Check parameter b1-02 (Run Command Source 1). Set b1-02 so that it corresponds with the correct Run command source.</p> <p>0: Digital operator  1: Control circuit terminal (default setting)  2: MEMOBUS/Modbus communications  3: Option card</p>
There is faulty wiring in the control circuit terminals.	<ul style="list-style-type: none"> <li>Check the wiring for the control terminal.</li> <li>Correct wiring mistakes.</li> <li>Check the input terminal status monitor (U1-10).</li> </ul>
The drive has been set to accept the frequency reference from the incorrect source.	<p>Check parameter b1-01 (Frequency Reference Source 1). Set b1-01 to the correct source of the frequency reference.</p> <p>0: Digital operator  1: Control circuit terminal (default setting)  2: MEMOBUS/Modbus communications  3: Option card  4: Pulse train input (RP)</p>
The terminal set to accept the main speed reference is set to the incorrect voltage and/or current.	<p>If the frequency reference is set at terminal A1, check parameter H3-01 for the correct signal level selection. If terminal A2 is used, check DIP switch S1 parameter H3-08. If terminal A3 is used, check parameter H3-08. <i>Refer to Terminal A2 Input Signal Selection on page 70.</i></p>
Selection for the sink/source mode and the internal/external power supply is incorrect.	Check jumper S3. <i>Refer to Sinking/Sourcing Mode Switch for Digital Inputs on page 68.</i>
Frequency reference is too low.	<ul style="list-style-type: none"> <li>Check the frequency reference monitor (U1-01).</li> <li>Increase the frequency by changing the maximum output frequency (E1-09).</li> </ul>
Multi-function analog input is set up to accept gain for the frequency reference, but no voltage (current) has been provided.	<ul style="list-style-type: none"> <li>Check the multi-function analog input settings.</li> <li>Check if analog input A1, A2, or A3 is set for frequency reference gain (H3-02, H3-10, H3-06 = 1). If so, check if the correct signal is applied to the terminal. The gain and the frequency reference will be 0 if no signal is applied to the gain input.</li> <li>Check if H3-02, H3-10, and H3-06 have been set to the proper values.</li> <li>Check if the analog input value has been set properly. (U1-13 to U1-15)</li> </ul>

Cause	Possible Solutions
The  button was pressed when the drive was started from a REMOTE source.	<ul style="list-style-type: none"> <li>When the  button is pressed, the drive will decelerate to stop.</li> <li>Switch off the Run command and then re-enter a new Run command.</li> <li>The  button can be disabled when o2-02 is set to 0.</li> </ul>
Motor starting torque is too low.	<i>Refer to Motor Performance Fine-Tuning on page 284</i>
Frequency reference value is too low or the drive does not accept the value entered.	Enter a value that is above the minimum output frequency determined by E1-09.
The sequence Start/Stop sequence is set up incorrectly.	<ul style="list-style-type: none"> <li>If the drive is supposed to be set up for a 2-wire sequence, then ensure parameters H1-03 through H1-08 are not set to 0.</li> <li>If the drive is supposed to be set up for a 3-wire sequence, then one of the parameters H1-03 through H1-08 must be set to 0. Terminal S1 will become the Start, terminal S2 will become the Stop input.</li> </ul>

### ? Motor Rotates in the Opposite Direction from the Run Command

Cause	Possible Solutions
Phase wiring between the drive and motor is incorrect.	<ul style="list-style-type: none"> <li>Check the motor wiring.</li> <li>Switch two motor cables (U, V, and W) to reverse motor direction.</li> <li>Connect drive output terminals U/T1, V/T2, and W/T3 in the right order to match motor terminals U, V, and W.</li> <li>Change the setting of parameter b1-14.</li> </ul>
The forward direction for the motor is setup incorrectly.	<p>Typically, forward is designated as being counterclockwise when looking from the motor shaft (see figure below).</p>  <p>1. <b>Forward Rotating Motor (looking down the motor shaft)</b> 2. <b>Motor Shaft</b></p>
The motor is running at almost 0 Hz and the Speed Search estimated the speed to be in the opposite direction.	Disable bi-directional search (b3-14 = "0") so that Speed Search is performed only in the specified direction.

**Note:** Check the motor specifications for the forward and reverse directions. The motor specifications will vary depending on the manufacturer of the motor.

### ? Motor Rotates in One Direction Only

Cause	Possible Solutions
The drive prohibits reverse rotation.	<ul style="list-style-type: none"> <li>Check parameter b1-04.</li> <li>Set the drive to allow the motor to rotate in reverse (b1-04 = 0).</li> </ul>
A Reverse run signal has not been entered, although 3-wire sequence is selected.	Make sure that one of the input terminals S3 to S8 used for the 3-wire sequence has been set for reverse.

### ? Motor is Too Hot

Cause	Possible Solutions
The load is too heavy.	<p>If the load is too heavy for the motor, the motor will overheat as it exceeds its rated torque value for an extended period of time. Keep in mind that the motor also has a short-term overload rating in addition to the possible solutions provided below:</p> <ul style="list-style-type: none"> <li>Reduce the load.</li> <li>Increase the acceleration and deceleration times.</li> <li>Check the values set for the motor protection (L1-01, L1-02) as well as the motor rated current (E2-01).</li> <li>Increase motor capacity.</li> </ul>
The air around the motor is too hot.	<ul style="list-style-type: none"> <li>Check the ambient temperature.</li> <li>Cool the area until it is within the specified temperature range.</li> </ul>

## 6.10 Troubleshooting without Fault Display

Cause	Possible Solutions
The drive is operating in a vector control mode but Auto-Tuning has not yet been performed.	<ul style="list-style-type: none"> <li>Perform Auto-Tuning.</li> <li>Calculate the motor value and reset the motor parameters.</li> <li>Change the motor control method to V/f Control (A1-02 = 0).</li> </ul>
Insufficient voltage insulation between motor phases.	<p>When the motor cable is long, high voltage surges occur between the motor coils and drive switching. Normally, surges can reach up to three times the drive input power supply voltage (600 V for 200 V class, and 1200 V for 400 V class).</p> <ul style="list-style-type: none"> <li>Use a motor with a voltage tolerance higher than the max voltage surge.</li> <li>Use a motor designed to work specifically with a drive when using a 400 V class unit.</li> <li>Install an AC reactor on the output side of the drive. The carrier frequency should be set to 2 kHz when installing an AC reactor.</li> </ul>
The motor fan has stopped or is clogged.	Check the motor fan.

### ? Drive Does Not Allow Selection the Desired Auto-Tuning Mode

Cause	Possible Solutions
The desired Auto-Tuning mode is not available for the selected control mode.	<ul style="list-style-type: none"> <li>Check if the desired tuning mode is available for the selected control mode. Refer to Auto-Tuning on page 95.</li> <li>Change the motor control method by setting A1-02.</li> </ul>

### ? oPE02 Error Occurs When Lowering the Motor Rated Current Setting

Cause	Possible Solutions
Motor rated current and the motor no-load current setting in the drive are incorrect.	<ul style="list-style-type: none"> <li>The user is trying to set the motor rated current in E2-01 to a value lower than the no-load current set in E2-03.</li> <li>Make sure that value set in E2-01 is higher than E2-03.</li> <li>If it is necessary to set E2-01 lower than E2-03, first lower the value set to E2-03, then change the setting in E2-01 as needed.</li> </ul>

### ? Motor Stalls during Acceleration or Acceleration Time is Too Long

Cause	Possible Solutions
Torque limit has been reached or current suppression keeps the drive from accelerating.	Take the following steps to resolve the problem: <ul style="list-style-type: none"> <li>Reduce the load.</li> <li>Increase motor capacity.</li> </ul>
Load is too heavy.	<b>Note:</b> Although the drive has a Stall Prevention function and a Torque Compensation Limit
Torque limit is not set properly.	Check the torque limit setting.
Frequency reference is too low.	<ul style="list-style-type: none"> <li>Check the maximum output frequency (E1-04).</li> <li>Increase E1-04 if it is set too low.</li> </ul>
	Check U1-01 for proper frequency reference.
	Check if a frequency reference signal switch has been set to one of the multi-function input terminals.
	Check for low gain level set to terminals A1, A2, or A3 (H3-03, H3-11, H3-07).
Load is too heavy.	Reduce the load so that the output current remains within the motor rated current.
	<ul style="list-style-type: none"> <li>Increase the acceleration time.</li> <li>Check if the mechanical brake is fully releasing as it should.</li> </ul>
	Check if the acceleration time parameters have been set too long (C1-01, C1-03, C1-05, C1-07).
Motor characteristics and drive parameter settings are incompatible with one another.	<ul style="list-style-type: none"> <li>Set the correct V/f pattern so that it matches the characteristics of the motor being used.</li> <li>Execute Rotational Auto-Tuning.</li> </ul>
Although the drive is operating in Open Loop Vector motor control method, Auto-Tuning has not been performed.	<ul style="list-style-type: none"> <li>Perform Auto-Tuning.</li> <li>Calculate motor data and reset motor parameters.</li> <li>Switch to V/f Control (A1-02 = 0).</li> </ul>
Incorrect frequency reference setting.	<ul style="list-style-type: none"> <li>Check the multi-function analog input settings. Multi-function analog input terminal A1, A2, or A3 is set for frequency gain (H3-02, H3-10, or H3-06 is set to "1"), but there is no voltage or current input provided.</li> <li>Make sure H3-02, H3-10, and H3-06 are set to the proper values.</li> <li>See if the analog input value is set to the right value (U1-13 to U1-15).</li> </ul>

Cause	Possible Solutions
The Stall Prevention level during acceleration and deceleration set too low.	<ul style="list-style-type: none"> <li>Check the Stall Prevention level during acceleration (L3-02).</li> <li>If L3-02 is set too low, acceleration may be taking too long.</li> <li>Increase L3-02.</li> </ul>
The Stall Prevention level during run has been set too low.	<ul style="list-style-type: none"> <li>Check the Stall Prevention level during run (L3-06).</li> <li>If L3-06 is set too low, speed will drop as the drive outputs torque.</li> <li>Increase the setting value.</li> </ul>
Drive reached the limitations of the V/f motor control method.	<ul style="list-style-type: none"> <li>The motor cable may be long enough (over 50 m) to require Auto-Tuning for line-to-line resistance.</li> <li>Be aware that V/f Control is comparatively limited when it comes to producing torque at low speeds.</li> <li>Consider switching to Open Loop Vector Control.</li> </ul>

## ? Drive Frequency Reference Differs from the Controller Frequency Reference Command

Cause	Possible Solutions
The analog input gain and bias for the frequency reference input are set to incorrect values.	<ul style="list-style-type: none"> <li>Check the gain and bias settings for the analog inputs that are used to set the frequency reference. Check parameters H3-03 and H3-04 for input A1, check parameters H3-11 and H3-12 for input A2, and check parameters H3-07 and H3-08 for input A3.</li> <li>Set these parameters to the appropriate values.</li> </ul>
A frequency bias signal is being entered via analog input terminals A1 to A3.	<ul style="list-style-type: none"> <li>If more than one of multi-function analog inputs A1 to A3 is set for frequency reference bias (H3-02, H3-10, or H3-06 is set to "0"), then the sum of all signals builds the frequency reference.</li> <li>Make sure that H3-02, H3-10, and H3-06 are set appropriately.</li> <li>Check the input level set for terminals A1 to A3 (U1-13 to U1-15).</li> </ul>
PID control is enabled, and the drive is consequently adjusting the output frequency to match the PID setpoint. The drive will only accelerate to the maximum output frequency set in E1-04 while PID control is active.	If PID control is not necessary for the application, disable it by setting b5-01 to "0".

## ? Excessive Motor Oscillation and Erratic Rotation

Cause	Possible Solutions
Poor balance between motor phases.	Check drive input power voltage to ensure that it provides stable power.
Hunting prevention function is disabled.	<ul style="list-style-type: none"> <li>Enable Hunting Prevention (n1-01 = 1).</li> <li>Increase the AFR gain (n2-01) or the AFR time constant 1 (n2-02).</li> </ul>

## ? Deceleration Takes Longer Than Expected with Dynamic Braking Enabled

Cause	Possible Solutions
L3-04 is set incorrectly.	<ul style="list-style-type: none"> <li>Check the Stall Prevention level during deceleration (L3-04).</li> <li>If a braking resistor option has been installed, disable Stall Prevention during deceleration (L3-04 = 0).</li> </ul>
The deceleration time is set too long.	Set deceleration to more appropriate time (C1-02, C1-04, C1-06, C1-08).
Insufficient motor torque.	<ul style="list-style-type: none"> <li>Assuming parameter settings are normal and that no overvoltage occurs when there is insufficient torque, it is likely that the demand on the motor has exceeded the motor capacity.</li> <li>Use a larger motor.</li> </ul>
Reaching the torque limit.	<ul style="list-style-type: none"> <li>Check the settings for the torque limit (L7-01 through L7-04).</li> <li>If the torque limit is enabled, deceleration might take longer than expected because the drive cannot output more torque than the limit setting. Ensure the torque limit is set to a high enough value.</li> <li>Increase the torque limit setting.</li> <li>If multi-function analog input terminal A1, A2, or A3 is set to torque limit (H3-02, H3-10, or H3-06 equals 10, 11, 12, or 15), ensure that the analog input levels are set to the correct levels.</li> <li>Ensure H3-02, H3-10, and H3-06 are set to the right levels.</li> <li>Ensure the analog input is set to the correct value (U1-13 to U1-15).</li> </ul>
Load exceeded the internal torque limit determined by the drive rated current.	Switch to a larger capacity drive.

## 6.10 Troubleshooting without Fault Display

### ? Load Falls When Brake is Applied

Cause	Possible Solutions
Insufficient DC Injection Braking.	Increase the amount of DC Injection Braking (b2-02).

### ? Noise From Drive or Output Lines When the Drive is Powered On

Cause	Possible Solutions
Relay switching in the drive generates excessive noise.	<ul style="list-style-type: none"><li>• Lower the carrier frequency (C6-02).</li><li>• Install a noise filter on the input side of drive input power.</li><li>• Install a noise filter on the output side of the drive.</li><li>• Place the wiring inside a metal conduit to shield it from switching noise.</li><li>• Ground the drive and motor properly.</li><li>• Separate the main circuit wiring and the control lines.</li><li>• Make sure wires and the motor have been properly grounded.</li></ul>

### ? Ground Fault Circuit Interrupter (GFCI) Trips During Run

Cause	Possible Solutions
Excessive leakage current trips GFCI.	<ul style="list-style-type: none"><li>• Increase the GFCI sensitivity or use GFCI with a higher threshold.</li><li>• Lower the carrier frequency (C6-02).</li><li>• Reduce the length of the cable used between the drive and the motor.</li><li>• Install a noise filter or reactor on the output side of the drive. Set the carrier frequency to 2 kHz when connecting a reactor.</li></ul>

### ? Connected Machinery Vibrates When Motor Rotates

#### ? Unexpected Noise from Connected Machinery

Cause	Possible Solutions
The carrier frequency is at the resonant frequency of the connected machinery.	Adjust the carrier frequency using parameters C6-02 through C6-05.
The drive output frequency is the same as the resonant frequency of the connected machinery.	Place the motor on a rubber pad to reduce vibration.

### ? Oscillation or Hunting

Cause	Possible Solutions
Insufficient tuning.	Perform Auto-Tuning. Refer to <i>Motor Performance Fine-Tuning on page 284</i> .
Gain is too low when using PID control.	Refer to b5: PID Control on page 135 for details.
The frequency reference is assigned to an external source and the signal is noisy.	<ul style="list-style-type: none"><li>• Ensure that noise is not affecting the signal lines.</li><li>• Separate main circuit wiring and control circuit wiring.</li><li>• Use twisted-pair cables or shielded wiring for the control circuit.</li><li>• Increase the analog input time filter constant (H3-13).</li></ul>
The cable between the drive and motor is too long.	<ul style="list-style-type: none"><li>• Perform Auto-Tuning.</li><li>• Reduce the length of the cable.</li></ul>

## ? PID Output Fault

Cause	Possible Solutions
No PID feedback input.	<ul style="list-style-type: none"> <li>Check the multi-function analog input terminal settings.</li> <li>Set multi-function analog input terminal A1, A2, or A3 for PID feedback (H3-02, H3-10, or H3-06 = "B").</li> <li>A signal input to the terminal selection for PID feedback is needed.</li> <li>Check the connection of the feedback signal.</li> <li>Check the various PID-related parameter settings.</li> <li>No PID feedback input to the terminal causes the value detected to be 0, causing a PID fault and the drive to operate at max frequency.</li> </ul>
The level of detection and the target value do not correspond with each other.	<ul style="list-style-type: none"> <li>PID control keeps the difference between target and detection values at 0. Set the input level for the values relative to one another.</li> <li>Use analog input gains H3-03 and H3-11 to adjust PID target and feedback signal scaling.</li> </ul>
Reverse drive output frequency and speed detection. When output frequency rises, the sensor detects a speed decrease.	Set PID output for reverse characteristics (b5-09 = 1).
Adjustment made to PID parameter settings are insufficient.	Refer to b5: PID Control on page 135 for details.

## ? Insufficient Starting Torque

Cause	Possible Solutions
Auto-Tuning has not yet been performed (required for vector control modes).	Perform Auto-Tuning. Refer to <i>Motor Performance Fine-Tuning on page 284</i> .
The control mode was changed after performing Auto-Tuning.	Perform Auto-Tuning again.
Only Stationary Auto-Tuning was performed.	Perform Rotational Auto-Tuning.

## ? Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking)

Cause	Possible Solutions
DC Injection Braking is set too low and the drive cannot decelerate properly.	<ul style="list-style-type: none"> <li>Adjust the DC Injection braking settings.</li> <li>Increase the current level for DC Injection Braking (b2-02).</li> <li>Increase the DC Injection Braking time at stop (b2-04).</li> </ul>
The stopping method is set so that the drive coasts to stop.	Set b1-03 (Stopping Method Selection) to 0 or 2.

## ? Output Frequency is not as High as Frequency Reference

Cause	Possible Solutions
Upper limit for the frequency reference has been exceeded.	<ul style="list-style-type: none"> <li>Set the maximum output frequency and the upper limit for the frequency reference to more appropriate values (E1-04, d2-01).</li> <li>The following calculation yields the upper value for the output frequency = <math>E1-04 \times d2-01 / 100</math></li> </ul>
Large load triggered Stall Prevention function during acceleration.	<ul style="list-style-type: none"> <li>Reduce the load.</li> <li>Adjust the Stall Prevention level during acceleration (L3-02).</li> </ul>

## ? Buzzing Sound from Motor at 2 kHz

Cause	Possible Solutions
Exceeded 110% of the rated output current of the drive while operating at low speeds.	<ul style="list-style-type: none"> <li>If the output current rises too high at low speeds, the carrier frequency is automatically reduced and causes a whining or buzzing sound.</li> <li>If the sound is coming from the motor, disable carrier frequency derating (L8-38 = 0).</li> <li>Disabling the automatic carrier frequency derating increases the chances of an overload fault (oL2). Switch to a larger capacity motor if oL2 faults occur too frequently.</li> </ul>

### ? Unstable Motor Speed when Using PM

Cause	Possible Solutions
The motor code for the PM motor (E5-01 or T2-02) is set incorrectly (Yaskawa motors only).	Refer to <i>Motor Performance Fine-Tuning on page 284</i> for details.
Drive is attempting to operate the motor beyond the speed control range listed in the specifications.	Check the speed control range and adjust the speed accordingly.
Motor hunting occurs.	Refer to <i>Motor Performance Fine-Tuning on page 284</i> for details.
Hunting occurs at start.	Increase the S-curve time at the start of acceleration (C2-01).
Too much current is flowing through the drive.	<ul style="list-style-type: none"><li>• Enter the correct motor code for the PM motor being used into E5-01.</li><li>• For special-purpose motors, enter the correct data to all E5 parameters according to the test report provided for the motor.</li></ul>

### ? Motor Does Not Restart after Power Loss

Cause	Possible Solutions
The Run command was not issued again when power was restored.	<ul style="list-style-type: none"><li>• Check the sequence and wiring that has been set up to enter the Run command.</li><li>• A relay should be set up to make sure the Run command remains enabled throughout any power loss.</li></ul>
The relay that is supposed to maintain the Run command has been switched off.	Check wiring and circuitry for the relay intended to keep the Run command enabled.

## Periodic Inspection & Maintenance

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This chapter describes the periodic inspection and maintenance of the drive to ensure that it receives the proper care to maintain overall performance.

<b>7.1</b>	<b>SECTION SAFETY</b> .....	<b>344</b>
<b>7.2</b>	<b>INSPECTION</b> .....	<b>347</b>
<b>7.3</b>	<b>PERIODIC MAINTENANCE</b> .....	<b>350</b>
<b>7.4</b>	<b>COOLING FAN AND CIRCULATION FAN</b> .....	<b>352</b>
<b>7.5</b>	<b>DRIVE REPLACEMENT</b> .....	<b>364</b>

## 7.1 Section Safety

### DANGER

#### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label once all indicators are OFF, and then measure the DC bus voltage level to confirm it has reached a safe level.

**Never connect or disconnect wiring, remove connectors or option cards, or replace the cooling fan while the power is on.**

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off.

### WARNING

#### Electrical Shock Hazard

**Do not operate equipment with covers removed.**

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

**Always ground the motor-side grounding terminal.**

Improper equipment grounding could result in death or serious injury by contacting the motor case.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

**Do not allow unqualified personnel to perform work on the drive.**

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of AC drives.

**Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.**

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

**Do not touch any terminals before the capacitors have fully discharged.**

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**⚠ WARNING****Fire Hazard**

**Tighten all terminal screws to the specified tightening torque.**

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

**Do not use an improper voltage source.**

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

**Do not use improper combustible materials.**

Failure to comply could result in death or serious injury by fire.

Attach the drive to metal or other noncombustible material.

**NOTICE**

**Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Follow cooling fan replacement instructions. The cooling fan cannot operate properly when it is installed incorrectly and could seriously damage the drive.**

Follow the instructions in this manual to replace the cooling fan, making sure that the label is on top before inserting the cooling fan into the drive. To ensure maximum useful product life, replace both cooling fans when performing maintenance.

**Never connect or disconnect the motor from the drive while the drive is outputting voltage.**

Improper equipment sequencing could result in damage to the drive.

**Do not use unshielded cable for control wiring.**

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive.

**Do not allow unqualified personnel to use the product.**

Failure to comply could result in damage to the drive or braking circuit.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

**Do not modify the drive circuitry.**

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for any modification of the product made by the user. This product must not be modified.

**Check all the wiring to ensure that all connections are correct after installing the drive and connecting any other devices.**

Failure to comply could result in damage to the drive.

**Comply with proper wiring practices.**

The motor may run in reverse if the phase order is backward.

Connect motor input terminals U, V and W to drive output terminals U/T1, V/T2, and W/T3. The phase order for the drive and motor should match.

### NOTICE

**Frequently switching the drive power supply to stop and start the motor can damage the drive.**

To get the full performance life out of the electrolytic capacitors and circuit relays, refrain from switching the drive power supply off and on more than once every 30 minutes. Frequent use can damage the drive. Use the drive to stop and start the motor.

**Do not operate damaged equipment.**

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

## 7.2 Inspection

Power electronics have limited life and may exhibit changes in characteristics or performance deterioration after years of use under normal conditions. To help avoid such problems, it is important to perform preventive maintenance and periodic inspection on the drive.

Drives contain a variety of power electronics such as power transistors, semiconductors, capacitors, resistors, fans, and relays. The electronics in the drive serve a critical role in maintaining proper motor control.

Follow the inspection lists provided in this chapter as a part of a regular maintenance program.

**Note:** The drive will require more frequent inspection if it is placed in harsh environments, such as:

- High ambient temperatures
- Frequent starting and stopping
- Fluctuations in the AC supply or load
- Excessive vibrations or shock loading
- Dust, metal dust, salt, sulfuric acid, chlorine atmospheres
- Poor storage conditions.

Perform the first equipment inspection one to two years after installation.

### ? Recommended Daily Inspection

**Table 7.1** outlines the recommended daily inspection for Yaskawa drives. Check the following items on a daily basis to avoid premature deterioration in performance or product failure. Copy this checklist and mark the “Checked” column after each inspection.

**Table 7.1 General Recommended Daily Inspection Checklist**

Inspection Category	Inspection Points	Corrective Action	Checked
<b>Motor</b>	<ul style="list-style-type: none"> <li>• Inspect for abnormal oscillation or noise coming from the motor.</li> </ul>	<ul style="list-style-type: none"> <li>• Check the load coupling.</li> <li>• Measure motor vibration.</li> <li>• Tighten all loose components.</li> </ul>	
<b>Cooling</b>	<ul style="list-style-type: none"> <li>• Inspect for abnormal heat generated from the drive or motor and visible discoloration.</li> </ul>	<ul style="list-style-type: none"> <li>• Check for excessive load.</li> <li>• Loose connections</li> <li>• Check for dirty heatsink or motor.</li> <li>• Ambient temperature</li> </ul>	
<b>Cooling Fan</b>	<ul style="list-style-type: none"> <li>• Inspect drive cooling fan and circulation fan operation.</li> </ul>	<ul style="list-style-type: none"> <li>• Check for clogged or dirty fan.</li> <li>• Check fan operation drive parameter.</li> </ul>	
<b>Environment</b>	<ul style="list-style-type: none"> <li>• Verify the drive environment complies with the specifications listed in <i>Installation Environment on page 36</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• Eliminate the source of contaminants or correct poor environment.</li> </ul>	
<b>Load</b>	<ul style="list-style-type: none"> <li>• The drive output current should not be higher than the motor or drive rating for an extended period of time.</li> </ul>	<ul style="list-style-type: none"> <li>• Check for excessive load.</li> <li>• Check the motor parameter settings of the drive.</li> </ul>	
<b>Power Supply Voltage</b>	<ul style="list-style-type: none"> <li>• Check main power supply and control voltages.</li> </ul>	<ul style="list-style-type: none"> <li>• Correct the voltage or power supply to within nameplate specifications.</li> <li>• Verify all main circuit phases.</li> </ul>	

## ? Recommended Periodic Inspection

**Table 7.2** outlines the recommended periodic inspections for Yaskawa drive installations. Although periodic inspections should generally be performed once a year; the drive may require more frequent inspection in harsh environments or with rigorous use. Operating and environmental conditions, along with experience in each application, will determine the actual inspection frequency for each installation. Periodic inspection will help to avoid premature deterioration in performance or product failure. Copy this checklist and mark the “Checked” column after each inspection.

## ? Periodic Inspection

**WARNING! Electrical Shock Hazard.** Do not inspect, connect, or disconnect any wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**Table 7.2 Periodic Inspection Checklist**

Inspection Area	Inspection Points	Corrective Action	Checked
<b>Main Circuit Periodic Inspection</b>			
<b>General</b>	<ul style="list-style-type: none"> <li>Inspect equipment for discoloration from overheating or deterioration.</li> <li>Inspect for damaged or deformed parts.</li> </ul>	<ul style="list-style-type: none"> <li>Replace damaged components as required.</li> <li>The drive has few serviceable parts and may require complete drive replacement.</li> </ul>	
	<ul style="list-style-type: none"> <li>Inspect for dirt, foreign particles, or dust collection on components.</li> </ul>	<ul style="list-style-type: none"> <li>Inspect enclosure door seal if used.</li> <li>Remove foreign particles and dust by sucking them out with a vacuum cleaner to avoid touching parts.</li> <li>Replace components if cleaning is not possible.</li> </ul>	
<b>Conductors and Wiring</b>	<ul style="list-style-type: none"> <li>Inspect wiring and connections for discoloration, damage, or heat stress.</li> <li>Inspect wire insulation and shielding for wear.</li> </ul>	<ul style="list-style-type: none"> <li>Repair or replace damaged wiring.</li> </ul>	
<b>Terminals</b>	<ul style="list-style-type: none"> <li>Inspect terminals for stripped, damaged, or loose connections.</li> </ul>	<ul style="list-style-type: none"> <li>Tighten loose screws and replace damaged screws or terminals.</li> </ul>	
<b>Relays and Contactors</b>	<ul style="list-style-type: none"> <li>Inspect contactors and relays for excessive noise during operation.</li> <li>Inspect coils for signs of overheating such as melted or cracked insulation.</li> </ul>	<ul style="list-style-type: none"> <li>Check coil voltage for over or under voltage conditions.</li> <li>Replace damaged removable relays contactors or circuit board.</li> </ul>	
<b>Braking Resistors</b>	<ul style="list-style-type: none"> <li>Inspect for discoloration of heat stress on or around resistors.</li> </ul>	<ul style="list-style-type: none"> <li>Minor discoloration may be acceptable.</li> <li>If discoloration exists check for loose connections.</li> </ul>	
<b>Electrolytic Capacitor</b>	<ul style="list-style-type: none"> <li>Inspect for leaking, discoloration, or cracks.</li> <li>Check if the cap has come off, for any swelling, or if the sides have burst open.</li> </ul>	<ul style="list-style-type: none"> <li>The drive has few serviceable parts and may require complete drive replacement.</li> </ul>	
<b>Diode, IGBT (Power Transistor)</b>	<ul style="list-style-type: none"> <li>Inspect for dust or other foreign material collected on the surface.</li> </ul>	<ul style="list-style-type: none"> <li>Remove foreign particles and dust by sucking them out with a vacuum cleaner to avoid touching parts.</li> </ul>	
<b>Motor Periodic Inspection</b>			
<b>Operation Check</b>	<ul style="list-style-type: none"> <li>Check for increased vibration or abnormal noise.</li> </ul>	<ul style="list-style-type: none"> <li>Stop the motor and contact qualified maintenance personnel as required.</li> </ul>	
<b>Control Circuit Periodic Inspection</b>			
<b>General</b>	<ul style="list-style-type: none"> <li>Inspect terminals for stripped, damaged, or loose connections.</li> <li>Make sure all terminals have been properly tightened.</li> </ul>	<ul style="list-style-type: none"> <li>Tighten loose screws and replace damaged screws or terminals.</li> <li>If terminals are integral to a circuit board, then board or drive replacement may be required.</li> </ul>	
<b>Circuit Boards</b>	<ul style="list-style-type: none"> <li>Check for any odor, discoloration, and rust. Make sure connections are properly fastened and that no dust or oil mist has accumulated on the surface of the board.</li> </ul>	<ul style="list-style-type: none"> <li>Fix any loose connections.</li> <li>If an antistatic cloth or vacuum plunger can't be used, replace the board.</li> <li>Do not use any solvents to clean the board.</li> <li>Remove foreign particles and dust by sucking them out with a vacuum cleaner to avoid touching parts.</li> <li>The drive has few serviceable parts and may require complete drive replacement.</li> </ul>	

Inspection Area	Inspection Points	Corrective Action	Checked
<b>Cooling System Periodic Inspection</b>			
<b>Cooling Fan, Circulation Fan</b>	<ul style="list-style-type: none"> <li>• Check for abnormal oscillation or unusual noise.</li> <li>• Check for damaged or missing fan blades.</li> </ul>	<ul style="list-style-type: none"> <li>• Replace as required.</li> <li>• <i>Refer to Cooling Fan and Circulation Fan on page 352</i> for information on cleaning or replacing the cooling fan.</li> </ul>	
<b>Heatsink</b>	<ul style="list-style-type: none"> <li>• Inspect for dust or other foreign material collected on the surface.</li> </ul>	<ul style="list-style-type: none"> <li>• Remove foreign particles and dust by sucking them out with a vacuum cleaner to avoid touching parts.</li> </ul>	
<b>Air Duct</b>	<ul style="list-style-type: none"> <li>• Inspect air intake and exhaust openings. They must be free from obstruction and properly installed.</li> </ul>	<ul style="list-style-type: none"> <li>• Visually inspect the area.</li> <li>• Clear obstructions and clean air duct as required.</li> </ul>	
<b>Display Periodic Inspection</b>			
<b>Digital Operator</b>	<ul style="list-style-type: none"> <li>• Make sure data appears on the operator properly.</li> <li>• Inspect for dust or other foreign material that may have collected on surrounding components.</li> </ul>	<ul style="list-style-type: none"> <li>• Contact your Yaskawa representative if there is any trouble with the display or keypad.</li> <li>• Clean the digital operator.</li> </ul>	

## 7.3 Periodic Maintenance

The drive has Maintenance Monitors that keep track of component wear. This feature provides advance maintenance warning and eliminates the need to shut down the entire system for unexpected problems. The drive allows the user to check predicted maintenance periods for the components listed below.

- Cooling Fan, Circulation Fan
- Electrolytic Capacitors
- Inrush Prevention Circuit
- IGBTs

### ? Replacement Parts

**Table 7.3** contains the estimated performance life of components that require replacement during the life of the drive. Only use Yaskawa replacement parts for the appropriate drive model and revision.

**Table 7.3 Estimated Performance Life**

Component	Estimated Performance Life
Cooling Fan, Circulation Fan	10 years
Electrolytic Capacitors	10 years </>

<1> The drive has few serviceable parts and may require complete drive replacement.

**NOTICE:** *Estimated performance life based on specific usage conditions. These conditions are provided for the purpose of replacing parts to maintain performance. Some parts may require more frequent replacement due to poor environments or rigorous use. Usage conditions for estimated performance life:*

- Ambient temperature: Yearly average of 40°C (IP20 enclosure)  
Yearly average of 30°C (side-by-side mounting/NEMA type 1 enclosure/finless drive or external heatsink installation)
- Load factor: 80% maximum
- Operation time: 24 hours a day

### ? Performance Life Monitors Maintenance Monitors

The drive calculates the maintenance period for components that may require replacement during the life of the drive. A percentage of the maintenance period is displayed on the digital operator by viewing the appropriate monitor parameter.

When the maintenance period reaches 100%, there is increased risk that the drive may malfunction. Yaskawa recommends checking the maintenance period regularly to ensure maximum performance life.

When using maintenance monitors, set parameter L8-12 (Ambient Temperature Setting) and L8-35 (Installation Method Selection) for use with the installation environment.

*Refer to Recommended Periodic Inspection on page 348* for more details.

**Table 7.4 Performance Life Monitors Used for Component Replacement**

Parameter	Component	Contents
U4-03	Cooling Fan, Circulation Fan	Displays the accumulated operation time of the fan, from 0 to 99999 hours. This value is automatically reset to 0 once it reaches 99999.
U4-04		Displays the accumulated fan operation time as a percentage of the specified maintenance period.
U4-05	DC Bus Capacitors	Displays the accumulated time the capacitors are used as a percentage of the specified maintenance period.
U4-06	Inrush (pre-charge) Relay	Displays the number of times the drive is powered up as a percentage of the performance life of the inrush circuit.
U4-07	IGBT	Displays the percentage of the maintenance period reached by the IGBTs.

## ? Alarm Outputs for Maintenance Monitors

An output can be set up to inform the user when a specific components has neared its expected performance life.

When one of multi-function digital output terminals has been assigned the maintenance monitor function (H2-□□ = 2F), the terminal will close when the cooling fan, circulation fan, DC bus capacitors, or DC bus pre-charge relay reach 90% of the expected performance life, or the IGBTs have reached 50% of their expect performance life. Additionally the digital operator will display an alarm like shown in [Table 7.5](#) to indicate the specific components that may need maintenance.

**Table 7.5 Maintenance Alarms**

Alarm Display		Function	Corrective Action
LED Operator	LCD Operator		
LT-1 <1>	LT-1	The fans have reached 90% of their designated life time.	Replace the fan.
LT-2 <2>	LT-2	The DC bus capacitors have reached 90% of their designated life time.	Replace the drive.
LT-3 <2>	LT-3	The DC bus charge circuit has reached 90% of its designated life time.	Replace the drive.
LT-4 <2>	LT-4	The IGBT's have reached 50% of their designated life time.	Check the load, carrier frequency, and output frequency.
LT-PC <2>	LTPC	The IGBT's have reached 90% of their designated life time.	Replace the drive.

<1> This alarm message will be output only if the Maintenance Monitor function is assigned to one of the digital outputs (H2-□□ = 2F). The alarm will also trigger a digital output that is programmed for alarm indication (H2-□□ = 10).

<2> This alarm message will always be output, even if the Maintenance Monitor function is not assigned to any of the digital outputs (H2-□□ = 2F). The alarm will also trigger a digital output that is programmed for alarm indication (H2-□□ = 10).

## ? Related Drive Parameters

Parameters o4-03, o4-05, o4-07, and o4-09 can be used to reset a Maintenance Monitor back to zero after a specific component has been replaced. [Refer to Parameter Table on page 408](#) for details on parameter settings.

**NOTICE:** If these parameters are not reset after the corresponding parts have been replaced, the Maintenance Monitor function will continue to count down the performance life from the value that was reached with the old part. If the Maintenance Monitor is not reset, the drive will not have the correct value of the performance life for the new component.

## 7.4 Cooling Fan and Circulation Fan

## 7.4 Cooling Fan and Circulation Fan

**NOTICE:** Follow cooling fan replacement instructions. The cooling fan cannot operate properly when installed incorrectly and could seriously damage the drive. To ensure maximum useful product life, replace all cooling fans when performing maintenance.

Contact your Yaskawa representative or the nearest Yaskawa sales office to order replacement cooling fans or circulation fans as required.

For drives with multiple cooling fans, replace all the fans when performing maintenance to ensure maximum product performance life.

### ? Number of Fans

Three-Phase 200 V Class				Three-Phase 400 V Class			
Model CIMR-T□	Cooling Fan	Circulation Fan	Page	Model CIMR-T□	Cooling Fan	Circulation Fan	Page
2A0004	—	—	—	4A0002	—	—	—
2A0006	—	—		4A0004	—	—	
2A0010	—	—		4A0005	—	—	
2A0012	—	—		4A0007	1	—	
2A0021	1	—	354	4A0009	1	—	354
2A0030	2	—		4A0011	1	—	
2A0040	2	—		4A0018	2	—	
2A0056	2	—		4A0023	2	—	
2A0069	2	—		4A0031	2	—	
2A0081	2	—		4A0038	2	—	
2A0110	2	—		4A0044	2	—	
2A0138	2	—	356	4A0058	2	—	356
2A0169	2	—	360	4A0072	2	—	358
2A0211	2	—		4A0088	2	—	
2A0250	2	—		4A0103	2	—	
2A0312	2	—		4A0139	2	—	360
2A0360	3	1		4A0165	2	—	
2A0415	3	1		4A0208	2	—	
				4A0250	3	—	
				4A0296	3	—	
				4A0362	3	1	

## ? Cooling Fan Component Names

**WARNING! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**CAUTION! Burn Hazard.** Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.

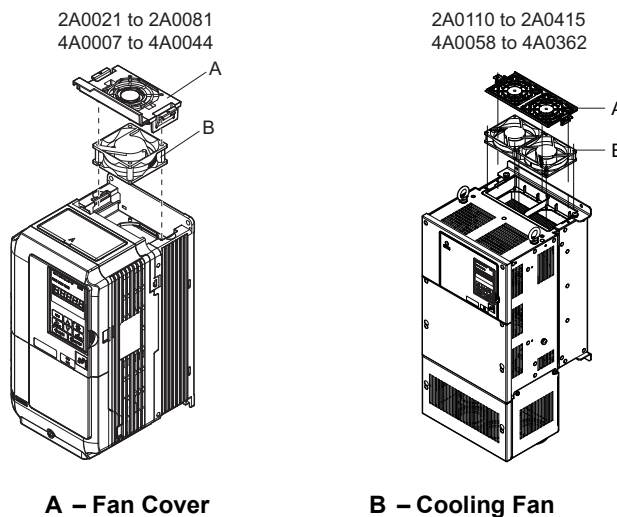


Figure 7.1 Cooling Fan Component Names: 2A0021 to 2A0415, 4A0007 to 4A0362

### ? Cooling Fan Replacement: 2A0021 to 2A0081 and 4A0007 to 4A0044

**WARNING! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**CAUTION! Burn Hazard.** Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.

**NOTICE: Prevent Equipment Damage.** Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could result in damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all fans when performing maintenance.

### ? Removing the Cooling Fan

1. Depress the right and left sides of the fan cover hooks and pull upward. Remove the fan cover from the top of the drive.

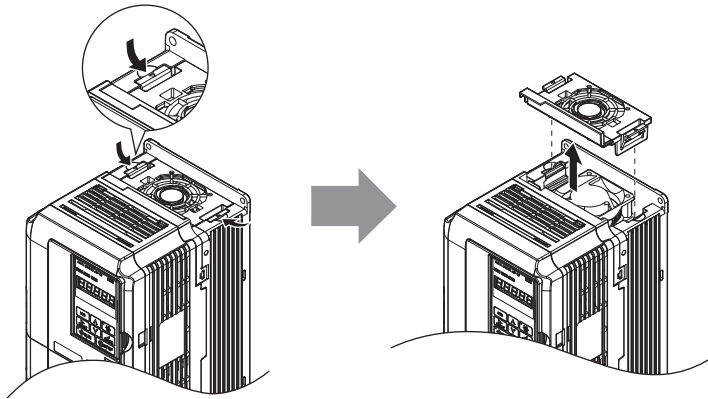


Figure 7.2 Removing the Fan Cover: 2A0021 to 2A0081, 4A0007 to 4A0044

2. Remove the cooling fan cartridge. Disconnect the pluggable connector and remove the fan.

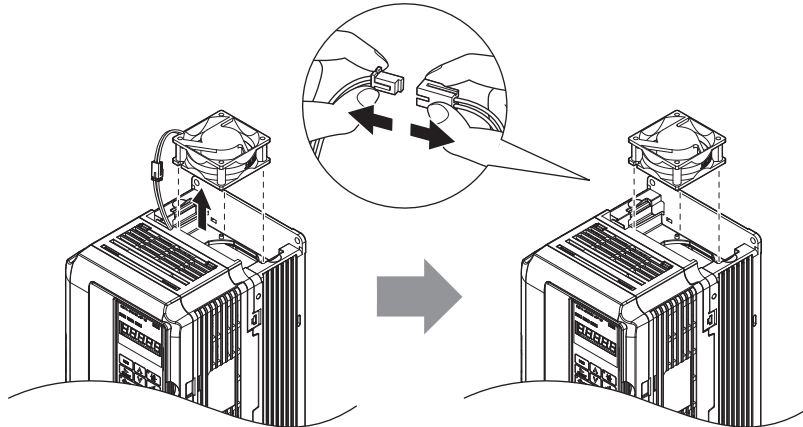
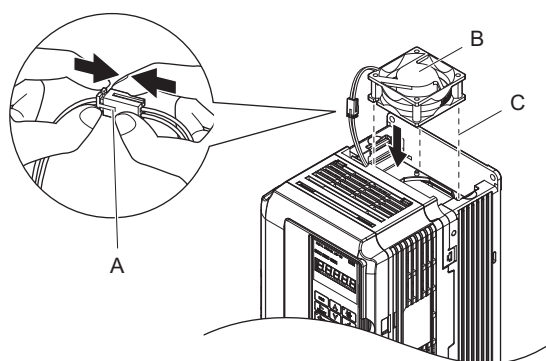


Figure 7.3 Removing the Cooling Fan: 2A0021 to 2A0081, 4A0007 to 4A0044

## ? Installing the Cooling Fan

Reverse the procedure described above to reinstall the cooling fan.

1. Install the replacement cooling fan into the drive, ensuring the alignment pins line up as shown in the figure below.



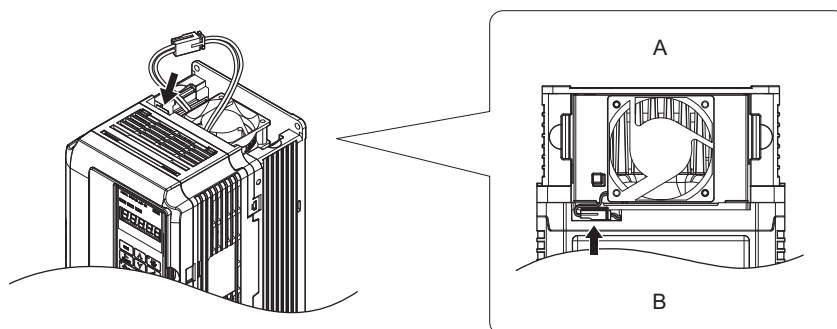
**A – Push the connectors together so no space remains between them.**

**B – Label facing up**

**C – Make sure the alignment pins line up properly**

**Figure 7.4 Installing the Cooling Fan: 2A0021 to 2A0081, 4A0007 to 4A0044**

2. Make sure the power lines for the fan are properly connected, then place the cable back into the recess of the drive.

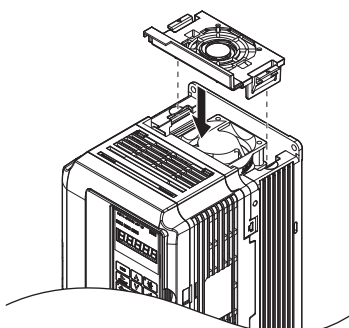


**A – Back**

**B – Front**

**Figure 7.5 Cooling Fan Power Supply Connectors: 2A0021 to 2A0081, 4A0007 to 4A0044**

3. While pressing in on the hooks on the left and right sides of the fan cover, guide the fan cover until it clicks back into place.



**Figure 7.6 Reattach the Fan Cover: 2A0021 to 2A0081, 4A0007 to 4A0044**

4. Turn the power supply back on and reset the cooling fan operation time for the Maintenance Monitor by setting o4-03 to 0.

### ? Cooling Fan Replacement: 2A0110 and 2A0138, 4A0058 and 4A0072

**WARNING! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**CAUTION! Burn Hazard.** Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.

**NOTICE: Prevent Equipment Damage.** Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could result in damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all fans when performing maintenance.

### ? Removing the Cooling Fan

1. While pressing in on the hooks located on the left and right sides of the fan cover, free the fan cover leading by lifting the back end first.

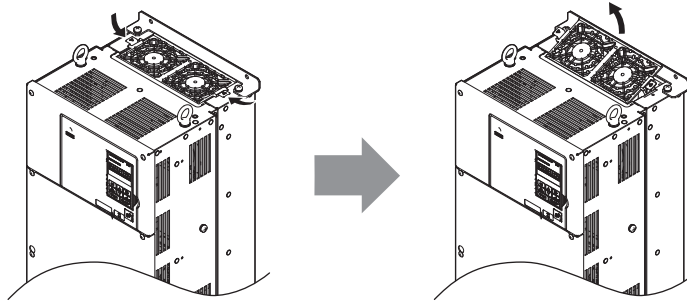


Figure 7.7 Removing the Cooling Fan Cover: 2A0110 and 2A0138, 4A0058 and 4A0072

2. Lift the fan cover out leading with the back end. Unplug the replay connector and free the fan cover from the drive.

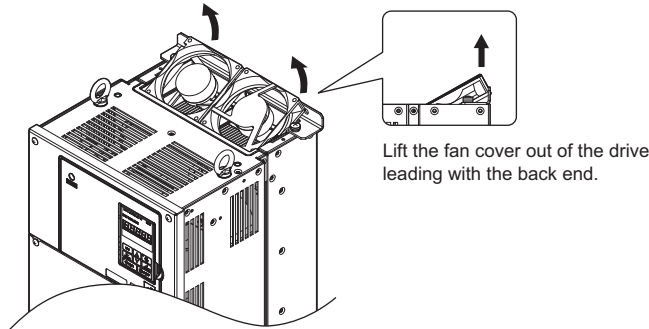
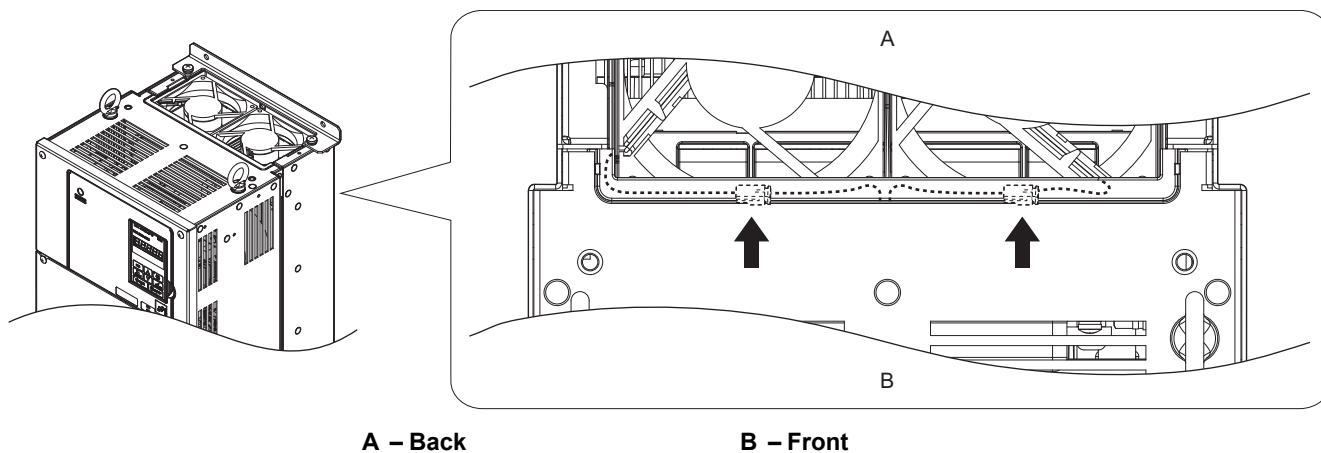


Figure 7.8 Removing the Cooling Fan: 2A0110 and 2A0138, 4A0058 and 4A0072

### ? Installing the Cooling Fan

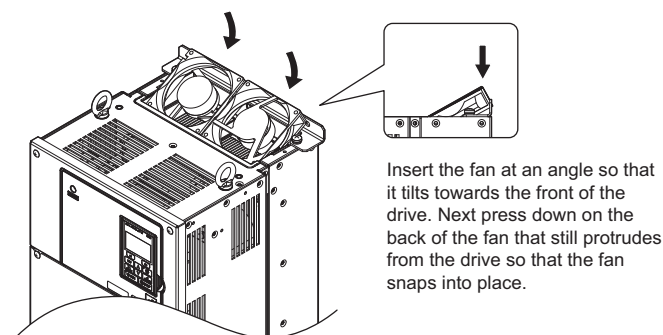
Reverse the procedure described above to reinstall the cooling fan.

1. Make sure the power lines for the fan are properly connected.
2. Place the power supply connectors and cable back into the recess of the drive.



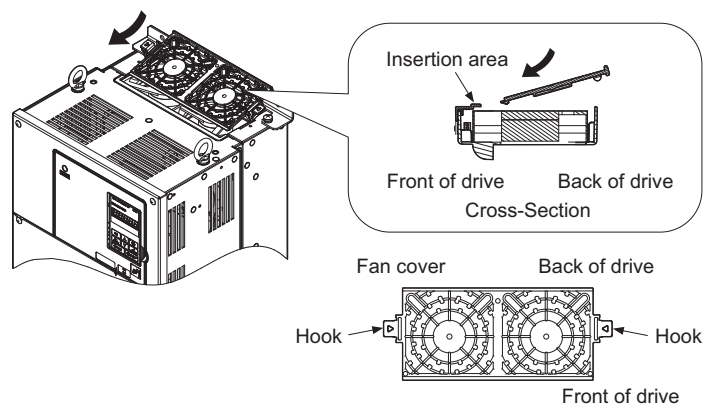
**Figure 7.9 Cooling Fan Power Supply Connectors: 2A0110 and 2A0138, 4A0058 and 4A0072**

3. Install the replacement fan into the drive.



**Figure 7.10 Installing the Cooling Fan: 2A0110 and 2A0138, 4A0058 and 4A0072**

4. Angle the fan cover so the back end tilts up. Slide the cover into the small opening towards the front of the drive, and then guide the entire fan cover into place.



**Figure 7.11 Reattach the Fan Cover: 2A0110 and 2A0138, 4A0058 and 4A0072**

## 7.4 Cooling Fan and Circulation Fan

5. While pressing in on the hooks on the left and right sides of the fan cover, guide the fan cover until it clicks back into place.

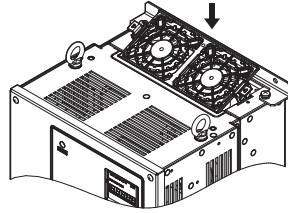


Figure 7.12 Reattach the Fan Cover: 2A0110 and 2A0138, 4A0058 and 4A0072

6. Turn the power supply back on and reset the cooling fan operation time for the Maintenance Monitor by setting o4-03 to 0.

### ? Cooling Fan Replacement: 4A0088 and 4A0103

**WARNING! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**CAUTION! Burn Hazard.** Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.

**NOTICE: Prevent Equipment Damage.** Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could result in damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all fans when performing maintenance.

### ? Removing the Cooling Fan

1. While pressing in on the hooks located on the left and right sides of the fan cover, free the fan cover leading by lifting the back end first.

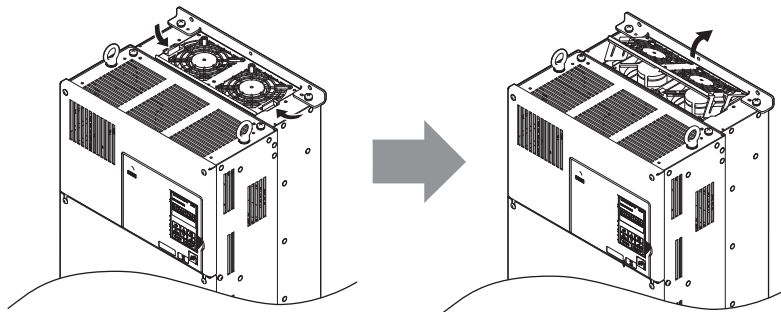


Figure 7.13 Removing the Cooling Fan Cover: 4A0088 and A0103

2. Lift the cooling fan directly up on the fan as shown below. Unplug the relay connector and free the fan from the drive.

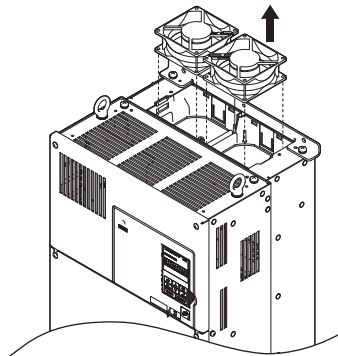
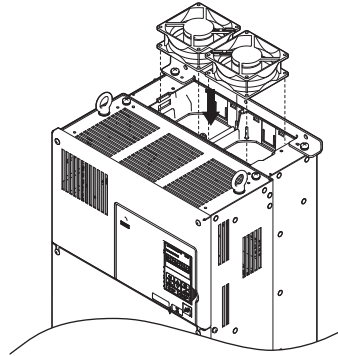


Figure 7.14 Removing the Cooling Fan: 4A0088 and 4A0103

### ? Installing the Cooling Fan

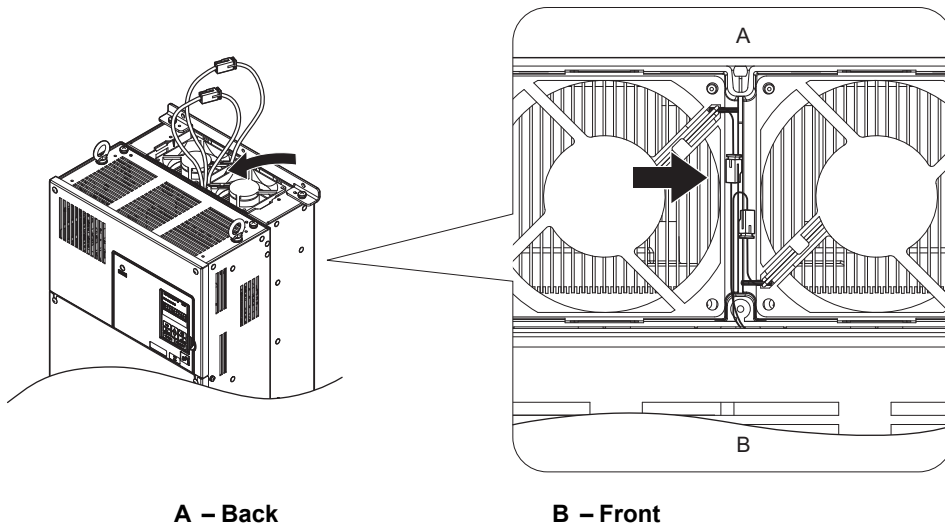
Reverse the procedure described above to reinstall the cooling fan.

1. Install the replacement fan into the drive, ensuring the alignment pins line up as shown in the figure below.



**Figure 7.15 Installing the Cooling Fan: 4A0088 and 4A0103**

2. Make sure the power lines for the fan are properly connected, then place the power supply connectors and cable back into the recess of the drive.

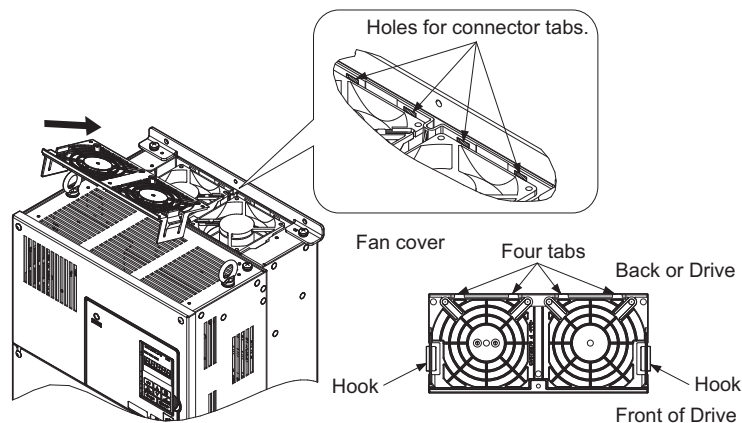


**A – Back**

**B – Front**

**Figure 7.16 Cooling Fan Power Supply Connectors: 4A0088 and 4A0103**

3. Angle the fan cover as shown and insert the connector tabs into the corresponding holes on the drive.



**Figure 7.17 Reattach the Fan Cover: 4A0088 and 4A0103**

## 7.4 Cooling Fan and Circulation Fan

4. While pressing in on the hooks on the left and right sides of the fan cover, guide the fan cover until it clicks back into place.

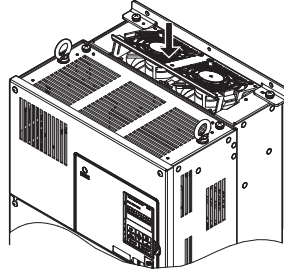


Figure 7.18 Reattach the Fan Cover: 4A0088 and 4A0103

5. Turn the power supply back on and reset the cooling fan operation time for the Maintenance Monitor by setting o4-03 to 0.

### ? Cooling Fan Replacement: 2A0169 to 2A0415, 4A0139 to 4A0362

**WARNING! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**CAUTION! Burn Hazard.** Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.

**NOTICE: Prevent Equipment Damage.** Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could result in damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all fans when performing maintenance.

### ? Removing and Disassembling the Cooling Fan Unit

1. Remove the terminal cover and drive cover. Refer to 3.5 Terminal cover (p.51) for detail.
2. Remove the fan connector (CN6). Remove the fan connector (CN6, CN7) in models 2A0360, 2A0415 and 4A0362.

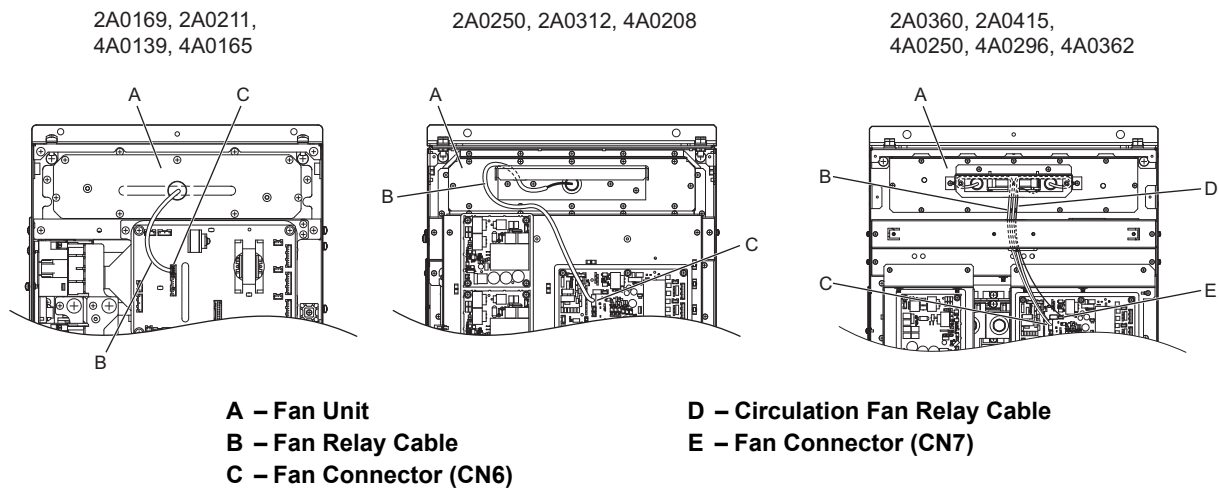


Figure 7.19 Cooling Fan Replacement: Fan Unit and Connectors

3. Remove the screws holding the fan unit in place and slide the fan unit out of the drive.

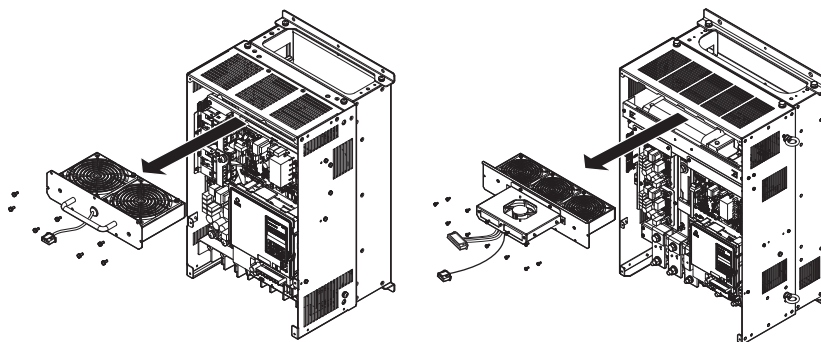


Figure 7.20 Removing the Fan Unit: 2A0169 and 2A0211, 4A0139 and 4A0165

4. Remove the fan guard and replace the cooling fans.

**Note:** Make sure the fan cable does not get pinched between parts when reassembling the fan unit.

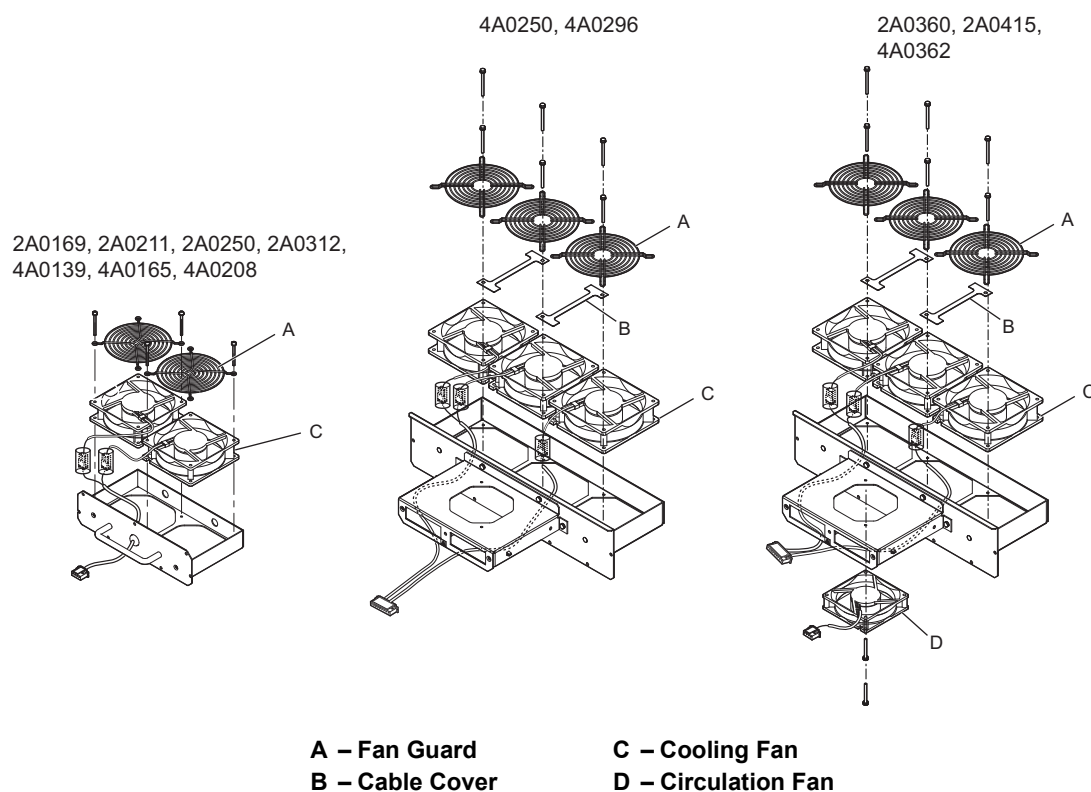
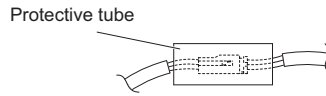


Figure 7.21 Fan Unit Disassembly: 2A0169 and 2A0211, 4A0139 and 4A0165

### ? Cooling Fan Wiring: 2A0169, 2A0211, 4A0139 and 4A0165

1. Position the protective tube so that the fan connector sits in the center of the protective tube.



2. Place the fan connector covered by the tube as shown in the drawings below.

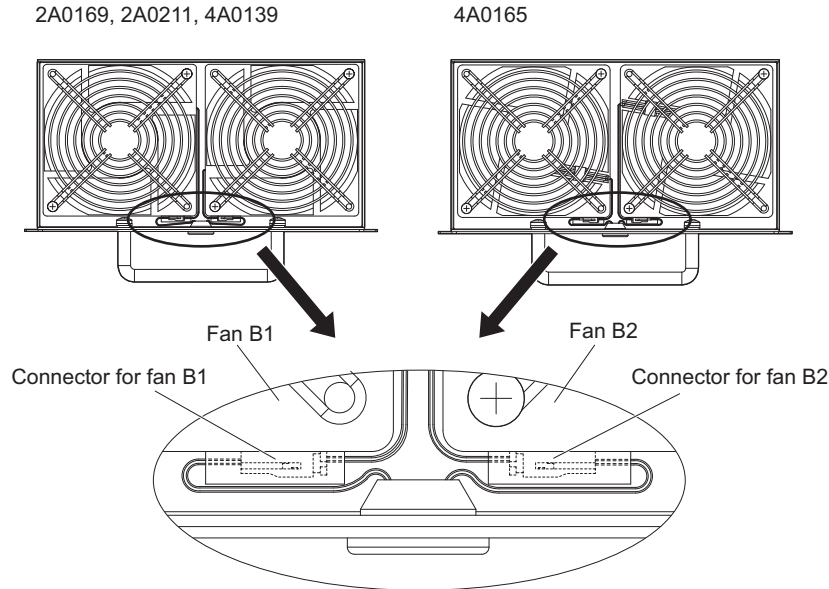
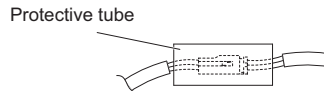


Figure 7.22 Cooling Fan Wiring: 2A0169 and 2A0211, 4A0139 and 4A0165

3. Make sure that the protective tube does not stick out beyond the fan guard.

### ? Cooling Fan Wiring: 2A0250, 2A0312 and 4A0208

1. Position the protective tube so that the fan connector sits in the center of the protective tube.



2. Place the connector for fan B2 before the B1 connector and guide the lead wire for fan B2 so that it is held in place by the cable hook.

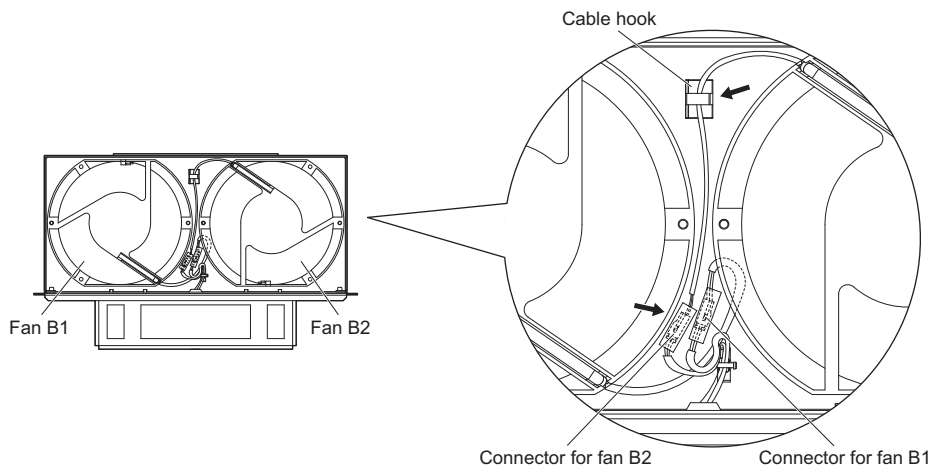
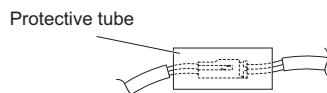


Figure 7.23 Cooling Fan Wiring: 2A0250, 2A0312 and 4A0208

3. Make sure that the protective tube does not stick out beyond the fan guard.

### ? Cooling Fan Wiring: 2A0360, 2A0415, 4A0250 to 4A0362

1. Position the protective tube so that the fan connector sits in the center of the protective tube.



2. The fan connector for fan B2 should be placed in front of the fan B1 connector between fans B1 and B2.
3. The connector for fan B3 should be pressed in between fan B2 and B3.

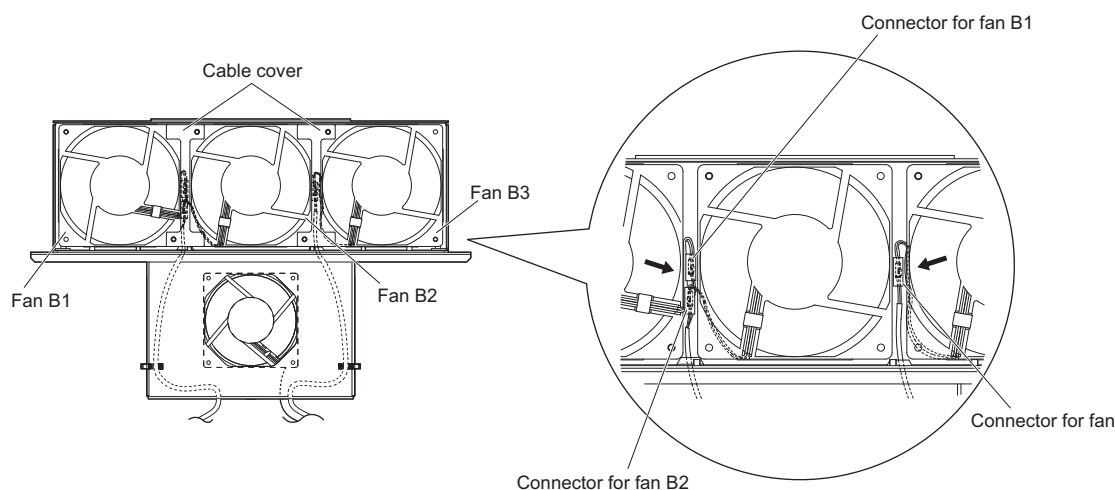


Figure 7.24 Cooling Fan Wiring: 2A0360, 2A0415, 4A0250 to 4A0362

4. Double check the relay connector to ensure that it is properly connected.
5. Reattach the cable cover to its original position and tighten the screws so that the fan guard holds the cable cover in place.

**Note:** Make sure the fan cable does not get pinched between parts when reassembling the fan unit.

### ? Installing the Cooling Fan Unit

1. Reverse the procedure described above to reinstall the cooling fan unit.

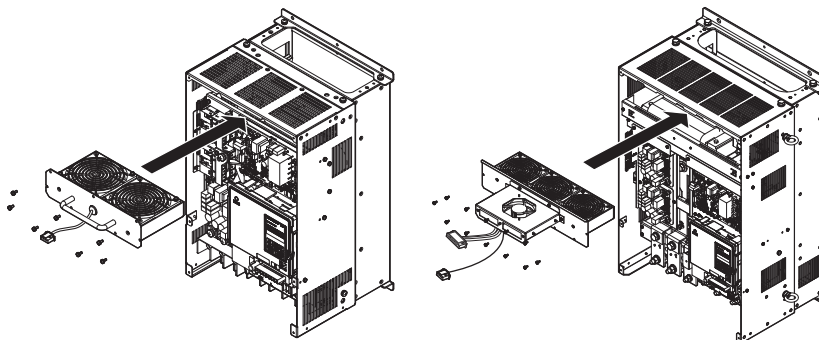


Figure 7.25 Installing the Cooling Fan Unit: 2A0169 to 2A0415, 4A0139 to 4A0362

2. Reattach the covers and digital operator.
3. Turn the power supply back on and reset the cooling fan operation time for the Maintenance Monitor by setting o4-03 to 0.

## 7.5 Drive Replacement

### ? Serviceable Parts

The drive contains some serviceable parts. The following parts can be replaced over the lifespan of the drive:

- Terminal board I/O PCBs
- Cooling fan(s), circulation fan
- Front cover

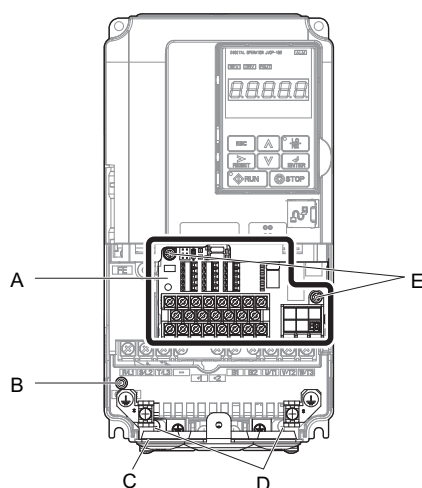
Replace the entire drive if the main power circuitry is damaged. Contact your local Yaskawa representative for more information.

Before replacing any individual parts of the drive, contact your local Yaskawa representative if the drive is still under warranty. Yaskawa reserves the right to replace or repair the drive according to Yaskawa warranty policy.

### ? Terminal Board

The drive has a modular I/O terminal block that facilitates quick drive replacement. The terminal board contains on-board memory that stores all drive parameter settings and allows the parameters to be saved and transferred to the replacement drive. To transfer the terminal board, disconnect the terminal board from the damaged drive then reconnect it to the replacement drive. Once transferred, there is no need to manually reprogram the replacement drive.

**Note:** If the damaged drive and the new replacement drive have different capacities, the data stored in the terminal board cannot be transferred to the new drive and an oPE01 error will appear on the display. The terminal board can still be used, but parameter setting from the old drive cannot be transferred. The replacement drive must be initialized and manually programmed.



A – Removable terminal board  
B – Charge LED  
C – Bottom front cover

D – Bottom cover screws  
E – Terminal board locking screws

Figure 7.26 Terminal Board

### ? Replacing the Drive

**WARNING! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**WARNING! Electrical Shock Hazard.** Do not allow unqualified personnel to perform work on the drive. Failure to comply could result in serious injury. Installation, maintenance, inspection and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

**NOTICE: Damage to Equipment.** Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards. Failure to comply may result in ESD damage to the drive circuitry.

The following procedure explains how to replace a drive. This section provides instructions for drive replacement only. To install option boards or other types of options, then refer to the specific manuals for those options.

**NOTICE:** When transferring a braking transistor, braking resistor, or other type of option from a damaged drive to a new replacement drive, make sure they are working properly before reconnecting them to the new drive. Replace broken options to prevent immediate break down of the replacement drive.

1. Remove the terminal cover.

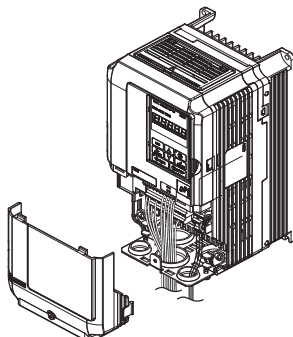


Figure 7.27 Drive Replacement: Removing the Terminal Cover

2. Loosen the screws holding the terminal board in place. Take out the screw securing the bottom cover and remove the bottom cover from the drive.

**Note:** Drives set up for compliance with IP00 do not have a bottom cover.

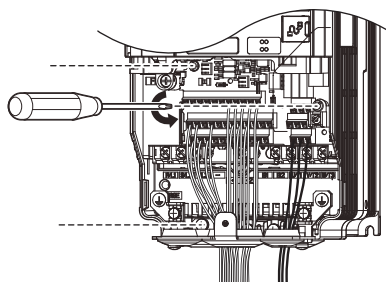


Figure 7.28 Drive Replacement: Removing the Terminal Board

3. Slide the terminal board as illustrated by the arrows, and remove it from the drive along with the bottom cover.

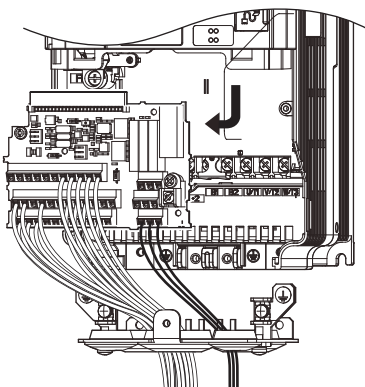


Figure 7.29 Drive Replacement: Remove the Terminal Board

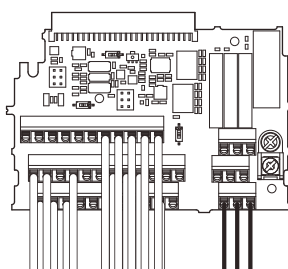


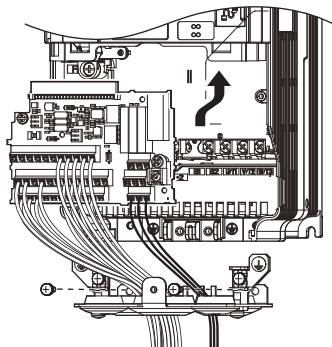
Figure 7.30 Drive Replacement:  
Removable Terminal Board Disconnected from the Drive

## 7.5 Drive Replacement

4. Disconnect all option cards and options. Make sure they are intact before reusing them.
5. Replace the drive and wire the main circuit.

### ? Installing the Drive

1. Once the main circuit has been wired, connect the terminal block to the drive as shown in [Figure 7.31](#). Use the installation screw to fasten the terminal block into place.



**Figure 7.31 Drive Replacement: Installing the Terminal Board**

2. Reconnect all options to the new drive in the same way they were installed in the old drive. Connect option boards to the same option ports in the new drive that were used in the old drive.
3. Put the terminal cover back into its original place.
4. When the power to the drive is first switched on, all parameter settings are transferred from the terminal board into the drive memory. Should an oPE04 error occur, load the parameter settings that have been saved on the terminal board onto the new drive by setting parameter A1-03 to 5550. Reset timers used for the Maintenance Monitor function by setting parameters o4-01 through o4-12 back to 0, and parameter o4-13 to 1.

## PERIPHERAL DEVICES & Options

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This chapter explains the installation of peripheral devices and options available for the drive.

<b>8.1</b>	<b>SECTION SAFETY .....</b>	<b>368</b>
<b>8.2</b>	<b>DRIVE OPTIONS AND PERIPHERAL DEVICES.....</b>	<b>370</b>
<b>8.3</b>	<b>CONNECTING PERIPHERAL DEVICES .....</b>	<b>372</b>
<b>8.4</b>	<b>OPTION CARD INSTALLATION .....</b>	<b>373</b>
<b>8.5</b>	<b>INSTALLING PERIPHERAL DEVICES .....</b>	<b>384</b>

# 8.1 Section Safety

### DANGER

#### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

### WARNING

#### Electrical Shock Hazard

**Do not operate equipment with covers removed.**

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

**Do not allow unqualified personnel to perform work on the drive.**

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

**Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.**

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

**Always ground the motor-side grounding terminal.**

Improper equipment grounding could result in death or serious injury by contacting the motor case.

#### Fire Hazard

**Tighten all terminal screws to the specified tightening torque.**

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

**NOTICE**

**Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Never connect or disconnect the motor from the drive while the drive is outputting voltage.**

Improper equipment sequencing could result in damage to the drive.

**When a fuse blows or if drive power has been interrupted, wait briefly before switching the power back on or operating the peripheral devices.**

Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified.

## 8.2 Drive Options and Peripheral Devices

The following table of peripheral devices lists the names of the various accessories and options available for Yaskawa drives. Contact Yaskawa or your Yaskawa agent to order these peripheral devices.

- **Peripheral Device Selection:** Refer to the Yaskawa catalog for selection and part numbers.
- **Peripheral Device Installation:** Refer to the corresponding option manual for installation instructions.

**Table 8.1 Available Peripheral Devices**

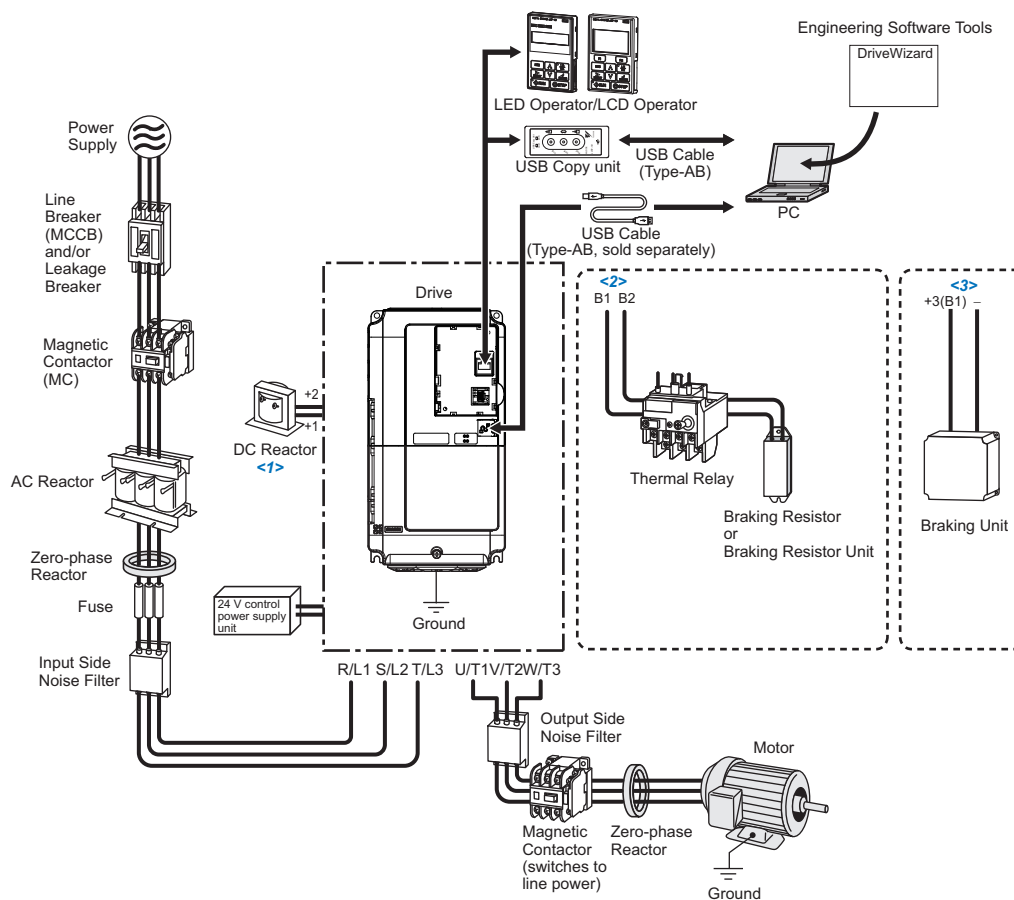
Option	Model Number	Description
<b>Power Options</b>		
DC Reactor	-	Improves the power factor by suppressing harmonic distortion from the power supply.
AC Reactor	-	Protects the drive when operating from a large power supply and improves the power factor by suppressing harmonic distortion. Highly recommended for power supplies that exceed 600 kVA.
Braking Resistor	ERF-150WJ Series	For use with systems that require dynamic braking with up to 3% ED. If higher ED is required, increase the capacity.
Braking Resistor with Fuse	CF120-B579 Series	For use with systems that require dynamic braking with up to 3% ED. If higher ED is required, increase the capacity.
Braking Unit	CDBR Series	External braking transistor
<b>Input / Output Option Cards</b>		
Analog Input	AI-A3	Allows high precision, high resolution analog reference input. Input channels: 3 Voltage input: -10 to 10 Vdc (20 kΩ), 13 bit signed Current input: 4 to 20 mA or 0 to 20 mA (250 kΩ), 12 bit
Analog Monitor	AO-A3	Provides extra multi-function analog output terminals. Output channels: 2 Output voltage: -10 to 10 V, 11 bit (signed)
Digital Input	DI-A3	Used to set the frequency reference by digital inputs Input channels: 18 (including SET signal and SIGN signal) Input signal type: BCD 16 bit (4 digit), 12 bit (3 digit), 8 bit (2 digit) Input signal: 24 Vdc, 8 mA
Digital Output	DO-A3	Provides extra insulated multi-function digital outputs. Photocoupler relays: 6 (48 V, up to 50 mA) Contact relays: 2 (250 Vac/up to 1 A, 30 Vdc/up to 1 A)
<b>Motor Speed Feedback Option Cards</b>		
Complementary PG	PG-B3	For speed feedback input by connecting a motor encoder Input: 3 track (can be used with one or two tracks), for HTL encoder connection, 50 kHz max Output: 3 track, open collector Encoder power supply: 12 V, max current 200 mA
Line Driver PG	PG-X3	For speed feedback input by connecting a motor encoder Input: 3 track (can be used with one or two tracks), line driver, 300 kHz max Output: 3 track, line driver Encoder power supply: 5 V or 12 V, max current 200 mA
<b>Communication Options Cards</b>		
PROFIBUS-DP	SI-P3	Connects to a PROFIBUS-DP network.
CC-Link	SI-C3	Connects to a CC-Link network
MECHATROLINK-II	SI-T3	Connects to a MECHATROLINK-II network
<b>Interface Options</b>		
LCD Operator	JVOP-180	Digital operator with 8 languages, clear text LCD display, and copy function; max. cable length for remote usage: 3 m
LED Operator	JVOP-182	5-digits LED operator; max. cable length for remote usage: 3 m
Remote Operator Cable	WV001/WV003	Extension cable (1 m or 3 m) to connect the digital operator for remote operation RJ-45, 8 pin straight through, UTP CAT5e cable
USB Copy Unit	JVOP-181	Allows the user to copy and verify parameter settings between drives. Can also be used as an adapter to connect the drive to the USB port on a PC.

Option	Model Number	Description
Mechanical Options		
Attachment for External Heatsink	EZZ02800A/B/C/D	Installation kit for mounting the drive with the heatsink outside of the panel (Side-by-Side mounting possible)
NEMA 1 Kit	EZZ020787	Parts to make the drive conform to NEMA Type 1 enclosure requirements
Installation Support Set A	EZZ020642A	For installing the digital operator keypad on the outside of an enclosure panel that houses the drive. Also refer to <i>Digital Operator Remote Installation on page 38</i> .
Installation Support Set B	EZZ020642B	
Others		
24 V Power Supply	200 V class: PS-A10LB 400 V class: PS-A10HB	Provides power to the control circuit and option boards in the event of power loss. Allows the user to still monitor drive settings and fault information even if the main circuit has no power.
PC Software Tools		
DriveWizard Plus	-	PC tool for drive setup and parameter management

## 8.3 Connecting Peripheral Devices

**Figure 8.1** illustrates how to configure the drive and motor to operate with various peripheral devices.

- For more detailed instructions on how to install each device shown below, refer to the specific manual for that device.



**Figure 8.1 Connecting Peripheral Devices**

- <1> Terminals +1 and +2 for connecting a DC choke are available only in units CIMR-T□2A0004 to 0081 and CIMR-T□4A0002 to 0044. Drives above have built in DC chokes.
- <2> Terminals B1 and B2 for connecting a braking resistor are available only in units CIMR-T□2A0004 to 0138 and CIMR-T□4A0002 to 0072.
- <3> When using an external braking chopper in drives from CIMR-T□2A0004 to 0138 and CIMR-T□4A0002 to 0072 connect the chopper to drive terminals B1 and -. When using larger drives connect the chopper to terminals +3 and -.

## 8.4 Option Card Installation

This section provides instructions on installing the option cards listed in [Table 8.1](#).

### ? Prior to Installing the Option

Prior to installing the option, wire the drive, make the necessary connections to the drive terminals, and verify that the drive functions normally. Refer to the [Table 8.2](#) for information on wiring and connecting the drive.

[Table 8.2](#) below lists the number of option cards that can be connected to the drive and the drive connectors for connecting those option cards.

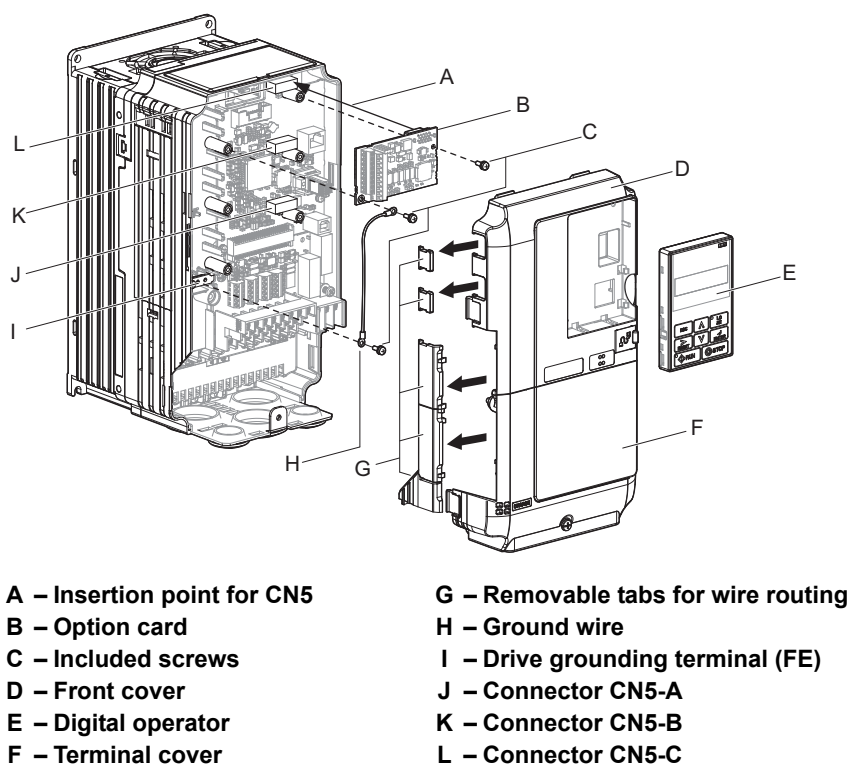
**Table 8.2 Option Card Installation**

Option Card	Port/Connector	Number of Cards Possible
SI-C3, SI-P3, SI-T3, AI-A3, DI-A3 <1>	CN5-A	1
PG-B3, PG-X3	CN5-B, C	2 <2>
DO-A3, AO-A3	CN5-A, B, C	1

<1> When AI-A3 and DI-A3 are to be used as monitors, the card can be connected to any of CN5-A, CN5-B or CN5-C. The input status of AI-A3 can then be viewed using U1-21, U1-22, and U1-23, and the input status of DI-A3 can then be viewed using U1-17.

<2> If only one PG option card is connected to the drive, use the CN5-C connector. If two PG option cards are connected, use both CN5-B and CN5-C.

[Figure 8.2](#) shows an exploded view of the drive with the option and related components for reference.



**Figure 8.2 Drive Components with Option**

### ? Installing the Option

Refer to the instructions below to install the option.

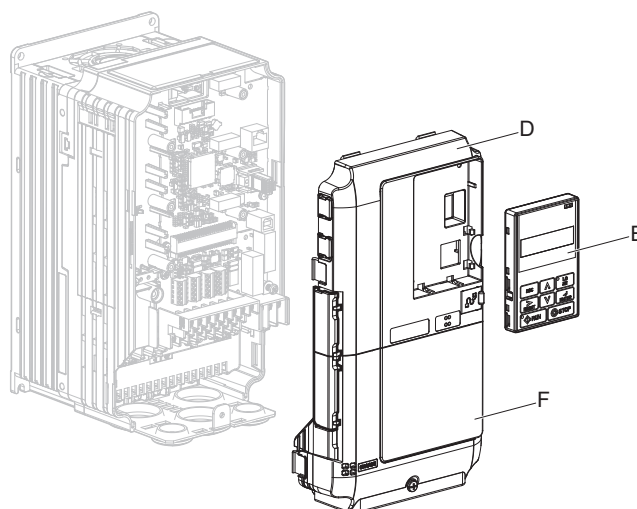
**DANGER! Electrical Shock Hazard.** Disconnect all power to the drive and wait at least the amount of time specified on the drive front cover safety label. After all indicators are off, measure the DC bus voltage to confirm safe level, and check for unsafe voltages before servicing to prevent electric shock. The internal capacitor remains charged even after the power supply is turned off.

**WARNING! Electrical Shock Hazard.** Do not allow unqualified personnel to perform work on the drive. Failure to comply could result in death or serious injury. Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives and Option Cards.

**NOTICE: Damage to Equipment.** Observe proper electrostatic discharge procedures (ESD) when handling the option card, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.

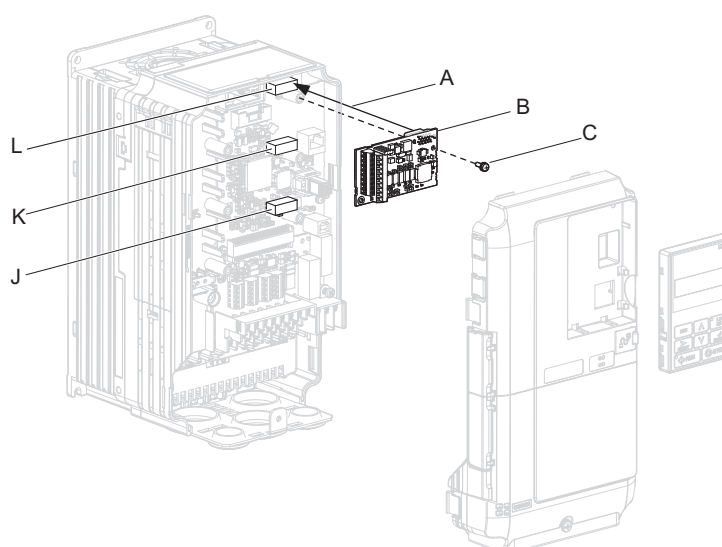
**NOTICE: Damage to Equipment.** Tighten all terminal screws to the specified tightening torque. Failure to comply may cause the application to operate incorrectly or damage the drive.

1. Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the digital operator (E) and front covers (D, F). Refer to [Digital Operator and Front Cover on page 53](#)



**Figure 8.3 Remove the Front Covers and Digital Operator**

2. Insert the option card (B) into the CN5-A (J), CN5-B (K), or CN5-C (L) connectors located on the drive and fasten it into place using one of the included screws (C).  
Use both CN5-B and CN5-C when connecting two options.



**Figure 8.4 Insert the Option Card**

3. Connect one end of the ground wire (H) to the ground terminal (I) using one of the remaining screws (C). Connect the other end of the ground wire (H) to the remaining ground terminal and installation hole on the option (B) using the last remaining provided screw (C).

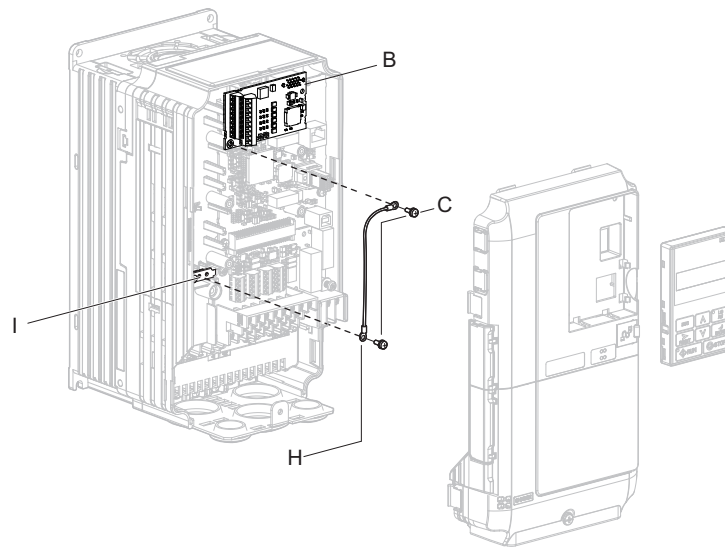


Figure 8.5 Connect the Ground Wire

- Note:**
1. The option package includes two ground wires. Use the longer wire when plugging the option into connector CN5-C on the drive side. Use the shorter wire when plugging the option into connector CN5-B. Refer to the option card instruction manual for more information.
  2. There are two screw holes on the drive for use as ground terminals (I). When connecting three options, two ground wires will need to share the same drive ground terminal.
4. Prepare and connect the wire ends as shown in [Figure 8.6](#) and [Figure 8.7](#). Refer to [Wire Gauges and Tightening Torques on page 378](#) to confirm that the proper tightening torque is applied to each terminal. Take particular precaution to ensure that each wire is properly connected and wire insulation is not accidentally pinched into electrical terminals.

**WARNING! Fire Hazard.** Tighten all terminal screws according to the specified tightening torque. Loose electrical connections could result in death or serious injury by fire due to overheating electrical connections. Tightening screws beyond the specified tightening torque may result in erroneous operation, damage to the terminal block, or cause a fire.

**NOTICE:** Heat shrink tubing or electrical tape may be required to ensure that cable shielding does not contact other wiring. Insufficient insulation may cause a short circuit and damage the option or drive.

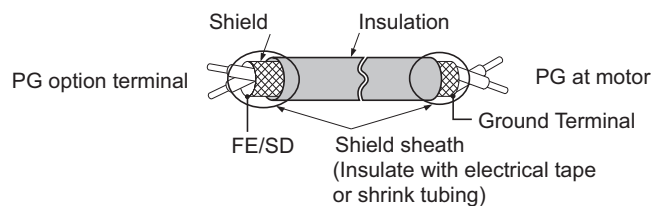


Figure 8.6 Preparing Ends of Shielded Cable

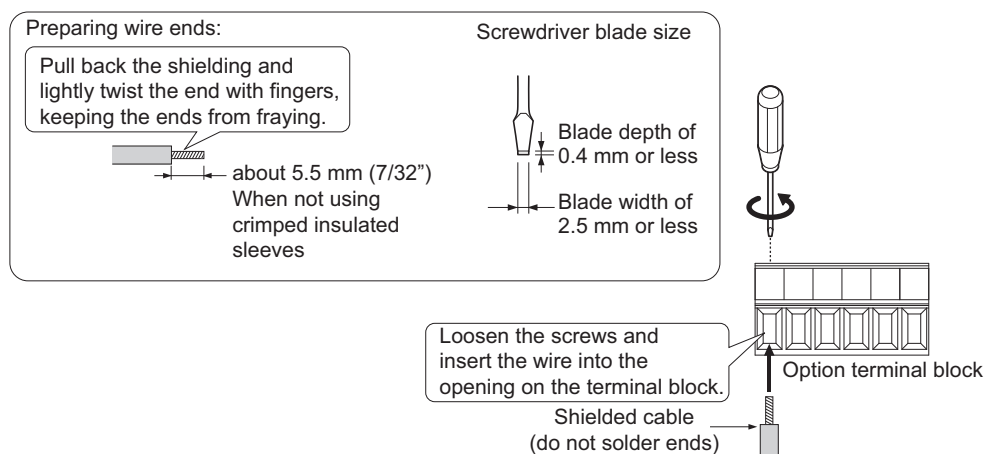


Figure 8.7 Preparing and Connecting Cable Wiring

8.4 Option Card Installation

5. For the PG-B3 and PG-X3 Option, wire the motor PG encoder to the terminal block. Refer to [Figure 8.8](#) and [Figure 8.12](#) for wiring instructions.  
Refer to [Terminal Functions on page 377](#) for a detailed description of the option terminal functions.

Connecting PG-B3 Option

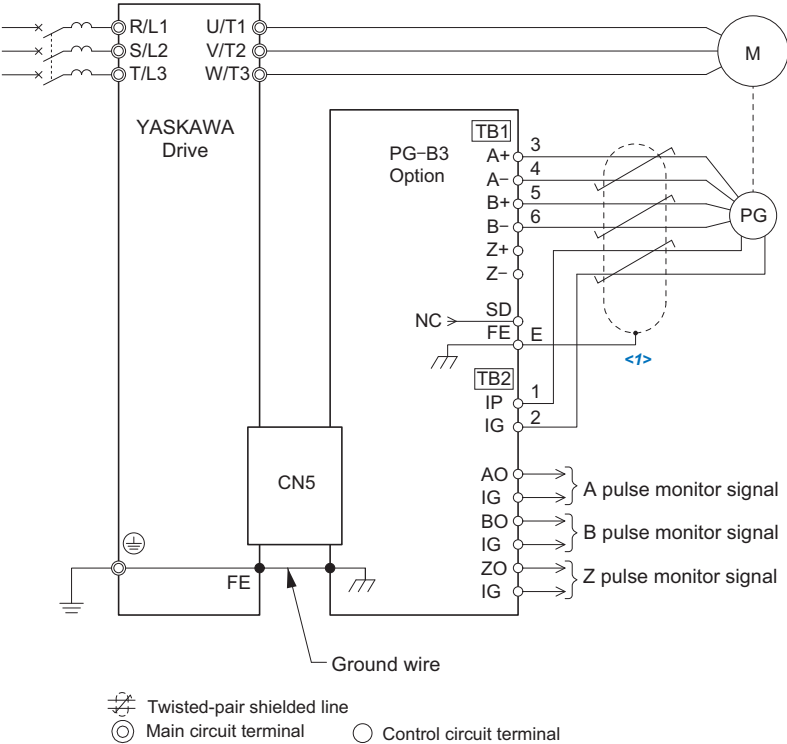
Parameter Settings and Connections for Different Encoder Types

- Connecting a Single-Pulse Encoder  
When using a single-pulse encoder in V/f with PG control mode, connect the pulse output from the PG to the option and set drive parameter F1-21 to 0.
- Connecting a Two-Pulse Encoder  
When using a two-pulse encoder, connect the A and B pulse outputs on the PG to the option and set F1-21 to 1.  
When using a two-pulse encoder in Closed Loop Vector control mode, connect pulse outputs A and B from the encoder to the corresponding terminals on the option.
- Connecting a Two-Pulse Encoder with Z Marker Pulse  
When using a two-pulse encoder with Z marker pulse, connect the A, B, and Z pulse outputs to the corresponding terminals on the option.

Control Method	V/f with PG		Closed Loop Vector	
No. of Encoders	1 (CN5-C)	2 (CN5-B)	1 (CN5-C)	2 (CN5-B)
Single Pulse (A)	F1-21 = 0	F1-37 = 0	N/A	N/A
Two Pulse (AB Quadrature)	F1-21 = 1	F1-37 = 1	No setting required	No setting required
Two Pulse with Marker (ABZ)	F1-21 = 1	F1-37 = 1	No setting required	No setting required

Connection Diagram of PG-B3

Refer to [Table 8.3](#) for a detailed description of the option board terminal functions.  
Refer to [Wire Gauges and Tightening Torques on page 378](#) for information on making cables.



<1> Ground the shield on the PG side and the drive side. If noise problems arise in the PG signal, remove the shield ground from one end of the signal line or remove the shield ground connection on both ends.

Figure 8.8 PG-B3 Option and Encoder Connection Diagram

**Note:** The PG-B3 Option reads a maximum input frequency from the PG encoder of 50 kHz. Be sure to select an PG encoder with an output pulse frequency of maximum 50 kHz when operating at maximum speed.

Take the following steps to prevent erroneous operation caused by noise interference:

- Use shielded wire for the PG encoder signal lines.
- Limit the length of all motor output power cables to less than 100 m. Limit the length of open-collector output lines to less than 50 m.
- Use separate conduit or cable tray dividers to separate option control wiring, main circuit input power wiring, and motor output power cables.

#### Interface Circuit

- Complementary Output

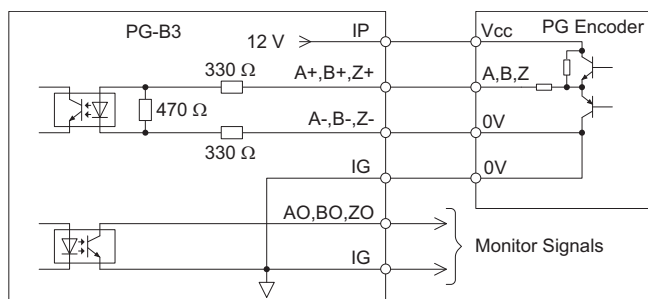


Figure 8.9 Complementary Outputs for the Interface Circuit

- Open-Collector Outputs

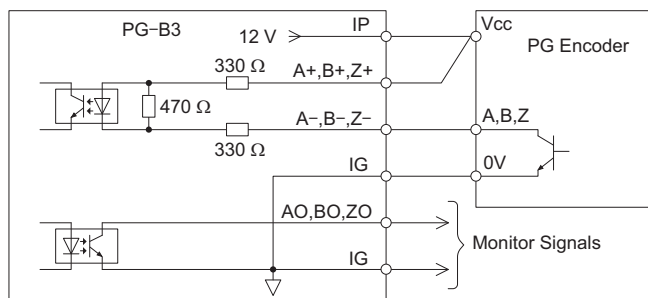


Figure 8.10 Open-Collector Outputs for the Interface Circuit

#### Terminal Functions

Table 8.3 Option Terminal Functions

	Terminal Block	Terminal	Function	Description
	TB1	A+	A+ pulse signal input	<ul style="list-style-type: none"> <li>• Pulse signal inputs from the PG</li> <li>• Signal inputs from complementary and open-collector outputs</li> <li>• Signal level H level: 8 to 12 V L level: 2.0 V or less</li> </ul>
		A-	A- pulse signal input	
		B+	B+ pulse signal input	
		B-	B- pulse signal input	
		Z+	Z+ pulse signal input	
		Z-	Z- pulse signal input	
		SD	NC pin (open)	For use when cables shields should not be grounded
		FE	Ground	Used for grounding shielded lines
	TB2	IP	PG power supply	<ul style="list-style-type: none"> <li>• Output voltage: 12.0 V <math>\pm</math> 5%</li> <li>• Max output current: 200 mA &lt;1&gt;</li> </ul>
		IG	PG power supply common	
		AO	A pulse monitor signal	
		BO	B pulse monitor signal	
		ZO	Z pulse monitor signal	
		IG	Monitor signal common	<ul style="list-style-type: none"> <li>• For open collector outputs from the option</li> <li>• Max voltage: 24 V</li> <li>• Max current: 30 mA</li> </ul>

<1> A separate UL-Listed class 2 power supply is necessary when the PG requires more than 200 mA to operate.

## 8.4 Option Card Installation

### Wire Gauges and Tightening Torques

Wire gauge and torque specifications are listed in [Table 8.4](#). For simpler and more reliable wiring, use crimp ferrules on the wire ends. Refer to the option manuals for the wire size and torque specifications of other options.

**Table 8.4 Wire Gauges and Tightening Torques**

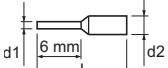
Terminal Signal	Screw Size	Tightening Torque N·m (in·lb)	Bare Cable		Crimp Terminals		Wire Type
			Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>	Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>	
A+, A-, B+, B-, Z+, Z-, FE, IP, IG	M2	0.22 to 0.25 (1.95 to 2.21)	0.75 (18 AWG)	Stranded wire: 0.25 to 1.0 (24 to 17 AWG)	0.5 (20 AWG)	0.25 to 0.5 (24 to 20 AWG)	Shielded twisted pair, etc.
AO, IG, BO, IG, ZO, IG				Solid wire: 0.25 to 1.5 (24 to 16 AWG)			Shielded cable, etc.

### Crimp Terminals

Yaskawa recommends using CRIMPFOX 6 by Phoenix Contact or equivalent crimp terminals with the specifications listed in [Table 8.5](#) for wiring to ensure proper connections.

**Note:** Properly trim wire ends so loose wire ends do not extend from the crimp terminals.

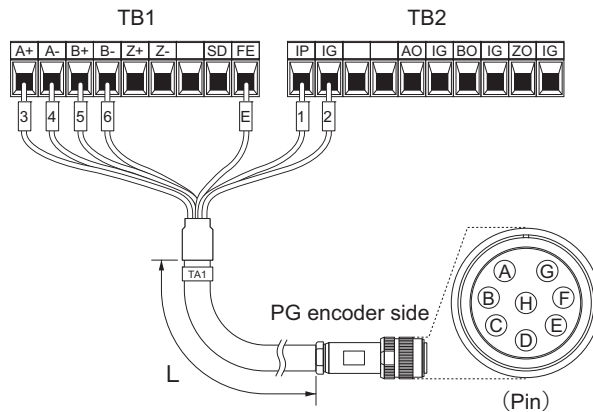
**Table 8.5 Crimp Terminal Sizes**

	Wire Size mm <sup>2</sup>	Phoenix Contact Model	L mm (in)	d1 mm (in)	d2 mm (in)
	0.25 (24 AWG)	AI 0.25 - 6YE	10.5 (13/32)	0.8 (1/32)	2 (5/64)
	0.34 (22 AWG)	AI 0.34 - 6TQ	10.5 (13/32)	0.8 (1/32)	2 (5/64)
	0.5 (20 AWG)	AI 0.5 - 6WH	14 (9/16)	1.1 (3/64)	2.5 (3/32)

### PG Encoder Cables for PG-B3 Option

Yaskawa recommends using a LMA-□□B-S185Y (complementary output) for cables running between the PG-B3 Option and the PG as show in [Figure 8.11](#).

For instructions on wiring the terminal block, refer to [Table 8.3](#).



**Figure 8.11 Wiring PG Encoder Cable**

**Table 8.6 Connecting the PG Encoder Cable Specification**

Option Terminal	PG Encoder Cable		
	Wire	Color	Pin
IP	1	Blue	C
IG	2	White	H
A+	3	Yellow	B
A-	4	White	G
B+	5	Green	A
B-	6	White	F
FE	E	N/A (shield)	D

Table 8.7 PG Encoder Cable Types

Length	Type	Length	Type
10 m (32 ft.)	W5010	50 m (164 ft.)	W5050
30 m (98 ft.)	W5030	100 m (328 ft.)	W5100

## Connecting PG-X3 Option

### Parameter Settings and Connections for Different Encoder Types

- Connecting a Single-Pulse Encoder

When using a single-pulse encoder in V/f with PG control mode, connect the pulse output from the PG to the option and set drive parameter F1-21 to 0.

- Connecting a Two-Pulse Encoder

When using a two-pulse encoder, connect the A and B pulse outputs on the PG to the option and set F1-21 to 1.

When using a two-pulse encoder in Closed Loop Vector control mode, connect pulse outputs A and B from the encoder to the corresponding terminals on the option.

- Connecting a Two-Pulse Encoder with Z Marker Pulse

When using a two-pulse encoder with Z marker pulse, connect the A, B, and Z pulse outputs to the corresponding terminals on the option.

When using a two-pulse encoder in CLV/PM control mode, connect pulse outputs A and B from the encoder to the corresponding terminals on the option.

Control Method	V/f with PG		Closed Loop Vector	
No. of Encoders	1 (CN5-C)	2 (CN5-B)	1 (CN5-C)	2 (CN5-B)
Single Pulse (A)	F1-21 = 0	F1-37 = 0	N/A	N/A
Two Pulse (AB Quadrature)	F1-21 = 1	F1-37 = 1	No setting required	No setting required
Two Pulse with Marker (ABZ)	F1-21 = 1	F1-37 = 1	No setting required	No setting required

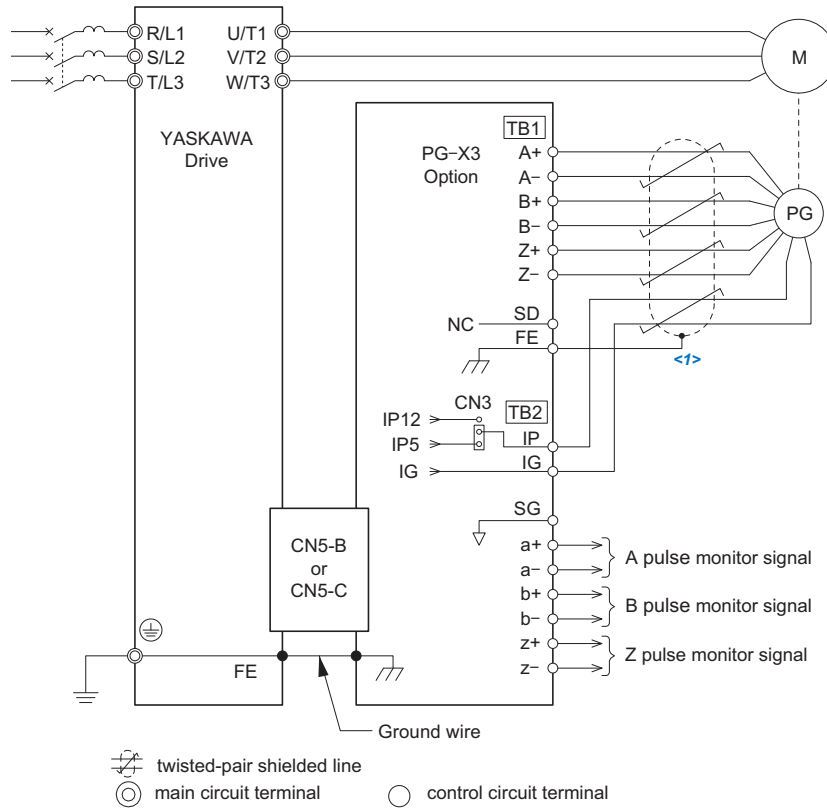
## 8.4 Option Card Installation

### Connection Diagram of PG-X3

Refer to [Table 8.8](#) for a detailed description of the option board terminal functions.

The positioning of jumper CN3 selects the PG encoder power supply voltage (5.5 V or 12 V). Select the voltage level for the PG encoder connected to the option and motor. If the wrong voltage is selected, the PG encoder may not operate properly or may become damaged as a result.

Refer to [Setting the PG Encoder Power Supply Voltage on page 381](#) for details.



<1> Ground the shield on the PG side and the drive side. If noise problems arise in the PG signal, remove the shield ground from one end of the signal line or remove the shield ground connection on both ends.

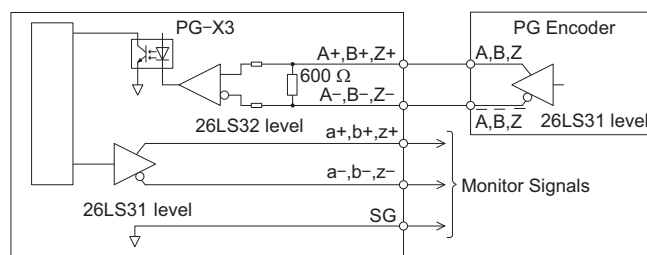
**Figure 8.12 PG-X3 Option and PG Encoder Connection Diagram**

**Note:** The PG-X3 Option reads a maximum input frequency from the PG of 300 kHz. Be sure to select a PG with an output pulse frequency of maximum 300 kHz when operating at maximum speed.

Take the following steps to prevent erroneous operation caused by noise interference:

- Use shielded wire for the PG encoder signal lines.
- Use separate conduit or cable tray dividers to separate option control wiring, main circuit input power wiring, and motor output power cables.

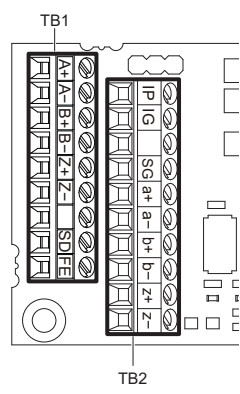
### Interface Circuit



**Figure 8.13 Interface Circuit (PG-X3)**

## Terminal Functions

Table 8.8 Option Terminal Functions

Terminal Block	Terminal	Function	Description
	A+	A+ pulse signal input	<ul style="list-style-type: none"> <li>Inputs for the A channel, B channel, and Z pulses from the PG encoder</li> <li>Signal level matches RS-422</li> </ul>
	A-	A- pulse signal input	
	B+	B+ pulse signal input	
	B-	B- pulse signal input	
	Z+	Z+ pulse signal input	
	Z-	Z- pulse signal input	
	SD	NC pin (open)	Open connection connectors for use when cable shields should not be grounded
	FE	Ground	Used as the shield ground termination point.
	IP	PG encoder power supply	<ul style="list-style-type: none"> <li>Output voltage: 12.0 V <math>\pm</math> 5% or 5.5 V <math>\pm</math> 5%</li> <li>Max. output current: 200 mA &lt;1&gt;</li> </ul>
	IG	PG encoder power supply common	
	SG	Monitor signal common	<ul style="list-style-type: none"> <li>Output signal for monitoring A channel, B channel, and Z pulses from the PG encoder</li> <li>Signal level matches RS-422</li> </ul>
	a+	A+ pulse monitor signal	
	a-	A- pulse monitor signal	
	b+	B+ pulse monitor signal	
	b-	B- pulse monitor signal	
	z+	Z+ pulse monitor signal	
	z-	Z- pulse monitor signal	

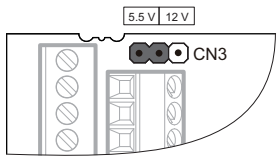
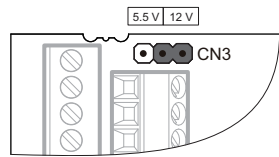
<1> A separate UL-Listed class 2 power supply is necessary when the PG requires more than 200 mA to operate.

## Setting the PG Encoder Power Supply Voltage

For the PG-X3 Option, set the voltage for the PG encoder power supply using jumper CN3 located on the option.

**NOTICE:** The positioning of jumper CN3 selects the PG encoder power supply voltage (5.5 V or 12 V). Select the voltage level for the PG encoder connected to the option and motor. If the wrong voltage is selected, the PG encoder may not operate properly or may become damaged as a result.

Table 8.9 Setting the PG Encoder Power Supply Voltage (IP) with Jumper CN3

Voltage Level	5.5 V $\pm$ 5% (default)	12.0 V $\pm$ 5%
Jumper CN3		

## Wire Gauges and Tightening Torques

Wire gauge and torque specifications are listed in [Table 8.10](#). For simpler and more reliable wiring, use crimp ferrules on the wire ends. Refer to the option manuals for the wire size and torque specifications of other options.

Table 8.10 Wire Gauges and Tightening Torques

Terminal Signal	Screw Size	Tightening Torque N·m (in·lb)	Bare Cable		Crimp Terminals		Wire Type
			Recomm. Gauge mm <sup>2</sup>	Applicable Gauges mm <sup>2</sup>	Recomm. Gauge mm <sup>2</sup>	Applicable Gauges mm <sup>2</sup>	
A+, A-, B+, B-, Z+, Z-, SD, FE, IP, IG	M2	0.22 to 0.25 (1.95 to 2.21)	0.75 (18 AWG)	Stranded wire: 0.25 to 1.0 (24 to 17 AWG)	0.5 (20 AWG)	0.25 to 0.5 (24 to 20 AWG)	Shielded twisted pair, etc.
a+, a-, b+, b-, z+, z-, SG				Solid wire: 0.25 to 1.5 (24 to 16 AWG)			Shielded cable, etc.

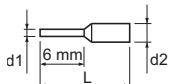
8.4 Option Card Installation

Crimp Terminals

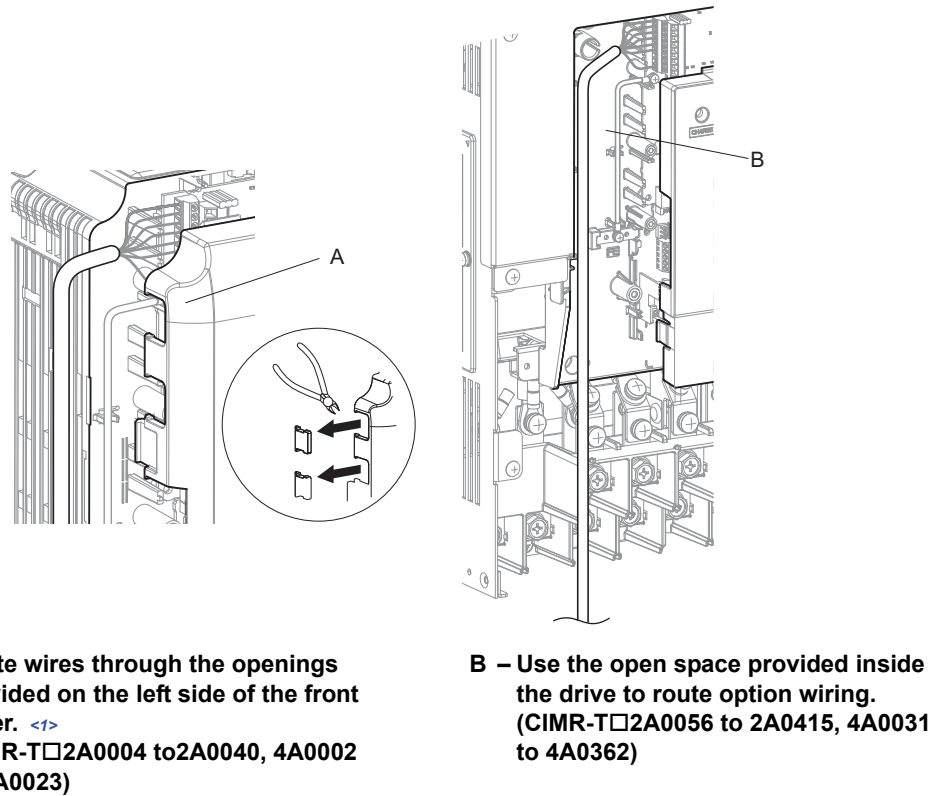
Yaskawa recommends using CRIMPFOX 6 by Phoenix Contact or equivalent crimp terminals with the specifications listed in [Table 8.11](#) for wiring to ensure proper connections.

**Note:** Properly trim wire ends so loose wire ends do not extend from the crimp terminals.

Table 8.11 Crimp Terminal Sizes

	Wire Gauge mm <sup>2</sup>	Phoenix Contact Model	L mm (in)	d1 mm (in)	d2 mm (in)
	0.25 (24 AWG)	AI 0.25 - 6YE	10.5 (13/32)	0.8 (1/32)	2 (5/64)
	0.34 (22 AWG)	AI 0.34 - 6TQ	10.5 (13/32)	0.8 (1/32)	2 (5/64)
	0.5 (20 AWG)	AI 0.5 - 6WH	14 (9/16)	1.1 (3/64)	2.5 (3/32)

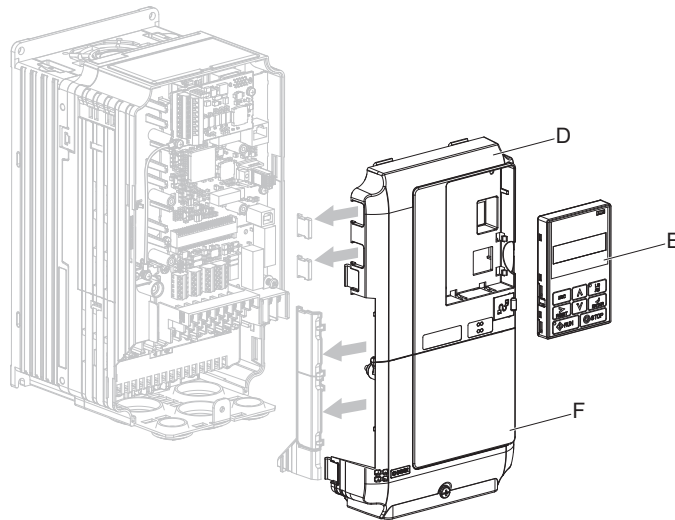
6. Route the option wiring.  
Depending on the drive model, some drives may require routing the wiring through the side of the front cover to the outside. For drive models CIMR-T□2A0004 through 2A0040 and 4A0002 through 4A0023, cut out the perforated openings on the left side of the drive front cover as shown in [Figure 8.14-A](#) and leave no sharp edges to damage wiring.  
Route the wiring inside the enclosure as shown in [Figure 8.14-B](#) for drive models CIMR-T□2A0056 through 2A0415 and 4A0031 through 4A0362 that do not require routing through the front cover.



<1> The drive will not meet NEMA Type 1 requirements if wiring is exposed outside the enclosure.

Figure 8.14 Wire Routing Examples

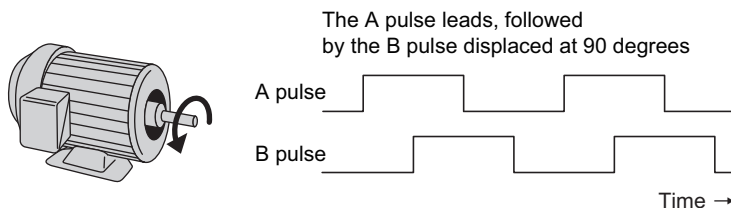
7. Replace and secure the front covers of the drive (D, F) and replace the digital operator (E).



**Figure 8.15 Replace the Front Covers and Digital Operator**

**Note:** Take proper precautions when wiring the option so that the front covers will easily fit back onto the drive. Make sure cables are not pinched between the front covers and the drive when replacing the covers.

8. For the PG-B3 and PG-X3 Option, set drive parameters for proper motor rotation. With a two-pulse or three-pulse PG encoder, the leading pulse determines the motor rotation direction. A PG encoder signal with leading A pulse is considered to be rotating forward (counter-clockwise when viewing rotation from motor load side).

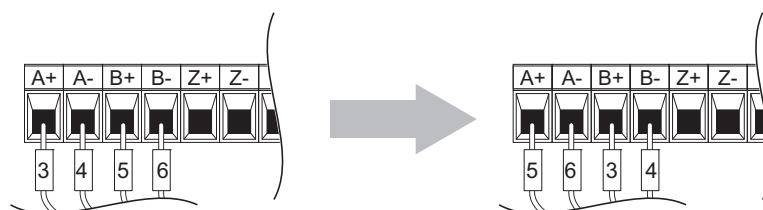


**Figure 8.16 Displacement of A and B Pulses**

After connecting the PG encoder outputs to the option, apply power to the drive and manually rotate the motor and check the rotation direction by viewing monitor U1-05 on the digital operator.

Reverse motor rotation is indicated by a negative value for U1-05; forward motor rotation is indicated by a positive value.

If monitor U1-05 indicates that the forward direction is opposite of what is intended, set F1-05 or F1-32 to 1, or reverse the two A pulse wires with the two B pulse wires on option terminal TB1 as shown in [Figure 8.17](#).



**Figure 8.17 A Channel and B Channel Wire Switching**

If switching the wires is inconvenient, set drive parameter F1-05/F1-32 to 1 to switch the direction of how the option reads pulses from the PG encoder output.

Please note that when the drive is initialized using A1-03 = 1110, 2220, 3330, the value for F1-05/F1-32 will reset to factory default and the parameter will need to be adjusted again to switch the direction.

## 8.5 Installing Peripheral Devices

This section describes the proper steps and precautions to take when installing or connecting various peripheral devices to the drive.

**NOTICE:** Use a class 2 power supply (UL standard) when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply.

### ? Dynamic Braking Options

Dynamic braking (DB) helps bring the motor to a smooth and rapid stop when working with high inertia loads. As the drive lowers the frequency of a motor moving a high inertia load, regeneration occurs. This can cause an overvoltage situation when the regenerative energy flows back into the DC bus capacitors. A braking resistor prevents these overvoltage faults.

**NOTICE:** Do not allow unqualified personnel to use the product. Failure to comply could result in damage to the drive or braking circuit. Carefully review the braking resistor instruction manual when connecting a braking resistor option to the drive.

- Note:**
1. The braking circuit must be sized properly in order to dissipate the power required to decelerate the load in the desired time. Ensure that the braking circuit can dissipate the energy for the set deceleration time prior to running the drive.
  2. Disable the drive's internal braking transistor protection by setting L8-01 = 0 when using braking resistor options.
  3. Ensure that Stall Prevention is disabled during deceleration (L3-04 = 0), when using a regenerative converter, a regenerative unit, a braking resistor or the Braking Resistor Unit. The default setting for the Stall Prevention function will interfere with the braking resistor.

**WARNING! Fire Hazard.** The braking resistor connection terminals are B1 and B2. Do not connect a braking resistor directly to any other terminals. Improper wiring connections could result in death or serious injury by fire. Failure to comply may result in damage to the braking circuit or drive.

**NOTICE:** Connect braking resistors to the drive as shown in the I/O wiring examples. Improperly wiring braking circuits could result in damage to the drive or equipment.

### ? Installing a Braking Resistor: ERF type

An ERF type braking resistors provides dynamic braking capability with up to 3% ED. It can be directly connected to the drives B1 and B2 terminals like shown in [Figure 8.18](#).

Enable the drive's braking resistor overload protection by setting L8-01 = 1 when using ERF type resistors.

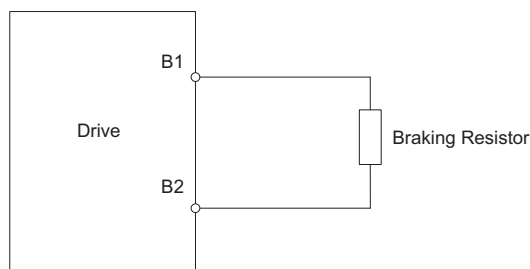
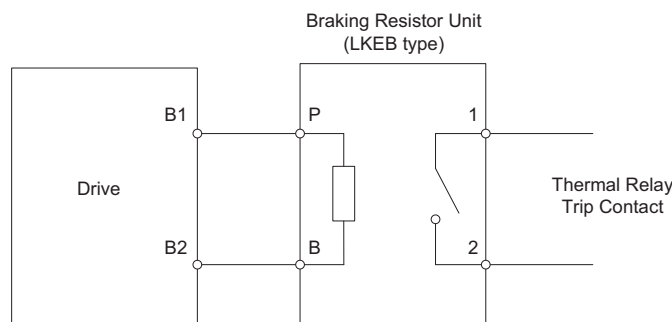


Figure 8.18 Connecting a Braking Resistor: ERF Type

### ? Installing a Braking Resistor Unit: LKEB type

LKEB type braking resistors provide dynamic braking capability with up to 10% ED. They can be directly connected to the drives B1 and B2 terminals as shown in *Figure 8.19*. The LKEB unit has a thermal overload contact that should be utilized in order to switch off the drive in case braking resistor overload occurs.

As the drives internal braking resistor overload protection cannot protect LKEB resistors, disable this function by setting L8-01 to 0.



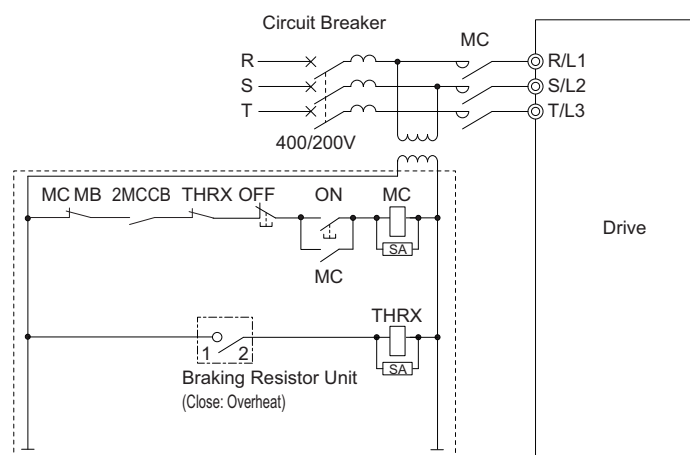
**Figure 8.19 Connecting a Braking Resistor Unit: LKEB Type**  
(CIMR-T□2A0004 to 0138, T□4A0002 to 0072)

### ? Installing Other Types of Braking Resistors

When installing braking resistors other than the ERF or LKEB types, make sure that the drive internal braking transistor will not be overloaded with the required duty cycle and the selected resistance value. Use a resistor that is equipped with a thermal overload relay contact, and utilize this contact to switch off the drive in case of braking resistor overload.

### ? Braking Resistor Overload Protection

If using a braking resistor option, a sequence such as the one shown in *Figure 8.20* should be set up to interrupt the power supply in case the braking resistor overheats.



**Figure 8.20 Power Supply Interrupt for Overheat Protection (Example)**

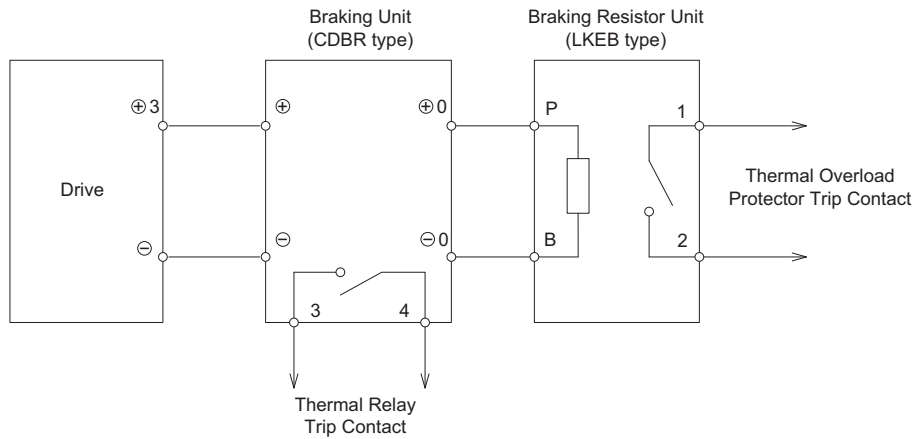
### ? Installing a Braking Unit: CDBR Type

To install a CDBR type braking unit, connect the drive's B1 terminal (units CIMR-T□2A0004 to 0138 and CIMR-T□4A0002 to 0072) or +3 terminal (units CIMR-T□2A0169 to 0415 and CIMR-T□4A0088 to 4A0362) to the positive terminal on the braking unit. Next wire the negative terminals on the drive and braking unit together. Terminal +2 is not used.

Connect the braking resistor to the CDBRs terminals +0 and -0.

Wire the thermal overload relay contact of the CDBR and the braking resistor in series, and connect this signal to a drive digital input. Use this input to trigger a fault in the drive in case a CDBR or braking resistor overload occurs.

Disable dynamic braking transistor protection by setting L8-55 = 0.

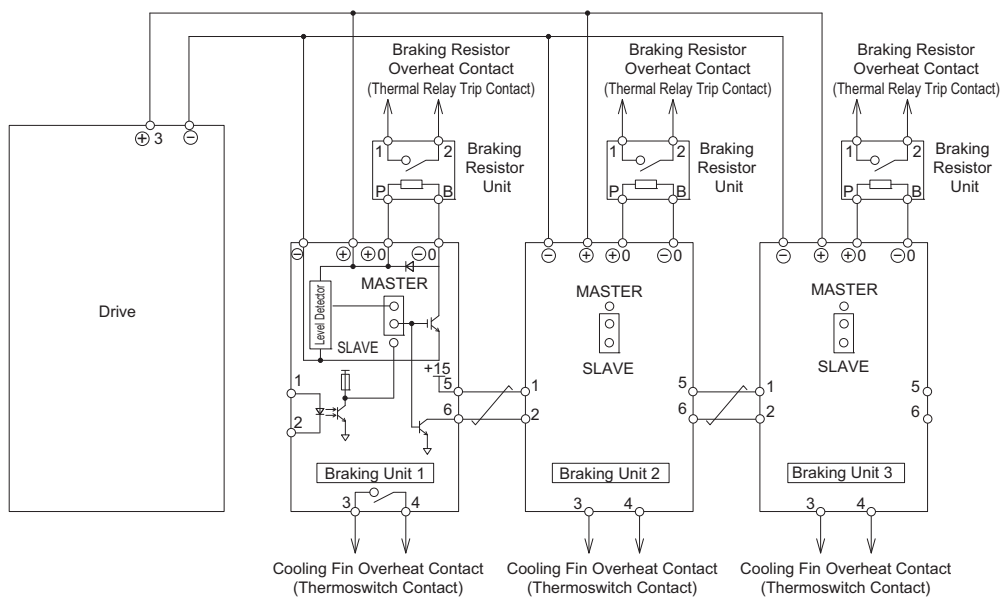


**Figure 8.21 Connecting a Braking Unit (CDBR type) and Braking Resistor Unit (LKEB type)**  
(CIMR-T□2A0169 to 0415, CIMR-T□4A0088 to 0362)

### ? Using Braking Units in Parallel

When multiple braking units are used, they must be installed with a master-slave configuration with a single braking unit acting as the master. *Figure 8.22* illustrates how to wire braking units in parallel.

Wire the thermal overload contacts relays of all CDBRs and all braking resistors in series, then connect this signal to a drive digital input. This input can be used to trigger a fault in the drive in case of overload in any of the CDBRs or braking resistors.



**Figure 8.22 Connecting Braking Units in Parallel**

### ? Installing a Molded Case Circuit Breaker (MCCB)

Install a MCCB for line protection between the power supply and the main circuit power supply input terminals R/L1, S/L2, and T/L3. This protects the main circuit and devices wired to the main circuit while also providing overload protection.

Consider the following when selecting and installing a MCCB:

- The capacity of the MCCB should be 1.5 to 2 times the rated output current of the drive. Use a MCCB with an operation characteristics so that the MCCB does not trip faster than the drive overload protection works (shuts off the drive after 1 min. operation at 150% of the drive rated current).
- If several drives are connected to one MCCB, use a sequence that shuts the power OFF when an error occurs in one drive by using magnetic contactor (MC) as shown in the following figure.

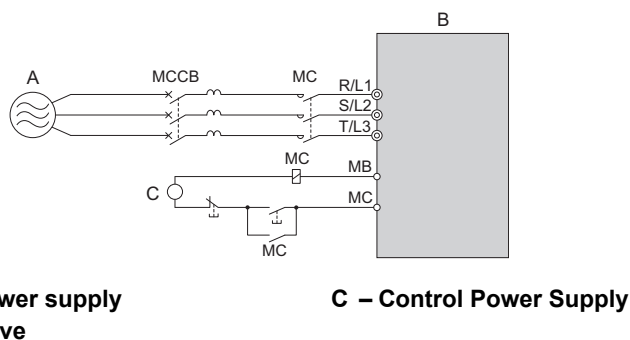


Figure 8.23 Power Supply Interrupt Wiring (Example)

**WARNING!** Electrical Shock Hazard. Shut off the power supply before wiring terminals. Failure to comply may result in serious injury or death.

### ? Installing a Leakage Breaker

Residual currents occurring in drive installations can contain AC, DC and high frequency components that may prevent a normal RCM/RCD from tripping. If an RCM/RCD is required in the installation, always use all current sensitive RCM/RCD (Type B according to IEC/EN 60755) to ensure proper ground fault interruption.

Leakage currents generated by the drive during normal operation may trip an RCM/RCD even if a ground fault is not present.

Factors in determining leakage current:

- Size of the AC drive
- AC drive carrier frequency
- Motor cable type and length
- EMI/RFI filter

If the RCM/RCD trips spuriously consider changing these items or use an RCM/RCD with a higher trip level.

### ? Installing a Magnetic Contactor at the Power Supply Side

Install a magnetic contactor to the drive input for the purposes explained below.

#### ? Disconnecting the Power Supply

The drive should be shut off with a magnetic contactor (MC) when a fault occurs in any external equipment such as braking resistors.

**NOTICE:** Do not connect electromagnetic switches or magnetic contactors to the output motor circuits without proper sequencing. Improper sequencing of output motor circuits could result in damage to the drive.

**NOTICE:** Install a MC on the input side of the drive when the drive should not automatically restart after power loss. To get the full performance life out of the electrolytic capacitors and circuit relays, refrain from switching the drive power supply off and on more than once every 30 minutes. Frequent use can damage the drive. Use the drive to stop and start the motor.

**NOTICE:** Use a magnetic contactor (MC) to ensure that power to the drive can be completely shut off when necessary. The MC should be wired so that it opens when a fault output terminal is triggered.

- Note:**
1. To keep the drive from restarting automatically when power is restored after momentary power loss, install a magnetic contactor to the drive input.
  2. To have the drive continue operating through momentary power loss, set up a delay for the magnetic contactor so that it does not open prematurely.

### ? Protecting the Braking Resistor or Braking Resistor Unit

Use an MC on the input side of the drive to protect a braking resistor or braking resistor unit from overheat or fire.

**WARNING!** Fire Hazard. When using a braking unit, use a thermal relay on the braking resistors and configure a fault contact output for the braking resistor unit to disconnect drive main power via an input contactor. Inadequate braking circuit protection could result in death or serious injury by fire from overheating resistors.

### ? Connecting an AC or DC Reactor

AC and DC reactors suppress surges in current and improve the power factor on the input side of the drive.

Use a DC reactor or AC reactor or both:

- To suppress harmonic current or improve the power factor of the power supply.
- When using a phase advancing capacitor switch.
- With a large capacity power supply transformer (over 600 kVA).

**Note:** Use an AC or DC reactor when also connecting a thyristor converter (such as a DC drive) to the same power supply system, regardless of the conditions of the power supply.

### ? Connecting an AC Reactor

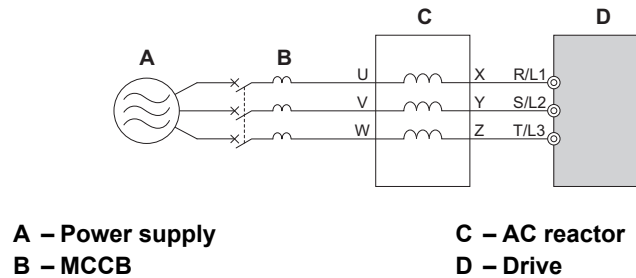


Figure 8.24 Connecting an AC Reactor

### ? Connecting a DC Reactor

A DC reactor can be installed to drive models CIMR-T□2A0004 to 0081 and CIMR-T□4A0002 to 0044. When installing a DC reactor, ensure the jumper between terminals +1 and +2 (terminals are jumpered for shipment) is removed. The jumper must be installed if no DC reactor is used. Refer to [Figure 8.25](#) for an example of DC reactor wiring.

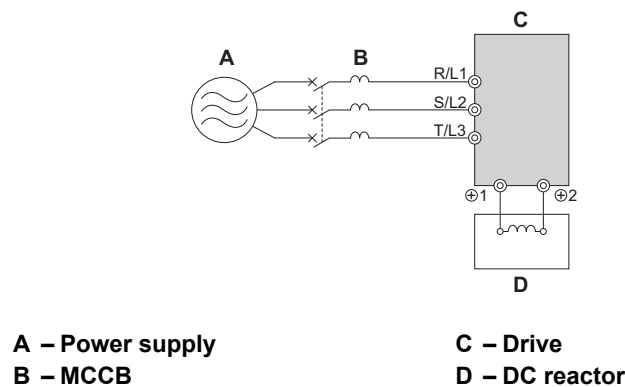


Figure 8.25 Connecting a DC Reactor

### ? Connecting a Noise Filter

#### ? Reducing Radiated, Conducted, and Induced Noise

Drives generate noise that can potentially affect surrounding devices like PLCs, etc.

- **Radiated Noise:** Electromagnetic waves noise throughout the radio bandwidth radiated from the drive and cables.
- **Conducted Noise:** Noise generated by the drive and emitted to through the power lines.
- **Induced Noise:** Noise generated by electromagnetic induction can affect control signal lines.

Take the following measurements to prevent noise causing malfunction of other drives or devices:

- Install all components on a well grounded metal plate.
- Keep the motor cable as short as possible.
- Use noise filters on the input side of the drive to reduce conducted noise.
- Install noise filters on the input and output side of the drive, install the drive in a metal enclosure panel and use a shielded motor cable to reduce radiated noise.

- Use shielded motor and control circuit lines and lay control circuit lines at least 30 cm away from power lines in order to prevent malfunction due to induced noise.

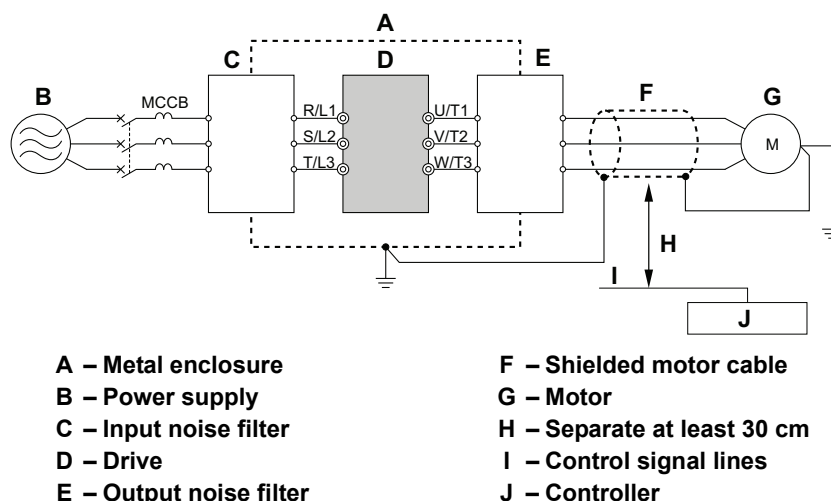


Figure 8.26 Reducing Radio Frequency Noise

### ? Input-Side Noise Filter

Drive outputs generate noise as a result of high-speed switching. This noise flows from inside the drive back to the power supply, possibly affecting other equipment. Installing a noise filter to the input side of the drive can reduce the amount of noise flowing back into the power supply. This also prevents noise from entering the drive from the power supply.

- Use a noise filter specifically designed for AC drives.
- Install the noise filter as close as possible to the drive.

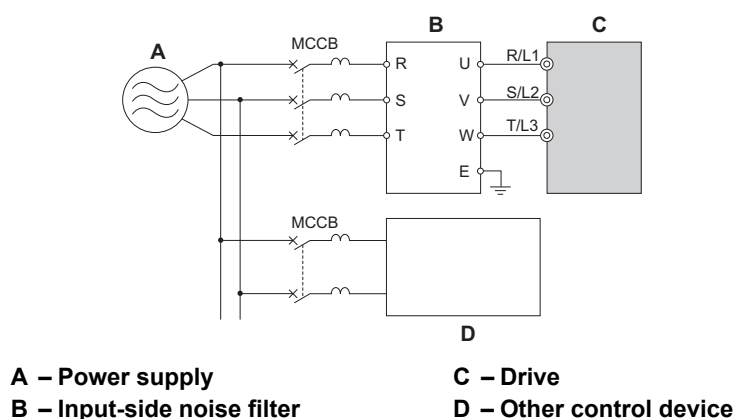


Figure 8.27 Input-Side Noise Filter (Three-Phase 200/400 V)

This drive is tested according to European standards IEC/EN 61800-5-1 and complies with the EMC guidelines. Refer to [EMC Filter Installation on page 545](#) for details about EMC filter selection and installation.

## 8.5 Installing Peripheral Devices

### ? Output-Side Noise Filter

A noise filter on the output side of the drive reduces inductive noise and radiated noise. [Figure 8.28](#) illustrates an example of output-side noise filter wiring.

**NOTICE:** Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Improper application of noise filters could result in damage to the drive.

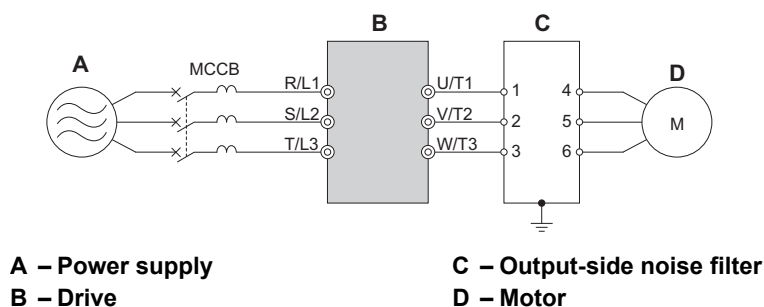


Figure 8.28 Output-Side Noise Filter

### ? Installing Input Fuses

**NOTICE:** When a fuse blows or if drive power has been interrupted, wait briefly before switching the power back on or operating the peripheral devices. Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified.

Yaskawa recommends installing a fuse to the input side of the drive to prevent damage to the drive if a short circuit occurs.

Select the appropriate fuse from the table [Table 8.12](#).

Table 8.12 Input Fuses

Model CIMR-T□	Fuse Type	
	Manufacturer: Busmann	
	Model	Fuse Ampere Rating
Three-Phase 200 V Class		
2A0004	FWH-70B	70
2A0006	FWH-70B	70
2A0010	FWH-70B	70
2A0012	FWH-70B	70
2A0021	FWH-90B	90
2A0030	FWH-100B	100
2A0040	FWH-200B	200
2A0056	FWH-200B	200
2A0069	FWH-200B	200
2A0081	FWH-300A	300
2A0110	FWH-300A	300
2A0138	FWH-350A	350
2A0169	FWH-400A	400
2A0211	FWH-400A	400
2A0250	FWH-600A	600
2A0312	FWH-700A	700
2A0360	FWH-800A	800
2A0415	FWH-1000A	1000

Model CIMR-T□	Fuse Type	
	Manufacturer: Busmann	
	Model	Fuse Ampere Rating
Three-Phase 400 V Class		
4A0002	FWH-40B	40
4A0004	FWH-50B	50
4A0005	FWH-70B	70
4A0007	FWH-70B	70
4A0009	FWH-90B	90
4A0011	FWH-90B	90
4A0018	FWH-80B	80
4A0023	FWH-100B	100
4A0031	FWH-125B	125
4A0038	FWH-200B	200
4A0044	FWH-250A	250
4A0058	FWH-250A	250
4A0072	FWH-250A	250
4A0088	FWH-250A	250
4A0103	FWH-250A	250
4A0139	FWH-350A	350
4A0165	FWH-400A	400
4A0208	FWH-500A	500
4A0250	FWH-600A	600
4A0296	FWH-700A	700
4A0362	FWH-800A	800

### ? Attachment for External Heatsink (IP00/NEMA type 1 Enclosure)

An external heatsink can be attached that projects outside the enclosure. Steps should be taken to ensure that there is enough air circulation around the heatsink.

Contact your Yaskawa sales representative or Yaskawa directly.

Refer to the precautions on page 549 for information on compliance with UL standards.

### ? Installing a Motor Thermal Overload (oL) Relay on the Drive Output

Motor thermal overload relays protect the motor by disconnecting power lines to the motor due to a motor overload condition.

Install a motor thermal overload relay between the drive and motor:

- When operating multiple motors on a single AC drive.
- When using a power line bypass to operate the motor directly from the power line.

It is not necessary to install a motor thermal overload relay when operating a single motor from a single AC drive. The AC drive has UL recognized electronic motor overload protection built into the drive software.

- Note:**
1. Disable the motor protection function (L1-01 = 0) when using an external motor thermal overload relay.
  2. The relay should shut off main power on the input side of the main circuit when triggered.

### ? General Precautions when Using Thermal Overload Relays

The following application precautions should be considered when using motor thermal overload relays on the output of AC drives in order to prevent nuisance trips or overheat of the motor at low speeds:

1. Low speed motor operation
2. Use of multiple motors on a single AC drive
3. Motor cable length
4. Nuisance tripping resulting from high AC drive carrier frequency

## 8.5 Installing Peripheral Devices

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### Low Speed Operation and Motor Thermal oL Relays

Generally, thermal relays are applied on general-purpose motors. When general-purpose motors are driven by AC drives, the motor current is approximately 5% to 10% greater than if driven by a commercial power supply. In addition, the cooling capacity of a motor with a shaft-driven fan decreases when operating at low speeds. Even if the load current is within the motor rated value, motor overheating may occur. A thermal relay cannot effectively protect the motor due to the reduction of cooling at low speeds. For this reason, apply the UL recognized electronic thermal overload protection function built into the drive whenever possible.

**UL recognized electronic thermal overload function of the drive:** Speed-dependent heat characteristics are simulated using data from standard motors and force-ventilated motors. The motor is protected from overload using this function.

### Using a Single Drive to Operate Multiple Motors

Set parameter L1-01 to 0 so that thermal overload protection for the drive is disabled.

**Note:** The UL recognized electronic thermal overload function cannot be applied when operating multiple motors with a single drive.

### Long Motor Cables

When a high carrier frequency and long motor cables are used, nuisance tripping of the thermal relay may occur due to increased leakage current. To avoid this, reduce the carrier frequency or increase the tripping level of the thermal overload relay.

### Nuisance Tripping Due to a High AC Drive Carrier Frequency

Current waveforms generated by high carrier frequency PWM drives tend to increase the temperature in overload relays. It may be necessary to increase the trip level setting when encountering nuisance triggering of the relay.

**WARNING! Fire Hazard.** Confirm an actual motor overload condition is not present prior to increasing the thermal oL trip setting. Check local electrical codes before making adjustments to motor thermal overload settings.

# Appendix: A

## Specifications

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A.1	HEAVY DUTY AND NORMAL DUTY RATINGS .....	394
A.2	THREE-PHASE 200 V CLASS DRIVES.....	395
A.3	THREE-PHASE 400 V CLASS DRIVES.....	396
A.4	DRIVE SPECIFICATIONS .....	397
A.5	DRIVE WATT LOSS DATA .....	399
A.6	DRIVE DERATING DATA.....	401

# A.1 Heavy Duty and Normal Duty Ratings

The capacity of the drive is based on two types of load characteristics: Heavy Duty (HD) and Normal Duty (ND).

*Refer to [Selecting the Appropriate Load Rating on page 394](#) for the differences between HD and ND.*

**Table A.1 Selecting the Appropriate Load Rating**

Setting Parameter C6-01	Rated Output Current	Overload Tolerance	Default Carrier Frequency
0: Heavy Duty (default)	HD Rating varies by model </>	150% rated output current for 60 s	2 kHz
1: Normal Duty	ND Rating varies by model </>	120% rated output current for 60 s varies by model	2 kHz

</> Refer to [Three-Phase 200 V Class Drives on page 395](#) and [Three-Phase 400 V Class Drives on page 396](#) for information on rating changes based on drive model.



**HD and ND:** HD refers to applications requiring constant torque output, while ND refers to applications with variable torque needs.

**Note:** Differences between HD ratings and ND ratings for the drive include rated input and output current, overload capacity, carrier frequency, and current limit. The default setting is for HD (C6-01 = 0).

## A.2 Three-Phase 200 V Class Drives

Table A.2 Power Ratings (Three-Phase 200 V Class)

Item			Specification																	
CIMR-T□2A			0004	0006	0010	0012	0021	0030	0040	0056	0069	0081	0110	0138	0169	0211	0250	0312	0360	0415
Maximum Applicable Motor Capacity (kW) <1>		HD Rating	0.55	1.1	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
		ND Rating	0.75	1.1	2.2	3	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	110
Input	Input Current (A) <2>	HD Rating	2.9	5.8	7.5	11	18.9	28	37	52	68	80	82	111	136	164	200	271	324	394
		ND Rating	3.9	7.3	10.8	13.9	24	37	52	68	80	96	111	136	164	200	271	324	394	471
	Rated Voltage Rated Frequency		Three-phase 200 to 240 Vac 50/60 Hz/270 to 340 Vdc <3>																	
	Allowable Voltage Fluctuation		-15 to 10%																	
	Allowable Frequency Fluctuation		±5%																	
	Input Power (kVA)	HD Rating	1.3	2.2	4.1	5.8	9.5	14	18	27	36	44	37	51	62	75	91	124	148	180
		ND Rating	2.2	3.1	5.8	7.8	14	18	27	36	44	52	51	62	75	91	124	148	180	215
Output	Rated Output Capacity (kVA) <4>	HD Rating	1.2	1.9	3	4.2	6.7	9.5	12.6	17.9	23	29	32	44	55	69	82	108	132	158
		ND Rating	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<7>	<7>	<7>	<7>	<7>	<5>
	Rated Output Current (A)	HD Rating	3.2	5	8	11	17.5	25	33	47	60	75	85	115	145	180	215	283	346	415
		ND Rating	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<7>	<7>	<7>	<7>	<7>	<5>
	Overload Tolerance		HD Rating: 150% of rated output current for 60 s (Derating may be required for applications that start and stop frequently) ND Rating: 120% of rated output current for 60 s																	
	Carrier Frequency		1 to 15 kHz <8>												1 to 10 kHz <8>					
	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)																	
	Maximum Output Frequency (Hz)		400 Hz <8>																	

<1> The motor capacity (kW) refers to a Yaskawa 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 220 V.

<5> Carrier frequency is set to 2 kHz. Current derating is required in order to raise the carrier frequency.

<6> Carrier frequency can be increased up to 8 kHz while keeping this current rating. Higher carrier frequency settings require derating.

<7> Carrier frequency can be increased up to 5 kHz while keeping this current rating. Higher carrier frequency settings require derating.

<8> User-adjustable

## A.3 Three-Phase 400 V Class Drives

Table A.3 Power Ratings (Three-Phase 400 V Class)

Item			Specification																				
CIMR-T□4A			0002	0004	0005	0007	0009	0011	0018	0023	0031	0038	0044	0058	0072	0088	0103	0139	0165	0208	0250	0296	0362
Maximum Applicable Motor Capacity (kW) <1>		HD Rating	0.55	1.1	1.5	2.2	3	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160
		ND Rating	0.75	1.5	2.2	3	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	185
Input	Input Current (A) <2>	HD Rating	1.8	3.2	4.4	6	8.2	10.4	15	20	29	39	44	43	58	71	86	105	142	170	207	248	300
		ND Rating	2.1	4.3	5.9	8.1	9.4	14	20	24	38	44	52	58	71	86	105	142	170	207	248	300	346
	Rated Voltage Rated Frequency		Three-phase 380 to 480 Vac 50/60 Hz/510 to 680 Vdc <3>																				
	Allowable Voltage Fluctuation		-15 to 10%																				
	Allowable Frequency Fluctuation		±5%																				
	Input Power (kVA)	HD Rating	1.4	2.3	4.3	6.1	8.1	10.0	14.6	19.2	28.4	37.5	46.6	39.3	53.0	64.9	78.6	96.0	130	156	189	227	274
		ND Rating	2.3	4.3	6.1	8.1	10.0	14.4	19.4	28.4	37.5	46.6	54.9	53.0	64.9	78.6	96.0	130	156	189	227	274	316
Output	Rated Output Capacity (kVA) <4>	HD Rating	1.4	2.6	3.7	4.2	5.5	7	11.3	13.7	18.3	24	30	34	46	57	69	85	114	137	165	198	232
		ND Rating <5>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<8>	<8>	<8>	<8>	<8>	<8>
	Rated Output Current (A)	HD Rating	1.8	3.4	4.8	5.5	7.2	9.2	14.8	18	24	31	39	45	60	75	91	112	150	180	216	260	304
		ND Rating <5>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<6>	<8>	<8>	<8>	<8>	<8>	<8>
	Overload Tolerance		HD Rating: 150% of rated output current for 60 s (Derating may be required for applications that start and stop frequently) ND Rating: 120% of rated output current for 60 s																				
	Carrier Frequency		1 to 15 kHz <7>															1 and 10 kHz <7>					
	Maximum Output Voltage (V)		Three-phase 380 to 480 V (proportional to input voltage)																				
	Maximum Output Frequency (Hz)		400 Hz <7>																				

<1> The motor capacity (kW) refers to a Yaskawa 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 440 V.

<5> Carrier frequency is set to 2 kHz. Current derating is required in order to raise the carrier frequency.

<6> Carrier frequency can be increased up to the 8 kHz while keeping this current rating. Higher carrier frequency settings require derating.

<7> User-adjustable

<8> Carrier frequency can be increased up to the 5 kHz while keeping this current rating. Higher carrier frequency settings require derating.

## A.4 Drive Specifications

- Note:** 1. Perform rotational Auto-Tuning to obtain the performance specifications given below.  
2. For optimum performance life of the drive, install the drive in an environment that meets the required specifications.

Item		Specification
Control Characteristics	Control Method	The following control methods can be set using drive parameters: <ul style="list-style-type: none"> <li>• V/f Control (V/f)</li> <li>• V/f Control with PG (V/f w/PG)</li> <li>• Open Loop Vector Control (OLV)</li> <li>• Closed Loop Vector Control (CLV)</li> <li>• Open Loop Vector Control for PM (OLV/PM)</li> <li>• Advanced Open Loop Vector Control for PM (AOLV/PM)</li> <li>• Closed Loop Vector Control for PM (CLV/PM)</li> </ul>
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within $\pm 0.01\%$ of the max output frequency ( $-10$ to $+40^{\circ}\text{C}$ ) Analog input: within $\pm 0.1\%$ of the max output frequency ( $25 \pm 10^{\circ}\text{C}$ )
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign)
	Output Frequency Resolution	0.001 Hz
	Frequency Setting Signal	Main speed frequency reference: DC $-10$ to $+10$ V (20 k $\Omega$ ), DC $0$ to $+10$ V (20 k $\Omega$ ), 4 to 20 mA (250 $\Omega$ ), 0 to 20 mA (250 $\Omega$ ), Main speed reference: Pulse train input (max. 32 kHz)
	Starting Torque	V/f, V/f w/PG: 150% at 3 Hz OLV: 200% at 0.3 Hz <-> CLV, AOLV/PM, CLV/PM: 200% at 0 r/min <-> OLV/PM: 100% at 5% speed
	Speed Control Range	V/f, V/f w/PG: 1:40 OLV: 1:200 CLV, CLV/PM: 1:1500 OLV/PM: 1:20 AOLV/PM: 1:100
	Speed Control Accuracy	OLV: $\pm 0.2\%$ ( $25 \pm 10^{\circ}\text{C}$ ) <->
	Speed Response	OLV, OLV/PM, AOLV/PM: 10 Hz CLV, CLV/PM: 50 Hz
	Torque Limit	Parameters setting allow separate limits in four quadrants (available in OLV, CLV, AOLV/PM, CLV/PM)
	Accel/Decel Time	0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Approx. 20% (approx. 125% when using braking resistor) <-> A dynamic braking transistor is built in to models CIMR-T□2A0004 to 2A0138 and CIMR-T□4A0002 to 4A0072. ① Short-time decel torque <->: over 100% for 0.4/ 0.75 kW motors, over 50% for 1.5 kW motors, and over 20% for 2.2 kW and above motors <-> (over excitation braking: approx. 40%) ② Continuous regenerative torque: approx. 20% <-> (approx. 125% with dynamic braking resistor option <->: 10% ED, 10s)
	Braking Transistor	Drives of 200/400 V 30 kW or less have a built-in braking transistor.
	V/f Characteristics	User-selected programs and V/f preset patterns possible
	Main Control Functions	Torque Control, Speed/torque Control Switching, Feed Forward Control, Zero Servo Function, Momentary Power Loss Ride-Thru, Speed Search, Overtorque/Undertorque Detection, Torque Limit, 9 Step Speed (max), Accel/decel Switch, S-curve Accel/decel, 3-wire Sequence, Auto-tuning (rotational, stationary tuning), Dwell, Cooling Fan on/off Switch, Slip Compensation, Torque Compensation, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Deceleration, PID Control (with sleep function), Energy Saving Control, MEMOBUS Comm. (RS-422/485 max, 115.2 kbps), Fault Restart, Removable Terminal Block with Parameter Backup Function, Online Tuning, KEB, Overexcitation Deceleration, Inertia (ASR) Tuning, Overvoltage Suppression, High Frequency Injection, Disturb Function...

## A.4 Drive Specifications

Item		Specification
Protection Functions	Motor Protection	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when output current exceeds 200% of Heavy Duty Rating
	Overload Protection	Drive stops after 60 s at 150% of rated Heavy Duty output current <6>
	Overvoltage Protection	200 V class: Stops when DC bus voltage exceeds approx. 410 V 400 V class: Stops when DC bus voltage exceeds approx. 820 V
	Undervoltage Protection	200 V class: Stops when DC bus voltage falls below approx. 190 V 400 V class: Stops when DC bus voltage falls below approx. 380 V
	Momentary Power Loss Ride-Thru	Immediately stop after 15 ms or longer power loss <7>. Continuous operation during power loss than 2 s (standard) <8>
	Heatsink Overheat Protection	Thermistor
	Braking Resistor Overheat Protection	Overheat input signal for braking resistor (Optional ERF-type, 3% ED)
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection <9>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	Area of Use	Indoors
	Ambient Temperature	Heatsink cooled drives: -10°C to +50°C Finless Type: IP20/IP00 enclosure: -10°C to +45°C
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 to 60°C (short-term temperature during transportation)
	Altitude	Up to 1000 <10>
	Vibration / Shock	10 to 20 Hz: 9.8 m/s <sup>2</sup> 20 to 55 Hz: 5.9 m/s <sup>2</sup> (models CIMR-T□2A0004 to 2A0211 and CIMR-T□4A0002 to 4A0165) 2.0 m/s <sup>2</sup> (2A0250 to 2A0415, 4A0208 to 4A0362)
Safety Standard		<ul style="list-style-type: none"> <li>• UL508C</li> <li>• IEC/EN 61800-3, IEC/EN 61800-5-1</li> <li>• Two Safe Disable inputs and one EDM output according to ISO/EN 13849-1 Cat. 3 PLd, IEC/EN 61508 SIL2</li> </ul>
Protection Design		IP20 enclosure

<1> Select control modes in accordance with the drive capacity.

<2> The accuracy of these values depends on motor characteristics, ambient conditions, and drive settings. Specifications may vary with different motors and with changing motor temperature. Contact Yaskawa for consultation.

<3> Ensure that Stall Prevention is disabled during deceleration (L3-04 = 0), when using a regenerative converter, a regenerative unit, a braking resistor or the Braking Resistor Unit. The default setting for the Stall Prevention function will interfere with the braking resistor.

<4> Instantaneous average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from the rated motor speed down to zero in the shortest time.

<5> Actual specifications may vary according to motor characteristics.

<6> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<7> May be shorter due to load conditions and motor speed.

<8> A separate Momentary Power Loss Ride-Thru Unit is required for the drives CIMR-T□2A0004 to 2A0056 and T□4A0002 to 4A0031 if the application needs to continue running during a momentary power loss up to 2 seconds.

<9> Ground protection cannot be provided when the impedance of the ground fault path is too low, or when the drive is powered up while a ground fault is present at the output.

<10> Up to 3000 m with output current and voltage derating. Refer to *Altitude Derating on page 404* for details.

## A.5 Drive Watt Loss Data

Table A.4 Watt Loss 200 V Class Three-Phase Models

Model Number CIMR-T□	Heavy Duty				Normal Duty			
	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)	Rated Amps (A) <3>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
2A0004	3.2 <1>	14.8	44	59	3.5	18.4	47	66
2A0006	5.0 <1>	24	48	72	6.0	31	51	82
2A0010	8.0 <1>	43	52	95	9.6	57	58	115
2A0012	11.0 <1>	64	58	122	12.0	77	64	141
2A0021	17.5 <1>	101	67	168	21	138	83	222
2A0030	25 <1>	194	92	287	30	262	117	379
2A0040	33 <1>	214	105	319	40	293	145	437
2A0056	47 <1>	280	130	410	56	371	175	546
2A0069	60 <1>	395	163	558	69	491	205	696
2A0081	75 <1>	460	221	681	81	527	257	785
2A0110	85 <1>	510	211	721	110	719	286	1005
2A0138	115 <1>	662	250	912	138	842	312	1154
2A0169	145 <1>	816	306	1122	169	1014	380	1394
2A0211	180 <2>	976	378	1354	211	1218	473	1691
2A0250	215 <2>	1514	466	1980	250	1764	594	2358
2A0312	283 <2>	1936	588	2524	312	2020	665	2686
2A0360	346 <2>	2564	783	3347	360	2698	894	3591
2A0415	415 <3>	2672	954	3626	415	2672	954	3626

<1> These values assume the carrier frequency is set to 8 kHz or less.

<2> These values assume the carrier frequency is set to 5 kHz or less.

<3> These values assume the carrier frequency is set to 2 kHz.

## A.5 Drive Watt Loss Data

Table A.5 Watt Loss 400 V Class Three-Phase Models

Model Number CIMR-T□	Heavy Duty				Normal Duty			
	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)	Rated Amps (A) <3>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4A0002	1.8 <1>	15.9	45	61	2.1	20	48	68
4A0004	3.4 <1>	25	46	70	4.1	32	49	81
4A0005	4.8 <1>	37	49	87	5.4	45	53	97
4A0007	5.5 <1>	48	53	101	6.9	62	59	121
4A0009	7.2 <1>	53	55	108	8.8	66	60	126
4A0011	9.2 <1>	69	61	130	11.1	89	73	162
4A0018	14.8 <1>	135	86	221	17.5	177	108	285
4A0023	18.0 <1>	150	97	247	23	216	138	354
4A0031	24 <1>	208	115	323	31	295	161	455
4A0038	31 <1>	263	141	403	38	340	182	521
4A0044	39 <1>	330	179	509	44	390	209	599
4A0058	45 <1>	349	170	518	58	471	215	686
4A0072	60 <1>	484	217	701	72	605	265	870
4A0088	75 <1>	563	254	817	88	684	308	993
4A0103	91 <1>	723	299	1022	103	848	357	1205
4A0139	112 <2>	908	416	1325	139	1215	534	1749
4A0165	150 <2>	1340	580	1920	165	1557	668	2224
4A0208	180 <2>	1771	541	2313	208	1800	607	2408
4A0250	216 <2>	2360	715	3075	250	2379	803	3182
4A0296	260 <2>	2391	787	3178	296	2448	905	3353
4A0362	304 <2>	3075	985	4060	362	3168	1130	4298

<1> These values assume the carrier frequency is set to 8 kHz or less.

<2> These values assume the carrier frequency is set to 5 kHz or less.

<3> These values assume the carrier frequency is set to 2 kHz.

## A.6 Drive Derating Data

The drive can be operated at above the rated temperature, altitude, and default carrier frequency by derating the drive capacity.

### ? Rated Current Depending on Carrier Frequency

The tables below show the drive output current depending on the carrier frequency settings.

The 2 kHz value is equal to the Normal Duty rated current. If the carrier frequency is increased above 2 kHz in ND, the rated output current is reduced.

The 8 kHz and 5 kHz values are equal to the Heavy Duty rated current. They define the value up to which the carrier frequency can be increased in HD without a current derating (default HD carrier frequency is 2 kHz). Increasing the carrier frequency above 8 kHz or 5 kHz reduces the rated output current.

Use the data in [Table A.6](#) to linearly calculate output current values for carrier frequencies not listed in the tables.

**Table A.6 Carrier Frequency and Current Derating**

Three-Phase 200 V Class						
Model CIMR-T□	Rated Current (A)					
	Heavy Duty Rating (HD)			Normal Duty Rating (ND)		
	2 kHz	8 kHz	15 kHz	2 kHz	8 kHz	15 kHz
2A0004	3.2	3.2	2.56	3.5	3.2	2.56
2A0006	5	5	4	6	5	4
2A0010	8	8	6.4	9.6	8	6.4
2A0012	11	11	8.8	12	11	8.8
2A0021	17.5	17.5	14	21	17.5	14
2A0030	25	25	20	30	25	20
2A0040	33	33	26.4	40	33	26.4
2A0056	47	47	37.6	56	47	37.6
2A0069	60	60	48	69	60	48
2A0081	75	75	53	81	75	53
2A0110	85	85	60	110	85	60
2A0138	115	115	81	138	115	81

Three-Phase 400 V Class						
Model CIMR-T□	Rated Current (A)					
	Heavy Duty Rating (HD)			Normal Duty Rating (ND)		
	2 kHz	8 kHz	15 kHz	2 kHz	8 kHz	15 kHz
4A0002	1.8	1.8	1.1	2.1	1.8	1.1
4A0004	3.4	3.4	2	4.1	3.4	2
4A0005	4.8	4.8	2.9	5.4	4.8	2.9
4A0007	5.5	5.5	3.3	6.9	5.5	3.3
4A0009	7.2	7.2	4.3	8.8	7.2	4.3
4A0011	9.2	9.2	5.5	11.1	9.2	5.5
4A0018	14.8	14.8	8.9	17.5	14.8	8.9
4A0023	18	18	10.8	23	18	10.8
4A0031	24	24	14.4	31	24	14.4
4A0038	31	31	18.6	38	31	18.6
4A0044	39	39	23.4	44	39	23.4
4A0058	45	45	27	58	45	27
4A0072	60	60	36	72	60	36
4A0088	75	75	45	88	75	45
4A0103	91	91	55	103	91	55

Three-Phase 200 V Class						
Model CIMR-T□	Rated Current (A)					
	Heavy Duty Rating (HD)			Normal Duty Rating (ND)		
	2 kHz	5 kHz	10 kHz	2 kHz	5 kHz	10 kHz
2A0169	145	145	116	169	145	116
2A0211	180	180	144	211	180	144
2A0250	215	215	172	250	215	172
2A0312	283	283	226	312	283	226
2A0360	346	346	277	360	346	277
2A0415	415	415	332	415	415	332

Three-Phase 400 V Class						
Model CIMR-T□	Rated Current (A)					
	Heavy Duty Rating (HD)			Normal Duty Rating (ND)		
	2 kHz	5 kHz	10 kHz	2 kHz	5 kHz	10 kHz
4A0139	112	112	78	139	112	78
4A0165	150	150	105	165	150	105
4A0208	180	180	126	208	180	126
4A0250	216	216	151	250	216	151
4A0296	160	260	182	296	260	182
4A0362	304	304	213	362	304	213

? Carrier Frequency Derating

As the carrier frequency of the drive is increased above the factory default setting, the drive’s rated output current must be derated according to *Figure A.1* to *Figure A.4*.

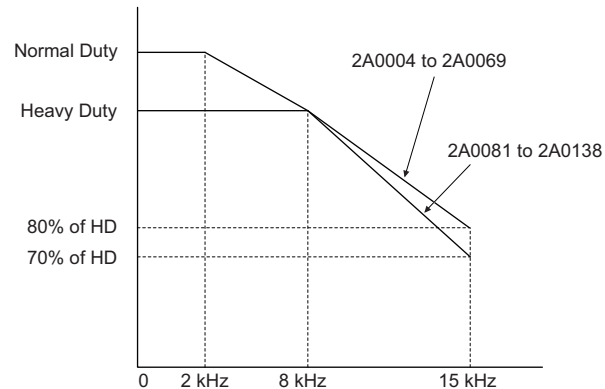


Figure A.1 Carrier Frequency Derating (CIMR-T□2A0004 to 2A0138)

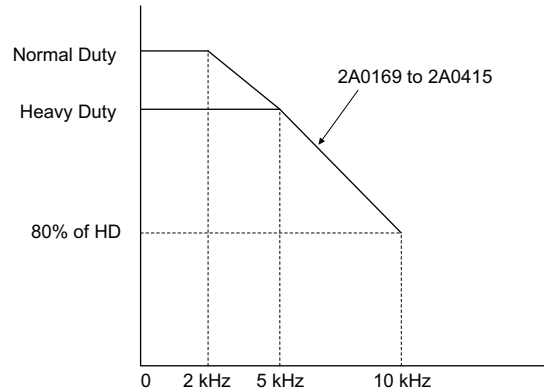


Figure A.2 Carrier Frequency Derating (CIMR-T□2A0169 to 2A0415)

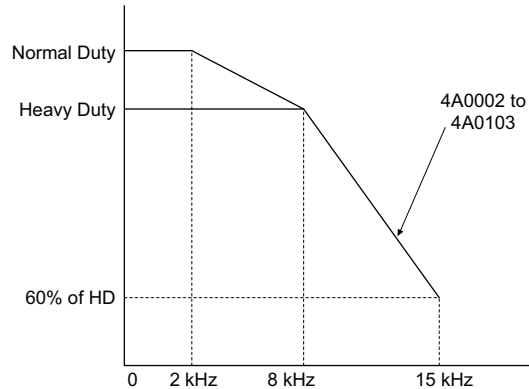


Figure A.3 Carrier Frequency Derating (CIMR-T□4A0002 to 4A0103)

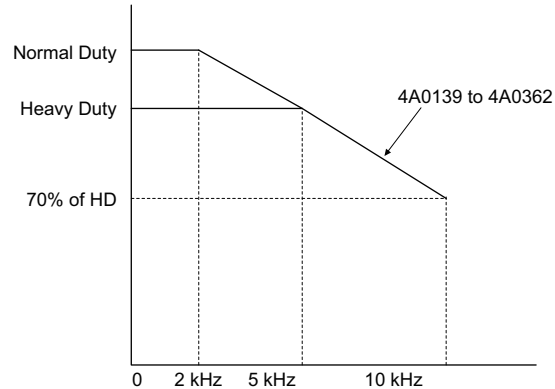


Figure A.4 Carrier Frequency Derating (CIMR-T□4A0139 to 4A0362)

## ? Temperature Derating

To ensure the maximum performance life, the drives output current must be derated like shown in [Figure A.5](#) to [Figure A.8](#) when the drive is installed in areas with high ambient temperature or if drives are Side-by-Side mounted in a cabinet. In order to ensure reliable drive overload protection, the parameters L8-12 and L8-35 must also be set according to the installation conditions.

## ? Parameter Settings

No.	Name	Description	Range	Def.
L8-12	Ambient Temperature Setting	Adjust the drive overload (oL2) protection level when the drive is installed in an environment that exceeds its ambient temperature rating.	-10 to 50	40°C
L8-35	Installation Method Selection	0: IP20 enclosure 1: Side-by-Side mounting 2: NEMA Type 1 3: Finless model or external heatsink installation	0 to 3	0

### IP20 enclosure

Drive operation between -10°C and 50°C allows 100% continuous current without derating.

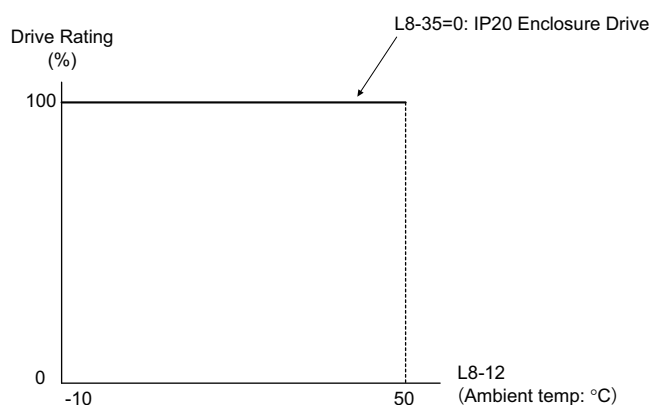


Figure A.5 Ambient Temperature and Installation Method Derating (L8-35 = 0)

### Side-by-Side mounting

Drive operation between -10°C and 30°C allows 100% continuous current without derating. Operation between 30°C and 50°C requires output current derating.

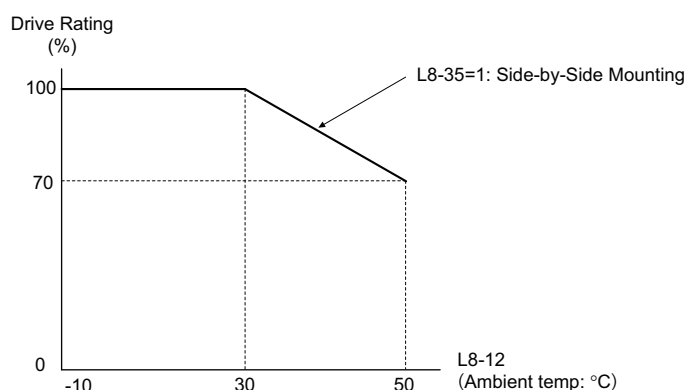


Figure A.6 Ambient Temperature and Installation Method Derating (L8-35 = 1)

A.6 Drive Derating Data

NEMA Type 1

Drive operation between -10°C and 40°C allows 100% continuous current without derating. Operation between 40°C and 50°C requires output current derating.

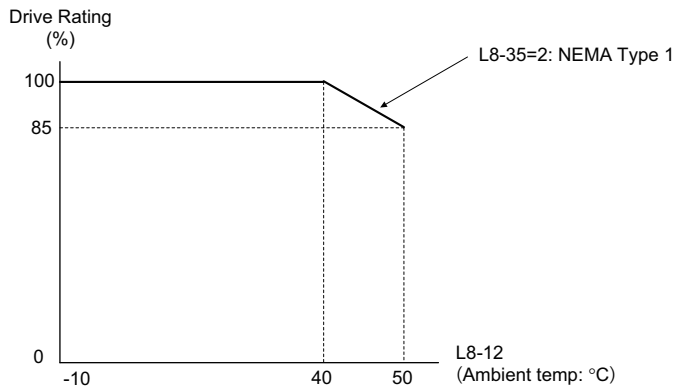


Figure A.7 Ambient Temperature and Installation Method Derating (L8-35 = 2)

External Heatsink Installation, Finless Drive

Drive operation between -10°C and 40°C allows 100% continuous current without derating. Operation between 40°C and 45°C requires output current derating.

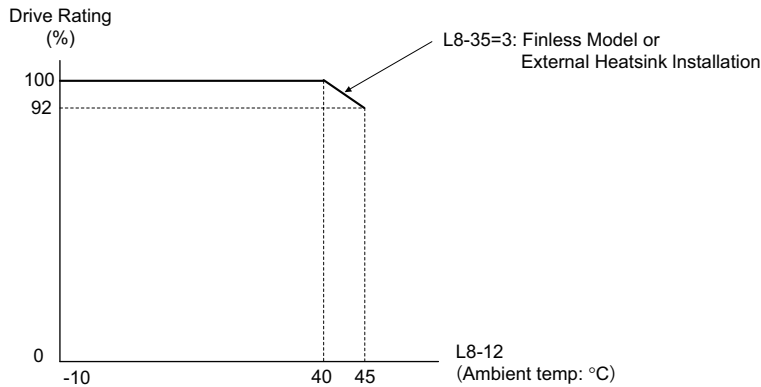


Figure A.8 Ambient Temperature and Installation Method Derating (L8-35 = 3)

? Altitude Derating

The drive standard ratings are valid for an installation altitude up to 1000 m. If the altitude exceeds 1000 m both the drive rated voltage and the rated output current must be derated for 1% per 100 m. The maximum altitude is 3000 m.

# Appendix: B

## Parameter List

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This appendix contains a full listing of all parameters and settings available in the drive.

<b>B.1</b>	<b>UNDERSTANDING THE PARAMETER TABLE .....</b>	<b>406</b>
<b>B.2</b>	<b>PARAMETER GROUPS .....</b>	<b>407</b>
<b>B.3</b>	<b>PARAMETER TABLE .....</b>	<b>408</b>
<b>B.4</b>	<b>PARAMETER DEFAULTS DETERMINED BY CONTROL MODE (A1-02) .....</b>	<b>479</b>
<b>B.5</b>	<b>PARAMETER DEFAULTS DETERMINED BY DRIVE MODEL (O2-04) AND DUTY RATING (C6-01) .....</b>	<b>483</b>
<b>B.6</b>	<b>PARAMETER DEFAULTS DETERMINED BY MOTOR CODE (E5-01) .....</b>	<b>493</b>










## B.1 Understanding the Parameter Table

### ? Control Modes, Symbols, and Terms

The table below lists terms and symbols used in this section to indicate which parameters are available in which control modes.

**Note:** For detailed instructions on each control mode, [Refer to Control Mode Selection on page 26.](#)

**Table B.1 Symbols and Icons Used in the Parameter Table**

Symbol	Description
	Indicates the parameter is accessible in all control modes.
	Parameter is available when operating the drive with V/f Control.
	Parameter is available when operating the drive with V/f with PG Control.
	Parameter is available when operating the drive with Open Loop Vector.
	Parameter is available when operating the drive with Closed Loop Vector.
	Parameter is available when operating the drive with Open Loop Vector for PM motors.
	Parameter is available when operating the drive with Advanced Open Loop Vector for PM motors.
	Parameter is available when operating the drive with Closed Loop Vector for PM motors.
	Indicates this parameter can be changed during run.
Motor 2	Refers to a second motor when the drive is operating two motors. Switch between these motors using the multi-function input terminals.

**Note:** If a parameter is not available in a certain control mode, the symbol for that control mode is grayed out.

## B.2 Parameter Groups



Parameter Group	Name	Page	Parameter Group	Name	Page
A1	Initialization	408	H6	Pulse Train Input/Output	446
A2	User Parameters	409	L1	Motor Protection	447
b1	Operation Mode Selection	409	L2	Momentary Power Loss Ride-Thru	448
b2	DC Injection Braking and Short Circuit Braking	410	L3	Stall Prevention	448
b3	Speed Search	411	L4	Speed Detection	450
b4	Delay Timer	412	L5	Fault Restart	450
b5	PID Control	412	L6	Torque Detection	451
b6	Dwell Function	415	L7	Torque Limit	452
b8	Energy Saving	415	L8	Drive Protection	452
b9	Zero Servo	416	n1	Hunting Prevention	455
C1	Acceleration and Deceleration Times	416	n2	Speed Feedback Detection Control (AFR) Tuning	455
C2	S-Curve Characteristics	417	n3	Overexcitation Deceleration	455
C3	Slip Compensation	417	n5	Feed Forward Control	456
C4	Torque Compensation	418	n6	Online Tuning	456
C5	Automatic Speed Regulator (ASR)	418	n8	PM Motor Control Tuning	456
C6	Carrier Frequency	420	n9	Hardware Settings	456
d1	Frequency Reference	421	o1	Digital Operator Display Selection	459
d2	Frequency Upper/Lower Limits	422	o2	Digital Operator Keypad Functions	459
d5	Torque Control	422	o3	Copy Function	460
d6	Field Weakening and Field Forcing	423	o4	Maintenance Monitor Settings	460
d7	Offset Frequency	423	S1	Disturb Function	461
E1	V/f Pattern for Motor 1	424	S2	Frequency Reference Gain Settings	461
E2	Motor 1 Parameters	425	S3	Braking Transistor and Output Voltage Gain	462
E3	V/f Pattern for Motor 2	426	S4	KEB Mode Selection	462
E4	Motor 2 Parameters	427	S5	KEB Accel/Decel Setting	463
E5	PM Motor Settings	427	S6	Power KEB Function	464
F1	PG Speed Control Card (PG-B3/PG-X3)	429	S9	Synchronous Operation	465
F2	Analog Input Card (AI-A3)	431	T1	Induction Motor Auto-Tuning	466
F3	Digital Input Card (DI-A3)	431	T2	PM Motor Auto-Tuning	467
F4	Analog Monitor Card (AO-A3)	432	T3	ASR and Inertia Tuning	469
F5	Digital Output Card (DO-A3)	432	U1	Operation Status Monitors	470
F6	Communication Option Card	433	U2	Fault Trace	472
H1	Multi-Function Digital Inputs	434	U3	Fault History	473
H2	Multi-Function Digital Outputs	439	U4	Maintenance Monitors	474
H3	Multi-Function Analog Inputs	442	U5	PID Monitors	476
H4	Multi-Function Analog Outputs	445	U6	Operation Status Monitors	476
H5	MEMOBUS/Modbus Serial Communication	445	U9	KEB Voltage Monitors	478

## B.3 Parameter Table

### ? A: Initialization Parameters

The A parameter group creates the operating environment for the drive. This includes the parameter Access Level, Motor Control Method, Password, User Parameters and more.

### ? A1: Initialization Parameters

No.(Addr.)	Name	Description	Setting	Page
A1-00 (100H)  <16>	Language Selection	<b>All Modes</b> 0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portuguese 7: Chinese	Default: 0 Min: 0 Max: 7	114
A1-01 (101H) 	Access Level Selection	<b>All Modes</b> 0: View and set A1-01 and A1-04. U□-□□ parameters can also be viewed. 1: User Parameters (access to a set of parameters selected by the user, A2-01 to A2-32) 2: Advanced Access (access to view and set all parameters)	Default: 2 Min: 0 Max: 2	114
A1-02 (102H) <16>	Control Method Selection	<b>All Modes</b> 0: V/f Control 1: V/f Control with PG 2: Open Loop Vector Control 3: Closed Loop Vector Control 5: Open Loop Vector Control for PM 6: Advanced Open Loop Vector Control for PM 7: Closed Loop Vector Control for PM	Default: 0 Min: 0 Max: 7	114
A1-03 (103H)	Initialize Parameters	<b>All Modes</b> 0: No initialization 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-wire initialization 3330: 3-wire initialization 5550: oPE04 error reset	Default: 0 Min: 0 Max: 5550	115
A1-04 (104H)	Password	<b>All Modes</b> When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 through A1-03, and A2-01 through A2-32 cannot be changed.	Default: 0000 Min: 0000 Max: 9999	116
A1-05 (105H)	Password Setting			

<16> Parameter setting value is not reset to the default value when the drive is initialized.

## ? A2: User Parameters

No.(Addr.)	Name	Description	Setting	Page
A2-01 to A2-32 (106 to 125H)	User Parameters 1 to 32	<b>All Modes</b> Parameters that were recently edited are listed here. The user can also select parameters to appear here for quick access.	Default: – Min: A1-00 Max: o4-13	118
A2-33 (126H)	User Parameter Automatic Selection	<b>All Modes</b> 0: Parameters A2-01 through A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access.	Default: 1 Min: 0 Max: 1	118

## ? b: Application

Application parameters configure the source of the Run command, DC Injection Braking, Speed Search, timer functions, PID control, the Dwell function, Energy Savings, and a variety of other application-related settings.

### ? b1: Operation Mode Selection





No.(Addr.)	Name	Description	Setting	Page
b1-01 (180H)	Frequency Reference Source 1	<b>All Modes</b> 0: Digital operator 1: Analog input terminals 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse input (terminal RP)	Default: 1 Min: 0 Max: 4	119
b1-02 (181H)	Run Command Source 1	<b>All Modes</b> 0: Digital operator 1: Digital input terminals 2: MEMOBUS/Modbus communications 3: Option PCB	Default: 1 Min: 0 Max: 3	120
b1-03 (182H)	Stopping Method Selection	<b>All Modes</b> 0: Ramp to stop 1: Coast to stop 2: DC Injection Braking to stop 3: Coast with timer	Default: 0 Min: 0 Max: 3 <a href="#">&lt;39&gt;</a>	121
b1-04 (183H)	Reverse Operation Selection	<b>All Modes</b> 0: Reverse enabled. 1: Reverse disabled.	Default: 0 Min: 0 Max: 1	123
b1-05 (184H)	Action Selection below Minimum Output Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Operates according to frequency reference (E1-09 is disabled). 1: Output shuts off (coast to stop if less than E1-09). 2: Operates according to E1-09 (frequency reference set to E1-09). 3: Zero speed (frequency reference becomes zero when less than E1-09).	Default: 0 Min: 0 Max: 3	123
b1-06 (185H)	Digital Input Reading	<b>All Modes</b> 0: Input status is read once and processed immediately (for quick response) 1: Input is read twice and processed only if the status is the same in both readings (robust against noisy signals)	Default: 1 Min: 0 Max: 1	124
b1-07 (186H)	LOCAL/REMOTE Run Selection	<b>All Modes</b> 0: An external Run command has to be cycled at the new source to be activated. 1: An external Run command at new source is accepted immediately.	Default: 0 Min: 0 Max: 1	125

### B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
b1-08 (187H)	Run Command Selection while in Programming Mode	<b>All Modes</b> 0: Run command not accepted while in the Programming Mode. 1: Run command accepted while in the Programming Mode. 2: Prohibit entering Programming Mode during run.	Default: 0 Min: 0 Max: 2	125
b1-14 (1C3H)	Phase Order Selection	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> 0: Standard 1: Switch phase order (reverses the direction of the motor)	Default: 0 Min: 0 Max: 1	125
b1-15 (1C4H)	Frequency Reference Source 2	<b>All Modes</b> Enabled when an input terminal set for “External reference” (H1-□□ = 2) closes. 0: Digital operator 1: Terminals (analog input terminals) 2: MEMOBUS/Modbus communications 3: Option card 4: Pulse train input	Default: 0 Min: 0 Max: 4	126
b1-16 (1C5H)	Run Command Source 2	<b>All Modes</b> Enabled when a terminal set for “External reference” (H1-□□ = 2) closes. 0: Digital operator 1: Digital input terminals 2: MEMOBUS/Modbus communications 3: Option card	Default: 0 Min: 0 Max: 3	126
b1-17 (1C6H)	Run Command at Power Up	<b>All Modes</b> 0: Disregarded. A new Run command needs to be issued after power up. 1: Allowed. Motor will start immediately after power up if a Run command is already enabled.	Default: 0 Min: 0 Max: 1	126

<39> The setting range is 0 to 1 in CLV.

### ? b2: DC Injection Braking and Short Circuit Braking

No.(Addr.)	Name	Description	Setting	Page
b2-01 (189H) 	DC Injection Braking Start Frequency	<b>All Modes</b> Sets the frequency to start executing DC Injection Braking, Short-Circuit Braking, and Zero Servo. Enabled when the stopping method is set for ramp to stop (b1-03 = 0).	Default: <34> Min: 0.0 Hz Max: 10.0 Hz	126
b2-02 (18AH) 	DC Injection Braking Current	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the DC Injection Braking current as a percentage of the drive rated current.	Default: 50% Min: 0% Max: 100%	127
b2-03 (18BH) 	DC Injection Braking Time at Start	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the time of DC Injection Braking (Zero Speed Control when in CLV and CLV/PM) time at start. Disabled when set to 0.00 seconds.	Default: 0.00 s Min: 0.00 s Max: 10.00 s	128
b2-04 (18CH) 	DC Injection Braking Time at Stop	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the time of DC Injection Braking (Zero Speed Control when in CLV and CLV/PM) at stop.	Default: <34> Min: 0.00 s Max: 10.00 s	128
b2-08 (190H)	Magnetic Flux Compensation Value	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the magnetic flux compensation as a percentage of the no-load current value (E2-03).	Default: 0% Min: 0% Max: 1000%	128
b2-10 (1FBH)	DC Injection Braking Current 2	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the DC Injection Braking 2 current as a percentage of the drive rated current.	Default: 50% Min: 0% Max: 100%	128

No.(Addr.)	Name	Description	Setting	Page
b2-12 (1BAH)	Short Circuit Brake Time at Start	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time for Short Circuit Braking operation at start. &lt;23&gt;</p>	Default: 0.00 s Min: 0.00 s Max: 25.50 s	129
b2-13 (1BBH)	Short Circuit Brake Time at Stop	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the Short Circuit Braking operation time at stop. &lt;23&gt;</p>	Default: 0.50 s <34> Min: 0.00 s Max: 25.50 s	129
b2-18 (177H)	Short Circuit Braking Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Determines the current level for Short Circuit Braking. Set as a percentage of the motor rated current.</p>	Default: 100.0% Min: 0.0% Max: 200.0%	129



<23> A coasting motor may require a braking resistor circuit to bring the motor to a stop in the required time.

<34> Default setting is determined by the control mode (A1-02).

## ? b3: Speed Search

No.(Addr.)	Name	Description	Setting	Page
b3-01 (191H)	Speed Search Selection at Start	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled 1: Enabled</p>	Default: <34> Min: 0 Max: 1	132
b3-02 (192H)	Speed Search Deactivation Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the current level at which the speed is assumed to be detected and Speed Search is ended. Set as a percentage of the drive rated current.</p>	Default: <34> Min: 0% Max: 200%	132
b3-03 (193H)	Speed Search Deceleration Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets output frequency reduction time during Speed Search.</p>	Default: 2.0 s Min: 0.1 s Max: 10.0 s	133
b3-04 (194H)	V/f Gain during Speed Search	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Determines how much to lower the V/f ratio during Speed Search. V/f during Speed Search equals the V/f setting multiplied by b3-04.</p>	Default: <24> Min: 10% Max: 100%	133
b3-05 (195H)	Speed Search Delay Time	<div>All Modes</div> <p>When using an external contactor on the output side, b3-05 delays executing Speed Search after a momentary power loss to allow time for the contactor to close.</p>	Default: 0.2 s Min: 0.0 s Max: 100.0 s	133
b3-06 (196H)	Output Current 1 during Speed Search	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the current injected to the motor at the beginning of Speed Estimation Speed Search. Set as a coefficient for the motor rated current.</p>	Default: <9> Min: 0.0 Max: 2.0	133
b3-10 (19AH)	Speed Search Detection Compensation Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the gain which is applied to the speed detected by Speed Estimation Speed Search before the motor is reaccelerated. Increase this setting if ov occurs when performing Speed Search after a relatively long period of baseblock.</p>	Default: 1.05 Min: 1.00 Max: 1.20	133
b3-14 (19EH)	Bi-Directional Speed Search Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled (uses the direction of the frequency reference) 1: Enabled (drive detects which way the motor is rotating)</p>	Default: <34> Min: 0 Max: 1	133
b3-17 (1F0H)	Speed Search Restart Current Level	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the Speed Search restart current level as a percentage of the drive rated current.</p>	Default: 150% Min: 0% Max: 200%	134

### B.3 Parameter Table



No.(Addr.)	Name	Description	Setting	Page
b3-18 (1F1H) 	Speed Search Restart Detection Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time to detect Speed Search restart.</p>	Default: 0.10 s Min: 0.00 s Max: 1.00 s	134
b3-19 (1F2H)	Number of Speed Search Restarts	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of times the drive can attempt to restart when performing Speed Search.</p>	Default: 3 Min: 0 Max: 10	134
b3-24 (1C0H)	Speed Search Method Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Current Detection 1: Speed Estimation 3: Synchronous Operation (V/f)</p>	Default: 0 Min: 0 Max: 3	134
b3-25 (1C8H) 	Speed Search Wait Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time the must wait between each Speed Search restart attempt.</p>	Default: 0.5 s Min: 0.0 s Max: 30.0 s	134
b3-27 (1C9H)	Start Speed Search Select	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Selects a condition to activate Speed Search Selection at Start (b3-01) or External Speed Search Command 1 or 2 from the multi-function input. 0: Triggered when a Run command is issued (normal). 1: Triggered when an external baseblock is released.</p>	Default: 0 Min: 0 Max: 1	135

<9> Default setting value varies by the drive model (o2-04).



<24> Default setting value is dependent on the drive model (o2-04) and the Drive Duty (C6-01).












<34> Default setting is determined by the control mode (A1-02).

#### ? b4: Timer Function






No.(Addr.)	Name	Description	Setting	Page
b4-01 (1A3H) 	Timer Function On-Delay Time	<div>All Modes</div> <p>Used to set the on-delay and off-delay times for a digital timer output (H2-□□=12). The output is triggered by a digital input programmed to H1-□□=18)</p>	Default: 0.0 s Min: 0.0 s Max: 3000.0 s	135
b4-02 (1A4H) 	Timer Function Off-Delay Time		Default: 0.0 s Min: 0.0 s Max: 3000.0 s	135

#### ? b5: PID Control

No.(Addr.)	Name	Description	Setting	Page
b5-01 (1A5H)	PID Function Setting	<div>All Modes</div> <p>0: Disabled 1: Enabled (PID output becomes output frequency reference, deviation D controlled) 2: Enabled (PID output becomes output frequency reference, feedback D controlled) 3: Enabled (PID output added to frequency reference, deviation D controlled) 4: Enabled (PID output added to frequency reference, feedback D controlled)</p>	Default: 0 Min: 0 Max: 4	139
b5-02 (1A6H) 	Proportional Gain Setting (P)	<div>All Modes</div> <p>Sets the proportional gain of the PID controller.</p>	Default: 1.00 Min: 0.00 Max: 25.00	139
b5-03 (1A7H) 	Integral Time Setting (I)	<div>All Modes</div> <p>Sets the integral time for the PID controller.</p>	Default: 1.0 s Min: 0.0 s Max: 360.0 s	139

No.(Addr.)	Name	Description	Setting	Page
b5-04 (1A8H) 	Integral Limit Setting	<b>All Modes</b> Sets the maximum output possible from the integrator as a percentage of the maximum output frequency.	Default: 100.0% Min: 0.0% Max: 100.0%	139
b5-05 (1A9H) 	Derivative Time (D)	<b>All Modes</b> Sets D control derivative time.	Default: 0.00 s Min: 0.00 s Max: 10.00 s	139
b5-06 (1AAH) 	PID Output Limit	<b>All Modes</b> Sets the maximum output possible from the entire PID controller as a percentage of the maximum output frequency.	Default: 100.0% Min: 0.0% Max: 100.0%	140
b5-07 (1ABH) 	PID Offset Adjustment	<b>All Modes</b> Applies an offset to the PID controller output. Set as a percentage of the maximum output frequency.	Default: 0.0% Min: -100.0% Max: 100.0%	140
b5-08 (1ACH) 	PID Primary Delay Time Constant	<b>All Modes</b> Sets a low pass filter time constant on the output of the PID controller.	Default: 0.00 s Min: 0.00 s Max: 10.00 s	140
b5-09 (1ADH)	PID Output Level Selection	<b>All Modes</b> 0: Normal output (direct acting) 1: Reverse output (reverse acting)	Default: 0 Min: 0 Max: 1	140
b5-10 (1AEH) 	PID Output Gain Setting	<b>All Modes</b> Sets the gain applied to the PID output.	Default: 1.00 Min: 0.00 Max: 25.00	140
b5-11 (1AFH)	PID Output Reverse Selection	<b>All Modes</b> 0: Negative PID output triggers zero limit. 1: Rotation direction reverses with negative PID output. When using setting 1, make sure reverse operation is permitted by parameter b1-04.	Default: 0 Min: 0 Max: 1	140
b5-12 (1B0H)	PID Feedback Loss Detection Selection	<b>All Modes</b> 0: No fault. Digital output only. 1: Fault detection. Alarm output, drive continues operation. 2: Fault detection. Fault output, drive output is shut off. 3: No fault. Digital output only. No fault detection when PID control is disabled. 4: Fault detection. Alarm is triggered and drive continues to run. Fault detection even when PID is disabled. 5: Fault detection. Drive output shuts off. No fault detection when PID control is disabled.	Default: 0 Min: 0 Max: 5	141
b5-13 (1B1H) 	PID Feedback Low Detection Level	<b>All Modes</b> Sets the PID feedback loss detection level as a percentage of the maximum output frequency.	Default: 0% Min: 0% Max: 100%	142
b5-14 (1B2H) 	PID Feedback Low Detection Time	<b>All Modes</b> Sets a delay time for PID feedback loss.	Default: 1.0 s Min: 0.0 s Max: 25.5 s	142
b5-15 (1B3H) 	PID Sleep Function Start Level	<b>All Modes</b> Sets the frequency level that triggers the sleep function.	Default: <del>34</del> Min: 0.0 Hz Max: 400.0 Hz	143
b5-16 (1B4H) 	PID Sleep Delay Time	<b>All Modes</b> Sets a delay time before the sleep function is triggered.	Default: 0.0 s Min: 0.0 s Max: 25.5 s	143
b5-17 (1B5H) 	PID Accel/Decel Time	<b>All Modes</b> Sets the acceleration and deceleration time to PID setpoint.	Default: 0.0 s Min: 0.0 s Max: 6000.0 s	143

## B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
b5-18 (1DCH)	PID Setpoint Selection	<b>All Modes</b> 0: Disabled 1: Enabled	Default: 0 Min: 0 Max: 1	143
b5-19 (1DDH) 	PID Setpoint Value	<b>All Modes</b> Sets the PID target value when b5-18 = 1. Set as a percentage of the maximum output frequency.	Default: 0.00% Min: 0.00% Max: 100.00%	143
b5-20 (1E2H)	PID Setpoint Scaling	<b>All Modes</b> 0: 0.01 Hz units 1: 0.01% units (100% = max. output frequency) 2: r/min units (set the no. of motor poles) 3: User-set units (use b5-38, b5-39)	Default: 1 Min: 0 Max: 3	144
b5-34 (19FH) 	PID Output Lower Limit	<b>All Modes</b> Sets the minimum output possible from the PID controller as a percentage of the maximum output frequency.	Default: 0.00% Min: -100.0% Max: 100.0%	144
b5-35 (1A0H) 	PID Input Limit	<b>All Modes</b> Limits the PID control input (deviation signal) as a percentage of the maximum output frequency. Acts as a bipolar limit.	Default: 1000.0% Min: 0% Max: 1000.0%	144
b5-36 (1A1H) 	PID Feedback High Detection Level	<b>All Modes</b> Sets the PID feedback high detection level as a percentage of the maximum output frequency.	Default: 100% Min: 0% Max: 100%	142
b5-37 (1A2H) 	PID Feedback High Detection Time	<b>All Modes</b> Sets the PID feedback high level detection delay time.	Default: 1.0 s Min: 0.0 s Max: 25.5 s	142
b5-38 (1FEH)	PID Setpoint User Display	<b>All Modes</b> Sets the display value of U5-01 and U5-04 when the maximum frequency is output.	Default: <2> Min: 1 Max: 60000	144
b5-39 (1FFH)	PID Setpoint Display Digits	<b>All Modes</b> 0: No decimal places 1: One decimal places 2: Two decimal places 3: Three decimal places	Default: <2> Min: 0 Max: 3	144
b5-40 (17FH)	Frequency Reference Monitor Content during PID	<b>All Modes</b> 0: Display the frequency reference (U1-01) after PID compensation has been added. 1: Display the frequency reference (U1-01) before PID compensation has been added.	Default: 0 Min: 0 Max: 1	144
b5-47 (17DH)	Reverse Operation Selection 2 by PID Output	<b>All Modes</b> 0: Zero limit when PID output is a negative value. 1: Reverse operation when PID output is a negative value (Zero limit if the reverse operation is prohibited by b1-04).	Default: 1 Min: 0 Max: 1	145

<2> Default setting is dependent on PID setpoint scaling (b5-20).



<34> Default setting is determined by the control mode (A1-02).

? **b6: Dwell Function**

No.(Addr.)	Name	Description	Setting	Page
b6-01 (1B6H)	Dwell Reference at Start	<div>All Modes</div> Parameters b6-01 and b6-02 set the frequency to hold and the time to maintain that frequency at start. Parameters b6-03 and b6-04 set the frequency to hold and the time to maintain that frequency at stop.	Default: <34> Min: 0.0 Hz Max: 400.0 Hz	146
b6-02 (1B7H)	Dwell Time at Start		Default: 0.0 s Min: 0.0 s Max: 10.0 s	146
b6-03 (1B8H)	Dwell Frequency at Stop		Default: <34> Min: 0.0 Hz Max: 400.0 Hz	146
b6-04 (1B9H)	Dwell Time at Stop		Default: 0.0 s Min: 0.0 s Max: 10.0 s	146

<34> Default setting is determined by the control mode (A1-02).

? **b8: Energy Saving**

No.(Addr.)	Name	Description	Setting	Page
b8-01 (1CCH)	Energy Saving Control Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled 1: Enabled	Default: <34> Min: 0 Max: 1	146
b8-02 (1CDH) 	Energy Saving Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the gain used for Energy Saving.	Default: <34> Min: 0.0 Max: 10.0	147
b8-03 (1CEH) 	Energy Saving Control Filter Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets a time constant for Energy Saving.	Default: <27> Min: 0.00 s Max: 10.00 s	147
b8-04 (1CFH)	Energy Saving Coefficient Value	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Determines the level of maximum motor efficiency. The setting range is 0.0 to 2000.0 for drives with a rated output power up to 3.7 kW as listed in <a href="#">Table 1.1</a> after the Drive Duty has been set in parameter C6-01.	Default: <21> <24> Min: 0.00 Max: 655.00	147
b8-05 (1D0H)	Power Detection Filter Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets a time constant filter for output power detection.	Default: 20 ms Min: 0 ms Max: 2000 ms	147
b8-06 (1D1H)	Search Operation Voltage Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the limit for the voltage search operation as a percentage of the motor rated voltage.	Default: 0% Min: 0% Max: 100%	147
b8-16 (1F8H)	Energy Saving Parameter (Ki) for PM Motors	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Coefficient to adjust torque linearity. This parameter rarely needs to be changed. When parameter E5-01, Motor Code Selection, is set to 1□□□ or 2□□□, the automatically calculated value will be set. This set value cannot be changed.	Default: 1.00 Min: 0.00 Max: 2.00	147
b8-17 (1F9H)	Energy Saving Parameter (Kt) for PM Motors	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Coefficient to adjust torque linearity. This parameter rarely needs to be changed. When parameter E5-01, Motor Code Selection, is set to 1□□□ or 2□□□, the automatically calculated value will be set. This set value cannot be changed.	Default: 1.00 Min: 0.00 Max: 2.00	148

<21> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

### B.3 Parameter Table

<24> Default setting value is dependent on the drive model (o2-04) and the Drive Duty (C6-01).

<27> Default setting is determined by the control mode (A1-02) and the drive model (o2-04).

<34> Default setting is determined by the control mode (A1-02).

#### ? b9: Zero Servo

No.(Addr.)	Name	Description	Setting	Page
b9-01 (1DAH)	Zero Servo Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the position loop gain for the Zero Servo function.	Default: 5 Min: 0 Max: 100	148
b9-02 (1DBH)	Zero Servo Completion Width	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the range to trigger an output terminal set for “Zero Servo Complete” during Zero Servo operation.	Default: 10 Min: 0 Max: 16383	149

#### ? C: Tuning


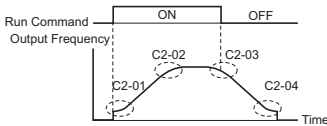



C parameters are used to adjust the acceleration and deceleration times, S-curves, slip compensation, torque compensation, and carrier frequency selections.

#### ? C1: Acceleration and Deceleration Times

No.(Addr.)	Name	Description	Setting	Page
C1-01 (200H) 	Acceleration Time 1	<div>All Modes</div> Sets the time to accelerate from 0 to maximum frequency.	Default: 10.0 s Min: 0.0 s Max: 6000.0 s <3>	150
C1-02 (201H) 	Deceleration Time 1	<div>All Modes</div> Sets the time to decelerate from maximum frequency to 0.		150
C1-03 (202H) 	Acceleration Time 2	<div>All Modes</div> Sets the time to accelerate from 0 to maximum frequency.		150
C1-04 (203H) 	Deceleration Time 2	<div>All Modes</div> Sets the time to decelerate from maximum frequency to 0.		150
C1-05 (204H) 	Acceleration Time 3 (Motor 2 Accel Time 1)	<div>All Modes</div> Sets the time to accelerate from 0 to maximum frequency.		150
C1-06 (205H) 	Deceleration Time 3 (Motor 2 Decel Time 1)	<div>All Modes</div> Sets the time to decelerate from maximum frequency to 0.		150
C1-07 (206H) 	Acceleration Time 4 (Motor 2 Accel Time 2)	<div>All Modes</div> Sets the time to accelerate from 0 to maximum frequency.		150
C1-08 (207H) 	Deceleration Time 4 (Motor 2 Decel Time 2)	<div>All Modes</div> Sets the time to decelerate from maximum frequency to 0.		150
C1-09 (208H)	Fast Stop Time	<div>All Modes</div> Sets the time for the Fast Stop function.	Default: 10.0 s Min: 0.0 s Max: 6000.0 s <3>	151
C1-10 (209H)	Accel/Decel Time Setting Units	<div>All Modes</div> 0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	Default: 1 Min: 0 Max: 1	152
C1-11 (20AH)	Accel/Decel Time Switching Frequency	<div>All Modes</div> Sets the frequency to switch between accel/decel time settings	Default: 0.0 Hz Min: 0.0 Hz Max: 400.0 Hz	151





<3> Setting range value is dependent on parameter C1-10, Accel/Decel Time Setting Units. When C1-10 = 0 (units of 0.01 seconds), the setting range becomes 0.00 to 600.00 seconds.

## ? C2: S-Curve Characteristics

No.(Addr.)	Name	Description	Setting	Page
C2-01 (20BH) 	S-Curve Characteristic at Accel Start	<b>All Modes</b> The S-curve can be controlled at the four points shown below. 	Default: <34> Min: 0.00 s Max: 10.00 s	152
C2-02 (20CH) 	S-Curve Characteristic at Accel End		Default: 0.20 s Min: 0.00 s Max: 10.00 s	152
C2-03 (20DH) 	S-Curve Characteristic at Decel Start		Default: 0.20 s Min: 0.00 s Max: 10.00 s	152
C2-04 (20EH) 	S-Curve Characteristic at Decel End		Default: 0.00 s Min: 0.00 s Max: 10.00 s	152

<34> Default setting is determined by the control mode (A1-02).

## ? C3: Slip Compensation

No.(Addr.)	Name	Description	Setting	Page
C3-01 (20FH) 	Slip Compensation Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the gain for the motor slip compensation function used for motor 1.	Default: <34> Min: 0.0 Max: 2.5	153
C3-02 (210H) 	Slip Compensation Primary Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Adjusts the slip compensation function delay time used for motor 1.	Default: <34> Min: 0 ms Max: 10000 ms	153
C3-03 (211H)	Slip Compensation Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets an upper limit for the slip compensation function as a percentage of motor rated slip for motor 1 (E2-02).	Default: 200% Min: 0% Max: 250%	153
C3-04 (212H)	Slip Compensation Selection during Regeneration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled. 1: Enabled above 6 Hz. 2: Enabled whenever slip compensation is possible.	Default: 0 Min: 0 Max: 2	153
C3-05 (213H)	Output Voltage Limit Operation Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled. 1: Enabled. Automatically decreases motor flux when output voltage saturation is reached.	Default: 0 Min: 0 Max: 1	154
C3-21 (33EH) 	Motor 2 Slip Compensation Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the slip compensation gain used for motor 2.	Default: <25> Min: 0.0 Max: 2.5	154
C3-22 (241H) 	Motor 2 Slip Compensation Primary Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the slip compensation delay time used for motor 2.	Default: <25> Min: 0 ms Max: 10000 ms	154

### B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
C3-23 (242H)	Motor 2 Slip Compensation Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the upper limit for the slip compensation function for motor 2. Set as a percentage of the motor rated slip (E4-02).</p>	Default: 200% Min: 0% Max: 250%	154
C3-24 (243H)	Motor 2 Slip Compensation Selection During Regeneration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled. 1: Enabled above 6 Hz. 2: Enabled whenever slip compensation is possible.</p>	Default: 0 Min: 0 Max: 2	155

<25> Default setting is determined by the control mode for motor 2 (E3-01).

<34> Default setting is determined by the control mode (A1-02).

### ? C4: Torque Compensation







No.(Addr.)	Name	Description	Setting	Page
C4-01 (215H)	Torque Compensation Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Used for motor 1.</p>	Default: <34> Min: 0.00 Max: 2.50	155
C4-02 (216H)	Torque Compensation Primary Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the torque compensation filter time.</p>	Default: <27> Min: 0 ms Max: 60000 ms	156
C4-03 (217H)	Torque Compensation at Forward Start	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets torque compensation at forward start as a percentage of motor torque.</p>	Default: 0.0% Min: 0.0% Max: 200.0%	156
C4-04 (218H)	Torque Compensation at Reverse Start	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets torque compensation at reverse start as a percentage of motor torque.</p>	Default: 0.0% Min: -200.0% Max: 0.0%	156
C4-05 (219H)	Torque Compensation Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time constant for torque compensation at forward start and reverse start (C4-03 and C4-04).</p>	Default: 10 ms Min: 0 ms Max: 200 ms	156
C4-06 (21AH)	Torque Compensation Primary Delay Time 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the torque compensation time 2.</p>	Default: 150 ms Min: 0 ms Max: 10000 ms	156
C4-07 (341H)	Motor 2 Torque Compensation Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the torque compensation gain used for motor 2.</p>	Default: 1.00 Min: 0.00 Max: 2.50	156

<27> Default setting is determined by the control mode (A1-02) and the drive model (o2-04).

<34> Default setting is determined by the control mode (A1-02).

### ? C5: Automatic Speed Regulator (ASR)

No.(Addr.)	Name	Description	Setting	Page
C5-01 (21BH)	ASR Proportional Gain 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the proportional gain of the speed control loop (ASR).</p>	Default: <34> Min: 0.00 Max: 300.00 <29>	159
C5-02 (21CH)	ASR Integral Time 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the integral time of the speed control loop (ASR).</p>	Default: <34> Min: 0.000 s Max: 10.000 s	159
C5-03 (21DH)	ASR Proportional Gain 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the speed control gain 2 of the speed control loop (ASR).</p>	Default: <34> Min: 0.00 Max: 300.00 <29>	159

No.(Addr.)	Name	Description	Setting	Page
C5-04 (21EH) 	ASR Integral Time 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the integral time 2 of the speed control loop (ASR).</p>	Default: <34> Min: 0.000 s Max: 10.000 s	159
C5-05 (21FH)	ASR Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the upper limit for the speed control loop (ASR) as a percentage of the maximum output frequency (E1-04).</p>	Default: 5.0% Min: 0.0% Max: 20.0%	160
C5-06 (220H)	ASR Primary Delay Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the filter time constant for the time from the speed loop to the torque command output.</p>	Default: <34> Min: 0.000 s Max: 0.500 s	160
C5-07 (221H)	ASR Gain Switching Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the frequency for switching between proportional gain 1, 2 and integral time 1, 2.</p>	Default: <34> Min: 0.0 Hz Max: 400.0 Hz	160
C5-08 (222H)	ASR Integral Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the ASR integral upper limit as a percentage of maximum output frequency (E1-04).</p>	Default: 400% Min: 0% Max: 400%	160
C5-11 (270H) 	Regenerative ASR Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets an upper limit for frequency compensation when using ASR. The value is set as a percentage of the maximum output frequency.</p>	Default: 0.0% Min: 0.0% Max: 20.0%	160
C5-12 (386H)	Integral Operation during Accel/Decel	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled. Integral functions are enabled only during constant speed. 1: Enabled. Integral functions are always enabled, during accel/decel and during constant speed.</p>	Default: 0 Min: 0 Max: 1	161
C5-17 (276H)	Motor Inertia	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor inertia. This value is automatically set during ASR or Inertia Auto-Tuning.</p>	Default: <7> <24> Min: 0.0001 kgm <sup>2</sup> Max: 600.00 kgm <sup>2</sup>	161
C5-18 (277H)	Load Inertia Ratio	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the ratio between the motor and load inertia. This value is automatically set during ASR or Inertia Auto-Tuning.</p>	Default: 1.0 Min: 0.0 Max: 6000.0	161
C5-21 (356H) 	Motor 2 ASR Proportional Gain 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the proportional gain of the speed control loop (ASR) for motor 2.</p>	Default: <25> Min: 0.00 Max: 300.00 <29>	161
C5-22 (357H) 	Motor 2 ASR Integral Time 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the integral time of the speed control loop (ASR) for motor 2.</p>	Default: <25> Min: 0.000 s Max: 10.000 s	161
C5-23 (358H) 	Motor 2 ASR Proportional Gain 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the speed control gain 2 of the speed control loop (ASR) for motor 2.</p>	Default: <25> Min: 0.00 Max: 300.00 <29>	161
C5-24 (359H) 	Motor 2 ASR Integral Time 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the integral time 2 of the speed control loop (ASR) for motor 2.</p>	Default: <25> Min: 0.000 s Max: 10.000 s	161
C5-25 (35AH)	Motor 2 ASR Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the upper limit for the speed control loop (ASR) for motor 2 as a percentage of the maximum output frequency (E3-04).</p>	Default: 5.0% Min: 0.0% Max: 20.0%	161

## B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
C5-26 (35BH)	Motor 2 ASR Primary Delay Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the filter time constant for the time from the speed loop to the torque command output used for motor 2.</p>	Default: 0.004 s Min: 0.000 s Max: 0.500 s	161
C5-27 (35CH)	Motor 2 ASR Gain Switching Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the frequency for motor 2 used to switch between proportional gain 1 and 2, and between the integral time 1 and 2.</p>	Default: 0.0 Hz Min: 0.0 Hz Max: 400.0 Hz	162
C5-28 (35DH)	Motor 2 ASR Integral Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the ASR integral upper limit for motor 2 as a percentage of maximum output frequency (E3-04).</p>	Default: 400% Min: 0% Max: 400%	162
C5-32 (361H)	Integral Operation during Accel/Decel for Motor 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled. Integral functions for motor 2 are enabled only during constant speed.            1: Enabled. Integral functions are always enabled for motor 2, during accel/decel and during constant speed.</p>	Default: 0 Min: 0 Max: 1	162
C5-37 (278H)	Motor 2 Inertia	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the inertia of motor 2 alone without the load. This value is automatically set during ASR or Inertia Auto-Tuning.</p>	Default: <24> Min: 0.0001 kgm <sup>2</sup> Max: 600.00 kgm <sup>2</sup>	162
C5-38 (279H)	Motor 2 Load Inertia Ratio	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the ratio between the motor 2 and machine inertia. This value is automatically set during ASR or Inertia Auto-Tuning.</p>	Default: 1.0 Min: 0.0 Max: 6000.0	162

<7> Default setting value is dependent on the motor code set to E5-01.

<24> Default setting value is dependent on the drive model set to o2-04 and the Drive Duty set to C6-01.

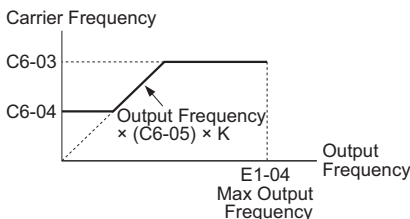
<25> Default setting is determined by the control mode for motor 2 (E3-01).

<29> The setting range is 1.00 to 300.0 in CLV, AOLV/PM, or CLV/PM.

<34> Default setting is determined by the control mode (A1-02).

### ? C6: Carrier Frequency

No.(Addr.)	Name	Description	Setting	Page
C6-01 (223H)	Drive Duty Selection	<div>All Modes</div> <p>0: Heavy Duty (HD)            Overload Tolerance: 150% rated output current (HD) for 60 s            Carrier Frequency: 2 kHz (default)            1: Normal Duty (ND)            Overload Tolerance: 120% rated output current (ND) for 60 s            Carrier Frequency: 2 kHz, Swing PWM (default)</p>	Default: 0 Min: 0 Max: 1	162
C6-02 (224H)	Carrier Frequency Selection	<div>All Modes</div> <p>1: 2.0 kHz            2: 5.0 kHz (4.0 Hz)            3: 8.0 kHz (6.0 Hz)            4: 10.0 kHz (8.0 Hz)            5: 12.5 kHz (10.0 Hz)            6: 15.0 kHz (12.0 Hz)            F: User defined (determined by C6-03 through C6-05)  <b>Note:</b> The default setting is 2 when using a PM motor. In all other control modes, 1 for HD and ND.</p>	Default: <F> Min: 1 Max: F	163

No.(Addr.)	Name	Description	Setting	Page
C6-03 (225H)	Carrier Frequency Upper Limit	<b>All Modes</b> <b>Note: C6-04 and C6-05 are available only in V/f and V/f w/PG control modes.</b> Determines the upper and lower limits for the carrier frequency. In OLV, C6-03 determines the upper limit of the carrier frequency. 	Default: <S> Min: 1.0 kHz Max: 15.0 kHz	164
C6-04 (226H)	Carrier Frequency Lower Limit		Default: <S> Min: 1.0 kHz Max: 15.0 kHz	164
C6-05 (227H)	Carrier Frequency Proportional Gain		Default: <S> Min: 0 Max: 99	164
C6-06 (228H)	PWM Method	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: 2-phase/3-phase conversion 1: 2-phase modulation 2: 3-phase modulation	Default: <S> Min: 0 Max: 2	164
C6-09 (22BH)	Carrier Frequency during Rotational Auto-Tuning	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Carrier Frequency = 5 kHz 1: Setting value for C6-03	Default: 0 Min: 0 Max: 1	164







<1> Default setting value is dependent on the drive model (o2-04), the control mode (A1-02), and the Drive Duty (C6-01).

<S> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection.

## ? d: References

Reference parameters are used to set the various frequency reference values during operation.

### ? d1: Frequency Reference

No.(Addr.)	Name	Description	Setting	Page
d1-01 (280H) 	Frequency Reference 1	<b>All Modes</b> Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min: 0.00 Hz Max: 400.00 Hz <11> <40>	165
d1-02 (281H) 	Frequency Reference 2			165
d1-03 (282H) 	Frequency Reference 3			165
d1-04 (283H) 	Frequency Reference 4			165
d1-05 (284H) 	Frequency Reference 5			165
d1-06 (285H) 	Frequency Reference 6			165

## B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
d1-07 (286H) 	Frequency Reference 7	<b>All Modes</b>	Default: 0.00 Hz Min: 0.00 Hz Max: 400.00 Hz <11> <40>	165
d1-08 (287H) 	Frequency Reference 8	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.		165
d1-17 (292H) 	Jog Frequency Reference	<b>All Modes</b> Sets the Jog frequency reference. Setting units are determined by parameter o1-03.	Default: 6.00 Hz Min: 0.00 Hz Max: 400.00 Hz <11> <40>	165

<11> Range upper limit is determined by the maximum output frequency (E1-04) and the upper limit of the frequency reference (d2-01).

<40> When using the AOLV/PM or CLV/PM control mode, the drive will automatically set parameter o1-03 = 1 and percentage units will be used.

### ? d2: Frequency Upper/Lower Limits

No.(Addr.)	Name	Description	Setting	Page
d2-01 (289H)	Frequency Reference Upper Limit	<b>All Modes</b> Sets the frequency reference upper limit as a percentage of the maximum output frequency.	Default: 100.0% Min: 0.0% Max: 110.0%	167
d2-02 (28AH) 	Frequency Reference Lower Limit	<b>All Modes</b> Sets the frequency reference lower limit as a percentage of the maximum output frequency.	Default: 0.0% Min: 0.0% Max: 110.0%	167
d2-03 (293H) 	Master Speed Reference Lower Limit	<b>All Modes</b> Sets the lower limit for frequency references from analog inputs as a percentage of the maximum output frequency.	Default: 0.0% Min: 0.0 Max: 110.0%	167
d2-04 (2A8H) 	Frequency Reference 2 Upper Limit	<b>All Modes</b> Sets the frequency reference 2 upper limit as a percentage of maximum output frequency.	Default: 100.0% Min: 0.0% Max: 110.0%	167
d2-05 (2A9H) 	Frequency Reference 2 Lower Limit	<b>All Modes</b> Sets the frequency reference 2 lower limit as a percentage of maximum output frequency.	Default: 100.0% Min: 0.0% Max: 110.0%	168

### ? d5: Torque Control

No.(Addr.)	Name	Description	Setting	Page
d5-01 (29AH)	Torque Control Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div><b>CLV</b></div> <div>OLV/PM</div> <div>AOLV/PM</div> <div><b>CLV/PM</b></div> </div> 0: Speed Control 1: Torque Control Set to 0 when using a digital input to switch between Speed and Torque Control (H1-□□ = 71).	Default: 0 Min: 0 Max: 1	171
d5-02 (29BH)	Torque Reference Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div><b>CLV</b></div> <div>OLV/PM</div> <div>AOLV/PM</div> <div><b>CLV/PM</b></div> </div> Sets a delay time for the torque reference signal. Used to suppress effects by noisy or fluctuating torque reference signals.	Default: <34> Min: 0 ms Max: 1000 ms	171
d5-03 (29CH)	Speed Limit Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div><b>CLV</b></div> <div>OLV/PM</div> <div>AOLV/PM</div> <div><b>CLV/PM</b></div> </div> 1: Limit set by the frequency reference in b1-01. 2: Limit set by d5-04.	Default: 1 Min: 1 Max: 2	171
d5-04 (29DH)	Speed Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div><b>CLV</b></div> <div>OLV/PM</div> <div>AOLV/PM</div> <div><b>CLV/PM</b></div> </div> Sets the speed limit during Torque Control as a percentage of the maximum output frequency. Enabled when d5-03 = 2. A negative setting set a limit in the opposite direction of the Run command.	Default: 0% Min: -120% Max: 120%	172

No.(Addr.)	Name	Description	Setting	Page
d5-05 (29EH)	Speed Limit Bias	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the speed limit bias as a percentage of the maximum output frequency. The bias is applied to the specified speed limit and can adjust the margin for the speed limit.</p>	Default: 10% Min: 0% Max: 120%	172
d5-06 (29FH)	Speed/Torque Control Switchover Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the delay time for switching between Speed and Torque Control using an input terminal (H1-□□ = 71). Reference values are held during this switch delay time.</p>	Default: 0 ms Min: 0 ms Max: 1000 ms	172
d5-08 (2B5H)	Unidirectional Speed Limit Bias	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled 1: Enabled</p>	Default: 1 Min: 0 Max: 1	172

<34> Default setting is determined by the control mode (A1-02).

## ? d6: Field Weakening and Field Forcing

No.(Addr.)	Name	Description	Setting	Page
d6-01 (2A0H)	Field Weakening Level	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the drive output voltage for the Field Weakening function as a percentage of the maximum output voltage. Enabled when a multi-function input is set for Field Weakening (H1-□□ = 63).</p>	Default: 80% Min: 0% Max: 100%	172
d6-02 (2A1H)	Field Weakening Frequency Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the lower limit of the frequency range where Field Weakening control is valid. The Field Weakening command is valid only at frequencies above this setting and only when the output frequency matches the frequency reference (speed agree).</p>	Default: 0.0 Hz Min: 0.0 Hz Max: 400.0 Hz	172
d6-03 (2A2H)	Field Forcing Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled 1: Enabled</p>	Default: 0 Min: 0 Max: 1	173
d6-06 (2A5H)	Field Forcing Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the upper limit of the excitation current command during magnetic field forcing. A setting of 100% is equal to motor no-load current. Disabled only during DC Injection Braking.</p>	Default: 400% Min: 100% Max: 400%	173

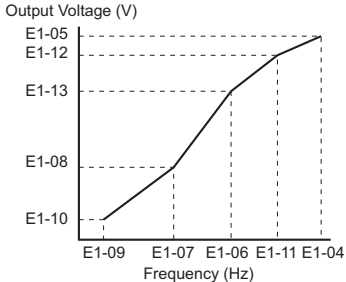
## ? d7: Offset Frequency

No.(Addr.)	Name	Description	Setting	Page
d7-01 (2B2H)	Offset Frequency 1	<div>All Modes</div> <p>Added to the frequency reference when the digital input "Frequency offset 1" (H1-□□ = 44) is switched on. Set as a percentage of the maximum output frequency.</p>	Default: 0.0% Min: -100.0% Max: 100.0%	173
d7-02 (2B3H)	Offset Frequency 2	<div>All Modes</div> <p>Added to the frequency reference when the digital input "Frequency offset 2" (H1-□□ = 45) is switched on. Set as a percentage of the maximum output frequency.</p>	Default: 0.0% Min: -100.0% Max: 100.0%	173
d7-03 (2B4H)	Offset Frequency 3	<div>All Modes</div> <p>Added to the frequency reference when the digital input "Frequency offset 3" (H1-□□ = 46) is switched on. Set as a percentage of the maximum output frequency.</p>	Default: 0.0% Min: -100.0% Max: 100.0%	173

## B.3 Parameter Table

### ? E: Motor Parameters

#### ? E1: V/f Pattern for Motor 1

No.(Addr.)	Name	Description	Setting	Page
E1-01 (300H)	Input Voltage Setting	<b>All Modes</b> This parameter must be set to the power supply voltage. <b>WARNING!</b> Drive input voltage (not motor voltage) must be set in E1-01 for the protective features of the drive to function properly. Failure to do so may result in equipment damage and/or death or personal injury.	Default: 200 V <15> Min: 155 V Max: 255 V	174
E1-03 (302H)	V/f Pattern Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> F: Custom V/f, E1-04 through E1-13 settings define the V/f pattern	Default: F Min: – Max: F	174
E1-04 (303H)	Maximum Output Frequency	<b>All Modes</b> To set linear V/f characteristics, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Ensure that the four frequencies are set according to these rules: $E1-09 \leq E1-07 < E1-06 \leq E1-11 \leq E1-04$ Note that if E1-11 = 0, then both E1-11 and E1-12 are disabled, and the above conditions do not apply. 	Default: <7> <34> Min: 40.0 Hz Max: 400.0 Hz <38>	174
E1-05 (304H)	Maximum Voltage		Default: <7> <15> <34> Min: 0.00 V Max: 255.0 V <15>	174
E1-06 (305H)	Base Frequency		Default: <7> <34> Min: 0.0 Hz Max: E1-04 <38>	174
E1-07 (306H)	Middle Output Frequency		Default: <34> Min: 0.0 Hz Max: E1-04	174
E1-08 (307H)	Middle Output Frequency Voltage		Default: <15> <34> Min: 0.0 V Max: 255.0 V <15>	174
E1-09 (308H)	Minimum Output Frequency		Default: <7> <34> Min: 0.0 Hz Max: E1-04 <38>	174
E1-10 (309H)	Minimum Output Frequency Voltage		Default: <15> <34> Min: 0.0 V Max: 255.0 V <15>	174
E1-11 (30AH) <17>	Middle Output Frequency 2		Default: 0.0 Hz Min: 0.0 Hz Max: E1-04	174
E1-12 (30BH) <17>	Middle Output Frequency Voltage 2		Default: 0.0 V Min: 0.0 V Max: 255.0 V <15>	174
E1-13 (30CH)	Base Voltage		Default: 0.0 V <35> Min: 0.0 V Max: 255.0 V <15>	174

<7> Default setting value is dependent on the motor code set to E5-01.

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<17> Parameter ignored when E1-11 (Motor 1 Mid Output Frequency 2) and E1-12 (Motor 1 Mid Output Frequency Voltage 2) are set to 0.0.

<34> Default setting value is determined by the control mode (A1-02).

<35> When Auto-Tuning is performed, E1-13 and E1-05 will be set to the same value.

<38> The setting range varies according to the motor code entered to E5-01 when using OLV/PM. The setting range is 0.0 to 400.0 Hz when E5-01 is set to FFFFH.

## ? E2: Motor 1 Parameters

No.(Addr.)	Name	Description	Setting	Page
E2-01 (30EH)	Motor Rated Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor nameplate full load current in Amps. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 10% of drive rated current Max: 200% of drive rated current <18>	175
E2-02 (30FH)	Motor Rated Slip	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor rated slip. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.00 Hz Max: 20.00 Hz	176
E2-03 (310H)	Motor No-Load Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the no-load current for the motor. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0 A Max: E2-01 <18>	176
E2-04 (311H)	Number of Motor Poles	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of motor poles. Automatically set during Auto-Tuning.</p>	Default: 4 Min: 2 Max: 48	176
E2-05 (312H)	Motor Line-to-Line Resistance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the phase-to-phase motor resistance. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.000 Ω Max: 65.000 Ω	176
E2-06 (313H)	Motor Leakage Inductance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.0% Max: 40.0%	176
E2-07 (314H)	Motor Iron-Core Saturation Coefficient 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor iron saturation coefficient at 50% of magnetic flux. Automatically set during Auto-Tuning.</p>	Default: 0.50 Min: 0.00 Max: 0.50	177
E2-08 (315H)	Motor Iron-Core Saturation Coefficient 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor iron saturation coefficient at 75% of magnetic flux. Automatically set during Auto-Tuning.</p>	Default: 0.75 Min: E2-07 Max: 0.75	177
E2-09 (316H)	Motor Mechanical Loss	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor mechanical loss as a percentage of motor rated power (kW).</p>	Default: 0.0% Min: 0.0% Max: 10.0%	177
E2-10 (317H)	Motor Iron Loss for Torque Compensation	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor iron loss.</p>	Default: <24> Min: 0 W Max: 65535 W	177
E2-11 (318H)	Motor Rated Power	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor rated power in kilowatts (1 HP = 0.746 kW). Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.00 kW Max: 650.00 kW	177

<18> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<24> Default setting value is dependent on the drive model (o2-04) and the Drive Duty (C6-01).

## B.3 Parameter Table

### ? E3: V/f Pattern for Motor 2

These parameters are hidden when a PM motor control mode has been selected for motor 1 (A1-02 = 5, 6, 7).

No.(Addr.)	Name	Description	Setting	Page
E3-01 (319H)	Motor 2 Control Mode Selection	<div><div>V/f</div><div>V/f w/PG</div><div>OLV</div><div>CLV</div><div>OLV/PM</div><div>AOLV/PM</div><div>CLV/PM</div></div> <p>0: V/f Control 1: V/f Control with PG 2: Open Loop Vector Control 3: Closed Loop Vector Control</p>	Default: 0 Min: 0 Max: 3	178
E3-04 (31AH)	Motor 2 Maximum Output Frequency	<div><div>V/f</div><div>V/f w/PG</div><div>OLV</div><div>CLV</div><div>OLV/PM</div><div>AOLV/PM</div><div>CLV/PM</div></div> <p>To set linear V/f characteristics, set the same values for E3-07 and E3-09. In this case, the setting for E3-08 will be disregarded. Ensure that the four frequencies are set according to these rules or an oPE10 fault will occur: E3-09 ≤ E3-07 &lt; E3-06 ≤ E3-11 ≤ E3-04</p> <div><p>Output Voltage (V)</p><p>E3-05 E3-12</p><p>E3-13</p><p>E3-08</p><p>E3-10</p><p>E3-09 E3-07 E3-06 E3-11 E3-04</p><p>Frequency (Hz)</p></div> <p><b>Note:</b> E3-07 and E3-08 are only available in the following control modes: V/f, V/f w/PG and OLV.</p>	Default: <25> Min: 40.0 Hz Max: 400.0 Hz	179
E3-05 (31BH)	Motor 2 Maximum Voltage		Default: <15> <25> Min: 0.0 V Max: 255.0 V <15>	179
E3-06 (31CH)	Motor 2 Base Frequency		Default: <25> Min: 0.0 Hz Max: E3-04	179
E3-07 (31DH)	Motor 2 Mid Output Frequency		Default: <25> Min: 0.0 Hz Max: E3-04	179
E3-08 (31EH)	Motor 2 Mid Output Frequency Voltage		Default: <15> <25> Min: 0.0 V Max: 255.0 V <15>	179
E3-09 (31FH)	Motor 2 Minimum Output Frequency		Default: <25> Min: 0.0 Hz Max: E3-04	179
E3-10 (320H)	Motor 2 Minimum Output Frequency Voltage		Default: <15> <25> Min: 0.0 V Max: 255.0 V <15>	179
E3-11 (345H) <17>	Motor 2 Mid Output Frequency 2		Default: 0.0 Hz <22> Min: 0.0 Hz Max: E3-04	179
E3-12 (346H) <22>	Motor 2 Mid Output Frequency Voltage 2		Default: 0.0 V Min: 0.0 V Max: 255.0 V <15>	179
E3-13 (347H)	Motor 2 Base Voltage		Default: 0.0 V Min: 0.0 V Max: 255.0 V <15>	179

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<17> Parameter ignored when E1-11 (Motor 1 Mid Output Frequency 2) and E1-12 (Motor 1 Mid Output Frequency Voltage 2) are set to 0.0.

<22> Parameter ignored when E3-11 (Motor 2 Mid Output Frequency 2) and E3-12 (Motor 2 Mid Output Frequency Voltage 2) are set to 0.

<25> Default setting is determined by the control mode for motor 2 (E3-01).

## ? E4: Motor 2 Parameters

These parameters are hidden when a PM motor control mode has been selected for motor 1 (A1-02 = 5, 6, 7).

No.(Addr.)	Name	Description	Setting	Page
E4-01 (321H)	Motor 2 Rated Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the full load current for motor 2. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 10% of drive rated current Max: 200% of drive rated current <18>	179
E4-02 (322H)	Motor 2 Rated Slip	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the rated slip for motor 2. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.00 Hz Max: 20.00 Hz	180
E4-03 (323H)	Motor 2 Rated No-Load Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the no-load current for motor 2. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0 A Max: E4-01 <18>	180
E4-04 (324H)	Motor 2 Motor Poles	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of poles of motor 2. Automatically set during Auto-Tuning.</p>	Default: 4 Min: 2 Max: 48	180
E4-05 (325H)	Motor 2 Line-to-Line Resistance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the phase-to-phase resistance for motor 2. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.000 Ω Max: 65.000 Ω	180
E4-06 (326H)	Motor 2 Leakage Inductance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the voltage drop for motor 2 due to motor leakage inductance as a percentage of rated voltage. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.0% Max: 40.0%	180
E4-10 (340H)	Motor 2 Iron Loss	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor iron loss.</p>	Default: <24> Min: 0 W Max: 65535 W	180
E4-11 (327H)	Motor 2 Rated Power	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor rated capacity in kW. Automatically set during Auto-Tuning.</p>	Default: <24> Min: 0.00 kW Max: 650.00 kW	181

<18> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<24> Default setting value is dependent on the drive model (o2-04) and the Drive Duty (C6-01).

## ? E5: PM Motor Settings

No.(Addr.)	Name	Description	Setting	Page
E5-01 (329H) <16>	Motor Code Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the Yaskawa motor code for the PM motor being used. Various motor parameters are automatically set based on the value of this parameter. Setting that were changed manually will be overwritten by the defaults of the selected motor code.</p> <p><b>Note 1.</b> Set to FFFF when using a non-Yaskawa PM motor or a special motor.</p> <p><b>2.</b> If an alarm or hunting occurs even though a motor code is used, enter the value indicated on the nameplate. For more details, refer to Auto-Tuning for Permanent Magnet Motors on page 96.</p>	Default: <19> <24> <34> Min: 0000 Max: FFFF <37>	181
E5-02 (32AH) <16>	Motor Rated Power	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the rated capacity of the motor.</p>	Default: <7> Min: 0.10 kW Max: 650.00 kW	181

## B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
E5-03 (32BH) <16>	Motor Rated Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor rated current.</p>	Default: <7> Min: 10% of drive rated current Max: 200% of drive rated current <18>	181
E5-04 (32CH) <16>	Number of Motor Poles	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of motor poles.</p>	Default: <7> Min: 2 Max: 48	182
E5-05 (32DH) <16>	Motor Stator Resistance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Set the resistance for each motor phase.</p>	Default: <7> Min: 0.000 Ω Max: 65.000 Ω	182
E5-06 (32EH) <16>	Motor d-Axis Inductance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the d-axis inductance for the PM motor.</p>	Default: <7> Min: 0.00 mH Max: 300.00 mH	182
E5-07 (32FH) <16>	Motor q-Axis Inductance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the q-axis inductance for the PM motor.</p>	Default: <7> Min: 0.00 mH Max: 600.00 mH	182
E5-09 (331H) <16>	Motor Induction Voltage Constant 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Set the induced phase peak voltage in units of 0.1 mV (rad/s) [electrical angle]. Set this parameter when using a Yaskawa SSR1 Series PM motor with derated torque, or a Yaskawa SST4 Series motor with constant torque. When setting this parameter, E5-24 should be set to 0.</p>	Default: <7> Min: 0.0 mV/(rad/s) Max: 2000.0 mV/(rad/s)	182
E5-11 (333H)	Encoder Z-pulse Offset	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the offset between the rotor magnetic axis and the Z pulse of an incremental encoder. Set during Z Pulse Offset Tuning.</p>	Default: 0.0 deg Min: -180 deg Max: 180 deg	182
E5-24 (353H) <16>	Motor Induction Voltage Constant 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Set the induced phase-to-phase rms voltage in units of 0.1 mV/(r/min) [mechanical angle]. Set this parameter when using a Yaskawa SMRA Series SPM motor. When setting this parameter, E5-09 should be set to 0.</p>	Default: <7> Min: 0.0 mV/(r/min) Max: 6500.0 mV/(r/min)	182

<7> Default setting value is dependent on the motor code set to E5-01.

<16> Parameter setting value is not reset to the default value when the drive is initialized.

<18> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<19> If using a Yaskawa SMRA Series SPM Motor, the default setting is 1800 r/min.

<24> Default setting value is determined by the drive model (o2-04) and the Drive Duty (C6-01).

<34> Default setting value is determined by the control mode (A1-02).

<37> Selections may vary depending on the motor code entered to E5-01.

## ? F: Options

F parameters are used to program the drive for PG feedback from the motor and to function with option cards.

### ? F1: PG Speed Control Card (PG-B3 / PG-X3)

Parameters F1-01, F1-05, F1-06, F1-12, F1-13, and F1-18 through F1-21 are used to set up a PG option card plugged into option port CN5-C of the drive. They include “PG 1” in the parameter name.

Parameters F1-21 through F1-37 are used to set up a PG option card plugged into option port CN5-B of the drive. They include “PG 2” in the parameter name.

Other parameters in the F1 group are used to set operation for PG options plugged into port CN5-C and CN5-B.

No.(Addr.)	Name	Description	Setting	Page
F1-01 (380H)	PG 1 Pulses Per Revolution	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of PG (pulse generator or encoder) pulses. Sets the number of pulses per motor revolution. <b>Note:</b> Setting range is 0 to 15000 ppr when A1-02 = 5, 6, 7 (PM control mode).</p>	Default: 1024 ppr Min: 0 ppr Max: 60000 ppr	183
F1-02 (381H)	Operation Selection at PG Open Circuit (PGo)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only.</p>	Default: 1 Min: 0 Max: 3	183
F1-03 (382H)	Operation Selection at Overspeed (oS)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only.</p>	Default: 1 Min: 0 Max: 3	183
F1-04 (383H)	Operation Selection at Deviation	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only.</p>	Default: 3 Min: 0 Max: 3	184
F1-05 (384H)	PG 1 Rotation Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Pulse A leads 1: Pulse B leads</p>	Default: <34> Min: 0 Max: 1	184
F1-06 (385H)	PG 1 Division Rate for PG Pulse Monitor	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the division ratio for the pulse monitor used of the PG option card installed to port CN5-C. By setting “xyz”, the division ratio becomes = [(1 + x) / yz]. If only using the A pulse for one track input, then the input ratio will be 1:1, regardless of what F1-06 is set to.</p>	Default: 1 Min: 1 Max: 132	184
F1-08 (387H)	Overspeed Detection Level	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the overspeed detection level as a percentage of the maximum output frequency.</p>	Default: 115% Min: 0% Max: 120%	183
F1-09 (388H)	Overspeed Detection Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time in seconds for an overspeed situation to trigger a fault (oS).</p>	Default: <34> Min: 0.0 s Max: 2.0 s	183
F1-10 (389H)	Excessive Speed Deviation Detection Level	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the speed deviation detection level as a percentage of the maximum output frequency.</p>	Default: 10% Min: 0% Max: 50%	184

## B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
F1-11 (38AH)	Excessive Speed Deviation Detection Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time in seconds for a speed deviation situation to trigger a fault (dEv).</p>	Default: 0.5 s Min: 0.0 s Max: 10.0 s	184
F1-12 (38BH)	PG 1 Gear Teeth 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div>	Default: 0 Min: 0 Max: 1000	184
F1-13 (38CH)	PG 1 Gear Teeth 2	<p>Sets the gear ratio between the motor shaft and the encoder (PG). A gear ratio of 1 will be used if either of these parameters is set to 0.</p>	Default: 0 Min: 0 Max: 1000	184
F1-14 (38DH)	PG Open-Circuit Detection Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time required to trigger a PG Open fault (PGo).</p>	Default: 2.0 s Min: 0.0 s Max: 10.0 s	183
F1-18 (3ADH)	dv3 Detection Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled 1: Enabled</p>	Default: 10 Min: 0 Max: 10	185
F1-19 (3AEH)	dv4 Detection Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled n: Number of pulses that the A and B pulse are reversed that triggers dv4 detection.</p>	Default: 128 Min: 0 Max: 5000	185
F1-20 (3B4H)	PG Option Card Disconnect Detection 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled 1: Enabled</p>	Default: 1 Min: 0 Max: 1	185
F1-21 (3BCH)	PG 1 Signal Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: A pulse detection 1: AB pulse detection</p>	Default: 0 Min: 0 Max: 1	185
F1-30 (3AAH)	PG Card Option Port for Motor 2 Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the port for the PG option card used by motor 2. 0: CN5-C 1: CN5-B</p>	Default: 1 Min: 0 Max: 1	185
F1-31 (3B0H)	PG 2 Pulses Per Revolution	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of pulses for a PG option card connected to port CN5-B.</p>	Default: 1024 ppr Min: 0 ppr Max: 60000 ppr	183
F1-32 (3B1H)	PG 2 Rotation Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Pulse A leads 1: Pulse B leads</p>	Default: 0 Min: 0 Max: 1	184
F1-33 (3B2H)	PG 2 Gear Teeth 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div>	Default: 0 Min: 0 Max: 1000	184
F1-34 (3B3H)	PG 2 Gear Teeth 2	<p>Sets the gear ratio between the motor shaft and the encoder (PG). A gear ratio of 1 will be used if either of these parameters is set to 0.</p>	Default: 0 Min: 0 Max: 1000	184
F1-35 (3BEH)	PG 2 Division Rate for Pulse Monitor	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the division ratio for the pulse monitor used of the PG option card 2 installed to port CN5-B. By setting “xyz”, the division ratio becomes = [(1 + x) / yz].</p>	Default: 1 Min: 1 Max: 132	184

No.(Addr.)	Name	Description	Setting	Page
F1-36 (3B5H)	PG Option Card Disconnect Detection 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	185
F1-37 (3BDH)	PG 2 Signal Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: A pulse detection 1: AB pulse detection	Default: 0 Min: 0 Max: 1	185

<34> Default setting is determined by the control mode (A1-02).

### ? F2: Analog Input Card (AI-A3)





No.(Addr.)	Name	Description	Setting	Page
F2-01 (38FH)	Analog Input Option Card Operation Selection	<div>All Modes</div> 0: Option card input terminals V1, V2, and V3 replace drive input terminals A1, A2, and A3. 1: Input signals to terminals V1, V2, and V3 are added together to create the frequency reference.	Default: 0 Min: 0 Max: 1	186
F2-02 (368H)	Analog Input Option Card Gain	<div>All Modes</div> Sets the gain for the input signal to the analog card.	Default: 100.0% Min: -999.9% Max: 999.9%	186
F2-03 (369H)	Analog Input Option Card Bias	<div>All Modes</div> Sets the bias for the input signal to the analog card.	Default: 0.0% Min: -999.9% Max: 999.9%	186

### ? F3: Digital Input Card (DI-A3)

No.(Addr.)	Name	Description	Setting	Page
F3-01 (390H)	Digital Input Option Card Input Selection	<div>All Modes</div> 0: BCD, 1% units 1: BCD, 0.1% units 2: BCD, 0.01% units 3: BCD, 1 Hz units 4: BCD, 0.1 Hz units 5: BCD, 0.01 Hz units 6: BCD customized setting (5 digit), 0.02 Hz units 7: Binary input The value set to F3-03 determines the setting range and units as follows: F3-03 = 0: 100%/255 (-255 to +255) F3-03 = 1: 100%/4095 (-4095 to +4095) F3-03 = 2: 100%/30000 (-33000 to +33000) When the digital operator units are set to be displayed in Hertz or user-set units (o1-03 = 2 or 3), the units for F3-01 are determined by parameter o1-03.	Default: 0 Min: 0 Max: 7	186
F3-03 (3B9H)	Digital Input Option DI-A3 Data Length Selection	<div>All Modes</div> 0: 8 bit 1: 12 bit 2: 16 bit	Default: 2 Min: 0 Max: 2	187

## B.3 Parameter Table

### ? F4: Analog Monitor Card (AO-A3)

No.(Addr.)	Name	Description	Setting	Page
F4-01 (391H)	Terminal V1 Monitor Selection	<b>All Modes</b> Sets the monitor signal for output from terminal V1. Set this parameter to the last three digits of the desired U□-□□ monitor. Some U parameters are available only in certain control modes.	Default: 102 Min: 000 Max: 999	187
F4-02 (392H) 	Terminal V1 Monitor Gain	<b>All Modes</b> Sets the gain for voltage output via terminal V1.	Default: 100.0% Min: -999.9% Max: 999.9%	187
F4-03 (393H)	Terminal V2 Monitor Selection	<b>All Modes</b> Sets the monitor signal for output from terminal V2. Set this parameter to the last three digits of the desired U□-□□ monitor. Some U parameters are available only in certain control modes.	Default: 103 Min: 000 Max: 999	187
F4-04 (394H) 	Terminal V2 Monitor Gain	<b>All Modes</b> Sets the gain for voltage output via terminal V2.	Default: 50.0% Min: -999.9% Max: 999.9%	187
F4-05 (395H) 	Terminal V1 Monitor Bias	<b>All Modes</b> Sets the amount of bias added to the voltage output via terminal V1.	Default: 0.0% Min: -999.9% Max: 999.9%	187
F4-06 (396H) 	Terminal V2 Monitor Bias	<b>All Modes</b> Sets the amount of bias added to the voltage output via terminal V2.	Default: 0.0% Min: -999.9% Max: 999.9%	187
F4-07 (397H)	Terminal V1 Signal Level	<b>All Modes</b> 0: 0 to 10 V 1: -10 to 10 V	Default: 0 Min: 0 Max: 1	188
F4-08 (398H)	Terminal V2 Signal Level		Default: 0 Min: 0 Max: 1	188

### ? F5: Digital Output Card (DO-A3)

No.(Addr.)	Name	Description	Setting	Page
F5-01 (399H)	Terminal P1-PC Output Selection	<b>All Modes</b> Sets the function for contact output terminals M1-M2, M3-M4, and photocoupler output terminals P1 through P6.	Default: 0 Min: 0 Max: 161	188
F5-02 (39AH)	Terminal P2-PC Output Selection		Default: 1 Min: 0 Max: 161	188
F5-03 (39BH)	Terminal P3-PC Output Selection		Default: 2 Min: 0 Max: 161	188
F5-04 (39CH)	Terminal P4-PC Output Selection		Default: 4 Min: 0 Max: 161	188
F5-05 (39DH)	Terminal P5-PC Output Selection		Default: 6 Min: 0 Max: 161	188
F5-06 (39EH)	Terminal P6-PC Output Selection		Default: 37 Min: 0 Max: 161	188
F5-07 (39FH)	Terminal M1-M2 Output Selection		Default: F Min: 0 Max: 161	188
F5-08 (3A0H)	Terminal M3-M4 Output Selection		Default: F Min: 0 Max: 161	188
F5-09 (3A1H)	DO-A3 Output Mode Selection	<b>All Modes</b> 0: Output terminals are each assigned separate output functions. 1: Binary code output 2: Use output terminal functions selected by parameters F5-01 through F5-08.	Default: 0 Min: 0 Max: 2	188

## ? F6: Communication Option Card (SI-C3, SI-P3, and SI-T3)

F6-01 through F6-03 and F6-06 through F6-08 are common settings used for CC-Link, PROFIBUS-DP, and MECHATROLINK-II option cards. Other parameters in the F6 group are used for communication protocol specific settings.

For more details on a specific option card, refer to the instruction manual for the option card.

No.(Addr.)	Name	Description	Setting	Page
F6-01 (3A2H)	Communications Error Operation Selection	<b>All Modes</b> 0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only.	Default: 1 Min: 0 Max: 3	189
F6-02 (3A3H)	External Fault from Comm. Option Detection Selection	<b>All Modes</b> 0: Always detected 1: Detection during run only	Default: 0 Min: 0 Max: 1	189
F6-03 (3A4H)	External Fault from Comm. Option Operation Selection	<b>All Modes</b> 0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only.	Default: 1 Min: 0 Max: 3	189
F6-04 (3A5H)	bUS Error Detection Time	<b>All Modes</b> Set the delay time for error detection if a bus error occurs.	Default: 2.0 s Min: 0.0 s Max: 5.0 s	—
F6-06 (3A7H)	Torque Reference/Torque Limit Selection from Comm. Option	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled. Torque reference/limit from option board disabled. 1: Enabled. Torque reference/limit from option board enabled.	Default: 0 Min: 0 Max: 1	190
F6-07 (3A8H)	Multi-Step Speed Enable/Disable Selection when NefRef/ComRef is Selected	<b>All Modes</b> 0: Multi-step reference disabled (same as F7) 1: Multi-step reference enabled (same as V7)	Default: 0 Min: 0 Max: 1	190
F6-08 (36AH) <16>	Reset Communication Parameters	<b>All Modes</b> 0: Communication-related parameters (F6-□□) are not reset when the drive is initialized using A1-03. 1: Reset all communication-related parameters (F6-□□) when the drive is initialized using A1-03.	Default: 0 Min: 0 Max: 1	190
F6-10 (3B6H)	CC-Link Node Address	<b>All Modes</b> Sets the node address if a CC-Link option card is installed.	Default: 0 Min: 0 Max: 64	—
F6-11 (3B7H)	CC-Link Communication Speed	<b>All Modes</b> 0: 156 Kbps 1: 625 Kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	Default: 0 Min: 0 Max: 4	—
F6-14 (3BBH)	CC-Link bUS Error Auto Reset	<b>All Modes</b> 0: Disabled 1: Enabled	Default: 0 Min: 0 Max: 1	—
F6-20 (36BH)	MECHATROLINK Station Address	<b>All Modes</b> Sets the station address when the MECHATROLINK option has been installed.	Default: 21 Min: 20 Max: 3FH	—
F6-21 (36CH)	MECHATROLINK Frame Size	<b>All Modes</b> 0: 32 byte 1: 17 byte	Default: 0 Min: 0 Max: 1	—
F6-22 (36DH)	MECHATROLINK Link Speed	<b>All Modes</b> 0: 10 Mbps 1: 4 Mbps	Default: 0 Min: 0 Max: 1	—

### B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
F6-23 (36EH)	MECHATROLINK Monitor Selection (E)	<b>All Modes</b> Sets the MECHATROLINK monitor (E).	Default: 0 Min: 0 Max: FFFFH	—
F6-24 (36FH)	MECHATROLINK Monitor Selection (F)	<b>All Modes</b> Sets the MECHATROLINK monitor (F).	Default: 0 Min: 0 Max: FFFFH	—
F6-25 (3C9H)	Operation Selection at MECHATROLINK Watchdog Timer Error (E5)	<b>All Modes</b> 0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only.	Default: 1 Min: 0 Max: 3	—
F6-26 (3CAH)	MECHATROLINK bUS Errors Detected	<b>All Modes</b> Sets the number of option communication errors (bUS).	Default: 2 Min: 2 Max: 10	—
F6-30 (3CBH)	PROFIBUS-DP Node Address	<b>All Modes</b> Sets the node address.	Default: 0 Min: 0 Max: 125	—
F6-31 (3CCH)	PROFIBUS-DP Clear Mode Selection	<b>All Modes</b> 0: Resets drive operation with a Clear mode command. 1: Maintains the previous operation state when Clear mode command is given.	Default: 0 Min: 0 Max: 1	—
F6-32 (3CDH)	PROFIBUS-DP Data Format Selection	<b>All Modes</b> 0: PPO Type 1: Conventional	Default: 0 Min: 0 Max: 1	—

<16> Parameter setting value is not reset to the default value when the drive is initialized.

## ? H Parameters: Multi-Function Terminals

H parameters assign functions to the multi-function input and output terminals.

### ? H1: Multi-Function Digital Inputs

No.(Addr.)	Name	Description	Setting	Page
H1-01 (438H)	Multi-Function Digital Input Terminal S1 Function Selection	<b>All Modes</b> Assigns a function to the multi-function digital inputs. Refer to page 435 to page 438 for a description of setting values. <b>Note:</b> Unused terminals should be set to F.	Default: 40 (F) <10> Min: 1 Max: 7E	191
H1-02 (439H)	Multi-Function Digital Input Terminal S2 Function Selection		Default: 41 (F) <10> Min: 1 Max: 7E	191
H1-03 (400H)	Multi-Function Digital Input Terminal S3 Function Selection		Default: 24 Min: 0 Max: 7E	191
H1-04 (401H)	Multi-Function Digital Input Terminal S4 Function Selection		Default: 14 Min: 0 Max: 7E	191
H1-05 (402H)	Multi-Function Digital Input Terminal S5 Function Selection		Default: 3(0) <10> Min: 0 Max: 7E	191
H1-06 (403H)	Multi-Function Digital Input Terminal S6 Function Selection		Default: 4(3) <10> Min: 0 Max: 7E	191
H1-07 (404H)	Multi-Function Digital Input Terminal S7 Function Selection		Default: 6(4) <10> Min: 0 Max: 7E	191
H1-08 (405H)	Multi-Function Digital Input Terminal S8 Function Selection		Default: 8 Min: 0 Max: 7E	191

<10> Value in parenthesis is the default setting when a 3-wire initialization is performed (A1-03 = 3330).

H1 Multi-Function Digital Input Selections			
H1-□□ Setting	Function	Description	Page
0	3-wire sequence	<b>All Modes</b> Closed: Reverse rotation (only if the drive is set up for 3-wire sequence) Terminals S1 and S2 are automatically set up for the Run command and Stop command.	192
1	LOCAL/REMOTE selection	<b>All Modes</b> Open: REMOTE (parameter settings determine the source of the frequency Reference 1 or 2 (b1-01, b1-02 or b1-15, b1-16) Closed: LOCAL, digital operator is run and reference source	192
2	External reference 1/2 selection	<b>All Modes</b> Open: Run command and frequency reference source 1 (determined by b1-01 and b1-02) Closed: Run command and frequency reference source 2 (determined by b1-15 and b1-16)	193
3	Multi-Step Speed Reference 1	<b>All Modes</b> When input terminals are set to Multi-Step Speed References 1 through 3, switching combinations of those terminals will create a multi-step speed sequence using the frequency references set in d1-01 through d1-08.	193
4	Multi-Step Speed Reference 2		193
5	Multi-Step Speed Reference 3		193
6	Jog reference selection	<b>All Modes</b> Closed: Jog frequency reference (d1-17) selected. Jog has priority over all other reference sources.	193
7	Accel/decel time selection 1	<b>All Modes</b> Used to switch between accel/decel time 1 (set in C1-01, C1-02) and accel/decel time 2 (set in C1-03, C1-04).	193
8	Baseblock command (N.O.)	<b>All Modes</b> Closed: No drive output	193
9	Baseblock command (N.C.)	<b>All Modes</b> Open: No drive output	193
A	Accel/decel ramp hold	<b>All Modes</b> Open: Accel/decel is not held Closed: The drive pauses during acceleration or deceleration and maintains the output frequency.	193
B	Drive overheat alarm (oH2)	<b>All Modes</b> Closed: Closes when an oH2 alarm occurs	193
C	Analog terminal input selection	<b>All Modes</b> Open: Function assigned by H3-14 is disabled. Closed: Function assigned by H3-14 is enabled.	194
D	PG encoder disable	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Open: Speed feedback for V/f Control with PG is enabled. Closed: Speed feedback disabled.	194
E	ASR integral reset	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Open: PI control Closed: Integral reset	194
F	Through mode	<b>All Modes</b> Select this setting when using the terminal in a pass-through mode. The terminal does not trigger a drive function but can be used as digital input for the controller the drive is connected to.	194
10	Up command	<b>All Modes</b> The drive accelerates when the Up command terminal closes, and decelerates when the Down command closes. When both terminals are closed or both are open, the drive holds the frequency reference. The Up and Down commands must always be used in conjunction with one another.	194
11	Down command		194

## B.3 Parameter Table

H1 Multi-Function Digital Input Selections			
H1-□□ Setting	Function	Description	Page
12	Forward Jog	<b>All Modes</b> Closed: Runs forward at the Jog frequency d1-17.	195
13	Reverse Jog	<b>All Modes</b> Closed: Runs reverse at the Jog frequency d1-17.	195
14	Fault reset	<b>All Modes</b> Closed: Resets faults if the cause is cleared and the Run command is removed.	195
15	Fast Stop (N.O.)	<b>All Modes</b> Closed: Decelerates at the Fast Stop time set to C1-09.	195
16	Motor 2 selection	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Open: Motor 1 (E1-□□, E2-□□) Closed: Motor 2 (E3-□□, E4-□□)	196
17	Fast Stop (N.C.)	<b>All Modes</b> Open: Decelerates to stop at the Fast Stop time set to C1-09.	195
18	Timer function input	<b>All Modes</b> Triggers the timer set up by parameters b4-01 and b4-02. Must be set in conjunction with the timer function output (H2-□□ = 12).	196
19	PID disable	<b>All Modes</b> Open: PID control enabled Closed: PID control disabled	196
1A	Accel/decel time selection 2	<b>All Modes</b> Used in conjunction with an input terminal set for “Accel/decel time selection 1” (H1-□□ = 7), and allows the drive to switch between accel/decel times 3 and 4.	197
1B	Program lockout	<b>All Modes</b> Open: Parameters cannot be edited (except for U1-01 if the reference source is assigned to the digital operator). Closed: Parameters can be edited and saved.	197
20 to 2F	External fault	<b>All Modes</b> 20: N.O., Always detected, ramp to stop 21: N.C., Always detected, ramp to stop 22: N.O., During run, ramp to stop 23: N.C., During run, ramp to stop 24: N.O., Always detected, coast to stop 25: N.C., Always detected, coast to stop 26: N.O., During run, coast to stop 27: N.C., During run, coast to stop 28: N.O., Always detected, Fast Stop 29: N.C., Always detected, Fast Stop 2A: N.O., During run, Fast Stop 2B: N.C., During run, Fast Stop 2C: N.O., Always detected, alarm only (continue running) 2D: N.C., Always detected, alarm only (continue running) 2E: N.O., During run, alarm only (continue running) 2F: N.C., During run, alarm only (continue running)	197
30	PID integral reset	<b>All Modes</b> Closed: Resets the PID control integral value.	197
31	PID integral hold	<b>All Modes</b> Open: Performs integral operation. Closed: Maintains the current PID control integral value.	197

H1 Multi-Function Digital Input Selections			
H1-□□ Setting	Function	Description	Page
34	PID soft starter cancel	<b>All Modes</b> Open: PID soft starter is enabled. Closed: Disables the PID soft starter b5-17.	197
35	PID input level selection	<b>All Modes</b> Closed: Inverts the PID input signal	198
40	Forward run command (2-wire sequence)	<b>All Modes</b> Open: Stop Closed: Forward run <b>Note:</b> Cannot be set together with settings 42 or 43.	198
41	Reverse run command (2-wire sequence)	<b>All Modes</b> Open: Stop Closed: Reverse run <b>Note:</b> Cannot be set together with settings 42 or 43.	198
42	Run command (2-wire sequence 2)	<b>All Modes</b> Open: Stop Closed: Run <b>Note:</b> Cannot be set together with settings 40 or 41.	198
43	FWD/REV command (2-wire sequence 2)	<b>All Modes</b> Open: Forward Closed: Reverse <b>Note:</b> Determines motor direction, but does not issue a Run command. Cannot be set together with settings 40 or 41.	198
44	Offset frequency 1	<b>All Modes</b> Closed: Adds d7-01 to the frequency reference.	198
45	Offset frequency 2	<b>All Modes</b> Closed: Adds d7-02 to the frequency reference.	198
46	Offset frequency 3	<b>All Modes</b> Closed: Adds d7-03 to the frequency reference.	198
50	Disturb Function Cancel	<b>All Modes</b> Open: Disturb function output is active. Closed: Cancels the Disturb function.	198
51	Synchronous Accel/Decel	<b>All Modes</b> Closed: Assigns the same accel/decel times to all motors in the line so that they reach the desired frequency at the same time.	198
53	Energy Saving On/Off	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Closed: Enables the Energy Saving function.	198
59	DC Injection Braking 1 Command	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Closed: Triggers DC Injection Braking 1 (b2-02).	199
60	DC Injection Braking 2 command	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Closed: Triggers DC Injection Braking 2 (b2-10).	199
61	External Speed Search command 1	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Closed: Activates Current Detection Speed Search from the maximum output frequency (E1-04).	199

## B.3 Parameter Table

H1 Multi-Function Digital Input Selections			
H1-□□ Setting	Function	Description	Page
62	External Speed Search command 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Closed: Activates Current Detection Speed Search from the frequency reference.</p>	199
63	Field Weakening	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Closed: The drive performs Field Weakening control as set for d6-01 and d6-02.</p>	199
65	KEB (N.C.)	<div>All Modes</div> <p>Open: KEB is enabled as selected in parameter S4-01.</p>	200
66	KEB (N.O.)	<div>All Modes</div> <p>Closed: KEB is enabled as selected in parameter S4-01.</p>	200
67	Communications test mode	<div>All Modes</div> <p>Tests the MEMOBUS/Modbus RS-485/422 interface. Displays “PASS” if the test completes successfully.</p>	200
6A	Drive enable	<div>All Modes</div> <p>Open: Drive disabled. If this input is opened during run, then the drive will stop as specified by b1-03.</p> <p>Closed: Ready for operation.</p>	200
71	Speed/Torque Control Switch	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Open: Speed Control</p> <p>Closed: Torque Control</p>	200
72	Zero Servo	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Closed: Zero Servo enabled</p>	200
77	ASR gain switch	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Open: ASR proportional gain 1 (C5-01)</p> <p>Closed: ASR proportional gain 2 (C5-03)</p>	200
78	External torque reference polarity inversion	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Open: Forward torque reference</p> <p>Closed: Reverse polarity</p>	200
7C	Short Circuit Braking (N.O.)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Closed: Short Circuit Braking enabled</p>	200
7D	Short Circuit Braking (N.C.)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Open: Short Circuit Braking enabled</p>	200
7E	Forward/reverse detection (V/f Control with Simple PG feedback)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Direction of rotation detection (for V/f with Simple PG Feedback)</p>	200

## ? H2: Multi-Function Digital Outputs

No.(Addr.)	Name	Description	Setting	Page
H2-01 (40BH)	Terminal M1-M2 function selection (relay)	<b>All Modes</b> Refer to <i>H2 Multi-Function Digital Output Settings on page 439</i> for a description of setting values.	Default: 0 Min: 0 Max: 161	201
H2-02 (40CH)	Terminal M3-M4 function selection (relay)		Default: 1 Min: 0 Max: 161	201
H2-03 (40DH)	Terminal M5-M6 function selection (relay)		Default: 2 Min: 0 Max: 161	201
H2-06 (437H)	Watt Hour Output Unit Selection	<b>All Modes</b> Outputs a 200 ms pulse signal when the watt-hour counter increases by the units selected. 0: 0.1 kWh units 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units	Default: 0 Min: 0 Max: 4	211

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	Description	Page	
0	During fun	<b>All Modes</b> Closed: A Run command is active or voltage is output.	202	
1	Zero Speed	<b>All Modes</b> Open: Output frequency is above the minimum output frequency set in E1-09. Closed: Output frequency is below the minimum output frequency set in E1-09.	202	
2	Speed agree 1	<b>All Modes</b> Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	202	
3	User-set speed agree 1	<b>All Modes</b> Closed: Output frequency and speed reference equal L4-01 (plus or minus the hysteresis set to L4-02).	203	
4	Frequency detection 1	<b>All Modes</b> Closed: Output frequency is less than or equal to the value in L4-01 with hysteresis determined by L4-02.	203	
5	Frequency detection 2	<b>All Modes</b> Closed: Output frequency is greater than or equal to the value in L4-01 with hysteresis determined by L4-02.	204	
6	Drive ready	<b>All Modes</b> Closed: Power up is complete and the drive is ready to accept a Run command.	204	
7	DC bus undervoltage	<b>All Modes</b> Closed: DC bus voltage is below the Uv trip level set in L2-05.	204	
8	During baseblock (N.O.)	<b>All Modes</b> Closed: Drive has entered the baseblock state (no output voltage).	204	
9	Frequency reference source	<b>All Modes</b> Open: External Reference 1 or 2 supplies the frequency reference (set in b1-01 or b1-15). Closed: Digital operator supplies the frequency reference.	204	
A	Run command source	<b>All Modes</b> Open: External Reference 1 or 2 supplies the Run command (set in b1-02 or b1-16). Closed: Digital operator supplies the Run command.	205	

## B.3 Parameter Table





H2 Multi-Function Digital Output Settings			
H2-□□ Setting	Function	Description	Page
B	Torque detection 1 (N.O.)	<b>All Modes</b> Closed: An overtorque or undertorque situation has been detected.	205
C	Frequency reference loss	<b>All Modes</b> Closed: Analog frequency reference has been lost.	205
D	Braking resistor fault	<b>All Modes</b> Closed: Braking resistor or transistor is overheated or faulted out.	205
E	Fault	<b>All Modes</b> Closed: Fault occurred.	205
F	Through mode	<b>All Modes</b> Set this value when using the terminal in the pass-through mode.	205
10	Minor fault	<b>All Modes</b> Closed: An alarm has been triggered, or the IGBTs have reached 90% of their expected life span.	205
11	Fault reset command active	<b>All Modes</b> Closed: A command has been entered to clear a fault via the input terminals or from the serial network.	205
12	Timer output	<b>All Modes</b> Closed: Timer output.	205
13	Speed agree 2	<b>All Modes</b> Closed: When drive output frequency equals the frequency reference $\pm L4-04$ .	206
14	User-set speed agree 2	<b>All Modes</b> Closed: When the drive output frequency is equal to the value in L4-03 $\pm L4-04$ .	206
15	Frequency detection 3	<b>All Modes</b> Closed: When the drive output frequency is less than or equal to the value in L4-03 $\pm L4-04$ .	207
16	Frequency detection 4	<b>All Modes</b> Closed: When the output frequency is greater than or equal to the value in L4-03 $\pm L4-04$ .	207
17	Torque detection 1 (N.C.)	<b>All Modes</b> Open: Overtorque or undertorque has been detected.	205
18	Torque detection 2 (N.O.)	<b>All Modes</b> Closed: Overtorque or undertorque has been detected.	205
19	Torque detection 2 (N.C.)	<b>All Modes</b> Open: Overtorque or undertorque has been detected.	205
1A	During reverse	<b>All Modes</b> Closed: Drive is running in the reverse direction.	208
1B	During baseblock (N.C.)	<b>All Modes</b> Open: Drive has entered the baseblock state (no output voltage).	208
1C	Motor 2 selection	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Closed: Motor 2 is selected by a digital input (H1-□□ = 16)	208
1D	During regeneration	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Closed: Motor is regenerating energy into the drive.	208
1E	Restart enabled	<b>All Modes</b> Closed: An automatic restart is performed	208
1F	Motor overload alarm (oL1)	<b>All Modes</b> Closed: oL1 is at 10% of its trip point or greater. An oH3 situation also triggers this alarm.	208



H2 Multi-Function Digital Output Settings			
H2-□□ Setting	Function	Description	Page
20	Drive overheat pre-alarm (oH)	<b>All Modes</b> Closed: Heatsink temperature exceeds the parameter L8-02 value.	208
2F	Maintenance period	<b>All Modes</b> Closed: Cooling fan, electrolytic capacitors, IGBTs, or the soft charge bypass relay may require maintenance.	208
30	During torque limit	<div> V/f   V/f w/PG   OLV   CLV  OLV/PM   AOLV/PM   CLV/PM </div> Closed: When the torque limit has been reached.	209
31	During speed limit	<div> V/f   V/f w/PG   OLV   CLV  OLV/PM   AOLV/PM   CLV/PM </div> Closed: Speed limit has been reached.	209
32	During speed limit in Torque Control	<div> V/f   V/f w/PG   OLV   CLV  OLV/PM   AOLV/PM   CLV/PM </div> Closed: Speed limit has been reached while using Torque Control.	209
33	Zero Servo complete	<div> V/f   V/f w/PG   OLV   CLV  OLV/PM   AOLV/PM   CLV/PM </div> Closed: Zero Servo operation has finished.	209
37	During frequency output	<b>All Modes</b> Open: Either the drive has stopped or baseblock, DC Injection Braking, or Initial Excitation is being performed. Closed: Drive is running the motor (not in a baseblock state and DC Injection is not being performed).	209
38	Drive enabled	<b>All Modes</b> Closed: Multi-function input set for “Drive enable” is closed (H1-□□ = 6A)	209
39	Watt hour pulse output	<b>All Modes</b> Output units are determined by H2-06. Outputs a pulse every 200 ms to indicate the kWh count.	209
3C	LOCAL/REMOTE status	<b>All Modes</b> Open: REMOTE Closed: LOCAL	210
3D	During Speed Search	<b>All Modes</b> Closed: Speed Search is being executed.	210
3E	PID feedback low	<b>All Modes</b> Closed: PID feedback level is too low.	210
3F	PID feedback high	<b>All Modes</b> Closed: The PID feedback level is too high.	210
4A	During KEB Operation	<b>All Modes</b> Closed: KEB is being performed.	210
4B	During Short-Circuit Braking	<div> V/f   V/f w/PG   OLV   CLV  OLV/PM   AOLV/PM   CLV/PM </div> Closed: Short Circuit Braking is active.	210
4C	During Fast Stop	<b>All Modes</b> Closed: A Fast Stop command has been entered from the operator or input terminals.	210
4E	Braking transistor fault (rr)	<b>All Modes</b> Closed: The built-in dynamic braking transistor failed. <b>Note:</b> This setting is not available in models CIMR-T□2A0169 through 2A0415 and 4A0088 through 4A362.	210

## B.3 Parameter Table

H2 Multi-Function Digital Output Settings			
H2-□□ Setting	Function	Description	Page
4F	Braking resistor overheat (oH)	<b>All Modes</b> Closed: The dynamic braking resistor has overheated. <b>Note:</b> This setting is not available in models CIMR-T□2A0169 through 2A0415 and 4A0088 through 4A362.	210
50	Disturb increase	<b>All Modes</b> Closed: Disturb waveform acceleration Open: Disturb waveform deceleration	210
51	During Disturb output	<b>All Modes</b> Closed: Disturb waveform is active Open: Disturb waveform is not being output	210
52	Uv during KEB	<b>All Modes</b> Closed: DC bus voltage has fallen below L2-05 during KEB	210
60	Internal cooling fan alarm	<b>All Modes</b> Closed: Internal cooling fan alarm	210
61	Rotor position detection complete	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Closed: Drive has successfully detected the rotor position of the PM motor.	210
100 to 161	Function 0 to 61 with inverse output	<b>All Modes</b> Inverts the output switching of the multi-function output functions. Set the last two digits of 1□□ to reverse the output signal of that specific function.	211

## ? H3: Multi-Function Analog Inputs

No.(Addr.)	Name	Description	Setting	Page
H3-01 (410H)	Terminal A1 Signal Level Selection	<b>All Modes</b> 0: 0 to 10 V 1: -10 to 10 V	Default: 0 Min: 0 Max: 1	211
H3-02 (434H)	Terminal A1 Function Selection	<b>All Modes</b> Sets the function of terminal A1.	Default: 0 Min: 0 Max: 41	212
H3-03 (411H) 	Terminal A1 Gain Setting	<b>All Modes</b> Sets the level of the input value selected in H3-02 when 10 V is input at terminal A1.	Default: 100.0% Min: -999.9% Max: 999.9%	212
H3-04 (412H) 	Terminal A1 Bias Setting	<b>All Modes</b> Sets the level of the input value selected in H3-02 when 0 V is input at terminal A1.	Default: 0.0% Min: -999.9% Max: 999.9%	212
H3-05 (413H)	Terminal A3 Signal Level Selection	<b>All Modes</b> 0: 0 to 10 V 1: -10 to 10 V	Default: 0 Min: 0 Max: 1	213
H3-06 (414H)	Terminal A3 Function Selection	<b>All Modes</b> Sets the function of terminal A3.	Default: 2 Min: 0 Max: 41	213
H3-07 (415H) 	Terminal A3 Gain Setting	<b>All Modes</b> Sets the level of the input value selected in H3-06 when 10 V is input at terminal A3.	Default: 100.0% Min: -999.9% Max: 999.9%	213
H3-08 (416H) 	Terminal A3 Bias Setting	<b>All Modes</b> Sets the level of the input value selected in H3-06 when 0 V is input at terminal A3.	Default: 0.0% Min: -999.9% Max: 999.9%	213
H3-09 (417H)	Terminal A2 Signal Level Selection	<b>All Modes</b> 0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA Current Input 3: 0 to 20 mA Current Input <b>Note:</b> Use DIP switch S1 to set input terminal A2 for a current or a voltage input signal.	Default: 2 Min: 0 Max: 3	213





No.(Addr.)	Name	Description	Setting	Page
H3-10 (418H)	Terminal A2 Function Selection	<b>All Modes</b> Sets the function of terminal A2.	Default: 0 Min: 0 Max: 41	213
H3-11 (419H) 	Terminal A2 Gain Setting	<b>All Modes</b> Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.	Default: 100.0% Min: -999.9% Max: 999.9%	214
H3-12 (41AH) 	Terminal A2 Bias Setting	<b>All Modes</b> Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.	Default: 0.0% Min: -999.9% Max: 999.9%	214
H3-13 (41BH)	Analog Input Filter Time Constant	<b>All Modes</b> Sets a primary delay filter time constant for terminals A1, A2, and A3. Used for noise filtering.	Default: 0.03 s Min: 0.00 s Max: 2.00 s	214
H3-14 (41CH)	Analog Input Terminal Enable Selection	<b>All Modes</b> Determines which of the analog input terminals will be enabled or disabled when a digital input programmed for “Analog input enable” (H1-□□ = C) is activated. 1: Terminal A1 only 2: Terminal A2 only 3: Terminals A1 and A2 only 4: Terminal A3 only 5: Terminals A1 and A3 6: Terminals A2 and A3 7: All terminals enabled	Default: 7 Min: 1 Max: 7	214
H3-16 (2F0H)	Terminal A1 Offset	<b>All Modes</b> Adds an offset when the analog signal to terminal A1 is at 0 V.	Default: 0 Min: -500 Max: 500	214
H3-17 (2F1H)	Terminal A2 Offset	<b>All Modes</b> Adds an offset when the analog signal to terminal A2 is at 0 V.	Default: 0 Min: -500 Max: 500	214
H3-18 (2F2H)	Terminal A3 Offset	<b>All Modes</b> Adds an offset when the analog signal to terminal A3 is at 0 V.	Default: 0 Min: -500 Max: 500	214

H3 Multi-Function Analog Input Settings			
H3-□□ Setting	Function	Description	Page
0	Frequency bias	<b>All Modes</b> 10 V = E1-04 (maximum output frequency)	215
1	Frequency gain	<b>All Modes</b> 0 to 10 V signal allows a setting of 0 to 100%. -10 to 0 V signal allows a setting of -100 to 0%.	215
2	Auxiliary frequency reference 1 (used as a Multi-Step Speed 2)	<b>All Modes</b> 10 V = E1-04 (maximum output frequency)	215
3	Auxiliary frequency reference 2 (3rd step analog)	<b>All Modes</b> 10 V = E1-04 (maximum output frequency)	215
4	Output voltage bias	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> 10 V = E1-05 (motor rated voltage)	215
5	Accel/decel time gain	<b>All Modes</b> 10 V = 100%	216
6	DC Injection Braking current	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> 10 V = Drive rated current	216

## B.3 Parameter Table

H3 Multi-Function Analog Input Settings			
H3-□□ Setting	Function	Description	Page
7	Overtorque/undertorque detection level	<b>All Modes</b> 10 V = Drive rated current (V/f, V/f w/PG) 10 V = Motor rated torque (OLV, CLV, OLV/PM, AOLV/PM, CLV/PM)	216
8	Stall Prevention level during run	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Drive rated current	216
9	Output frequency lower limit level	<b>All Modes</b> 10 V = E1-04 (maximum output frequency)	216
B	PID feedback	<b>All Modes</b> 10 V = 100%	216
C	PID setpoint	<b>All Modes</b> 10 V = 100%	217
D	Frequency bias	<b>All Modes</b> 10 V = E1-04 (maximum output frequency)	217
E	Motor temperature (PTC input)	<b>All Modes</b> 10 V = 100%	217
F	Through mode	<b>All Modes</b> Set this value when using the terminal in the pass-through mode.	217
10	Forward torque limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Motor rated torque	217
11	Reverse torque limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Motor rated torque	217
12	Regenerative torque limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Motor rated torque	217
13	Torque reference / Torque limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Motor rated torque	217
14	Torque compensation	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Motor rated torque	217
15	General torque limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 10 V = Motor rated torque	217
16	Differential PID feedback	<b>All Modes</b> 10 V = 100%	217
1F	Through mode	<b>All Modes</b> Set this value when using the terminal in the pass-through mode.	217
41	Output Voltage Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0 V (4 mA) to 10 V (20 mA): can be adjusted between 2% to 200%	218

## ? H4: Analog Outputs

No.(Addr.)	Name	Description	Setting	Page
H4-01 (41DH)	Multi-Function Analog Output Terminal FM Monitor Selection	<b>All Modes</b> Selects the data to be output through multi-function analog output terminal FM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter “103” for U1-03.	Default: 102 Min: 000 Max: 999	218
H4-02 (41EH) 	Multi-Function Analog Output Terminal FM Gain	<b>All Modes</b> Sets the signal level at terminal FM that is equal to 100% of the selected monitor value.	Default: 100.0% Min: -999.9% Max: 999.9%	219
H4-03 (41FH) 	Multi-Function Analog Output Terminal FM Bias	<b>All Modes</b> Sets the signal level at terminal FM that is equal to 0% of the selected monitor value.	Default: 0.0% Min: -999.9% Max: 999.9%	219
H4-04 (420H)	Multi-Function Analog Output Terminal AM Monitor Selection	<b>All Modes</b> Selects the data to be output through multi-function analog output terminal AM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter “103” for U1-03.	Default: 103 Min: 000 Max: 999	218
H4-05 (421H) 	Multi-Function Analog Output Terminal AM Gain	<b>All Modes</b> Sets the signal level at terminal AM that is equal to 100% of the selected monitor value.	Default: 50.0% Min: -999.9% Max: 999.9%	219
H4-06 (422H) 	Multi-Function Analog Output Terminal AM Bias	<b>All Modes</b> Sets the signal level at terminal AM that is equal to 0% of the selected monitor value.	Default: 0.0% Min: -999.9% Max: 999.9%	219
H4-07 (423H)	Multi-Function Analog Output Terminal FM Signal Level Selection	<b>All Modes</b> 0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA	Default: 0 Min: 0 Max: 2	220
H4-08 (424H)	Multi-Function Analog Output Terminal AM Signal Level Selection	<b>All Modes</b> 0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA	Default: 0 Min: 0 Max: 2	220

## ? H5: MEMOBUS/Modbus Serial Communication





No.(Addr.)	Name	Description	Setting	Page
H5-01 (425H) <20>	Drive Node Address	<b>All Modes</b> Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	Default: 1F Min: 0 Max: FFH	514
H5-02 (426H)	Communication Speed Selection	<b>All Modes</b> 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps Cycle power for the setting to take effect.	Default: 3 Min: 0 Max: 8	514
H5-03 (427H)	Communication Parity Selection	<b>All Modes</b> 0: No parity 1: Even parity 2: Odd parity Cycle power for the setting to take effect.	Default: 0 Min: 0 Max: 2	514



## B.3 Parameter Table

No.(Addr.)	Name	Description	Setting	Page
H5-04 (428H)	Stopping Method After Communication Error (CE)	<b>All Modes</b> 0: Ramp to stop 1: Coast to stop 2: Fast Stop 3: Alarm only	Default: 3 Min: 0 Max: 3	514
H5-05 (429H)	Communication Fault Detection Selection	<b>All Modes</b> 0: Disabled 1: Enabled. If communication is lost for more than two seconds, a CE fault will occur.	Default: 1 Min: 0 Max: 1	515
H5-06 (42AH)	Drive Transmit Wait Time	<b>All Modes</b> Set the wait time between receiving and sending data.	Default: 5 ms Min: 5 ms Max: 65 ms	515
H5-07 (42BH)	RTS Control Selection	<b>All Modes</b> 0: Disabled. RTS is always on. 1: Enabled. RTS turns on only when sending.	Default: 1 Min: 0 Max: 1	515
H5-09 (435H)	CE Detection Time	<b>All Modes</b> Sets the time required to detect a communications error. Adjustment may be needed when networking several drives.	Default: 2.0 s Min: 0.0 s Max: 10.0 s	515
H5-10 (436H)	Unit Selection for MEMOBUS/Modbus Register 0025H	<b>All Modes</b> 0: 0.1 V units 1: 1 V units	Default: 0 Min: 0 Max: 1	515
H5-11 (43CH)	Communications ENTER Function Selection	<b>All Modes</b> 0: Drive requires an Enter command before accepting any changes to parameter settings. 1: Parameter changes are activated immediately without the Enter command.	Default: 0 Min: 0 Max: 1	516
H5-12 (43DH)	Run Command Method Selection	<b>All Modes</b> 0: FWD/Stop, REV/Stop 1: Run/Stop, FWD/REV	Default: 0 Min: 0 Max: 1	516

<20> If this parameter is set to 0, the drive will be unable to respond to MEMOBUS/Modbus commands.

## ? H6: Pulse Train Input/Output

No.(Addr.)	Name	Description	Setting	Page
H6-01 (42CH)	Pulse Train Input Terminal RP Function Selection	<b>All Modes</b> 0: Frequency reference 1: PID feedback value 2: PID setpoint value 3: V/f Control with Simple PG feedback (possible only when using motor 1 in V/f Control)	Default: 0 Min: 0 Max: 3	220
H6-02 (42DH) 	Pulse Train Input Scaling	<b>All Modes</b> Sets the terminal RP input signal frequency that is equal to 100% of the value selected in H6-01.	Default: 1440 Hz Min: 100 Hz Max: 32000 Hz	221
H6-03 (42EH) 	Pulse Train Input Gain	<b>All Modes</b> Sets the level of the value selected in H6-01 when a frequency with the value set in H6-02 is input.	Default: 100.0% Min: 0.0% Max: 1000.0%	221
H6-04 (42FH) 	Pulse Train Input Bias	<b>All Modes</b> Sets the level of the value selected in H6-01 when 0 Hz is input.	Default: 0.0% Min: -100.0% Max: 100.0%	222
H6-05 (430H) 	Pulse Train Input Filter Time	<b>All Modes</b> Sets the pulse train input filter time constant.	Default: 0.10 s Min: 0.00 s Max: 2.00 s	222

No.(Addr.)	Name	Description	Setting	Page
H6-06 (431H) 	Pulse Train Monitor Selection	<b>All Modes</b> Select the pulse train monitor output function (value of the $\square-\square\square$ part of $U\square-\square\square$ ). Example: To select U5-01, set “501”. <b>Note:</b> Set this value as 000 when using the terminal in the pass-through mode.	Default: 102 Min: 000 Max: 502	222
H6-07 (432H) 	Pulse Train Monitor Scaling	<b>All Modes</b> Sets the terminal MP output signal frequency when the monitor value is 100%. To have the pulse train monitor output equal the output frequency, set H6-06 to 102 and H6-07 to 0.	Default: 1440 Hz Min: 0 Hz Max: 32000 Hz	222
H6-08 (43FH)	Pulse Train Input Minimum Frequency	<b>All Modes</b> Sets the minimum frequency for the pulse train input to be detected. Enabled when H6-01 = 0, 1, or 2.	Default: 0.5 Hz Min: 0.1 Hz Max: 1000.0 Hz	222

## ? L: Protection Function

L parameters provide protection to the drive and motor, such as: control during momentary power loss, Stall Prevention, frequency detection, fault restarts, overtorque detection, torque limits, and other types of hardware protection.

### ? L1: Motor Protection

No. (Addr.)	Name	Description	Setting	Page
L1-01 (480H)	Motor Overload Protection Selection	<b>All Modes</b> 0: Disabled 1: General purpose motor (standard fan cooled) 2: Drive dedicated motor with a speed range of 1:10 3: Vector motor with a speed range of 1:100 4: PM motor with variable torque 5: PM motor with constant torque control 6: General purpose motor (50 Hz) The drive may not be able to provide protection when multiple motors are used, even if overload is enabled in L1-01. Set L1-01 to 0 and install separate thermal relay to each motor.	Default: <34> Min: 0 Max: 6	223
L1-02 (481H)	Motor Overload Protection Time	<b>All Modes</b> Sets the motor thermal overload protection (oL1) time.	Default: 1.0 min Min: 0.1 min Max: 5.0 min	226
L1-03 (482H)	Motor Overheat Alarm Operation Selection (PTC input)	<b>All Modes</b> Sets operation when the motor temperature analog input (H3-02, H3-06, or H3-10 = E) exceeds the oH3 alarm level. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09) 3: Alarm only (“oH3” will flash)	Default: 3 Min: 0 Max: 3	228
L1-04 (483H)	Motor Overheat Fault Operation Selection (PTC input)	<b>All Modes</b> Sets stopping method when the motor temperature analog input (H3-02, H3-06, or H3-10 = E) exceeds the oH4 fault level. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09)	Default: 1 Min: 0 Max: 2	228
L1-05 (484H)	Motor Temperature Input Filter Time (PTC input)	<b>All Modes</b> Adjusts the filter for the motor temperature analog input (H3-02, H3-06, or H3-10 = E).	Default: 0.20 s Min: 0.00 s Max: 10.00 s	228
L1-13 (46DH)	Continuous Electrothermal Operation Selection	<b>All Modes</b> 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	228

<34> Default setting is determined by the control mode (A1-02).

### B.3 Parameter Table

#### ? L2: Momentary Power Loss Ride-Thru



No. (Addr.)	Name	Description	Setting	Page
L2-01 (485H)	Momentary Power Loss Operation Selection	<b>All Modes</b> 0: Disabled. Drive trips on (Uv1) fault when power is lost during Run. 1: Recover within the time set in L2-02. Uv1 will be detected if power loss is longer than L2-02. 2: Recover as long as CPU has power. Uv1 is not detected.	Default: 0 Min: 0 Max: 2	229
L2-02 (486H)	Momentary Power Loss Ride-Thru Time	<b>All Modes</b> Sets the Power Loss Ride-Thru time. Enabled only when L2-01 = 1 or S4-01 = 2.	Default: <24> Min: 0.0 s Max: 25.5 s	229
L2-03 (487H)	Momentary Power Loss Minimum Baseblock Time	<b>All Modes</b> Sets the minimum wait time for residual motor voltage decay before the drive output reenergizes after performing Power Loss Ride-Thru. Increasing the time set to L2-03 may help if overcurrent or overvoltage occur during Speed Search or during DC Injection Braking.	Default: <24> Min: 0.1 s Max: 5.0 s	229
L2-04 (488H)	Momentary Power Loss Voltage Recovery Ramp Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the time for the output voltage to return to the preset V/f pattern during Speed Search.	Default: <24> Min: 0.0 s Max: 5.0 s	229
L2-05 (489H)	Undervoltage Detection Level (Uv)	<b>All Modes</b> Sets the DC bus undervoltage trip level.	Default: 190 V <6> <15> Min: 150 Vdc <15> Max: 250 Vdc <15>	230

<6> The setting value is dependent on the setting for the input voltage (E1-01).

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<24> Default setting is determined by the drive model (o2-04) and duty selection (C6-01).

#### ? L3: Stall Prevention

No. (Addr.)	Name	Description	Setting	Page
L3-01 (48FH)	Stall Prevention Selection during Acceleration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled. 1: General purpose. Acceleration is paused as long as the current is above the L3-02 setting. 2: Intelligent. Accelerate in the shortest possible time without exceeding the L3-02 level. <b>Note: Setting 2 is not available when using OLV/PM.</b>	Default: 1 Min: 0 Max: 2	230
L3-02 (490H) 	Stall Prevention Level during Acceleration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Used when L3-01 = 1 or 2. 100% is equal to the drive rated current.	Default: <4> Min: 0% Max: 150% <4>	231
L3-03 (491H) 	Stall Prevention Limit during Acceleration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets Stall Prevention lower limit during acceleration when operating in the constant power range. Set as a percentage of the drive's rated current.	Default: 50% Min: 0% Max: 100%	231
L3-04 (492H)	Stall Prevention Selection during Deceleration	<b>All Modes</b> 0: Disabled. Deceleration at the active deceleration rate. An ov fault may occur. 1: General purpose. Deceleration is paused when the DC bus voltage exceeds the Stall Prevention level. 2: Intelligent. Decelerate as fast as possible while avoiding ov faults. 3: Stall Prevention with braking resistor. Stall Prevention during deceleration is enabled in coordination with dynamic braking. 4: Overexcitation Deceleration 1. Decelerates while increasing the motor flux. 5: Overexcitation Deceleration 2. Adjust the deceleration rate according to the DC bus voltage.	Default: 1 Min: 0 Max: 5 <26>	232

No. (Addr.)	Name	Description	Setting	Page
L3-05 (493H)	Stall Prevention Selection during Run	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled. Drive runs at a set frequency. A heavy load may cause speed loss.            1: Decel time 1. Uses the deceleration time set to C1-02 while Stall Prevention is performed.            2: Decel time 2. Uses the deceleration time set to C1-04 while Stall Prevention is performed.</p>	Default: 1 Min: 0 Max: 2	233
L3-06 (494H)	Stall Prevention Level during Run	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enabled when L3-05 is set to 1 or 2. 100% is equal to the drive rated current.</p>	Default: <4> Min: 30% Max: 150% <4>	234
L3-11 (4C7H)	Overvoltage Suppression Function Selection	<div>All Modes</div> <p>Enables or disables the ov suppression function, which allows the drive to change the output frequency as the load changes to prevent an ov fault.            0: Disabled            1: Enabled</p>	Default: 0 Min: 0 Max: 1	234
L3-17 (462H)	Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention	<div>All Modes</div> <p>Sets the desired value for the DC bus voltage during overvoltage suppression and Stall Prevention during deceleration.</p>	Default: 375 Vdc <15> <41> Min: 150 Vdc <15> Max: 400 Vdc <15>	235
L3-22 (4F9H)	Deceleration Time at Stall Prevention during Acceleration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the deceleration time used for Stall Prevention during acceleration in OLV/PM.</p>	Default: 0.0 s Min: 0.0 s Max: 6000.0 s	232
L3-23 (4FDH)	Automatic Reduction Selection for Stall Prevention during Run	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Sets the Stall Prevention level set in L3-06 that is used throughout the entire frequency range.            1: Automatic Stall Prevention level reduction in the constant output range. The lower limit value is 40% of L3-06.</p>	Default: 0 Min: 0 Max: 1	234
L3-26 (455H)	Additional DC Bus Capacitors	<div>All Modes</div> <p>When DC bus capacitors have been added externally, be sure to add those values to the internal capacitor table for proper DC bus calculations.</p>	Default: 0 μF Min: 0 μF Max: 65000 μF	235
L3-27 (456H)	Stall Prevention Detection Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time the current must exceed the Stall Prevention level to activate Stall Prevention.</p>	Default: 50 ms Min: 0 ms Max: 5000 ms	235

<4> The upper limit of the setting range is determined by the values set to C6-01 and L8-38.












<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<26> Setting range is dependent on the control mode (A1-02). When using OLV/PM, the setting range is 0 to 2 seconds. When using AOLV/PM or CLV/PM, the setting range is 0 to 1 second.

<41> Changing the input voltage setting in E1-01 will reset this parameter back its default value.

## B.3 Parameter Table

### ? L4: Speed Detection

No. (Addr.)	Name	Description	Setting	Page
L4-01 (499H) 	Speed Agreement Detection Level	<b>All Modes</b> L4-01 sets the frequency detection level for digital output functions H2-□□ = 2, 3, 4, 5.	Default: 0.0 Hz Min: 0.0 Hz Max: 400.0 Hz <12>	235
L4-02 (49AH) 	Speed Agreement Detection Width	L4-02 sets the hysteresis or allowable margin for speed detection.	Default: <34> Min: 0.0 Hz Max: 20.0 Hz <13>	235
L4-03 (49BH) 	Speed Agreement Detection Level (+/-)	<b>All Modes</b> L4-03 sets the frequency detection level for digital output functions H2-□□ = 13, 14, 15, 16.	Default: 0.0 Hz Min: -400.0 Hz Max: 400.0 Hz <14>	236
L4-04 (49CH) 	Speed Agreement Detection Width (+/-)	L4-04 sets the hysteresis or allowable margin for speed detection.	Default: <34> Min: 0.0 Hz Max: 20.0 Hz <13>	236
L4-05 (49DH)	Frequency Reference Loss Detection Selection	<b>All Modes</b> 0: Stop. Drive stops when the frequency reference is lost. 1: Run. Drive runs at a reduced speed when the frequency reference is lost.	Default: 0 Min: 0 Max: 1	236
L4-06 (4C2H)	Frequency Reference at Reference Loss	<b>All Modes</b> Sets the percentage of the frequency reference that the drive should run with when the frequency reference is lost.	Default: 80.0% Min: 0.0% Max: 100.0%	236
L4-07 (470H)	Speed Agreement Detection Selection	<b>All Modes</b> 0: During run only (no detection while drive output is shut off) 1: Detection always enabled.	Default: 0 Min: 0 Max: 1	236
L4-08 (47FH)	Frequency Agree Condition Selection	<div>     </div> <div>    </div> Sets whether a frequency agree situation should be determined by the soft starter output frequency or by the estimated speed of the motor. 0: Use the soft starter output frequency to determine frequency agree 1: Use the motor speed to determine frequency agree	Default: 1 Min: 0 Max: 1	237

<12> The setting range depends on the control mode selected for the drive. The setting range is 0.0 to 100.0% in AOLV/PM and CLV/PM.

<13> The setting range depends on the control mode selected for the drive. The setting range is 0.0 to 40.0% in AOLV/PM and CLV/PM.





<14> The setting range depends on the control mode selected for the drive. The setting range is -100.0 to 100.0% in AOLV/PM and CLV/PM.

<34> Default setting is determined by the control mode (A1-02).

### ? L5: Fault Restart

No. (Addr.)	Name	Description	Setting	Page
L5-01 (49EH)	Number of Auto Restart Attempts	<b>All Modes</b> Sets the number of times the drive may attempt to restart after the following faults occur: GF, LF, oC, ov, PF, rH, rr, oL1, oL2, oL3, oL4, STo, Uv1.	Default: 0 Time Min: 0 Time Max: 10 Times	238
L5-02 (49FH)	Auto Restart Fault Output Operation Selection	<b>All Modes</b> 0: Fault output not active. 1: Fault output active during restart attempt.	Default: 0 Min: 0 Max: 1	238
L5-04 (46CH)	Fault Reset Interval Time	<b>All Modes</b> Sets the amount of time to wait between performing fault restarts.	Default: 10.0 s Min: 0.5 s Max: 600.0 s	238
L5-05 (467H)	Fault Reset Operation Selection	<b>All Modes</b> 0: Continuously attempt to restart while incrementing restart counter only at a successful restarts (same as F7 and G7). 1: Attempt to restart with the interval time set in L5-04 and increment the restart counter with each attempt (same V7).	Default: 0 Min: 0 Max: 1	239

## ? L6: Torque Detection

No. (Addr.)	Name	Description	Setting	Page
L6-01 (4A1H)	Torque Detection Selection 1	<b>All Modes</b> 0: Disabled 1: oL3 detection only active during speed agree, operation continues after detection 2: oL3 detection always active during run, operation continues after detection 3: oL3 detection only active during speed agree, output shuts down on an oL3 fault 4: oL3 detection always active during run, output shuts down on an oL3 fault 5: UL3 detection only active during speed agree, operation continues after detection 6: UL3 detection always active during run, operation continues after detection 7: UL3 detection only active during speed agree, output shuts down on an oL3 fault 8: UL3 detection always active during run, output shuts down on an oL3 fault	Default: 0 Min: 0 Max: 8	240
L6-02 (4A2H) 	Torque Detection Level 1	<b>All Modes</b> Sets the overtorque and undertorque detection level.	Default: 150% Min: 0% Max: 300%	240
L6-03 (4A3H) 	Torque Detection Time 1	<b>All Modes</b> Sets the time an overtorque or undertorque condition must exist to trigger torque detection 1.	Default: 0.1 s Min: 0.0 s Max: 10.0 s	240
L6-04 (4A4H)	Torque Detection Selection 2	<b>All Modes</b> 0: Disabled 1: oL4 detection only active during speed agree, operation continues after detection 2: oL4 detection always active during run, operation continues after detection 3: oL4 detection only active during speed agree, output shuts down on an oL4 fault 4: oL4 detection always active during run, output shuts down on an oL4 fault 5: UL4 detection only active during speed agree, operation continues after detection 6: UL4 detection always active during run, operation continues after detection 7: UL4 detection only active during speed agree, output shuts down on an oL4 fault 8: UL4 detection always active during run, output shuts down on an oL4 fault	Default: 0 Min: 0 Max: 8	240
L6-05 (4A5H) 	Torque Detection Level 2	<b>All Modes</b> Sets the overtorque and undertorque detection level.	Default: 150% Min: 0% Max: 300%	240
L6-06 (4A6H) 	Torque Detection Time 2	<b>All Modes</b> Sets the time an overtorque or undertorque condition must exist to trigger torque detection 2.	Default: 0.1 s Min: 0.0 s Max: 10.0 s	240

## B.3 Parameter Table

### ? L7: Torque Limit

No. (Addr.)	Name	Description	Setting	Page
L7-01 (4A7H) 	Forward Torque Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set.</p>	Default: 200% Min: 0% Max: 300%	241
L7-02 (4A8H) 	Reverse Torque Limit		Default: 200% Min: 0% Max: 300%	241
L7-03 (4A9H) 	Forward Regenerative Torque Limit		Default: 200% Min: 0% Max: 300%	241
L7-04 (4AAH) 	Reverse Regenerative Torque Limit		Default: 200% Min: 0% Max: 300%	241
L7-06 (4ACH) 	Torque Limit Integral Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the integral time constant for the torque limit.</p>	Default: 200 ms Min: 5 ms Max: 10000 ms	241
L7-07 (4C9H)	Torque Limit Control Method Selection during Accel/Decel	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Proportional control (changes to integral control at constant speed). Use this setting when acceleration to the desired speed should take precedence over the torque limit. 1: Integral control. Set L7-07 to 1 if the torque limit should take precedence.</p>	Default: 0 Min: 0 Max: 1	242
L7-16 (44DH)	Torque Limit Process at Start	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disable 1: Enable</p>	Default: 0 Min: 0 Max: 1	242

### ? L8: Drive Protection

No. (Addr.)	Name	Description	Setting	Page
L8-01 (4ADH)	Internal Dynamic Braking Resistor Protection Selection (ERF type)	<div>All Modes</div> <p>0: Resistor overheating protection disabled 1: Resistor overheating protection enabled</p>	Default: 1 Min: 0 Max: 1	242
L8-02 (4AEH)	Overheat Alarm Level	<div>All Modes</div> <p>An overheat alarm will occur if the heatsink temperature exceeds the level set in L8-02.</p>	Default: <24> Min: 50°C Max: 150°C	242
L8-03 (4AFH)	Overheat Pre-Alarm Operation Selection	<div>All Modes</div> <p>0: Ramp to stop. A fault is triggered. 1: Coast to stop. A fault is triggered. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. A fault is triggered. 3: Continue operation. An alarm is triggered.</p>	Default: 3 Min: 0 Max: 3	243
L8-05 (4B1H)	Input Phase Loss Protection Selection	<div>All Modes</div> <p>Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled 1: Enabled (software detection only) 4: Enabled (both software and hardware detection)</p>	Default: 1 Min: 0 Max: 4	243
L8-07 (4B3H)	Output Phase Loss Protection Selection	<div>All Modes</div> <p>0: Disabled 1: Enabled (triggered by a single phase loss) 2: Enabled (triggered when two phases are lost)</p>	Default: 0 Min: 0 Max: 2	243

No. (Addr.)	Name	Description	Setting	Page
L8-09 (4B5H)	Output Ground Fault Detection Selection	<b>All Modes</b> 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	244
L8-10 (4B6H)	Heatsink Cooling Fan Operation Selection	<b>All Modes</b> 0: During run only. Fan operates only during run and for L8-11 seconds after stop. 1: Fan always on. Cooling fan operates whenever the drive is powered up.	Default: 0 Min: 0 Max: 1	244
L8-11 (4B7H)	Heatsink Cooling Fan Off Delay Time	<b>All Modes</b> Sets a delay time to shut off the cooling fan after the Run command is removed when L8-10 = 0.	Default: 60 s Min: 0 s Max: 300 s	244
L8-12 (4B8H)	Ambient Temperature Setting	<b>All Modes</b> Enter the ambient temperature. This value adjusts the oL2 detection level.	Default: 40°C Min: -10°C Max: 50°C	244
L8-15 (4BBH)	oL2 Characteristics Selection at Low Speeds	<b>All Modes</b> 0: No oL2 level reduction below 6 Hz. 1: oL2 level is reduced linearly below 6 Hz. It is halved at 0 Hz.	Default: 1 Min: 0 Max: 1	244
L8-18 (4BEH)	Software Current Limit Selection	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> 0: Disabled 1: Enabled	Default: 0 Min: 0 Max: 1	245
L8-27 (4DDH)	Overcurrent Detection Gain	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the gain for overcurrent detection as a percentage of the motor rated current. Overcurrent is detected using the drive's overcurrent level or the value set to L8-27, whichever is lower.	Default: 300.0% Min: 0.0% Max: 300.0%	245
L8-29 (4DFH)	Current Unbalance Detection (LF2)	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	245
L8-32 (4E2H)	Main Contactor and Cooling Fan Power Supply Failure Selection	<b>All Modes</b> Determines the action the drive should take when a fault occurs with the internal cooling fan. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09) 3: Alarm only ("FAn" will flash)	Default: 1 Min.: 0 Max.: 3	245
L8-35 (4ECH)	Installation Method Selection	<b>All Modes</b> 0: IP20 enclosure 1: Side-by-Side mounting 2: NEMA Type 1 3: Finless model or external heatsink installation	Default: <9> <16> Min: 0 Max: 3	246
L8-38 (4EFH)	Carrier Frequency Reduction Selection	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> 0: Disabled 1: Enabled below 6 Hz 2: Enabled for the entire speed range	Default: <27> Min: 0 Max: 2	246
L8-40 (4F1H)	Carrier Frequency Reduction Off Delay Time	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Sets the time that the drive continues running with reduced carrier frequency after the carrier reduction condition is gone. Setting 0.00 s disables the carrier frequency reduction time.	Default: <34> Min: 0.00 s Max: 2.00 s	246

## B.3 Parameter Table

No. (Addr.)	Name	Description	Setting	Page
L8-41 (4F2H)	High Current Alarm Selection	<b>All Modes</b> 0: Disabled 1: Enabled. An alarm is triggered at output currents above 150% of the drives rated current.	Default: 0 Min: 0 Max: 1	247
L8-46 (4FAH)	AVR Function Selection	<b>All Modes</b> 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	247
L8-55 (45FH)	Internal Braking Transistor Protection	<b>All Modes</b> 0: Disabled. L8-55 should be disabled when using a regen converter or an optional braking unit. 1: Protection enabled.	Default: 1 Min: 0 Max: 1	247
L8-93 (73CH)	Pull-Out Detection Time at Low Speed	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div><b>AOLV/PM</b></div> <div>CLV/PM</div> </div> Sets the amount of time until baseblock is executed once pull-out has been detected at low speed. A setting of 0.0 s essentially disables this parameters.	Default: 1.0 s Min: 0.0 s Max: 10.0 s	247
L8-94 (73DH)	Pull-Out Detection Level at Low Speed	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div><b>AOLV/PM</b></div> <div>CLV/PM</div> </div> Determines the detection level of pull-out at low speed. Set as a percentage of the maximum frequency.	Default: 3% Min: 0% Max: 10%	248
L8-95 (77FH)	Average Pull-Out Frequency at Low Speed	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div><b>AOLV/PM</b></div> <div>CLV/PM</div> </div> Sets the average number of times pull-out can occur at low speed.	Default: 10 Times Min: 1 Time Max: 50 Times	248

<9> Default setting value varies by the drive model (o2-04).

<16> Parameter setting value is not reset to the default value when the drive is initialized.

<24> Default setting is determined by the drive model (o2-04) and duty selection (C6-01).

<27> Default setting is determined by the control mode (A1-02) and the drive model (o2-04).

<34> Default setting is determined by the control mode (A1-02).

## ? n: Advanced Performance Set-Up

The n parameters are used to adjust more advanced performance characteristics such as Hunting Prevention, speed feedback detection, Overexcitation Deceleration, and Online Tuning for motor line-to-line resistance.

### ? n1: Hunting Prevention

No. (Addr.)	Name	Description	Setting	Page
<b>n1: Hunting Prevention</b>				
n1-01 (580H)	Hunting Prevention Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	249
n1-02 (581H)	Hunting Prevention Gain Setting	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> If the motor vibrates while lightly loaded, increase the gain by 0.1 until vibration ceases. If the motor stalls, decrease the gain by 0.1 until the stalling ceases.	Default: 1.00 Min: 0.00 Max: 2.50	249
n1-03 (582H)	Hunting Prevention Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the time constant used for Hunting Prevention.	Default: <9> Min: 0 ms Max: 500 ms	249
n1-05 (530H)	Hunting Prevention Gain while in Reverse	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the gain used for Hunting Prevention. If set to 0, the gain set to n1-02 is used for operation in reverse.	Default: 0.00 Min: 0.00 Max: 2.50	249

<9> Default setting value varies by the drive model (o2-04).

### ? n2: Speed Feedback Detection Control (AFR) Tuning

No. (Addr.)	Name	Description	Setting	Page
n2-01 (584H)	Speed Feedback Detection Control (AFR) Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the internal speed feedback detection control gain in the automatic frequency regulator (AFR). If hunting occurs, increase the set value. If response is low, decrease the set value.	Default: 1.00 Min: 0.00 Max: 10.00	250
n2-02 (585H)	Speed Feedback Detection Control (AFR) Time Constant 1	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the time constant used for speed feedback detection control (AFR).	Default: 50 ms Min: 0 ms Max: 2000 ms	250
n2-03 (586H)	Speed Feedback Detection Control (AFR) Time Constant 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the AFR time constant to be used during Speed Search and during regen.	Default: 750 ms Min: 0 ms Max: 2000 ms	250

### ? n3: Overexcitation Deceleration

No. (Addr.)	Name	Description	Setting	Page
n3-13 (531H)	Overexcitation Deceleration Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the gain applied to the V/f pattern during Overexcitation Deceleration (L3-04 = 4).	Default: 1.10 Min: 1.00 Max: 1.40	251
n3-14 (532H)	High Frequency Injection during Overexcitation Deceleration	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled 1: Enabled	Default: 0 Min: 0 Max: 1	251

## B.3 Parameter Table

No. (Addr.)	Name	Description	Setting	Page
n3-21 (579H)	Overslip Suppression Current Level	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets output current level at which the drive will start reducing the overexcitation gain in order to prevent a too high motor slip during Overexcitation Deceleration. Set as a percentage of the drive rated current.</p>	Default: 100% Min: 0% Max: 150%	251
n3-23 (57BH)	Overexcitation Operation Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Enabled in both directions 1: Enabled only when rotating forward 2: Enabled only when in reverse</p>	Default: 0 Min: 0 Max: 2	251

### ? n5: Feed Forward Control

No. (Addr.)	Name	Description	Setting	Page
n5-01 (5B0H)	Feed Forward Control Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled 1: Enabled</p>	Default: 0 Min: 0 Max: 1	252
n5-02 (5B1H)	Motor Acceleration Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time required to accelerate the motor at the rated torque from stop to rated speed.</p>	Default: <7> <24> Min: 0.001 s Max: 10.000 s	252
n5-03 (5B2H)	Feed Forward Control Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the ratio between motor and load inertia. Lower this setting if overshoot occurs at the end of acceleration.</p>	Default: 1.00 Min: 0.00 Max: 100.00	253

<7> Default setting value is dependent on the motor code set to E5-01.

<24> Default setting value is dependent on the drive model set to o2-04 and the Drive Duty set to C6-01.

### ? n6: Online Tuning

No. (Addr.)	Name	Description	Setting	Page
n6-05 (5C7H)	Online Tuning Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Decrease this setting for motors with a relatively large rotor time constant. If overload occurs, increase this setting slowly in increments of 0.10.</p>	Default: 1.0 Min: 0.1 Max: 50.0	254

### ? n8: PM Motor Control Tuning

No. (Addr.)	Name	Description	Setting	Page
n8-01 (540H)	Initial Rotor Position Estimation Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the current used for initial rotor position estimation as a percentage of the motor rated current (E5-03). This parameter rarely requires adjustment. If the motor nameplate lists an "Si" value, that value should be entered here.</p>	Default: 50% Min: 0% Max: 100%	254
n8-02 (541H)	Pole Attraction Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the current during initial polar attraction as a percentage of the motor rated current. Enter a high value when attempting to increase starting torque.</p>	Default: 80% Min: 0% Max: 150%	254

No. (Addr.)	Name	Description	Setting	Page
n8-35 (562H)	Initial Rotor Position Detection Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Pull-in 1: High frequency injection 2: Pulse injection</p>	Default: 1 Min: 0 Max: 2	254
n8-45 (538H)	Speed Feedback Detection Control Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Increase this setting if hunting occurs. Decrease to lower the response.</p>	Default: 0.80 Min: 0.00 Max: 10.00	255
n8-47 (53AH)	Pull-In Current Compensation Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the time constant to make the pull-in current reference and actual current value agree. Decrease the value if the motor begins to oscillate, and increase the value if it takes too long for the current reference to equal the output current.</p>	Default: 5.0 s Min: 0.0 s Max: 100.0 s	255
n8-48 (53BH)	Pull-In Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Defines the d-axis current reference during no-load operation at a constant speed. Set as a percentage of the motor rated current. Increase this setting if hunting occurs while running at constant speed.</p>	Default: 30% Min: 20% Max: 200%	255
n8-49 (53CH)	d-Axis Current for High Efficiency Control	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the d-axis current reference when running a high load at constant speed. Set as a percentage of the motor rated current.</p>	Default: <7> Min: -200.0% Max: 0.0%	255
n8-51 (53EH)	Acceleration/Deceleration Pull-In Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the d-axis current reference during acceleration/deceleration as a percentage of the motor rated current. Set to a high value when more starting torque is needed.</p>	Default: 50% Min: 0% Max: 200%	255
n8-54 (56DH)	Voltage Error Compensation Time Constant	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Adjusts the value when hunting occurs at low speed. If hunting occurs with sudden load changes, increase n8-54 in increments of 0.1. Reduce this setting if oscillation occurs at start.</p>	Default: 1.00 s Min: 0.00 s Max: 10.00 s	256
n8-55 (56EH)	Load Inertia	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the ratio between motor and machine inertia. 0: less than 1:10. 1: between 1:10 to 1:30. 2: between 1:30 to 1:50. 3: higher than 1:50.</p>	Default: 0 Min: 0 Max: 3	256
n8-57 (574H)	High Frequency Injection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: Disabled. Disable when using an SPM motor. 1: Enabled. Use this setting to enhance the speed control range when using an IPM motor.</p>	Default: 0 Min: 0 Max: 1	256
n8-62 (57DH)	Output Voltage Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Prevents output voltage saturation. Should be set just below the voltage provided by the input power supply.</p>	Default: 200.0 V <15> Min: 0.0 V Max: 230.0 V <15>	257
n8-65 (65CH)	Speed Feedback Detection Control Gain during ov Suppression	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the gain used for internal speed feedback detection during ov suppression</p>	Default: 1.50 Min: 0.00 Max: 10.00	257

## B.3 Parameter Table

No. (Addr.)	Name	Description	Setting	Page
n8-69 (65DH)	Speed Calculation Gain	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the proportional gain for PLL control of an extended observer. There is normally no need to change this parameter from the default value.</p>	Default: 1.00 Min: 0.00 Max: 20.00	257
n8-84 (2D3H)	Polarity Judge Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the current to determine polarity for the initial polarity calculation as a percentage of the motor rated current. <b>Note:</b> If an “Si” value is listed on the nameplate for a Yaskawa motor, n8-84 should be set to “Si” value × 2.</p>	Default: 100% Min: 0% Max: 150%	257

<7> Default setting value is dependent on the motor code set to E5-01.

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

### ? n9: Hardware Settings










No. (Addr.)	Name	Description	Setting	Page
n9-10 (5D9H)	AVR Time Constant	<div>All Modes</div> <p>Sets a delay time for output voltage compensation.</p>	Default: 1.0 ms Min: 0.0 ms Max: 100.0 ms	257
n9-12 (5DBH)	On-Delay Compensation Time	<div>All Modes</div> <p>Sets the time value used for IGBT On-delay compensation.</p>	Default: <9> Min: 0.00 μs Max: 20.00 μs	257
n9-62 (64FH)	On-Delay Compensation Derating Start Frequency	<div>All Modes</div> <p>Sets the frequency at which the drive begins to compensate the output voltage for the IGBT On-Delay.</p>	Default: 60.0 Hz Min: 0.0 Hz Max: E1-04	258
n9-63 (650H)	On-Delay Compensation Disable Frequency	<div>All Modes</div> <p>Sets the frequency at which the drive stops compensating the output voltage for the IGBT On-Delay.</p>	Default: 120.0 Hz Min: 0.0 Hz Max: E1-04	258

<9> Default setting value varies by the drive model (o2-04).

## ? o: Operator Related Parameters

The o parameters are used to set up the digital operator displays.

### ? o1: Digital Operator Display Selection

No. (Addr.)	Name	Description	Setting	Page
o1-01 (500H) 	Drive Mode Unit Monitor Selection	<b>All Modes</b> Selects the content of the last monitor that is shown when scrolling through Drive Mode display. Enter the last three digits of the monitor parameter number to be displayed: U□-□□.	Default: 106 (Monitor U1-06) Min: 104 Max: 905	259
o1-02 (501H) 	User Monitor Selection after Power Up	<b>All Modes</b> 1: Frequency reference (U1-01) 2: Direction 3: Output frequency (U1-02) 4: Output current (U1-03) 5: User-selected monitor (set by o1-01)	Default: 1 Min: 1 Max: 5	259
o1-03 (502H)	Digital Operator Display Selection	<b>All Modes</b> Sets the units the drive should use to display the frequency reference and motor speed monitors. 0: 0.01 Hz 1: 0.01% (100% = E1-04) 2: r/min (calculated using the number of motor poles setting in E2-04, E4-04, or E5-04) 3: User-selected units (set by o1-10 and o1-11)	Default: <34> Min: 0 Max: 3	259
o1-04 (503H)	V/f Pattern Display Unit	       0: Hz 1: r/min	Default: <34> Min: 0 Max: 1	260
o1-10 (520H)	User-Set Display Units Maximum Value	<b>All Modes</b> These settings define the display values when o1-03 is set to 3. o1-10 sets the display value that is equal to the maximum output frequency.	Default: <8> Min: 1 Max: 60000	260
o1-11 (521H)	User-Set Display Units Decimal Display	o1-11 sets the position of the decimal position.	Default: <8> Min: 0 Max: 3	260

<8> Default setting value is determined by the digital operator display selection (o1-03).

<34> Default setting is determined by the control mode (A1-02).

### ? o2: Digital Operator Keypad Functions

No. (Addr.)	Name	Description	Setting	Page
o2-01 (505H)	LO/RE Key Function Selection	<b>All Modes</b> 0: Disabled 1: Enabled. LO/RE key switches between LOCAL and REMOTE operation.	Default: 1 Min: 0 Max: 1	260
o2-02 (506H)	STOP Key Function Selection	<b>All Modes</b> 0: Disabled. STOP key is disabled in REMOTE operation. 1: Enabled. STOP key is always enabled.	Default: 1 Min: 0 Max: 1	261
o2-03 (507H)	User Parameter Default Value	<b>All Modes</b> 0: No change. 1: Set defaults. Saves parameter settings as default values for a User Initialization. 2: Clear all. Clears the default settings that have been saved for a User Initialization.	Default: 0 Min: 0 Max: 2	261

## B.3 Parameter Table

No. (Addr.)	Name	Description	Setting	Page
o2-04 (508H)	Drive Model Selection	<b>All Modes</b> Enter the drive model. Setting required only if installing a new control board.	Default: Determined by drive capacity Min: – Max: –	261
o2-05 (509H)	Frequency Reference Setting Method Selection	<b>All Modes</b> 0: ENTER key must be pressed to enter a frequency reference. 1: ENTER key is not required. The frequency reference can be adjusted using the up and down arrow keys only.	Default: 0 Min: 0 Max: 1	261
o2-06 (50AH)	Operation Selection when Digital Operator is Disconnected	<b>All Modes</b> 0: The drive continues operating if the digital operator is disconnected. 1: A fault is triggered (oPr) and the motor coasts to stop.	Default: 0 Min: 0 Max: 1	262
o2-07 (527H)	Motor Direction at Power Up when Using Operator	<b>All Modes</b> 0: Forward 1: Reverse This parameter requires that drive operation be assigned to the digital operator.	Default: 0 Min: 0 Max: 1	262
o2-09 (50DH)	Reserved	–	–	–

### ? o3: Copy Function

No. (Addr.)	Name	Description	Setting	Page
o3-01 (515H)	Copy Function Selection	<b>All Modes</b> 0: No action 1: Read parameters from the drive, saving them onto the digital operator. 2: Copy parameters from the digital operator, writing them to the drive. 3: Verify parameter settings on the drive to check if they match the data saved on the operator.	Default: 0 Min: 0 Max: 3	262
o3-02 (516H)	Copy Allowed Selection	<b>All Modes</b> 0: Read operation prohibited 1: Read operation allowed	Default: 0 Min: 0 Max: 1	263

### ? o4: Maintenance Monitor Settings






No. (Addr.)	Name	Description	Setting	Page
o4-01 (50BH)	Cumulative Operation Time Setting	<b>All Modes</b> Sets the value for the cumulative operation time of the drive in units of 10 h.	Default: 0 Min: 0 Max: 9999	263
o4-02 (50CH)	Cumulative Operation Time Selection	<b>All Modes</b> 0: Logs power-on time 1: Logs operation time when the drive output is active (output operation time).	Default: 0 Min: 0 Max: 1	263
o4-03 (50EH)	Cooling Fan Operation Time Setting	<b>All Modes</b> Sets the value of the fan operation time monitor U4-03 in units of 10 h.	Default: 0 Min: 0 Max: 9999	263
o4-05 (51DH)	Capacitor Maintenance Setting	<b>All Modes</b> Sets the value of the Maintenance Monitor for the capacitors. See U4-05 to check when the capacitors may need to be replaced.	Default: 0% Min: 0% Max: 150%	263
o4-07 (523H)	DC Bus Pre-charge Relay Maintenance Setting	<b>All Modes</b> Sets the value of the Maintenance Monitor for the soft charge bypass relay. See U4-06 to check when the bypass relay may need to be replaced.	Default: 0% Min: 0% Max: 150%	264
o4-09 (525H)	IGBT Maintenance Setting	<b>All Modes</b> Sets the value of the Maintenance Monitor for the IGBTs. See U4-07 to check when the IGBTs may need to be replaced.	Default: 0% Min: 0% Max: 150%	264

No. (Addr.)	Name	Description	Setting	Page
o4-11 (510H)	U2, U3 Initialize Selection	<b>All Modes</b> 0: U2-□□ and U3-□□ monitor data is not reset when the drive is initialized (A1-03). 1: U2-□□ and U3-□□ monitor data is reset. After that, o4-11 will be reset to 0.	Default: 0 Min: 0 Max: 1	264
o4-12 (512H)	kWh Monitor Initialization	<b>All Modes</b> 0: U4-10 and U4-11 monitor data is not reset when the drive is initialized (A1-03). 1: U4-10 and U4-11 monitor data is reset.	Default: 0 Min: 0 Max: 1	264
o4-13 (528H)	Number of Run Commands Counter Initialization	<b>All Modes</b> 0: Number of Run commands counter is not reset when the drive is initialized (A1-03). 1: Number of Run commands counter is reset.	Default: 0 Min: 0 Max: 1	264



## ? S: Functions for Textile Applications

The S parameters are designed specifically for textile applications. They set and adjust the Disturb function, gain levels for the frequency reference, braking transistor characteristics, and various aspects of KEB.

### ? S1: Disturb Function

No. (Addr.)	Name	Description	Setting	Page
S1-01 (680H) 	Disturb Function Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Disabled 1: Enabled 2: Enabled, outputs the Disturb waveform during accel/decel	Default: 0 Min: 0 Max: 2	266
S1-02 (681H) 	Disturb Function Amplitude	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Set the amplitude of the Disturb waveform as a percentage of the frequency reference.	Default: 0.0% Min: 0.0% Max: 20.0%	266
S1-03 (682H) 	Disturb Step	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the step applied at the end of disturb acceleration or deceleration as a percentage of the Disturb amplitude in S1-02.	Default: 0.0% Min: 0.0% Max: 50.0%	266
S1-04 (683H) 	Disturb Deceleration Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the deceleration time for the Disturb function.	Default: 0.0 s Min: 0.0 s Max: 120.0 s	266
S1-05 (684H) 	Disturb Acceleration Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the acceleration time for the Disturb function.	Default: 0.0 s Min: 0.0 s Max: 120.0 s	266

### ? S2: Frequency Reference Gain Settings

No. (Addr.)	Name	Description	Setting	Page
S2-01 (690H) 	Frequency Reference Gain	<b>All Modes</b> Determines how much to reduce or amplify the frequency reference. The frequency reference cannot exceed the upper limit set to d2-01.	Default: 100.0% Min: 0.0% Max: 1000.0%	266
S2-02 (691H) 	Frequency Reference Gain Change Ramp	<b>All Modes</b> Determines the time required to accelerate from 0.0% to the gain level set in S2-01.	Default: 0.0 s Min: 0.0 s Max: 600.0 s	266

## B.3 Parameter Table








### ? S3: Braking Transistor and Output Voltage Gain

No. (Addr.)	Name	Description	Setting	Page
S3-01 (6A0H)	Braking Transistor Operation Selection	<b>All Modes</b> 0: During run only 1: Always enabled	Default: 0 Min: 0 Max: 1	267
S3-02 (6A1H)	Braking Transistor Operation Voltage Level	<b>All Modes</b> Sets the voltage level that triggers drive built-in the braking transistor.	Default: 394 Vdc <15> Min: 300 Vdc <15> Max: 400 Vdc <15>	267
S3-03 (6A2H)	Output Voltage Gain Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Enables and disables the output voltage gain setting in parameter H3-□□ = 41 (Output Voltage Gain) or in MEMOBUS register 03H. 0: Disabled 1: Enabled	Default: 0 Min: 0 Max: 1	267
S3-04 (6A3H)	Output Voltage Gain Change Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the drive uses to change the output voltage gain set in parameter H3-□□ = 41 (Output Voltage Gain) or in MEMOBUS register 03H.	Default: 0.5 s Min: 0.0 s Max: 10.0 s	267

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.






### ? S4: KEB Mode Selection

No. (Addr.)	Name	Description	Setting	Page
S4-01 (6B0H)	KEB Mode Selection	<b>All Modes</b> 0: KEB disabled 1: DC bus voltage control (KEB 1) 2: Synchronous accel/decel (KEB 2) 3: Power KEB (KEB 3)	Default: 0 Min: 0 Max: 3	270
S4-02 (6B1H)	KEB Start/End Voltage	<b>All Modes</b> Determines how the KEB start and end voltage in parameters S4-03 and S4-06 are set. 0: Set as a Percentage of E1-01 × 1.414 1: Set as a percentage of the DC bus voltage before KEB was triggered.	Default: 0 Min: 0 Max: 1	271
S4-03 (6B2H)	KEB Start Voltage	<b>All Modes</b> Determines the voltage level in the DC bus that will trigger KEB. The setting value depends on the selection in parameter S4-02. A setting of 200.0% essentially disables S4-03.	Default: 200.0% Min: 0.0% Max: 200.0%	271
S4-04 (6B3H)	KEB Start dV/dt Level	<b>All Modes</b> Sets the level of voltage fluctuation in the DC bus that triggers KEB.	Default: 0 Vdc/s Min: 0 Vdc/s Max: 10000 Vdc/s	271
S4-05 (6B4H)	KEB Start dV/dt filter	<b>All Modes</b> Sets the time required for the voltage fluctuation level defined in S4-04 to trigger KEB.	Default: 20 ms Min: 0 ms Max: 50 ms	271
S4-06 (6B5H)	KEB End Voltage	<b>All Modes</b> Sets the DC bus voltage level at that the drive assumes the power supply has returned. If this level is exceeded for longer than S4-07 the drive starts reaccelerating to the set frequency reference. The setting value depends on the selection in parameter S4-02.	Default: 200.0% Min: 0.0% Max: 200.0%	271
S4-07 (6B6H)	KEB End Detection Time	<b>All Modes</b> Sets the time for that the DC bus voltage must exceed the level set in S4-06 in order to end the KEB function and reaccelerate to the set frequency reference.	Default: 0 ms Min: 0 ms Max: 2000 ms	272






No. (Addr.)	Name	Description	Setting	Page
S4-08 (6B7H) 	KEB 1 Phase Loss Detection Level	<b>All Modes</b> Defines the DC bus voltage ripple that indicates a one phase loss, thus triggering the KEB function.	Default: 0 V Min: 0 V Max: 800 V <small>&lt;15&gt;</small>	272
S4-09 (6B8H) 	KEB 1 Phase Loss Sampling Time	<b>All Modes</b> Sets the sampling time used to detect one input phase loss.	Default: 0 ms Min: 0 ms Max: 3000 ms	272
S4-10 (6B9H) 	KEB 1 Phase Loss Detection Time	<b>All Modes</b> Sets the time that the ripple in the DC bus voltage must exceed the level set in S4-08 to trigger one phase loss detection.	Default: 10 ms Min: 0 ms Max: 10 ms	272
S4-11 (6BAH)	KEB Target Voltage	<b>All Modes</b> When KEB 1 or KEB 3 is selected, the drive attempts to keep the DC bus voltage at the target voltage defined in S4-11 multiplied by E1-01.	Default: 1.35 Min: 0.80 Max: 1.50	272
S4-12 (6BBH) 	KEB Hold Time	<b>All Modes</b> Once the power is restored during KEB, S4-12 sets the time to hold the frequency reference before reacceleration.	Default: 0.0 s Min: 0.0 s Max: 10.0 s	272
S4-13 (6BCH) 	KEB Minimum Operation Time	<b>All Modes</b> Sets the minimum operation time for KEB once it is triggered.	Default: 50 ms Min: 0 ms Max: 2000 ms	272
S4-14 (6BDH) 	KEB Reacceleration Prohibit Frequency	<b>All Modes</b> Sets the frequency level to prohibit re-acceleration after the power returned. If the drive output frequency fell below S4-14 during KEB operation the drive will decelerate the motor to stop, even if the power returns. When KEB is triggered by One Phase Loss detection, the drive will never reaccelerate.	Default: 0.0% Min: 0.0% Max: 100.0%	273
S4-15 (6BEH) 	KEB Supply Loss Detection Selection	<b>All Modes</b> This parameter can be used to trigger KEB operation when the hardware detection circuit detects that the AC supply voltage has been lost. 0: Disabled 1: Enabled	Default: 1 Min: 0 Max: 1	273

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

## ? S5: KEB Accel/Decel Settings

No. (Addr.)	Name	Description	Setting	Page
S5-01 (6C0H) 	KEB Decel Time 1	<b>All Modes</b> Sets decel time 1 for the start of KEB. S5-01 is enabled when the output frequency is greater than S5-03.	Default: 0.0 s Min: 0.0 s Max: 200.0 s	273
S5-02 (6C1H) 	KEB Decel Time 2	<b>All Modes</b> Sets decel time 2 for the start of KEB. S5-02 is enabled when the output frequency is less than or equal to S5-03.	Default: 0.0 s Min: 0.0 s Max: 200.0 s	273
S5-03 (6C2H) 	KEB Decel Time Switching Frequency	<b>All Modes</b> Sets the frequency for KEB to switch between KEB decel time 1 and KEB decel time 2.	Default: 0.0% Min: 0.0% Max: 100.0%	273
S5-04 (6C3H) 	KEB Decel Time Switching Time	<b>All Modes</b> Sets the time constant used to switch over from deceleration time 1 to deceleration time 2 during KEB.	Default: 0.0 s Min: 0.0 s Max: 10.0 s	273
S5-05 (6C4H) 	KEB Synchronous Acceleration Time	<b>All Modes</b> Sets time to accelerate from the frequency after KEB to the set frequency reference. This setting can be used to let multiple drives accelerate synchronously back to the set speed after power loss.	Default: 0.0 s Min: 0.0 s Max: 200.0 s	274

## B.3 Parameter Table

No. (Addr.)	Name	Description	Setting	Page
S5-06 (6C5H) 	S-Curve at KEB Deceleration Start	<b>All Modes</b> Sets the S-curve time when KEB begins decelerating the drive.	Default: 0.20 s Min: 0.00 s Max: 2.50 s	274
S5-07 (6C6H) 	Frequency Gain at KEB Start during Constant Speed	<b>All Modes</b> Sets the output frequency reduction step applied when power loss is detected during constant speed operation. Percent of frequency reduction = (slip frequency just before KEB) × S5-07 × 2	Default: 100% Min: 0% Max: 300%	274
S5-08 (6C7H) 	Frequency Gain at KEB Start during Acceleration	<b>All Modes</b> Sets the output frequency reduction step applied when power loss is detected during acceleration. Percent of frequency reduction = (slip frequency just before KEB) × S5-08 × 2	Default: 100% Min: 0% Max: 300%	274
S5-09 (6C8H) 	Frequency Gain at KEB Start during Deceleration	<b>All Modes</b> Sets the output frequency reduction step applied when power loss is detected during deceleration. Percent of frequency reduction = (slip frequency just before KEB) × S5-09 × 2	Default: 100% Min: 0% Max: 300%	274
S5-10 (6C9H)	Synchronous Deceleration ov Prevention	<b>All Modes</b> Enables or disables overvoltage prevention during synchronous KEB operation (S4-01 = 2). 0: Disabled (requires a braking option) 1: Enabled	Default: 0 Min: 0 Max: 1	274
S5-11 (6CAH) 	KEB Frequency Reduction Step Lower Limit	<b>All Modes</b> Sets the percentage to reduce the output frequency in steps at the start of KEB operation. The reduction width is calculated as Reduction width = Motor rated slip (E2-02) × S5-11 The drive compares the reduction width calculated from S5-11 with the reduction widths of S5-07, S5-08, and S5-09, then uses the largest value to reduce the output frequency. <b>Note:</b> When using one of the control modes for a PM motor, S5-11 will be disabled, regardless of what value it has been set to.	Default: 20% Min: 0% Max: 500%	275

## ? S6: Power KEB Function

No. (Addr.)	Name	Description	Setting	Page
S6-01 (6D0H)	DC Bus Capacity	<b>All Modes</b> Sets the size of any external capacitors that were added.	Default: <9> Min: 0 μF Max: 65000 μF	275
S6-02 (6D1H)	Motor Acceleration Time	<b>All Modes</b> The time required for the motor to accelerate from zero up to the maximum frequency at the rated torque. If E2-11 is changed by the user or by performing Auto-Tuning, then S6-02 will automatically be set to the value of a Yaskawa 4-pole motor.	Default: <7> <21> <24> Min: 0.001 s Max: 10.000 s	275
S6-03 (6D2H)	Load / Inertia Ratio	<b>All Modes</b> Enter the ratio between the inertia of the load and the inertia of the motor the drive is running.	Default: 1.0 Min: 0.0 Max: 1000.0	276
S6-04 (6D3H)	DC Bus Adjustment Gain	<b>All Modes</b> Sets the gain to keep the voltage in the DC bus at the target level. If overvoltage or undervoltage is a problem at the start of Power KEB, gradually increasing S6-04 in increments of 0.1 may help.	Default: <34> Min: 0.00 Max: 5.00	276
S6-05 (6D4H)	Accel/Decel Calculation Gain	<b>All Modes</b> Sets the gain used to calculate the acceleration and deceleration rates used for Power KEB, overvoltage suppression, and “intelligent” method of Stall Prevention during deceleration (L3-04 = 2).	Default: 1.00 Min: 0.00 Max: 200.00	276

No. (Addr.)	Name	Description	Setting	Page
S6-06 (6D5H)	ASR Primary Delay Time Constant 2	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the filter time constant in seconds for the time from the speed loop to the torque reference output when the Power KEB Ride-Thru is enabled (S4-01 = 3).</p>	Default: 0.000 s Min: 0.000 s Max: 0.500 s	277
S6-07 (6D6H)	Torque Limit Delay Time	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the filter time constant in seconds for the torque limit value to return to set value when the Power KEB Ride-Thru is enabled (S4-01 = 3).</p>	Default: <34> Min: 0.000 s Max: 1.000 s	277

<7> Default setting value is dependent on the motor code set to E5-01.

<9> Default setting value varies by the drive model (o2-04).

<21> Parameter value is changed if E2-11 is manually changed or changed by Auto-Tuning.

<24> Default setting is determined by the drive model (o2-04) and duty selection (C6-01).

<34> Default setting is determined by the control mode (A1-02).

## ? S9: Synchronous Operation

No. (Addr.)	Name	Description	Setting	Page
S9-03 (6FAH)	Speed Detection Change Rate Limit	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Assigns a limit to how much the motor speed detection may fluctuate each millisecond.</p>	Default: 0.01 Hz Min: 0.00 Hz Max: 5.00 Hz	277
S9-06 (6FDH)	Speed Detection Width After Coasting	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor speed detection width as soon as the motor is done coasting. Once the motor is done coasting, the drive will apply the motor speed detection value if the value detected is less than S9-06 plus the previous value.</p>	Default: 0.20 Hz Min: 0.00 Hz Max: 1.00 Hz	277

## ? T: Motor Tuning

Enter data into the following parameters to tune the motor and drive for optimal performance

### ? T1: Induction Motor Auto-Tuning

No. (Addr.)	Name	Description	Setting	Page
T1-00 (700H)	Motor 1 / Motor 2 Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 1: Motor 1 (sets E1-□□, E2-□□) 2: Motor 2 (sets E3-□□, E4-□□)	Default: 1 Min: 1 Max: 2	101
T1-01 (701H) <28>	Auto-Tuning Mode Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> 0: Rotational Auto-Tuning 1: Stationary Auto-Tuning 1 2: Stationary Auto-Tuning for Line-to-Line Resistance 3: Rotational Auto-Tuning for V/f Control (necessary for Energy Savings and Speed Estimation Speed Search) 4: Stationary Auto-Tuning 2 8: Inertia Tuning (perform Rotational Auto-Tuning prior to Inertia Tuning) 9: ASR Gain Tuning (perform Rotational Auto-Tuning prior to ASR Gain Auto-Tuning) <b>Note 1.</b> When using an induction synchronous motor, the only available selection is Stationary Auto-Tuning for line-to-line resistance. <b>2.</b> Rotational Auto-Tuning should be performed prior to Inertia Tuning in order to ensure torque accuracy. <b>3.</b> Inertia Tuning and ASR Gain Auto-Tuning might not be available if gears are between the machine and the motor shaft.	Default: 0 <34> Min: 0 <34> Max: 9 <34>	101
T1-02 (702H)	Motor Rated Power	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the motor rated power as specified on the motor nameplate. <b>Note:</b> Use the following formula to convert horsepower into kilowatts: 1HP = 0.746 kW.	Default: <24> Min: 0.03 kW Max: 650.00 kW	101
T1-03 (703H)	Motor Rated Voltage	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the motor rated voltage as specified on the motor nameplate.	Default: 200.0 V <15> Min: 0.0 V Max: 255.0 V <15>	101
T1-04 (704H)	Motor Rated Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the motor rated current as specified on the motor nameplate.	Default: <9> Min: 10% of drive rated current Max: 200% of drive rated current	102
T1-05 (705H)	Rated Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the rated frequency of the motor as specified on the motor nameplate.	Default: 50.0 Hz Min: 0.0 Hz Max: 400.0 Hz	102
T1-06 (706H)	Number of Motor Poles	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the number of motor poles as specified on the motor nameplate.	Default: 4 Min: 2 Max: 48	102
T1-07 (707H)	Rated Speed	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Sets the rated speed of the motor as specified on the motor nameplate.	Default: 1450 r/min Min: 0 r/min Max: 24000 r/min	102
T1-08 (708H)	PG Number of Pulses Per Revolution	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> </div> <div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> Set the number of pulses per revolution for the PG being used (pulse generator or encoder).	Default: 1024 ppr Min: 0 ppr Max: 60000 ppr	102

No. (Addr.)	Name	Description	Setting	Page
T1-09 (709H)	Motor No-Load Current (Stationary Auto-Tuning)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the no-load current for the motor. After setting the motor capacity to T1-02 and the motor rated current to T1-04, this parameter will automatically display the no-load current for a standard 4 pole Yaskawa motor. Enter the no-load current as indicated on the motor test report.</p>	Default: – Min: 0 A Max: T1-04	102
T1-10 (70AH)	Motor Rated Slip (Stationary Auto-Tuning)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor rated slip. After setting the motor capacity to T1-02, this parameter will automatically display the motor slip for a standard 4 pole Yaskawa motor. Enter the motor slip as indicated on the motor test report.</p>	Default: – Min: 0.00 Hz Max: 20.00 Hz	103
T1-11 (70BH)	Motor Iron Loss	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the iron loss for determining the Energy Saving coefficient. The value is set to E2-10 (motor iron loss) set when the power is cycled. If T1-02 is changed, a default value appropriate for the motor capacity that was entered will appear.</p>	Default: 14 W <31> Min: 0 W Max: 65535 W	103

<9> Default setting value varies by the drive model (o2-04).

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<24> Default setting value is dependent on the drive model set to o2-04 and the Drive Duty set to C6-01.

<28> The availability of certain Auto-Tuning methods depends on the control mode selected for the drive.

<31> Default setting value differs depending on the motor code value and motor parameter settings.

<34> Default setting is determined by the control mode (A1-02).

## ? T2: PM Motor Auto-Tuning

No. (Addr.)	Name	Description	Setting	Page
T2-01 (750H)	PM Motor Auto-Tuning Mode Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: PM Motor Parameter Settings 1: PM Stationary Auto-Tuning 2: PM Stationary Auto-Tuning for Stator Resistance 3: Z Pulse Offset Tuning 8: Inertia Tuning 9: ASR Gain Auto-Tuning 11: Back EMF Constant Tuning Prior to executing Inertia Tuning or ASR Gain Auto-Tuning, be sure to take the following steps:</p> <ul style="list-style-type: none"> <li>perform Auto-Tuning for motor data (T2-01 = 0, 1, or 2) or set the motor code to E5-01.</li> <li>verify all motor data entered to the drive with the motor nameplate or the motor test report.</li> </ul> <p><b>Note:</b> Inertia Tuning and ASR Gain Auto-Tuning might not be available if gears are between the machine and the motor shaft.</p>	Default: 0 Min: 0 Max: 11 <34>	103
T2-02 (751H)	PM Motor Code Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the motor code when using a Yaskawa PM motor. Once the motor code is entered, the drive automatically sets parameters T2-03 through T2-14. When using a motor that is not supported motor code or a non-Yaskawa motor, set FFFF here and then adjust the other T2 parameters according the motor nameplate or the motor test report.</p>	Default: <27> Min: 0000 Max: FFFF	103
T2-03 (752H)	PM Motor Type	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: IPM motor 1: SPM motor. Parameter T2-17 will not be displayed with this setting.</p>	Default: 1 Min: 0 Max: 1	104

## B.3 Parameter Table

No. (Addr.)	Name	Description	Setting	Page
T2-04 (730H)	PM Motor Rated Power	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor rated power.  <b>Note:</b> Use the following formula to convert horsepower into kilowatts:  1HP = 0.746 kW.</p>	Default: <24> Min: 0.00 kW Max: 650.00 kW	104
T2-05 (732H)	PM Motor Rated Voltage	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the motor rated voltage as indicated on the motor nameplate.</p>	Default: 200.0 V <15> Min: 0.0 V Max: 255.0 V <15>	104
T2-06 (733H)	PM Motor Rated Current	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the motor rated current as indicated on the motor nameplate.</p>	Default: <9> Min: 10% of drive rated current Max: 200% of drive rated current	104
T2-07 (753H)	PM Motor Rated Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the motor rated frequency as indicated on the motor nameplate.</p>	Default: 87.5 Hz Min: 0.0 Hz Max: 400.0 Hz	104
T2-08 (734H)	Number of PM Motor Poles	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the number of motor poles for the PM motor as indicated on the motor nameplate.</p>	Default: 6 Min: 2 Max: 48	104
T2-09 (731H)	PM Motor Rated Speed	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the rated speed for the PM motor as indicated on the motor nameplate.</p>	Default: 1750 r/min Min: 0 r/min Max: 24000 r/min	104
T2-10 (754H)	PM Motor Stator Resistance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the rotor resistance for the PM motor as indicated on the motor nameplate.</p>	Default: <32> Min: 0.000 Ω Max: 65.000 Ω	104
T2-11 (735H)	PM Motor d-Axis Inductance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the d-axis inductance for the PM motor as indicated on the motor nameplate.</p>	Default: <32> Min: 0.00 mH Max: 600.00 mH	105
T2-12 (736H)	PM Motor q-Axis Inductance	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the q-axis inductance for the PM motor as indicated on the motor nameplate.</p>	Default: <32> Min: 0.00 mH Max: 600.00 mH	105
T2-13 (755H)	Induced Voltage Constant Unit Selection	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>0: mV/(r/min). E5-09 will automatically be set to 0.0, and E5-24 will be used.  1: mV/(rad/sec). E5-24 will automatically be set to 0.0, and E5-09 will be used</p>	Default: 1 Min: 0 Max: 1	105
T2-14 (737H)	PM Motor Induced Voltage Constant (Ke)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Enter the induced voltage coefficient for the PM motor as indicated on the motor nameplate.</p>	Default: <32> Min: 0.1 Max: 2000.0	105
T2-15 (756H)	Pull-In Current Level for PM Motor Tuning	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the amount of pull-in current to use for Auto-Tuning as a percentage of the motor rated current. Increase this setting for high inertia loads.</p>	Default: 30% Min: 0% Max: 120%	105

No. (Addr.)	Name	Description	Setting	Page
T2-16 (738H)	PG Number of Pulses Per Revolution for PM Motor Tuning	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the number of pulses per revolution for the PG being used (pulse generator or encoder).</p>	Default: 1024 ppr Min: 1 ppr Max: 15000 ppr	105
T2-17 (757H)	Encoder Z-Pulse Offset ( $\Delta\theta$ )	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the offset between encoder offset and the rotor magnetic axis.</p>	Default: 0.0 deg Min: -180.0 deg Max: 180.0 deg	105

<9> Default setting value varies by the drive model (o2-04).

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<24> Default setting value is dependent on the drive model set to o2-04 and the Drive Duty set to C6-01.

<27> Default setting is determined by the control mode (A1-02) and the drive model (o2-04).

<32> Default setting is determined by the drive capacity and the motor code selected in T2-02.

<34> Default setting is determined by the control mode (A1-02).

### ? T3: ASR and Inertia Tuning

No. (Addr.)	Name	Description	Setting	Page
T3-01 (760H) <33>	Test Signal Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the frequency of the test signal used during Inertia Tuning and ASR Gain Auto-Tuning. Reduce this value if the inertia is large or if a fault occurs.</p>	Default: 3.0 Hz Min: 0.1 Hz Max: 20.0 Hz	106
T3-02 (761H) <33>	Test Signal Amplitude	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the amplitude of the test signal used during Inertia and ASR Gain Auto-Tuning. Reduce this value if the inertia is too large or if a fault occurs.</p>	Default: 0.5 rad Min: 0.1 rad Max: 10.0 rad	106
T3-03 (762H) <33>	Motor Inertia	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the motor inertia. Default setting is the inertia of a Yaskawa motor.</p>	Default: <7> <24> Min: 0.0001 kgm <sup>2</sup> Max: 600.00 kgm <sup>2</sup>	106
T3-04 (763H) <33>	System Response Frequency	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Sets the response frequency of the mechanical system connected to the motor. Oscillation may result if set too high.</p>	Default: 10.0 Hz Min: 0.1 Hz Max: 50.0 Hz	106

<7> Default setting value is dependent on the motor code set to E5-01.

<24> Default setting value is dependent on the drive model set to o2-04 and the Drive Duty set to C6-01.


<33> Displayed only when performing Inertia Tuning or ASR Gain Auto-Tuning (T1-01 = 9 or T2-01 = 9).

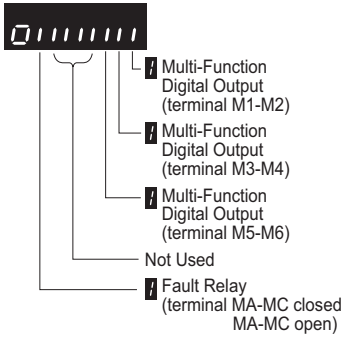
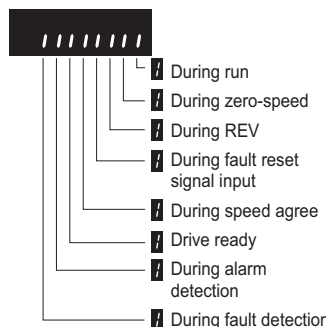
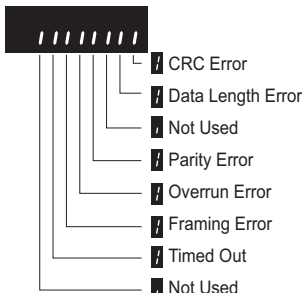
## B.3 Parameter Table

### ? U: Monitors

Monitor parameters allow the user to view drive status, fault information, and other data concerning drive operation.

### ? U1: Operation Status Monitors

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U1-01 (40H)	Frequency Reference	<b>All Modes</b> Monitors the frequency reference. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz	–
U1-02 (41H)	Output Frequency	<b>All Modes</b> Displays the output frequency. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz	–
U1-03 (42H)	Output Current	<b>All Modes</b> Displays the output current.	10 V: Drive rated current	<18> <49>	–
U1-04 (43H)	Control Method	<b>All Modes</b> 0: V/f Control 1: V/f Control with PG 2: Open Loop Vector Control 3: Closed Loop Vector Control 5: Open Loop Vector Control for PM 6: Advanced Open Loop Vector Control for PM 7: Closed Loop Vector Control for PM	No signal output available	–	–
U1-05 (44H)	Motor Speed	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the motor speed feedback. Display units are determined by o1-03.	10 V: Max Frequency	0.01 Hz	–
U1-06 (45H)	Output Voltage Reference	<b>All Modes</b> Displays the output voltage.	10 V: 200 Vrms <15>	0.1 Vac	–
U1-07 (46H)	DC Bus Voltage	<b>All Modes</b> Displays the DC bus voltage.	10 V: 400 V <15>	1 Vdc	–
U1-08 (47H)	Output Power	<b>All Modes</b> Displays the output power (this value is calculated internally).	10 V: Drive capacity (Motor rated capacity) kW <41>	<36>	–
U1-09 (48H)	Torque Reference	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Monitors the internal torque reference.	10 V: Motor rated torque	0.1%	–
U1-10 (49H)	Input Terminal Status	<b>All Modes</b> Displays the input terminal status.  1 Digital input 1 (terminal S1 enabled) 2 Digital input 2 (terminal S2 enabled) 3 Digital input 3 (terminal S3 enabled) 4 Digital input 4 (terminal S4 enabled) 5 Digital input 5 (terminal S5 enabled) 6 Digital input 6 (terminal S6 enabled) 7 Digital input 7 (terminal S7 enabled) 8 Digital input 8 (terminal S8 enabled)	No signal output available	–	–

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U1-11 (4AH)	Output Terminal Status	<p><b>All Modes</b></p> <p>Displays the output terminal status.</p> 	No signal output available	—	—
U1-12 (4BH)	Drive Status	<p><b>All Modes</b></p> <p>Verifies the drive operation status.</p> 	No signal output available	—	—
U1-13 (4EH)	Terminal A1 Input Level	<p><b>All Modes</b></p> <p>Displays the signal level to analog input terminal A1.</p>	10 V: 100%	0.1%	—
U1-14 (4FH)	Terminal A2 Input Level	<p><b>All Modes</b></p> <p>Displays the signal level to analog input terminal A2.</p>	10 V: 100%	0.1%	—
U1-15 (50H)	Terminal A3 Input Level	<p><b>All Modes</b></p> <p>Displays the signal level to analog input terminal A3.</p>	10 V: 100%	0.1%	—
U1-16 (53H)	Output Frequency after Soft Starter	<p><b>All Modes</b></p> <p>Displays output frequency with ramp time and S-curves. Units determined by o1-03.</p>	10 V: Max frequency	0.01 Hz	—
U1-17 (58H)	DI-A3 Input Status	<p><b>All Modes</b></p> <p>Displays the reference value input from the DI-A3 option card. Display will appear in hexadecimal as determined by the digital card input selection in F3-01. 3FFFF: Set (1 bit) + sign (1 bit) + 16 bit</p>	No signal output available	—	—
U1-18 (61H)	oPE Fault Parameter	<p><b>All Modes</b></p> <p>Displays the parameter number that caused the oPE02 or oPE08 error.</p>	No signal output available	—	—
U1-19 (66H)	MEMOBUS/Modbus Error Code	<p><b>All Modes</b></p> <p>Displays the contents of a MEMOBUS/Modbus error.</p> 	No signal output available	—	—

## B.3 Parameter Table

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U1-21 (77H)	AI-A3 Terminal V1 Input Voltage Monitor	<b>All Modes</b> Displays the input voltage to terminal V1 on analog input card AI-A3.	10 V: 100%	0.1%	–
U1-22 (72AH)	AI-A3 Terminal V2 Input Voltage Monitor	<b>All Modes</b> Displays the input voltage to terminal V2 on analog input card AI-A3.	10 V: 100%	0.1%	–
U1-23 (72BH)	AI-A3 Terminal V3 Input Voltage Monitor	<b>All Modes</b> Displays the input voltage to terminal V3 on analog input card AI-A3.	10 V: 100%	0.1%	–
U1-24 (7DH)	Input Pulse Monitor	<b>All Modes</b> Displays the frequency to pulse train input terminal RP.	Determined by H6-02	1 Hz	–
U1-25 (4DH)	Software Number (Flash)	<b>All Modes</b> FLASH ID	No signal output available	–	–
U1-26 (5BH)	Software No. (ROM)	<b>All Modes</b> ROM ID	No signal output available	–	–

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<18> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<36> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 kW) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 kW) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<41> When using V/f Control, 10 V is the drive capacity in kW. When using one of the vector control modes, 10 V is the motor capacity (E2-11).

<49> When reading the value of this monitor via MEMOBUS/Modbus a value of 8192 is equal to 100% of the drive rated output current.

### ? U2: Fault Trace

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U2-01 (80H)	Current Fault	<b>All Modes</b> Displays the current fault.	No signal output available	–	–
U2-02 (81H)	Previous Fault	<b>All Modes</b> Displays the previous fault.	No signal output available	–	–
U2-03 (82H)	Frequency Reference at Previous Fault	<b>All Modes</b> Displays the frequency reference at the previous fault.	No signal output available	0.01 Hz	–
U2-04 (83H)	Output Frequency at Previous Fault	<b>All Modes</b> Displays the output frequency at the previous fault.	No signal output available	0.01 Hz	–
U2-05 (84H)	Output Current at Previous Fault	<b>All Modes</b> Displays the output current at the previous fault.	No signal output available	<18> <49>	–
U2-06 (85H)	Motor Speed at Previous Fault	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the motor speed at the previous fault.	No signal output available	0.01 Hz	–
U2-07 (86H)	Output Voltage at Previous Fault	<b>All Modes</b> Displays the output voltage at the previous fault.	No signal output available	0.1 Vac	–
U2-08 (87H)	DC Bus Voltage at Previous Fault	<b>All Modes</b> Displays the DC bus voltage at the previous fault.	No signal output available	1 Vdc	–
U2-09 (88H)	Output Power at Previous Fault	<b>All Modes</b> Displays the output power at the previous fault.	No signal output available	0.1 kW	–
U2-10 (89H)	Torque Reference at Previous Fault	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the torque reference at the previous fault.	No signal output available	0.1%	–
U2-11 (8AH)	Input Terminal Status at Previous Fault	<b>All Modes</b> Displays the input terminal status at the previous fault. Displayed as in U1-10.	No signal output available	–	–

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U2-12 (8BH)	Output Terminal Status at Previous Fault	<b>All Modes</b> Displays the output status at the previous fault. Displays the same status displayed in U1-11.	No signal output available	—	—
U2-13 (8CH)	Drive Operation Status at Previous Fault	<b>All Modes</b> Displays the operation status of the drive at the previous fault. Displays the same status displayed in U1-12.	No signal output available	—	—
U2-14 (8DH)	Cumulative Operation Time at Previous Fault	<b>All Modes</b> Displays the cumulative operation time at the previous fault.	No signal output available	1 h	—
U2-15 (7E0H)	Soft Starter Speed Reference at Previous Fault	<b>All Modes</b> Displays the speed reference for the soft starter at the previous fault.	No signal output available	0.01 Hz	—
U2-16 (7E1H)	Motor q-Axis Current at Previous Fault	<b>All Modes</b> Displays the q-axis current for the motor at the previous fault.	No signal output available	0.1%	—
U2-17 (7E2H)	Motor d-Axis Current at Previous Fault	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the d-axis current for the motor at the previous fault.	No signal output available	0.1%	—
U2-19 (7ECH)	Rotor Deviation at Previous Fault	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the degree of rotor deviation when the most recent fault occurred (same status will appear as shown in U6-10).	No signal output available	0.1 deg	—
U2-20 (8EH)	Heatsink Temperature at Previous Fault	<b>All Modes</b> Displays the temperature of the heatsink when the most recent fault occurred.	No signal output available	1°C	—

<18> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01 A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1 A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<49> When reading the value of this monitor via MEMOBUS/Modbus a value of 8192 is equal to 100% of the drive rated output current.

**Note:** Fault trace (i.e., the fault history) is not kept when CPF00, CPF01, CPF06, CPF24, Uv1, Uv2, Uv3, oFA00, oFB00, oFC00 occur.

### ? U3: Fault History

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U3-01 to U3-04 (90H to 93H (800H to 803H))	First to 4th Most Recent Fault	<b>All Modes</b> Displays the first to the fourth most recent faults.	No signal output available	—	—
U3-05 to U3-10 (804H to 809H)	5th to 10th Most Recent Fault	<b>All Modes</b> Displays the fifth to the tenth most recent faults. After ten faults have occurred in the drive, data for the oldest fault is deleted. The most recent fault appears in U3-01, with the next most recent fault appearing in U3-02. The data is moved to the next monitor parameter every time a fault occurs.	No signal output available	—	—
U3-11 to U3-14 (94H to 97H (80AH to 80DH))	Cumulative Operation Time at 1st to 4th Most Recent Fault	<b>All Modes</b> Displays the cumulative operation time when the first to the fourth most recent faults occurred.	No signal output available	1 h	—
U3-15 to U3-20 (80EH to 813H)	Cumulative Operation Time at 5th to 10th Most Recent Fault	<b>All Modes</b> Displays the cumulative operation time when the fifth to the tenth most recent faults occurred.	No signal output available	1 h	—

**Note:** Fault trace (i.e., the fault history) is not kept when CPF00, CPF01, CPF06, CPF24, Uv1, Uv2, Uv3, oFA00, oFB00, oFC00 occur.

## ? U4: Maintenance Monitors

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U4-01 (4CH) <50>	Cumulative Operation Time	<b>All Modes</b> Displays the cumulative operation time of the drive. The value for the cumulative operation time counter can be reset in parameter o4-01. Use parameter o4-02 to determine if the operation time should start as soon as the power is switched on or only while the Run command is present. The maximum number displayed is 99999, after which the value is reset to 0.	No signal output available	1 h	–
U4-02 (75H)	Number of Run Commands	<b>All Modes</b> Displays the number of times the Run command is entered. Reset the number of Run commands using parameter o4-13. This value will reset to 0 and start counting again after reaching 65535.	No signal output available	1 Time	–
U4-03 (67H) <51>	Cooling Fan Operation Time	<b>All Modes</b> Displays the cumulative operation time of the cooling fan. The default value for the fan operation time is reset in parameter o4-03. This value will reset to 0 and start counting again after reaching 99999.	No signal output available	1 h	–
U4-04 (7EH)	Cooling Fan Maintenance	<b>All Modes</b> Displays main cooling fan usage time in as a percentage of its expected performance life. The fan should be replaced when this monitor reaches 90%. Parameter o4-03 can be used to reset this monitor.	No signal output available	1%	–
U4-05 (7CH)	Capacitor Maintenance	<b>All Modes</b> Displays main circuit capacitor usage time in as a percentage of their expected performance life. The fan should be replaced when this monitor reaches 90%. Parameter o4-05 can be used to reset this monitor.	No signal output available	1%	–
U4-06 (7D6H)	Soft Charge Bypass Relay Maintenance	<b>All Modes</b> Displays the soft charge bypass relay maintenance time as a percentage of its estimated performance life. The fan should be replaced when this monitor reaches 90%. Parameter o4-07 can be used to reset this monitor.	No signal output available	1%	–
U4-07 (7D7H)	IGBT Maintenance	<b>All Modes</b> Displays IGBT usage time as a percentage of the expected performance life. The fan should be replaced when this monitor reaches 90%. Parameter o4-09 can be used to reset this monitor.	No signal output available	1%	–
U4-08 (68H)	Heatsink Temperature	<b>All Modes</b> Displays the heatsink temperature.	10 V: 100°C	1°C	–
U4-09 (5EH)	LED Check	<b>All Modes</b> Lights all segments of the LED to verify that the display is working properly.	No signal output available	–	–
U4-10 (5CH)	kWh, Lower 4 Digits	<b>All Modes</b> Monitors the drive output power. The value is shown as a 9 digit number displayed across two monitor parameters, U4-10 and U4-11. Example: 12345678.9 kWh is displayed as: U4-10: 678.9 kWh U4-11: 12345 MWh	No signal output available	1 kWh	–
U4-11 (5DH)	kWh, Upper 5 Digits		No signal output available	1 MWh	–
U4-13 (7CFH)	Peak Hold Current	<b>All Modes</b> Displays the highest current value that occurred during run.	No signal output available	0.01 A <49>	–
U4-14 (7D0H)	Peak Hold Output Frequency	<b>All Modes</b> Displays the output frequency when the current value shown in U4-13 occurred.	No signal output available	0.01 Hz	–
U4-16 (7D8H)	Motor Overload Estimate (oL1)	<b>All Modes</b> Shows the value of the motor overload detection accumulator. 100% is equal to the oL1 detection level.	10 V: 100%	0.1%	–

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U4-18 (7DAH)	Frequency Reference Source Selection	<b>All Modes</b> Displays the source for the frequency reference as XY-nn. X: indicates which reference is used: 1 = Reference 1 (b1-01) 2 = Reference 2 (b1-15) Y-nn: indicates the reference source 0-01 = Digital operator 1-00 = Analog (not assigned) 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 1-03 = Analog (terminal A3) 2-01 to 2-08, 17 = Multi-step speed (d1-01 to 08, 17) 3-01 = MEMOBUS/Modbus communications 4-01 = Communication option card 5-01 = Pulse input	No signal output available	—	—
U4-19 (7DBH)	Frequency Reference from MEMOBUS/ Modbus Comm.	<b>All Modes</b> Displays the frequency reference provided by MEMOBUS/Modbus (decimal).	No signal output available	0.01%	—
U4-20 (7DCH)	Option Frequency Reference	<b>All Modes</b> Displays the frequency reference input by an option card (decimal).	No signal output available	—	—
U4-21 (7DDH)	Run Command Source Selection	<b>All Modes</b> Displays the source for the Run command as XY-nn. X: Indicates which Run source is used: 1 = Reference 1 (b1-02) 2 = Reference 2 (b1-16) Y: Input power supply data 0 = Digital operator 1 = External terminals 3 = MEMOBUS/Modbus communications 4 = Communication option card nn: Run command limit status data 00: No limit status. 01: Run command was left on when stopped in the PRG mode 02: Run command was left on when switching from LOCAL to REMOTE operation 03: Waiting for soft charge bypass contactor after power up (Uv or Uv1 flashes after 10 s) 04: Waiting for “Run command prohibited” time period to end 05: Fast Stop (digital input, digital operator) 06: b1-17 (Run command given at power-up) 07: During baseblock while coast to stop with timer 08: Frequency reference is below minimal reference during baseblock 09: Waiting for Enter command	No signal output available	—	—
U4-22 (7DEH)	MEMOBUS/Modbus Communications Reference	<b>All Modes</b> Displays the drive control data set by MEMOBUS/Modbus communications register no. 0001H as a four-digit hexadecimal number.	No signal output available	—	—
U4-23 (7DFH)	Communication Option Card Reference	<b>All Modes</b> Displays drive control data set by an option card as a four-digit hexadecimal number.	No signal output available	—	—

<49> When reading the value of this monitor via MEMOBUS/Modbus a value of 8192 is equal to 100% of the drive rated output current.  
 <50> The MEMOBUS/Modbus communications data is in 10 h units. If data in 1 h units are also required, refer to register number 0099H.  
 <51> The MEMOBUS/Modbus communications data is in 10 h units. If data in 1 h units are also required, refer to register number 009BH.

## B.3 Parameter Table

### ? U5: PID Monitors

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U5-01 (57H)	PID Feedback	<b>All Modes</b> Displays the PID feedback value.	10 V: 100%	0.01%	–
U5-02 (63H)	PID Input	<b>All Modes</b> Displays the amount of PID input (deviation between PID setpoint and feedback).	10 V: 100%	0.01%	–
U5-03 (64H)	PID Output	<b>All Modes</b> Displays PID control output.	10 V: 100%	0.01%	–
U5-04 (65H)	PID Setpoint	<b>All Modes</b> Displays the PID setpoint.	10 V: 100%	0.01%	–
U5-05 (7D2H)	PID Differential Feedback	<b>All Modes</b> Displays the 2nd PID feedback value if differential feedback is used (H3-□□ = 16).	10 V: 100%	0.01%	–
U5-06 (7D3H)	PID Adjusted Feedback	<b>All Modes</b> Displays the difference of both feedback values if differential feedback is used (U5-01 - U5-05). If differential feedback is not used, then U5-01 and U5-06 will be the same.	10 V: 100%	0.01%	–
U5-21 (872H)	Automatically Calculated Energy Saving Coefficient Ki Value	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the energy saving coefficient Ki value.	No signal output available	0.01	–
U5-22 (873H)	Automatically Calculated Energy Saving Coefficient Kt Value	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the energy saving coefficient Kt value.	No signal output available	0.01	–

### ? U6: Operation Status Monitors

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U6-01 (51H)	Motor Secondary Current (Iq)	<b>All Modes</b> Displays the value of the motor secondary current (Iq). Motor rated secondary current is 100%.	10 V: Motor secondary rated current	0.1%	–
U6-02 (52H)	Motor Excitation Current (Id)	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the value calculated for the motor excitation current (Id). Motor rated secondary current is 100%.	10 V: Motor secondary rated current	0.1%	–
U6-03 (54H)	ASR Input	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the input and output values when using ASR control.	10 V: Max frequency	0.01%	–
U6-04 (55H)	ASR Output		10 V: Motor secondary rated current		
U6-05 (59H)	Output Voltage Reference (Vq)	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Output voltage reference (Vq) for the q-axis.	10 V: 200 Vrms <15>	0.1 Vac	–
U6-06 (5AH)	Output Voltage Reference (Vd)	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Output voltage reference (Vd) for the d-axis.	10 V: 200 Vrms <15>	0.1 Vac	–
U6-07 (5FH)	q-Axis ACR Output	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the output value for current control relative to motor secondary current (q-axis).	10 V: 200 Vrms <15>	0.1%	–

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U6-08 (60H)	d-Axis ACR Output	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Displays the output value for current control relative to motor secondary current (d-axis).</p>	10 V: 200 Vrms <15>	0.1%	–
U6-09 (7C0H)	Advance Phase Compensation ( $\Delta \theta$ )	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Displays the degree of forward phase correction after calculating the deviation of <math>\Delta \theta_{cmp}</math>.</p>	10 V: 180 deg -10 V: -180 deg	0.1 deg	–
U6-10 (7C1H)	Control Axis Deviation ( $\Delta \theta$ )	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Displays the amount of deviation between the actual d-axis / q-axis and the <math>\gamma</math>-axis / <math>\delta</math>-axis used for motor control.</p>	10 V: 180 deg -10 V: -180 deg	0.1 deg	–
U6-13 (7CAH)	Flux Position Detection (sensor)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Monitors the value of the flux position detection (sensor).</p>	10 V: 180 deg -10 V: -180 deg	0.1 deg	–
U6-14 (7CBH)	Flux Position Estimation (observer)	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Monitors the value of the flux position estimation.</p>	10 V: 180 deg -10 V: -180 deg	0.1 deg	–
U6-18 (7CDH)	Speed Detection PG1 Counter	<div>All Modes</div> <p>Monitors the number of pulses for speed detection (PG1).</p>	10 V: 65536	1 ppr	–
U6-19 (7E5H)	Speed Detection PG2 Counter	<div>All Modes</div> <p>Monitors the number of pulses for speed detection (PG2).</p>	10 V: 65536	1 ppr	–
U6-21 (7D5H)	Offset Frequency	<div>All Modes</div> <p>Displays the frequency added to the main frequency reference.</p>	–	0.1%	–
U6-22 (62H)	Zero Servo Pulse Movement	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Displays how far the rotor has moved from its last position in PG pulses (multiplied by 4).</p>	10 V: No. of pulses per revolution	1	–
U6-25 (6BH)	Feedback Control Output	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Output monitor for the ASR speed loop.</p>	10 V: Motor secondary rated current	0.01%	–
U6-26 (6CH)	Feed Forward Control Output	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Output monitor for Feed Forward control.</p>	10 V: Motor secondary rated current	0.01%	–
U6-54 (74EH)	ACR Id Deviation Integral	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Monitors the value of the ACR Id deviation integral.</p>	10 V: 100%	0.10%	–
U6-55 (74FH)	ACR Id Deviation Proportional	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Monitors the value of the ACR Id deviation proportional.</p>	10 V: 100%	0.10%	–
U6-57 (7C4H)	Integrated Current Deviation during Judging Polarity	<div> <div>V/f</div> <div>V/f w/PG</div> <div>OLV</div> <div>CLV</div> <div>OLV/PM</div> <div>AOLV/PM</div> <div>CLV/PM</div> </div> <p>Displays the deviation from the integrated current when judging motor polarity. If this value is lower than 819, then increase the value set to n8-84. The value 8192 is equivalent to the motor rated current.</p>	No signal output available	1	–
U6-80 to U6-99 (7B0 to 7F9H)	Option Monitors 1 to 20	<div>All Modes</div> <p>Displays the data select for option monitors 1 through 20.</p>	–	–	–

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

## B.3 Parameter Table

### ? U9: KEB Voltage Monitors

No. (Addr.)	Name	Description	Analog Output Level	Unit	Page
U9-01 (820H)	KEB Start Voltage	<b>All Modes</b> DC bus voltage value used as KEB trigger level.	No signal output available	1 Vdc	–
U9-02 (821H)	KEB End Voltage	<b>All Modes</b> DC bus voltage used as KEB end level.	No signal output available	1 Vdc	–
U9-03 (822H)	KEB Function Limit Monitor	<b>All Modes</b> Displays a 5 digit number if the KEB start or end levels exceed the allowable range. If the first is “1”, then the KEB start voltage exceeded the 150 - 400 V internal limit. If the second digit is “1”, then the KEB end voltage exceeds the internal limit of 150 - 400 V.	No signal output available	–	–
U9-04 (823H)	Detected Motor Speed (Synchronous Operation)	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the motor speed detected by the Synchronous Operation Function (b3-24 = 3).	10 V: Max frequency	0.01 Hz	–
U9-05 (824H)	Detected Motor Residual Voltage (Synchronous Operation)	<b>V/f</b> <b>V/f w/PG</b> <b>OLV</b> <b>CLV</b> <b>OLV/PM</b> <b>AOLV/PM</b> <b>CLV/PM</b> Displays the residual voltage detected by the Synchronous Operation Function (b3-24 = 3).	10 V: 200 Vms <15>	0.1 Vac	–

<15> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

## B.4 Parameter Defaults Determined by Control Mode (A1-02)

The tables below list parameters that depend on the control mode selection (A1-02 for motor 1, E3-01 for motor 2). These parameters are initialized to the shown values if the control mode is changed.

### ? A1-02 (Motor 1 Control Mode) Dependent Parameters

Table B.2 A1-02 (Motor 1 Control Mode) Dependent Parameters and Default Values

No.	Name	Setting Range	Resolution	Control Modes (A1-02)			
				V/f (0)	V/f w/PG (1)	OLV (2)	CLV (3)
b2-01	DC Injection Braking Start Frequency	0.0 to 10.0	0.1 Hz	0.5	0.5	0.5	0.5
b2-04	DC Injection Braking Time at Stop	0.00 to 10.00	0.01 s	0.50	0.50	0.50	0.50
b2-13	Short Circuit Brake Time at Stop	0.00 to 25.50	0.01 s	—	—	—	—
b3-01	Speed Search Selection at Start	0 to 1	—	0	1	0	—
b3-02	Speed Search Deactivation Current	0 to 200	1%	120	—	100	—
b3-14	Bi-Directional Speed Search Selection	0,1	—	1	0	1	—
b5-15	PID Sleep Function Start Level	0.0 to 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
b6-01	Dwell Reference at Start	0.0 to 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
b6-03	Dwell Reference at Stop	0.0 to 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
b8-01	Energy Saving Control Selection	0 to 1	—	0	0	0	0
b8-02	Energy Saving Gain	0.0 to 10.0	0.1	—	—	0.7	1.0
b8-03	Energy Saving Control Filter Time Constant	0.00 to 10.00	0.01 s	—	—	0.50 2.00 (Motor Capacity: 55 kW and above)	0.01 0.05 (Motor Capacity: 55 kW and above)
C1-11	Accel/Decel Time Switching Frequency	0.0 to 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
C2-01	S-Curve Time at Acceleration Start	0.00 to 10.00	0.01 s	0.20	0.20	0.20	0.20
C3-01	Slip Compensation Gain	0.0 to 2.5	0.1	0.0	—	1.0	1.0
C3-02	Slip Compensation Primary Delay Time	0 to 10000	1 ms	2000	—	200	—
C4-01	Torque Compensation Gain	0.00 to 2.50	0.01	1.00	1.00	1.00	—
C4-02	Torque Compensation Primary Delay Time	0 to 60000	1 ms	200 <4>	200 <4>	20	—
C5-01	ASR Proportional Gain 1	0.00 to 300.00	0.01	—	0.20	—	20.00
C5-02	ASR Integral Time 1	0.000 to 10.000	0.001 s	—	0.200	—	0.500
C5-03	ASR Proportional Gain 2	0.00 to 300.00	0.01	—	0.02	—	20.00
C5-04	ASR Integral Time 2	0.000 to 10.000	0.001 s	—	0.050	—	0.500
C5-06	ASR Primary Delay Time Constant	0.000 to 0.500	0.001 s	—	—	—	0.004
C5-07	ASR Gain Switching Frequency	0.0 to 400.0	0.1	—	—	—	0.0 Hz
C6-02	Carrier Frequency Selection	1 to F	—	1 <4>	1 <4>	1 <4>	1
E1-04	Maximum Output Frequency	40.0 to 400.0	0.1 Hz	50.0	50.0	50.0	50.0
E1-05	Maximum Voltage <4>	0.0 to 255.0	0.1 V	200.0	200.0	200.0	200.0
E1-06	Base Frequency	0.0 to 400.0	0.1 Hz	50.0	50.0	50.0	50.0
E1-07	Middle Output Frequency	0.0 to 400.0	0.1 Hz	2.5	2.5	3.0	—

## B.4 Parameter Defaults Determined by Control Mode (A1-02)

No.	Name	Setting Range	Resolution	Control Modes (A1-02)			
				V/f (0)	V/f w/PG (1)	OLV (2)	CLV (3)
E1-08	Middle Output Frequency Voltage <4>	0.0 to 255.0	0.1 V	<5>	15.0 (Motor Capacity: 0.55 to 4.0 kW) 14.0 (5.5 to 45 kW) 12.0 (55 kW and above)	14.4 (Motor Capacity: 0.55 to 4.0 kW) 13.2 (5.5 kW and above)	—
E1-09	Minimum Output Frequency	0.0 to 400.0	0.1 Hz	1.3	1.3	0.5	0.0
E1-10	Minimum Output Frequency Voltage <4>	0.0 to 255.0	0.1 V	<6>	9.0 (Motor Capacity: 0.55 to 4.0 kW) 7.0 (5.5 to 45 kW) 6.0 (55 kW and above)	3.0 (Motor Capacity: 0.55 to 4.0 kW) 2.4 (5.5 kW and above)	—
F1-05	PG 1 Rotation Selection	0 to 1	—	—	0	—	0
F1-09	Overspeed Detection Delay Time	0.0 to 2.0	0.1 s	—	1.0	—	0.0
L1-01	Motor Overload Protection Selection	0 to 6	—	1	1	1	1
L4-01	Speed Agreement Detection Level	0.0 to 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
L4-02	Speed Agreement Detection Width	0.0 to 20.0	0.1 Hz	2.0	2.0	2.0	2.0
L4-03	Speed Agreement Detection Level (+/-)	-400.0 to 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0	0.1 Hz	2.0	2.0	2.0	2.0
L8-38	Carrier Frequency Reduction Selection	0 to 2	—	<2>	<2>	<2>	<2>
L8-40	Carrier Frequency Reduction Off Delay Time	0.00 to 2.00	0.01 s	0.50	0.50	0.50	0.50
o1-03	Digital Operator Display Selection	0 to 3	—	0	0	0	0
o1-04	V/f Pattern Display Unit	0, 1	—	—	—	—	0
S6-04	DC Bus Adjustment Gain	0.00 to 5.00	0.01	1.00	1.00	0.30	0.30
S6-07	Torque Limit Delay Time	0.000 to 1.000	0.001 s	—	—	—	—

<1> This setting value depends on a Maximum Applicable Motor Capacity: 1000 s in models CIMR-T□2A0138 to 2A0415 and CIMR-T□4A0139 to 4A0362.

<2> Default setting is determined by the drive model (o2-04) and duty selection (C6-01).

<3> This setting value depends on a Maximum Applicable Motor Capacity.

<4> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<5> Default setting value varies by the drive model (o2-04).

- CIMR-T□2A0004 to 2A0021, CIMR-T□4A0002 to 4A0011: 15.0V
- CIMR-T□2A0030 to 2A0211, CIMR-T□4A0018 to 4A0103: 14.0V
- CIMR-T□2A0250 to 2A0415, CIMR-T□4A0139 to 4A0362: 12.0V

<6> Default setting value varies by the drive model (o2-04).

- CIMR-T□2A0004 to 2A0021, CIMR-T□4A0002 to 4A0011: 9.0V
- CIMR-T□2A0030 to 2A0211, CIMR-T□4A0018 to 4A0103: 7.0V
- CIMR-T□2A0250 to 2A0415, CIMR-T□4A0139 to 4A0362: 6.0V

**Table B.3 A1-02 (Motor 1 Control Mode) Dependent Parameters and Default Values**

No.	Name	Setting Range	Resolution	Control Modes (A1-02)		
				OLV/PM (5)	AOLV/PM (6)	CLV/PM (7)
b2-01	DC Injection Braking Start Frequency	0.0 to 10.0	0.1 Hz	0.5	1.0% <1>	0.5% <1>
b2-04	DC Injection Braking Time at Stop	0.00 to 10.00	0.01 s	0.50	—	0.50
b2-13	Short Circuit Brake Time at Stop	0.00 to 25.50	0.01 s	0.50	0.00	—
b3-01	Speed Search Selection at Start	0 to 1	—	0	0	—
b3-02	Speed Search Deactivation Current	0 to 200	1%	—	—	—
b3-14	Bi-Directional Speed Search Selection	0,1	—	—	—	—
b5-15	PID Sleep Function Start Level	0.0 to 400.0 <2>	0.1	0.0 Hz	0.0%	0.0%
b6-01	Dwell Reference at Start	0.0 to 400.0 <2>	0.1	0.0 Hz	0.0%	0.0%
b6-03	Dwell Reference at Stop	0.0 to 400.0 <2>	0.1	0.0 Hz	0.0%	0.0%
b8-01	Energy Saving Control Selection	0 to 1	—	—	1	1
b8-02	Energy Saving Gain	0.0 to 10.0	0.1	—	—	—
b8-03	Energy Saving Control Filter Time Constant	0.00 to 10.00	0.01 s	—	—	—

## B.4 Parameter Defaults Determined by Control Mode (A1-02)

No.	Name	Setting Range	Resolution	Control Modes (A1-02)		
				OLV/PM (5)	AOLV/PM (6)	CLV/PM (7)
C1-11	Accel/Decel Time Switching Frequency	0.0 to 400.0 <2>	0.1	0.0 Hz	0.0%	0.0%
C2-01	S-Curve Time at Acceleration Start	0.00 to 10.00	0.01 s	1.00	1.00	1.00
C3-01	Slip Compensation Gain	0.0 to 2.5	0.1	—	—	—
C3-02	Slip Compensation Primary Delay Time	0 to 10000	1 ms	—	—	—
C4-01	Torque Compensation Gain	0.00 to 2.50	0.01	0.00	—	—
C4-02	Torque Compensation Primary Delay Time	0 to 10000	1 ms	100	—	—
C5-01	ASR Proportional Gain 1	0.00 to 300.00	0.01	—	—	—
C5-02	ASR Integral Time 1	0.000 to 10.000	0.001 s	—	—	—
C5-03	ASR Proportional Gain 2	0.00 to 300.00	0.01	—	—	—
C5-04	ASR Integral Time 2	0.000 to 10.000	0.001 s	—	—	—
C5-06	ASR Primary Delay Time Constant	0.000 to 0.500	0.001 s	—	—	—
C5-07	ASR Gain Switching Frequency	0.0 to 400.0 <2>	0.1	—	0.0%	0.0%
C6-02	Carrier Frequency Selection	1 to F	—	2	2	2
E1-04	Maximum Output Frequency	40.0 to 400.0	0.1 Hz	<3>	<3>	<3>
E1-05	Maximum Voltage <5>	0.0 to 255.0	0.1 V	<3>	<3>	<3>
E1-06	Base Frequency	0.0 to 400.0	0.1 Hz	<3>	<3>	<3>
E1-07	Middle Output Frequency	0.0 to 400.0	0.1 Hz	—	—	—
E1-08	Middle Output Frequency Voltage <5>	0.0 to 255.0	0.1 V	—	—	—
E1-09	Minimum Output Frequency	0.0 to 400.0	0.1 Hz	<3>	<3>	<3>
E1-10	Minimum Output Frequency Voltage <5>	0.0 to 255.0	0.1 V	—	—	—
F1-05	PG 1 Rotation Selection	0 to 1	—	—	—	1
F1-09	Overspeed Detection Delay Time	0.0 to 2.0	0.1 s	—	0.0	0.0
L1-01	Motor Overload Protection Selection	0 to 6	—	4	4	5
L4-01	Speed Agreement Detection Level	0.0 to 400.0 <2>	0.1	0.0 Hz	0.0%	0.0%
L4-02	Speed Agreement Detection Width	0.0 to 20.0	0.1 Hz	2.0	4.0% <4>	4.0% <4>
L4-03	Speed Agreement Detection Level (+/-)	-400.0 to 400.0 <4>	0.1	0.0 Hz	0.0%	0.0%
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0	0.1 Hz	2.0	4.0% <4>	4.0% <4>
L8-38	Carrier Frequency Reduction Selection	0 to 2	—	0	—	0
L8-40	Carrier Frequency Reduction Off Delay Time	0.00 to 2.00	0.01 s	0.00	—	0.00
o1-03	Digital Operator Display Selection	0 to 3	—	0	1	1
o1-04	V/f Pattern Display Unit	0, 1	—	—	1	1
S6-04	DC Bus Adjustment Gain	0.00 to 5.00	0.01	0.65	0.65	0.65
S6-07	Torque Limit Delay Time	0.000 to 1.000	0.001 s	—	0.200	0.020

<1> This default setting is calculated as a percentage of the maximum output frequency.

<2> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (0.0 to 100.0%) instead of in Hz.

<3> Default setting value is dependent on the motor code set to parameter E5-01.

<4> In AOLV/PM and CLV/PM control modes, the setting units and range are expressed as a percent (-100.0 to 100.0%) instead of in Hz.

<5> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

## B.4 Parameter Defaults Determined by Control Mode (A1-02)

### ? E3-01 (Motor 2 Control Mode) Dependent Parameters

**Table B.4 E3-01 (Motor 2 Control Mode) Dependent Parameters and Default Values**

No.	Name	Setting Range	Resolution	Control Modes (E3-01)			
				V/f (0)	V/f w/PG (1)	OLV (2)	CLV (3)
C3-21	Motor 2 Slip Compensation Gain	0.0 to 2.5	0.1	0.0	—	1.0	1.0
C3-22	Motor 2 Slip Compensation Primary Delay Time	0 to 10000	1 ms	2000	—	200	—
C5-21	Motor 2 ASR Proportional Gain 1	0.00 to 300.00	0.01	—	0.20	—	20.00
C5-22	Motor 2 ASR Integral Time 1	0.000 to 10.000	0.001 s	—	0.200	—	0.500
C5-23	Motor 2 ASR Proportional Gain 2	0.00 to 300.00	0.01	—	0.02	—	20.00
C5-24	Motor 2 ASR Integral Time 2	0.000 to 10.000	0.001 s	—	0.050	—	0.500
E3-04	Motor 2 Maximum Output Frequency	40.0 to 400.0	0.1 Hz	50.0	50.0	50.0	50.0
E3-05	Motor 2 Maximum Output Voltage <1>	0.0 to 255.0	0.1 V	200.0	200.0	200.0	200.0
E3-06	Motor 2 Base Frequency	0.0 to 400.0	0.1 Hz	50.0	50.0	50.0	50.0
E3-07	Motor 2 Mid Output Frequency	0.0 to 400.0	0.1 Hz	2.5	2.5	3.0	—
E3-08	Motor 2 Mid Output Frequency Voltage <2>	0.0 to 255.0	0.1 V	15.0 (Motor Capacity: 0.55 to 4.0 kW) 14.0 (5.5 to 45 kW) 12.0 (55 kW and above)	15.0 (Motor Capacity: 0.55 to 4.0 kW) 14.0 (5.5 to 45 kW) 12.0 (55 kW and above)	14.4 (Motor Capacity: 0.55 to 4.0 kW) 13.2 (5.5 kW and above)	—
E3-09	Motor 2 Minimum Output Frequency	0.0 to 400.0	0.1 Hz	1.3	1.3	0.5	0.0
E3-10	Motor 2 Minimum Output Voltage <2>	0.0 to 255.0	0.1 V	9.0 (Motor Capacity: 0.55 to 4.0 kW) 7.0 (5.5 to 45 kW) 6.0 (55 kW and above)	9.0 (Motor Capacity: 0.55 to 4.0 kW) 7.0 (5.5 to 45 kW) 6.0 (55 kW and above)	3.0 (Motor Capacity: 0.55 to 4.0 kW) 2.4 (5.5 kW and above)	0.0

<1> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<2> Default setting is determined by the drive model (o2-04) and duty selection (C6-01).

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

The following tables show parameters and default settings that change with the drive model selection (o2-04). Parameter numbers shown in parenthesis are valid for motor 2.

**Table B.5 200 V Class Drives Default Settings by Drive Model Selection and ND/HD settings**

No.	Name	Unit	Default Settings					
–	Model CIMR-T□	–	2A0004		2A0006		2A0010	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND
o2-04	Drive Model Selection	Hex.	62		63		65	
E2-11 (E4-11)	Motor Rated Output	kW	0.4	0.75	0.75	1.1	1.5	2.2
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	1	1	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	288.2	223.7	223.7	196.6	169.4	156.8
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.0015	0.0028	0.0028	0.0068	0.0068	0.0088
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	1.9	3.3	3.3	4.9	6.2	8.5
E2-02 (E4-02)	Motor Rated Slip	Hz	2.9	2.5	2.5	2.6	2.6	2.9
E2-03 (E4-03)	Motor No-Load Current	A	1.2	1.8	1.8	2.3	2.8	3
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	9.842	5.156	5.156	3.577	1.997	1.601
E2-06 (E4-06)	Motor Leakage Inductance	%	18.2	13.8	13.8	18.5	18.5	18.4
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	14	26	26	38	53	77
E5-01	Motor Code Selection	Hex.	1202	1202	1203	1203	1205	1205
L2-02	Momentary Power Loss Ride-Thru Time	s	0.1	0.1	0.2	0.2	0.3	0.3
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.2	0.3	0.3	0.4	0.4	0.5
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat Alarm Level	°C	115	115	115	115	115	115
L8-35	Installation Method Selection	–	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.178	0.142	0.142	0.142	0.166	0.145
n9-12	On-Delay Compensation Time	μs	1.8	1.8	1.8	1.8	1.8	1.8
S6-01	DC Bus Capacity	μF	500	500	500	500	1000	1000
S6-02	Motor Acceleration Time	s	0.178	0.142	0.142	0.142	0.166	0.145

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings					
–	Model CIMR-T□	–	2A0012		2A0021		2A0030	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND
o2-04	Drive Model Selection	Hex.	66		68		6A	
E2-11 (E4-11)	Motor Rated Output	kW	2.2	3.0	3.7	5.5	5.5	7.5
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	156.8	136.4	122.9	94.75	94.75	72.69
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.0088	0.0158	0.0158	0.0255	0.026	0.037
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	8.5	11.4	14	19.6	19.6	26.6
E2-02 (E4-02)	Motor Rated Slip	Hz	2.9	2.7	2.73	1.5	1.5	1.3
E2-03 (E4-03)	Motor No-Load Current	A	3	3.7	4.5	5.1	5.1	8
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	1.601	1.034	0.771	0.399	0.399	0.288
E2-06 (E4-06)	Motor Leakage Inductance	%	18.4	19	19.6	18.2	18.2	15.5
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	77	91	112	172	172	262
E5-01	Motor Code Selection	Hex.	1206	1206	1208	1208	120A	120A
L2-02	Momentary Power Loss Ride-Thru Time	s	0.5	0.5	1	1	1	1
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.5	0.5	0.6	0.7	0.7	0.8
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat Alarm Level	°C	125	125	110	110	120	120
L8-35	Installation Method Selection	–	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.145	0.145	0.154	0.168	0.168	0.175
n9-12	On-Delay Compensation Time	μs	1.8	1.8	1.6	1.6	1.5	1.5
S6-01	DC Bus Capacity	μF	1000	1000	2100	2100	2220	2220
S6-02	Motor Acceleration Time	s	0.145	0.145	0.154	0.168	0.168	0.175

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	2A0040		2A0056		2A0069		2A0081	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	6B		6D		6E		6F	
E2-11 (E4-11)	Motor Rated Power	kW	7.5	11	11	15	15	18.5	18.5	22
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	72.69	70.44	70.44	63.13	63.13	57.87	57.87	51.79
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.037	0.053	0.053	0.076	0.076	0.138	0.138	0.165
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	26.6	39.7	39.7	53	53	65.8	65.8	77.2
E2-02 (E4-02)	Motor Rated Slip	Hz	1.3	1.7	1.7	1.6	1.6	1.67	1.67	1.7
E2-03 (E4-03)	Motor No-Load Current	A	8	11.2	11.2	15.2	15.2	15.7	15.7	18.5
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	0.288	0.23	0.23	0.138	0.138	0.101	0.101	0.079
E2-06 (E4-06)	Motor Leakage Inductance	%	15.5	19.5	19.5	17.2	17.2	15.7	20.1	19.5
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	262	245	245	272	272	505	505	538
E5-01	Motor Code Selection	Hex.	120B	120B	120D	120D	120E	120E	120F	120F
L2-02	Momentary Power Loss Ride-Thru Time	s	1	1	2	2	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.8	0.9	0.9	1	1	1	1	1
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.6	0.6	0.6	0.6	0.6
L8-02	Overheat Alarm Level	°C	125	125	120	120	120	120	125	125
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.175	0.265	0.265	0.244	0.244	0.317	0.317	0.355
n9-12	On-Delay Compensation Time	μs	1.5	1.5	2	2	2	2	2	2
S6-01	DC Bus Capacity	μF	2670	2670	3600	3600	4980	4980	6000	6000
S6-02	Motor Acceleration Time	s	0.175	0.265	0.265	0.244	0.244	0.317	0.317	0.355

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	2A0110		2A0138		2A0169		2A0211	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	70		72		73		74	
E2-11 (E4-11)	Motor Rated Power	kW	22	30	30	37	37	45	45	55
b3-04	V/f Gain during Speed Search	%	100	80	80	80	80	80	80	80
b3-06	Output Current I during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50	0.50	2.00
b8-04	Energy Saving Coefficient Value	–	51.79	46.27	46.27	38.16	38.16	35.78	35.78	31.35
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.165	0.220	0.220	0.273	0.273	0.333	0.333	0.490
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	77.2	105	105	131	131	160	160	190
E2-02 (E4-02)	Motor Rated Slip	Hz	1.7	1.8	1.8	1.33	1.33	1.6	1.6	1.43
E2-03 (E4-03)	Motor No-Load Current	A	18.5	21.9	21.9	38.2	38.2	44	44	45.6
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	0.079	0.064	0.064	0.039	0.039	0.03	0.03	0.022
E2-06 (E4-06)	Motor Leakage Inductance	%	19.5	20.8	20.8	18.8	18.8	20.2	20.2	20.5
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	538	699	699	823	823	852	852	960
E5-01	Motor Code Selection	Hex.	1210	1210	1212	1212	1213	1213	1214	1214
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1	1.1	1.1	1.1	1.1	1.2	1.2	1.3
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.6	0.6	0.6	0.6	0.6	1	1	1
L8-02	Overheat Alarm Level	°C	130	130	130	130	130	130	125	125
L8-35	Installation Method Selection	–	0	0	0	0	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.355	0.323	0.323	0.32	0.32	0.387	0.387	0.317
n9-12	On-Delay Compensation Time	μs	2	2	2	2	2	2	2	2
S6-01	DC Bus Capacity	μF	5800	5800	9400	9400	8000	8000	9600	9600
S6-02	Motor Acceleration Time	s	0.355	0.323	0.323	0.32	0.32	0.387	0.387	0.317

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	2A0250		2A0312		2A0360		2A0415	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	75		76		77		78	
E2-11 (E4-11)	Motor rated Output	kW	55	75	75	90	90	110	110	110
b3-04	V/f Gain during Speed Search	%	80	80	80	80	80	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
b8-03	Energy Saving Control Filter Time Constant	s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	31.35	23.1	23.1	20.65	20.65	18.12	18.12	18.12
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.49	0.90	0.90	1.10	1.10	1.90	1.90	1.90
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	190	260	260	260	260	260	260	260
E2-02 (E4-02)	Motor Rated Slip	Hz	1.43	1.39	1.39	1.39	1.39	1.39	1.39	1.39
E2-03 (E4-03)	Motor No-Load Current	A	45.6	72	72	72	72	72	72	72
E2-05 (E4-05)	Motor Line to Line Resistance	Ω	0.022	0.023	0.023	0.023	0.023	0.023	0.023	0.023
E2-06 (E4-06)	Motor Leakage Inductance	%	20.5	20	20	20	20	20	20	20
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	960	1200	1200	1200	1200	1200	1200	1200
E5-01	Motor Code Selection	Hex.	1215	1215	1216	1216	FFFF	FFFF	FFFF	FFFF
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.3	1.5	1.5	1.5	1.5	1.7	1.7	1.7
L2-04	Momentary Power Loss Voltage Recovery Time	s	1	1	1	1	1	1	1	1
L8-02	Overheat Alarm Level	°C	115	115	120	120	120	120	120	120
L8-35	Installation Method Selection	–	0	0	0	0	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	100	100	100	100
n5-02	Motor Acceleration Time	s	0.317	0.533	0.533	0.592	0.592	0.646	0.646	0.646
n9-12	On-Delay Compensation Time	μs	2	2	2	2	2	2	2	2
S6-01	DC Bus Capacity	μF	17400	17400	24600	24600	21600	21600	33000	33000
S6-02	Motor Acceleration Time	s	0.317	0.533	0.533	0.592	0.592	0.646	0.646	0.646

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

Table B.6 400 V Class Drives Default Settings by Drive Capacity and ND/HD Setting

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	4A0002		4A0004		4A0005		4A0007	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	92		93		94		95	
E2-11 (E4-11)	Motor rated power	kW	0.4	0.75	0.75	1.5	1.5	2.2	2.2	3.0
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	576.4	447.4	447.4	338.8	338.8	313.6	313.6	265.7
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.0015	0.0028	0.0028	0.0068	0.0068	0.0088	0.0088	0.0158
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	1	1.6	1.6	3.1	3.1	4.2	4.2	5.7
E2-02 (E4-02)	Motor Rated Slip	Hz	2.9	2.6	2.6	2.5	2.5	3	3	2.7
E2-03 (E4-03)	Motor No-Load Current	A	0.6	0.8	0.8	1.4	1.4	1.5	1.5	1.9
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	38.198	22.459	22.459	10.1	10.1	6.495	6.495	4.360
E2-06 (E4-06)	Motor Leakage Inductance	%	18.2	14.3	14.3	18.3	18.3	18.7	18.7	19
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	14	26	26	53	53	77	77	105
E5-01	Motor Code Selection	Hex.	1232	1232	1233	1233	1235	1235	1236	1236
L2-02	Momentary Power Loss Ride-Thru Time	s	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.5
L2-03	Momentary Power Loss Min. Baseblock Time	s	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat Alarm Level	°C	110	110	110	110	110	110	110	110
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.178	0.142	0.142	0.166	0.166	0.145	0.145	0.145
n9-12	On-Delay Compensation Time	μs	1.5	1.5	1.5	1.5	1.7	1.7	1.7	1.7
S6-01	DC Bus Capacity	μF	250	250	250	250	250	250	375	375
S6-02	Motor Acceleration Time	s	0.178	0.142	0.142	0.166	0.166	0.145	0.145	0.145

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	4A0009		4A0011		4A0018		4A0023	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	96		97		99		9A	
E2-11 (E4-11)	Motor Rated Power	kW	3.0	3.7	3.7	5.5	5.5	7.5	7.5	11
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	265.7	245.8	245.8	189.5	189.5	145.38	145.38	140.88
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.0158	0.0158	0.0158	0.0255	0.026	0.037	0.037	0.053
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	5.7	7	7	9.8	9.8	13.3	13.3	19.9
E2-02 (E4-02)	Motor Rated Slip	Hz	2.7	2.7	2.7	1.5	1.5	1.3	1.3	1.7
E2-03 (E4-03)	Motor No-Load Current	A	1.9	2.3	2.3	2.6	2.6	4	4	5.6
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	4.360	3.333	3.333	1.595	1.595	1.152	1.152	0.922
E2-06 (E4-06)	Motor Leakage Inductance	%	19	19.3	19.3	18.2	18.2	15.5	15.5	19.6
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	105	130	130	193	193	263	263	385
E5-01	Motor Code Selection	Hex.	FFFF	FFFF	1238	1238	123A	123A	123B	123B
L2-02	Momentary Power Loss Ride-Thru Time	s	0.5	0.5	0.5	0.5	0.8	0.8	1	1
L2-03	Momentary Power Loss Min. Baseblock Time	s	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat Alarm Level	°C	110	110	110	110	110	110	115	115
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.145	0.154	0.154	0.168	0.168	0.175	0.175	0.265
n9-12	On-Delay Compensation Time	μs	1.5	1.5	1.5	1.5	1.5	1.5	1.7	1.7
S6-01	DC Bus Capacity	μF	675	675	675	675	480	480	590	590
S6-02	Motor Acceleration Time	s	0.145	0.154	0.154	0.168	0.168	0.175	0.175	0.265

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	4A0031		4A0038		4A0044		4A0058	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	9C		9D		9E		9F	
E2-11 (E4-11)	Motor Rated Power	kW	11	15	15	18.5	18.5	22	22	30
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current I during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	140.88	126.26	126.26	115.74	115.74	103.58	103.58	92.54
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.053	0.076	0.076	0.138	0.138	0.165	0.165	0.220
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	19.9	26.5	26.5	32.9	32.9	38.6	38.6	52.3
E2-02 (E4-02)	Motor Rated Slip	Hz	1.7	1.6	1.6	1.67	1.67	1.7	1.7	1.8
E2-03 (E4-03)	Motor No-Load Current	A	5.6	7.6	7.6	7.8	7.8	9.2	9.2	10.9
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	0.922	0.55	0.55	0.403	0.403	0.316	0.316	0.269
E2-06 (E4-06)	Motor Leakage Inductance	%	19.6	17.2	17.2	20.1	20.1	23.5	23.5	20.7
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	385	440	440	508	508	586	586	750
E5-01	Motor Code Selection	Hex.	123D	123D	123E	123E	123F	123F	1240	1240
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.9	1	1	1	1	1	1	1.1
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6
L8-02	Overheat Alarm Level	°C	120	120	120	120	115	115	120	120
L8-35	Installation Method Selection	–	2	2	2	2	2	2	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10
n5-02	Motor Acceleration Time	s	0.265	0.244	0.244	0.317	0.317	0.355	0.355	0.323
n9-12	On-Delay Compensation Time	μs	1.6	1.6	1.5	1.5	1.5	1.5	2	2
S6-01	DC Bus Capacity	μF	960	960	1180	1180	1300	1300	1700	1700
S6-02	Motor Acceleration Time	s	0.265	0.244	0.244	0.317	0.317	0.355	0.355	0.323

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings									
–	Model CIMR-T□	–	4A0072		4A0088		4A0103		4A0139		4A0165	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	A1		A2		A3		A4		A5	
E2-11 (E4-11)	Motor rated power	kW	30	37	37	45	45	55	55	75	75	90
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	80	80	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.7
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50	2.00	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	92.54	76.32	76.32	71.56	71.56	67.2	67.2	46.2	46.2	38.91
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	0.220	0.273	0.273	0.333	0.333	0.490	0.490	0.900	0.900	1.100
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	52.3	65.6	65.6	79.7	79.7	95	95	130	130	156
E2-02 (E4-02)	Motor Rated Slip	Hz	1.8	1.33	1.33	1.6	1.6	1.46	1.46	1.39	1.39	1.4
E2-03 (E4-03)	Motor No-Load Current	A	10.9	19.1	19.1	22	22	24	24	36	36	40
E2-05 (E4-05)	Motor Line-to-Line Resistance	Ω	0.269	0.155	0.155	0.122	0.122	0.088	0.088	0.092	0.092	0.056
E2-06 (E4-06)	Motor Leakage Inductance	%	20.7	18.8	18.8	19.9	19.9	20	20	20	20	20
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	750	925	925	1125	1125	1260	1260	1600	1600	1760
E5-01	Motor Code Selection	Hex.	1242	1242	1243	1243	1244	1244	1245	1245	1246	1246
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2	2	2	2	2	2	2
L2-03	Momentary Power Loss Min. Basebl. Time	s	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.5
L2-04	Momentary Power Loss Volt. Recov. Time	s	0.6	0.6	0.6	0.6	0.6	1	1	1	1	1
L8-02	Overheat Alarm Level	°C	120	120	110	110	120	120	130	130	130	130
L8-35	Installation Method Selection	–	0	0	0	0	0	0	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	30	30	30	30
n5-02	Motor Acceleration Time	s	0.323	0.32	0.32	0.387	0.387	0.317	0.317	0.533	0.533	0.592
n9-12	On-Delay Compensation Time	μs	2	2	2	2	2	2	2	2	2	2
S6-01	DC Bus Capacity	μF	2500	2500	2900	2900	3300	3300	4000	4000	4000	4000
S6-02	Motor Acceleration Time	s	0.323	0.32	0.32	0.387	0.387	0.317	0.317	0.533	0.533	0.592

## B.5 Parameter Defaults Determined by Drive Model (o2-04) and Duty Rating (C6-01)

No.	Name	Unit	Default Settings							
–	Model CIMR-T□	–	4A0208		4A0250		4A0296		4A0362	
C6-01	Drive Duty Selection	–	HD	ND	HD	ND	HD	ND	HD	ND
			0	1	0	1	0	1	0	1
o2-04	Drive Model Selection	Hex.	A6		A7		A8		A9	
E2-11 (E4-11)	Motor rated Output	kW	90	110	110	132	132	160	160	185
b3-04	V/f Gain during Speed Search	%	60	60	60	60	60	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
b8-03	Energy Saving Control Filter Time Constant	s	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	38.91	36.23	36.23	32.79	32.79	30.13	30.13	30.57
C5-17 (C5-37)	Motor Inertia	kgm <sup>2</sup>	1.10	1.90	1.90	2.10	2.10	3.30	3.30	3.60
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1	1	1
E2-01 (E4-01)	Motor Rated Current	A	156	190	190	223	223	270	270	310
E2-02 (E4-02)	Motor Rated Slip	Hz	1.4	1.4	1.4	1.38	1.38	1.35	1.35	1.3
E2-03 (E4-03)	Motor No-Load Current	A	40	49	49	58	58	70	70	81
E2-05 (E4-05)	Motor Line to Line Resistance	Ω	0.056	0.046	0.046	0.035	0.035	0.029	0.029	0.025
E2-06 (E4-06)	Motor Leakage Inductance	%	20	20	20	20	20	20	20	20
E2-10 (E4-10)	Motor Iron Loss for Torque Compensation	W	1760	2150	2150	2350	2350	2850	2850	3200
E5-01	Motor Code Selection	Hex.	1247	1247	1248	1248	1249	1249	124A	124A
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.5	1.7	1.7	1.7	1.7	1.8	1.8	1.9
L2-04	Momentary Power Loss Voltage Recovery Time	s	1	1	1	1	1	1	1	1
L8-02	Overheat Alarm Level	°C	120	120	120	120	125	125	130	130
L8-35	Installation Method Selection	–	0	0	0	0	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	30	30	30	30	30	30	30
n5-02	Motor Acceleration Time	s	0.592	0.646	0.646	0.673	0.673	0.777	0.777	0.864
n9-12	On-Delay Compensation Time	μs	2	2	2	2	2	2	2	2
S6-01	DC Bus Capacity	μF	7400	7400	6400	6400	7750	7750	11000	11000
S6-02	Motor Acceleration Time	s	0.592	0.646	0.646	0.673	0.673	0.777	0.777	0.864

## B.6 Parameter Defaults Determined by Motor Code (E5-01)

The following tables show parameters and default settings that change with the motor code selection E5-01 when Open Loop Vector for PM motors is used.

### ? Yaskawa SMRA Series SPM Motor

**Table B.7 1800 r/min Type Yaskawa SMRA Series SPM Motor Settings**

No.	Name	Unit	Default Settings				
E5-01	Motor Code Selection	—	0002	0003	0005	0006	0008
	Voltage Class	V	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7
	Rated Speed	r/min	1800	1800	1800	1800	1800
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7
E5-03	Motor Rated Current	A	2.1	4.0	6.9	10.8	17.4
E5-04	Number of Motor Poles	—	8	8	8	8	8
E5-05	Motor Stator Resistance	$\Omega$	2.47	1.02	0.679	0.291	0.169
E5-06	Motor d-Axis Inductance	mH	12.7	4.8	3.9	3.6	2.5
E5-07	Motor q-Axis Inductance	mH	12.7	4.8	3.9	3.6	2.5
E5-09	Motor Induction Voltage Constant 1	mVs/rad	0	0	0	0	0
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	62.0	64.1	73.4	69.6	72.2
E1-04	Maximum Output Frequency	Hz	120	120	120	120	120
E1-05	Maximum Voltage	V	200.0	200.0	200.0	200.0	200.0
E1-06	Base Frequency	Hz	120	120	120	120	120
E1-09	Minimum Output Frequency	Hz	6	6	6	6	6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0007	0.0014	0.0021	0.0032	0.0046
n5-02	Motor Acceleration Time	s	0.064	0.066	0.049	0.051	0.044
n8-49	d-Axis Current for High Efficiency Control	%	0	0	0	0	0
S6-02	Motor Acceleration Time	s	0.064	0.066	0.049	0.051	0.044

**Table B.8 3600 r/min Type Yaskawa SMRA Series SPM Motor Settings**

No.	Name	Unit	Default Settings			
E5-01	Motor Code Selection	—	0103	0105	0106	0108
	Voltage Class	V	200	200	200	200
	Rated Power	kW	0.75	1.5	2.2	3.7
	Rated Speed	r/min	3600	3600	3600	3600
E5-02	Motor Rated Power	kW	0.75	1.5	2.2	3.7
E5-03	Motor Rated Current	A	4.1	8.0	10.5	16.5
E5-04	Number of Motor Poles	—	8	8	8	8
E5-05	Motor Stator Resistance	$\Omega$	0.538	0.20	0.15	0.097
E5-06	Motor d-Axis Inductance	mH	3.2	1.3	1.1	1.1
E5-07	Motor q-Axis Inductance	mH	3.2	1.3	1.1	1.1
E5-09	Motor Induction Voltage Constant 1	mVs/rad	0	0	0	0
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	32.4	32.7	36.7	39.7
E1-04	Maximum Output Frequency	Hz	240	240	240	240
E1-05	Maximum Voltage	V	200.0	200.0	200.0	200.0
E1-06	Base Frequency	Hz	240	240	240	240
E1-09	Minimum Output Frequency	Hz	12	12	12	12
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0007	0.0014	0.0021	0.0032
n5-02	Motor Acceleration Time	s	0.137	0.132	0.132	0.122
n8-49	d-Axis Current for High Efficiency Control	%	0	0	0	0
S6-02	Motor Acceleration Time	s	0.137	0.132	0.132	0.122

## B.6 Parameter Defaults Determined by Motor Code (E5-01)

### ? Yaskawa SSR1 Series IPM Motor (For Derated Torque)

Table B.9 200 V, 1750 r/min Type Yaskawa SSR1 Series Motor

No.	Name	Unit	Default Settings															
E5-01	Motor Code Selection	—	1202	1203	1205	1206	1208	120A	120B	120D	120E	120F	1210	1212	1213	1214	1215	1216
	Voltage Class	V	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22	30	37	45	55	75
	Rated Speed	r/min	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15.00	18.50	22.00	30.00	37.00	45.00	55.00	75.00
E5-03	Motor Rated Current	A	1.77	3.13	5.73	8.44	13.96	20.63	28.13	41.4	55.4	68.2	80.6	105.2	131.3	153.1	185.4	257.3
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	$\Omega$	8.233	2.284	1.470	0.827	0.455	0.246	0.198	0.094	0.066	0.051	0.037	0.030	0.020	0.014	0.012	0.006
E5-06	Motor d-Axis Inductance	mH	54.84	23.02	17.22	8.61	7.20	4.86	4.15	3.40	2.45	2.18	1.71	1.35	0.99	0.83	0.79	0.44
E5-07	Motor q-Axis Inductance	mH	64.10	29.89	20.41	13.50	10.02	7.43	5.91	3.91	3.11	2.55	2.05	1.82	1.28	1.01	0.97	0.56
E5-09	Motor Induction Voltage Constant 1	mVs/rad	223.7	220.3	240.8	238.0	238.7	239.6	258.2	239.3	248.1	253.6	250.0	280.9	264.2	280.4	311.9	268.0
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum Output Frequency	Hz	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0011	0.0017	0.0023	0.0043	0.0083	0.014	0.017	0.027	0.046	0.055	0.064	0.116	0.140	0.259	0.31	0.42
n5-02	Motor Acceleration Time	s	0.092	0.076	0.051	0.066	0.075	0.083	0.077	0.084	0.102	0.103	0.098	0.130	0.127	0.193	0.191	0.187
n8-49	d-Axis Current for High Efficiency Control	%	-7.6	-11.5	-9.1	-19.0	-18.7	-23.4	-18.5	-10.9	-16.5	-11.3	-12.8	-16.8	-15.6	-10.7	-9.6	-13.3
S6-02 <1>	Motor Acceleration Time	s	0.092	0.076	0.051	0.066	0.075	0.083	0.077	0.084	0.102	0.103	0.098	0.130	0.127	0.193	0.191	0.187

<1> Default setting value varies by the drive model (o2-04).

Table B.10 400 V, 1750 r/min Type Yaskawa SSR1 Series Motor

No.	Name	Unit	Default Settings									
E5-01	Motor Code Selection	—	1232	1233	1235	1236	1238	123A	123B	123D	123E	123F
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18
	Rated Speed	r/min	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50
E5-03	Motor Rated Current	A	0.89	1.56	2.81	4.27	7.08	10.31	13.65	20.7	27.5	33.4
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	25.370	9.136	6.010	3.297	1.798	0.982	0.786	0.349	0.272	0.207
E5-06	Motor d-Axis Inductance	mH	169.00	92.08	67.71	34.40	32.93	22.7	16.49	13.17	10.30	8.72
E5-07	Motor q-Axis Inductance	mH	197.50	119.56	81.71	54.00	37.70	26.80	23.46	15.60	12.77	11.22
E5-09	Motor Induction Voltage Constant 1	mVs/rad	392.6	440.6	478.3	466.3	478.8	478.1	520.0	481.5	498.8	509.5
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum Output Frequency	Hz	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0011	0.0017	0.0023	0.0043	0.0083	0.014	0.017	0.027	0.046	0.055
n5-02	Motor Acceleration Time	s	0.092	0.076	0.051	0.066	0.075	0.083	0.077	0.084	0.102	0.103
n8-49	d-Axis Current for High Efficiency Control	%	-8.6	-11.5	-10.3	-19.8	-8.5	-11.0	-18.6	-12.5	-15.5	-17.9
S6-02 <1>	Motor Acceleration Time	s	0.092	0.076	0.051	0.066	0.075	0.083	0.077	0.084	0.102	0.103


&lt;1&gt; Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings									
E5-01	Motor Code Selection	—	1240	1242	1243	1244	1245	1246	1247	1248	1249	124A
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	22	30	37	45	55	75	90	110	132	160
	Rated Speed	r/min	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
E5-02	Motor Rated Power	kW	22.00	30.00	37.00	45.00	55.00	75.00	90.00	110.00	132	160
E5-03	Motor Rated Current	A	39.8	52.0	65.8	77.5	92.7	126.6	160.4	183.3	222.9	267.7
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	0.148	0.235	0.079	0.054	0.049	0.029	0.019	0.017	0.012	0.008
E5-06	Motor d-Axis Inductance	mH	6.81	5.4	4.08	3.36	3.16	2.12	1.54	1.44	1.21	0.97
E5-07	Motor q-Axis Inductance	mH	8.47	7.26	5.12	3.94	3.88	2.61	2.06	2.21	1.46	1.28
E5-09	Motor Induction Voltage Constant 1	mVs/rad	503.9	561.7	528.5	558.1	623.8	594.5	524.1	583.7	563.6	601.2
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum Output Frequency	Hz	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
C5-17	Motor Inertia	kgm <sup>2</sup>	0.064	0.116	0.140	0.259	0.31	0.42	0.56	0.83	0.96	1.61
n5-02	Motor Acceleration Time	s	0.098	0.130	0.127	0.193	0.191	0.187	0.208	0.254	0.243	0.338
n8-49	d-Axis Current for High Efficiency Control	%	-15.1	-16.8	-14.1	-8.8	-9.6	-10.3	-17.0	-21.7	-10.9	-13.2
S6-02 <1>	Motor Acceleration Time	s	0.098	0.130	0.127	0.193	0.191	0.187	0.208	0.254	0.243	0.338

&lt;1&gt; Default setting value varies by the drive model (o2-04).

## B.6 Parameter Defaults Determined by Motor Code (E5-01)

Table B.11 200 V, 1450 r/min Type Yaskawa SSR1 Series Motor

No.	Name	Unit	Default Settings														
E5-01	Motor Code Selection	—	1302	1303	1305	1306	1308	130A	130B	130D	130E	130F	1310	1312	1313	1314	1315
	Voltage Class	V	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22	30	37	45	55
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15.00	18.50	22.00	30.00	37.00	45.00	55.00
E5-03	Motor Rated Current	A	1.88	3.13	5.63	8.33	14.17	20.63	27.71	39.6	55.5	65.6	75.1	105.2	126.0	153.1	186.5
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	3.190	1.940	1.206	0.665	0.341	0.252	0.184	0.099	0.075	0.057	0.041	0.034	0.023	0.015	0.012
E5-06	Motor d-Axis Inductance	mH	32.15	26.12	14.72	12.27	8.27	6.49	6.91	4.07	3.29	2.53	1.98	1.75	1.48	1.04	0.87
E5-07	Motor q-Axis Inductance	mH	41.74	34.30	20.15	14.77	9.81	7.74	7.66	4.65	3.84	3.01	2.60	2.17	1.70	1.31	1.10
E5-09	Motor Induction Voltage Constant 1	mVs/rad	264.3	269.6	284.3	287.1	284.5	298.0	335.0	303.9	311.2	300.9	327.7	354.2	369.6	351.6	374.7
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0017	0.0023	0.0043	0.0083	0.0136	0.017	0.027	0.046	0.055	0.064	0.116	0.140	0.259	0.312	0.42
n5-02	Motor Acceleration Time	s	0.098	0.071	0.066	0.087	0.085	0.072	0.084	0.096	0.085	0.082	0.122	0.108	0.161	0.160	0.175
n8-49	d-Axis Current for High Efficiency Control	%	-6.6	-10.9	-13.5	-9.0	-9.5	-10.1	-6.0	-9.3	-10.7	-13.2	-15.7	-11.5	-7.0	-11.8	-10.2
S6-02 	Motor Acceleration Time	s	0.098	0.071	0.066	0.087	0.085	0.072	0.084	0.096	0.085	0.082	0.122	0.108	0.161	0.160	0.175

<1> Default setting value varies by the drive model (o2-04).

Table B.12 400 V, 1450 r/min Type Yaskawa SSR1 Series Motor

No.	Name	Unit	Default Settings									
E5-01	Motor Code Selection	—	1332	1333	1335	1336	1338	133A	133B	133D	133E	133F
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50
E5-03	Motor Rated Current	A	0.94	1.56	2.81	4.27	6.98	10.21	13.85	19.5	27.4	32.9
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	12.760	7.421	4.825	2.656	1.353	0.999	0.713	0.393	0.295	0.223
E5-06	Motor d-Axis Inductance	mH	128.60	85.11	58.87	46.42	31.73	26.20	27.06	15.51	12.65	9.87
E5-07	Motor q-Axis Inductance	mH	166.96	113.19	80.59	60.32	40.45	30.94	33.45	19.63	15.87	12.40
E5-09	Motor Induction Voltage Constant 1	mVs/rad	528.6	544.2	568.5	572.8	562.9	587.6	670.1	612.7	624.6	610.4
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0017	0.0023	0.0043	0.0083	0.0136	0.017	0.027	0.046	0.055	0.064
n5-02	Motor Acceleration Time	s	0.098	0.071	0.066	0.087	0.085	0.072	0.084	0.096	0.085	0.082
n8-49	d-Axis Current for High Efficiency Control	%	-6.6	-9.2	-13.5	-12.1	-13.7	-10.1	-12.2	-15.5	-15.1	-16.0
S6-02 <1>	Motor Acceleration Time	s	0.098	0.071	0.066	0.087	0.085	0.072	0.084	0.096	0.085	0.082

&lt;1&gt; Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings								
E5-01	Motor Code Selection	—	1340	1342	1343	1344	1345	1346	1347	1348	1349
	Voltage Class	V	400	400	400	400	400	400	400	400	400
	Rated Power	kW	22	30	37	45	55	75	90	110	132
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	22.00	30.00	37.00	45.00	55.00	75.00	90.00	110.00	132.00
E5-03	Motor Rated Current	A	37.6	52.5	63.2	76.4	96.1	124.0	153.1	186.5	226.0
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	0.164	0.137	0.093	0.059	0.048	0.028	0.024	0.015	0.011
E5-06	Motor d-Axis Inductance	mH	7.90	7.01	5.93	4.17	3.11	2.32	2.20	1.45	1.23
E5-07	Motor q-Axis Inductance	mH	10.38	8.68	6.79	5.22	4.55	2.97	3.23	1.88	1.67
E5-09	Motor Induction Voltage Constant 1	mVs/rad	655.4	708.4	739.2	703.0	747.1	639.3	708.0	640.7	677.0
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm²	0.116	0.140	0.259	0.312	0.42	0.56	0.83	0.96	1.61
n5-02	Motor Acceleration Time	s	0.122	0.108	0.161	0.160	0.175	0.171	0.213	0.201	0.281
n8-49	d-Axis Current for High Efficiency Control	%	-15.7	-11.5	-6.8	-11.5	-14.8	-15.8	-19.6	-14.9	-15.1
S6-02 ⚡	Motor Acceleration Time	s	0.122	0.108	0.161	0.160	0.175	0.171	0.213	0.201	0.281

&lt;1&gt; Default setting value varies by the drive model (o2-04).

## B.6 Parameter Defaults Determined by Motor Code (E5-01)

Table B.13 200 V, 1150 r/min Type Yaskawa SSR1 Series Motor

No.	Name	Unit	Default Settings													
E5-01	Motor Code Selection	—	1402	1403	1405	1406	1408	140A	140B	140D	140E	140F	1410	1412	1413	1414
	Voltage Class	V	200	200	200	200	200	200	200	200	200	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22	30	37	45
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50	22.00	30.00	37.00	45.00
E5-03	Motor Rated Current	A	1.88	3.02	6.00	8.85	14.27	20.21	26.67	39.9	55.6	63.5	74.4	104.2	129.6	154.2
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	4.832	2.704	1.114	0.511	0.412	0.303	0.165	0.113	0.084	0.066	0.048	0.035	0.023	0.016
E5-06	Motor d-Axis Inductance	mH	48.68	32.31	19.22	12.15	7.94	11.13	6.59	4.96	3.83	3.33	2.38	2.04	1.53	1.16
E5-07	Motor q-Axis Inductance	mH	63.21	40.24	24.38	15.35	11.86	14.06	8.55	6.12	4.65	4.50	3.15	2.86	2.27	1.54
E5-09	Motor Induction Voltage Constant 1	mVs/rad	320.4	327.1	364.4	344.4	357.5	430.8	391.5	384.4	372.1	421.3	410.9	436.1	428.8	433.3
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0017	0.0023	0.0083	0.0136	0.0171	0.027	0.046	0.055	0.064	0.116	0.140	0.259	0.312	0.418
n5-02	Motor Acceleration Time	s	0.062	0.044	0.080	0.090	0.067	0.072	0.088	0.073	0.062	0.093	0.092	0.125	0.122	0.135
n8-49	d-Axis Current for High Efficiency Control	%	-8.8	-9.9	-9.3	-10.0	-17.7	-12.3	-15.3	-13.9	-14.4	-17.9	-15.9	-17.9	-20.1	-13.7
S6-02 <1>	Motor Acceleration Time	s	0.062	0.044	0.080	0.090	0.067	0.072	0.088	0.073	0.063	0.093	0.092	0.125	0.122	0.135

<1> Default setting value varies by the drive model (o2-04).

Table B.14 400 V, 1150 r/min Type Yaskawa SSR1 Series Motor

No.	Name	Unit	Default Settings								
E5-01	Motor Code Selection	—	1432	1433	1435	1436	1438	143A	143B	143D	143E
	Voltage Class	V	400	400	400	400	400	400	400	400	400
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150	1150
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15
E5-03	Motor Rated Current	A	0.94	1.51	3.00	4.43	7.08	10.10	13.33	19.9	27.8
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	$\Omega$	19.320	10.800	4.456	2.044	1.483	1.215	0.660	0.443	0.331
E5-06	Motor d-Axis Inductance	mH	194.70	129.20	76.88	48.60	37.58	44.54	26.36	19.10	15.09
E5-07	Motor q-Axis Inductance	mH	252.84	160.90	97.52	61.40	47.65	56.26	34.20	24.67	18.56
E5-09	Motor Induction Voltage Constant 1	mVs/rad	640.9	654.1	728.8	688.9	702.0	861.5	783.0	762.2	749.6
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0017	0.0023	0.0083	0.0136	0.0171	0.027	0.046	0.055	0.064
n5-02	Motor Acceleration Time	s	0.062	0.044	0.080	0.090	0.067	0.072	0.088	0.073	0.062
n8-49	d-Axis Current for High Efficiency Control	%	-8.8	-9.9	-9.3	-10.0	-12.8	-12.3	-15.3	-16.7	-14.9
S6-02 <1>	Motor Acceleration Time	s	0.062	0.044	0.080	0.090	0.067	0.072	0.088	0.073	0.062


&lt;1&gt; Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings								
E5-01	Motor Code Selection	—	143F	1440	1442	1443	1444	1445	1446	1447	1448
	Voltage Class	V	400	400	400	400	400	400	400	400	400
	Rated Power	kW	18	22	30	37	45	55	75	90	110
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150	1150
E5-02	Motor Rated Power	kW	18.50	22.00	30.00	37.00	45.00	55.00	75.00	90.00	110.00
E5-03	Motor Rated Current	A	31.8	37.2	52.1	64.8	76.6	92.0	127.1	150.5	185.4
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	$\Omega$	0.264	0.192	0.140	0.093	0.063	0.051	0.033	0.027	0.015
E5-06	Motor d-Axis Inductance	mH	13.32	9.52	8.16	6.13	4.63	3.96	3.03	2.60	1.89
E5-07	Motor q-Axis Inductance	mH	18.00	12.60	11.40	9.10	6.15	5.00	5.14	3.28	2.33
E5-09	Motor Induction Voltage Constant 1	mVs/rad	842.7	821.8	872.3	857.7	866.6	854.0	823.1	853.4	829.2
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
C5-17	Motor Inertia	kgm <sup>2</sup>	0.116	0.140	0.259	0.312	0.418	0.56	0.83	0.96	1.61
n5-02	Motor Acceleration Time	s	0.093	0.092	0.125	0.122	0.135	0.147	0.161	0.154	0.212
n8-49	d-Axis Current for High Efficiency Control	%	-17.9	-15.9	-17.7	-20.1	-13.8	-12.5	-28.8	-13.3	-11.6
S6-02 <1>	Motor Acceleration Time	s	0.093	0.092	0.125	0.122	0.135	0.147	0.161	0.154	0.212

&lt;1&gt; Default setting value varies by the drive model (o2-04).

## Yaskawa SST4 Series IPM Motor (For Constant Torque)

Table B.15 200 V, 1750 r/min Type Yaskawa SST4 Series Motor

No.	Name	Unit	Default Settings															
E5-01	Motor Code Selection	—	2202	2203	2205	2206	2208	220A	220B	220D	220E	220F	2210	2212	2213	2214	2215	2216
	Voltage Class	V	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22	30	37	45	55	75
	Rated Speed	r/min	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50	22.00	30.00	37.00	45.00	55.00	75.00
E5-03	Motor Rated Current	A	1.77	3.54	6.56	8.96	14.79	20.94	29.58	41.1	54.2	68.2	78.6	104.2	129.2	153.1	205.2	260.4
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	2.247	1.132	0.774	0.479	0.242	0.275	0.161	0.111	0.071	0.049	0.040	0.030	0.020	0.013	0.009	0.006
E5-06	Motor d-Axis Inductance	mH	22.32	12.38	8.90	7.39	5.06	5.82	3.86	3.59	2.67	1.98	1.69	1.31	0.88	0.77	0.55	0.40
E5-07	Motor q-Axis Inductance	mH	32.50	15.72	11.96	9.63	6.42	6.74	4.66	4.32	3.10	2.41	2.12	1.61	1.14	1.04	0.69	0.50
E5-09	Motor Induction Voltage Constant 1	mVs/rad	215.2	203.9	219.3	230.6	235.1	251.7	235.7	252.0	253.7	244.6	256.3	283.1	266.3	260.0	261.5	259.3
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum Output Frequency	Hz	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0016	0.0022	0.0042	0.0081	0.0133	0.013	0.017	0.027	0.044	0.054	0.063	0.113	0.137	0.252	0.30	0.41
n5-02	Motor Acceleration Time	s	0.134	0.099	0.094	0.124	0.121	0.081	0.075	0.082	0.099	0.101	0.096	0.126	0.124	0.188	0.186	0.184
n8-49	d-Axis Current for High Efficiency Control	%	-9.3	-6.4	-10.0	-9.9	-9.7	-8.4	-11.5	-13.1	-10.9	-14.3	-15.1	-11.3	-14.1	-18.8	-11.4	-12.2
S6-02 	Motor Acceleration Time	s	0.134	0.099	0.094	0.124	0.121	0.081	0.075	0.082	0.099	0.101	0.096	0.126	0.124	0.188	0.186	0.184

<1> Default setting value varies by the drive model (o2-04).

Table B.16 400 V, 1750 r/min Type Yaskawa SST4 Series Motor

No.	Name	Unit	Default Settings											
E5-01	Motor Code Selection	–	2232	2233	2235	2236	2238	223A	223B	223D	223E	223F	2240	2242
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22	30
	Rated Speed	r/min	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50	22.00	30.00
E5-03	Motor Rated Current	A	0.92	1.77	3.33	4.48	7.50	10.42	14.27	20.5	26.4	34.2	38.8	52.2
E5-04	Number of Motor Poles	–	6	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	8.935	4.570	3.096	1.906	0.972	1.103	0.630	0.429	0.275	0.196	0.160	0.120
E5-06	Motor d-Axis Inductance	mH	80.14	48.04	35.60	30.31	20.03	23.41	14.86	14.34	9.99	7.92	6.82	5.24
E5-07	Motor q-Axis Inductance	mH	110.76	64.88	47.84	38.36	24.97	28.70	17.25	17.25	12.37	9.64	8.51	6.44
E5-09	Motor Induction Voltage Constant 1	mVs/rad	416.5	399.4	438.5	475.5	463.7	485.8	470.4	513.4	505.3	489.2	509.5	566.2
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum Output Frequency	Hz	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0016	0.0022	0.0042	0.0081	0.0133	0.013	0.017	0.027	0.044	0.054	0.063	0.113
n5-02	Motor Acceleration Time	s	0.134	0.099	0.094	0.124	0.121	0.081	0.075	0.082	0.099	0.101	0.096	0.126
n8-49	d-Axis Current for High Efficiency Control	%	-7.5	-8.5	-9.8	-8.2	-9.1	-13.1	-9.2	-12.4	-15.1	-14.3	-15.3	-11.3
S6-02 <1>	Motor Acceleration Time	s	0.134	0.099	0.094	0.124	0.121	0.081	0.075	0.082	0.099	0.101	0.096	0.126

&lt;1&gt; Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings											
E5-01	Motor Code Selection	–	2243	2244	2245	2246	2247	2248	2249	224A	224C	224D	224E	
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400	400	
	Rated Power	kW	37	45	55	75	90	110	132	160	200	220	300	
	Rated Speed	r/min	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
E5-02	Motor Rated Power	kW	37.00	45.00	55.00	75.00	90.00	110.00	132.00	160.00	200.00	250.00	300.00	
E5-03	Motor Rated Current	A	65.4	77.6	99.3	130.2	153.1	184.4	229.2	269.8	346.9	421.9	520.8	
E5-04	Number of Motor Poles	–	6	6	6	6	6	6	6	6	6	6	6	
E5-05	Motor Stator Resistance	Ω	0.077	0.052	0.036	0.023	0.019	0.017	0.012	0.008	0.005	0.004	0.002	
E5-06	Motor d-Axis Inductance	mH	3.57	2.98	1.59	1.59	1.51	1.43	1.13	0.96	0.65	0.67	0.40	
E5-07	Motor q-Axis Inductance	mH	4.65	3.75	2.78	1.97	1.76	1.92	1.54	1.26	0.88	0.74	0.52	
E5-09	Motor Induction Voltage Constant 1	mVs/rad	531.6	530.6	515.2	515.2	538.3	590.9	548.2	603.9	556.8	593.1	495.4	
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
E1-04	Maximum Output Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	
E1-06	Base Frequency	Hz	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	
E1-09	Minimum Output Frequency	Hz	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	
C5-17	Motor Inertia	kgm <sup>2</sup>	0.137	0.252	0.30	0.41	0.55	0.82	0.96	1.60	1.95	2.82	3.70	
n5-02	Motor Acceleration Time	s	0.124	0.188	0.186	0.184	0.205	0.250	0.244	0.336	0.327	0.379	0.414	
n8-49	d-Axis Current for High Efficiency Control	%	-14.5	-13.2	-22.6	-11.9	-8.6	-14.8	-17.5	-12.5	-14.7	-5.1	-16.3	
S6-02 <1>	Motor Acceleration Time	s	0.124	0.188	0.186	0.184	0.205	0.250	0.244	0.336	0.327	0.379	0.414	

&lt;1&gt; Default setting value varies by the drive model (o2-04).

## B.6 Parameter Defaults Determined by Motor Code (E5-01)

**Table B.17 200 V, 1450 r/min Type Yaskawa SST4 Series Motor**

No.	Name	Unit	Default Settings							
E5-01	Motor Code Selection	—	2302	2303	2305	2306	2308	230A	230B	230D
	Voltage Class	V	200	200	200	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0
E5-03	Motor Rated Current	A	1.77	3.33	5.94	9.48	14.17	20.42	27.92	39.6
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	3.154	1.835	0.681	0.308	0.405	0.278	0.180	0.098
E5-06	Motor d-Axis Inductance	mH	28.46	19.46	10.00	6.88	8.15	5.77	6.32	3.34
E5-07	Motor q-Axis Inductance	mH	39.29	25.89	15.20	9.25	10.76	8.60	8.80	4.61
E5-09	Motor Induction Voltage Constant 1	mVs/rad	268.8	256.9	271.9	260.2	286.8	314.9	300.8	292.3
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0016	0.0022	0.0081	0.0133	0.0133	0.017	0.027	0.044
n5-02	Motor Acceleration Time	s	0.092	0.068	0.125	0.139	0.083	0.070	0.082	0.092
n8-49	d-Axis Current for High Efficiency Control	%	-7.5	-9.4	-13.9	-10.0	-15.0	-17.9	-22.7	-20.5
S6-02 <1>	Motor Acceleration Time	s	0.092	0.068	0.125	0.139	0.083	0.070	0.082	0.092

<1> Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings							
E5-01	Motor Code Selection	—	230E	230F	2310	2312	2313	2314	2315	2316
	Voltage Class	V	200	200	200	200	200	200	200	200
	Rated Power	kW	15	18	22	30	37	45	55	75
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	15.0	18.50	22.00	30.00	37.00	45.00	55.00	75.00
E5-03	Motor Rated Current	A	54.2	68.3	75.2	102.0	131.3	160.4	191.7	257.3
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	0.073	0.055	0.048	0.034	0.023	0.016	0.012	0.007
E5-06	Motor d-Axis Inductance	mH	2.94	2.23	2.08	1.67	1.39	0.94	0.82	0.56
E5-07	Motor q-Axis Inductance	mH	3.65	2.85	2.66	2.04	1.73	1.22	1.06	0.76
E5-09	Motor Induction Voltage Constant 1	mVs/rad	305.1	297.6	355.8	355.4	324.0	302.4	337.2	323.4
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.054	0.063	0.113	0.137	0.252	0.304	0.41	0.55
n5-02	Motor Acceleration Time	s	0.083	0.081	0.118	0.105	0.157	0.156	0.172	0.169
n8-49	d-Axis Current for High Efficiency Control	%	-14.6	-16.4	-11.8	-10.5	-14.5	-17.4	-13.8	-17.5
S6-02 <1>	Motor Acceleration Time	s	0.083	0.081	0.118	0.105	0.157	0.156	0.172	0.169

<1> Default setting value varies by the drive model (o2-04).

Table B.18 400 V, 1450 r/min Type Yaskawa SST4 Series Motor

No.	Name	Unit	Default Settings										
E5-01	Motor Code Selection	—	2332	2333	2335	2336	2338	233A	233B	233D	233E	233F	2340
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50	22.00
E5-03	Motor Rated Current	A	0.91	1.67	3.02	4.74	7.08	10.21	13.96	20.5	27.1	34.2	37.6
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	12.616	7.340	2.724	1.232	1.509	1.112	0.720	0.393	0.291	0.220	0.192
E5-06	Motor d-Axis Inductance	mH	113.84	77.84	40.00	27.52	31.73	23.09	25.28	13.36	11.77	8.94	8.32
E5-07	Motor q-Axis Inductance	mH	157.16	103.56	60.80	37.00	40.88	34.39	35.20	18.44	14.60	11.40	10.64
E5-09	Motor Induction Voltage Constant 1	mVs/rad	490.8	513.8	543.7	520.3	580.8	602.7	601.5	584.6	610.3	595.2	711.6
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0016	0.0022	0.0081	0.0133	0.0133	0.017	0.027	0.044	0.054	0.063	0.113
n5-02	Motor Acceleration Time	s	0.092	0.068	0.125	0.139	0.083	0.070	0.082	0.092	0.083	0.081	0.118
n8-49	d-Axis Current for High Efficiency Control	%	-9.5	-9.4	-13.7	-10.0	-12.9	-19.9	-22.8	-19.8	-14.5	-16.1	-11.8
S6-02 <1>	Motor Acceleration Time	s	0.092	0.068	0.125	0.139	0.083	0.070	0.082	0.092	0.083	0.081	0.118

&lt;1&gt; Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings										
E5-01	Motor Code Selection	—	2342	2343	2344	2345	2346	2347	2348	2349	234A	234C	234D
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	30	37	45	55	75	90	110	132	160	200	250
	Rated Speed	r/min	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
E5-02	Motor Rated Power	kW	30.00	37.00	45.00	55.00	75.00	90.00	110.00	132.00	160.00	200.00	250.00
E5-03	Motor Rated Current	A	50.9	65.4	80.2	96.1	129.2	153.1	191.7	226.0	268.8	331.3	422.9
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	0.136	0.091	0.064	0.048	0.028	0.024	0.015	0.011	0.007	0.006	0.003
E5-06	Motor d-Axis Inductance	mH	6.68	5.30	3.76	3.09	2.24	2.20	1.34	1.23	0.92	0.84	0.61
E5-07	Motor q-Axis Inductance	mH	8.16	6.80	4.88	4.75	3.03	3.23	2.16	1.67	1.30	1.25	0.89
E5-09	Motor Induction Voltage Constant 1	mVs/rad	710.8	652.7	604.8	669.1	646.8	708.0	637.8	677.0	661.7	687.1	655.9
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
E1-04	Maximum Output Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5
E1-09	Minimum Output Frequency	Hz	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
C5-17	Motor Inertia	kgm <sup>2</sup>	0.137	0.252	0.304	0.41	0.55	0.82	0.96	1.60	1.95	2.82	3.70
n5-02	Motor Acceleration Time	s	0.105	0.157	0.156	0.172	0.169	0.210	0.201	0.279	0.281	0.325	0.341
n8-49	d-Axis Current for High Efficiency Control	%	-10.5	-15.6	-17.4	-21.7	-17.3	-19.6	-24.1	-15.1	-17.0	-19.8	-19.3
S6-02 <1>	Motor Acceleration Time	s	0.105	0.157	0.156	0.172	0.169	0.210	0.201	0.279	0.281	0.325	0.341

&lt;1&gt; Default setting value varies by the drive model (o2-04).

## B.6 Parameter Defaults Determined by Motor Code (E5-01)

**Table B.19 200 V, 1150 r/min Type Yaskawa SST4 Series Motor**

No.	Name	Unit	Default Settings							
E5-01	Motor Code Selection	—	2402	2403	2405	2406	2408	240A	240B	240D
	Voltage Class	V	200	200	200	200	200	200	200	200
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0
E5-03	Motor Rated Current	A	1.77	3.44	5.94	9.17	14.79	20.21	27.40	39.0
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	2.680	1.520	1.071	0.542	0.362	0.295	0.162	0.115
E5-06	Motor d-Axis Inductance	mH	30.55	15.29	17.48	11.98	8.60	9.54	5.31	4.44
E5-07	Motor q-Axis Inductance	mH	42.71	24.28	22.51	15.51	10.69	13.84	8.26	5.68
E5-09	Motor Induction Voltage Constant 1	mVs/rad	313.1	313.1	345.3	342.9	363.8	384.3	379.9	370.2
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0022	0.0042	0.0081	0.0133	0.0168	0.027	0.044	0.054
n5-02	Motor Acceleration Time	s	0.080	0.081	0.078	0.088	0.066	0.070	0.085	0.071
n8-49	d-Axis Current for High Efficiency Control	%	-8.4	-11.0	-10.7	-10.7	-9.4	-22.5	-22.2	-16.7
S6-02 <1>	Motor Acceleration Time	s	0.080	0.081	0.078	0.088	0.066	0.070	0.085	0.071

<1> Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings							
E5-01	Motor Code Selection	—	240E	240F	2410	2412	2413	2414	2415	2416
	Voltage Class	V	200	200	200	200	200	200	200	200
	Rated Power	kW	15	18	22	30	37	45	55	75
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150
E5-02	Motor Rated Power	kW	15	18.50	22.00	30.00	37.00	45.00	55.00	75.00
E5-03	Motor Rated Current	A	55.9	65.4	77.0	103.5	126.0	153.1	188.5	260.4
E5-04	Number of Motor Poles	—	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	0.083	0.065	0.052	0.035	0.026	0.019	0.013	0.009
E5-06	Motor d-Axis Inductance	mH	3.50	2.92	2.55	2.03	1.59	1.24	0.98	0.70
E5-07	Motor q-Axis Inductance	mH	4.23	3.79	3.22	2.46	1.92	1.64	1.37	0.97
E5-09	Motor Induction Voltage Constant 1	mVs/rad	364.5	404.5	445.1	444.4	447.3	470.8	422.4	418.3
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-05	Maximum Voltage	V	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
C5-17	Motor Inertia	kgm <sup>2</sup>	0.063	0.113	0.137	0.252	0.304	0.410	0.55	0.82
n5-02	Motor Acceleration Time	s	0.061	0.091	0.090	0.122	0.119	0.132	0.145	0.159
n8-49	d-Axis Current for High Efficiency Control	%	-13.7	-15.2	-10.9	-9.8	-9.3	-11.5	-17.7	-17.1
S6-02 <1>	Motor Acceleration Time	s	0.061	0.091	0.090	0.122	0.119	0.132	0.145	0.159

<1> Default setting value varies by the drive model (o2-04).

Table B.20 400 V, 1150 r/min Type Yaskawa SST4 Series Motor

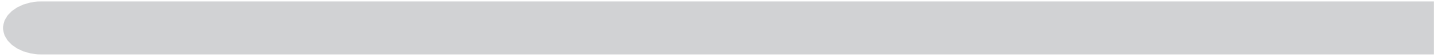
No.	Name	Unit	Default Settings										
E5-01	Motor Code Selection	–	2432	2433	2435	2436	2438	243A	243B	243D	243E	243F	2440
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400	400
	Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18	22
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
E5-02	Motor Rated Power	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15	18.50	22.00
E5-03	Motor Rated Current	A	0.89	1.72	3.02	4.58	7.40	10.21	13.75	19.5	27.7	32.7	39.2
E5-04	Number of Motor Poles	–	6	6	6	6	6	6	6	6	6	6	6
E5-05	Motor Stator Resistance	Ω	10.720	6.080	4.336	2.143	1.428	1.199	0.648	0.460	0.325	0.260	0.209
E5-06	Motor d-Axis Inductance	mH	122.20	61.16	70.24	46.20	33.87	41.67	21.24	17.76	12.83	11.68	10.09
E5-07	Motor q-Axis Inductance	mH	170.80	97.12	90.04	60.28	42.98	69.15	33.04	22.72	17.19	15.16	16.25
E5-09	Motor Induction Voltage Constant 1	mVs/rad	626.1	626.1	703.1	727.6	699.0	861.5	759.7	740.4	716.6	809.1	786.2
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
C5-17	Motor Inertia	kgm <sup>2</sup>	0.0022	0.0042	0.0081	0.0133	0.0168	0.027	0.044	0.054	0.063	0.113	0.137
n5-02	Motor Acceleration Time	s	0.080	0.081	0.078	0.088	0.066	0.070	0.085	0.071	0.061	0.091	0.090
n8-49	d-Axis Current for High Efficiency Control	%	-8.4	-11.0	-9.9	-9.0	-11.4	-23.2	-22.1	-16.7	-20.2	-15.2	-27.7
S6-02 <1>	Motor Acceleration Time	s	0.080	0.081	0.078	0.088	0.066	0.070	0.085	0.071	0.061	0.091	0.090

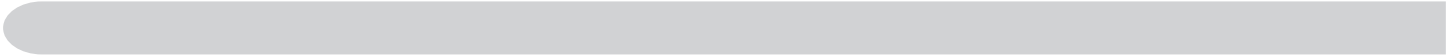
&lt;1&gt; Default setting value varies by the drive model (o2-04).

No.	Name	Unit	Default Settings										
E5-01	Motor Code Selection	–	2442	2443	2444	2445	2446	2447	2448	2449	244A	244C	
	Voltage Class	V	400	400	400	400	400	400	400	400	400	400	
	Rated Power	kW	30	37	45	55	75	90k	110	132	160	200	
	Rated Speed	r/min	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	
E5-02	Motor Rated Power	kW	30.00	37.00	45.00	55.00	75.00	90.00	110.00	132.00	160.00	200.00	
E5-03	Motor Rated Current	A	51.8	63.0	76.6	93.1	128.1	153.1	186.5	221.9	269.8	336.5	
E5-04	Number of Motor Poles	–	6	6	6	6	6	6	6	6	6	6	
E5-05	Motor Stator Resistance	Ω	0.140	0.106	0.076	0.051	0.032	0.026	0.015	0.012	0.009	0.007	
E5-06	Motor d-Axis Inductance	mH	8.12	6.43	4.96	3.99	2.97	2.44	1.87	1.49	1.41	1.22	
E5-07	Motor q-Axis Inductance	mH	9.84	7.71	6.56	5.39	3.90	3.23	2.46	2.08	1.88	1.51	
E5-09	Motor Induction Voltage Constant 1	mVs/rad	888.8	857.7	941.6	853.8	829.6	835.6	833.4	848.6	889.1	915.0	
E5-24	Motor Induction Voltage Constant 2	mV/(r/min)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
E1-04	Maximum Output Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	
E1-05	Maximum Voltage	V	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	
E1-06	Base Frequency	Hz	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	57.5	
E1-09	Minimum Output Frequency	Hz	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	
C5-17	Motor Inertia	kgm <sup>2</sup>	0.252	0.304	0.410	0.55	0.82	0.96	1.60	1.95	2.82	3.70	
n5-02	Motor Acceleration Time	s	0.122	0.119	0.132	0.145	0.159	0.155	0.211	0.214	0.256	0.268	
n8-49	d-Axis Current for High Efficiency Control	%	-9.8	-10.2	-11.5	-15.9	-15.7	-15.7	-14.7	-16.5	-14.1	-10.3	
S6-02 <1>	Motor Acceleration Time	s	0.122	0.119	0.132	0.145	0.159	0.155	0.211	0.214	0.256	0.268	

&lt;1&gt; Default setting value varies by the drive model (o2-04).







# Appendix: C

## **MEMOBUS/Modbus Communications**

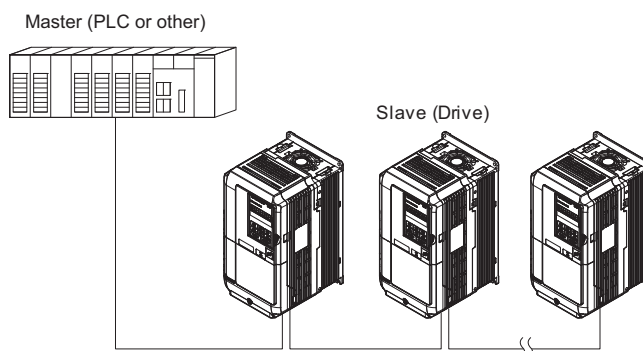
<b>C.1</b>	<b>MEMOBUS/MODBUS CONFIGURATION .....</b>	<b>510</b>
<b>C.2</b>	<b>COMMUNICATION SPECIFICATIONS .....</b>	<b>511</b>
<b>C.3</b>	<b>CONNECTING TO A NETWORK .....</b>	<b>512</b>
<b>C.4</b>	<b>MEMOBUS/MODBUS SETUP PARAMETERS .....</b>	<b>514</b>
<b>C.5</b>	<b>DRIVE OPERATIONS BY MEMOBUS/MODBUS .....</b>	<b>517</b>
<b>C.6</b>	<b>COMMUNICATIONS TIMING .....</b>	<b>518</b>
<b>C.7</b>	<b>MESSAGE FORMAT .....</b>	<b>519</b>
<b>C.8</b>	<b>MESSAGE EXAMPLES .....</b>	<b>521</b>
<b>C.9</b>	<b>MEMOBUS/MODBUS DATA TABLE .....</b>	<b>523</b>
<b>C.10</b>	<b>ENTER COMMAND .....</b>	<b>537</b>
<b>C.11</b>	<b>COMMUNICATION ERRORS .....</b>	<b>538</b>
<b>C.12</b>	<b>SELF-DIAGNOSTICS .....</b>	<b>539</b>

### C.1 MEMOBUS/Modbus Configuration

Drives can be controlled from a PLC or other master device via serial communications using the MEMOBUS/Modbus protocol.

MEMOBUS/Modbus communication can be configured using one master (PLC) and a maximum of 255 slaves. The drive has slave functionality only, meaning that serial communication is normally initiated from the master and responded to by the slaves.

The master performs serial communications with only one slave at a time. The address or node for each slave must be set beforehand so that the master can communicate with the slave at that address. A slave that receives a command from the master will perform the specified function and then send a response back to the master.



**Figure C.1 Connecting Multiple Drives to a PLC**

## C.2 Communication Specifications

MEMOBUS/Modbus specifications appear in the following table:

Item	Specifications	
Interface	RS-422, RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communication Parameters	Communication Speeds Available	1.2; 2.4; 4.8; 9.6; 19.2; 38.4; 57.6; 76.8; 115.2 kbps
	Data length	8 bit (fixed)
	Parity	Select even, odd, or none
	Stop bit	1 bit (fixed)
Protocol	MEMOBUS/Modbus (using RTU mode only)	
Max Number of Slaves	255 drives	

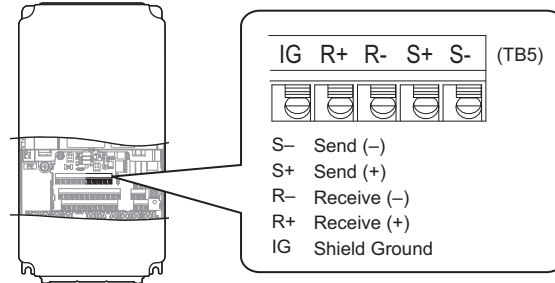
### C.3 Connecting to a Network

This section explains how to connect the drive to a MEMOBUS/Modbus network and the network termination required.

#### ? Network Cable Connection

Follow the instructions below to connect the drive to a MEMOBUS/Modbus network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminals TB5 for MEMOBUS/Modbus.



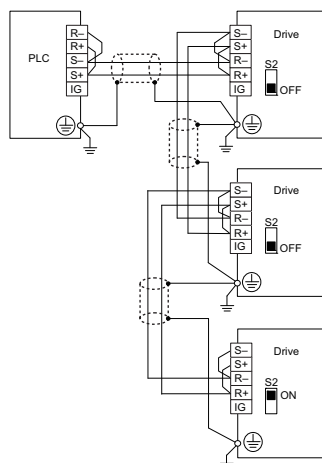
**Figure C.2 Serial Communications Cable Connection Terminals (TB5)**

- Note:** Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.
2. Check or set the termination resistor selection at all slaves. Use the description in [Network Termination on page 513](#) for slaves that are T1000A drives.
  3. Switch the power on.
  4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
  5. Shut the power off and wait until the display on the digital operator goes out completely.
  6. Turn the power back on.
  7. The drive is now ready to begin communicating with the master.

#### ? Wiring Diagram for Multiple Connection

[Figure C.3](#) and [Figure C.4](#) explain the wiring diagrams for multiple connections using MEMOBUS/Modbus communication.

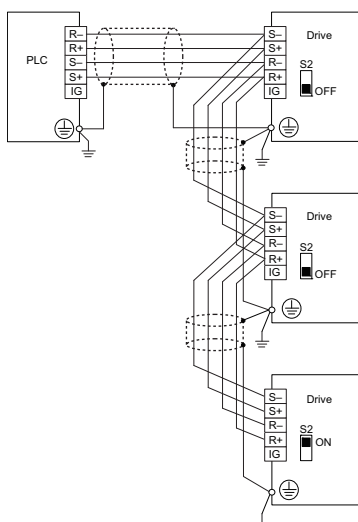
#### ? RS-485 Interface



**Figure C.3 RS-485 Interface**

- Note:**
1. Turn on the DIP switch on the drive that is located at the end of the network. All other slave devices must have this DIP switch set to the OFF position.
  2. Set H5-07 to "1" when using the RS-485 interface.

## ? RS-422 Interface



**Figure C.4 RS-422 Interface**

- Note:**
1. Turn on the DIP switch on the drive that is located at the end of the network. All other slave devices must have this DIP switch set to the OFF position.
  2. Set H5-07 to “0” when using the RS-485 interface.

## ? Network Termination

The two ends of the MEMOBUS/Modbus network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S2. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S2 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

Refer to [MEMOBUS/Modbus Termination on page 71](#) for details on setting S2.

## C.4 MEMOBUS/Modbus Setup Parameters

### ? MEMOBUS/Modbus Serial Communication

This section describes parameters necessary to set up MEMOBUS/Modbus communications.

#### ? H5-01: Drive Slave Address

Sets the drive slave address used for MEMOBUS/Modbus communications.

**Note:** After changing this parameter, the power must be cycled to enable the new setting.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FFH </>	1FH

<1> If the address is set to 0, no response will be provided during communications.

For serial communications to work, each individual slave drive must be assigned a unique slave address. Setting H5-01 to any value besides 0 assigns the drive its address in the network. Slave address don't need to be assigned in sequential order, but each address needs to be unique so that no two drives have the same address.

#### ? H5-02: Communication Speed Selection

Sets the MEMOBUS/Modbus communications speed.

**Note:** After changing this parameter, the power must be cycled to enable the new setting.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	3

H5-02	Communication Speed	H5-02	Communication Speed
0	1200 bps	5	38400 bps
1	2400 bps	6	57600 bps
2	4800 bps	7	76800 bps
3	9600 bps	8	115200 bps
4	19200 bps		

#### ? H5-03: Communication Parity Selection

Sets the parity used for MEMOBUS/Modbus communications.

**Note:** After changing this parameter, the power must be cycled to enable the new setting.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

**Setting 0: No parity**

**Setting 1: Even parity**

**Setting 2: Odd parity**

#### ? H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after Communication Error	0 to 3	3

**Setting 0: Ramp to stop (uses the deceleration time currently enabled)**

**Setting 1: Coast to stop**

**Setting 2: Fast Stop (uses the deceleration time in C1-09)**

**Setting 3: Alarm only (continue operation)**

### ? H5-05: Communication Fault Detection Selection

Enables or disabled the communication error (CE) detection for MEMOBUS/Modbus communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

#### Setting 0: Disabled

No communication error detection. The drive continues operation.

#### Setting 1: Enabled

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

### ? H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

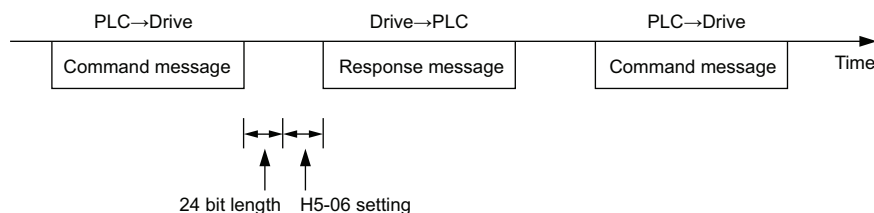


Figure C.5 Drive Transmit Wait Time Setting

### ? H5-07: RTS Control Selection

Enables or disables RTS control.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

#### Setting 0: Disabled. RTS is always on.

Use this setting with point-to-point RS-422 communications.

#### Setting 1: Enabled. RTS switches while sending.

Use this setting when using the RS-485 signals for communications or when using the RS-422 signals for point-to-point or multi-drop communications.

### ? H5-09: CE Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	CE Detection Time	0.0 to 10.0 s	2.0 s

### ? H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

#### Setting 0: 0.1 V units

#### Setting 1: 1 V units

### ? H5-11: Communications Enter Function Selection

Selects if an Enter command is needed to change parameter values via MEMOBUS/Modbus communications. *Refer to Enter Command on page 537.*

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

#### Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

#### Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

### ? H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to MEMOBUS/Modbus communications (b1-02, b1-16 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

#### Setting 0: FWD/Stop, REV/Stop

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

#### Setting 1: Run/Stop, FWD/REV

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive. Setting bit 1 changes the direction.

## C.5 Drive Operations by MEMOBUS/Modbus

The drive operations that can be performed by MEMOBUS/Modbus communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

### ? Observing the Drive Operation

A PLC can perform the following actions with MEMOBUS/Modbus communications at any time regardless of parameter settings (except H5-□□).

- Observe drive status and drive control terminal status from a PLC.
- Read and write parameters.
- Set and reset faults.
- Set multi-function inputs. Inputs settings from the input terminals (S1 to S8) and from MEMOBUS/Modbus communications are both linked by an OR operation.

### ? Controlling the Drive

To start and stop the drive or set the frequency reference using MEMOBUS/Modbus communications, an external reference must be selected and the parameters listed in [Table C.1](#) must be adjusted accordingly.

**Table C.1 Setting Parameters for Drive Control from MEMOBUS/Modbus**

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Source 1	2
	b1-02	Run Command Source 1	2
External Reference 2	b1-15	Frequency Reference Source 2	2
	b1-16	Run Command Source 2	2

*Refer to b1-01: Frequency Reference Source 1 on page 119 and Refer to b1-02: Run Command Source 1 on page 120 for details on external reference parameter selections. Refer to Setting 2: External reference 1/2 selection on page 193 for instructions on how to select external reference 1 and 2.*

# C.6 Communications Timing

To prevent overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

## ? Command Messages from Master to Drive

In order to prevent overrun and data loss, the master must wait between receiving a response and sending the same type of command as before to the same slave drive. The minimum wait time depends on the command as shown in the table below.

Table C.2 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	<ul style="list-style-type: none"><li>Control command (Run, Stop)</li><li>Set inputs/outputs</li><li>Read monitors and parameter values</li></ul>	5 ms </>
2	<ul style="list-style-type: none"><li>Write parameters</li></ul>	H5-11 = 0: 50 ms H5-11 = 1: 200ms </>
3	<ul style="list-style-type: none"><li>Save changes using an Enter command</li></ul>	200 ms to 2 s, depending on the number of parameters that were changed </>

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

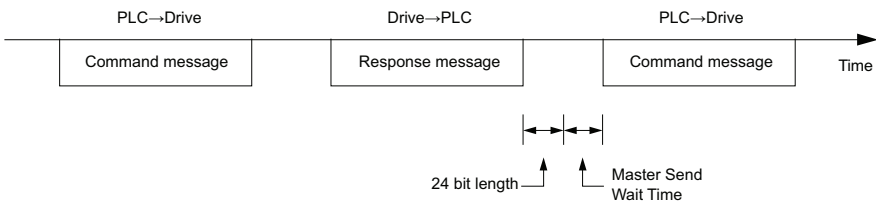


Figure C.6 Minimum Wait Time for Sending Messages

A timer should be set in the master to check how long it takes for the slave drive(s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

## ? Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes overrun in the master.

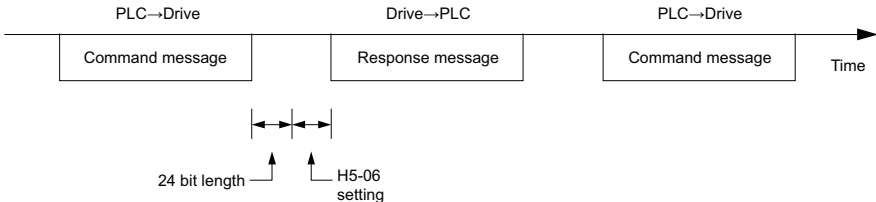


Figure C.7 Minimum Response Wait Time

## C.7 Message Format

### ? Message Content

In MEMOBUS/Modbus communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets depends on the command (function) content.

SLAVE ADDRESS
FUNCTION CODE
DATA
ERROR CHECK

### ? Slave Address

The slave address in the message defines the node the message is sent to. Use addresses between 0 and FF (hex). If a message with slave address 0 is sent (broadcast), the command from the master will be received by all slaves. The slaves do not provide a response to a broadcast type message.

### ? Function Code

The three types of function codes are shown in the table below.

Function Code	Function Name	Data Length (bytes)			
		Command Message		Response Message	
		Minimum	Maximum	Minimum	Maximum
03H	Read MEMOBUS/Modbus registers	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write to multiple MEMOBUS/Modbus registers	11	41	8	8

### ? Data

Configure consecutive data by combining the MEMOBUS/Modbus register address (test code in case of a loopback test) and the data the register contains. The data length changes depending on the command details.

A drive MEMOBUS/Modbus register always has a data length of two bytes. Therefore data written into drive registers must also always have a length of two bytes. Register data read out from the drive will always consist of two bytes.

### ? Error Check

The drive uses a CRC-16 (cyclic redundancy check, checksum method) for checking data validity. Use the procedure described below when calculating the CRC-16 checksum for command data or when verifying response data.

#### ? Command Data

When the drive receives data, it calculates the CRC-16 checksum from the data and compares it to the CRC-16 value received within the message. Both must match before a command is processed.

An initial value of FFFFH (i.e., all 16 bits equal 1) must be used for CRC-16 calculations in the MEMOBUS/Modbus protocol.

Calculate the CRC-16 checksum using the following steps:

1. The starting value is FFFFH.
2. Perform an XOR operation of this value and the slave address.
3. Right shift the result.
4. When the overflow bit of the shift operation becomes 1, perform an XOR operation of the result from step 3 above and the fix value A001H.
5. Repeat steps 3 and 4 until eight shift operations have been performed.

## C.7 Message Format

6. After eight shift operations, perform an XOR operation with the result and the next data in the message (function code, register address, data). Continue with steps 3 to 5 until the last data has been processed.
7. The result of the last shift or XOR operation is the checksum.

The example in **Table C.3** shows the CRC-16 calculation of the slave address 02H and the function code 03H, yielding the result D140H.

**Note:** This example does not show the calculation for a complete MEMOBUS/Modbus command. Normally data would follow in the calculation.

**Table C.3 CRC-16 Checksum Calculation Example**

Description	Calculation	Overflow	Description	Calculation	Overflow
Initial Value (FFFFH)	1111 1111 1111 1111		Function Code 03H	0000 0000 0000 0011	
Address 02H	0000 0000 0000 0010		XOR w result	1000 0001 0011 1101	
XOR w initial value	1111 1111 1111 1101		Shift 1	0100 0000 1001 1110	1
Shift 1	0111 1111 1111 1110	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1110 0000 1001 1111	
XOR result	1101 1111 1111 1111		Shift 2	0111 0000 0100 1111	1
Shift 2	0110 1111 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1101 0000 0100 1110	
XOR result	1100 1111 1111 1110		Shift 3	0110 1000 0010 0111	0
Shift 3	0110 0111 1111 1111	0	Shift 4	0011 0100 0001 0011	1
Shift 4	0011 0011 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1001 0100 0001 0010	
XOR result	1001 0011 1111 1110		Shift 5	0100 1010 0000 1001	0
Shift 5	0100 1001 1111 1111	0	Shift 6	0010 0101 0000 0100	1
Shift 6	0010 0100 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1000 0101 0000 0101	
XOR result	1000 0100 1111 1110		Shift 7	0100 0010 1000 0010	1
Shift 7	0100 0010 0111 1111	0	XOR w A001H	1010 0000 0000 0001	
Shift 8	0010 0001 0011 1111	1	XOR result	1110 0010 1000 0011	
XOR w A001H	1010 0000 0000 0001		Shift 8	0111 0001 0100 0001	1
XOR result	1000 0001 0011 1110		XOR w A001H	1010 0000 0000 0001	
Perform operations with next data (function code)			XOR result	1101 0001 0100 0000	
			CRC-16	1101 0001 0100 0000	
				D 1 4 0 (Lower) (Upper)	
			Continue from here with next data.		

### ? Response Data

To be sure that the data is valid, perform a CRC-16 calculation on the response message data as described above. Compare the result to the CRC-16 checksum that was received within the response message. Both should match.

## C.8 Message Examples

Below are some examples of command and response messages.

### ? Reading Drive MEMOBUS/Modbus Register Contents

Using the function code 03H (Read), a maximum of 16 MEMOBUS/Modbus registers can be read out at a time.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		02H	Slave Address		02H	Slave Address		02H
Function Code		03H	Function Code		03H	Function Code		83H
Starting No.	Upper	00H	Data Quantity		08H	Error Code		03H
	Lower	20H	1st storage register	Upper	00H	CRC-16	Upper	F1H
Data Quantity	Upper	00H		Lower	65H		Lower	31H
	Lower	04H	Next storage register	Upper	00H			
CRC-16	Upper	45H		Lower	00H			
	Lower	F0H	Next storage register	Upper	00H			
				Lower	00H			
			Next storage register	Upper	01H			
				Lower	F4H			
			CRC-16	Upper	AFH			
				Lower	82H			

### ? Loopback Test

Function code 08H performs a loopback test. This test returns a response message with exactly the same content as the command message and can be used to check communications between the master and slave. User-defined test code and data values can be set.

The following table shows a message example when performing a loopback test with the slave 1 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		08H	Function Code		08H	Function Code		88H
Test Code	Upper	00H	Test Code	Upper	00H	Error Code		01H
	Lower	00H		Lower	00H	CRC-16	Upper	86H
Data	Upper	A5H	Data	Upper	A5H		Lower	50H
	Lower	37H		Lower	37H			
CRC-16	Upper	DAH	CRC-16	Upper	DAH			
	Lower	8DH		Lower	8DH			

### ? Writing to Multiple Registers

Function code 10h allows the user to write multiple drive MEMOBUS/Modbus registers with one message. This process works similar to reading registers, i.e., the address of the first register that is to be written and the data quantity must be set in the command message. The data to be written must be consecutive so that the register addresses are in order, starting from the specified address in the command message. The data order must be high byte, then lower byte.

The following table shows an example of a message where a forward operation has been set with a frequency reference of 60.00 Hz for the slave 1 drive.

If parameter values are changed using the Write command, depending on the setting of H5-11, an Enter command will be necessary to activate the data or save them. [Refer to H5-11: Communications Enter Function Selection on page 516](#) and [Refer to Enter Command on page 537](#) for detailed descriptions.

Command Message			Response Message (normal)			Response Message (fault)					
Slave Address		01H	Slave Address		01H	Slave Address		01H			
Function Code		10H	Function Code		10H	Function Code		90H			
Starting No.	Upper	00H	Starting No.	Upper	00H	Error Code		02H			
	Lower	01H		Lower	01H	CRC-16	Upper	CDH			
Data Quantity	Upper	00H	Data Quantity	Upper	00H		Lower	C1H			
	Lower	02H		Lower	02H						
Number of Bytes		04H	CRC-16	Upper	10H						
Starting Data	Upper	00H		Lower	08H						
	Lower	01H									
Next Data	Upper	17H									
	Lower	70H									
CRC-16	Upper	6DH									
	Lower	67H									

**Note:** For the number of bytes in the command message, take double the number of the data quantity.

## C.9 MEMOBUS/Modbus Data Table

Table below lists all MEMOBUS/Modbus data. There are three types of data: command data, monitor data, and broadcast data.

### ? Command Data

It is possible to both read and write command data.

**Note:** Bits that are not used should be set to 0. Refrain from writing to reserved registers.

Register No.	Contents	
0000H	Reserved	
0001H	Operation Commands and Multi-function Inputs	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Forward Run) H5-12 = 1: Run Command (0 = Stop, 1 = Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Reverse Run) H5-12 = 1: Forward/Reverse (0 = Forward, 1 = Reverse)
	bit 2	External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input 1 Function is ComRef when H1-01 = 40 (Forward/Stop). Refer to <a href="#">d: Reference Settings on page 165</a> for ComRef explanations. <b>Note:</b> When the bit at ComCtrl is turned on, commands from MEMOBUS/Modbus communications take control of the operation. However, when a communications option card is connected, that option card is given priority.
	bit 5	Multi-Function Input 2 Function is ComCtrl when H1-02 = 41 (Reverse/Stop).
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B	Multi-Function Input 8
	bit C to F	Reserved
0002H	Frequency Reference	Units are determined by parameter o1-03, unsigned.
0003H	Output Voltage Gain	0.1% units Setting Range: 20 (2.0%) to 2000 (200.0%), default at power up: 1000 (100.0%)
0004H	Torque Reference/Torque Limit, 0.1% units, signed	
0005H	Torque Compensation, 0.1% units, signed	
0006H	PID Target, 0.01% units, signed	
0007H	Analog Output Terminal FM Setting (10 V / 4000 H)	
0008H	Analog Output Terminal AM Setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Digital Outputs	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 5	Reserved
	bit 6	Enables the function in bit 7
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
000AH	Pulse Output Terminal MP Setting, 1 Hz units, Setting Range: 0 to 32000	
000BH to 000EH	Reserved	

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents
000FH	Control Selection Setting
	bit 0 Reserved
	bit 1 PID Target Input
	bit 2 Torque reference / torque limit input (enables the setting from MEMOBUS/Modbus)
	bit 3 Torque compensation input (enables the setting from MEMOBUS/Modbus)
	bit 4 to B Reserved
	bit C Enable Terminal S5 Input for Broadcast Data
	bit D Enable Terminal S6 Input for Broadcast Data
	bit E Enable Terminal S7 Input for Broadcast Data
	bit F Enable Terminal S8 Input for Broadcast Data
0010H to 001AH	Reserved
001BH	Analog Monitor Option AO-A3 Analog Output 1 (10 V/4000 H)
001CH	Analog Monitor Option AO-A3 Analog Output 2 (10 V/4000 H)
001DH	Digital Output Option DO-A3 Output (Binary)
001EH, 001FH	Reserved

### ? Monitor Data

Monitor data can be read only.

Register No.	Contents
0020H	Drive Status 1
	bit 0 During Run
	bit 1 During Reverse
	bit 2 Drive Ready
	bit 3 Fault
	bit 4 Data Setting Error
	bit 5 Multi-Function Contact Output 1 (terminal M1-M2)
	bit 6 Multi-Function Contact Output 2 (terminal M3-M4)
	bit 7 Multi-Function Contact Output 3 (terminal M5-M6)
	bit 8 to bit D Reserved
	bit E ComRef status
	bit F ComCtrl status
0021H	Fault Contents 1
	bit 0 Overcurrent (oC), Ground fault (GF)
	bit 1 Overvoltage (ov)
	bit 2 Drive Overload (oL2)
	bit 3 Overheat 1 (oH1), Drive Overheat Warning (oH2)
	bit 4 Dynamic Braking Transistor Fault (rr), Braking Resistor Overheat (rH)
	bit 5 Reserved
	bit 6 PID Feedback Loss (FbL / FbH)
	bit 7 EF to EF8: External Fault
	bit 8 CPF□□: Hardware Fault (includes oF□)
	bit 9 Motor Overload (oL1), Overtorque Detection 1/2 (oL3/oL4), Undertorque Detection 1/2 (UL3/UL4)
	bit A PG Disconnected (PGo), PG Hardware Fault (PGoH), Overspeed (oS), Excessive Speed Deviation (dEv),
	bit B Main Circuit Undervoltage (Uv)
	bit C Undervoltage (Uv1), Control Power Supply Undervoltage (Uv2), Soft Charge Circuit Fault (Uv3)
	bit D Output Phase Loss (LF), Input Phase Loss (PF)
	bit E MEMOBUS/Modbus Communication Error (CE), Option Communication Error (bUS)
	bit F Operator Connection Fault (oPr)

Register No.	Contents	
0022H	Data Link Status	
	bit 0	Writing data or switching motors
	bit 1	Reserved
	bit 2	
	bit 3	Upper or lower limit error
	bit 4	Data conformity error
	bit 5	Writing to EEPROM
	bit 6 to bit F	Reserved
0023H	Frequency Reference, <f>	
0024H	Output Frequency, <f>	
0025H	Output Voltage Reference, 0.1 V units (units are determined by parameter H5-10)	
0026H	Output Current, 0.1 A units	
0027H	Output Power	
0028H	Torque Reference	
0029H	Fault Contents 2	
	bit 0	Reserved
	bit 1	Ground Fault (GF)
	bit 2	Input Phase Loss (PF)
	bit 3	Output Phase Loss (LF)
	bit 4	Braking Resistor Overheat (rH)
	bit 5	Reserved
	bit 6	Motor Overheat 2 (PTC input) (oH4)
	bit 7 to bit F	Reserved
002AH	Alarm Contents1	
	bit 0, 1	Reserved
	bit 2	Run Command Input Error (EF)
	bit 3	Drive Baseblock (bb)
	bit 4	Overtorque Detection 1 (oL3)
	bit 5	Heatsink Overheat (oH)
	bit 6	Overvoltage (ov)
	bit 7	Undervoltage (Uv)
	bit 8	Cooling Fan Error (FAn)
	bit 9	MEMOBUS/Modbus Communication Error (CE)
	bit A	Option Communication Error (bUS)
	bit B	Undertorque Detection 1/2 (UL3/UL4)
	bit C	Motor Overheat (oH3)
	bit D	PID Feedback Loss (FbL, FbH)
	bit E	Reserved
	bit F	Serial Communication Transmission Error (CALL)
002BH	Input Terminal Status	
	bit 0	Terminal S1 Closed
	bit 1	Terminal S2 Closed
	bit 2	Terminal S3 Closed
	bit 3	Terminal S4 Closed
	bit 4	Terminal S5 Closed
	bit 5	Terminal S6 Closed
	bit 6	Terminal S7 Closed
	bit 7	Terminal S8 Closed
	bit 8 to bit F	Reserved

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
002CH	Drive Status 2	
	bit 0	During Run
	bit 1	Zero Speed
	bit 2	Speed Agree
	bit 3	User Speed Agree
	bit 4	Frequency Detection 1
	bit 5	Frequency Detection 2
	bit 6	Drive Ready
	bit 7	During Undervoltage
	bit 8	During Baseblock
	bit 9	Frequency Reference from Operator Keypad
	bit A	Run Command from Operator Keypad
	bit B	Over/Undertorque 1, 2
	bit C	Frequency Reference Loss
	bit D	During Fault Restart
	bit E	Fault
	bit F	Communication Timeout
002DH	Output Terminal Status	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 6	Reserved
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
002EH-0030H	Reserved	
0031H	DC Bus Voltage, 1 Vdc units	
0032H	Torque Reference (U1-09), 1% units	
0033H	Reserved	
0034H	Product Code 1 [ASCII], Product Type (T1000 = TO)	
0035H	Product Code 2 [ASCII], Region Code	
0036H, 0037H	Reserved	
0038H	PID Feedback, 0.1% units, unsigned, 100% / max. output frequency	
0039H	PID Input, 0.1% units, signed, 100% / max. output frequency	
003AH	PID Output, 0.1% units, signed, 100% / max. output frequency	
003BH, 003CH	Reserved	
003DH	Communications Error Contents <3>	
	bit 0	CRC Error
	bit 1	Data Length Error
	bit 2	Reserved
	bit 3	Parity Error
	bit 4	Overflow Error
	bit 5	Framing Error
	bit 6	Timeout
	bit 7 to bit F	Reserved
003EH	Output Frequency	r/min <4>
003FH		0.01% units
0040H to 004AH	Used for various monitors U1-□□. Refer to <i>U: Monitors on page 470</i> for parameter details.	

Register No.	Contents	
004BH	Drive Status (U1-12)	
	bit 0	During Run
	bit 1	During Zero Speed
	bit 2	During Reverse Run
	bit 3	During Fault Reset Signal Input
	bit 4	During Speed Agree
	bit 5	Drive Ready
	bit 6	Alarm
	bit 7	Fault
	bit 8	During Operation Error (oPE□□)
	bit 9	During Momentary Power Loss
	bit A	Motor 2 selected
	bit B	Reserved
	bit E	ComRef status, NetRef status
	bit F	ComCtrl status, NetCtrl status
004CH to 007EH	Used for various monitors U1-□□, U4-□□, U5-□□ and U6-□□. Refer to <a href="#">U2: Fault Trace on page 472</a> for parameter details.	
007FH	Alarm Code, Refer to <a href="#">Alarm Register Contents on page 536</a> for alarm codes.	
0080H to 0097H	Used for monitors U2-□□, U3-□□. Refer to <a href="#">U: Monitors on page 470</a> for parameter details and Refer to <a href="#">Fault Trace Contents on page 534</a> for register value descriptions.	
0098H, 0099H	U4-01 (Cumulative Operation Time) Example: When U4-01 (Cumulative Operation Time) is 12345 hours, then 0098H = 1234 and 0099H = 5.	
009AH, 009BH	U4-03 (Cooling Fan Operation Time) Example: When U4-03 (Cooling Fan Operation Time) is 12345 hours, then 009AH = 1234 and 009BH = 5.	
009CH to 00AAH	Reserved	
00ABH	Drive Rated Current <2>	
00ACH	Motor Speed (U1-05)	r/min units <4>
00ADH		0.01% units
00AEH, 00AFH	Reserved	
00B0H	Option Code Connected to CN5-A	Register contains ASCII code of the option card. DI-A3 = 0001H DO-A3 = 0002H AI-A3 = 0003H AO-A3 = 0004H PG-B3 = 0011H PG-X3 = 0012H SI-C3 = 5343H SI-P3 = 5350H SI-T3 = 5354H
00B1H	Reserved	
00B2H	Option Code Connected to CN5-B	
00B3H	Option Code Connected to CN5-C	
00B4H	Reserved	
00B5H	Frequency Reference After	r/min units <4>
00B6H	Soft-starter (U1-16)	0.01% units
00B7H	Frequency Reference	r/min <4>
00B8H		0.01% units
00B9H to 00BEH	Reserved	
00BFH	Lists the last to digits of operation error code oPE□□.	

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00C0H	Fault Contents 3	
	bit 1	Undervoltage (Uv1)
	bit 2	Control Power Supply Undervoltage (Uv2)
	bit 3	Soft Charge Circuit Fault (Uv3)
	bit 4	Output Short-Circuit or IGBT Fault (SC)
	bit 5	Ground Fault (GF)
	bit 6	Overcurrent (oC)
	bit 7	Overvoltage (ov)
	bit 8	Heatsink Overheat (oH)
	bit 9	Heatsink Overheat (oH1)
	bit A	Motor Overload (oL1)
	bit B	Drive Overload (oL2)
	bit C	Overtorque Detection 1 (oL3)
	bit D	Overtorque Detection 2 (oL4)
	bit E	Dynamic Braking Transistor Fault (rr)
	bit F	Braking Resistor Overheat (rH)
00C1H	Fault Contents 4	
	bit 0	External Fault at input terminal S3 (EF3)
	bit 1	External Fault at input terminal S4 (EF4)
	bit 2	External Fault at input terminal S5 (EF5)
	bit 3	External Fault at input terminal S6 (EF6)
	bit 4	External Fault at input terminal S7 (EF7)
	bit 5	External Fault at input terminal S8 (EF8)
	bit 6	Cooling Fan Error (FAn)
	bit 7	Overspeed (os)
	bit 8	Excessive Speed Deviation (dEv)
	bit 9	PG Disconnected (PGo)
	bit A	Input Phase Loss (PF)
	bit B	Output Phase Loss (LF)
	bit C	Motor Overheat (PTC input) (oH3)
	bit D	Digital Operator Connection Fault (oPr)
	bit E	EEPROM Write Error (Err)
	bit F	Motor Overheat Fault (PTC input) (oH4)
00C2H	Fault Contents 5	
	bit 0	MEMOBUS/Modbus Communication Error (CE)
	bit 1	Option Communication Error (bUS)
	bit 2, 3	Reserved
	bit 4	Control Fault (CF)
	bit 5	Zero Servo Fault (SvE)
	bit 6	Option External Fault (EF0)
	bit 7	PID Feedback Loss (FbL)
	bit 8	Undertorque Detection 1 (UL3)
	bit 9	Undertorque Detection 2 (UL4)
	bit A to E	Reserved
	bit F	Hardware Fault (includes oF□)
00C3H	Fault Contents 6	
	bit 0	Reserved
	bit 1	Z Pulse Fall Detection (dv1)
	bit 2	Z Pulse Noise Fault Detection (dv2)
	bit 3	Inversion Detection (dv3)
	bit 4	Inversion Prevention Detection (dv4)
	bit 5	Current Imbalance (LF2)
	bit 6	Pullout Detection (STo)
	bit 7	PG Hardware Fault (PGoH)
	bit 8	MECHATROLINK Watchdog Timer Error (E5)
	bit 9	Reserved
	bit A	Too many speed search restarts (SEr)
	bit B to F	Reserved

Register No.	Contents	
00C4H	Fault Contents 7	
	bit 0	PID Feedback Loss (FbH)
	bit 1	External Fault 1, input terminal S1 (EF1)
	bit 2	External Fault 2, input terminal S2 (EF2)
	bit 3, 4	Reserved
	bit 5	Current Offset Fault (CoF)
	bit 6 to B	Reserved
	bit C	Output Voltage Detection Fault (voF)
	bit D	Braking Resistor Fault (rF)
	bit E	Braking Transistor Overload Fault (boL)
	bit F	Motor Overheat (NTC Input) (oH5)
00C5H	Fault Contents 8	
	bit 0	LSo Fault (LSo)
	bit 1	Node Setup Fault (nSE)
	bit 2	Thermistor Disconnect (THo)
	bit 3 to 9	Reserved
	bit A	Initial Polarity Estimation Timeout (dv7)
	bit B to F	Reserved
00C6H, 00C7H	Reserved	
00C8H	Alarm Contents 2	
	bit 0	Undervoltage (Uv)
	bit 1	Overvoltage (ov)
	bit 2	Heatsink Overheat (oH)
	bit 3	Drive Overheat (oH2)
	bit 4	Overtorque 1 (oL3)
	bit 5	Overtorque 2 (oL4)
	bit 6	Run Commands Input Error (EF)
	bit 7	Drive Baseblock (bb)
	bit 8	External Fault 3, input terminal S3 (EF3)
	bit 9	External Fault 4, input terminal S4 (EF4)
	bit A	External Fault 5, input terminal S5 (EF5)
	bit B	External Fault 6, input terminal S6 (EF6)
	bit C	External Fault 7, input terminal S7 (EF7)
	bit D	External Fault 8, input terminal S8 (EF8)
	bit E	Cooling Fan Error (FAn)
	bit F	Overspeed (oS)
00C9H	Alarm Contents 3	
	bit 0	Excessive Speed Deviation (dEv)
	bit 1	PG Disconnected (PGo)
	bit 2	Digital Operator Connection Fault (oPr)
	bit 3	MEMOBUS/Modbus Communication Error (CE)
	bit 4	Option Communication Error (bUS)
	bit 5	Serial Communication Transmission Error (CALL)
	bit 6	Motor Overload (oL1)
	bit 7	Drive Overload (oL2)
	bit 8	Reserved
	bit 9	Option Card External fault (EF0)
	bit A	Motor 2 Switch command input during run (rUn)
	bit B	Reserved
	bit C	Serial Communication Transmission Error (CALL)
	bit D	Undertorque Detection 1 (UL3)
	bit E	Undertorque Detection 2 (UL4)
	bit F	MEMOBUS/Modbus Test Mode Fault (SE)

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00CAH	Alarm Contents 4	
	bit 0	Reserved
	bit 1	Motor Overheat 1 (PTC Input) (oH3)
	bit 2 to 5	Reserved
	bit 6	PID Feedback Loss (FbL)
	bit 7	PID Feedback Loss (FbH)
	bit 9	Drive Disabled (dnE)
	bit A	PG Disconnected (PGo)
	bit B to F	Reserved
00CBH	Alarm Contents 5	
	bit 0	MECHATROLINK Watchdog Timer Error (E5)
	bit 1	Station Number Setting Error (AEr)
	bit 2	MECHATROLINK Comm. Cycle Setting Error (CyC)
	bit 3	High Current Alarm (HCA)
	bit 4	Cooling Fan Maintenance Time (LT-1)
	bit 5	Soft Charge Bypass Relay Maintenance Time (LT-2)
	bit 6	Reserved
	bit 7	SI-S EEPROM Error (EEP)
	bit 8	External Fault 1 (input terminal S1) (EF1)
	bit 9	External Fault 2 (input terminal S2) (EF2)
	bit A	Safe Disable Input (HbbF)
	bit B	Safe Disable Input (Hbb)
	bit C to F	Reserved
00CCH	Alarm Contents 6	
	bit 0	Output Voltage Detection Fault (VoF)
	bit 1	IGBT Maintenance Time (90%) (TrPC)
	bit 2	Capacitor Maintenance Time (LT-3)
	bit 3	IGBT Maintenance Time (50%) (LT-4)
	bit 4	Braking Transistor Overload Fault (boL)
	bit 5	Reserved
	bit 6	Input Phase Loss (PF)
	bit 7 to F	Reserved
00CDH, 00CEH	Reserved	
00CFH	Alarm Contents 7	
	bit 0	Undervoltage (Uv)
	bit 1 to F	Reserved
00D0H	CPF Contents 1	
	bit 0, 1	Reserved
	bit 2	A/D Conversion Error (CPF02)
	bit 3	PWM Data Fault (CPF03)
	bit 4, 5	Reserved
	bit 6	EEPROM Memory Data Error (CPF06)
	bit 7	Terminal Board Connection Error (CPF07)
	bit 8	EEPROM Serial Communications Fault (CPF08)
	bit 9, A	Reserved
	bit B	RAM Fault (CPF11)
	bit C	FLASH Memory Fault (CPF12)
	bit D	Watchdog Circuit Exception (CPF13)
	bit E	Control Circuit Fault (CPF14)
	bit F	Reserved

Register No.	Contents	
00D1H	CPF Contents 2	
	bit 0	Clock Fault (CPF16)
	bit 1	Timing Fault (CPF17)
	bit 2	Control Circuit Fault (CPF18)
	bit 3	Control Circuit Fault (CPF19)
	bit 4	Hardware fault at power up (CPF20)
	bit 5	Hardware fault at communication start up (CPF21)
	bit 6	A/D Conversion Fault (CPF22)
	bit 7	PWM Feedback Fault (CPF23)
	bit 8	Drive Unit Signal Fault (CPF24)
	bit 9	Terminal board is not properly connected. (CPF25)
	bit A	ASIC BB Circuit Error (CPF26)
	bit B	ASIC PWM Setting Register Error (CPF27)
	bit C	ASIC PWM Pattern Error (CPF28)
	bit D	ASIC On-delay Error (CPF29)
	bit E	ASIC BBON Error (CPF30)
	bit F	ASIC Code Error (CPF31)
00D2H	CPF Contents 3	
	bit 0	ASIC Start-up Error (CPF32)
	bit 1	Watch-dog Error (CPF33)
	bit 2	ASIC Power/Clock Error (CPF34)
	bit 3	External A/D Converter Error (CPF35)
	bit 4 to 7	Reserved
	bit 8	Control Circuit Error (CPF40)
	bit 9	Control Circuit Error (CPF41)
	bit A	Control Circuit Error (CPF42)
	bit B	Control Circuit Error (CPF43)
	bit C	Control Circuit Error (CPF44)
	bit D	Control Circuit Error (CPF45)
	bit E, F	Reserved
00D3H to 00D7H	oFA0x Contents (CN5-A)	
00D8H	oFA0x Contents (CN5-A)	
	bit 0	Option Compatibility Error (oFA00)
	bit 1	Option not properly connected (oFA01)
	bit 2 to 4	Reserved
	bit 5	A/D Conversion Error (oFA05)
	bit 6	Option Response Error (oFA06)
	bit 7 to F	Reserved
00D9H	oFA1x Contents (CN5-A)	
	bit 0	Option RAM Fault (oFA10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFA11)
	bit 2	Drive Receive CRC Error (oFA12)
	bit 3	Drive Receive Frame Error (oFA13)
	bit 4	Drive Receive Abort Error (oFA14)
	bit 5	Option Receive CRC Error (oFA15)
	bit 6	Option Receive Frame Error (oFA16)
	bit 7	Option Receive Abort Error (oFA17)
	bit 8 to F	Reserved
00DAH	Reserved	

## C.9 MEMOBUS/Modbus Data Table

Register No.	Contents	
00DBH	oFA3x Contents (CN5-A)	
	bit 0	Comm. ID Error (oFA30)
	bit 1	Model Code Error (oFA31)
	bit 2	Sumcheck Error (oFA32)
	bit 3	Comm. option timeout waiting for response (oFA33)
	bit 4	MEMOBUS Timeout (oFA34)
	bit 5	Drive timeout waiting for response (oFA35)
	bit 6	CI Check Error (oFA36)
	bit 7	Drive timeout waiting for response (oFA37)
	bit 8	Control Command Selection Error (oFA38)
	bit 9	Drive timeout waiting for response (oFA39)
	bit A	Control Response Selection 1 Error (oFA40)
	bit B	Drive timeout waiting for response (oFA41)
	bit C	Control Response Selection 2 Error (oFA42)
	bit D	Control Response Selection Error (oFA43)
	bit E, F	Reserved
00DCH	oFb0x Contents (CN5-B)	
	bit 0	Option compatibility error (oFb00)
	bit 1	Option not properly connected (oFb01)
	bit 2	Same type of option card already connected (oFb02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFb05)
	bit 6	Option Response Error (oFb06)
	bit 7 to F	Reserved
00DDH	oFb1x Contents (CN5-B)	
	bit 0	Option RAM Fault (oFb10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFb11)
	bit 2	Drive Receive CRC Error (oFb12)
	bit 3	Drive Receive Frame Error (oFb13)
	bit 4	Drive Receive Abort Error (oFb14)
	bit 5	Option Receive CRC Error (oFb15)
	bit 6	Option Receive Frame Error (oFb16)
	bit 7	Option Receive Abort Error (oFb17)
	bit 8 to F	Reserved
00DEH, 00DFH	Reserved	
00E0H	oFb3x Contents (CN5-B)	
	bit 0	Comm. ID Error (oFb30)
	bit 1	Model Code Error (oFb31)
	bit 2	Sumcheck Error (oFb32)
	bit 3	Comm. option timeout waiting for response (oFb33)
	bit 4	MEMOBUS Timeout (oFb34)
	bit 5	Drive timeout waiting for response (oFb35)
	bit 6	CI Check Error (oFb36)
	bit 7	Drive timeout waiting for response (oFb37)
	bit 8	Control Command Selection Error (oFb38)
	bit 9	Drive timeout waiting for response (oFb39)
	bit A	Control Response Selection 1 Error (oFb40)
	bit B	Drive timeout waiting for response (oFb41)
	bit C	Control Response Selection 2 Error (oFb42)
	bit D	Control Response Selection Error (oFb43)
	bit E, F	Reserved

Register No.	Contents	
00E1H	oFC0x Contents (CN5-C)	
	bit 0	Option compatibility error (oFC00)
	bit 1	Option not properly connected (oFC01)
	bit 2	Same type of option card already connected (oFC02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFC05)
	bit 6	Option Response Error (oFC06)
	bit 7 to F	Reserved
00E2H	oFC1x Contents (CN5-C)	
	bit 0	Option RAM Fault (oFC10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFC11)
	bit 2	Drive Receive CRC Error (oFC12)
	bit 3	Drive Receive Frame Error (oFC13)
	bit 4	Drive Receive Abort Error (oFC14)
	bit 5	Option Receive CRC Error (oFC15)
	bit 6	Option Receive Frame Error (oFC16)
	bit 7	Option Receive Abort Error (oFC17)
	bit 8 to F	Reserved
00E3H to 00FAH	Reserved	
00FBH	Output Current <2>	
00FCH to 00FFH	Reserved	
0820H to 0824H	Used for various monitors U9-□□. Refer to <a href="#">U9: KEB Voltage Monitors on page 478</a> for parameter details.	

<1> Units are determined by parameter o1-03.

<2> This value's number of decimal places depends on the drive model and the Heavy/Normal duty selection in parameter C6-01. The value will have two decimal places (0.01A) if the drive is set for a Maximum Applicable Motor Capacity up to 11 kW (refer to [Table A.2](#) and [Table A.3](#)) and one decimal place (0.1A) if the set Maximum Applicable Motor Capacity is higher than 11 kW.

<3> The contents of a communication error are saved until the fault is reset.

<4> Depending on the motor used, the correct motor pole number must be set to parameter E2-04, E4-04, or E5-05.

## ? Broadcast Messages

Data can be written from the master to all slave devices at the same time.

The slave address in a broadcast command message must be set to 00H. All slaves will receive the message, but will not respond.

Register No.	Contents	
0001H	Digital Input Command	
	bit 0	Forward Run (0: Stop 1: Run)
	bit 1	Direction Command (0: Forward, 1: Reverse)
	bit 2, 3	Reserved
	bit 4	External Fault
	bit 5	Fault Reset
	bit 6 to B	Reserved
	bit C	Multi-Function Digital Input S5
	bit D	Multi-Function Digital Input S6
	bit E	Multi-Function Digital Input S7
	bit F	Multi-Function Digital Input S8
0002H	Frequency Reference	30000/100%

## ? Fault Trace Contents

The table below shows the fault codes that can be read out by MEMOBUS/Modbus commands from the U2-□□ monitor parameters.

**Table C.4 Fault Trace / History Register Contents**

Fault Code	Fault Name	Fault Code	Fault Name
0002H	Undervoltage (Uv1)	0098H	PWM Feedback Fault (CPF23)
0003H	Control Power Supply Undervoltage (Uv2)	0099H	Drive Unit Signal Fault (CPF24)
0004H	Soft Charge Circuit Fault (Uv3)	009AH	Terminal board is not properly connected. (CPF25)
0005H	Output Short-Circuit or IGBT Fault (SC)	009BH	ASIC BB Circuit Error (CPF26)
0006H	Ground Fault (GF)	009CH	ASIC PWM Setting Register Error (CPF27)
0007H	Overcurrent (oC)	009DH	ASIC PWM Pattern Error (CPF28)
0008H	Overvoltage (ov)	009EH	ASIC On-Delay Error (CPF29)
0009H	Heatsink Overheat (oH)	009FH	ASIC BBON Error (CPF30)
000AH	Heatsink Overheat (oH1)	00A0H	ASIC Code Error (CPF31)
000BH	Motor Overload (oL1)	00A1H	ASIC Start-p Error (CPF32)
000CH	Drive Overload (oL2)	00A2H	Watch-dog Error (CPF33)
000DH	Overtorque Detection 1 (oL3)	00A3H	ASIC Power/Clock Error (CPF34)
000EH	Overtorque Detection 2 (oL4)	00A4H	External A/D Converter Error (CPF35)
000FH	Dynamic Braking Transistor (rr)	00A9H	Control Circuit Error (CPF40)
0010H	Braking Resistor Overheat (rH)	00AAH	Control Circuit Error (CPF41)
0011H	External Fault at input terminal S3 (EF3)	00ABH	Control Circuit Error (CPF42)
0012H	External Fault at input terminal S4 (EF4)	00ACH	Control Circuit Error (CPF43)
0013H	External Fault at input terminal S5 (EF5)	00ADH	Control Circuit Error (CPF44)
0014H	External Fault at input terminal S6 (EF6)	00AEH	Control Circuit Error (CPF45)
0015H	External Fault at input terminal S7 (EF7)	0101H	Option compatibility error (oFA00)
0016H	External Fault at input terminal S8 (EF8)	0102H	Option not properly connected (oFA01)
0017H	Internal Fan Fault (FAn)	0106H	A/D Conversion Error (oFA05)
0018H	Overspeed (oS)	0107H	Option Response Error (oFA06)
0019H	Excessive Speed Deviation (dEv)	0111H	Option RAM Fault (oFA10)
001AH	PG Disconnect (PGo)	0112H	Option Operation Mode Fault (SLMOD) (oFA11)
001BH	Input Phase Loss (PF)	0113H	Drive Receive CRC Error (oFA12)
001CH	Output Phase Loss (LF)	0114H	Drive Receive Frame Error (oFA13)
001DH	Motor Overheat (PTC input) (oH3)	0115H	Drive Receive Abort Error (oFA14)
001EH	Digital Operator Connection (oPr)	0116H	Option Receive CRC Error (oFA15)

Fault Code	Fault Name	Fault Code	Fault Name
001FH	EEPROM Write Error (Err)	0117H	Option Receive Frame Error (oFA16)
0020H	Motor Overheat (PTC input) (oH4)	0118H	Option Receive Abort Error (oFA17)
0021H	MEMOBUS/Modbus Communication Error (CE)	0131H	Comm. ID Error (oFA30)
0022H	Option Communication Error (bUS)	0132H	Model Code Error (oFA31)
0025H	Control fault (CF)	0133H	Sumcheck Error (oFA32)
0026H	Zero-Serve Fault (SvE)	0134H	Comm. option timeout waiting for response (oFA33)
0027H	Option External Fault (EF0)	0135H	MEMOBUS Timeout (oFA34)
0028H	PID Feedback Loss (FbL)	0136H	Drive timeout waiting for response (oFA35)
0029H	Undertorque Detection 1 (UL3)	0137H	CI Check Error (oFA36)
002AH	Undertorque Detection 2 (UL4)	0138H	Drive timeout waiting for response (oFA37)
0032H	Z Pulse Fall Detection (dv1)	0139H	Control Command Selection Error (oFA38)
0033H	Z Pulse Noise Fault Detection (dv2)	013AH	Drive timeout waiting for response (oFA39)
0034H	Inversion Detection (dv3)	013BH	Control Response Selection 1 Error (oFA40)
0035H	Inversion Prevention Detection (dv4)	013CH	Drive timeout waiting for response (oFA41)
0036H	Output Current Imbalance (LF2)	013DH	Control Response Selection 2 Error (oFA42)
0037H	Pullout Detection (STo)	013EH	Control Response Selection Error (oFA43)
0038H	PG Hardware Fault (PGoH)	0201H	Option Connection Error (oFb01)
0039H	MECHATROLINK Watchdog Timer Error (E5)	0202H	Same type of option card already connected (oFb02)
003BH	Too many speed search restarts (SEr)	0205H	A/D Conversion Error (oFb05)
0041H	PID Feedback Loss (FbH)	0206H	Option Response Error (oFb06)
0042H	External Fault 1, input terminal S1 (EF1)	0210H	Option RAM Fault (oFb10)
0043H	External Fault 2, input terminal S2 (EF2)	0211H	Option Operation Mode Fault (SLMOD) (oFb11)
0046H	Current Offset Fault (CoF)	0212H	Drive Receive CRC Error (oFb12)
0047H	PLC Detection Error 1 (PE1)	0213H	Drive Receive Frame Error (oFb13)
0048H	PLC Detection Error 2 (PE2)	0214H	Drive Receive Abort Error (oFb14)
004DH	Output Voltage Detection Fault (voF)	0215H	Option Receive CRC Error (oFb15)
004EH	Braking Resistor Transistor Fault (rF)	0216H	Option Receive Frame Error (oFb16)
004FH	Braking Transistor Overload Fault (boL)	0217H	Option Receive Abort Error (oFb17)
0051H	LSO Fault (LSO)	0231H	Comm. ID Error (oFb30)
0052H	Node Setup Fault (nSE)	0232H	Model Code Error (oFb31)
005BH	Initial Polarity Estimation Timeout (dv7)	0233H	Sumcheck Error (oFb32)
0083H	A/D Conversion Error (CPF02)	0234H	Comm. option timeout waiting for response (oFb33)
0084H	PWM Data Fault (CPF03)	0235H	MEMOBUS Timeout (oFb34)
0087H	EEPROM Memory Data Error (CPF06)	0236H	Drive timeout waiting for response (oFb35)
0088H	Terminal Board Connection Error (CPF07)	0237H	CI Check Error (oFb36)
0089H	EEPROM Serial Communication Fault (CPF08)	0238H	Drive timeout waiting for response (oFb37)
008CH	RAM Fault (CPF11)	0239H	Control Command Selection Error (oFb38)
008DH	Flash Memory Circuit Exception (CPF12)	023AH	Drive timeout waiting for response (oFb39)
008EH	Watchdog Circuit Exception (CPF13)	023BH	Control Response Selection 1 Error (oFb40)
008FH	Control Circuit Fault (CPF14)	023CH	Drive timeout waiting for response (oFb41)
0091H	Clock Fault (CPF16)	023DH	Control Response Selection 2 Error (oFb42)
0092H	Timing Fault (CPF17)	023EH	Control Response Selection Error (oFb43)
0093H	Control Circuit Fault (CPF18)	0300H	Option Compatibility Error (oFC00)
0094H	Control Circuit Fault (CPF19)	0301H	Option not properly connected (oFC01)
0095H	Hardware fault at power up (CPF20)	0302H	Same type of option card already connected (oFC02)
0096H	Hardware fault at communication start up (CPF21)	0305H	A/D Conversion Error (oFC05)
0097H	A/D Conversion Fault (CPF22)	0306H	Option Response Error (oFC06)

## ? Alarm Register Contents

The table below shows the alarm codes that can be read out from MEMOBUS/Modbus register 007FH.

**Table C.5 Alarm Register 007FH Contents**

Alarm Code	Fault Name	Alarm Code	Fault Name
0001H	Undervoltage (Uv)	0020H	MEMOBUS/Modbus Test Mode Fault (SE)
0002H	Overvoltage (ov)	0022H	Motor Overheat (oH3)
0003H	Heatsink Overheat (oH)	0027H	PID Feedback Loss (FbL)
0004H	Drive Overheat (oH2)	0028H	PID Feedback Loss (FbH)
0005H	Overtorque 1 (oL3)	002AH	Drive Disabled (dnE)
0006H	Overtorque 2 (oL4)	002BH	PG Disconnected (PGo)
0007H	Run commands input error (EF)	0031H	MECHATROLINK Watchdog Timer Error (E5)
0008H	Drive Baseblock (bb)	0032H	Station Number Setting Error (AEr)
0009H	External Fault 3, input terminal S3 (EF3)	0033H	MECHATROLINK Comm. Cycle Setting Error (CyC)
000AH	External Fault 4, input terminal S4 (EF4)	0034H	High Current Alarm (HCA)
000BH	External Fault 5, input terminal S5 (EF5)	0035H	Cooling Fan Maintenance Time (LT-1)
000CH	External Fault 6, input terminal S6 (EF6)	0036H	Capacitor Maintenance Time (LT-2)
000DH	External Fault 7, input terminal S7 (EF7)	0038H	SI-S EEPROM Error (EEP)
000EH	External Fault 8, input terminal S8 (EF8)	0039H	External Fault (input terminal S1) (EF1)
000FH	Cooling Fan Error (FAn)	003AH	External Fault (input terminal S2) (EF2)
0010H	Overspeed (oS)	003BH	Safe Disable Input (HbbF)
0011H	Excessive Speed Deviation (dEv)	003CH	Safe Disable Input (Hbb)
0012H	PG Disconnected (PGo)	003FH	PLC Alarm (PA1)
0014H	MEMOBUS/Modbus Communication Error (CE)	0040H	PLC Alarm (PA2)
0015H	Option Communication Error (bUS)	0041H	Output Voltage Detection Fault (voF)
0016H	Serial Communication Transmission Error (CALL)	0042H	IGBT Maintenance Time (90%) (TrPC)
001AH	Option Card External Fault (EF0)	0043H	Soft Charge Bypass Relay Maintenance Time (LT-3)
001BH	Motor Switch command input during run (rUn)	0044H	IGBT Maintenance Time (50%) (LT-4)
001DH	Serial Communication Transmission Error (CALL)	0045H	Braking Transistor Overload (boL)
001EH	Undertorque Detection 1 (UL3)	0047H	Input Phase Loss (PF)
001FH	Undertorque Detection 2 (UL4)	0071H	Undervoltage (Uv)

## C.10 Enter Command

When writing parameters to the drive from the PLC using MEMOBUS/Modbus communication, parameter H5-11 determines if an Enter command must be issued to enable these parameters or not. This section describes the types of Enter commands and how they work.

### ? Enter Command Types

The drive supports two types of Enter commands as shown in the table below. An Enter command is enabled by writing 0 to register number 0900H or 0910H. These registers can only be written to. An error will occur if the user attempts to read from these registers.

**Table C.6 Enter Command Types**

Register No.	Description
0900H	Writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM at the same time. Parameter changes remain even if the power supply is cycled.
0910H	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.

**Note:** Because the EEPROM can be written to a maximum of 100,000 times, refrain from writing to the EEPROM too often. The Enter command registers are write-only. Consequently, if these registers are read, then the register address will be invalid (Error code: 02H). An Enter command is not required if reference or broadcast data are sent to the drive.

### ? Enter Command Settings when Upgrading the Drive

When replacing earlier Yaskawa drive models with the T1000A and keeping the MEMOBUS/Modbus communications settings, parameter H5-11 needs to be set in accordance with how the Enter command was set up in the older drive. H5-11 determines if an Enter command is needed or not in order to activate parameter changes in the drive.

- If upgrading from a G7 or F7 series drive to an T1000A, set parameter H5-11 to 0.
- If upgrading from a V7 series drive to an T1000A, set parameter H5-11 to 1.

### ? H5-11 and the Enter Command

H5-11 Settings	H5-11 = 0	H5-11 = 1
Drive being replaced	G7, F7	V7
How parameter settings are enabled	When the Enter command is received from the master.	As soon as the value is changed.
Upper/lower limit check	Upper/lower limit check is performed, taking the settings of related parameters into account.	Checks only the upper/lower limits of the parameters that were changed.
Default value of related parameters	Not affected. The settings of related parameters remain unchanged. They must be changed manually if needed.	Default settings of related parameters are changed automatically.
Error handling when setting multiple parameters	Data is accepted even if one setting is invalid. The invalid setting will be discarded. No error message occurs.	Error occurs if only one setting is invalid. All data that was sent are discarded.

## C.11 Communication Errors

### ? MEMOBUS/Modbus Error Codes

A list of MEMOBUS/Modbus errors appears below.

When an error occurs, remove whatever caused the error and restart communications.

Error Code	Error Name
	Cause
01H	Function Code Error
	<ul style="list-style-type: none"> <li>Attempted to set a function code from a PLC other than 03H, 08H, and 10H.</li> </ul>
02H	Register Number Error
	<ul style="list-style-type: none"> <li>A register number specified in the command message does not exist.</li> <li>Attempted to send a broadcast message using other register numbers than 0001H or 0002H.</li> </ul>
03H	Bit Count Error
	<ul style="list-style-type: none"> <li>Read data or write data is greater than 16 bits. Invalid command message quantity.</li> <li>In a write message, the "Number of Data Items" contained within the message does not equal twice the amount of data words (i.e., the total of Data 1+ Data 2, etc.).</li> </ul>
21H	Data Setting Error
	<ul style="list-style-type: none"> <li>Control data or parameter write data is outside the allowable setting range.</li> <li>Attempted to write a contradictory parameter setting.</li> </ul>
22H	Write Mode Error
	<ul style="list-style-type: none"> <li>During run, the user attempted to write a parameter that cannot be written to during run.</li> <li>During an EEPROM memory data error (CPF06), the master attempted to write to a parameter other than A1-00 to A1-05, or o2-04.</li> <li>Attempted to write to read-only data.</li> </ul>
23H	DC Bus Undervoltage Write Error
	<ul style="list-style-type: none"> <li>During an undervoltage situation, the master attempted to write to parameters that cannot be written to during undervoltage.</li> </ul>
24H	Write Error During Parameter Process
	<ul style="list-style-type: none"> <li>Master attempted writing to the drive while the drive was processing parameter data.</li> </ul>

### ? Slave Not Responding

In the following situations, the slave drive will ignore the command message sent from the master, and not send a response message:

- When a communications error (overflow, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the drive do not match (remember to set the slave address for the drive using H5-01).
- When the gap between two blocks (8 bit) of a message exceeds 24 bits.
- When the command message data length is invalid.

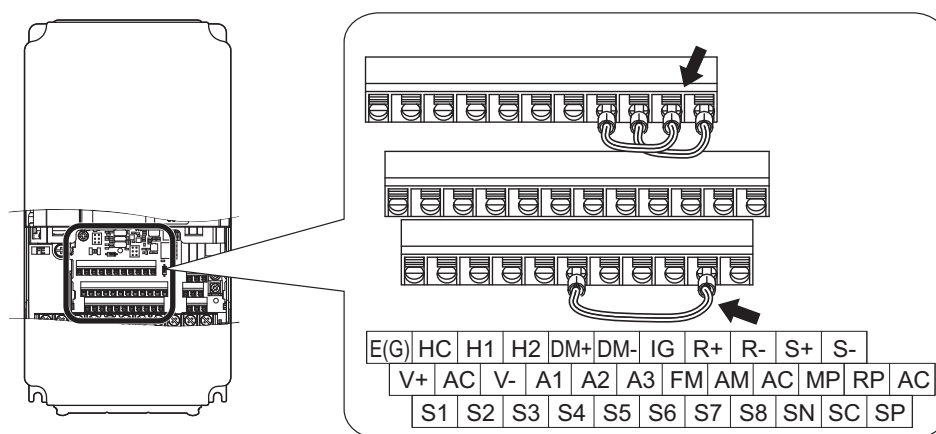
**Note:** If the slave address specified in the command message is 00H, all slaves execute the write function, but do not return response messages to the master.

## C.12 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function, use the following procedure.

**DANGER! Electrical Shock Hazard.** Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least one minute after all indicators are OFF and measure the DC bus voltage level to confirm safe level.

1. Turn on the power to the drive.
2. Note the present terminal S6 function selection setting (H1-06) and set it for the communications test mode (H1-06 = 67).
3. Turn off the power to the drive.



**Figure C.8 Terminal Connections for Communication Self-Diagnostics**

4. With the power off, wire the drive as shown in the following diagram, connecting terminals R+ and S+, R- and S-, and S6 and SC.
5. Set jumper S3 to source mode (internal power supply).
6. Turn the power to the drive back on.
7. During normal operation, the drive will display *PRSS*. This indicates that the communications test mode is operating normally.  
When a fault occurs, the drive will display *EE* on the keypad display.
8. Turn off the power supply.
9. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SC. Set back jumper S3 to its original position. Set terminal S6 to its original function.
10. Return to normal operation.



# Appendix: D

## Standards Compliance

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This appendix explains the guidelines and criteria for maintaining CE and UL standards.

D.1	SECTION SAFETY .....	542
D.2	EUROPEAN STANDARDS.....	544
D.3	UL STANDARDS .....	549
D.4	SAFE DISABLE INPUT FUNCTION.....	559

## D.1 Section Safety

### DANGER

#### Electrical Shock Hazard

**Do not connect or disconnect wiring while the power is on.**

Failure to comply will result in death or serious injury.

### WARNING

#### Electrical Shock Hazard

**Do not operate equipment with covers removed.**

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

**Always ground the motor-side grounding terminal.**

Improper equipment grounding could result in death or serious injury by contacting the motor case.

**Do not touch any terminals before the capacitors have fully discharged.**

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

**Do not allow unqualified personnel to perform work on the drive.**

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

**Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.**

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

**Do not remove covers or touch circuit boards while the power is on.**

Failure to comply could result in death or serious injury.

**⚠ WARNING****Fire Hazard**

**Tighten all terminal screws to the specified tightening torque.**

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

**Do not use an improper voltage source.**

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

**Do not use improper combustible materials.**

Failure to comply could result in death or serious injury by fire.

Attach the drive to metal or other noncombustible material.

**NOTICE**

**Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.**

Failure to comply may result in ESD damage to the drive circuitry.

**Never connect or disconnect the motor from the drive while the drive is outputting voltage.**

Improper equipment sequencing could result in damage to the drive.

**Do not use unshielded wire for control wiring.**

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

**Do not allow unqualified personnel to use the product.**

Failure to comply could result in damage to the drive or braking circuit.

Carefully review instruction manual TOBP C720600 00 when connecting a braking option to the drive.

**Do not modify the drive circuitry.**

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for modification of the product made by the user. This product must not be modified.

**Check all the wiring to ensure that all connections are correct after installing the drive and connecting other devices.**

Failure to comply could result in damage to the drive.

**When a fuse blows or if drive power has been interrupted, wait briefly before switching the power back on or operating the peripheral devices.**

Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified.

## D.2 European Standards



Figure D.1 CE Mark

The CE mark indicates compliance with European safety and environmental regulations. It is required for engaging in business and commerce in Europe.

European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers, and the EMC guidelines for controlling noise.

This drive displays the CE mark based on the EMC guidelines and the Low Voltage Directive.

- **Low Voltage Directive:** 2006/95/EC
- **EMC Guidelines:** 2004/108/EC

Devices used in combination with this drive must also be CE certified and display the CE mark. When using drives displaying the CE mark in combination with other devices, it is ultimately the responsibility of the user to ensure compliance with CE standards. After setting up the device, verify that conditions meet European standards.

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### ? CE Low Voltage Directive Compliance

This drive has been tested according to European standard IEC/EN 61800-5-1, and it fully complies with the Low Voltage Directive.

To comply with the Low Voltage Directive, be sure to meet the following conditions when combining this drive with other devices:

#### ? Area of Use

Do not use drives in areas with pollution higher than severity 2 and overvoltage category 3 in accordance with IEC/EN 664.

#### ? Installing Fuses on the Input Side

Always install fuses at the drive input side. Refer to *Installing Input Fuses on page 390* for selecting fuses.

#### ? Guarding Against Harmful Materials

When installing IP20 enclosure drives, use an enclosure that prevents foreign material from entering the drive from above or below.

#### ? Grounding

The drive is designed to be used in T-N (grounded neutral point) networks. If installing the drive in other types of grounded systems, contact your Yaskawa representative for instructions.

## ? EMC Guidelines Compliance

This drive is tested according to European standards IEC/EN 61800-3: 2004, and complies with the EMC guidelines.

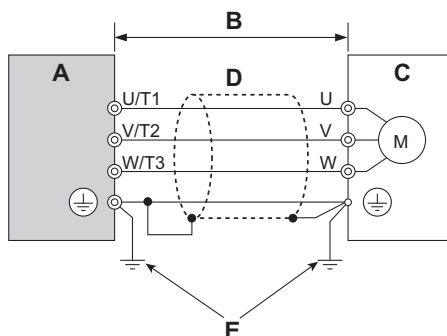
## ? EMC Filter Installation

The following conditions must be met to ensure continued compliance with guidelines. *Refer to EMC Filters on page 547* for EMC filter selection.

### Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with this drive also comply with EMC guidelines.

1. Install an EMC noise filter to the input side specified by Yaskawa for compliance with European standards.
2. Place the drive and EMC noise filter in the same enclosure.
3. Use braided shield cable for the drive and motor wiring, or run the wiring through a metal conduit.
4. Keep wiring as short as possible. Ground the shield on both the drive side and the motor side.



A – Drive

B – 10 m max cable length between drive and motor

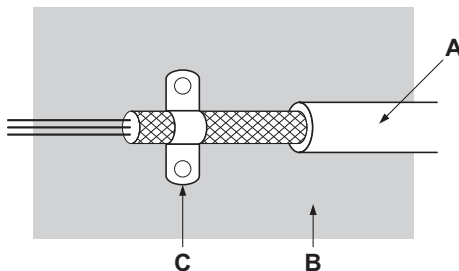
C – Motor

D – Metal conduit

E – Ground wire should be as short as possible.

Figure D.2 Installation Method

5. Ground the largest possible surface area of the shield to the metal conduit when using braided shield cable. Yaskawa recommends using a cable clamp.



A – Braided shield cable

B – Metal panel

C – Cable clamp (conductive)

Figure D.3 Ground Area

6. Connect a DC reactor to minimize harmonic distortion. See page 548.

### Three-Phase 200 V / 400 V Class

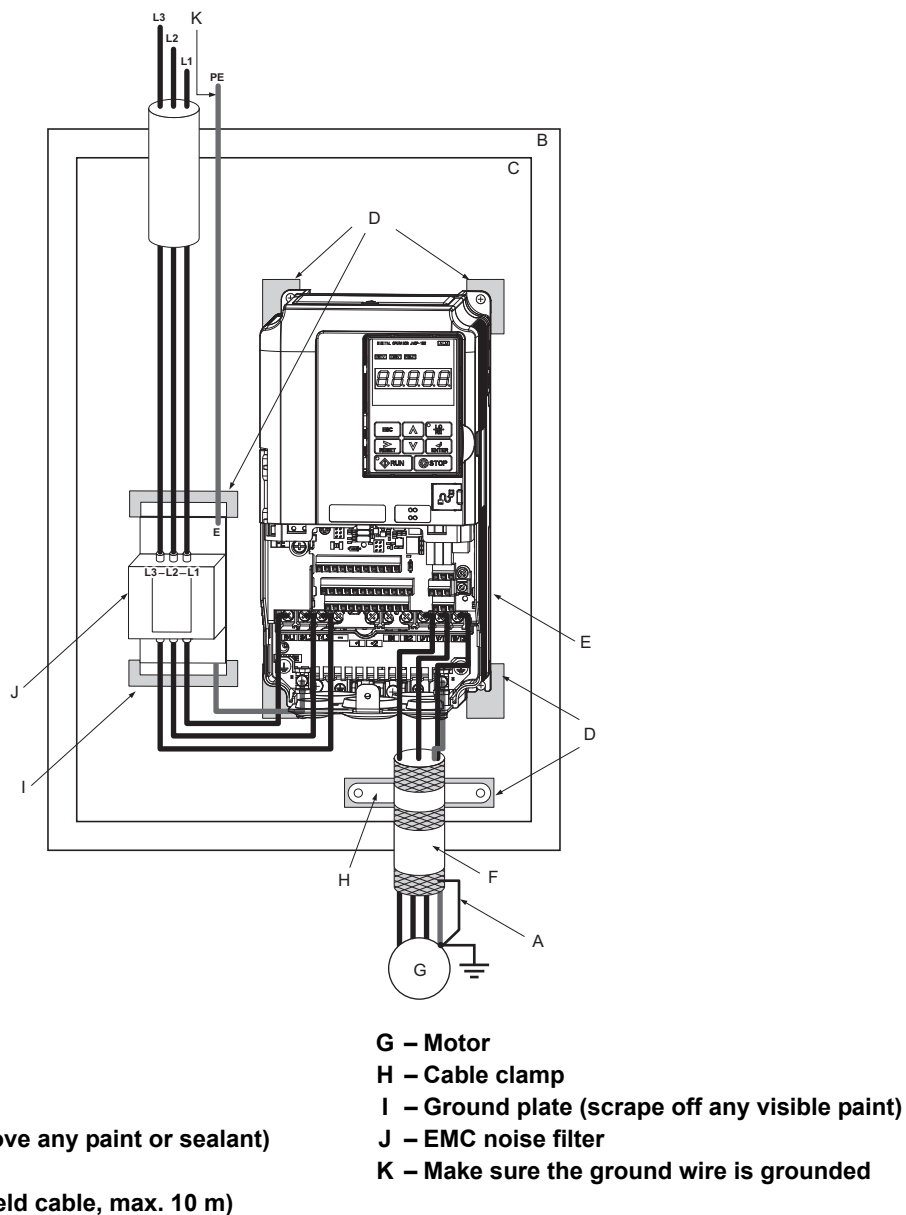


Figure D.4 EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

## ? EMC Filters

The drive should be installed with the EMC filters listed below in order to comply with the IEC/EN 61800-3 requirements.

**Note:** If the Safe Disable function of the drive is part of the safety concept of a machine or installation and used for a safe stop according to IEC/EN 60204-1, stop category 0, use only filters manufactured by Schaffner as listed below.

**Table D.1 IEC/EN 61800-3 Filters**

Model CIMR-T□	Filter Data (Manufacturer: Schaffner)					
	Type	Rated Current (A)	Weight (kg)	Dimensions [W x H x D] (mm)	Y x X	Figure
Three-Phase 200 V Class						
2A0004	FS5972-10-07	10	1.2	141 × 330 × 46	115 × 313	1
2A0006						
2A0010	FS5972-18-07	18	1.3	141 × 330 × 46	115 × 313	1
2A0012						
2A0021	FS5972-35-07	35	2.1	206 × 355 × 50	175 × 336	1
2A0030						
2A0040	FS5972-60-07	60	4.0	236 × 408 × 65	205 × 390	1
2A0056						
2A0069	FS5972-100-35	100	3.4	90 × 330 × 150	65 × 255	2
2A0081						
2A0110	FS5972-170-40	170	6.0	120 × 451 × 170	102 × 365	2
2A0138						
2A0169	FS5972-250-37	250	11.7	130 × 610 × 240	90 × 498	2
2A0211						
2A0250	FS5972-410-99	410	10.5	260 × 386 × 115	235 × 120	3
2A0312						
2A0360	FS5972-600-99	600	11	260 × 386 × 135	235 × 120	
2A0415						
Three-Phase 400 V Class						
4A0002	FS5972-10-07	10	1.2	141 × 330 × 46	115 × 313	1
4A0004						
4A0005						
4A0007						
4A0009	FS5972-18-07	18	1.3	141 × 330 × 46	115 × 313	1
4A0011						
4A0018	FS5972-35-07	35	2.1	206 × 355 × 50	175 × 336	1
4A0023						
4A0031						
4A0038	FS5972-60-07	60	4	236 × 408 × 65	202 × 390	1
4A0044						
4A0058						
4A0072	FS5972-100-35	100	3.4	90 × 330 × 150	65 × 255	2
4A0088						
4A0103	FS5972-170-35	170	6.0	120 × 451 × 170	102 × 365	2
4A0139						
4A0165						
4A0208	FS5972-250-37	250	11.7	130 × 610 × 240	90 × 498	3
4A0250	FS5972-410-99	410	10.5	260 × 386 × 115	235 × 120	
4A0296						
4A0362						

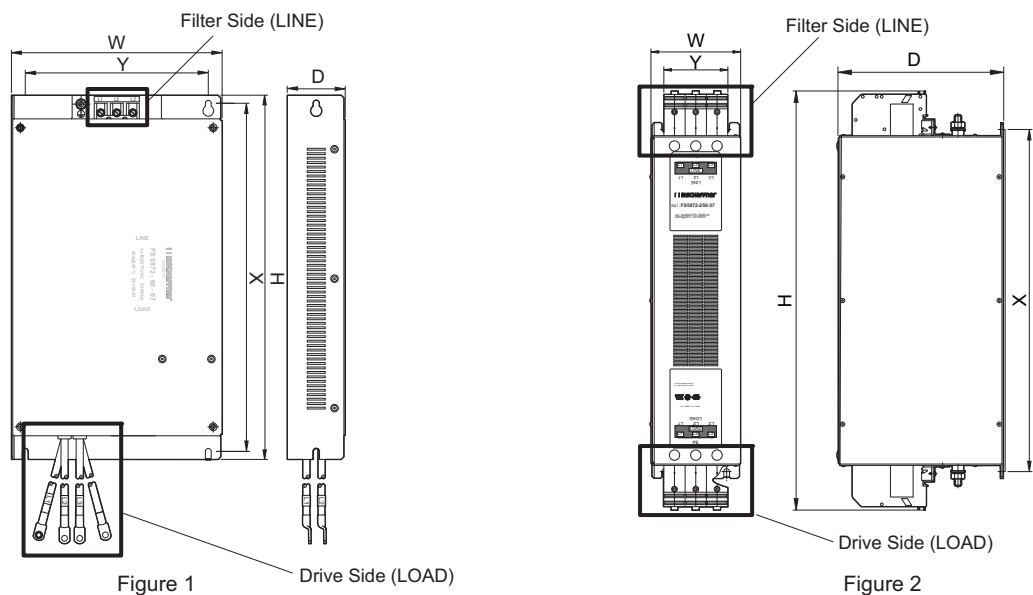


Figure 1

Figure 2

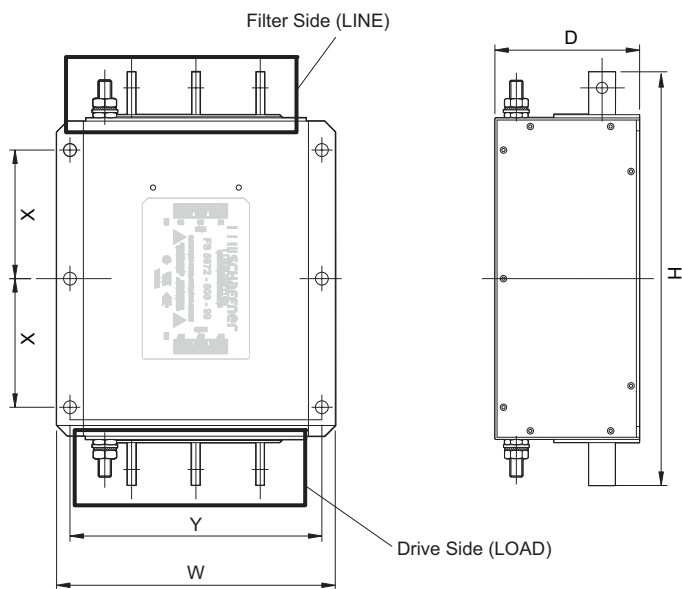


Figure 3

Figure D.5 EMC Filter Dimensions

? DC Reactors for IEC/EN 61000-3-2 Compliance

Table D.2 DC Reactors for Harmonics Reduction

Drive Model CIMR-T□	DC Reactor	
	Model	Rating
200V Three-Phase Units		
2A0004	UZDA-B	5.4 A
2A0006		8 mH
400 V Three-Phase Units		
4A0002	UZDA-B	3.2 A
4A0004		28 mH

**Note:** Drive models not listed in the table above do not require a DC reactor for EMC compliance.

## D.3 UL Standards

### ? UL Standards Compliance

The UL/cUL mark applies to products in the United States and Canada. It indicates that UL has performed product testing and evaluation, and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.



Figure D.6 UL/cUL Mark

This drive is tested in accordance with UL standard UL508C and complies with UL requirements. The conditions described below must be met to maintain compliance when using this drive in combination with other equipment:

### ? Installation Area

Do not install the drive to an area greater than pollution degree 2 (UL standard).

### ? Ambient Temperature

Heatsink cooled drives: -10°C to +50°C

Finless Type: IP20/IP00 enclosure: -10°C to +45°C

### ? Main Circuit Terminal Wiring

Yaskawa recommends using closed-loop crimp terminals on all drive models. UL/cUL approval requires the use of UL Listed closed-loop crimp terminals when wiring the drive main circuit terminals on models CIMR-T□2A0110 to 2A0415 and 4A0058 to 4A0362. Use only the tools recommended by the terminal manufacturer for crimping.

The wire gauges listed in [Table D.3](#) and [Table D.4](#) are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

Table D.3 Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Model CIMR-T□	Terminal	For Europe and China <1>		For U.S.A. <2>		For Asia <3>		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>	Recomm. Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>		
2A0004 2A0006 2A0010 <4>	R/L1, S/L2, T/L3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⊕	2.5	2.5 to 6	10	14 to 10	2	2 to 5.5		
2A0012 <4>	R/L1, S/L2, T/L3	2.5	2.5 to 6	12	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⊕	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5		
2A0021 <4>	R/L1, S/L2, T/L3	4	2.5 to 6	10	12 to 10	5.5	3.5 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	10	12 to 10	3.5	3.5 to 5.5		
	–, +1, +2	–	4 to 6	–	12 to 10	5.5	3.5 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⊕	4	4 to 6	10	12 to 10	3.5	3.5 to 5.5		

## D.3 UL Standards

Model CIMR-T□	Terminal	For Europe and China <1>		For U.S.A. <2>		For Asia <3>		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>	Recomm. Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>		
<b>2A0030</b> <4>	R/L1, S/L2, T/L3	6	4 to 16	8	10 to 6	14	5.5 to 14	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	6	4 to 16	8	10 to 6	8	5.5 to 14		
	–, +1, +2	–	6 to 16	–	10 to 6	14	5.5 to 14		
	B1, B2	–	4 to 6	–	14 to 10	3.5	2 to 5.5		
	⊕	6	6 to 10	8	10 to 8	5.5	5.5 to 8	M5	2.0 to 2.5 (17.7 to 22.1)
<b>2A0040</b> <4>	R/L1, S/L2, T/L3	10	6 to 16	6	8 to 6	14	14	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	10	6 to 16	8	8 to 6	14	8 to 14		
	–, +1, +2	–	16	–	6	14	14		
	B1, B2	–	4 to 6	–	12 to 10	5.5	3.5 to 5.5		
	⊕	10	6 to 10	8	10 to 8	5.5	5.5 to 8	M5	2.0 to 2.5 (17.7 to 22.1)
<b>2A0056</b>	R/L1, S/L2, T/L3	16	16 to 25	4	6 to 4	22	14 to 22	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	16	16 to 25	4	6 to 4	14	14 to 22		
	–, +1, +2	–	16 to 25	–	6 to 4	22	14 to 22		
	B1, B2	–	6 to 10	–	10 to 6	14	5.5 to 14	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	10 to 16	6	8 to 6	8	8 to 14	M6	5.4 to 6.0 (47.8 to 53.1)
<b>2A0069</b>	R/L1, S/L2, T/L3	25	16 to 25	3	4 to 3	30	22 to 30	M8	9.9 to 11 (87.6 to 97.4)
	U/T1, V/T2, W/T3	16	16 to 25	3	4 to 3	22	14 to 30		
	–, +1, +2	–	25	–	4 to 3	30	22 to 30		
	B1, B2	–	10 to 16	–	8 to 6	14	8 to 14	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	16 to 25	6	6 to 4	8	8 to 22	M6	5.4 to 6.0 (47.8 to 53.1)
<b>2A0081</b>	R/L1, S/L2, T/L3	35	25 to 35	2	3 to 2	38	30 to 38	M8	9.9 to 11 (87.6 to 97.4)
	U/T1, V/T2, W/T3	25	25 to 35	2	3 to 2	30	22 to 38		
	–, +1, +2	–	25 to 35	–	3 to 2	38	30 to 38		
	B1, B2	–	16	–	6	14	14	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	16 to 25	6	6 to 4	14	14 to 22	M6	5.4 to 6.0 (47.8 to 53.1)
<b>2A0110</b> <4>	R/L1, S/L2, T/L3	35	25 to 50	1/0	3 to 1/0	38	30 to 50	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	35	25 to 50	1/0	3 to 1/0	38	30 to 50		
	–, +1	–	35 to 50	–	2 to 1/0	60	38 to 60		
	B1, B2	–	16 to 50	–	6 to 1/0	22	14 to 50		
	⊕	16	16 to 25	6	6 to 4	14	14 to 38		
<b>2A0138</b> <4>	R/L1, S/L2, T/L3	50	35 to 70	2/0	1 to 2/0	60	50 to 60	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50	35 to 70	2/0	1 to 2/0	60	50 to 60		
	–, +1	–	50 to 70	–	1/0 to 3/0	80	60 to 80		
	B1, B2	–	25 to 70	–	4 to 2/0	30	22 to 60		
	⊕	25	25	4	4	22	22 to 38	M8	9.0 to 11 (79.7 to 97.4)
<b>2A0169</b> <4>	R/L1, S/L2, T/L3	70	50 to 95	4/0	2/0 to 4/0	80	60 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70	50 to 95	4/0	3/0 to 4/0	80	60 to 100		
	–, +1	–	35 to 95	–	1 to 4/0	50 × 2P	50 to 100		
	+3	–	50 to 95	–	1/0 to 4/0	60	50 to 100		
	⊕	35	25 to 35	4	4 to 2	22	22 to 60		

Model CIMR-T□	Terminal	For Europe and China <1>		For U.S.A. <2>		For Asia <3>		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>	Recomm. Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recomm. Wire Size mm <sup>2</sup>	Applicable Wire Size mm <sup>2</sup>		
2A0211 <5>	R/L1, S/L2, T/L3	95	70 to 95	1/0 × 2P	1/0 to 2/0	100	80 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95	70 to 95	1/0 × 2P	1/0 to 2/0	50 × 2P	50 to 60		
	–, +1	–	35 to 95	–	1 to 4/0	50 × 2P	50 to 100		
	+3	–	50 to 95	–	1/0 to 4/0	80	60 to 100		
	⊕	50	25 to 50	4	4 to 1/0	22	22 to 60		
2A0250 <5>	R/L1, S/L2, T/L3	95 × 2P	95 to 150	3/0 × 2P	3/0 to 300	80 × 2P	38 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150	3/0 × 2P	3/0 to 300	80 × 2P	38 to 150		
	–, +1	–	70 to 150	–	3/0 to 300	80 × 2P	80 to 150		
	+3	–	35 to 150	–	2 to 300	80 × 2P	30 to 150	M10	18 to 23 (159 to 204)
	⊕	95	95 to 150	3	3 to 300	22	22 to 150	M12	32 to 40 (283 to 354)
2A0312 <5>	R/L1, S/L2, T/L3	95 × 2P	95 to 150	4/0 × 2P	3/0 to 300	80 × 2P	70 to 150	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	95 × 2P	95 to 150	3/0 × 2P	3/0 to 300	80 × 2P	70 to 200		
	–, +1	–	70 to 150	–	3/0 to 300	150 × 2P	80 to 150		
	+3	–	70 to 150	–	3/0 to 300	80 × 2P	80 to 150	M10	18 to 23 (159 to 204)
	⊕	95	95 to 150	2	2 to 300	38	38 to 150	M12	32 to 40 (283 to 354)
2A0360 <5>	R/L1, S/L2, T/L3	240	95 to 300	250 × 2P	4/0 to 600	100 × 2P	80 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	240	95 to 300	4/0 × 2P	4/0 to 600	100 × 2P	80 to 325		
	–, +1	–	125 to 300	–	250 to 600	150 × 2P	125 to 325		
	+3	–	70 to 300	–	3/0 to 600	80 × 2P	80 to 325	M10	18 to 23 (159 to 204)
	⊕	120	120 to 240	1	1 to 350	38	38 to 200	M12	32 to 40 (283 to 354)
2A0415 <5>	R/L1, S/L2, T/L3	120 × 2P	95 to 300	350 × 2P	250 to 600	125 × 2P	100 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300	95 to 300	300 × 2P	300 to 600	125 × 2P	125 to 325		
	–, +1	–	150 to 300	–	300 to 600	200 × 2P	150 to 325		
	+3	–	70 to 300	–	3/0 to 600	100 × 2P	80 to 325	M10	18 to 23 (159 to 204)
	⊕	120	120 to 240	1	1 to 350	60	60 to 200	M12	32 to 40 (283 to 354)

<1> Gauges listed here are for use in Europe and China.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Asia except for China.

<4> When an EMC filter is installed, additional measures must be taken in order to comply with IEC/EN 61800-5-1. Refer to [EMC Filter Installation on page 545](#).

<5> Drive models CIMR-T□2A0110 to 2A0415 require the use of closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

**Note:** Use crimp insulated terminals or insulated tubing for wiring these connections. Wires should have a continuous maximum allowable temperature of 75°C 600 V UL approved vinyl sheathed insulation. Ambient temperature should not exceed 40°C.

**Table D.4 Wire Gauge and Torque Specifications (Three-Phase 400 V Class)**

Model CIMR-T□	Terminal	For Europe and China <1>		For U.S.A. <2>		For Asia <3>		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Wire Size mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Recomm. Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recomm. Wire Size mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>		
4A0002 4A0004	R/L1, S/L2, T/L3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⊕	2.5	2.5 to 4	12	14 to 12	2	2 to 5.5		

### D.3 UL Standards

Model CIMR-T□	Terminal	For Europe and China <1>		For U.S.A. <2>		For Asia <3>		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Wire Size mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Recomm. Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recomm. Wire Size mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⊕	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5		
4A0011	R/L1, S/L2, T/L3	2.5	2.5 to 6	12	14 to 10	2	2 to 5.5	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2.5	2.5 to 6	14	14 to 10	2	2 to 5.5		
	–, +1, +2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	B1, B2	–	2.5 to 6	–	14 to 10	2	2 to 5.5		
	⊕	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5		
4A0018	R/L1, S/L2, T/L3	2.5	2.5 to 16	10	12 to 6	3.5	2 to 14	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	2.5	2.5 to 16	10	12 to 6	3.5	2 to 14		
	–, +1, +2	–	4 to 16	–	12 to 6	3.5	2 to 14		
	B1, B2	–	4 to 6	–	12 to 10	2	2 to 5.5		
	⊕	2.5	2.5 to 6	10	14 to 10	3.5	2 to 5.5	M5	2.0 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	4	2.5 to 16	10	10 to 6	5.5	3.5 to 14	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	4	2.5 to 16	10	10 to 6	5.5	3.5 to 14		
	–, +1, +2	–	4 to 16	–	12 to 6	5.5	3.5 to 14		
	B1, B2	–	4 to 6	–	12 to 10	2	2 to 5.5		
	⊕	4	4 to 6	10	12 to 10	3.5	3.5 to 5.5	M5	2.0 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	6	6 to 16	8	8 to 6	14	5.5 to 14	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	6	6 to 16	8	10 to 6	8	5.5 to 8		
	–, +1, +2	–	6 to 16	–	10 to 6	14	5.5 to 14		
	B1, B2	–	6 to 10	–	10 to 8	3.5	2 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	6	6 to 10	8	10 to 8	5.5	5.5 to 8	M6	5.4 to 6.0 (47.8 to 53.1)
4A0038	R/L1, S/L2, T/L3	10	10 to 16	6	8 to 6	14	14	M5	3.6 to 4.0 (31.8 to 35.4)
	U/T1, V/T2, W/T3	6	6 to 16	8	8 to 6	14	8 to 14		
	–, +1, +2	–	6 to 16	–	6	14	14		
	B1, B2	–	6 to 10	–	10 to 8	5.5	3.5 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	10	6 to 16	6	10 to 6	8	5.5 to 14	M6	5.4 to 6.0 (47.8 to 53.1)
4A0044	R/L1, S/L2, T/L3	16	16 to 25	6	6 to 4	14	14 to 22	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	16	16 to 25	6	6 to 4	14	14 to 22		
	–, +1, +2	–	16 to 25	–	6 to 4	14	14 to 22		
	B1, B2	–	6 to 10	–	10 to 8	8	5.5 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⊕	16	10 to 16	6	8 to 6	8	8 to 14	M6	5.4 to 6.0 (47.8 to 53.1)
4A0058 ⋈	R/L1, S/L2, T/L3	16	10 to 16	4	6 to 4	14	14	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	16	10 to 16	4	6 to 4	14	14		
	–, +1	–	16 to 35	–	6 to 1	22	14 to 38		
	B1, B2	–	10 to 16	–	8 to 4	14	8 to 14		
	⊕	16	10 to 16	6	8 to 6	8	8 to 14		
4A0072 ⋈	R/L1, S/L2, T/L3	16	16 to 25	3	4 to 3	22	14 to 22	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	16 to 25	3	4 to 3	22	14 to 22		
	–, +1	–	25 to 35	–	4 to 1	30	22 to 38		
	B1, B2	–	16 to 25	–	6 to 3	14	14 to 22		
	⊕	16	16 to 25	6	6	14	14 to 22		

Model CIMR-T□	Terminal	For Europe and China <1>		For U.S.A. <2>		For Asia <3>		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Wire Size mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>	Recomm. Gauge AWG, kcmil	Applicable Gauge AWG, kcmil	Recomm. Wire Size mm <sup>2</sup>	Applicable Gauge mm <sup>2</sup>		
4A0088 ↔	R/L1, S/L2, T/L3	25	16 to 50	2	3 to 1/0	30	22 to 60	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	25	25 to 50	2	3 to 1/0	30	22 to 60		
	–, +1	–	25 to 50	–	3 to 1/0	38	30 to 60		
	+3	–	16 to 50	–	6 to 1/0	22	14 to 60		
	⊕	16	16 to 25	4	6 to 4	22	14 to 22		
4A0103 ↔	R/L1, S/L2, T/L3	35	25 to 50	1/0	2 to 1/0	38	30 to 60	M8	9.0 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	35	25 to 50	1	2 to 1/0	38	30 to 60		
	–, +1	–	25 to 50	–	3 to 1/0	60	30 to 60		
	+3	–	25 to 50	–	4 to 1/0	30	22 to 60		
	⊕	16	16 to 25	4	6 to 4	22	14 to 22		
4A0139 ↔	R/L1, S/L2, T/L3	50	35 to 95	3/0	1/0 to 4/0	60	38 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	50	35 to 95	2/0	1/0 to 4/0	60	50 to 100		
	–, +1	–	50 to 95	–	1/0 to 4/0	100	60 to 100		
	+3	–	25 to 95	–	3 to 4/0	50	30 to 100		
	⊕	25	25	4	4	22	22		
4A0165 ↔	R/L1, S/L2, T/L3	70	50 to 95	4/0	3/0 to 4/0	80	60 to 100	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	70	70 to 95	4/0	3/0 to 4/0	80	80 to 100		
	–, +1	–	35 to 95	–	1 to 4/0	50 × 2P	50 to 100		
	+3	–	50 to 95	–	1/0 to 4/0	60	50 to 100		
	⊕	35	25 to 35	4	4 to 2	22	22 to 30		
4A0208 ↔	R/L1, S/L2, T/L3	95	35 to 95	300	2 to 300	150	30 to 150	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	95	35 to 95	300	2 to 300	150	30 to 150		
	–, +1	–	35 to 150	–	1 to 250	80 × 2P	38 to 150		
	+3	–	25 to 70	–	3 to 3/0	80	22 to 80		
	⊕	50	50 to 150	4	4 to 300	22	22 to 150		
4A0250 ↔	R/L1, S/L2, T/L3	120	95 to 300	400	1 to 600	150	38 to 325	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	120	95 to 300	400	1/0 to 600	150	38 to 325		
	–, +1	–	70 to 300	–	3/0 to 600	200	80 to 325		
	+3	–	35 to 300	–	1 to 325	125	38 to 325		
	⊕	70	70 to 240	2	2 to 350	22	22 to 200		
4A0296 ↔	R/L1, S/L2, T/L3	185	95 to 300	500	2/0 to 600	200	80 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	185	95 to 300	500	2/0 to 600	200	80 to 325		
	–, +1	–	70 to 300	–	3/0 to 600	325	80 to 325	M10	18 to 23 (159 to 204)
	+3	–	35 to 300	–	1 to 325	150	38 to 325		
	⊕	95	95 to 240	2	2 to 350	30	30 to 200	M12	32 to 40 (283 to 354)
4A0362 ↔	R/L1, S/L2, T/L3	240	95 to 300	4/0 × 2P	3/0 to 600	250	80 to 325	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	240	95 to 300	4/0 × 2P	3/0 to 600	250	80 to 325		
	–, +1	–	95 to 300	–	4/0 to 600	325	100 to 325	M10	18 to 23 (159 to 204)
	+3	–	70 to 300	–	3/0 to 600	200	80 to 325		
	⊕	120	120 to 240	1	1 to 350	30	30 to 200	M12	32 to 40 (283 to 354)

<1> Gauges listed here are for use in Europe and China.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Asia except for China.

<4> Drive models CIMR-T□4A0058 to 4A0362 require the use of closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

**Note:** Use crimp insulated terminals or insulated tubing for wiring these connections. Wires should have a continuous maximum allowable temperature of 75°C 600 V UL approved vinyl sheathed insulation. Ambient temperature should not exceed 40°C.

### Closed-Loop Crimp Terminal Recommendations

Yaskawa recommends using closed-loop crimp terminals on all drive models. UL approval requires the use of UL Listed crimp terminals when wiring the drive main circuit terminals on models CIMR-T□2A0110 to 2A0415 and 4A0058 to 4A0362. Use only crimping tools as specified by the crimp terminal manufacturer. Yaskawa recommends crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap.

**Table D.5** matches the wire gauges and terminal screw sizes with Yaskawa - recommended crimp terminals, tools, and insulation caps. Refer to the appropriate Wire Gauge and Torque Specifications table for the wire gauge and screw size for your drive model. Place orders with a Yaskawa representatives or the Yaskawa sales department.

**Table D.5 Closed-Loop Crimp Terminal Size**

Wire Gauge	Terminal Screws	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
			Machine No.	Die Jaw		
2 mm <sup>2</sup> 14 AWG	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
3.5 / 5.5 mm <sup>2</sup> 12 / 10 AWG	M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
8 mm <sup>2</sup> 8 AWG	M4	8-4	YA-4	AD-901	TP-008	100-054-031
	M5	R8-5	YA-4	AD-901	TP-008	100-054-032
14 mm <sup>2</sup> 6 AWG	M4	14-NK4	YA-4	AD-902	TP-014	100-054-033
	M5	R14-5	YA-4	AD-902	TP-014	100-054-034
	M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	M8	R14-8	YA-5	AD-952	TP-014	100-054-035
22 mm <sup>2</sup> 4 AWG	M6	R22-6	YA-5	AD-953	TP-022	100-051-262
	M8	R22-8	YA-5	AD-953	TP-022	100-051-263
30 / 38 mm <sup>2</sup> 3 / 2 AWG	M8	R38-8	YA-5	AD-954	TP-038	100-051-264
50 / 60 mm <sup>2</sup> 1 AWG 1/0 AWG 1/0 AWG × 2P	M8	R60-8	YA-5	AD-955	TP-060	100-051-265
	M10	R60-10	YF-1, YET-300-1	TD-321, TD-311	TP-060	100-051-266
1 AWG × 2P 2 AWG × 2P	M10	38-L10	YF-1, YET-150-1	TD-224, TD-212	TP-038	100-051-556
80 mm <sup>2</sup> 2/0 / 3/0 AWG 2/0 AWG × 2P	M10	80-10	YF-1, YET-300-1	TD-323, TD-312	TP-080	100-051-267
3/0 AWG × 2P 3/0 AWG × 4P	M10	80-L10	YF-1, YET-150-1	TD-227, TD-214	TP-080	100-051-557
	M12	80-L12	YF-1, YET-300-1	TD-323, TD-312	TP-080	100-051-558
100 mm <sup>2</sup> 4/0 AWG	M10	R100-10	YF-1, YET-300-1 YF-1, YET-150-1	TD-324, TD-312 TD-228, TD-214	TP-100	100-051-269
4/0 AWG × 2P 4/0 AWG × 4P	M10	100-L10	YF-1, YET-150-1	TD-228, TD-214	TP-100	100-051-559
	M12	100-L12	YF-1, YET-300-1	TD-324, TD-312	TP-100	100-051-560
150 mm <sup>2</sup> 250 / 300 kcmil	M10	R150-10	YF-1, YET-150-1	TD-229, TD-215	TP-150	100-051-272
	M12	R150-12	YF-1, YET-300-1	TD-325, TD-313	TP-150	100-051-273
250 kcmil × 2P 250 kcmil × 4P 300 kcmil × 2P 300 kcmil × 4P	M10	150-L10	YF-1, YET-150-1	TD-229, TD-215	TP-150	100-051-561
	M12	150-L12	YF-1, YET-300-1	TD-325, TD-313	TP-150	100-051-562
200 mm <sup>2</sup> 350 kcmil 400 kcmil	M10	200-10	YF-1, YET-300-1	TD-327, TD-314	TP-200	100-051-563
	M12	R200-12	YF-1, YET-300-1	TD-327, TD-314	TP-200	100-051-275
350 kcmil × 2P 400 kcmil × 2P	M12	200-L12	YF-1, YET-300-1	TD-327, TD-314	TP-200	100-051-564
325 mm <sup>2</sup> 500 kcmil 600 / 650 kcmil 500 kcmil × 2P 600 kcmil × 2P	M10	325-10	YF-1, YET-300-1	TD-328, TD-315	TP-325	100-051-565
	M12	325-12	YF-1, YET-300-1	TD-328, TD-315	TP-325	100-051-277

<1> Codes refer to a set of three crimp terminals and three insulation caps. Prepare input and output wiring using two sets for each connection.

Example 1: Models with 300 kcmil for both input and output require one set for input terminals and one set for output terminals, so the user should order two sets of [100-051-272].

Example 2: Models with 4/0 AWG × 2P for both input and output require two sets for input terminals and two sets for output terminals, so the user should order four sets of [100-051-560].

## Input Fuse Installation

The installation manual specifies that branch circuit protection should be provided by fuses listed in [Table D.6](#).

**Table D.6 Recommended Input Fuse Selection**

Model CIMR-T□	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
<b>Three-Phase 200 V Class</b>		
2A0004	FWH-70B	70
2A0006	FWH-70B	70
2A0010	FWH-70B	70
2A0012	FWH-70B	70
2A0021	FWH-90B	90
2A0030	FWH-100B	100
2A0040	FWH-200B	200
2A0056	FWH-200B	200
2A0069	FWH-200B	200
2A0081	FWH-300A	300
2A0110	FWH-300A	300
2A0138	FWH-350A	350
2A0169	FWH-400A	400
2A0211	FWH-400A	400
2A0250	FWH-600A	600
2A0312	FWH-700A	700
2A0360	FWH-800A	800
2A0415	FWH-1000A	1000
<b>Three-Phase 400 V Class</b>		
4A0002	FWH-40B	40
4A0004	FWH-50B	50
4A0005	FWH-70B	70
4A0007	FWH-70B	70
4A0009	FWH-90B	90
4A0011	FWH-90B	90
4A0018	FWH-80B	80
4A0023	FWH-100B	100
4A0031	FWH-125B	125
4A0038	FWH-200B	200
4A0044	FWH-250A	250
4A0058	FWH-250A	250
4A0072	FWH-250A	250
4A0088	FWH-250A	250
4A0103	FWH-250A	250
4A0139	FWH-350A	350
4A0165	FWH-400A	400
4A0208	FWH-500A	500
4A0250	FWH-600A	600
4A0296	FWH-700A	700
4A0362	FWH-800A	800

### ? Low Voltage Wiring for Control Circuit Terminals

Wire low voltage wires with NEC Class 1 circuit conductors. Refer to national state or local codes for wiring. Use a class 2 power supply for the control circuit terminal when not using the internal control power supply of the drive. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits for requirements concerning class 1 circuit conductors and class 2 power supplies.

**Table D.7 Control Circuit Terminal Power Supply**

Input / Output	Terminal Signal	Power Supply Specifications
Open Collector Outputs	DM+, DM-	Requires class 2 power supply.
Digital inputs	S1-S8, SN, SC, SP, HC, H1, H2	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.
Analog inputs / outputs	+V, -V, A1, A2, A3, AC, AM, FM	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.

### ? Drive Short-Circuit Rating

This drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 600 V ac maximum (Up to 240 V in 200 V class drives, up to 480 V for 400 V class drives), when protected by Bussmann Type FWH fuses as specified in [Table D.6](#).

### ? Drive Motor Overload Protection

Set parameter E2-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL Listed and in accordance with the NEC and CEC.

#### ? E2-01 Motor Rated Current

Setting Range: Model Dependent

Default Setting: Model Dependent

Parameter E2-01 (motor rated current) protects the motor if parameter L1-01 is not set to 0 (default is 1, enabling protection for standard induction motors).

If Auto-Tuning has been performed successfully, the motor data entered to T1-04 is automatically written into parameter E2-01. If Auto-Tuning has not been performed, manually enter the correct motor rated current to parameter E2-01.

#### ? L1-01 Motor Overload Protection Selection

The drive has an electronic overload protection function (oL1) based on time, output current, and output frequency, which protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal relay for single motor operation.

This parameter selects the motor overload curve used according to the type of motor applied.

**Table D.8 Overload Protection Settings**

Setting	Description	
0	Disabled	Disabled the drive's internal motor overload protection.
1	Standard fan cooled motor (default)	Selects protection characteristics for a standard self cooled motor with limited cooling capabilities when running below the rated speed. The motor overload detection level (oL1) is automatically reduces when running below the motor rated speed.
2	Drive duty motor with a speed range of 1:10	Selects protection characteristics for a motor with self-cooling capability within a speed range of 10:1. The motor overload detection level (oL1) is automatically reduced when running below 1/10 of the motor rated speed.
3	Vector motor with a speed range of 1:100	Selects protection characteristics for a motor capable of cooling itself at any speed — including zero speed (externally cooled motor). The motor overload detection level (oL1) is constant over the entire speed range.
4	Permanent Magnet motor with variable torque	Selects protection characteristics for a variable torque PM motor. The motor overload detection level (oL1) is automatically reduces when running below the motor rated speed.
5	Permanent Magnet motor with constant torque	Selects protection characteristics for a constant torque PM motor. The motor overload detection level (oL1) is constant over the whole speed range.
6	Standard fan cooled motor (50 Hz)	Selects protection characteristics for a standard self cooled motor with limited cooling capabilities when running below the rated speed. The motor overload detection level (oL1) is automatically reduces when running below the motor rated speed.

When connecting the drive to more than one motor for simultaneous operation, disable the electronic overload protection (L1-01 = 0) and wire each motor with its own motor thermal overload relay.

Enable the motor overload protection (L1-01 = 1 to 6) when connecting the drive to a single motor, unless another motor overload preventing device is installed. The drive electronic thermal overload function causes an oL1 fault, which shuts off the output of the drive and prevents additional overheating of the motor. The motor temperature is continually calculated as long as the drive is powered up.

### ? L1-02 Motor Overload Protection Time

Setting Range: 0.1 to 5.0 min

Factory Default: 1.0 min

Parameter L1-02 determines how long the motor is allowed to operate before the oL1 fault occurs when the drive is running at 50 Hz and at 150% of the full load amp rating (E2-01) of the motor. Adjusting the value of L1-02 can shift the set of oL1 curves up the y axis of the diagram below, but will not change the shape of the curves.

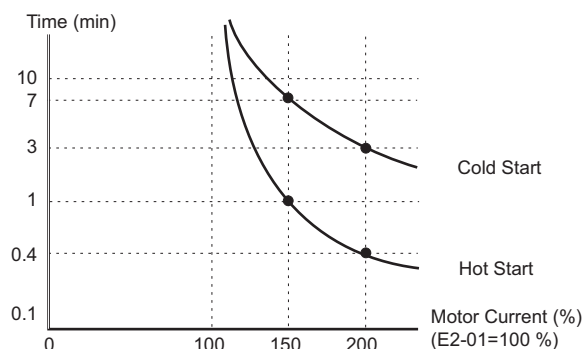


Figure D.7 Motor Overload Protection Time

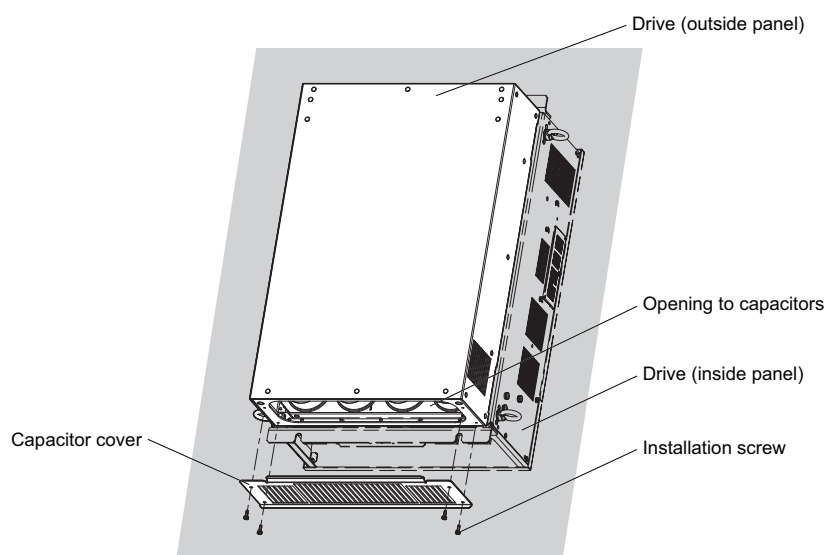
### ? Precautionary Notes on External Heatsink (IP00 Enclosure)

When using an external heatsink, UL compliance requires that exposed capacitors in the main circuit are covered to prevent injury to surrounding personnel.

The portion of the external heatsink that projects out can either be protected with the enclosure, or with the appropriate capacitor cover after drive installation is complete. Use the table below to match drive models and capacitor cover. Capacitor covers can be ordered from a Yaskawa representative or directly from the Yaskawa sales department. The table below lists available capacitor covers.

**Table D.9 Capacitor Cover**

Drive Model CIMR-T□	Code Number	Model
2A0110	100-061-273	ECAT31875-11
2A0138	100-061-274	ECAT31876-11
2A0169	100-061-275	ECAT31877-11
2A0211		
2A0250		
2A0312	100-061-277	ECAT31726-11
2A0360		
2A0415		
4A0058	100-061-273	ECAT31875-11
4A0072	100-061-274	ECAT31876-11
4A0088	100-061-276	ECAT31878-11
4A0103		
4A0139		
4A0165	100-061-275	ECAT31877-11
4A0208		
4A0250		
4A0296	100-061-278	ECAT31698-11
4A0362		



**Figure D.8 Capacitor Cover**

## D.4 Safe Disable Input Function

### ? Specifications

Inputs / Outputs		Two Safe Disable inputs and one EDM output according to ISO/EN 13849-1 Cat. 3 PLd, IEC/EN 61508 SIL2.
Operation Time		Time from input open to drive output stop is less than 1 ms.
Failure Probability	Demand Rate Low	PFD = $5.15E^{-5}$
	Demand Rate High/Continuous	PFH = $1.2E^{-9}$
Performance Level		The Safe Disable Inputs satisfy all requirements of Performance Level (PL) d according to ISO/EN 13849-1. (Note: DC from EDM considered.)

### ? Precautions

**DANGER!** Improper use of the Safe Disable function can result in serious injury or even death. Make sure the whole system or machinery that the Safe Disable function is used in complies with safety requirements. When implementing the Safe Disable function into the safety system of a machine, a thorough risk assessment for the whole system has to be carried out to assure it complies with relevant safety norms (e.g., ISO/EN 13849, IEC/EN 61508, IEC/EN 62061,...).

**DANGER!** When using a PM motor, even if the drive output is shut off by the Safe Disable function, a break down of two output transistors can cause current to flow through the motor winding, resulting in a rotor movement for a maximum angle of 180 degree (electrically). Make sure such a situation would have no effect on the safety of the application when using the Safe Disable function. This is not a concern with induction motors.

**DANGER!** The Safe Disable function can switch off the drive output, but does not cut the drive power supply and cannot electrically isolate the drive output from the input. Always shut off the drive power supply when performing maintenance or installations on the drive input side as well as the drive output side.

**DANGER!** When using the Safe Disable inputs, make sure to remove the wire links between terminals H1, H2, and HC that were installed prior to shipment. Failing to do so will keep the Safe Disable circuit from operating properly and can cause injury or even death.

**DANGER!** All safety features (including Safe Disable) should be inspected daily and periodically. If the system is not operating normally, there is a risk of serious personal injury.

**DANGER!** Only a qualified technician with a thorough understanding of the drive, the instruction manual, and safety standards should be permitted to wire, inspect, and maintain the Safe Disable input.

**NOTICE:** From the moment terminal inputs H1 and H2 have opened, it takes up to 1 ms for drive output to shut off completely. The sequence set up to trigger terminals H1 and H2 should make sure that both terminals remain open for at least 1 ms in order to properly interrupt drive output.

**NOTICE:** The Safe Disable Monitor (output terminals DM+ and DM-) should not be used for any other purpose than to monitor the Safe Disable status or to discover a malfunction in the Safe Disable inputs. The monitor output is not considered a safe output.

**NOTICE:** When utilizing the Safe Disable function, use only the EMC filters recommended in [EMC Filter Installation on page 545](#).

### ? Using the Safe Disable Function

The Safe Disable inputs provide a stop function in compliance with “Safe Torque Off” as defined in the IEC/EN 61800-5-2. Safe Disable inputs have been designed to meet the requirements of the ISO/EN 13849-1, Category 3 PLd, and IEC/EN 61508, SIL2.

A Safe Disable Status Monitor for error detection in the safety circuit is also provided.

### ? Safe Disable Circuit

The Safe Disable circuit consists of two independent input channels that can block the output transistors. In addition, it provides a monitoring channel that indicates the status of those two input channels.

The input can either use the drive internal power supply or an external power supply. Both modes, Sink mode and Source mode are supported. The mode that is selected for the digital input terminals S1 to S8 by switch S3 will also be used for the Safe Disable inputs. Refer to [Sinking/Sourcing Mode Selection for Safe Disable Inputs on page 68](#).

The Safe Disable Monitor uses a single channel photocoupler output. Refer to [Output Terminals on page 63](#) for signal specifications when using this output.

## D.4 Safe Disable Input Function

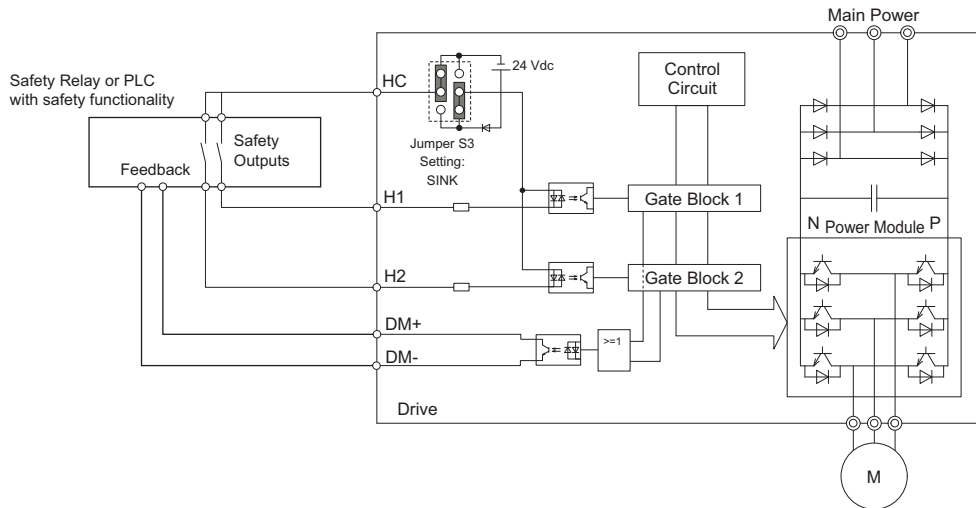


Figure D.9 Safe Disable Function Wiring Example (SINK Mode)

### ? Disabling and Enabling the Drive Output (“Safe Torque Off”)

Figure D.10 illustrates the Safe Disable input operation.

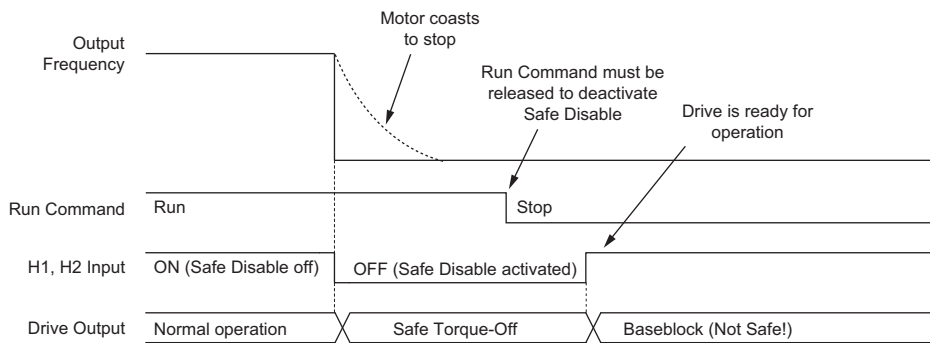


Figure D.10 Safe Disable Operation

### Entering the “Safe Torque Off” State

Whenever either one Safe Disable input or both inputs open, the motor torque is shut off by switching off the drive output. If the motor was running before the Safe Disable inputs opened, then the motor will coast to stop, regardless of the stopping method set in parameter b1-03.

Notice that the “Safe Torque Off” state can only be achieved using the Safe Disable function. Removing the Run command stops the drive and shuts the output off (baseblock), but does not create a “Safe Torque Off” status.

**Note:** To avoid an uncontrolled stop during normal operation, make sure that the Safe Disable inputs are opened first when the motor has completely stopped.

### Returning to Normal Operation after Safe Disable

The Safe Disable function can only be deactivated when a Run command is not active.

When Safe Disable was activated during stop, normal operation can be resumed by simply turning on both Safe Disable inputs (i.e., by deactivating “Safe Torque Off”).

When Safe Disable was activated during run, first the Run command has to be removed and then the Safe Disable inputs have to be turned on before the drive can be restarted.

## ? Safe Disable Monitor Output Function and Digital Operator Display

*Table D.10* explains the drive output and Safe Disable monitor state depending on the Safe Disable inputs.

**Table D.10 Safety Input and EDM Terminal Status**

Safe Disable Input Status		Safe Disable Status Monitor, DM+ - DM-	Drive Output Status	Digital Operator Display
Input 1, H1-HC	Input 2, H2-HC			
OFF	OFF	OFF	Safely disabled, “Safe Torque Off”	Hbb (flashes)
ON	OFF	ON	Output Disabled (Baseblock)	HbbF (flashes)
OFF	ON	ON	Output Disabled (Baseblock)	HbbF (flashes)
ON	ON	ON	Ready for Operation	Normal display

### Safe Disable Status Monitor

With the Safe Disable monitor output (terminals DM+ and DM-), the drive provides a safety status feedback signal. This signal should be read by the device that controls the Safe Disable inputs (PLC or a safety relay) in order to prohibit leaving the “Safe Torque Off” status in case the safety circuit malfunctions. Refer to the instruction manual of the safety device for details on this function.

### Digital Operator Display

When both Safe Disable inputs are open, “Hbb” will flash in the digital operator display.

Should only one of the Safe Disable channels be on while the other is off, “HbbF” will flash in the display to indicate that there is a problem in the safety circuit or in the drive. This display should not appear under normal conditions if the Safe Disable circuit is utilized properly. *Refer to Alarm Codes, Causes, and Possible Solutions on page 313* to resolve possible errors.



# Appendix: E

## Quick Reference Sheet

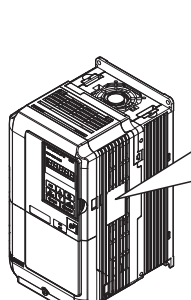
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This section provides tables to keep record of the drive specification, motor specification and drive settings. Fill in the data after commissioning the application and have them ready when contacting Yaskawa for technical assistance.

<b>E.1</b>	<b>DRIVE AND MOTOR SPECIFICATIONS .....</b>	<b>564</b>
<b>E.2</b>	<b>BASIC PARAMETER SETTINGS.....</b>	<b>565</b>
<b>E.3</b>	<b>USER SETTING TABLE.....</b>	<b>567</b>

## E.1 Drive and Motor Specifications

### ? Drive Specifications



AC drive model ——— MODEL : CIMR-TC2A0021BMA

Input specifications ——— MAX APPLI. MOTOR : 5.5kW / 3.7kW REV : A

Output specifications ——— INPUT : AC3PH 200-240V 50/60Hz 24A/18.9A

Lot number ——— OUTPUT : AC3PH 0-240V 0-400Hz 21A/17.5A

Serial number ——— MASS : 3.5 kg (PRG : 600X)

Software version ——— IND. CONTEQ. 7J48

Enclosure type ———

Normal Duty Amps / Heavy Duty Amps

UL LISTED

CE

RoHS

YASKAWA ELECTRIC CORPORATION  
2-1 Kurosaki-Shiroishi, Yahatanishi-ku  
Kitakyushu 806-0004 Japan

MADE IN JAPAN  
Kitakyushu 806-0004 Japan

IP20

PASS

FILE NO : E131457

Items	Value
Model	CIMR-T
Serial Number	
Software Version (PRG)	
Options used (Option cards, braking transistor, etc.)	

### ? Motor Specifications

#### ? Induction Motor

Items	Value	Items	Value
Manufacturer		Motor Rated Current	A
Model		Motor Base Frequency	Hz
Motor Rated Power	kW	Number of Motor Poles	
Motor Rated Voltage	V	Motor Rated Speed (T1-07)	r/min

#### ? Permanent Magnet Motor

Items	Value	Items	Value
Manufacturer		Induction Voltage Constant	mVs/rad
Model		Induction Voltage Constant	mV/(r/min)
PM Motor Rated Power	kW	PM Motor Rated Current	A
PM Motor Rated Voltage	V	PM Motor Base Frequency	Hz
d-Axis Inductance	mH	Number of PM Motor Poles	
q-Axis Inductance	mH	PM Motor Base Speed	r/min

#### ? Motor Speed Encoder (if used)

Items	Value	Items	Value
Manufacturer		Resolution	
Interface			

## E.2 Basic Parameter Settings

Use these tables to keep record of the most important parameters. Have these data available when contacting the technical support.

### ? Basic Setup

Item	Setting Value	Memo	Item	Setting Value	Memo
Control Mode	A1-02 =		Frequency Reference Source	b1-01 =	
Normal/Heavy Duty Selection	C6-01 =		Run Command Source	b1-02 =	

### ? V/f Pattern Setup

Item	Setting Value	Memo	Item	Setting Value	Memo
V/f Pattern Selection	E1-03 =		Middle Output Frequency	E1-07 =	
Max. Output Frequency	E1-04 =		Mid. Output Freq. Voltage	E1-08 =	
Maximum Voltage	E1-05 =		Min. Output Frequency	E1-09 =	
Base Frequency	E1-06 =		Min. Output Freq. Voltage	E1-10 =	

### ? Motor Setup

	Item	Setting Value	Memo	Item	Setting Value	Memo
Induction Motor	Motor Rated Current	E2-01 =		Number of Motor Poles	E2-04 =	
	Motor Rated Slip	E2-02 =		Line-to-Line Resistance	E2-05 =	
	Motor No-Load Current	E2-03 =		Motor Leakage Inductance	E2-06 =	
PM Motor	Motor Code Selection	E5-01 =		Motor d-Axis Inductance	E5-06 =	
	Motor Rated Power	E5-02 =		Motor q-Axis Inductance	E5-07 =	
	Motor Rated Current	E5-03 =		Induction Volt. Const. 1	E5-09 =	
	Number of Motor Poles	E5-04 =		Encoder Z-pulse Offset	E5-11 =	
	Motor Stator Resistance	E5-05 =		Induction Volt. Const. 2	E5-24 =	

### ? Multi-Function Digital Inputs

Terminal	Input Used	Setting Value and Function Name	Memo	Terminal	Input Used	Setting Value and Function Name	Memo
S1		H1-01 =		S5		H1-05 =	
S2		H1-02 =		S6		H1-06 =	
S3		H1-03 =		S7		H1-07 =	
S4		H1-04 =		S8		H1-08 =	

## E.2 Basic Parameter Settings

---

### ? Pulse Train Input/Analog Inputs

Terminal	Input Used	Setting Value and Function Name	Memo
RP		H6-01 =	
A1		H3-02 =	
A2		H3-10 =	
A3		H3-06 =	

### ? Multi-Function Digital Outputs

Terminal	Output Used	Setting Value and Function Name	Memo
M1-M2		H2-01 =	
M3-M4		H2-02 =	
M5-M6		H2-03 =	

### ? Monitor Outputs

Terminal	Output Used	Setting Value and Function Name	Memo
FM		H4-01 =	
AM		H4-04 =	
MP		H6-06 =	

## E.3 User Setting Table

Use the Verify Menu to see which parameters have been changed from their original default settings.

- The diamond below the parameter number indicates that the parameter setting can be changed during run.
- Parameter names in boldface type are included in the Setup Group of parameters.

No.	Name	User Setting
A1-00 ◆	Language Selection	
A1-01 ◆	Access Level Selection	
A1-02	<b>Control Method Selection</b>	
A1-03	Initialize Parameters	
A1-04	Password	
A1-05	Password Setting	
A2-01 to A2-32	User Parameters, 1 to 32	
A2-33	User Parameter Automatic Selection	
b1-01	<b>Frequency Reference Source 1</b>	
b1-02	<b>Run Command Source 1</b>	
b1-03	<b>Stopping Method Selection</b>	
b1-04	Reverse Operation Selection	
b1-05	Action Selection below Minimum Output Frequency	
b1-06	Digital Input Reading	
b1-07	LOCAL/REMOTE Run Selection	
b1-08	Run Command Selection while in Programming Mode	
b1-14	Phase Order Selection	
b1-15	Frequency Reference Source 2	
b1-16	Run Command Source 2	
b1-17	Run Command at Power Up	
b2-01 ◆	DC Injection Braking Start Frequency	
b2-02 ◆	DC Injection Braking Current	
b2-03 ◆	DC Injection Braking Time at Start	
b2-04 ◆	DC Injection Braking Time at Stop	
b2-08	Magnetic Flux Compensation Value	
b2-10	DC Injection Braking Current 2	
b2-12	Short Circuit Brake Time at Start	
b2-13	Short Circuit Brake Time at Stop	
b2-18	Short Circuit Braking Current	
b3-01	Speed Search Selection at Start	
b3-02 ◆	Speed Search Deactivation Current	
b3-03 ◆	Speed Search Deceleration Time	
b3-04 ◆	V/f Gain during Speed Search	
b3-05 ◆	Speed Search Delay Time	
b3-06 ◆	Output Current 1 during Speed Search	

No.	Name	User Setting
b3-10 ◆	Speed Search Detection Compensation Gain	
b3-14	Bi-Directional Speed Search Selection	
b3-17 ◆	Speed Search Restart Current Level	
b3-18 ◆	Speed Search Restart Detection Time	
b3-19	Number of Speed Search Restarts	
b3-24	Speed Search Method Selection	
b3-25 ◆	Speed Search Wait Time	
b3-27	Start Speed Search Select	
b4-01 ◆	Timer Function On-Delay Time	
b4-02 ◆	Timer Function Off-Delay Time	
b5-01	PID Function Setting	
b5-02 ◆	Proportional Gain Setting (P)	
b5-03 ◆	Integral Time Setting (I)	
b5-04 ◆	Integral Limit Setting	
b5-05 ◆	Derivative Time (D)	
b5-06 ◆	PID Output Limit	
b5-07 ◆	PID Offset Adjustment	
b5-08 ◆	PID Primary Delay Time Constant	
b5-09	PID Output Level Selection	
b5-10 ◆	PID Output Gain Setting	
b5-11	PID Output Reverse Selection	
b5-12	PID Feedback Loss Detection Selection	
b5-13 ◆	PID Feedback Low Detection Level	
b5-14 ◆	PID Feedback Low Detection Time	
b5-15 ◆	PID Sleep Function Start Level	
b5-16 ◆	PID Sleep Delay Time	
b5-17 ◆	PID Accel/Decel Time	
b5-18	PID Setpoint Selection	
b5-19 ◆	PID Setpoint Value	
b5-20	PID Setpoint Scaling	

### E.3 User Setting Table

No.	Name	User Setting
b5-34 ◆	PID Output Lower Limit	
b5-35 ◆	PID Input Limit	
b5-36 ◆	PID Feedback High Detection Level	
b5-37 ◆	PID Feedback High Detection Time	
b5-38	PID Setpoint User Display	
b5-39	PID Setpoint Display Digits	
b5-40	Frequency Reference Monitor Content during PID	
b5-47	Reverse Operation Selection 2 by PID Output	
b6-01	Dwell Reference at Start	
b6-02	Dwell Time at Start	
b6-03	Dwell Frequency at Stop	
b6-04	Dwell Time at Stop	
b8-01	Energy Saving Control Selection	
b8-02 ◆	Energy Saving Gain	
b8-03 ◆	Energy Saving Control Filter Time Constant	
b8-04	Energy Saving Coefficient Value	
b8-05	Power Detection Filter Time	
b8-06	Search Operation Voltage Limit	
b8-16	Energy Saving Parameter (Ki) for PM Motors	
b8-17	Energy Saving Parameter (Kt) for PM Motors	
b9-01	Zero Servo Gain	
b9-02	Zero Servo Completion Width	
C1-01 ◆	<b>Acceleration Time 1</b>	
C1-02 ◆	<b>Deceleration Time 1</b>	
C1-03 ◆	Acceleration Time 2	
C1-04 ◆	Deceleration Time 2	
C1-05 ◆	Acceleration Time 3 (Motor 2 Accel Time 1)	
C1-06 ◆	Deceleration Time 3 (Motor 2 Decel Time 1)	
C1-07 ◆	Acceleration Time 4 (Motor 2 Accel Time 2)	
C1-08 ◆	Deceleration Time 4 (Motor 2 Decel Time 2)	
C1-09	Fast-Stop Time	
C1-10	Accel/Decel Time Setting Units	
C1-11	Accel/Decel Time Switching Frequency	
C2-01 ◆	S-Curve Characteristic at Accel Start	
C2-02 ◆	S-Curve Characteristic at Accel End	
C2-03 ◆	S-Curve Characteristic at Decel Start	
C2-04 ◆	S-Curve Characteristic at Decel End	
C3-01 ◆	Slip Compensation Gain	

No.	Name	User Setting
C3-02 ◆	Slip Compensation Primary Delay Time	
C3-03	Slip Compensation Limit	
C3-04	Slip Compensation Selection during Regeneration	
C3-05	Output Voltage Limit Operation Selection	
C3-21 ◆	Motor 2 Slip Compensation Gain	
C3-22 ◆	Motor 2 Slip Compensation Primary Delay Time	
C3-23	Motor 2 Slip Compensation Limit	
C3-24	Motor 2 Slip Compensation Selection during Regeneration	
C4-01 ◆	Torque Compensation Gain	
C4-02 ◆	Torque Compensation Primary Delay Time	
C4-03	Torque Compensation at Forward Start	
C4-04	Torque Compensation at Reverse Start	
C4-05	Torque Compensation Time Constant	
C4-06	Torque Compensation Primary Delay Time 2	
C4-07 ◆	Motor 2 Torque Compensation Gain	
C5-01 ◆	ASR Proportional Gain 1	
C5-02 ◆	ASR Integral Time 1	
C5-03 ◆	ASR Proportional Gain 2	
C5-04 ◆	ASR Integral Time 2	
C5-05	ASR Limit	
C5-06	ASR Primary Delay Time Constant	
C5-07	ASR Gain Switching Frequency	
C5-08	ASR Integral Limit	
C5-11 ◆	Regenerative ASR Limit	
C5-12	Integral Operation during Accel/Decel	
C5-17	Motor Inertia	
C5-18	Load Inertia Ratio	
C5-21 ◆	Motor 2 ASR Proportional Gain 1	
C5-22 ◆	Motor 2 ASR Integral Time 1	
C5-23 ◆	Motor 2 ASR Proportional Gain 2	
C5-24 ◆	Motor 2 ASR Integral Time 2	
C5-25	Motor 2 ASR Limit	
C5-26	Motor 2 ASR Primary Delay Time Constant	
C5-27	Motor 2 ASR Gain Switching Frequency	
C5-28	Motor 2 ASR Integral Limit	
C5-32	Integral Operation during Accel/Decel for Motor 2	
C5-37	Motor 2 Inertia	
C5-38	Motor 2 Load Inertia Ratio	
C6-01	<b>Duty Mode Selection</b>	

No.	Name	User Setting
C6-02	<b>Carrier Frequency Selection</b>	
C6-03	Carrier Frequency Upper Limit	
C6-04	Carrier Frequency Lower Limit	
C6-05	Carrier Frequency Proportional Gain	
C6-06	PWM Method	
C6-09	Carrier Frequency during Rotational Auto-Tuning	
d1-01 ◆	<b>Frequency Reference 1</b>	
d1-02 ◆	<b>Frequency Reference 2</b>	
d1-03 ◆	<b>Frequency Reference 3</b>	
d1-04 ◆	<b>Frequency Reference 4</b>	
d1-05 ◆	Frequency Reference 5	
d1-06 ◆	Frequency Reference 6	
d1-07 ◆	Frequency Reference 7	
d1-08 ◆	Frequency Reference 8	
d1-17 ◆	<b>Jog Frequency Reference</b>	
d2-01	Frequency Reference Upper Limit	
d2-02 ◆	Frequency Reference Lower Limit	
d2-03 ◆	Master Speed Reference Lower Limit	
d2-04 ◆	Frequency Reference 2 Upper Limit	
d2-05 ◆	Frequency Reference 2 Lower Limit	
d5-01	Torque Control Selection	
d5-02	Torque Reference Delay Time	
d5-03	Speed Limit Selection	
d5-04	Speed Limit	
d5-05	Speed Limit Bias	
d5-06	Speed/Torque Control Switchover Time	
d5-08	Unidirectional Speed Limit Bias	
d6-01	Field Weakening Level	
d6-02	Field Weakening Frequency Limit	
d6-03	Field Forcing Selection	
d6-06	Field Forcing Limit	
d7-01 ◆	Offset Frequency 1	
d7-02 ◆	Offset Frequency 2	
d7-03 ◆	Offset Frequency 3	
E1-01	<b>Input Voltage Setting</b>	
E1-03	<b>V/f Pattern Selection</b>	
E1-04	<b>Maximum Output Frequency</b>	
E1-05	<b>Maximum Voltage</b>	
E1-06	<b>Base Frequency</b>	
E1-07	Middle Output Frequency	

No.	Name	User Setting
E1-08	Middle Output Frequency Voltage	
E1-09	<b>Minimum Output Frequency</b>	
E1-10	Minimum Output Frequency Voltage	
E1-11	Middle Output Frequency 2	
E1-12	Middle Output Frequency Voltage 2	
E1-13	<b>Base Voltage</b>	
E2-01	<b>Motor Rated Current</b>	
E2-02	Motor Rated Slip	
E2-03	Motor No-Load Current	
E2-04	<b>Number of Motor Poles</b>	
E2-05	Motor Line-to-Line Resistance	
E2-06	Motor Leakage Inductance	
E2-07	Motor Iron-Core Saturation Coefficient 1	
E2-08	Motor Iron-Core Saturation Coefficient 2	
E2-09	Motor Mechanical Loss	
E2-10	Motor Iron Loss for Torque Compensation	
E2-11	<b>Motor Rated Output</b>	
E3-01	Motor 2 Control Mode Selection	
E3-04	Motor 2 Maximum Output Frequency	
E3-05	Motor 2 Maximum Voltage	
E3-06	Motor 2 Base Frequency	
E3-07	Motor 2 Mid Output Frequency	
E3-08	Motor 2 Mid Output Frequency Voltage	
E3-09	Motor 2 Minimum Output Frequency	
E3-10	Motor 2 Minimum Output Frequency Voltage	
E3-11	Motor 2 Mid Output Frequency 2	
E3-12	Motor 2 Mid Output Frequency Voltage 2	
E3-13	Motor 2 Base Voltage	
E4-01	Motor 2 Rated Current	
E4-02	Motor 2 Rated Slip	
E4-03	Motor 2 Rated No-Load Current	
E4-04	Motor 2 Motor Poles	
E4-05	Motor 2 Line-to-Line Resistance	
E4-06	Motor 2 Leakage Inductance	
E4-10	Motor 2 Iron Loss	
E4-11	Motor 2 Rated Capacity	
E5-01	Motor Code Selection	
E5-02	Motor Rated Power	
E5-03	Motor Rated Current	
E5-04	Number of Motor Poles	
E5-05	Motor Stator Resistance	
E5-06	Motor d-Axis Inductance	
E5-07	Motor q-Axis Inductance	
E5-09	Motor Induction Voltage Constant 1	
E5-11	Encoder Z-pulse Offset	
E5-24	Motor Induction Voltage Constant 2	
F1-01	PG 1 Pulses Per Revolution	
F1-02	Operation Selection at PG Open Circuit (PGo)	
F1-03	Operation Selection at Overspeed (oS)	
F1-04	Operation Selection at Deviation	
F1-05	PG 1 Rotation Selection	
F1-06	PG 1 Division Rate for PG Pulse Monitor	
F1-08	Overspeed Detection Level	
F1-09	Overspeed Detection Delay Time	

## E.3 User Setting Table

No.	Name	User Setting
F1-10	Excessive Speed Deviation Detection Level	
F1-11	Excessive Speed Deviation Detection Delay Time	
F1-12	PG 1 Gear Teeth 1	
F1-13	PG 1 Gear Teeth 2	
F1-14	PG Open-Circuit Detection Time	
F1-18	dv3 Detection Selection	
F1-19	dv4 Detection Selection	
F1-20	PG Option Card Disconnect Detection 1	
F1-21	PG 1 Signal Selection	
F1-30	PG Option Card Port for Motor 2 Selection	
F1-31	PG 2 Pulses Per Revolution	
F1-32	PG 2 Rotation Selection	
F1-33	PG 2 Gear Teeth 1	
F1-34	PG 2 Gear Teeth 2	
F1-35	PG 2 Division Rate for PG Pulse Monitor	
F1-36	PG Option Card Disconnect Detection 2	
F1-37	PG2 Signal Selection	
F2-01	Analog Input Option Card Operation Selection	
F2-02 ◆	Analog Input Option Card Gain	
F2-03 ◆	Analog Input Option Card Bias	
F3-01	Digital Input Option Card Input Selection	
F3-03	Digital Input Option DI-A3 Data Length Selection	
F4-01	Terminal V1 Monitor Selection	
F4-02 ◆	Terminal V1 Monitor Gain	
F4-03	Terminal V2 Monitor Selection	
F4-04 ◆	Terminal V2 Monitor Gain	
F4-05 ◆	Terminal V1 Monitor Bias	
F4-06 ◆	Terminal V2 Monitor Bias	
F4-07	Terminal V1 Signal Level	
F4-08	Terminal V2 Signal Level	
F5-01	Terminal P1-PC Output Selection	
F5-02	Terminal P2-PC Output Selection	
F5-03	Terminal P3-PC Output Selection	
F5-04	Terminal P4-PC Output Selection	
F5-05	Terminal P5-PC Output Selection	
F5-06	Terminal P6-PC Output Selection	
F5-07	Terminal M1-M2 Output Selection	
F5-08	Terminal M3-M4 Output Selection	
F5-09	DO-A3 Output Mode Selection	
F6-01	Communications Error Operation Selection	
F6-02	External Fault from Comm. Option Detection Selection	
F6-03	External Fault from Comm. Option Operation Selection	
F6-04	bUS Error Detection Time	
F6-06	Torque Reference/Torque Limit Selection from Comm. Option	

No.	Name	User Setting
F6-07	Multi-Step Speed Enable/Disable Selection when NetRef/ComRef is Selected	
F6-08	Reset Communication Parameters	
F6-10	CC-Link Node Address	
F6-11	CC-Link Communications Speed	
F6-14	CC-Link bUS Error Auto Reset	
F6-20	MECHATROLINK Station Address	
F6-21	MECHATROLINK Frame Size	
F6-22	MECHATROLINK Link Speed	
F6-23	MECHATROLINK Monitor Selection (E)	
F6-24	MECHATROLINK Monitor Selection (F)	
F6-25	Operation Selection at MECHATROLINK Watchdog Timer Error (E5)	
F6-26	MECHATROLINK bUS Errors Detected	
F6-30	PROFIBUS-DP Node Address	
F6-31	PROFIBUS-DP Clear Mode Selection	
F6-32	PROFIBUS-DP Data Format Selection	
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	
H2-01	Terminal M1-M2 Function Selection	
H2-02	Terminal M3-M4 Function Selection	
H2-03	Terminal M5-M6 Function Selection	
H2-06	Watt Hour Output Unit Selection	
H3-01	Terminal A1 Signal Level Selection	
H3-02	Terminal A1 Function Selection	
H3-03 ◆	Terminal A1 Gain Setting	
H3-04 ◆	Terminal A1 Bias Setting	
H3-05	Terminal A3 Signal Level Selection	
H3-06	Terminal A3 Function Selection	
H3-07 ◆	Terminal A3 Gain Setting	
H3-08 ◆	Terminal A3 Bias Setting	
H3-09	Terminal A2 Signal Level Selection	
H3-10	Terminal A2 Function Selection	
H3-11 ◆	Terminal A2 Gain Setting	
H3-12 ◆	Terminal A2 Bias Setting	
H3-13	Analog Input Filter Time Constant	
H3-14	Analog Input Terminal Enable Selection	

No.	Name	User Setting
H3-16	Terminal A1 Offset	
H3-17	Terminal A2 Offset	
H3-18	Terminal A3 Offset	
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	
H4-02 ◆	<b>Multi-Function Analog Output Terminal FM Gain</b>	
H4-03 ◆	Multi-Function Analog Output Terminal FM Bias	
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	
H4-05 ◆	Multi-Function Analog Output Terminal AM Gain	
H4-06 ◆	Multi-Function Analog Output Terminal AM Bias	
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	
H5-01	Drive Node Address	
H5-02	Communication Speed Selection	
H5-03	Communication Parity Selection	
H5-04	Stopping Method After Communication Error (CE)	
H5-05	Communication Fault Detection Selection	
H5-06	Drive Transmit Wait Time	
H5-07	RTS Control Selection	
H5-09	CE Detection Time	
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	
H5-11	Communications ENTER Function Selection	
H5-12	Run Command Method Selection	
H6-01	Pulse Train Input Terminal RP Function Selection	
H6-02 ◆	Pulse Train Input Scaling	
H6-03 ◆	Pulse Train Input Gain	
H6-04 ◆	Pulse Train Input Bias	
H6-05 ◆	Pulse Train Input Filter Time	
H6-06 ◆	Pulse Train Monitor Selection	
H6-07 ◆	Pulse Train Monitor Scaling	
H6-08	Pulse Train Input Minimum Frequency	
L1-01	<b>Motor Overload Protection Selection</b>	
L1-02	Motor Overload Protection Time	
L1-03	Motor Overheat Alarm Operation Selection (PTC input)	
L1-04	Motor Overheat Fault Operation Selection (PTC input)	
L1-05	Motor Temperature Input Filter Time (PTC input)	
L1-13	Continuous Electrothermal Operation Selection	
L2-01	Momentary Power Loss Operation Selection	

No.	Name	User Setting
L2-02	Momentary Power Loss Ride-Thru Time	
L2-03	Momentary Power Loss Minimum Baseblock Time	
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	
L2-05	Undervoltage Detection Level (Uv)	
L3-01	Stall Prevention Selection during Acceleration	
L3-02 ◆	Stall Prevention Level during Acceleration	
L3-03 ◆	Stall Prevention Limit during Acceleration	
L3-04	<b>Stall Prevention Selection during Deceleration</b>	
L3-05	Stall Prevention Selection during Run	
L3-06 ◆	Stall Prevention Level during Run	
L3-11	Overvoltage Suppression Function Selection	
L3-17 ◆	Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention	
L3-22 ◆	Deceleration Time at Stall Prevention during Acceleration	
L3-23	Automatic Reduction Selection for Stall Prevention during Run	
L3-26	Additional DC Bus Capacitors	
L3-27	Stall Prevention Detection Time	
L4-01 ◆	Speed Agreement Detection Level	
L4-02 ◆	Speed Agreement Detection Width	
L4-03 ◆	Speed Agreement Detection Level (+/-)	
L4-04 ◆	Speed Agreement Detection Width (+/-)	
L4-05	Frequency Reference Loss Detection Selection	
L4-06	Frequency Reference at Reference Loss	
L4-07	Speed Agreement Detection Selection	
L4-08	Frequency Agree Condition Selection	
L5-01	Number of Auto Restart Attempts	
L5-02	Auto Restart Fault Output Operation Selection	
L5-04	Fault Reset Interval Time	
L5-05	Fault Reset Operation Selection	
L6-01	Torque Detection Selection 1	
L6-02 ◆	Torque Detection Level 1	
L6-03 ◆	Torque Detection Time 1	
L6-04	Torque Detection Selection 2	
L6-05 ◆	Torque Detection Level 2	
L6-06 ◆	Torque Detection Time 2	
L7-01 ◆	Forward Torque Limit	
L7-02 ◆	Reverse Torque Limit	

## E.3 User Setting Table

No.	Name	User Setting
L7-03 ◆	Forward Regenerative Torque Limit	
L7-04 ◆	Reverse Regenerative Torque Limit	
L7-06 ◆	Torque Limit Integral Time Constant	
L7-07	Torque Limit Control Method Selection during Accel/Decel	
L7-16	Torque Limit Process at Start	
L8-01	Internal Dynamic Braking Resistor Protection Selection (ERF type)	
L8-02	Overheat Alarm Level	
L8-03	Overheat Pre-Alarm Operation Selection	
L8-05	Input Phase Loss Protection Selection	
L8-07	Output Phase Loss Protection	
L8-09	Output Ground Fault Detection Selection	
L8-10	Heatsink Cooling Fan Operation Selection	
L8-11	Heatsink Cooling Fan Off Delay Time	
L8-12	Ambient Temperature Setting	
L8-15	oL2 Characteristics Selection at Low Speeds	
L8-18	Software Current Limit Selection	
L8-27	Overcurrent Detection Gain	
L8-29	Current Unbalance Detection (LF2)	
L8-32	Main Contactor and Cooling Fan Power Supply Failure Selection	
L8-35	Installation Method Selection	
L8-38	Carrier Frequency Reduction Selection	
L8-40	Carrier Frequency Reduction Off Delay Time	
L8-41	High Current Alarm Selection	
L8-46	AVR Function Selection	
L8-55	Internal Braking Transistor Protection	
L8-93	Pull-Out Detection Time at Low Speed	
L8-94	Pull-Out Detection Level at Low Speed	
L8-95	Average Pull-Out Frequency at Low Speed	
n1-01	Hunting Prevention Selection	
n1-02	Hunting Prevention Gain Setting	
n1-03	Hunting Prevention Time Constant	
n1-05 ◆	Hunting Prevention Gain while in Reverse	
n2-01 ◆	Speed Feedback Detection Control (AFR) Gain	
n2-02 ◆	Speed Feedback Detection Control (AFR) Time Constant 1	
n2-03 ◆	Speed Feedback Detection Control (AFR) Time Constant 2	
n3-13 ◆	Overexcitation Deceleration Gain	
n3-14	High Frequency Injection during Overexcitation Deceleration	
n3-21	Overslip Suppression Current Level	
n3-23	Overexcitation Operation Selection	
n5-01	Feed Forward Control Selection	
n5-02	Motor Acceleration Time	
n5-03	Feed Forward Control Gain	
n6-05	Online Tuning Gain	
n8-01	Initial Rotor Position Estimation Current	

No.	Name	User Setting
n8-02	Pole Attraction Current	
n8-35	Initial Rotor Position Detection Selection	
n8-45 ◆	Speed Feedback Detection Control Gain	
n8-47	Pull-In Current Compensation Time Constant	
n8-48 ◆	Pull-In Current	
n8-49 ◆	d-Axis Current for High Efficiency Control	
n8-51 ◆	Acceleration/Deceleration Pull-In Current	
n8-54 ◆	Voltage Error Compensation Time Constant	
n8-55	Load Inertia	
n8-57	High Frequency Injection	
n8-62	Output Voltage Limit	
n8-65	Speed Feedback Detection Control Gain during ov Suppression	
n8-69	Speed Calculation Gain	
n8-84	Polarity Judge Current	
n9-10	AVR Time Constant	
n9-12	On-Delay Compensation Time	
n9-62	On-Delay Compensation Derating Start Frequency	
n9-63	On-Delay Compensation Disable Frequency	
o1-01 ◆	Drive Mode Unit Monitor Selection	
o1-02 ◆	User Monitor Selection After Power Up	
o1-03	Digital Operator Display Selection	
o1-04	V/f Pattern Display Unit	
o1-10	User-Set Display Units Maximum Value	
o1-11	User-Set Display Units Decimal Display	
o2-01	LO/RE Key Function Selection	
o2-02	STOP Key Function Selection	
o2-03	User Parameter Default Value	
o2-04	Drive Model Selection	
o2-05	Frequency Reference Setting Method Selection	
o2-06	Operation Selection when Digital Operator is Disconnected	
o2-07	Motor Direction at Power Up when Using Operator	
o3-01	Copy Function Selection	
o3-02	Copy Allowed Selection	
o4-01	Cumulative Operation Time Setting	
o4-02	Cumulative Operation Time Selection	
o4-03	Cooling Fan Maintenance Operation Time Setting	
o4-05	Capacitor Maintenance Setting	
o4-07	DC Bus Pre-charge Relay Maintenance Setting	
o4-09	IGBT Maintenance Setting	
o4-11	U2, U3 Initialize Selection	
o4-12	kWh Monitor Initialization	
o4-13	Number of Run Commands Counter Initialization	

No.	Name	User Setting
S1-01 ◆	Disturb Function Selection	
S1-02 ◆	Disturb Function Amplitude	
S1-03 ◆	Disturb Step	
S1-04 ◆	Disturb Deceleration Time	
S1-05 ◆	Disturb Acceleration Time	
S2-01 ◆	Frequency Reference Gain	
S2-02 ◆	Frequency Reference Gain Change Ramp	
S3-01	Braking Transistor Operation Selection	
S3-02	Braking Transistor Operation Voltage Level	
S3-03	Output Voltage Gain Selection	
S3-04 ◆	Output Voltage Gain Change Time	
S4-01	KEB Mode Selection	
S4-02 ◆	KEB Start/End Voltage	
S4-03 ◆	KEB Start Voltage	
S4-04 ◆	KEB Start dV/dt level	
S4-05 ◆	KEB Start dV/dt filter	
S4-06 ◆	KEB End Voltage	
S4-07 ◆	KEB End Detection Time	
S4-08 ◆	KEB 1 Phase Loss Detection Level	
S4-09 ◆	KEB 1 Phase Loss Sampling Time	
S4-10 ◆	KEB 1 Phase Loss Detection Time	
S4-11	KEB Target Voltage	
S4-12 ◆	KEB Hold Time	
S4-13 ◆	KEB Minimum Operation Time	
S4-14 ◆	KEB Reacceleration Prohibit Frequency	
S4-15 ◆	KEB Supply Loss Detection Selection	
S5-01 ◆	KEB Decel Time 1	
S5-02 ◆	KEB Decel Time 2	
S5-03 ◆	KEB Decel Time Switching Frequency	
S5-04 ◆	KEB Decel Time Switching Time	
S5-05 ◆	KEB Synchronous Acceleration Time	
S5-06 ◆	S-Curve at KEB Deceleration Start	

No.	Name	User Setting
S5-07 ◆	Frequency Gain at KEB Start during Constant Speed	
S5-08 ◆	Frequency Gain at KEB Start during Acceleration	
S5-09 ◆	Frequency Gain at KEB Start during Deceleration	
S5-10	Synchronous Deceleration ov Prevention	
S5-11 ◆	KEB Frequency Reduction Step Lower Limit	
S6-01	DC Bus Capacity	
S6-02	Motor Acceleration Time	
S6-03	Load/Inertia Ratio	
S6-04	Main Circuit Voltage Adjustment Gain	
S6-05	Accel/Decel Calculation Gain	
S6-06	ASR Primary Delay Time Constant 2	
S6-07	Torque Limit Delay Time	
S9-03	Speed Detection Change Rate Limit	
S9-06	Speed Detection Width After Coasting	
T1-00	Motor 1/Motor 2 Selection	
T1-01	Auto-Tuning Mode Selection	
T1-02	Motor Rated Power	
T1-03	Motor Rated Voltage	
T1-04	Motor Rated Current	
T1-05	Rated Frequency	
T1-06	Number of Motor Poles	
T1-07	Rated Speed	
T1-08	PG Number of Pulses Per Revolution	
T1-09	Motor No-Load Current	
T1-10	Motor Rated Slip	
T1-11	Motor Iron Loss	
T2-01	PM Motor Auto-Tuning Mode Selection	
T2-02	PM Motor Code Selection	
T2-03	PM Motor Type	
T2-04	PM Motor Rated Power	
T2-05	PM Motor Rated Voltage	
T2-06	PM Motor Rated Current	
T2-07	PM Motor Rated Frequency	
T2-08	Number of PM Motor Poles	
T2-09	PM Motor Rated Speed	
T2-10	PM Motor Stator Resistance	
T2-11	PM Motor d-Axis Inductance	
T2-12	PM Motor q-Axis Inductance	
T2-13	Induced Voltage Constant Unit Selection	
T2-14	PM Motor Induced Voltage Constant	
T2-15	Pull-In Current Level for PM Motor Tuning	
T2-16	PG Number of Pulses Per Revolution for PM Motor Tuning	
T2-17	Encoder Z-Pulse Offset	
T3-01	Inertia Tuning Frequency Reference	
T3-02	Inertia Tuning Reference Amplitude	
T3-03	Motor Inertia	
T3-04	ASR Response Frequency	

# Index

## Symbols

-	61
+1	61
+2	61
+3	61
+V	70

## Numerics

1800 r/min Type Yaskawa SMRA Series SPM	
Motor Settings	504
200 V, 1150 r/min Type Yaskawa SSR1 Series Motor	509
200 V, 1150 r/min Type Yaskawa SST4 Series Motor	515
200 V, 1450 r/min Type Yaskawa SSR1 Series Motor	507
200 V, 1450 r/min Type Yaskawa SST4 Series Motor	513
200 V, 1750 r/min Type Yaskawa SSR1 Series Motor	505
200 V, 1750 r/min Type Yaskawa SST4 Series Motor	511
24 V Power Supply	380
2-Wire Initialization	123
3600 r/min Type Yaskawa SMRA Series SPM	
Motor Settings	504
3-Wire Initialization	123
3-Wire Sequence	201
3-Wire Sequence Wiring Diagram	201
400 V, 1150 r/min Type Yaskawa SSR1 Series Motor	510
400 V, 1150 r/min Type Yaskawa SST4 Series Motor	516
400 V, 1450 r/min Type Yaskawa SSR1 Series Motor	508
400 V, 1450 r/min Type Yaskawa SST4 Series Motor	514
400 V, 1750 r/min Type Yaskawa SSR1 Series Motor	506
400 V, 1750 r/min Type Yaskawa SST4 Series Motor	512
5th Most Recent Fault	483

## A

A/D Conversion Error	299, 304
A1	70
A1-01	116
A1-02	310, 345
A1-02 (Motor 1 Control Mode) Dependent Parameters	489
A1-03	116, 304
A1-04	117, 343
A1-05	117, 343
A2	70
A2-01	116
A2-32	116
A2-33	116
A3	70
AC	70, 71
AC Reactor	378
Accel/Decel Calculation Gain	284
Accel/Decel Time	297, 407
Accel/Decel Time Setting Units	160
Accel/Decel Time Switching Frequency	159
Acceleration Error	302, 336
Acceleration Time	158
Acceleration Time Pull-In Current	467
Acceleration/Deceleration Pull-In Current	264
Access Level Selection	116, 122
Action Selection below Minimum Output Frequency	131
Additional DC Bus Capacitors	244
Adjusted Slip Calculation Error	334
Adjusting the ASR Parameters	165
AEr	300, 320

AFR	258
AFR Gain	293
AFR Time Constant 1	293
AFR Time Constant 2	293
AI-A3	380
AI-A3 Settings	195
Alarm	302
Alarm Outputs for Maintenance Monitors	359
Alarm Register 007FH Contents	546
Alarms and Errors	298
Allowable Frequency Fluctuation	405, 406
Allowable Voltage Fluctuation	405, 406
ALM LED Light	87
Altitude	40
AM	71
Ambient Temperature	40
Ambient Temperature and Installation	
Method Derating	413, 414
Ambient Temperature and Installation Method Derating	414
Ambient Temperature Setting	253, 413, 463
Analog Filter Time Constant	297
Analog Input Card Settings	195
Analog Input Filter Time Constant	223
Analog Input Option Card Bias	195
Analog Input Option Card Gain	195
Analog Input Option Card Operation Selection	195
Analog Input Terminal Enable Selection	223
Analog Inputs / Pulse Train Input	70
Analog Monitor Card Settings	196
AO-A3	380
AO-A3 Settings	196
Application Notes	17
Application Selection Error	332
Applications with Specialized Motors	21
ASR	165
ASR Gain Auto-Tuning	103
ASR Gain Switching Frequency	168
ASR Integral Limit	168
ASR Integral Time	167
ASR Limit	168
ASR Primary Delay Time Constant	168
ASR Proportional Gain	167
ASR Response Frequency	113
Attachment for External Heatsink	379, 401
Auto Restart Fault Output Operation Selection	247
Auto Restart Operation Selection	460
Automatic Reduction Selection for Stall	
Prevention during Run	243, 459
Automatic Speed Regulator	165
Auto-Tuning	101, 104, 106
Auto-Tuning Codes	334
Auto-Tuning Error Displays	302
Auto-Tuning Errors	302
Auto-Tuning Fault Codes	105
Auto-Tuning Fault Detection	334
Auto-Tuning Fault Solutions	334
Auto-Tuning for Induction Motors	101
Auto-Tuning for Permanent Magnet Motors	102
Auto-Tuning Input Data	102, 103
Auto-Tuning Interruption and Fault Codes	105
Auto-Tuning Mode Selection	107, 476
Average Pull-Out Frequency at Low Speed	257
AVR Function Selection	256
AVR Time Constant	266

## B

B1	61
----	----

b1-01	343
b1-02	314, 343
b1-03	331
b1-04	344
B2	61
b2-02	347, 348
b2-04	348
b3-02	313, 315
b3-03	313, 315
b3-10	317
b3-14	317
b3-17	317
b3-18	317
b3-19	315, 317
b3-24	313, 314, 315
b5-01	329, 331
b5-09	348
b5-12	308
b5-13	308, 323
b5-13 and b5-14	308
b5-14	308, 323
b5-36	308, 323
b5-36 and b5-37	308
b5-37	308, 323
b6-01 through b6-04	297
Back EMF Constant Tuning	102
Backing Up Parameter Values	116
Base Frequency	182, 313
Base Voltage	183
Baseblock	320
Baseblock Signal Input	301
Basic Auto-Tuning Preparations	104
Basic Start-up and Motor Tuning	96
bb	300, 320
Before Auto-Tuning the Drive	104
Bi-Directional Speed Search Selection	141
boL	303, 320
Braking Resistor	378, 393
Braking Resistor Fault	316
Braking Resistor Overheat	316
Braking Resistor Overheat Protection	408
Braking Resistor Overload Protection	394
Braking Resistor Unit	378
Braking Torque	407
Braking Transistor	407
Braking Transistor Operation Selection	276
Braking Transistor Operation Voltage Level	276
Braking Transistor Overload Fault	303, 320
Braking Unit	378
Broadcast Messages	544
bUS	299, 300, 303, 320
Buzzing Sound from Motor at 2 kHz	348

## C

C1-01	94, 336
C1-01 through C1-08	305, 312, 313, 314, 316, 317, 322, 324, 325
C1-01, -03, -05, -07	309
C1-02	303
C1-02, -04, -06, -08	315
C2-01	317
C2-01 through C2-04	297, 309
C3-01	292, 293
C3-02	293
C4-01	292, 310, 314
C4-02	292, 293, 331
C4-06	293, 331
C5-01	315, 326

C5-02	315, 326
C6-01	292
C6-02	83, 292, 293, 312, 314, 347
C6-05	347
Cable Length Between Drive and Motor	67
CALL	300, 321
Cannot Change Parameter Settings	342
Cannot Reset	300
Capacitor Maintenance	484
Capacitor Maintenance Setting	272, 470
Capacitor Maintenance Time	324
Carrier Frequency	170, 405, 406
Carrier Frequency and Current Derating	411
Carrier Frequency Derating	412
Carrier Frequency during Rotational Auto-Tuning	172
Carrier Frequency Lower Limit	172
Carrier Frequency Proportional Gain	172
Carrier Frequency Reduction	463
Carrier Frequency Reduction Off-Delay Time	255
Carrier Frequency Reduction Selection	255
Carrier Frequency Selection	171, 292, 293
Carrier Frequency Setting Error	301, 332
Carrier Frequency Upper Limit	172
CC-Link Parameters	199
CE	299, 300, 303, 321
CE Detection Time	525
CE Low Voltage Directive Compliance	554
CE mark	554
CF	299, 303
Changing Parameter Settings or Values	93
Closed Loop Vector control	28
Closed Loop Vector Control for PM Motors	28
Coast to stop	129
Coast to Stop with Timer	130
Command Messages from Master to Drive	528
Communication Error	338
Communication Fault Detection Selection	525
Communication Option Card	198
Communication Option Card Reference	485
Communication Parity Selection	524
Communication Speed Selection	524
Communications Enter Function Selection	526
Communications Error Operation Selection	198
Communications Timing	528
Comparing Parameter Settings	339
Complementary PG	380
Component Names	33
Connected Machinery Vibrates When Motor Rotates	347
Connecting a DC Reactor	397
Connecting a Noise Filter	398
Connecting a Suppression Diode	71
Connecting a Surge Absorber	397
Connecting an AC Reactor	397
Connecting Braking Units in Parallel	395
Connecting Peripheral Devices	381
Connecting to a PC (USB)	80
Connection of a Motor PTC	236
Continuous Electrothermal Operation Selection	237
Control Board Connection Error	304, 305
Control Circuit Connection Diagram	69
Control Circuit Error	304, 305
Control Circuit Fault	299
Control Circuit Input Terminals	70
Control Circuit Output Terminals	71
Control Circuit Terminal Arrangement	72
Control Circuit Terminal Block Functions	70
Control Circuit Wiring	69

Control Dial for Frequency Setting Potentiometer	379	DC Bus Adjustment Gain	284
Control Fault	299, 303	DC Bus Capacity	283
Control Method Selection	122	DC Bus Overvoltage	326
Control Method Selection Error	330	DC Bus Pre-Charge Relay Maintenance Setting	273
Control Mode	122, 480	DC Bus Undervoltage	318
Control Mode Dependent Parameter Default Values	489	DC Bus Voltage	480
Control Mode Mismatch	338	DC Bus Voltage at Previous Fault	482
Control Mode Selection	28	DC Injection Braking	347
Control Modes and their Features	28	DC Injection Braking 1	208
Control Power Supply Undervoltage	300	DC Injection Braking 2	208
Control Power Supply Voltage Fault	318	DC Injection Braking at Stop	348
Cooling Fan	33, 34	DC Injection Braking Current	135, 348
Cooling Fan Maintenance	484	DC Injection Braking Current 2	136
Cooling Fan Maintenance Setting (Operation Time)	470	DC Injection Braking Start Frequency	134
Cooling Fan Maintenance Time	324	DC Injection Braking Time at Start	136
Cooling Fan Operation Time	484	DC Injection Braking Time at Stop	136
Cooling Fan Operation Time Setting	272	DC Injection Braking to Stop	130
Cooling Fan Replacement	361	DC Reactor	378
CoPy	338	DC Reactors for IEC/EN 61000-3-2 Compliance	559
Copy Allowed Selection	272	Deceleration Time	158
Copy Errors	302	Deceleration Time at Stall Prevention	
Copy Function	117, 271	during Acceleration	241, 459
Copy Function Errors	298	Defaults by Drive Model Selection (o2-04)	
Copy Function Selection	271	and ND/HD (C6-01)	494
Copy Unit Error	338	Delay Timers	143
CopyUnitManager	117	Derivative Time (D)	147
CPEr	338	dEv	299, 300, 305, 322
CPF02	304	dFPS	338
CPF03	304	DI-A3	380
CPF06	304	DI-A3 Settings	195
CPF07	304	Diagnosing and Resetting Faults	340
CPF08	304	Digital Input Card Settings	195
CPF11 to CPF14	304	Digital Input Option Card Input Selection	195
CPF20	299, 304	Digital Input Option DI-A3 Data Length Selection	196
CPF21	299, 304	Digital Input Reading	132
CPF22	299, 305	Digital Operator	33, 34, 87, 88
CPF23	299, 305	Digital Operator Dimensions	42
CPF24	299, 305	Digital Operator Display Selection	268, 469
CPF25	305	Digital Operator Installation Methods and Required Tools	43
CPF26 to CPF35	305	Digital Operator Keypad Functions	269
CPyE	338	Digital Operator Menu and Screen Structure	90
CRC-16	529	Digital Operator Remote Installation	42
CRC-16 Checksum Calculation Example	530	Digital Operator Remote Usage	42
CrST	300, 321	Digital Output Card Settings	197
CSEr	338	Digital Output Option Card Terminal Function Selection	197
Cumulative Operation Time	484	Digital Text Display	88
Cumulative Operation Time at 5th Most Recent Fault	483	Dimensions for IP00 Enclosure	
Cumulative Operation Time at Most Recent Fault	483	200 V Class	47
Cumulative Operation Time at Previous Fault	483	400 V Class	47
Cumulative Operation Time Selection	272, 470	Dimensions for IP20 Enclosure	
Cumulative Operation Time Setting	272, 470	200 V Class	46
Current Alarm	301, 324	400 V Class	46
Current Detection Error	302, 336	DIP Switch S1	35
Current Detection Speed Search	137	DIP Switch S2	35, 81, 523
Current Fault	482	Disturb Acceleration Time	275
Current Imbalance	300	Disturb Deceleration Time	275
Current Unbalance Detection (LF2)	254, 463	Disturb Function	274
CyC	300, 321	Disturb Function Amplitude	275
Cyclic Redundancy Check	529	Disturb Function Cancel	207
<b>D</b>		Disturb Function Enabled/Disabled	219
D Control	144	Disturb Function Selection	275
d References	431	Disturb Function Up	219
d2-01	348	Disturb Step	275
Daily Inspection	355	DM-	71
d-Axis ACR Output	487	DM+	71
d-Axis Current for High Efficiency Control	264	dnE	300, 322
		DO-A3	380

DO-A3 Output Mode Selection . . . . .	197	E2-03 . . . . .	292, 335
DO-A3 Settings . . . . .	197	E2-07 . . . . .	334
Drive Baseblock . . . . .	300	E2-08 . . . . .	334
Drive Capacity Setting Fault . . . . .	329	E3-01 (Motor 2 Control Mode) Dependent Parameters . . . . .	492
Drive Capacity Signal Fault . . . . .	299	E3-04 through E3-10 . . . . .	310
Drive Cooling Fans . . . . .	360	E5 . . . . .	300, 306
Drive Cover . . . . .	33, 34	E5-01 . . . . .	310, 331
Drive Derating Data . . . . .	411	E5-09 . . . . .	331
Drive Disabled . . . . .	300, 322	E5-24 . . . . .	331
Drive Does Not Allow Selection of Rotational Auto-Tuning . . . . .	345	EEPROM Memory Data Error . . . . .	304
Drive Duty Mode Selection . . . . .	170	EEPROM Write Error . . . . .	300, 307
Drive Mode . . . . .	91, 92	EF . . . . .	300, 322
Drive Mode Unit Monitor Selection . . . . .	268, 469	EF0 . . . . .	299, 307, 322
Drive Model Mismatch . . . . .	338	EF1 . . . . .	307, 322
Drive Model Selection . . . . .	270	EF1 to EF7 . . . . .	299, 301
Drive Models and Types . . . . .	45	EF2 . . . . .	307, 322
Drive Motor Overload Protection . . . . .	568	EF3 . . . . .	307, 322
Drive Operation Status at Previous Fault . . . . .	483	EF4 . . . . .	307, 322
Drive Overheat . . . . .	301	EF5 . . . . .	307, 322
Drive Overheat Warning . . . . .	325	EF6 . . . . .	307, 322
Drive Overload . . . . .	299, 314	EF7 . . . . .	307, 322
Drive Ready . . . . .	82	EF8 . . . . .	307, 322
Drive Replacement . . . . .	372	Electrical Installation . . . . .	49
Drive Short-Circuit Rating . . . . .	568	EMC Filter and Drive Installation for CE Compliance . . . . .	557
Drive Slave Address . . . . .	524	EMC Filter Installation . . . . .	556
Drive Specifications . . . . .	407	EMC Filters . . . . .	558
Drive Standard Connection Diagram . . . . .	53	EMC Guidelines . . . . .	554
Drive Status . . . . .	481	EMC Guidelines Compliance . . . . .	556
Drive Transmit Wait Time . . . . .	525	Enclosure Types . . . . .	32
Drive Unit Setting Error . . . . .	301	Encoder Z-Pulse Offset . . . . .	112, 191
Drive Unit Signal Fault . . . . .	305	End . . . . .	338
Drive Watt Loss Data . . . . .	409	End1 . . . . .	302, 334
Drive/kVA Selection . . . . .	470	End2 . . . . .	302, 334
DriveWizard Plus . . . . .	117, 380	End3 . . . . .	302, 334
DRV LED Light . . . . .	87	End4 . . . . .	334
During Frequency Output Time Chart . . . . .	218	End5 . . . . .	334
During Run 2, Motor Switch Command Input . . . . .	301	End6 . . . . .	334
During Run Time Chart . . . . .	211	End7 . . . . .	335
dv1 . . . . .	305	Energy Saving . . . . .	154
dv2 . . . . .	306	Energy Saving Coefficient Value . . . . .	155
dv3 . . . . .	306	Energy Saving Control Filter Time Constant . . . . .	155
dv3 Detection Selection . . . . .	194	Energy Saving Control Selection . . . . .	154
dv4 . . . . .	306	Energy Saving Gain . . . . .	155
dv4 Detection Selection . . . . .	194	Energy Saving On/Off . . . . .	207
dv7 . . . . .	306	Enter Command . . . . .	547
Dwell Function . . . . .	154, 297	Enter command necessary . . . . .	526
Dwell Reference at Start . . . . .	154	Enter command not necessary . . . . .	526
Dwell Reference at Stop . . . . .	154	Enter Command Settings when Upgrading the Drive . . . . .	547
Dwell Time at Start . . . . .	154	Enter Command Types . . . . .	547
Dwell Time at Stop . . . . .	154	Enter Data from the Motor Nameplate . . . . .	106
Dynamic Braking Options . . . . .	393	Er-01 . . . . .	302, 335
Dynamic Braking Resistor . . . . .	300	Er-02 . . . . .	302, 335
Dynamic Braking Transistor . . . . .	300, 317	Er-03 . . . . .	302, 335
<b>E</b> . . . . .		Er-04 . . . . .	302, 335
E (G) . . . . .	70	Er-05 . . . . .	302, 335
E1-04 . . . . .	345, 348	Er-08 . . . . .	302, 336
E1-04 through E1-10 . . . . .	310, 312, 313, 314, 325	Er-09 . . . . .	302, 336
E1-06 . . . . .	313	Er-10 . . . . .	336
E1-07 . . . . .	332	Er-11 . . . . .	302, 336
E1-08 . . . . .	292, 294, 312, 313, 314	Er-12 . . . . .	302, 336
E1-08 and E1-10 . . . . .	325	Er-13 . . . . .	336
E1-09 . . . . .	332, 343	Er-14 . . . . .	337
E1-10 . . . . .	292, 294, 312, 314	Er-15 . . . . .	337
E2-01 . . . . .	292, 312, 313	Er-16 . . . . .	337
E2-02 . . . . .	292	Er-17 . . . . .	337
		Er-18 . . . . .	337
		Er-19 . . . . .	337

Er-20	337
Er-21	337
Err.	300, 307
Error Reading Data	339
Error Writing Data	338
Errors and Displays When Using the Copy Function	302
European Standards	554
Excessive Motor Oscillation and Erratic Rotation	346
Excessive PID Feedback	300, 301, 308, 323
Excessive Speed Deviation (for Simple V/f with PG)	299, 300
Excessive Speed Deviation Detection Delay Time	193
Excessive Speed Deviation Detection Level	193
Excessive V/f Setting	302, 334
Exterior and Mounting Dimensions	45
External Digital Operator Connection Fault	314
External Fault	307, 322, 323
External Fault (input terminal S1 to S7)	299, 301
External Fault from Comm. Option Detection Selection	198
External Fault from Comm. Option Operation Selection	198
External Interlock	82
<b>F</b>	
F1-08	315
F1-08 and F1-09	315, 326
F1-10	305, 322
F1-10 and F1-11	305
F1-11	305, 322
F1-14	316, 327
FAn	307, 323
Fan Connector Cable (CN6)	368
Fan Cover	361
Fan Guard	33, 34, 369
Fan Relay Cable	368
Fan Unit	33, 34, 368
Fast Stop Sequence	205
Fast Stop Time	159
Fault Causes and Solutions	303
Fault Detection	303
Fault Displays	299, 303
Fault History	286, 340, 483
Fault Relay	71
Fault Reset Interval Time	247, 460
Fault Reset Methods	341
Fault Reset Operation Selection	248, 460
Fault Restart	247
Fault Trace	286, 340, 482
Fault Trace / History Register Contents	544
Fault Trace Example	340
Faults	298, 299
FbH	300, 301, 308, 323
FbL	300, 301, 308, 323
Feed Forward Control	261
Feed Forward Control Diagram	261
Feed Forward Control Gain	262
Feed Forward Control Selection	261
Ferrule Dimensions	73
Ferrule Terminal Types and Sizes	73
Ferrule-Type Wire Terminals	73
Field Forcing	180
Field Forcing Limit	181
Field Forcing Selection	181
Field Weakening	180
Field Weakening Frequency Limit	180
Field Weakening Level	180
Fine-Tuning Advanced Open Loop Vector Control for PM Motors	296
Fine-Tuning Closed Loop Vector Control	294

Fine-Tuning Closed Loop Vector Control for PM Motors	296
Fine-Tuning Open Loop Vector Control	293
Fine-Tuning Open Loop Vector Control for PM Motors	295
Fine-Tuning V/f Control and V/f Control with PG	292
FJOG/RJOG Operation	204
FM	71
Formula to calculate the amount of voltage drop	61
Forward Regenerative Torque Limit	250, 462
Forward Torque Limit	250, 462
Forward/Reverse Run Command Input Error	322
FOUT LED Light	87
Frequency Accuracy (Temperature Fluctuation)	407
Frequency Control Range	407
Frequency Detection 1 Time Chart	212
Frequency Detection 2 Time Chart	213
Frequency Detection 3 Example with a Positive L3-04 Value	216
Frequency Detection 4 Example with Positive L3-04 Value	216
Frequency Gain at KEB Start during Acceleration	282
Frequency Gain at KEB Start during Constant Speed	282
Frequency Gain at KEB Start during Deceleration	282
Frequency Meter / Ammeter	379
Frequency Meter Potentiometer	379
Frequency Reference	173, 480
Frequency Reference 2 Lower Limit	176
Frequency Reference 2 Upper Limit	175
Frequency Reference at Previous Fault	482
Frequency Reference at Reference Loss	245, 460
Frequency Reference from MEMOBUS/Modbus Comm.	485
Frequency Reference Gain	275
Frequency Reference Gain Change Ramp	275
Frequency Reference Loss Detection Selection	245, 460
Frequency Reference Lower Limit	175
Frequency Reference Monitor Content During PID	152
Frequency Reference Setting / Decimal Display	469
Frequency Reference Setting and User-Set Display	469
Frequency Reference Setting Hierarchy	173
Frequency Reference Setting Method Selection	270, 470
Frequency Reference Source 1	127, 343, 419
Frequency Reference Source 2	134
Frequency Reference Source Selection	485
Frequency Reference Upper Limit	175
Frequency Setting Potentiometer	379
Frequency Setting Resolution	407
Frequency Setting Signal	407
Front Cover	33, 34
Front Cover Screw	34
Function Code	529
Functions for Terminals S1 to S8	200
Functions for Textile Applications	274
Fuse	379, 400
Fuse Holder	400
Fuse Selection	555, 567

## G

General Safety Information	15
GF	300, 308
Ground Fault	300, 308
Ground Fault Circuit Interrupter (GFCI)	378
Ground Terminal	35
Ground Wiring	67

## H

H1	70
H1 Multi-Function Digital Input Selections	445
H1-01 through to H1-07	329
H2	70

H3 Multi-Function Analog Input Settings	453
H3-02	313, 345, 346, 348
H3-02 and H3-10	331
H3-02 or H3-10	325
H3-09	79
H3-09 Details	79
H3-10	313, 346, 348
H3-11	348
H3-13	297, 347
H5-09	321
H6-02 through H6-05	315, 326
Hbb	301, 323
HbbF	301, 323
HC	70
HCA	301, 324
HD	171
HD and ND	404
Heatsink	33, 34
Heatsink Cooling Fan Off-Delay Time	253
Heatsink Cooling Fan Operation Delay Time	463
Heatsink Cooling Fan Operation Selection	253, 463
Heatsink Overheat	299, 301, 312, 325
Heatsink Temperature	484
Heavy Duty	30, 171, 404
Heavy Duty Ratings	404
High Current Alarm Selection	256
High Frequency Injection	265
High Frequency Injection during Overexcitation Deceleration	260
High Performance Operation Using OLV or CLV	98
Humidity	40
Hunting Prevention	258
Hunting Prevention Gain	292
Hunting Prevention Gain Setting	258, 465
Hunting Prevention Gain while in Reverse	258, 465
Hunting Prevention Selection	258, 465
Hunting Prevention Time Constant	258, 465

## I

I Control	143
IEC/EN 61800-3 C2 Filters	558
iFEr	338
IG	71
IGBT Maintenance	484
IGBT Maintenance Setting	273, 470
IGBT Maintenance Time (50%)	324
IGBT Maintenance Time (90%)	327
Induced Noise	399
Induced Voltage Constant Unit Selection	111
Induction Voltage Error	337
Inertia Detection Error	337
Inertia Tuning	103
Inertia Tuning Frequency Reference	112
Inertia Tuning Reference Amplitude	112
Initial Operation	96
Initial Polarity Estimation Timeout	306
Initial Rotor Position Detection Selection	263
Initial Rotor Position Estimation Current	263
Initialization	122
Initialization required	330
Initialize Parameters	116, 123
Input Current	405, 406
Input Fuses	400, 555, 567
Input Noise Filter	379
Input Phase Loss	299, 316, 326
Input Phase Loss Protection Selection	252, 462
Input Power	405, 406

Input Pulse Monitor	482
Input Terminal Status	480
Input Terminal Status at Previous Fault	482
Input Terminals	95
Input Voltage Setting	182
Inrush Prevention Circuit Fault	319
Inrush Prevention Relay Maintenance Setting	470
Inspection	355, 356
Installation Environment	40
Installation Method Selection	255
Installation Orientation	40
Installation Orientation and Spacing	40
Installation Spacing	41
Installing a Braking Resistor Unit: LKEB type	394
Installing a Braking Resistor: ERF type	393
Installing a Braking Unit: CDBR Type	394
Installing a Leakage Breaker	396
Installing a Magnetic Contactor	396
Installing a Molded Case Circuit Breaker (MCCB)	395
Installing a Motor Thermal Overload (oL) Relay on the Drive Output	401
Installing Other Types of Braking Resistors	394
Installing Peripheral Devices	393
Installing the Cooling Fan	363, 365, 371
Integral Limit Setting	147
Integral Operation during Accel/Decel	169
Integral Operation during Accel/Decel for Motor 2	170
Integral Time Setting (I)	147
Interlock Circuit Example	82
Internal Braking Transistor Protection	256
Internal Dynamic Braking Resistor Protection Selection (ERF type)	251, 462
Internal Fan Fault	307, 323
Inversion Detection	306
Inversion Prevention Detection	306
IP00 Enclosure	32
IP20 Enclosure	32
Isolator	379

## J

Jog Frequency Reference	173
Jumper S3	76

## K

KEB (N.C.), (N.O.)	209
KEB 1	279
KEB 1 Phase Loss Detection Level	280
KEB 1 Phase Loss Detection Time	280
KEB 1 Phase Loss Sampling Time	280
KEB 2	279
KEB 3	279
KEB End Detection Time	280
KEB End Voltage	279
KEB Hold Time	280
KEB Minimum Operation Time	280
KEB Mode Selection	276, 278
KEB Reacceleration Prohibit Frequency	281
KEB Start Conditions	281
KEB Start dv/dt Filter	279
KEB Start dv/dt Level	279
KEB Start Voltage	279
KEB Start/End Voltage Setting Mode	279
KEB Synchronous Acceleration Time	282
KEB Target Voltage	280
KEB Voltage Monitors	287
Keys and Displays on the Digital Operator	87
kWh	484
kWh Monitor Initial Value Selection	471

kWh Monitor Initialization . . . . .	273
kWh, Lower 4 Digits . . . . .	484
kWh, Upper 5 Digits . . . . .	484
<b>L</b>	
L Protection Function . . . . .	457
L1-01 . . . . .	313
L2-05 . . . . .	318
L3-01 through L3-06 . . . . .	297
L3-02 . . . . .	346, 348
L3-04 . . . . .	313, 315, 346
L3-06 . . . . .	297, 346
L3-07 . . . . .	297
L3-11 . . . . .	297
L3-25 . . . . .	315
L5-01 . . . . .	326
L6-02 . . . . .	314, 318, 325
L6-02 and L6-03 . . . . .	318, 327
L6-03 . . . . .	314, 318, 325
L6-05 . . . . .	314, 318, 325
L6-05 and L6-06 . . . . .	318, 325, 327
L6-06 . . . . .	314, 318, 325
L7-01 . . . . .	336
L7-01 through L3-04 . . . . .	297
L7-01 through L7-04 . . . . .	303, 346
L7-02 . . . . .	336
L8-01 . . . . .	316
L8-02 . . . . .	312, 325
L8-05 . . . . .	316
L8-07 . . . . .	308
L8-09 . . . . .	308
L8-12 . . . . .	413
L8-29 . . . . .	413
L8-38 . . . . .	348
Language Selection . . . . .	122
LCD Operator . . . . .	379
Leakage Inductance Alarm . . . . .	334
Leakage Inductance Error . . . . .	336
LED Check . . . . .	484
LED Screen Displays . . . . .	88
LF . . . . .	300, 308
LF2 . . . . .	300, 309
Line Driver PG . . . . .	380
Line-to-Line Resistance Error . . . . .	302, 335
LO/RE . . . . .	89, 95, 114
LO/RE (LOCAL/REMOTE) Key Function Selection . . . . .	269
LO/RE LED . . . . .	89
LO/RE Light . . . . .	87
Load Current . . . . .	467
Load Falls When Brake is Applied . . . . .	347
Load Inertia . . . . .	265, 467
Load Inertia Ratio . . . . .	169, 315
Load/Inertia Ratio . . . . .	283
LOCAL . . . . .	95
LOCAL/REMOTE Key Function Selection . . . . .	469
LOCAL/REMOTE Run Selection . . . . .	133
Loopback Test . . . . .	531
Loss of Reference Function . . . . .	245
Low Voltage Directive . . . . .	554
Low Voltage Wiring . . . . .	568
Low Voltage Wiring for Control Circuit Terminals . . . . .	568
LSo . . . . .	309
LSo Fault . . . . .	309
LT-1 . . . . .	324
LT-2 . . . . .	324
LT-3 . . . . .	324
LT-4 . . . . .	324

## M

M1 . . . . .	71
M2 . . . . .	71
MA . . . . .	71
Magnetic Contactor (Input) . . . . .	378
Magnetic Flux Compensation Value . . . . .	136
Main Circuit Connection Diagram . . . . .	55, 68
Main Circuit Terminal . . . . .	35
Main Circuit Terminal and Motor Wiring . . . . .	67
Main Circuit Terminal Block Configuration . . . . .	56
Main Circuit Terminal Functions . . . . .	61
Main Circuit Terminal Wiring . . . . .	68
Main Circuit Wiring . . . . .	61
Maintenance . . . . .	358, 359
Maintenance Alarms . . . . .	359
Maintenance Monitor Settings . . . . .	272
Maintenance Monitors . . . . .	286, 484
Master Speed Reference Lower Limit . . . . .	175
Max. Motor Capacity . . . . .	30
Maximum Applicable Motor Capacity . . . . .	405, 406
Maximum Output Frequency . . . . .	182, 405, 406
Maximum Output Voltage . . . . .	405, 406
Maximum Voltage . . . . .	182
MB . . . . .	71
MC . . . . .	71
Mechanical Installation . . . . .	37
MECHATROLINK Comm. Cycle	
Setting Error (CyC) . . . . .	300, 321
MECHATROLINK Watchdog Timer Error (E5) . . . . .	300, 306
MEMOBUS/Modbus Comm. Test Mode Complete . . . . .	326
MEMOBUS/Modbus Communication . . . . .	71
MEMOBUS/Modbus Communication Error . . . . .	299, 300, 303, 321
MEMOBUS/Modbus Communication Test Mode Error . . . . .	327
MEMOBUS/Modbus Communications . . . . .	519
MEMOBUS/Modbus Communications Reference . . . . .	485
MEMOBUS/Modbus Data Table . . . . .	533
MEMOBUS/Modbus Error Code . . . . .	481
MEMOBUS/Modbus Error Codes . . . . .	548
MEMOBUS/Modbus Setup Parameters . . . . .	524
MEMOBUS/Modbus Specifications . . . . .	521
MEMOBUS/Modbus Switch Settings . . . . .	81
MEMOBUS/Modbus Termination . . . . .	81
MEMOBUS/Modbus Test Mode Complete . . . . .	301
Menu Structure for Digital Operator . . . . .	90
Message Format . . . . .	529
Meter Plate . . . . .	379
Mid Output Voltage A . . . . .	292, 294
Middle Output Frequency . . . . .	182
Middle Output Frequency 2 . . . . .	183
Middle Output Frequency Voltage . . . . .	182
Middle Output Frequency Voltage 2 . . . . .	183
Minimum Output Frequency . . . . .	182
Minimum Output Frequency Voltage . . . . .	183
Minimum Output Voltage . . . . .	292, 294
Minimum Wait Time for Sending Messages . . . . .	528
Minor Alarms . . . . .	300
Minor Fault . . . . .	335
Minor Fault and Alarm Displays . . . . .	300
Minor Faults . . . . .	300
Minor Faults and Alarms . . . . .	298, 300
Model Number and Nameplate Check . . . . .	30
Model, Voltage Class, Capacity Mismatch . . . . .	339
Modes . . . . .	91
Molded Case Circuit Breaker . . . . .	378
Momentary Overcurrent Protection . . . . .	408
Momentary Power Loss Minimum Baseblock Time . . . . .	238, 458
Momentary Power Loss Operation Selection . . . . .	238, 458

Momentary Power Loss Recovery Unit . . . . .	379	Motor Overheat 1 (PTC input) . . . . .	299
Momentary Power Loss Ride-Thru . . . . .	238, 408	Motor Overheat 2 (PTC input) . . . . .	299
Momentary Power Loss Ride-Thru Time . . . . .	238, 458	Motor Overheat Alarm (PTC Input) . . . . .	312
Momentary Power Loss Voltage Recovery Ramp Time . . . . .	238, 458	Motor Overheat Alarm Operation Selection . . . . .	237, 457
Monitor Output . . . . .	71	Motor Overheat Fault (PTC Input) . . . . .	313
Monitor Parameters . . . . .	286, 480	Motor Overheat Fault Operation Selection . . . . .	237, 457
Most Recent Fault . . . . .	483	Motor Overload . . . . .	299, 313
Motor 1 Parameters . . . . .	183	Motor Overload Estimate (oL1) . . . . .	484
Motor 1/Motor 2 Selection . . . . .	107	Motor Overload Protection Selection . . . . .	232, 457, 568
Motor 2 ASR Gain Switching Frequency . . . . .	170	Motor Overload Protection Time . . . . .	235, 457, 569
Motor 2 ASR Integral Limit . . . . .	170	Motor Parameters . . . . .	182
Motor 2 ASR Integral Time . . . . .	169	Motor Performance Fine-Tuning . . . . .	292
Motor 2 ASR Limit . . . . .	169	Motor Poles . . . . .	106
Motor 2 ASR Primary Delay Time Constant . . . . .	169	Motor Produces Insufficient Torque . . . . .	348
Motor 2 ASR Proportional Gain . . . . .	169	Motor Protection . . . . .	232
Motor 2 Base Frequency . . . . .	187	Motor Protection Function . . . . .	313
Motor 2 Base Voltage . . . . .	187	Motor Protection Using a Positive Temperature Coefficient . . . . .	236
Motor 2 Control Mode Selection . . . . .	186	Motor PTC Characteristics . . . . .	236
Motor 2 Inertia . . . . .	170	Motor Pull Out or Step Out Detection . . . . .	317
Motor 2 Iron Loss . . . . .	188	Motor q-Axis Current at Previous Fault . . . . .	483
Motor 2 Leakage Inductance . . . . .	188	Motor q-Axis Inductance . . . . .	190
Motor 2 Line-to-Line Resistance . . . . .	188	Motor Rated Current . . . . .	106, 108, 183, 190, 476, 568
Motor 2 Load Inertia Ratio . . . . .	170	Motor Rated Power . . . . .	107, 185, 190, 476
Motor 2 Max Output Frequency . . . . .	187	Motor Rated Slip . . . . .	109, 184
Motor 2 Max Voltage . . . . .	187	Motor Rated Voltage . . . . .	106, 107, 476
Motor 2 Mid Output Frequency . . . . .	187	Motor Rotates After the Drive Output is Shut Off . . . . .	348
Motor 2 Mid Output Frequency 2 . . . . .	187	Motor Rotates Faster Than the Frequency Reference . . . . .	346
Motor 2 Mid Output Frequency Voltage . . . . .	187	Motor Rotates in One Direction Only . . . . .	344
Motor 2 Mid Output Frequency Voltage 2 . . . . .	187	Motor Secondary Current (Iq) . . . . .	486
Motor 2 Minimum Output Frequency . . . . .	187	Motor Selection . . . . .	205
Motor 2 Minimum Output Frequency Voltage . . . . .	187	Motor Selection 1/2 . . . . .	476
Motor 2 Motor Poles . . . . .	188	Motor Speed . . . . .	480
Motor 2 Parameters . . . . .	187	Motor Speed at Previous Fault . . . . .	482
Motor 2 Rated Current . . . . .	187	Motor Speed Error . . . . .	302
Motor 2 Rated No-Load Current . . . . .	188	Motor Speed Error 2 . . . . .	337
Motor 2 Rated Power . . . . .	189	Motor Speed Fault . . . . .	336
Motor 2 Rated Slip . . . . .	188	Motor Stalls During Acceleration or With Large Loads . . . . .	345
Motor 2 Slip Compensation Gain . . . . .	162	Motor Stator Resistance . . . . .	190
Motor 2 Slip Compensation Limit . . . . .	162	Motor Switch during Run . . . . .	327
Motor 2 Slip Compensation Primary Delay Time . . . . .	162	Motor Temperature Input Filter Time . . . . .	237, 457
Motor 2 Slip Compensation Selection during Regeneration . . . . .	163	Motor Wiring . . . . .	67
Motor 2 Torque Compensation Gain . . . . .	164	Mounting Hole . . . . .	33, 34
Motor Acceleration Time . . . . .	261, 283	MP . . . . .	71
Motor Code Selection . . . . .	189, 504	Multi-Function Analog Input Selection Error . . . . .	302, 331
Motor Data Error . . . . .	302, 335	Multi-Function Analog Input Terminal Settings . . . . .	224
Motor d-Axis Current at Previous Fault . . . . .	483	Multi-Function Analog Inputs . . . . .	220
Motor d-Axis Inductance . . . . .	190	Multi-Function Analog Output Terminal AM Bias . . . . .	228
Motor Direction at Power Up when Using Operator . . . . .	271, 470	Multi-Function Analog Output Terminal AM Gain . . . . .	228
Motor Direction Error . . . . .	336	Multi-Function Analog Output Terminal AM . . . . .	
Motor Does Not Rotate . . . . .	343	Monitor Selection . . . . .	227
Motor Excitation Current (Id) . . . . .	486	Multi-Function Analog Output Terminal AM . . . . .	
Motor Hunting and Oscillation Control Parameters . . . . .	297	Signal Level Selection . . . . .	229
Motor Induction Voltage Constant 1 . . . . .	190	Multi-Function Analog Output Terminal FM Bias . . . . .	228
Motor Induction Voltage Constant 2 . . . . .	191	Multi-Function Analog Output Terminal FM Gain . . . . .	228
Motor Inertia . . . . .	112, 169	Multi-Function Analog Output Terminal FM . . . . .	
Motor Iron Core Saturation Coefficient Error . . . . .	302	Monitor Selection . . . . .	227
Motor Iron Loss . . . . .	109, 477	Multi-Function Analog Output Terminal FM . . . . .	
Motor Iron Loss for Torque Compensation . . . . .	185	Signal Level Selection . . . . .	229
Motor Iron-Core Saturation Coefficient . . . . .	334	Multi-Function Analog Outputs . . . . .	227
Motor Iron-Core Saturation Coefficient 1 . . . . .	185	Multi-Function Digital Input Terminal Settings . . . . .	200
Motor Iron-Core Saturation Coefficient 2 . . . . .	185	Multi-Function Digital Inputs . . . . .	70, 200
Motor is Too Hot . . . . .	344	Multi-Function Digital Output . . . . .	71
Motor Leakage Inductance . . . . .	184	Multi-Function Digital Output Terminal Settings . . . . .	210
Motor Line-to-Line Resistance . . . . .	184	Multi-Function Digital Outputs . . . . .	210
Motor Mechanical Loss . . . . .	185	Multi-Function Input Selection Error . . . . .	329
Motor No-Load Current . . . . .	109, 184	Multi-Function Input Setting Error . . . . .	301
Motor Overheat . . . . .	301, 325	Multi-Function Photocoupler Output . . . . .	71

Multiple Drive Installation	41
Multiple Drive Wiring	67
Multi-Step Speed Selection	173
<b>N</b>	
n Advanced Performance Set Up	465
n1 Hunting Prevention	465
n1-02	292, 315
n2	293
n2-01	293
n2-02	293, 315, 331
n2-03	293, 315, 331
n3-13	310, 313
n8-45	315
n8-47	315
n8-51	317
Nameplate	30
ND	171
ndAT	339
NetRef/ComRef Function Selection	199
Network Termination	523
Node Setup Error	300, 309
Noise From the Drive or Output Lines When the Drive is Powered On	347
No-Load Current Alarm	335
No-Load Current Error	302, 335
No-Load Operation	114
No-Load Operation Test Run	114
Normal Duty	30, 171, 404
Normal Duty Ratings	404
Notes on Inertia Tuning and ASR Gain Auto-Tuning	105
Notes on Motor Operation	20
Notes on Rotational Auto-Tuning	104
Notes on Stationary Auto-Tuning	104
nSE	300, 309
Number of Auto Restart Attempts	247, 460
Number of Motor Poles	108, 184, 190, 476
Number of PM Motor Poles	110
Number of Run Commands	484
Number of Run Commands Counter Initialization	273
Number of Speed Search Restarts	142
<b>O</b>	
o Operator Related Parameters	469
o2-01	343
o2-02	344
o2-03	116
o2-04	292, 312, 325, 329
o2-06	314
o4-03	312, 325
oC	300, 309
oFA00	300, 310
oFA01	300, 310
oFA03 to oFA06	310
oFA10	310
oFA11	310
oFA12 to oFA17	310
oFA30 to oFA43	299, 310
oFb00	310
oFb01	311
oFb02	311
oFb03 to oFb11	311
oFb12 to oFb17	311
oFC00	311
oFC01	311
oFC02	311
oFC03 to oFC11	312
oFC12 to oFC17	312

Offset Frequency	181, 487
oH	299, 301, 312, 325
oH1	299, 312
oH2	301, 325
oH3	299, 301, 312, 325
oH4	299, 313
oL1	299, 313
oL2	299, 314, 348
oL2 Characteristics Selection at Low Speeds	253, 463
oL3	299, 301, 314, 325
oL4	299, 301, 314, 325
On-Delay Compensation Derating Start Frequency	267
On-Delay Compensation Disable Frequency	267
On-Delay Compensation Time	266
Online Tuning Gain	263
oPE	329
oPE Fault Parameter	329, 481
oPE01	301, 329
oPE02	301, 329
oPE03	301, 329
oPE04	301, 330
oPE05	302, 330
oPE06	330
oPE07	302, 331
oPE08	302, 331
oPE09	301, 331
oPE10	301, 332
oPE11	301, 332
oPE13	301, 332
oPE14	332
oPE15	332, 333
Open Loop Vector Control	28, 294, 303, 346, 348
Open Loop Vector Control for IPM Motors	28
Open Loop Vector Control for PM Motors	28
Open Loop Vector Control Mode Tuning	293
Open Loop Vector Control Mode Tuning Parameters	293, 294, 295, 296
Operating with the Load Connected	115
Operation Error Displays	301
Operation Errors	298, 301
Operation Selection at Deviation (dEv)	193
Operation Selection at Overspeed (oS)	192
Operation Selection at PG Open Circuit (PGo)	192
Operation Selection when Digital Operator is Disconnected	271, 470
Operation Status Monitors	286, 287, 480, 486
Operation with Permanent Magnet Motors	99
Operator Connection Fault	299
Operator Programming Errors	329
Operator Related Settings	268
oPr	299, 314
Option Card Communications Error	300
Option Card Connection Error at Option Port CN5-A	310
Option Card Connection Error at Option Port CN5-C	311
Option card connector (CN5-A)	35
Option card connector (CN5-B)	35
Option card connector (CN5-C)	35
Option card error occurred at option port CN5-A	310
Option card error occurred at option port CN5-B	311
Option card error occurred at option port CN5-C	312
Option Card External Fault	299, 307, 322
Option Card Fault at Option Port CN5-A	310
Option Card Fault at Option Port CN5-B	310, 311
Option Card Fault at Option Port CN5-C	311
Option Card Installation	382
Option Communication Error	299, 303, 320
Option Frequency Reference	485

Option Settings	192	Parameter Access Level	116
Option Unit Fault	300	Parameter Range Setting Error	329
Optional 24 V DC power supply connector cover	34	Parameter Selection Error	302, 331
Options	375	Parameter Setting Range Error	301
oS	299, 301, 315, 326	Parameter Settings	93
Oscillation or Hunting	347	Parameters that Change with the Motor Code Selection	504
Output Current	480	Parameters to Minimize Motor Hunting and Oscillation	297
Output Current 1 During Speed Search	141	PASS	301, 326
Output Current at Previous Fault	482	Password	117, 124
Output Current Imbalance	309	Password Setting	124
Output Frequency	480	Password Settings	117
Output Frequency after Soft Start	481	PC	71
Output Frequency at Previous Fault	482	Peak Hold Current	484
Output Frequency is not as High as Frequency Reference	348	Peak Hold Output Frequency	484
Output Frequency Resolution	407	Performance Life	358
Output Ground Fault Detection Selection	253, 463	Performance Life Monitors Maintenance Monitors	358
Output Noise Filter	379	Periodic Inspection	356
Output of speed control (ASR) (for Simple V/f PG)	486	Periodic Maintenance	358
Output Phase Loss	300, 308	Peripheral Devices	375
Output Phase Loss Protection	462	Permanent Magnet Motor Control	99
Output Phase Loss Protection Selection	252	PF	299, 316, 326
Output Power	480	PG 1 Division Rate for PG Pulse Monitor	193
Output Power at Previous Fault	482	PG 1 Gear Teeth 1	193
Output Short-Circuit or IGBT Fault	317	PG 1 Gear Teeth 2	193
Output Terminal Status	481	PG 1 Pulses Per Revolution	192
Output Terminal Status at Previous Fault	483	PG 1 Rotation Selection	193
Output Voltage at Previous Fault	482	PG 1 Signal Selection	194
Output Voltage Detection Fault	319, 328	PG 2 Division Rate for PG Pulse Monitor	193
Output Voltage Gain Selection	276	PG 2 Gear Teeth 1	193
Output Voltage Limit	266	PG 2 Gear Teeth 2	193
Output Voltage Limit Operation Selection	162	PG 2 Pulses Per Revolution	192
Output Voltage Meter	379	PG 2 Rotation Selection	193
Output Voltage Reference	480	PG 2 Signal Selection	194
Output Voltage Reference (Vd)	486	PG Disconnect (for any control modes using a PG option card)	316
Output Voltage Reference (Vq)	486	PG Disconnect (for Control Mode with PG)	327
ov	299, 301, 315, 326	PG Disconnect (for Simple V/f with PG)	299, 301
ov Suppression Function Selection	459	PG Hardware Fault	316
Overcurrent	300, 309	PG Hardware Fault (detected when using a PG-X3 option card)	327
Overcurrent Detection Gain	254, 463	PG Number of Pulses Per Revolution	108
Overexcitation Deceleration	259	PG Number of Pulses Per Revolution for PM Motor Tuning	111
Overexcitation Deceleration Gain	260, 310, 465	PG Open-Circuit Detection Time	192
Overexcitation Operation Selection	260, 466	PG Option Card Disconnection Detection 1	194
Overheat 1 (Heatsink Overheat)	312	PG Option Card Disconnection Detection 2	194
Overheat Alarm Level	251, 462	PG Option Card Port for Motor 2 Selection	194
Overheat Pre-Alarm Operation Selection	252, 462	PG Speed Control Card Settings	192
Overload Protection	408	PG-B3	380
Overload Tolerance	405, 406	PG-B3 Settings	192
Overslip Suppression Current Level	260, 466	PGo	299, 301, 316, 327
Overspeed	299, 315	PGoH	316, 327
Overspeed (for Control Mode with PG)	326	PG-X3	380
Overspeed (for Simple V/f with PG)	301	PG-X3 Settings	192
Overspeed Detection Delay Time	192	Phase Order Selection	133
Overspeed Detection Level	192	Photocoupler and Contact Outputs	78
Overtorque 1	301, 325	PID Accel/Decel Time	151
Overtorque 2	301, 325	PID Block Diagram	146
Overtorque Detection 1	299, 314	PID Control	143
Overtorque Detection 2	299, 314	PID Control Selection Error	301
Overtorque Detection Operation	248	PID Control Selection Fault	331
Overvoltage	299, 301, 315	PID Feedback	486
Overvoltage Protection	408	PID Feedback High Detection Level	150
Overvoltage Suppression Function	243	PID Feedback High Detection Time	150
Overvoltage Suppression Function Selection	243	PID Feedback Input Methods	145
<b>P</b>		PID Feedback Loss	300, 301, 308, 323
P Control	143	PID Feedback Loss Detection Selection	149
P1	71	PID Feedback Low Detection Level	150
P2	71		

PID Feedback Low Detection Time	150
PID Fine Tuning	153
PID Function Setting	147
PID Input (feedback)	486
PID Input Limit	152
PID Monitors	286, 486
PID Offset Adjustment	148
PID Output	486
PID Output Fault	348
PID Output Gain Setting	148
PID Output Level Selection	148
PID Output Limit	148
PID Output Lower Limit	152
PID Output Reverse Selection	148
PID Primary Delay Time Constant	148
PID Setpoint	486
PID Setpoint Display Digits	152
PID Setpoint Input Methods	144
PID Setpoint Scaling	152
PID Setpoint Selection	151
PID Setpoint User Display	152
PID Setpoint Value	151
PID Sleep	150
PID Sleep Delay Time	151
PID Sleep Function Start Level	151
PM Inductance Error	337
PM Motor Auto-Tuning Mode Selection	109
PM Motor Code	189
PM Motor Code Selection	109
PM Motor Control Tuning	263
PM Motor d-Axis Inductance	111
PM Motor Induced Voltage Constant	111
PM Motor Parameter Settings	102
PM Motor q-Axis Inductance	111
PM Motor Rated Current	110
PM Motor Rated Frequency	110
PM Motor Rated Power	110
PM Motor Rated Speed	111
PM Motor Rated Voltage	110
PM Motor Settings	189
PM Motor Stator Resistance	111
PM Motor Type	110
PM Speed Feedback Detection Suppression Gain	315
PM Stationary Auto-Tuning	102
PM Stationary Auto-Tuning for Stator Resistance	102
Pole Attraction Current	263
Power Detection Filter Time	155
Power KEB	279
Power KEB Function	283
Power Ratings (Three-Phase 200 V Class)	405
Power Ratings (Three-Phase 400 V Class)	406
Power Supply Inputs Instead of the Safe Disable Feature	77
Powerboard Failure	305
Powering Up the Drive	100
Preface	14
Preparing the Ends of Shielded Cables	75
Preset Reference Timing Diagram	174
Previous Fault	482
PROFIBUS-DP Parameters	199
Programming Mode	91, 93
Proportional Gain Setting (P)	147
Protective Cover	68
Protective cover to prevent miswiring	35
Protective Covers, Reattaching	58
Protective Covers, Removing	57, 58
PTC	236
Pull-In Current	264, 467

Pull-In Current Compensation Time Constant	264, 315, 467
Pull-In Current during Accel/Decel for PM	317
Pull-In Current Level for PM Motor Tuning	111
Pull-Out Detection	300
Pull-Out Detection Level at Low Speed	257
Pull-Out Detection Time at Low Speed	256
Pulse Monitor Selection Error	332
Pulse Output Connection Using External Voltage Supply	79
Pulse Output Connection Using Internal Voltage Supply	78
Pulse Train Input Bias	231
Pulse Train Input Filter Time	231
Pulse Train Input Gain	230
Pulse Train Input Minimum Frequency	231
Pulse Train Input Scaling	230
Pulse Train Input Terminal RP Function Selection	229
Pulse Train Input/Output	229
Pulse Train Monitor Scaling	231
Pulse Train Monitor Selection	231
PWM Method	172

## Q

q-axis ACR Output	486
-------------------	-----

## R

R-	71
R/L1	61
R+	71
Radiated and Radio Frequency Noise	399
Ramp to stop	129
Rated Current Depending on Carrier Frequency	411
Rated Current Setting Alarm	302, 334
Rated Frequency	106, 108, 476
Rated Output Capacity	405, 406
Rated Output Current	405, 406
Rated Slip Error	302, 336
Rated Speed	106, 108, 476
Rated Voltage, Rated Frequency	405, 406
rdEr	339
READ	271
rEAd	339
Reading Drive MEMOBUS/Modbus Register Contents	531
Reading Parameter Settings	339
Reattaching the Digital Operator	59
Reattaching the Front Cover	60
Reattaching the Terminal Cover on an IP00 Enclosure Drive	58
Reattaching the Terminal Cover on an IP20 Enclosure Drive	57
REMOTE	95
Removing the Cooling Fan	362
Removing the Cooling Fan (2A0169, 2A0211, 4A0139, 4A0165)	368
Removing the Digital Operator	59
Removing the Front Cover	59
Removing the Terminal Cover on an IP00 Enclosure Drive	58
Removing the Terminal Cover on an IP20 Enclosure Drive	57
Replacement Parts	358
Replacing the Drive	372
Reset Communication Parameters	199
Resistance Tuning Error	334
Response Messages from Drive to Master	528
REV LED Light	87
Reverse Direction Output Example Time Chart	217
Reverse Operation Selection	131
Reverse Prohibited Error	337
Reverse Regenerative Torque Limit	250, 462
Reverse Torque Limit	250, 462
rF	316

rH	300, 316	Short Circuit Brake Time at Start	137
Rotational Auto-Tuning	101, 104	Short Circuit Brake Time at Stop	137
Rotational Auto-Tuning for V/f Control	101	Short Circuit Braking Current	137
RP	70	SI-C3	380
rr	300, 317	Side-by-Side Installation	41
RS-422 Interface	523	Side-by-Side Mounting	413
RS-485 Interface	522	Side-by-Side Setup	41
RTS Control Selection	525	Simple Motor Setup Using V/f Control	97
rUn	301, 327	Simplified Setup Using the Setup Group	94
Run Command at Power Up	134	Sink Mode (0 V Common), Internal Power Supply	76
Run Command Input Error	300	Sink/source jumper S3	35
Run Command Method Selection	526	Sink/Source Mode, External Power Supply	77
Run Command Selection Error	302	SI-P3	380
Run command selection while in Programming Mode	133	SI-T3	380
Run Command Source 1	128, 343, 419	Slave Address	529
Run Command Source 2	134	Slip Compensation	160
Run Command Source Selection	485	Slip Compensation Gain	161, 293
Run Command/Frequency Reference Source		Slip Compensation Limit	161
Selection Error	330	Slip Compensation Primary Delay Time	161, 293
RUN LED	89	Slip Compensation Selection during Regeneration	161
RUN LED and Drive Operation	89	Soft Charge Bypass Relay Maintenance	484
RUN LED Status and Meaning	89	Soft Charge Bypass Relay Maintenance Time	324
RUN Light	87	Soft Charge Circuit Fault	300
<b>S</b>		Soft CLA Selection	463
S-	71	Soft Starter Speed Reference at Previous Fault	483
S/L2	61	Software Current Limit Selection	254
S+	71	Software No. (Flash)	482
S1	70	Software No. (ROM)	482
S2	70	Software version	30
S3	70	Source Mode (+24 V Common), Internal Power Supply	76
S4	70	Space Between Drives (Side-by-Side Mounting)	41
S5	70	Speed Agree 1 Time Chart	211
S6	70	Speed Agree 2 Time Chart	215
S7	70	Speed Agreement Detection Level	244, 460
S8	70	Speed Agreement Detection Level (+/-)	245, 460
Safe Disable Circuit	571	Speed Agreement Detection Selection	245
Safe Disable Function Wiring Example (Source Mode)	572	Speed Agreement Detection Width	244, 460
Safe Disable Input Function	571	Speed Agreement Detection Width (+/-)	245, 460
Safe Disable Inputs	70	Speed Control Accuracy	407
Safe Disable Monitor Output Function and Digital		Speed Control Integral Time 1	315, 326
Operator Display	573	Speed Control Loop Auto-Tuning	103
Safe Disable Signal Input	301, 323	Speed Control Proportional Gain 1	315, 326
Safety Hazard Definitions	15	Speed Control Range	407
Safety Information	15	Speed Deviation (for Control Mode with PG)	305
Safety Input and EDM Terminal Status	573	Speed Deviation (when using a PG option card)	322
Safety Monitor Output	71	Speed Estimation Type Speed Search	138, 315
Safety Standard	408	Speed Feedback Detection Control (AFR) Tuning	258
Save Disable Signal Input	323	Speed Feedback Detection Control (AFR) Gain	259, 465
SC	70, 317	Speed Feedback Detection Control (AFR)	
S-Curve at KEB Deceleration Start	282	Time Constant 1	259, 465
S-Curve Characteristics	160, 297	Speed Feedback Detection Control (AFR)	
SE	301, 327	Time Constant 2	259, 465
Search Operation Voltage Limit	155	Speed Feedback Detection Control Gain	264, 467
Self-diagnosing function of the serial communication		Speed Feedback Detection Control Gain during	
interface circuits	549	ov Suppression	266
SEr	300, 317	Speed Limit	180
Serial Communication Terminals	71	Speed Limit Bias	178, 180
Serial Communication Transmission Error	300, 321	Speed Limit Selection	179
Serial Communications Cable Connection		Speed Limitation	178
Terminals (TB5)	522	Speed Response	407
Serial Communications Terminal and DIP Switch S2	523	Speed Search	137, 317
Serviceable Parts	372	Speed Search Deactivation Current	140
Setup Group	94	Speed Search Deceleration Time	141
Setup Group Parameters	95	Speed Search Delay Time	141
Setup Mode	94	Speed Search Detection Compensation Gain	141
Shielded Twisted-Pair Cables	75	Speed Search Estimation Type	314
		Speed Search Method Selection	142

Speed Search Restart Current Level . . . . .	142	Terminal Block (TB 4) . . . . .	72
Speed Search Restart Detection Time . . . . .	142	Terminal Block (TB 5) . . . . .	72
Speed Search Selection at Start . . . . .	140	Terminal Block (TB 6) . . . . .	72
Speed Search Wait Time . . . . .	142	Terminal Block Configuration . . . . .	56
Speed/Torque Control Switchover Time . . . . .	180	Terminal Board . . . . .	34, 35, 372
Stall Prevention . . . . .	239, 297, 315	Terminal Board Connection Error . . . . .	304
Stall Prevention Detection Time . . . . .	244	Terminal Board Connector . . . . .	35
Stall Prevention during Deceleration . . . . .	313	Terminal Board Not Connected . . . . .	305
Stall Prevention Level during Acceleration . . . . .	240, 458	Terminal Board Wiring . . . . .	74
Stall Prevention Level during Run . . . . .	243, 459	Terminal Board Wiring Guide . . . . .	74
Stall Prevention Limit during Acceleration . . . . .	240, 458	Terminal Connections for Communication	
Stall Prevention Selection during Acceleration . . . . .	239, 458	Self-Diagnostics . . . . .	549
Stall Prevention Selection during Deceleration . . . . .	241, 458	Terminal Cover . . . . .	34, 57
Stall Prevention Selection during Run . . . . .	242, 459	Terminal M1-M2 Function Selection . . . . .	210
Standard Connection Diagram . . . . .	52	Terminal M1-M2 Output Selection . . . . .	197
Start Speed Search Select . . . . .	143	Terminal M3-M4 Output Selection . . . . .	197
Starting Torque . . . . .	407	Terminal P1-PC Function Selection . . . . .	210
Start-Up Flowcharts . . . . .	96	Terminal P1-PC Output Selection . . . . .	197
Station Address Setting Error		Terminal P2-PC Function Selection . . . . .	210
(CC-Link, MECHATROLINK) (AEr) . . . . .	300, 320	Terminal P2-PC Output Selection . . . . .	197
Stationary Auto-Tuning . . . . .	105	Terminal P3-PC Output Selection . . . . .	197
Stationary Auto-Tuning 1 . . . . .	101	Terminal P4-PC Output Selection . . . . .	197
Stationary Auto-Tuning 2 . . . . .	101	Terminal P5-PC Output Selection . . . . .	197
Stationary Auto-Tuning for Line-to-Line Resistance . . . . .	101	Terminal P6-PC Output Selection . . . . .	197
Stator Resistance Error . . . . .	337	Terminal V1 Monitor Bias . . . . .	196
Status Display . . . . .	100	Terminal V1 Monitor Gain . . . . .	196
STo . . . . .	300, 317	Terminal V1 Monitor Selection . . . . .	196
STOP button Input . . . . .	302, 335	Terminal V1 Signal Level . . . . .	197
STOP Key Function Selection . . . . .	270, 469	Terminal V2 Monitor Bias . . . . .	196
Stopping Method after Communication Error . . . . .	524	Terminal V2 Monitor Gain . . . . .	196
Stopping Method Selection . . . . .	129	Terminal V2 Monitor Selection . . . . .	196
Storage Temperature . . . . .	40	Terminal V2 Signal Level . . . . .	197
Surge Protector . . . . .	378	Termination . . . . .	81
SvE . . . . .	317	Test Run . . . . .	104, 105, 106, 114
Switching Between LOCAL and REMOTE . . . . .	95	Test Run Checklist . . . . .	118
Switching Between Torque and Speed Control . . . . .	178	Test Run with Load Connected . . . . .	115
Synchronous Accel/Decel . . . . .	207	Tightening Torque . . . . .	61, 73
Synchronous Deceleration ov Prevention . . . . .	282	Timer Function Off-Delay Time . . . . .	143
<b>T</b>		Timer Function On-Delay Time . . . . .	143
T Motor Tuning . . . . .	476	Too Many Speed Search Restarts . . . . .	300, 317
T/L3 . . . . .	61	Torque Compensation . . . . .	163
T1000A Models . . . . .	27	Torque Compensation at Forward Start . . . . .	164
T1-02 . . . . .	106, 335	Torque Compensation at Reverse Start . . . . .	164
T1-03 . . . . .	106, 334	Torque Compensation Gain . . . . .	163, 292
T1-04 . . . . .	106, 334, 335	Torque Compensation Primary Delay Time . . . . .	164, 292
T1-05 . . . . .	106, 334, 335	Torque Compensation Primary Delay Time 2 . . . . .	164
T1-06 . . . . .	106	Torque Compensation Primary Delay Time Constant 1 . . . . .	293
T1-07 . . . . .	106, 335	Torque Compensation Primary Delay Time Constant 2 . . . . .	293
Target DC Bus Voltage for Overvoltage Suppression and Stall		Torque Compensation Time Constant . . . . .	164
Prevention . . . . .	244	Torque Control . . . . .	176
Task Complete . . . . .	338	Torque Control Block Diagram . . . . .	176
Temperature Derating . . . . .	413	Torque Control Input Value Selection . . . . .	177
Terminal A1 Bias Setting . . . . .	221	Torque Control Reference Sources . . . . .	176
Terminal A1 Function Selection . . . . .	221	Torque Control Selection . . . . .	179
Terminal A1 Gain Setting . . . . .	221	Torque Control Setting Error . . . . .	332
Terminal A1 Signal Level Selection . . . . .	220	Torque Detection . . . . .	248
Terminal A2 Bias Setting . . . . .	223	Torque Detection Level 1 . . . . .	249, 461
Terminal A2 Function Selection . . . . .	222	Torque Detection Level 2 . . . . .	249, 461
Terminal A2 Gain Setting . . . . .	223	Torque Detection Selection 1 . . . . .	249, 461
Terminal A2 Signal Level Selection . . . . .	222	Torque Detection Selection 2 . . . . .	249, 461
Terminal A3 Bias Setting . . . . .	222	Torque Detection Time 1 . . . . .	249, 461
Terminal A3 Function Selection . . . . .	222	Torque Detection Time 2 . . . . .	249, 461
Terminal A3 Gain Setting . . . . .	222	Torque Limit . . . . .	250, 407
Terminal A3 Signal Level Selection . . . . .	222	Torque Limit Control Method Selection during	
Terminal Block (TB 1) . . . . .	72	Accel/Decel . . . . .	251, 462
Terminal Block (TB 2) . . . . .	72	Torque Limit Integral Time Constant . . . . .	250, 462
		Torque Limit Process at Start . . . . .	251

Torque Limits	297
Torque Reference	480
Torque Reference / Torque Limit Selection from Comm. Option	199
Torque Reference at Previous Fault	482
Torque Reference Delay Time	179
Torque Saturation Error	337
Torque Specifications, Three Phase 200 V Class	62, 560
Torque Specifications, Three Phase 400 V Class	64, 563
Transistor Input Signal	76
Troubleshooting	289
Troubleshooting without Fault Display	342
TrPC	327
Tuning Errors	298
Types of Alarms, Faults, and Errors	298
Types of Auto-Tuning for Induction Motors	101
Types of Auto-Tuning for Permanent Magnet Motors	102
<b>U</b>	
U Monitors	480
U/T1	61
U1-01	343, 345
U1-07	343
U1-09	343
U2, U3 Initial Value Selection	471
U2, U3 Initialization	273
U2-02	340
U2-03 through U2-17	340
U4-05	316, 318, 328
U4-06	318, 319
UL Standards	560
UL/cUL Mark	560
UL3	300, 301, 318, 327
UL4	300, 301, 318, 327
Undertorque 1	301
Undertorque 2	301
Undertorque Detection 1	300, 318, 327
Undertorque Detection 2	300, 318, 327
Undertorque Detection Operation	248
Undervoltage	300, 301, 328
Undervoltage 3	319
Undervoltage 3 (Soft-Charge Bypass Circuit Fault)	319
Undervoltage Detection Level (Uv1)	238, 458
Undervoltage Protection	408
Unexpected Noise from Connected Machinery	347
Unidirectional Speed Limit Bias	180
Unit Code	270
Unit Selection for MEMOBUS/Modbus Register 0025H	525
Unstable Motor Speed when Using PM	349
Up/Down Command Operation	204
USB Copy Unit	117, 379
USB port (type-B)	33, 34, 80
User Monitor Selection after Power Up	268, 469
User Parameter Automatic Selection	116, 126, 419
User Parameter Default Value	116, 270, 469
User Parameters	116
User Parameters 1 to 32	116, 126, 419
User Set Speed Agree 1 Time Chart	212
User Set Speed Agree 2 Example with a Positive L3-04 Value	215
User-Set Display Units Decimal Display	269
User-Set Display Units Maximum Value	269
Using Braking Units in Parallel	395
Using the Pulse Train Output	78
Using the Safe Disable Function	571
Uv	301, 328
Uv during KEB	219

Uv1	300, 318
Uv2	300, 318
Uv3	300, 319

## V

-V	70
V/f Characteristics	407
V/f Control	28
V/f Control Mode Tuning	292
V/f Control Mode Tuning Parameters	292
V/f control using motor speed feedback	28
V/f Control with Simple Speed Feedback	230
V/f Data Setting Error	301, 332
V/f Gain Change Time	276
V/f Gain During Speed Search	141
V/f Pattern Display Unit	269
V/f Pattern for Motor 1	182
V/f Pattern for Motor 2	186
V/f Pattern Selection	182
V/T2	61
vAEr	339
VERIFY	271
Verify Menu	93
Verifying Parameter Changes	93
vFyE	339
voF	319, 328
Voltage Class, Capacity Mismatch	339
Voltage Error Compensation Time Constant	265
vrFy	339

## W

W/T3	61
Warranty Information	23
Watt Hour Output Example	220
Watt Hour Output Unit Selection	220
Watt Loss 200 V Class Three Phase Models	409
Watt Loss 400 V Class Three Phase Models	410
Wire Gauge, Three Phase 200 V Class	62, 560
Wire Gauge, Three Phase 400 V Class	64, 563
Wire Gauges	61, 73
Wiring Checklist	83
Wiring Diagram for 2-Wire Sequence	207
Wiring Distance	172
Wiring the Control Circuit Terminal	74
WRITE	271
Writing Parameter Settings	338
Writing to Multiple Registers	532

## Z

Z Pulse Correction Error	337
Z Pulse Fault	305
Z Pulse Noise Fault Detection	306
Z Pulse Offset Tuning	102
Zero Phase Reactor	379
Zero Servo	156
Zero Servo Completion Width	157
Zero Servo Fault	317
Zero Servo Gain	156
Zero-Speed Time Chart	211

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# YASKAWA AC Drive T1000A

## AC Drive for Textile Applications

## Technical Manual

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# YASKAWA

YASKAWA ELECTRIC CORPORATION

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply. Specifications are subject to change without notice for ongoing product modifications and improvements.

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