YASKAWA

YASKAWA AC Drive P1000

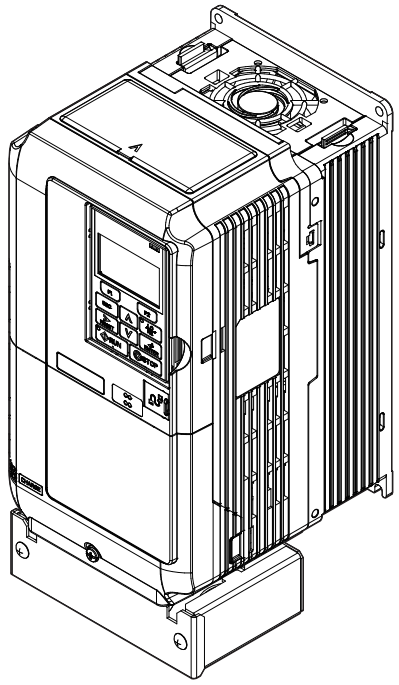
Industrial Fan and Pump Drive

Technical Manual

Type: CIMR-PU□A□□□□

Models: 200 V Class: 3/4 to 175 HP ND
400 V Class: 3/4 to 500 HP ND
600 V Class: 2 to 250 HP ND

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

Easily Set Parameters for Specific Applications	
Preset parameter defaults are available for setting up applications. *Refer to Application Selection on page 118*.	

Perform Auto-Tuning
Automatic tuning sets motor parameters. *Refer to Auto-Tuning on page 121*.

Maintenance Check Using Drive Monitors
Use drive monitors to check if fans, capacitors, or other components require maintenance. *Refer to Performance Life Monitors Maintenance Monitors on page 329*.

Fault Display and Troubleshooting
Refer to Drive Alarms, Faults, and Errors on page 279 and *Refer to Troubleshooting without Fault Display on page 314*.

Standards Compliance	
Refer to European Standards on page 500 and *Refer to UL and CSA Standards on page 507* <1> .	

<1> CE marking applies to 200 V class and 400 V class models only.

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Table of Contents

QUICK REFERENCE 3

i. PREFACE & GENERAL SAFETY 15

i.1 Preface 16

Applicable Documentation 16
Symbols 16
Terms and Abbreviations 16
Trademarks 16

i.2 General Safety 17

Supplemental Safety Information 17
Safety Messages 18
General Application Precautions 20
Motor Application Precautions 21
Drive Label Warning Example 24
Warranty Information 24

1. RECEIVING 25

1.1 Section Safety 26

1.2 General Description 27

P1000 Model Selection 27
Control Mode Details 28

1.3 Model Number and Nameplate Check 29

Nameplate 29

1.4 Drive Models and Enclosure Types 32

1.5 Component Names 34

IP20/NEMA Type 1 Enclosure 34
IP00/Open Type Enclosure 37
Front Views 41

2. MECHANICAL INSTALLATION 43

2.1 Section Safety 44

2.2 Mechanical Installation 46

Installation Environment 46
Installation Orientation and Spacing 46
Digital Operator Remote Usage 48
Exterior and Mounting Dimensions 51

3. ELECTRICAL INSTALLATION 59

3.1 Section Safety 60

3.2 Standard Connection Diagram 62

3.3 Main Circuit Connection Diagram 65

Three-Phase 200 V Class Models 2A0004 to 2A0081
Three-Phase 400 V Class Models 4A0002 to 4A0044
Three-Phase 600 V Class Models 5A0003 to 5A0032 65

Three-Phase 200 V Class Models 2A0110, 2A0138
Three-Phase 400 V Class Models 4A0058, 4A0072
Three-Phase 600 V Class Models 5A0041, 5A0052 65

Three-Phase 200 V Class Models 2A0169 to 2A0211
Three-Phase 400 V Class Models 4A0088 to 4A0139
Three-Phase 600 V Class Models 5A0062 to 5A0099 66

Three-Phase 200 V Class Models 2A0250 to 2A0415
Three-Phase 400 V Class Models 4A0165 to 4A0675
Three-Phase 600 V Class Models 5A0125 to 5A0242 66

3.4 Terminal Block Configuration 67

3.5 Terminal Cover 69

Models 2A0004 to 2A0081, 4A0002 to 4A0044, 5A0003 to 5A0032 (IP20/NEMA Type 1 Enclosure) 69

Models 2A0110 to 2A0250, 4A0208 to 4A0675, and 5A0125 to 5A0242 (IP00/Open Type Enclosure) 70

3.6 Digital Operator and Front Cover 71

Removing/Reattaching the Digital Operator 71
Removing/Reattaching the Front Cover 71

3.7 Top Protective Cover 74

Removing the Top Protective Cover 74
Reattaching the Top Protective Cover 74

3.8 Main Circuit Wiring 75

Main Circuit Terminal Functions 75
Protecting Main Circuit Terminals 75
Wire Gauges and Tightening Torque 77
Main Circuit Terminal and Motor Wiring 83

3.9 Control Circuit Wiring 86

Control Circuit Connection Diagram 86
Control Circuit Terminal Block Functions 86
Terminal Configuration 88
Wiring the Control Circuit Terminal 89
Switches and Jumpers on the Terminal Board 91

3.10 Control I/O Connections 92

Sinking/Sourcing Mode Switch for Digital Inputs 92
Using the Pulse Train Output 92
Terminals A1, A2, and A3 Input Signal Selection 93
Terminal AM/FM Signal Selection 94
MEMOBUS/Modbus Termination 94

3.11 Connect to a PC 95

3.12 External Interlock 96

Drive Ready 96

3.13 Wiring Checklist 97

4. START-UP PROGRAMMING & OPERATION 99

4.1 Section Safety 100

4.2 Using the Digital Operator 101

Keys and Displays 101
LCD Display 102
ALARM (ALM) LED Displays 103
LO/RE LED and RUN LED Indications 103
Menu Structure for Digital Operator 105

4.3 The Drive, Programming, and Clock Adjustment Modes 106

Real-Time Clock (RTC) 106
Clock Adjustment 106
Navigating the Drive and Programming Modes 109
Changing Parameter Settings or Values 110
Verifying Parameter Changes: Verify Menu 112
Simplified Setup Using the Setup Groups 113
Switching Between LOCAL and REMOTE 114

4.4 Start-Up Flowchart 116

4.5 Powering Up the Drive 117

Powering Up the Drive and Operation Status Display 117

4.6 Application Selection 118

A1-03 = 8008: Pump 118
A1-03 = 8009: Pump w/ PI 118
A1-03 = 8010: Fan 119
A1-03 = 8011: Fan w/ PI 119
Default Values for Fan and Pump Applications 120

4.7 Auto-Tuning 121

Types of Auto-Tuning 121
Before Auto-Tuning the Drive 121
Auto-Tuning Interruption and Fault Codes 122
Auto-Tuning Operation Example 122
T1: Parameter Settings during Induction Motor Auto-Tuning 124

4.8 No-Load Operation Test Run 126

No-Load Operation Test Run 126

4.9 Test Run with Load Connected 128

Test Run with the Load Connected 128

4.10 Verifying Parameter Settings and Backing Up Changes 129

Backing Up Parameter Values: o2-03 129
Parameter Access Level: A1-01 129
Password Settings: A1-04, A1-05 129
Copy Function 130

4.11 Test Run Checklist 131

5. PARAMETER DETAILS 133

5.1 A: Initialization 134

A1: Initialization 134
A2: User Parameters 138

5.2 b: Application 139
b1: Operation Mode Selection 139
b2: DC Injection Braking and Short Circuit Braking 144
b3: Speed Search 145
b4: Delay Timers 151
b5: PID Control 151
EZ Sleep/Wake-up Function 159
b6: Dwell Function 165
b8: Energy Saving 166
5.3 C: Tuning 168
C1: Acceleration and Deceleration Times 168
C2: S-Curve Characteristics 169
C3: Slip Compensation 170
C4: Torque Compensation 171
C6: Carrier Frequency 171
5.4 d: Reference Settings 173
d1: Frequency Reference 173
d2: Frequency Upper/Lower Limits 175
d3: Jump Frequency 176
d4: Frequency Reference Hold and Up/Down 2 Function 177
d6: Field Weakening and Field Forcing 181
5.5 E: Motor Parameters 182
E1: V/f Pattern for Motor 1 182
E2: Motor 1 Parameters 186
5.6 F: Option Settings 189
F4: Analog Monitor Card Settings 189
F6: Communication Option Card 190
CC-Link Parameters 191
MECHATROLINK Parameters 191
PROFIBUS-DP Parameters 192
CANopen Parameters 193
DeviceNet Parameters 193
5.7 H: Terminal Functions 196
H1: Multi-Function Digital Inputs 196
H2: Multi-Function Digital Outputs 206
H3: Multi-Function Analog Inputs 216
H4: Multi-Function Analog Outputs 221
H5: MEMOBUS/Modbus Serial Communication 223
H6: Pulse Train Input/Output 223
5.8 L: Protection Functions 225
L1: Motor Protection 225
L2: Momentary Power Loss Ride-Thru 229
L3: Stall Prevention 235
L4: Speed Detection 241
L5: Fault Restart 242
L6: Torque Detection 243
L8: Drive Protection 245
5.9 n: Special Adjustments 251
n1: Hunting Prevention 251
n3: High Slip Braking (HSB) and Overexcitation Braking 251

5.10 o: Operator Related Settings 254
o1: Digital Operator Display Selection 254
o2: Digital Operator Keypad Functions 256
o3: Copy Function 259
o4: Maintenance Monitor Settings 259
5.11 S: Special Application 262
S1: Dynamic Audible Noise Control Function 262
S2: Programmable Run Timers 263
S3: Secondary PI (PI2) Control 268
S6: P1000 Protection 271
T: Motor Tuning 272
5.12 U: Monitor Parameters 273
U1: Operation Status Monitors 273
U2: Fault Trace 273
U3: Fault History 273
U4: Maintenance Monitors 273
U5: PID Monitors 273
U6: Operation Status Monitors 273

6. TROUBLESHOOTING 275
6.1 Section Safety 276
6.2 Motor Performance Fine-Tuning 278
Fine-Tuning V/f Control 278
Parameters to Minimize Motor Hunting and Oscillation 278
6.3 Drive Alarms, Faults, and Errors 279
Types of Alarms, Faults, and Errors 279
Alarm and Error Displays 280
6.4 Fault Detection 283
Fault Displays, Causes, and Possible Solutions 283
6.5 Alarm Detection 297
Alarm Codes, Causes, and Possible Solutions 297
6.6 Operator Programming Errors 304
Operator Programming Error Codes, Causes, and Possible Solutions 304
6.7 Auto-Tuning Fault Detection 307
Auto-Tuning Codes, Causes, and Possible Solutions 307
6.8 Copy Function Related Displays 310
Tasks, Errors, and Troubleshooting 310
6.9 Diagnosing and Resetting Faults 312
Fault Occurs Simultaneously with Power Loss 312
If the Drive Still has Power After a Fault Occurs 312
Viewing Fault Trace Data After Fault 312
Fault Reset Methods 313
6.10 Troubleshooting without Fault Display 314
Common Problems 314
Cannot Change Parameter Settings 314
Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command 315
Motor is Too Hot 316

oPE02 Error Occurs When Lowering the Motor Rated Current Setting 317
Motor Stalls during Acceleration or Acceleration Time is Too Long 317
Drive Frequency Reference Differs from the Controller Frequency Reference Command 318
Excessive Motor Oscillation and Erratic Rotation 318
Deceleration Takes Longer Than Expected with Dynamic Braking Enabled 318
Noise From Drive or Motor Cables When the Drive is Powered On 319
Ground Fault Circuit Interrupter (GFCI) Trips During Run 319
Connected Machinery Vibrates When Motor Rotates 319
PID Output Fault 320
Insufficient Starting Torque 320
Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking) 320
Output Frequency is Not as High as Frequency Reference 320
Sound from Motor 320
Motor Does Not Restart after Power Loss 321

7. PERIODIC INSPECTION & MAINTENANCE 323

7.1 Section Safety 324

7.2 Inspection 326

Recommended Daily Inspection 326
Recommended Periodic Inspection 327

7.3 Periodic Maintenance 329

Replacement Parts 329

7.4 Drive Cooling Fans 331

Number of Cooling Fans 331
Cooling Fan Component Names 333
Cooling Fan Replacement: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032 333
Cooling Fan Replacement: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052 336
Cooling Fan Replacement: 4A0088 and 4A0103 338
Cooling Fan Replacement: 2A0169 to 2A0415, 4A0139 to 4A0362, and 5A0062 to 5A0242 340
Cooling Fan Replacement: 4A0414 344
Cooling Fan Replacement: 4A0515 and 4A0675 346

7.5 Drive Replacement 350

Serviceable Parts 350
Terminal Board 350
Replacing the Drive 351

8. PERIPHERAL DEVICES & OPTIONS 353

8.1 Section Safety 354

8.2 Drive Options and Peripheral Devices 355

8.3 Connecting Peripheral Devices 356

8.4 Option Installation 357

Prior to Installing the Option 357
Communication Option Installation Example 358
Communication Option Installation Example 360

8.5 Installing Peripheral Devices 363

Dynamic Braking Options 363
Installing a Molded Case Circuit Breaker (MCCB) or Ground Fault Circuit Interrupter (GFCI) 366
Installing a Magnetic Contactor at the Power Supply Side 366
Connecting an AC Reactor or DC Link Choke 367
Connecting a Surge Absorber 367

Connecting a Noise Filter 368
Installing Input Fuses 369
Attachment for External Heatsink Mounting 371
Installing a Motor Thermal Overload (oL) Relay on the Drive Output 371

A. SPECIFICATIONS 373

A.1 Power Ratings 374
Three-Phase 200 V Class Drive Models 2A0004 to 2A0030 374
Three-Phase 200 V Class Drive Models 2A0040 to 2A0211 375
Three-Phase 200 V Class Drive Models 2A0250 to 2A0415 376
Three-Phase 400 V Class Drive Models 4A0002 to 4A0031 377
Three-Phase 400 V Class Drive Models 4A0038 to 4A0165 378
Three-Phase 400 V Class Drive Models 4A0208 to 4A0675 379
Three-Phase 600 V Class Drive Models 5A0003 to 5A0032 380
Three-Phase 600 V Class Drive Models 5A0041 to 5A0099 381
Three-Phase 600 V Class Drive Models 5A0125 to 5A0242 382
A.2 Drive Specifications 383
A.3 Drive Watt Loss Data 385
A.4 Drive Derating Data 387
Rated Current Depending on Carrier Frequency 387
Temperature Derating 389
Altitude Derating 390

B. PARAMETER LIST 391

B.1 Understanding Parameter Descriptions 392
Parameter Icons 392
Parameter Groups 392
B.2 A: Initialization Parameters 393
A1: Initialization 393
A2: User Parameters 393
B.3 b: Application 394
b1: Operation Mode Selection 394
b2: DC Injection Braking and Short Circuit Braking 394
b3: Speed Search 395
b4: Timer Function 396
b5: PID Control 396
b6: Dwell Function 399
b8: Energy Saving 399
B.4 C: Tuning 400
C1: Acceleration and Deceleration Times 400
C2: S-Curve Characteristics 400
C3: Slip Compensation 401
C4: Torque Compensation 401
C6: Carrier Frequency 401
B.5 d: References 402
d1: Frequency Reference 402
d2: Frequency Upper/Lower Limits 403
d3: Jump Frequency 403
d4: Frequency Reference Hold and Up/Down 2 Function 403
d6: Field Weakening and Field Forcing 404

B.6 E: Motor Parameters 405
E1: V/f Pattern 405
E2: Motor 1 Parameters 406
F4: Analog Monitor Card (AO-A3) 406
F6, F7: Communication Option Card 407
B.7 H Parameters: Multi-Function Terminals 411
H1: Multi-Function Digital Inputs 411
H2: Multi-Function Digital Outputs 414
H3: Multi-Function Analog Inputs 416
H4: Analog Outputs 417
H5: MEMOBUS/Modbus Serial Communication 418
H6: Pulse Train Input/Output 419
B.8 L: Protection Function 420
L1: Motor Protection 420
L2: Momentary Power Loss Ride-Thru 420
L3: Stall Prevention 421
L4: Speed Detection 422
L5: Fault Restart 423
L6: Torque Detection 423
L8: Drive Protection 425
B.9 n: Special Adjustment 427
n1: Hunting Prevention 427
n3: High Slip Braking (HSB) and Overexcitation Braking 427
B.10 o: Operator-Related Settings 428
o1: Digital Operator Display Selection 428
o2: Digital Operator Keypad Functions 429
o3: Copy Function 429
o4: Maintenance Monitor Settings 430
B.11 S: Special Application 431
S1: Dynamic Noise Control Function 431
S2: Programmable Run Timers 431
S3: Secondary PI (PI2) Control 434
S6: P1000 Protection 435
B.12 T: Motor Tuning 436
T1: Induction Motor Auto-Tuning 436
B.13 U: Monitors 437
U1: Operation Status Monitors 437
U2: Fault Trace 439
U3: Fault History 440
U4: Maintenance Monitors 441
U5: PID Monitors 443
U6: Operation Status Monitors 444
B.14 V/f Pattern Default Values 445
B.15 Defaults by Drive Model 446

C. MEMOBUS/MODBUS COMMUNICATIONS 463
C.1 MEMOBUS/Modbus Configuration 464
C.2 Communication Specifications 465
C.3 Connecting to a Network 466

Network Cable Connection 466
Wiring Diagram for Multiple Connections 466
Network Termination 467
C.4 MEMOBUS/Modbus Setup Parameters 468
MEMOBUS/Modbus Serial Communication 468
C.5 Drive Operations by MEMOBUS/Modbus 471
Observing the Drive Operation 471
Controlling the Drive 471
C.6 Communications Timing 472
Command Messages from Master to Drive 472
Response Messages from Drive to Master 472
C.7 Message Format 473
Message Content 473
Slave Address 473
Function Code 473
Data 473
Error Check 473
C.8 Message Examples 475
Reading Drive MEMOBUS/Modbus Register Contents 475
Loopback Test 475
Writing to Multiple Registers 476
C.9 MEMOBUS/Modbus Data Table 477
Command Data 477
Monitor Data 478
Broadcast Messages 489
Fault Trace Contents 490
Alarm Register Contents 492
C.10 Enter Command 493
Enter Command Types 493
Enter Command Settings when Upgrading the Drive 493
C.11 Communication Errors 494
MEMOBUS/Modbus Error Codes 494
Slave Not Responding 494
C.12 Self-Diagnostics 495

D. STANDARDS COMPLIANCE 497

D.1 Section Safety 498
D.2 European Standards 500
CE Low Voltage Directive Compliance 500
EMC Guidelines Compliance 502
D.3 UL and CSA Standards 507
UL Standards Compliance 507
CSA Standards Compliance 520
Drive Motor Overload Protection 520
Precautionary Notes on External Heatsink (IP00/Open Type Enclosure) 522

E. QUICK REFERENCE SHEET 525

E.1 Drive and Motor Specifications 526

Drive Specifications 526
Motor Specifications 526
E.2 Basic Parameter Settings 527
Basic Setup 527
V/f Pattern Setup 527
Motor Setup 527
Multi-Function Digital Inputs 527
Pulse Train Input/Analog Inputs 528
Multi-Function Digital Outputs 528
Monitor Outputs 528
E.3 User Setting Table 529
INDEX 535

i

Preface & General Safety

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.

i.1 PREFACE....16

i.2 GENERAL SAFETY....17

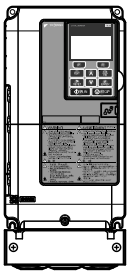
i.1 Preface

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, EXPRESS 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 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 P1000 series drives:

	P1000 Series AC Drive Technical Manual (SIEPYAIP1U01)
	This manual provides detailed information on parameter settings, drive functions, and MEMOBUS/Modbus specifications. Use this manual to expand drive functionality and to take advantage of higher performance features. This manual is available for download on our documentation website, www.yaskawa.com.
	P1000 Series AC Drive Quick Start Guide (TOEPYAIP1U01)
	Read this guide first. This guide is packaged together with the product and contains basic information required to install and wire the drive. It also gives an overview of fault diagnostics, maintenance, and parameter settings. The purpose of this guide is to prepare the drive for a trial run with an application and for basic operation. This manual is available for download on our documentation website, www.yaskawa.com.

◆ 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 P1000-Series Drive
- **BCD:** Binary Coded Decimal
- **H:** Hexadecimal Number Format
- **IGBT:** Insulated Gate Bipolar Transistor
- **kbps:** Kilobits per Second
- **MAC:** Media Access Control
- **Mbps:** Megabits per Second
- **r/min:** Revolutions per Minute
- **V/f:** V/f Control

◆ Trademarks

- CANopen is a trademark of CAN in Automation (CiA).
- CC-Link is a trademark of CC-Link Partner Association (CLPA).
- DeviceNet is a trademark of Open DeviceNet Vendor Association, Inc. (ODVA).
- PROFIBUS-DP is a trademark of PROFIBUS International (PI).
- MECHATROLINK-I/MECHATROLINK-II are trademarks 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. Replace the 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 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! *may 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! *may 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: *may 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.

Make sure the protective earthing conductor complies with technical standards and local safety regulations.

Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.

Always use appropriate equipment for Ground Fault Circuit Interrupters (GFCIs).

The drive can cause a residual current with a DC component in the protective earthing conductor. Where a residual current operated protective or monitoring device is used for protection in case of direct or indirect contact, always use a type B GFCI according to IEC 60755.

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.

⚠ WARNING

Install adequate branch circuit protection according to applicable local codes and this Installation Manual. Failure to comply could result in fire and damage to the drive or injury to personnel.

The device is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V class) and 480 Vac maximum (400 V class), and 600 Vac maximum (600 V class) when protected by branch circuit protection devices specified in this supplement.

Crush Hazard

Do not use this drive in lifting applications without installing external safety circuitry to prevent accidental dropping of the load.

The drive does not possess built-in load drop protection for lifting applications.

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

Install electrical and/or mechanical safety circuit mechanisms independent of drive circuitry.

⚠ 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 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.

If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices.

Contact your supplier if the cause cannot be identified after checking the above.

Do not restart the drive immediately operate the peripheral devices if a fuse is blown or a GFCI is tripped.

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 use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class), and 600 Vac maximum (600 V Class) when protected by Bussmann Type FWH or FWP fuses as specified in *Factory Recommended Branch Circuit Protection* on page *500*.

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.

◆ General Application Precautions

■ Selection

Installing a Reactor

Use an AC reactor or DC link choke in the following situations:

- 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 link choke is built in to drive models 2A0110 to 2A0415 and 4A0058 to 4A0675.

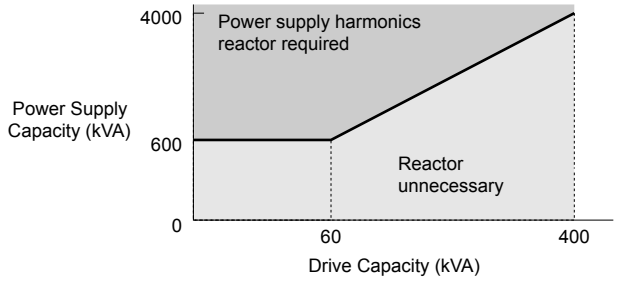


Figure i.1 Installing a Reactor

Drive Capacity

For specialized motors, make sure that the motor rated current is less than the 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 [total motor rated current × 1.1].

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

During a drive fault condition, the output shuts off but the motor does not stop immediately. A mechanical brake may be required when it is necessary to stop the motor faster than the ability of the Fast Stop function of the drive.

Options

NOTICE: *The B1, B2, , –, +1, +2, and +3 terminals are used to connect optional drive-specific compatible devices only. Connecting non-Yaskawa-approved devices to these terminals may damage the drive.*

Repetitive Starting/Stopping

Laundry machines, punching presses, and other applications with frequent starts and stops often approach 150% of their rated current values. Heat stress generated from repetitive high current will shorten the life span of the IGBTs.

Yaskawa recommends lowering the carrier frequency, particularly when audible noise is not a concern. It is beneficial to reduce the load, increase the acceleration and deceleration times, or switch to a larger drive to help keep peak current levels under 150%. Be sure to check the peak current levels when starting and stopping repeatedly during the initial test run, and make adjustments accordingly.

■ Installation

Enclosure Panels

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

Installation Direction

NOTICE: *Install the drive upright as specified in the manual.* ***Refer to Mechanical Installation on page 46*** *for more information on installation. Failure to comply may damage the drive due to improper cooling.*

■ Settings

Upper Limits

NOTICE: *The drive is capable of running the motor up to 400 Hz. Be sure to set the upper limit for the frequency of the drive to prevent the possible danger of accidentally operating equipment at higher than rated speed. The default setting for the maximum output frequency is 60 Hz.*

DC Injection Braking

NOTICE: *Excessive current during DC Injection Braking and excessive duration of DC Injection Braking can cause motor overheat.*

Acceleration/Deceleration Times

Acceleration and deceleration times are affected by the amount of torque generated by the motor, 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 in operation. Install one of the available braking options or increase the capacity of the drive for faster acceleration and deceleration.

■ General Handling

Wiring Check

NOTICE: *Do not connect power supply lines to output terminals U/T1, V/T2, or W/T3. Failure to comply will destroy the drive. Be sure to perform a final check of all sequence wiring and other connections before turning on the power and also check for short circuits on the control terminals, which may damage the drive.*

Selecting a Circuit Breaker or Circuit Interrupter

Yaskawa recommends installing a Ground Fault Circuit Interrupter (GFCI) to the power supply side. The GFCI should be designed for use with AC drives (e.g., Type B according to IEC 60755).

Select a Molded Case Circuit Breaker (MCCB) or GFCI with a rated current 1.5 to 2 times higher than the drive rated current to avoid nuisance trips caused by harmonics in the drive input current. ***Refer to Installing a Molded Case Circuit Breaker (MCCB) or Ground Fault Circuit Interrupter (GFCI) on page 366*** for more information.

Magnetic Contactor Installation

WARNING! *Fire Hazard. Shut off the drive with a magnetic contactor (MC) when a fault occurs in any external equipment such as braking resistors.* ***Refer to Installing a Magnetic Contactor at the Power Supply Side on page 366****. Failure to comply may cause resistor overheating, fire, and injury to personnel.*

NOTICE: *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.*

Inspection and Maintenance

WARNING! *Electrical Shock Hazard. Capacitors in the drive do not immediately discharge after shutting off the power. Wait for at least the amount of time specified on the drive before touching any components after shutting off the power. Failure to comply may cause injury to personnel from electrical shock.*

WARNING! *Burn Hazard. Because the heatsink can get very hot during operation, take proper precautions 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. Failure to comply may cause burn injury to personnel.*

Wiring

Yaskawa recommends using ring terminals on all drive models. Drive models 2A0069 to 2A0415 and 4A0058 to 4A0675 require the use of use ring terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

Transporting the Drive

NOTICE: *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.*

◆ Motor Application Precautions

■ Standard Induction Motors

Low-Speed Range

The cooling fan of a standard motor should 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. Reduce the load torque as the motor slows to prevent motor damage from overheat. ***Figure i.2*** shows the allowable load characteristics for a Yaskawa standard motor. Use a motor designed specifically for operation with a drive when 100% continuous torque is needed at low speeds.

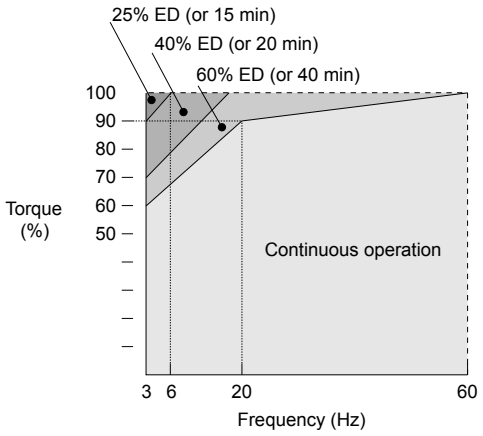


Figure i.2 Allowable Load Characteristics for a Yaskawa Motor

Insulation Tolerance

NOTICE: *Consider motor voltage tolerance levels and motor insulation in applications with an input voltage of over 440 V or particularly long wiring distances.*

High-Speed Operation

NOTICE: *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

The drive allows selection of high carrier PWM control and low carrier PWM. Selecting high carrier PWM can help reduce motor oscillation.

Take particular caution when adding a variable speed drive to an application running a motor from line power at a constant speed. If resonance occurs, install shock-absorbing rubber around the base of the motor and enable the Jump frequency selection to prevent continuous operation in the resonant frequency range.

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 motor speed can create unpleasant motor noise.

■ Synchronous Motors

- Contact Yaskawa or a Yaskawa agent when planning to use a synchronous motor not endorsed by Yaskawa.
- Use a standard induction motor when running multiple synchronous motors simultaneously. A single drive does not have this capability.
- A synchronous motor may rotate slightly in the opposite direction of the Run command at start depending on parameter settings and rotor position.
- The amount of generated starting torque differs depending on the control mode and motor type. 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 a Yaskawa agent when planning to use a motor that does not fall within these specifications:

- To restart a coasting motor rotating over 200 Hz while in V/f Control, first use the Short Circuit Braking function to bring the motor to a stop. Short Circuit Braking requires a special braking resistor. Contact Yaskawa or a Yaskawa agent for details.
- To restart a coasting motor rotating below 200 Hz, use the Speed Search function if the motor cable is not too long. If the motor cable is relatively long, stop the motor using Short Circuit Braking.

■ Specialized Motors

Multi-Pole Motor

The rated current of a multi-pole motor differs from that of a standard motor, so be sure to check the maximum current when selecting a drive. Always stop the motor before switching between the number of motor poles. The motor will coast to stop if a regen overvoltage (ov) fault occurs or if overcurrent (oC) protection is triggered.

Submersible Motor

The rated current of a submersible motor is greater than that of a standard motor, so select the drive capacity accordingly. Use a motor cable large enough to avoid decreasing the maximum torque level from voltage drop caused by a long motor cable.

Explosion-Proof Motor

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

When attaching an encoder to an explosion-proof motor, make sure the encoder is also explosion-proof. Use an insulating signal converter to connect the encoder signal lines to the speed feedback option card.

Geared Motor

Make sure that the gear and the lubricant are rated for the desired speed range to avoid gear damage when operating at low speeds or very high speeds. 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 to operate 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 burn out the starter coils because the internal centrifugal switch is not activated. The drive is for use with three-phase motors only.

Motor with Brake

Take caution when using the 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, so be sure to install a separate power supply for the motor brake. Note that motors with built-in brakes tend to generate a fair amount of noise when running at low speeds.

■ Notes on Power Transmission Machinery

Installing an AC drive in machinery that was previously connected directly to the power supply will allow the machine to operate at variable speeds. Continuous operation outside of the rated speeds can wear on lubrication material in gear boxes and other power transmission parts. Make sure that lubrication is sufficient within the entire speed range to avoid machine damage. Note that operation above the rated speed can increase the noise generated by the machine.

◆ Drive Label Warning Example

Always heed the warning information listed in *Figure i.3* in the position shown in *Figure i.4*.

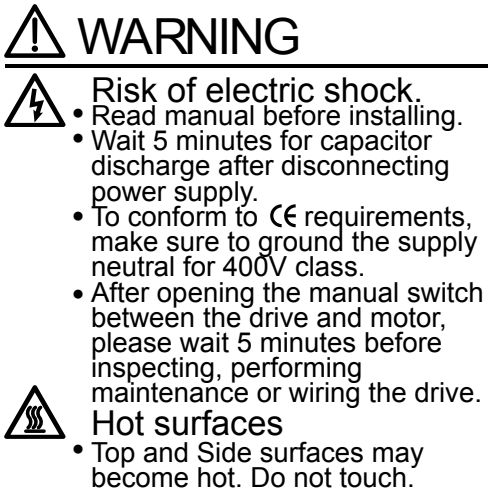


Figure i.3 Warning Information Example

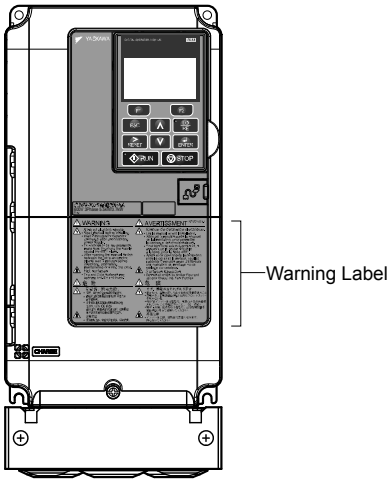


Figure i.4 Warning Information Position

◆ Warranty Information

■ Restrictions

The drive is 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.

WARNING! *Injury to Personnel. 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.*

1

Receiving

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

1.1 SECTION SAFETY....26
1.2 GENERAL DESCRIPTION....27
1.3 MODEL NUMBER AND NAMEPLATE CHECK....29
1.4 DRIVE MODELS AND ENCLOSURE TYPES....32
1.5 COMPONENT NAMES....34

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

◆ P1000 Model Selection

Refer to *Table 1.1* for drive selection depending on motor power.

Note: The models and capacities in shown here are based on standard settings and operation conditions. Higher carrier frequencies and higher ambient temperatures require derating.

Table 1.1 P1000 Models

Motor Power HP	Three-Phase 200 V Class		Three-Phase 400 V Class		Three-Phase 600 V Class	
	Drive Model	Rated Output Current (A) <1>	Drive Model	Rated Output Current (A) <1>	Drive Model	Rated Output Current (A) <1>
0.75	2A0004	3.5	4A0002	2.1	–	–
1	2A0006	6	–		–	–
2	2A0008	8	4A0004	4.1	5A0003	2.7
	–	–	–	–	–	–
3	–	–	–	–	–	–
	2A0010	9.6	4A0005	5.4	5A0004	3.9
	2A0012	12	4A0007	6.9	–	–
5	–	–	–	–	–	–
	2A0018	17.5	4A0009	8.8	5A0006	6.1
7.5	2A0021	21	4A0011	11.1	5A0009	9
10	2A0030	30	4A0018	17.5	5A0011	11
15	2A0040	40	4A0023	23	5A0017	17
20	2A0056	56	4A0031	31	5A0022	22
25	2A0069	69	4A0038	38	5A0027	27
25-30	–	–	–	–	–	–
	–	–	–	–	–	–
30	2A0081	81	4A0044	44	5A0032	32
40	2A0110	110	4A0058	58	5A0041	41
50	2A0138	138	4A0072	72	5A0052	52
50-60	–	–	–	–	–	–
	–	–	–	–	–	–
60	2A0169	169	4A0088	88	5A0062	62
75	2A0211	211	4A0103	103	5A0077	77
100	2A0250	250	4A0139	139	5A0099	99
125	2A0312	312	4A0165	165	5A0125	125
125-150	–	–	–	–	–	–
150	2A0360	360	4A0208	208	5A0145	145
175	2A0415	415	–	–	–	–
200	–	–	4A0250	250	5A0192	192
250	–	–	4A0296	296	5A0242	242
300	–	–	4A0362	362	–	–
350	–	–	4A0414	414	–	–
400-450	–	–	4A0515	515	–	–
400-450-500	–	–	–	–	–	–
500-550	–	–	4A0675	675	–	–

<1> These values assume the carrier frequency is set to 2 kHz.

Note: Current derating is required when setting the carrier frequency higher. *Refer to Drive Derating Data on page 387* for details.

◆ Control Mode Details

Table 1.2 gives an overview of the various P1000 control mode features.

Table 1.2 Control Mode Details

Motor Type		Induction Motors	Comments
Control Mode		V/f	–
Basic Description		V/f control	–
Type of Applications	Motor Type	IM	–
	Multi Motor	YES	–
	Motor data unknown	YES	–
Control Characteristics	Speed Control Range	1:40	May fluctuate with characteristics and motor temperature.
	Speed Accuracy	±2 to 3%	Speed deviation when operating at constant speed may fluctuate with characteristics and motor temperature.
	Speed Response	3 Hz (approx.)	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	Starting torque may fluctuate with characteristics and motor temperature. Performance may differ by capacity.
Application-Specific	Auto-Tuning	• Energy Saving Tuning • Line to line resistance	Automatically adjusts parameter settings that concern electrical characteristics of the motor.
Application-Specific	Speed Search	YES	Bi-directional speed detection of a coasting motor to restart it without stopping.
	Energy-Saving Control	YES	Saves energy by always operating the motor at its maximum efficiency.
	High Slip Braking	YES	Increases motor loss to allow for faster deceleration than normal without a braking resistor. Effectiveness may vary based on motor characteristics.
	Kinetic Energy Buffering	YES	Decelerates the drive to allow it to ride through a momentary power loss and continue operation.
	Over-excitation Deceleration	YES	Provides fast deceleration without using a braking resistor.
	Overvoltage Suppression	YES	Prevents overvoltage by increasing speed during regeneration.

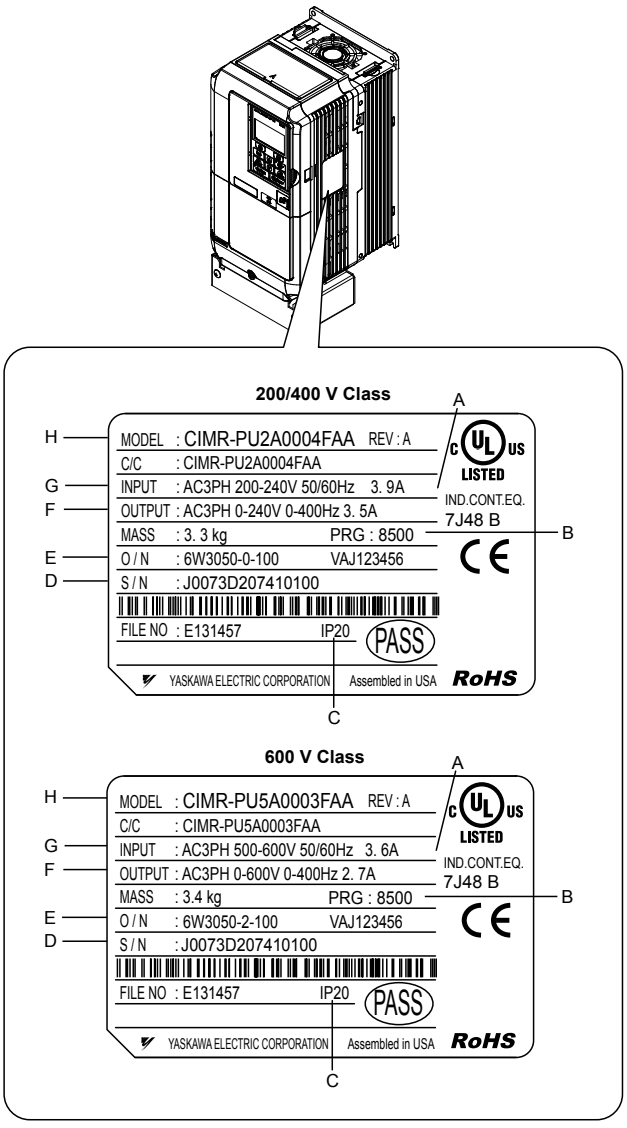
1.3 Model Number and Nameplate Check

Please perform the following tasks after receiving the drive:

- Inspect the drive for damage.

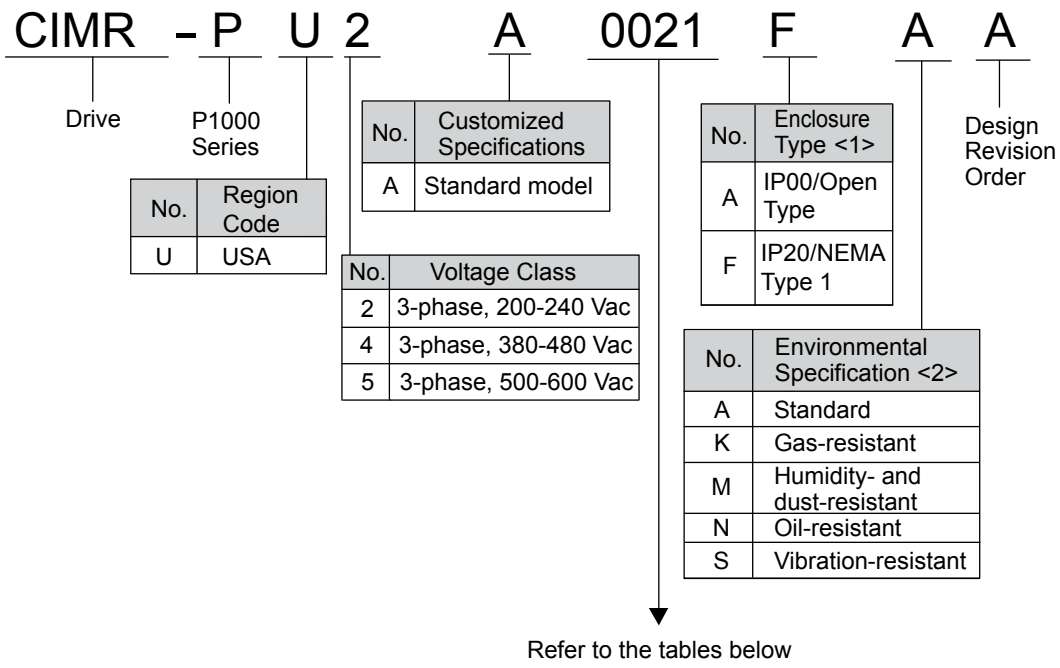
  If the drive appears damaged upon receipt, contact the shipper immediately.
- Verify receipt of the correct model by checking the information on the nameplate.
- If you have received the wrong model or the drive does not function properly, contact your supplier.

◆ Nameplate



A – Normal Duty Amps
B – Software version
C – Enclosure type
D – Serial number
E – Lot number
F – Output specifications
G – Input specifications
H – AC drive model

Figure 1.1 Nameplate Information Example



<1> *Refer to Drive Models and Enclosure Types on page 32* for differences regarding enclosure protection types and component descriptions.

<2> Drives with these specifications do not guarantee complete protection for the environmental conditions indicated.

■ Three-Phase 200 V

Table 1.3 Model Number and Specifications (200 V)

Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
2A0004	0.75 (0.75)	3.5
2A0006	1.1 (1)	6.0
2A0008	1.5 (2)	8.0
2A0010	2.2 (3)	9.6
2A0012	3.0 (3)	12
2A0018	3.7 (5)	17.5
2A0021	5.5 (7.5)	21
2A0030	7.5 (10)	30
2A0040	11 (15)	40
2A0056	15 (20)	56
2A0069	18.5 (25)	69
2A0081	22 (30)	81
2A0110	30 (40)	110
2A0138	37 (50)	138
2A0169	45 (60)	169
2A0211	55 (75)	211
2A0250	75 (100)	250
2A0312	90 (125)	312
2A0360	110 (150)	360
2A0415	110 (175)	415

■ Three-Phase 400 V

Table 1.4 Model Number and Specifications (400 V)

Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
4A0002	0.75 (0.75)	2.1
4A0004	1.5 (2)	4.1
4A0005	2.2 (3)	5.4
4A0007	3.0 (3)	6.9
4A0009	3.7 (5)	8.8
4A0011	5.5 (7.5)	11.1
4A0018	7.5 (10)	17.5
4A0023	11 (15)	23
4A0031	15 (20)	31
4A0038	18.5 (25)	38
4A0044	22 (30)	44
4A0058	30 (40)	58
4A0072	37 (50)	72
4A0088	45 (60)	88
4A0103	55 (75)	103
4A0139	75 (100)	139
4A0165	90 (125)	165
4A0208	110 (150)	208
4A0250	132 (200)	250
4A0296	160 (250)	296
4A0362	185 (300)	362
4A0414	220 (350)	414
4A0515	250 (400-450)	515
4A0675	355 (500-550)	675

■ Three-Phase 600 V

Table 1.5 Model Number and Specifications (600 V)

Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
5A0003	1.5 (2)	2.7
5A0004	2.2 (3)	3.9
5A0006	3.7 (5)	6.1
5A0009	5.5 (7.5)	9
5A0011	7.5 (10)	11
5A0017	11 (15)	17
5A0022	15 (20)	22
5A0027	18.5 (25)	27
5A0032	22 (30)	32
5A0041	30 (40)	41
5A0052	37 (50)	52
5A0062	45 (60)	62
5A0077	55 (75)	77
5A0099	75 (100)	99
5A0125	90 (125)	125
5A0145	110 (150)	145
5A0192	160 (200)	192
5A0242	185 (250)	242

1.4 Drive Models and Enclosure Types

Two types of enclosures are offered for P1000 drives:

- IP20/NEMA Type 1 enclosure models mount to an indoor wall or in an enclosure panel.
- IP00/Open Type enclosure models are designed for installation in an enclosure panel that serves to protect personnel from injury caused by accidentally touching live parts.

Table 1.6 describes drive enclosures and models.

Table 1.6 Drive Models and Enclosure Types

Voltage Class	Enclosure Type	
	IP20/NEMA Type 1 Enclosure <1> Drive Model Number	IP00/Open Type Enclosure Drive Model Number
Three-Phase 200 V Class	2A0004F	<1>
	2A0006F	<1>
	2A0008F	<1>
	2A0010F	<1>
	2A0012F	<1>
	2A0018F	<1>
	2A0021F	<1>
	2A0030F	<1>
	2A0040F	<1>
	2A0056F	<1>
	2A0069F	<1>
	2A0081F	<1>
	2A0110F	<1>
	2A0138F	<1>
	2A0169F	<1>
	2A0211F	<1>
	<2>	2A0250A
	<2>	2A0312A
	<2>	2A0360A
	<3>	2A0415A
Three-Phase 400 V Class	4A0002F	<1>
	4A0004F	<1>
	4A0005F	<1>
	4A0007F	<1>
	4A0009F	<1>
	4A0011F	<1>
	4A0018F	<1>
	4A0023F	<1>
	4A0031F	<1>
	4A0038F	<1>
	4A0044F	<1>
	4A0058F	<1>

Voltage Class	Enclosure Type	
	IP20/NEMA Type 1 Enclosure <1> Drive Model Number	IP00/Open Type Enclosure Drive Model Number
Three-Phase 400 V Class	4A0072F	<1>
	4A0088F	<1>
	4A0103F	<1>
	4A0139F	<1>
	4A0165F	<1>
	<2>	4A0208A
	<2>	4A0250A
	<2>	4A0296A
	<2>	4A0362A
	<3>	4A0414A
	<3>	4A0515A
	<3>	4A0675A
Three-Phase 600 V Class	5A0003F	<1>
	5A0004F	<1>
	5A0006F	<1>
	5A0009F	<1>
	5A0011F	<1>
	5A0017F	<1>
	5A0022F	<1>
	5A0027F	<1>
	5A0032F	<1>
	5A0041F	<1>
	5A0052F	<1>
	5A0062F	<1>
	5A0077F	<1>
	5A0099F	<1>
	<2>	5A0125A
	<2>	5A0145A
	<2>	5A0192A
	<2>	5A0242A

<1> Removing the top protective cover from a IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while retaining IP20 conformity.

<2> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. *Refer to IP20/NEMA Type 1 Kit Selection on page 58* to select the appropriate kit.

<3> Contact a Yaskawa representative for IP20/NEMA Type 1 Kit availability for these models.

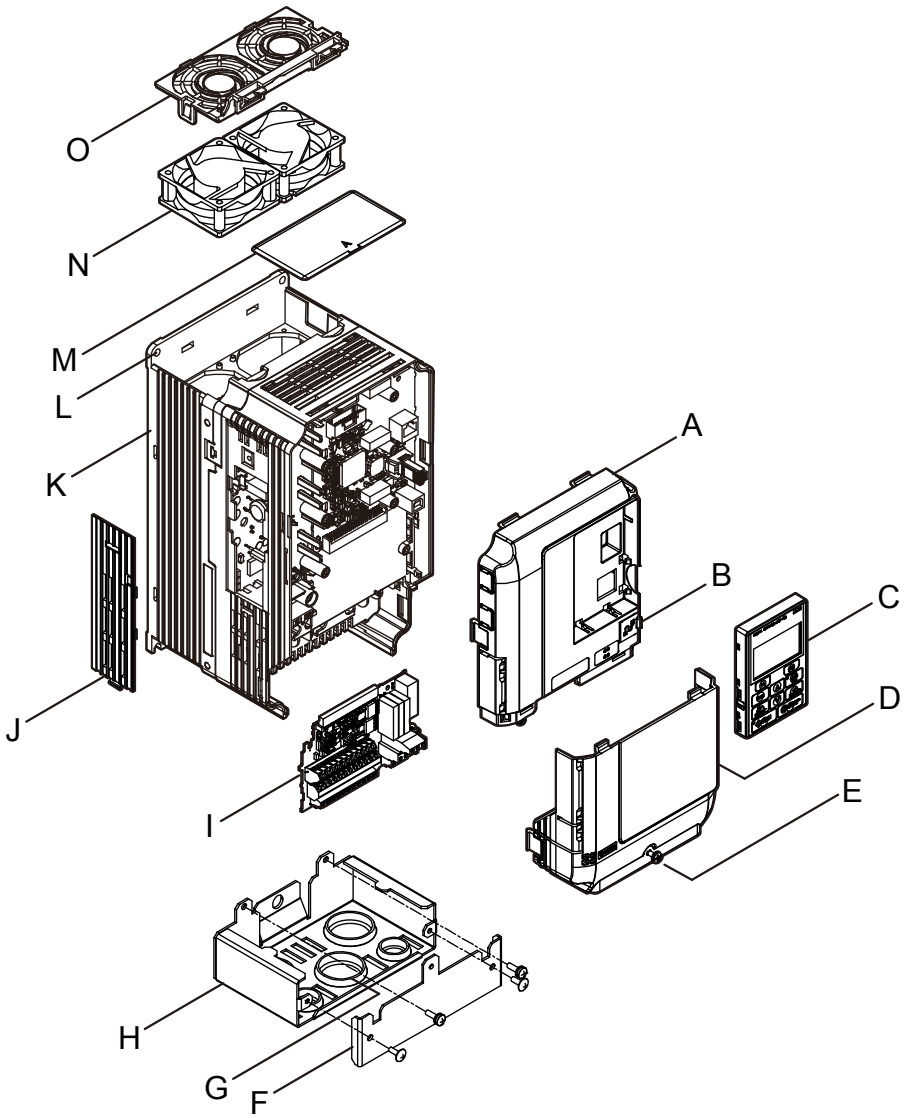
1.5 Component Names

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

Note: 1. *Refer to Using the Digital Operator on page 101* for a description of the operator keypad.
2. The drive may have no cooling fans or up to two cooling fans depending on the model.

◆ IP20/NEMA Type 1 Enclosure

■ Three-Phase AC 200 V Models 2A0004F to 2A0081F
Three-Phase AC 400 V Models 4A0002F to 4A0044F
Three-Phase AC 600 V Models 5A0003F to 5A0032F

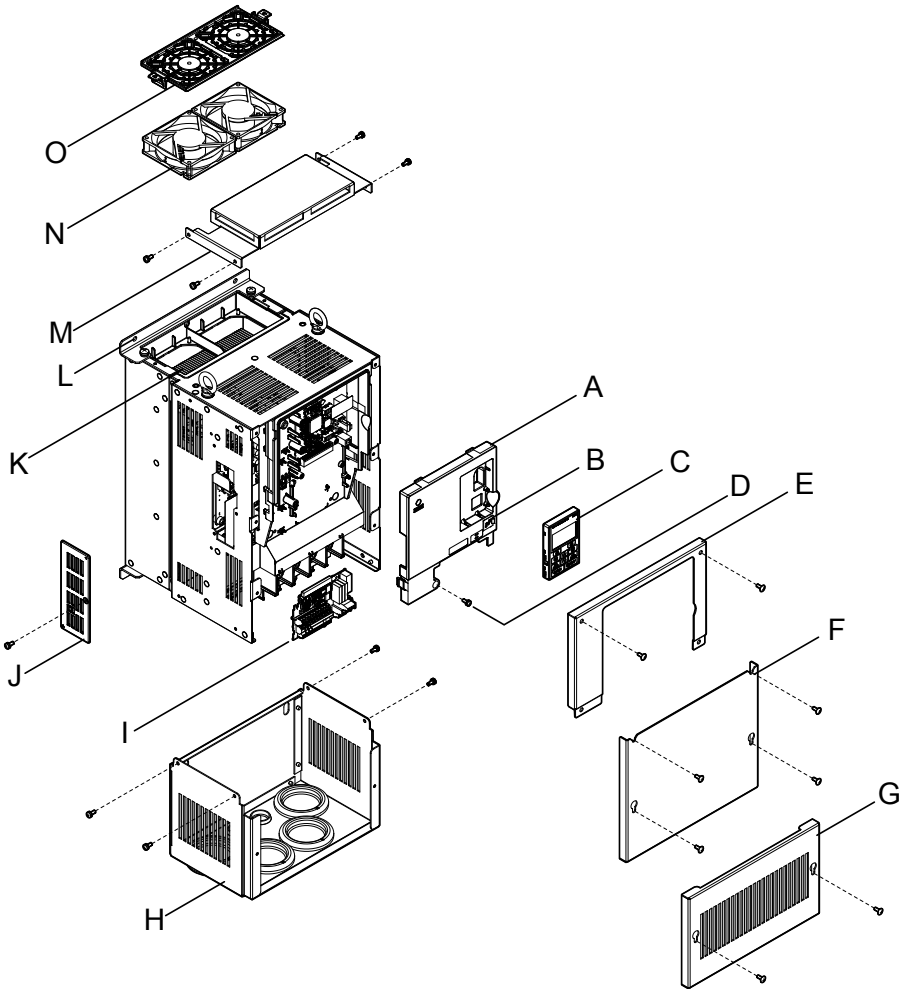


A – Front cover
B – USB port (type-B)
C – Digital operator
D – Terminal cover
E – Terminal cover screw
F – Conduit bracket front cover
G – Rubber bushing
H – Conduit bracket
I – Terminal board
J – Optional 24 V DC power supply connector cover
K – Heatsink
L – Mounting hole
M – Top protective cover
N – Cooling fan <1>
O – Fan finger guard <1>

Figure 1.2 Exploded View of IP20/NEMA Type 1 Components (Model 2A0030F)

<1> Drive models 2A0018, 2A0021, 4A0007 to 4A0011, 5A0006F, and 5A0009F have a single cooling fan. Drive models 2A0004 to 2A0012, 4A0002 to 4A0005, 5A0003F, and 5A0004F do not have a cooling fan or a fan finger guard.

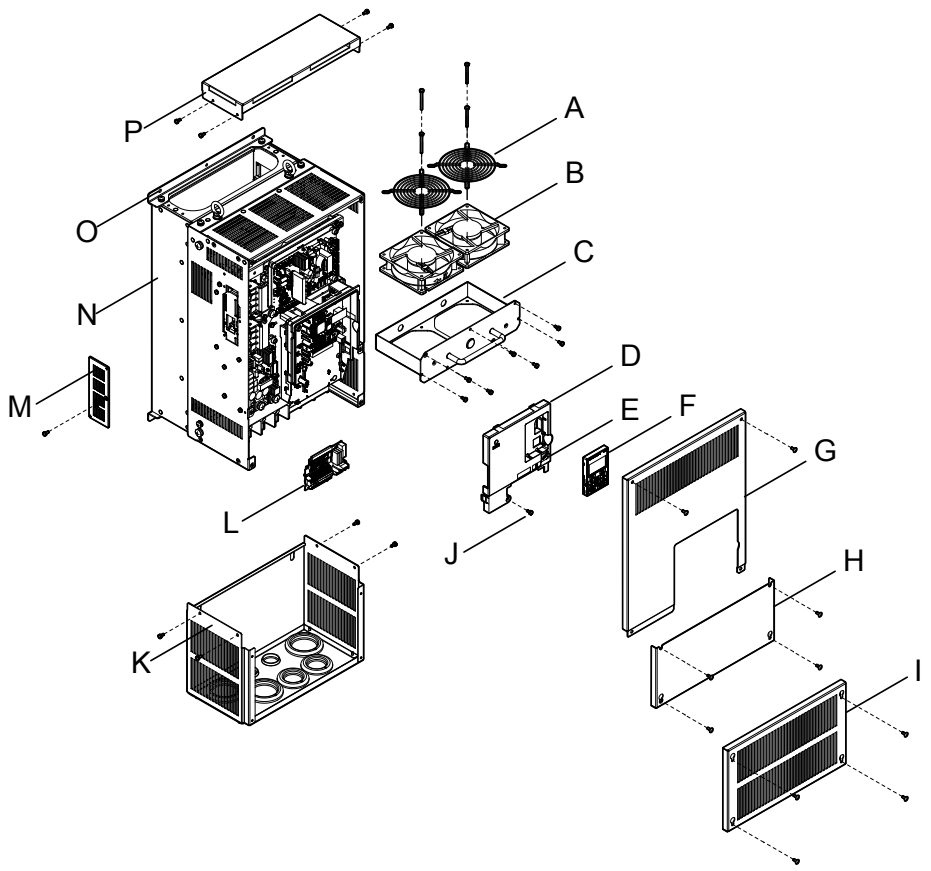
■ Three-Phase AC 200 V Models 2A0110F, 2A0138F
Three-Phase AC 400 V Models 4A0058F to 4A0103F
Three-Phase AC 600 V Models 5A0041F, 5A0052F



A – Front cover
B – USB port (type-B)
C – Digital operator
D – Front cover screw
E – Drive cover
F – Terminal cover
G – Conduit bracket front cover
H – Conduit bracket
I – Terminal board
J – Optional 24 V DC power supply connector cover
K – Heatsink
L – Mounting hole
M – Top protective cover
N – Cooling fan
O – Fan finger guard

Figure 1.3 Exploded View of IP20 Enclosure Components (Model 2A0110F)

■ Three-Phase AC 200 V Models 2A0169F, 2A0211F
Three-Phase AC 400 V Models 4A0139F to 4A0165F
Three-Phase AC 600 V Models 5A0062F to 5A0099F

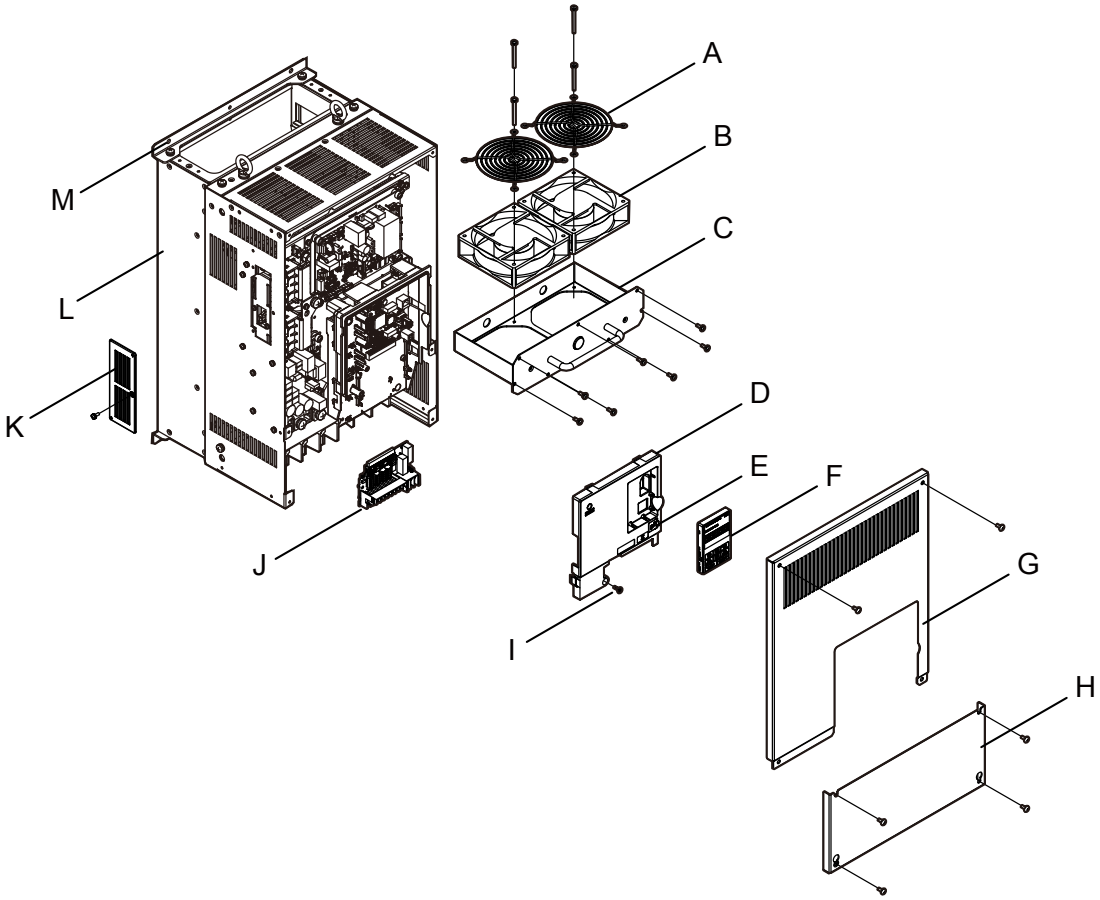


A – Fan guard
B – Cooling fan
C – Fan bracket
D – Front cover
E – USB port (type-B)
F – Digital operator
G – Drive cover
H – Terminal cover
I – Conduit bracket front cover
J – Front cover
K – Conduit bracket
L – Terminal board
M – Optional 24 V DC power supply connector cover
N – Heatsink
O – Mounting hole
P – Top protective cover

Figure 1.4 Exploded View of IP20/NEMA Type 1 Enclosure Components (Model 4A0165F)

◆ IP00/Open Type Enclosure

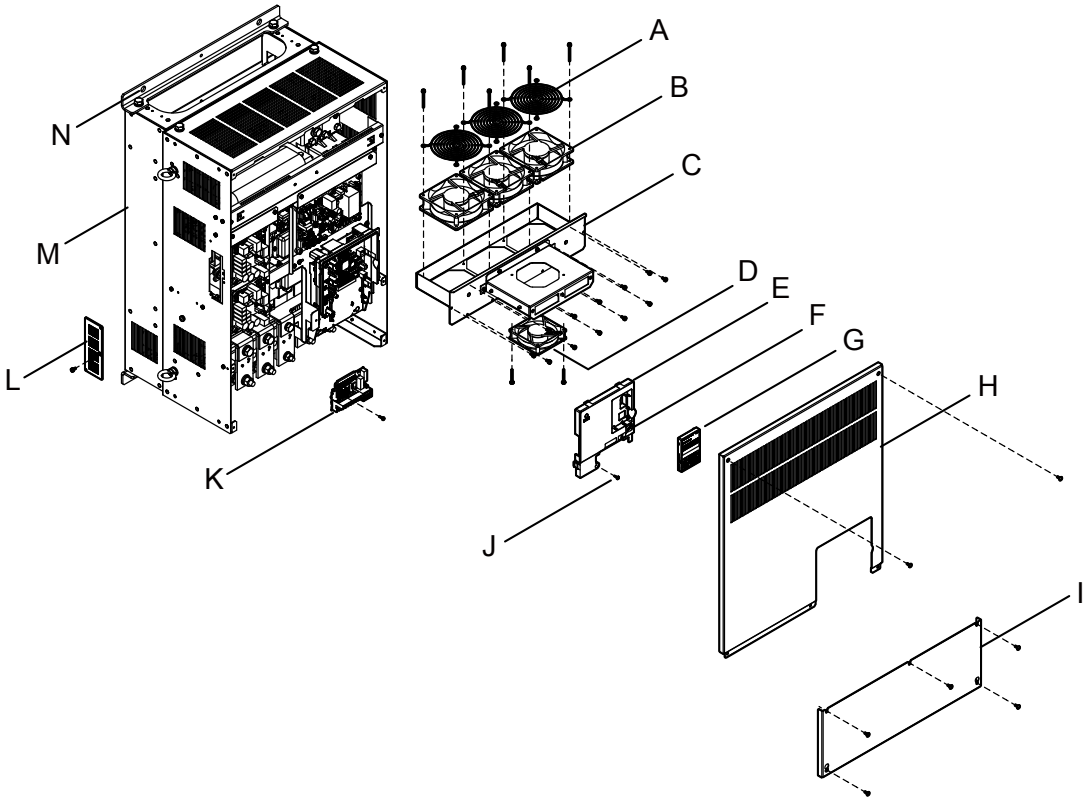
■ Three-Phase AC 200 V Models 2A0250A, 2A0312A
Three-Phase AC 400 V Model 4A0208A
Three-Phase AC 600 V Models 5A0125A, 5A0145A



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

Figure 1.5 Exploded view of IP00/Open Type Enclosure Components (Model 4A0208A)

■ Three-Phase AC 200 V Models 2A0360A, 2A0415A
Three-Phase AC 400 V Models 4A0250A to 4A0362A
Three-Phase AC 600 V Models 5A0192A, 5A0242A

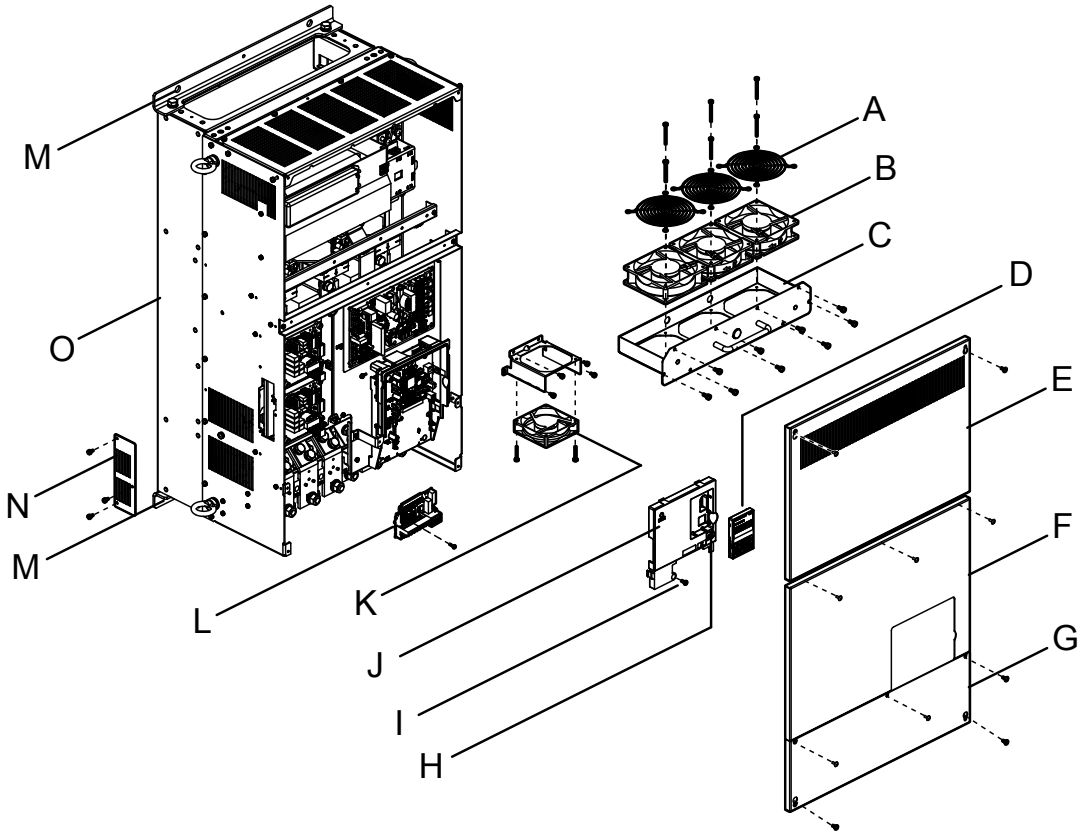


A – Fan guard
B – Cooling fan
C – Fan bracket
D – Circulation fan <1>
E – Front cover
F – USB port (type-B)
G – Digital operator
H – Drive cover
I – Terminal cover
J – Front cover screw
K – Terminal board
L – Optional 24 V DC power supply connector cover
M – Heatsink
N – Mounting hole

Figure 1.6 Exploded view of IP00/Open Type Enclosure Components (Model 4A0362A)

<1> Drive models 2A0360, 2A0415, and 4A0362 have a built-in circulation fan.

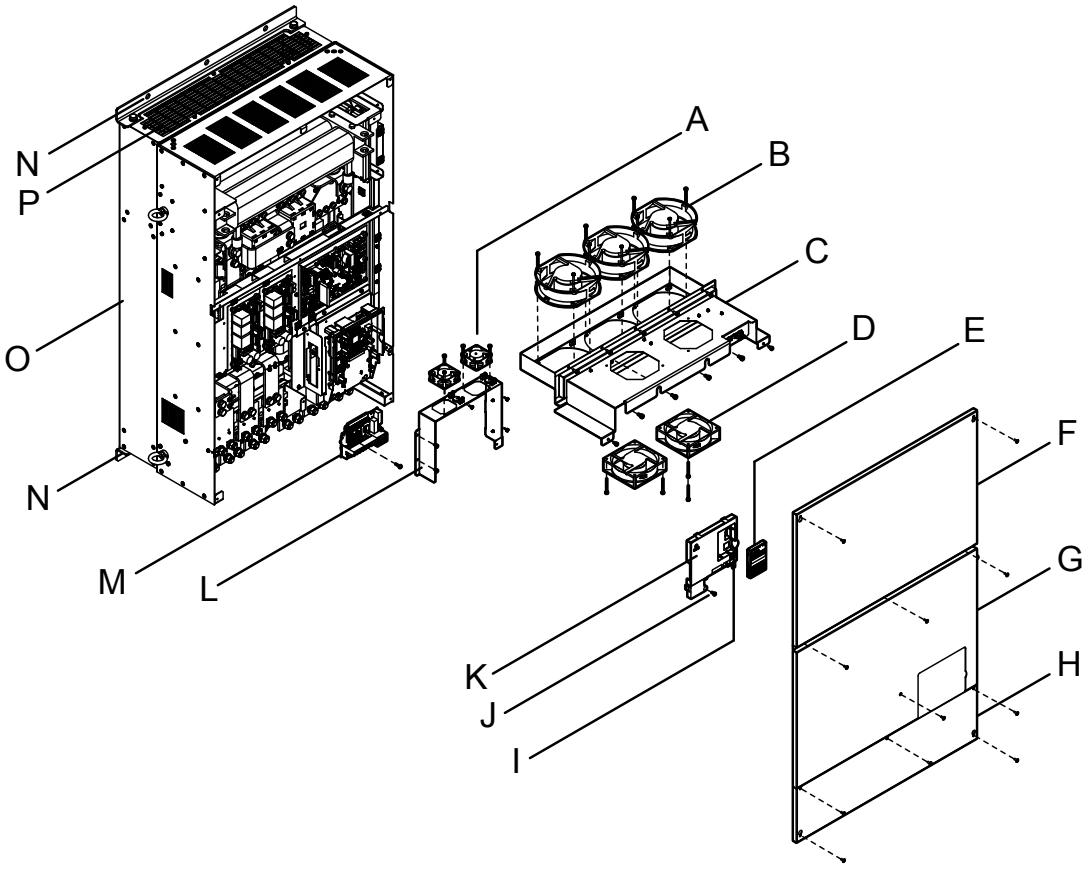
■ Three-Phase AC 400 V Model 4A0414A



A – Fan guard
B – Cooling fan
C – Fan bracket
D – Digital operator
E – Drive cover 1
F – Drive cover 2
G – Terminal cover
H – USB port (type-B)
I – Front cover screw
J – Front cover
K – Circulation fan
L – Terminal board
M – Mounting hole
N – Optional 24 V DC power supply connector cover
O – Heatsink

Figure 1.7 Exploded view of IP00/Open Type Enclosure Components (Model 4A0414A)

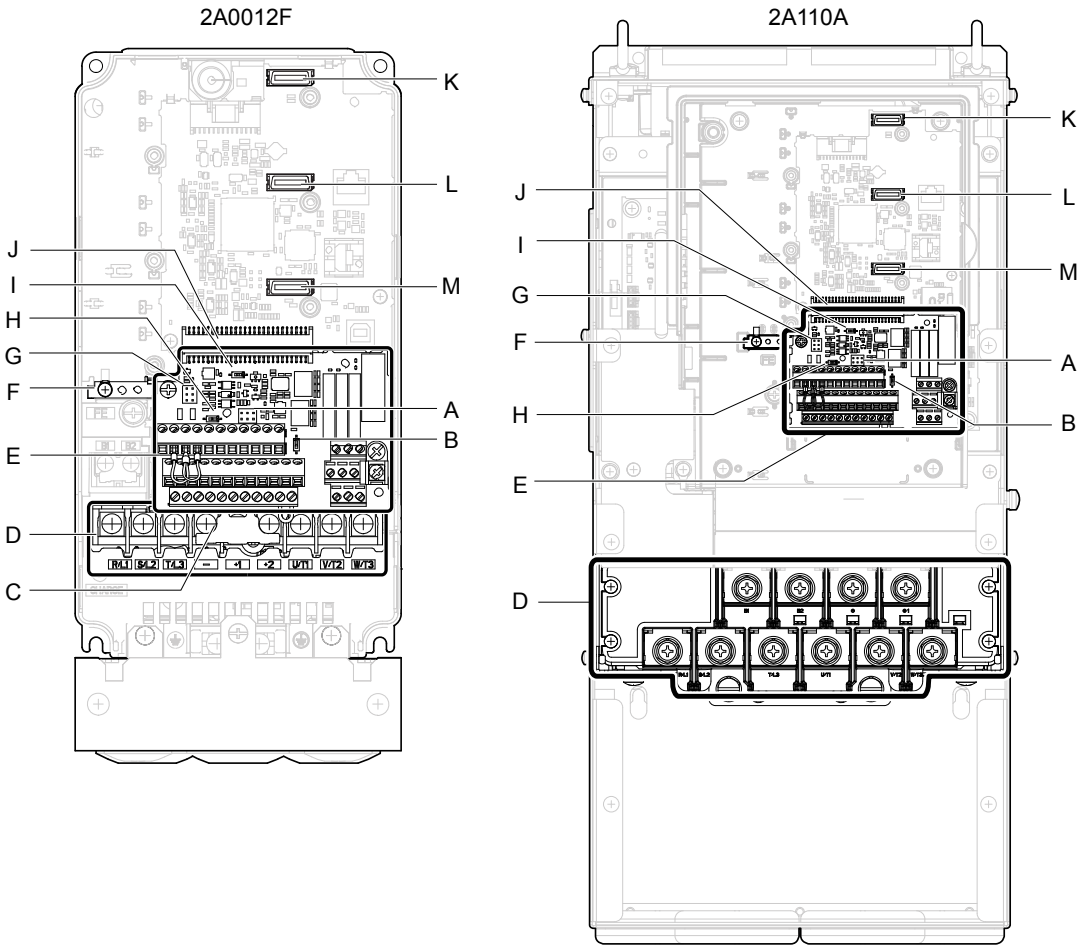
■ Three-Phase AC 400 V Models 4A0515A, 4A0675A



A – Circuit board cooling fan
B – Cooling fan
C – Fan bracket
D – Circulation Fan
E – Digital operator
F – Drive cover 1
G – Drive cover 2
H – Terminal cover
I – USB port (type-B)
J – Front cover screw
K – Front cover
L – Circuit board cooling fan unit case
M – Terminal board
N – Mounting hole
O – Heatsink
P – Fan guard

Figure 1.8 Exploded view of IP00/Open Type Enclosure Components (Model 4A0675A)

◆ Front Views



A – Terminal board connector
B – Jumper S1 (*Refer to Terminals A1, A2, and A3 Input Signal Selection on page 93*)
C – DIP switch S2 (*Refer to MEMOBUS/Modbus Termination on page 94*)
D – Sink/source jumper S3 (*Refer to Sinking/Sourcing Mode Switch for Digital Inputs on page 92*)
E – Ground terminal
F – Terminal board (*Refer to Control Circuit Wiring on page 86*)
G – Main circuit terminal (*Refer to Wiring the Main Circuit Terminal on page 84*)
H – Protective cover to prevent miswiring
I – Option card connector (CN5-C)
J – Option card connector (CN5-B)
K – Option card connector (CN5-A)
L – Jumper S5 (*Refer to Terminal AM/FM Signal Selection on page 94*)
M – DIP switch S4

Figure 1.9 Front View of Drives

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2

Mechanical Installation

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

2.1 SECTION SAFETY.....44
2.2 MECHANICAL INSTALLATION.....46

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 40 °C.

Crush Hazard

Use a dedicated lifter when transporting the drive by a lifter.

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

Only use vertical suspension to temporarily lift the drive during installation to an enclosure panel. Do not use vertical suspension to transport the drive.

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

Use screws to securely affix the drive front cover, terminal blocks, and other drive components prior to vertical suspension.

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

Do not subject the drive to vibration or impact greater than 1.96 m/s^2 (0.2 G) while it is suspended by the cables.

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

Do not attempt to flip the drive over or leave the drive unattended while it is suspended by the wires.

Failure to comply may result in serious injury or death 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.

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-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 or use the frequency jump function to skip a frequency resonating the machine.

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

Install the drive in an environment matching the specifications in *Table 2.1* to help prolong the optimum performance life of the drive.

Table 2.1 Installation Environment

Environment	Conditions
Installation Area	Indoors
Ambient Temperature	-10 °C to +40 °C (IP20/NEMA Type 1 enclosure) -10 °C to +50 °C (IP00/Open Type enclosure) 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: • oil mist and dust • metal shavings, oil, water, or other foreign materials • radioactive materials • combustible materials (e.g., wood) • harmful gases and liquids • excessive vibration • chlorides • direct sunlight.
Altitude	1000 m or lower, up to 3000 m with derating. *Refer to Drive Derating Data on page 387* for details.
Vibration	10 to 20 Hz at 9.8 m/s^2 20 to 55 Hz at 5.9 m/s^2 (Models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) or 2.0 m/s^2 (Models 2A0250 to 2A0415, 4A0208 to 4A0675, and 5A0125 to 5A0242)
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 drive start-up, 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.

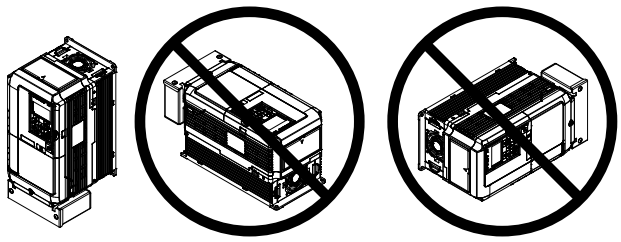
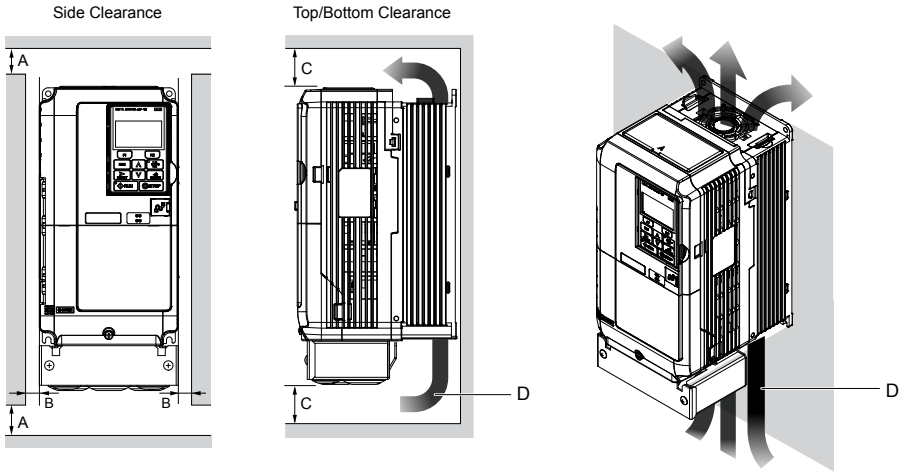


Figure 2.1 Correct Installation Orientation

■ Single Drive Installation

Figure 2.2 shows the installation distance required to maintain sufficient space for airflow and wiring. Install the heatsink against a closed surface to avoid diverting cooling air around the heatsink.



A – 50 mm minimum
B – 30 mm minimum
C – 120 mm minimum
D – Airflow direction

Figure 2.2 Correct Installation Spacing

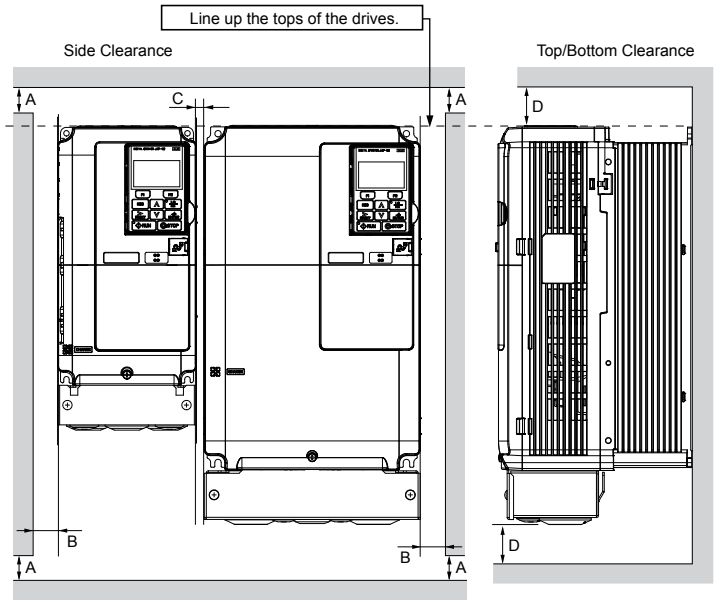
Note: IP20/NEMA Type 1 enclosure and IP00/Open Type enclosure models require the same amount of space above and below the drive for installation.

■ Multiple Drive Installation (Side-by-Side Installation)

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 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*, set parameter L8-35 to 1 while considering derating. *Refer to L8-35: Installation Method Selection on page 249* for details.



A – 50 mm minimum
B – 30 mm minimum
C – 2 mm minimum
D – 120 mm minimum

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

Note: Align the tops of the drives when installing drives of different heights in the same enclosure panel. Leave space between the tops and bottoms of stacked drives for easier cooling fan replacement.

Remove the top protective covers of all drives as shown in *Figure 2.4* when mounting IP20/NEMA Type 1 enclosure drives side-by-side. *Refer to Top Protective Cover on page 74* to remove and reattach the top protective cover.

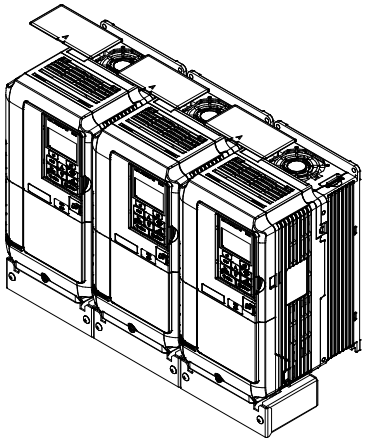


Figure 2.4 IP20/NEMA 1 Side-by-Side Mounting in Enclosure

◆ 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 to facilitate operation when the drive is installed in a location where it can not be easily accessed.

The digital operator can also be permanently mounted remote locations such as panel doors using an extension cable and an installation support set (depending on the installation type).

Note: *Refer to Drive Options and Peripheral Devices on page 355* for information on extension cables and installation support sets.

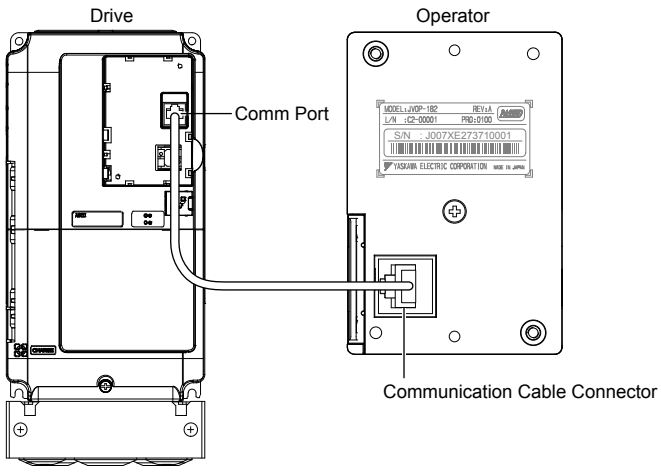


Figure 2.5 Communication Cable Connection

■ Digital Operator Remote Installation

Digital Operator Dimensions

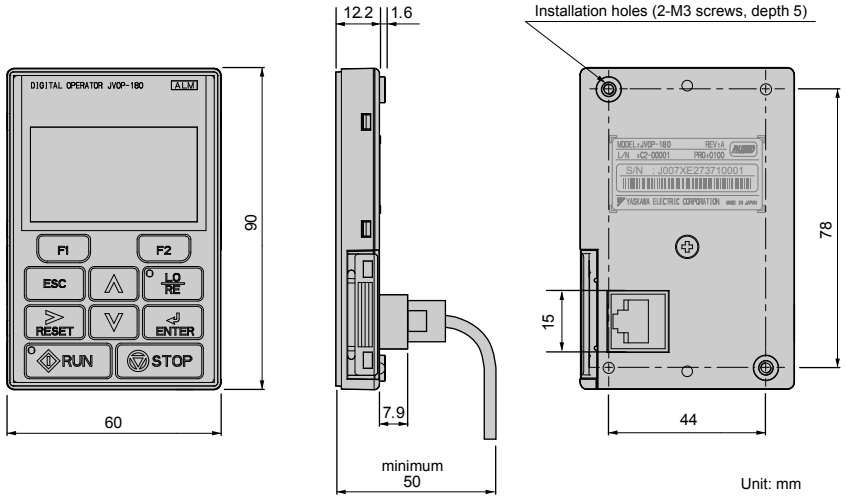


Figure 2.6 Digital Operator Dimensions

NEMA Keypad Kits

Yaskawa offers keypad kits that provide the functionality of the digital operator on enclosures designed for NEMA Type 1, 3R, 4, 4X, 12, or IPX6 environments. These kits are for use with digital operator models JVOP-180 and JVOP-182.

Table 2.2 Installation Environment

Keypad Kit Model	Description
UUX000526	Blank label on the front.
UUX000527	Yaskawa brand label on the front.

Installation Types and Required Materials

The digital operator mounts to an enclosure two different ways:

- **External/face-mount** installs the operator outside the enclosure panel
- **Internal/flush-mount** installs the operator inside the enclosure panel

Table 2.3 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 front of 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)

NOTICE: *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 drive start-up, 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 2.8***.
2. Position the digital operator so the display faces outwards, and mount it to the enclosure panel as shown in ***Figure 2.7***.

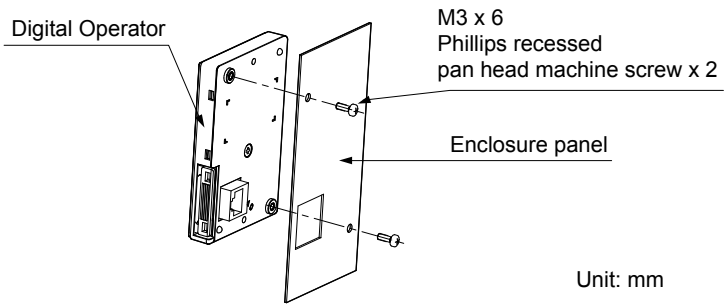


Figure 2.7 External/Face-Mount Installation

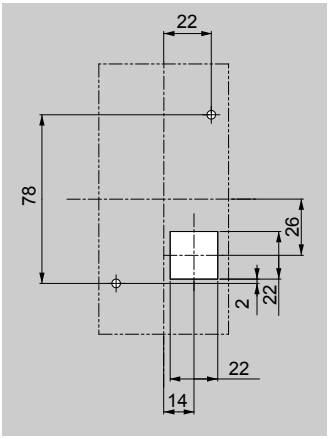


Figure 2.8 Panel Cut-Out Dimensions (External/Face-Mount Installation)

Internal/Flush-Mount

An internal flush-mount requires an installation support set that must be purchased separately. Contact a Yaskawa representative to order an installation support set and mounting hardware. ***Figure 2.9*** 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 2.10***.
2. Mount the digital operator to the installation support.
3. Mount the installation support set and digital operator to the enclosure panel.

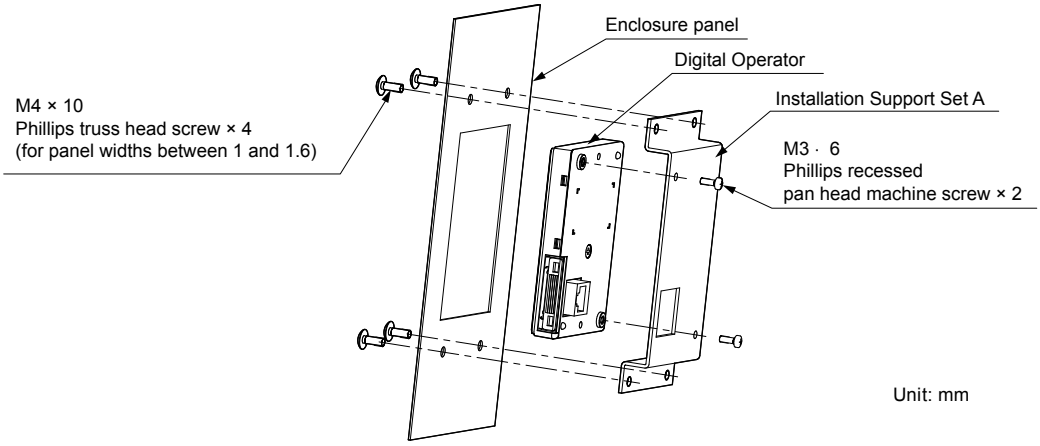
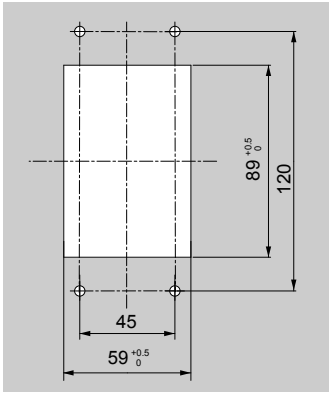


Figure 2.9 Internal/Flush Mount Installation

Note: Use a gasket between the enclosure panel and the digital operator in environments with a significant amount of dust or other airborne debris.



Unit : mm

Figure 2.10 Panel Cut-Out Dimensions (Internal/Flush-Mount Installation)

◆ Exterior and Mounting Dimensions

Table 2.4 Drive Models and Types

Protective Design	Drive Model			Page
	Three-Phase 200 V Class	Three-Phase 400 V Class	Three-Phase 600 V Class	
IP20/NEMA Type 1 Enclosure	2A0004F 2A0006F 2A0008F 2A0010F 2A0012F 2A0018F 2A0021F 2A0030F 2A0040F 2A0056F 2A0069F 2A0081F 2A0110F 2A0138F 2A0169F 2A0211F	4A0002F 4A0004F 4A0005F 4A0007F 4A0009F 4A0011F 4A0018F 4A0023F 4A0031F 4A0038F 4A0044F 4A0058F 4A0072F 4A0088F 4A0103F 4A0139F 4A0165F	5A0003F 5A0004F 5A0006F 5A0009F 5A0011F 5A0017F 5A0022F 5A0027F 5A0032F 5A0041F 5A0052F 5A0062F 5A0077F 5A0099F	*52*
IP00/Open Type Enclosure	2A0250A <1> 2A0312A <1> 2A0360A <1> 2A0415A <2>	4A0208A <1> 4A0250A <1> 4A0296A <1> 4A0362A <1> 4A0414A <2> 4A0515A <2> 4A0675A <2>	5A0125A <1> 5A0145A <1> 5A0192A <1> 5A0242A <1>	*56*

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. *Refer to IP20/NEMA Type 1 Kit Selection on page 58* to select the appropriate kit.

<2> Contact a Yaskawa representative for IP20/NEMA Type 1 Kit availability for these models.

■ IP20/NEMA Type 1 Enclosure Drives

Note: Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity.

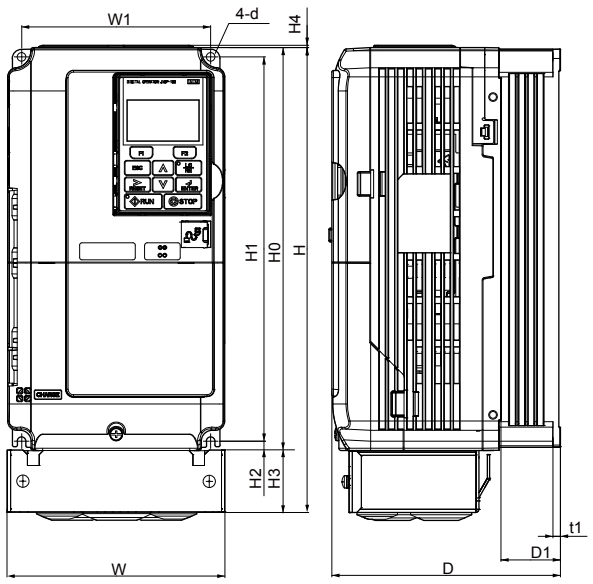


Figure 1

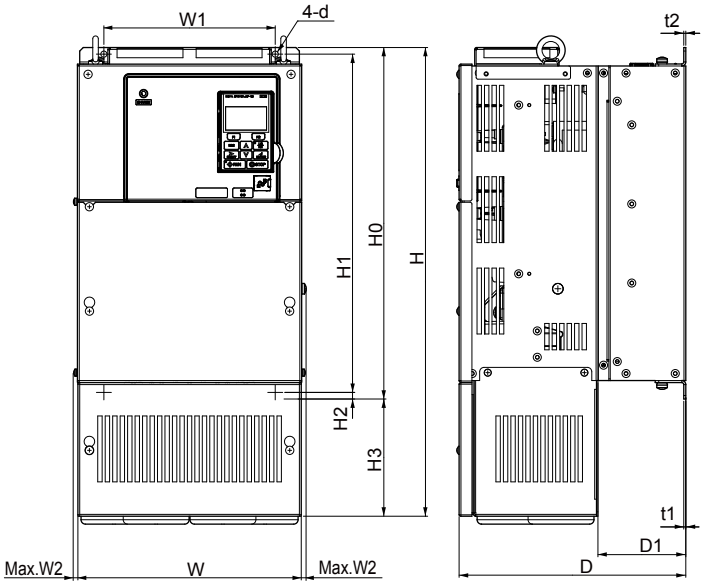


Figure 2

Table 2.5 Dimensions for IP20/NEMA Type 1 Enclosure: 200 V Class

Drive Model	Dimensions (in)															
	Figure	W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Wt. (lb)
2A0004F	1 <1>	5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.3
2A0006F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.3
2A0008F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
2A0010F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
2A0012F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
2A0018F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
2A0021F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
2A0030F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.3
2A0040F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.3
2A0056F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.0
2A0069F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	20.1
2A0081F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	22.0
2A0110F	2 <1>	10.00	21.02	10.16	7.68	0.31	15.75	15.16	0.30	5.28	–	3.94	0.09	0.09	M6	50.7
2A0138F		10.98	24.17	10.16	8.66	0.31	17.72	17.13	0.30	6.46	–	3.94	0.09	0.09	M6	61.7
2A0169F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	90.4
2A0211F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	92.6
Dimensions below are the dimensions of IP00/Open Type models after customer installation of the appropriate IP20/NEMA Type 1 Kit.																
2A0250A	2	17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	183.0
2A0312A		17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	194.0
2A0360A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	238.1

<1> Removing the top protective cover from a IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while retaining IP20 conformity.

Table 2.6 Dimensions for IP20/NEMA Type 1 Enclosure: 400 V Class

Drive Model	Dimensions (in)															
	Figure	W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Wt. (lb)
4A0002F	1 <1>	5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
4A0004F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
4A0005F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
4A0007F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	7.9
4A0009F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
4A0011F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
4A0018F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.0
4A0023F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.0
4A0031F		7.09	13.39	6.57	6.30	–	11.81	11.18	0.31	1.57	0.06	2.17	0.20	–	M5	12.6
4A0038F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.2
4A0044F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	19.2
4A0058F	2 <1>	10.00	18.31	10.16	7.68	0.31	15.75	15.16	0.30	2.56	–	3.94	0.09	0.09	M6	50.7
4A0072F		10.98	20.28	10.16	8.66	0.31	17.72	17.13	0.30	2.56	–	3.94	0.09	0.09	M6	59.5
4A0088F		12.95	24.80	10.16	10.24	0.31	20.08	19.49	0.30	4.72	–	4.13	0.09	0.13	M6	86.0
4A0103F		12.95	24.80	10.16	10.24	0.31	20.08	19.49	0.30	4.72	–	4.13	0.09	0.13	M6	86.0
4A0139F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
4A0165F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	101.4
Dimensions below are the dimensions of IP00/Open Type models after customer installation of the appropriate IP20/NEMA Type 1 Kit.																
4A0208A	2	17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	191.8
4A0250A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	233.7
4A0296A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	246.9
4A0362A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	257.9

<1> Removing the top protective cover from a IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while retaining IP20 conformity.

Table 2.7 Dimensions for IP20/NEMA Type 1 Enclosure: 600 V Class

Drive Model	Dimensions (in)															
	Figure	W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Wt. (lb)
5A0003F	1 <1>	5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
5A0004F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
5A0006F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
5A0009F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
5A0011F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.0
5A0017F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.2
5A0022F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.2
5A0027F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	19.2
5A0032F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	19.2
5A0041F	2	10.98	20.28	10.16	8.66	0.31	17.72	17.13	0.30	2.56	–	3.94	0.09	0.09	M6	59.5
5A0052F		10.98	20.28	10.16	8.66	0.31	17.72	17.13	0.30	2.56	–	3.94	0.09	0.09	M6	59.5
5A0062F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
5A0077F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
5A0099F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
Dimensions below are the dimensions of IP00/Open Type models after customer installation of the appropriate IP20/NEMA Type 1 Kit.																
5A0125A	2	17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	191.8
5A0145A		17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	191.8
5A0192A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	233.7
5A0242A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	257.9

<1> Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity.

IP20/NEMA Type 1 Enclosure Conduit Bracket Dimensions

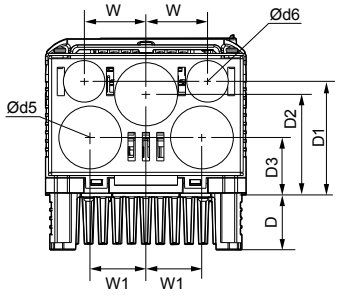


Figure 1

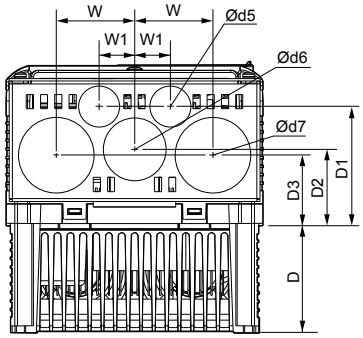


Figure 2

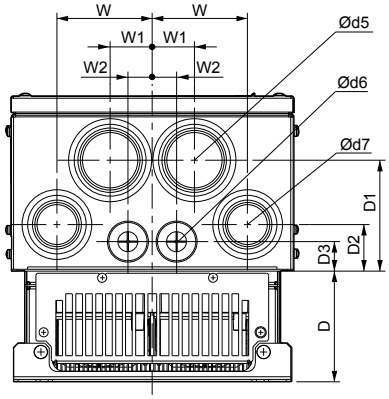


Figure 3

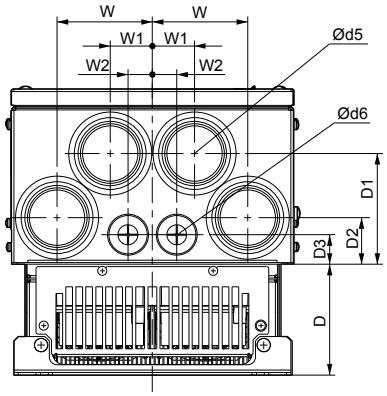


Figure 4

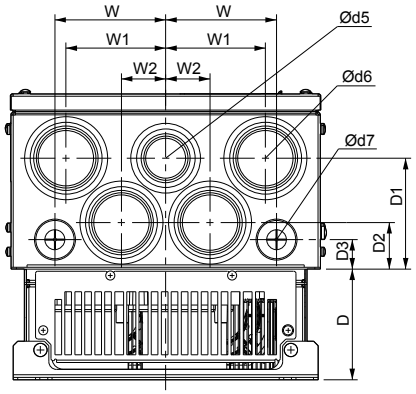


Figure 5

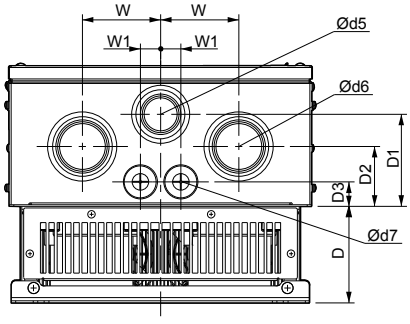


Figure 6

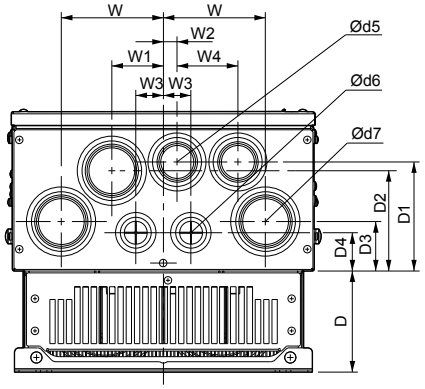


Figure 7

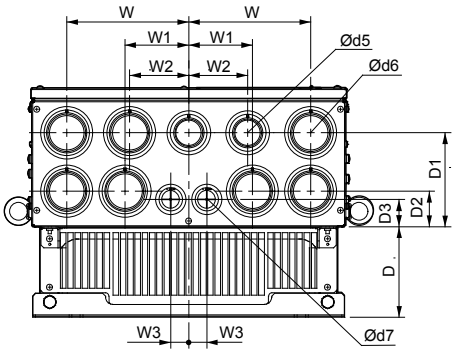


Figure 8

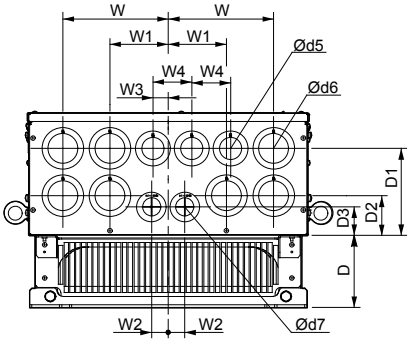


Figure 9

Table 2.8 Conduit Bracket Dimensions for IP20/NEMA Type 1

Drive Model	Dimensions (in)											Diameter (in)		
	Figure	W	D	W1	W2	W3	W4	D1	D2	D3	D4	d5	d6	d7
200 V Class														
2A0004F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
2A0006F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
2A0008F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	–	–	–
2A0010F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
2A0012F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–

Drive Model	Dimensions (in)											Diameter (in)		
	Figure	W	D	W1	W2	W3	W4	D1	D2	D3	D4	d5	d6	d7
2A0018F	2	1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	1.4	0.9	1.7
2A0021F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	1.4	0.9	1.7
2A0030F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	1.4	0.9	1.7
2A0040F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
2A0056F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
2A0069F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
2A0081F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
2A0110F	4	3.4	3.9	1.5	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	–
2A0138F	5	3.9	3.9	3.5	1.6	–	–	3.9	1.7	1.0	–	2.0	2.4	1.1
2A0169F	7	4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
2A0211F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
2A0250A	8	6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
2A0312A		6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
2A0360A	9	7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
400 V Class														
4A0002F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0004F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0005F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0007F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0009F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0011F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0018F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0023F	2	1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
4A0031F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
4A0038F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
4A0044F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
4A0058F	3	3.4	3.9	1.5	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
4A0072F		3.5	3.9	1.6	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
4A0088F	6	3.3	4.1	0.9	–	–	–	3.9	2.6	1.0	–	2.0	2.4	1.1
4A0103F		3.3	4.1	0.9	–	–	–	3.9	2.6	1.0	–	2.0	2.4	1.1
4A0139F	7	4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
4A0165F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
4A0208A	8	6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
4A0250A	9	7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
4A0296A		7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
4A0362A		7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
600 V Class														
5A0003F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0004F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0006F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0009F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0011F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–

Drive Model	Dimensions (in)											Diameter (in)		
	Figure	W	D	W1	W2	W3	W4	D1	D2	D3	D4	d5	d6	d7
5A0017F	2	1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
5A0022F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
5A0027F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
5A0032F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
5A0041F	3	3.5	3.9	1.6	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
5A0052F		3.5	3.9	1.6	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
5A0062F	7	4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
5A0077F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
5A0099F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
5A0125A	8	6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
5A0145A		6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
5A0192A	9	7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
5A0242A		7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7

Note: Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity.

■ IP00/Open Type Enclosure Drives

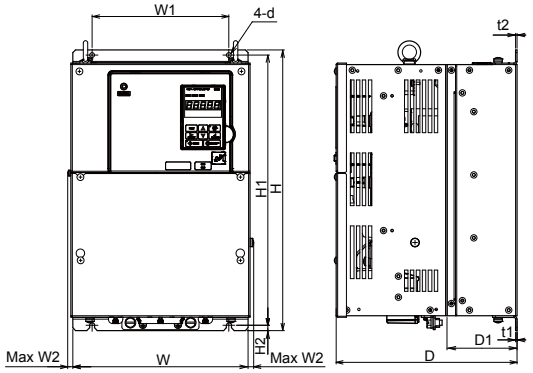


Figure 1

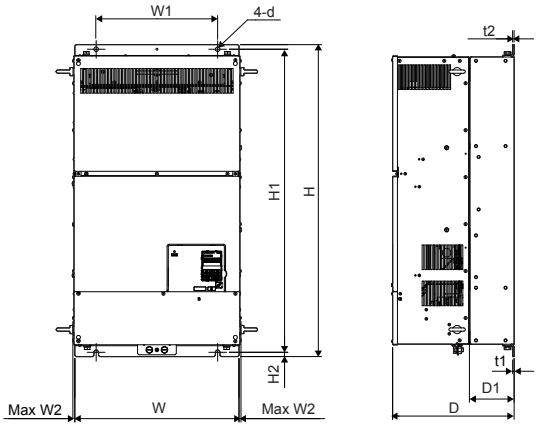


Figure 2

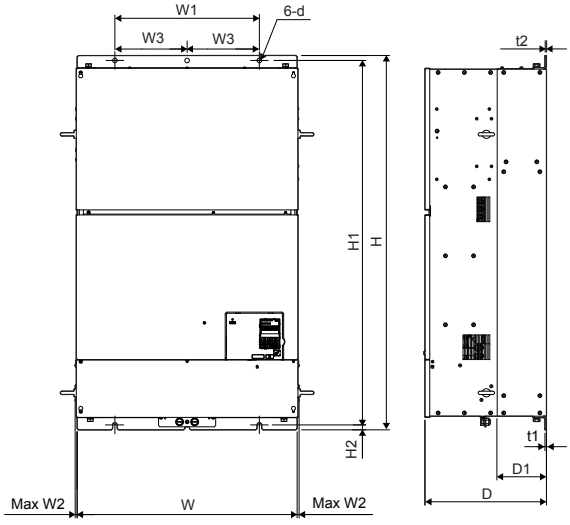


Figure 3

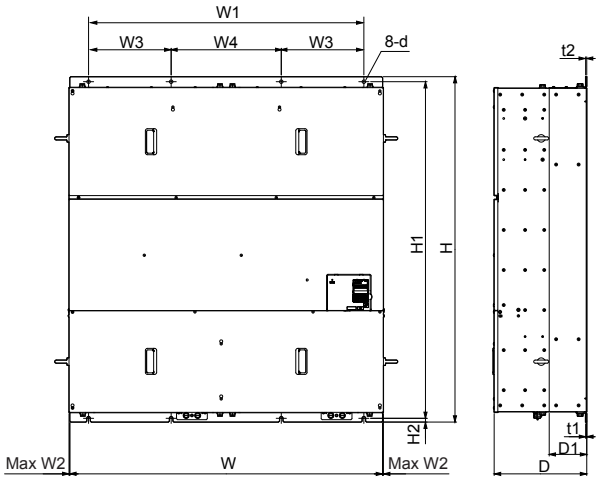


Figure 4

Table 2.9 Dimensions for IP00/Open Type Enclosure: 200 V Class

Drive Model	Dimensions (in)												
	Figure	W	H	D	W1	W2	H1	H2	D1	t1	t2	d	Wt. (lb)
2A0250A <1>	1	17.72	27.76	12.99	12.80	0.39	26.77	0.49	5.12	0.13	0.13	M10	167.6
2A0312A <1>		17.72	27.76	12.99	12.80	0.39	26.77	0.49	5.12	0.13	0.13	M10	176.4
2A0360A <1>		19.69	31.50	13.78	14.57	0.39	30.43	0.51	5.12	0.18	0.18	M12	216.1
2A0415A		19.69	31.50	13.78	14.57	0.39	30.43	0.51	5.12	0.18	0.18	M12	218.3

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. *Refer to IP20/NEMA Type 1 Kit Selection on page 58* to select the appropriate kit.

Table 2.10 Dimensions for IP00/Open Type Enclosure: 400 V Class

Drive Model	Dimensions (in)													
	Figure	W	H	D	W1	W2	W3	W4	H1	H2	D1	t1	t2	d	Wt. (lb)
4A0208A <1>	1	17.72	27.76	12.99	12.80	0.39	–	–	26.77	0.49	5.12	0.13	0.13	M10	174.2
4A0250A <1>		19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	211.6
4A0296A <1>		19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	224.9
4A0362A <1>		19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	235.9
4A0414A	2	19.69	37.40	14.57	14.57	0.31	–	–	36.34	0.51	5.31	0.18	0.18	M12	275.6
4A0515A	3	26.38	44.88	14.57	17.32	0.24	8.66	–	43.70	0.59	5.91	0.18	0.18	M12	476.2
4A0675A		26.38	44.88	14.57	17.32	0.24	8.66	–	43.70	0.59	5.91	0.18	0.18	M12	487.2

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. *Refer to IP20/NEMA Type 1 Kit Selection on page 58* to select the appropriate kit.

Table 2.11 Dimensions for IP00/Open Type Enclosure: 600 V Class

Drive Model	Dimensions (in)													
	Figure	W	H	D	W1	W2	W3	W4	H1	H2	D1	t1	t2	d	Wt. (lb)
5A0125A <1>	1	17.72	27.76	12.99	12.80	0.39	–	–	26.77	0.49	5.12	0.13	0.13	M10	174.2
5A0145A <1>		17.72	27.76	12.99	12.80	0.39	–	–	26.77	0.49	5.12	0.13	0.13	M10	174.2
5A0192A <1>		19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	235.9
5A0242A <1>		19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	235.9

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. *Refer to IP20/NEMA Type 1 Kit Selection on page 58* to select the appropriate kit.

IP20/NEMA Type 1 Kit Selection

Customers may convert IP00/Open Type models to IP20/NEMA Type 1 enclosures. Refer to *Table 2.12* to select the appropriate IP20/NEMA Type 1 Kit when performing the conversion.

Contact a Yaskawa representative for IP20/NEMA Type 1 Kit availability for IP00/Open Type models not listed.

Table 2.12 IP20/NEMA Type 1 Kit Selection

IP00/Open Type Drive Model	IP20/NEMA Type 1 Kit Code	Comments
2A0250A	100-054-503	*Refer to IP20/NEMA Type 1 Enclosure Drives on page 52* for drive dimensions with the IP20/NEMA Type 1 Kit installed.
2A0312A		
2A0360A		
4A0208A		
4A0250A	100-054-504	
4A0296A		
4A0362A		
5A0125A	100-054-503	
5A0145A		
5A0192A	100-054-504	
5A0242A		

3

Electrical Installation

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

3.1 SECTION SAFETY....60
3.2 STANDARD CONNECTION DIAGRAM....62
3.3 MAIN CIRCUIT CONNECTION DIAGRAM....65
3.4 TERMINAL BLOCK CONFIGURATION....67
3.5 TERMINAL COVER....69
3.6 DIGITAL OPERATOR AND FRONT COVER....71
3.7 TOP PROTECTIVE COVER....74
3.8 MAIN CIRCUIT WIRING....75
3.9 CONTROL CIRCUIT WIRING....86
3.10 CONTROL I/O CONNECTIONS....92
3.11 CONNECT TO A PC....95
3.12 EXTERNAL INTERLOCK....96
3.13 WIRING CHECKLIST....97

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.

Make sure the protective earthing conductor complies with technical standards and local safety regulations.

Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.

Always use appropriate equipment for Ground Fault Circuit Interrupters (GFCIs).

The drive can cause a residual current with a DC component in the protective earthing conductor. Where a residual current operated protective or monitoring device is used for protection in case of direct or indirect contact, always use a type B GFCI according to IEC 60755.

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.

⚠ WARNING

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 dynamic braking options, 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 TOBPC72060000 or TOBPC72060001 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 99*** 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), 480 Vac maximum (400 V class), 600 Vac maximum (600 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.*

Note: The minimum load for the relay outputs M1-M2, M3-M4, MA-MB-MC, and MD-ME-MF is 10 mA.

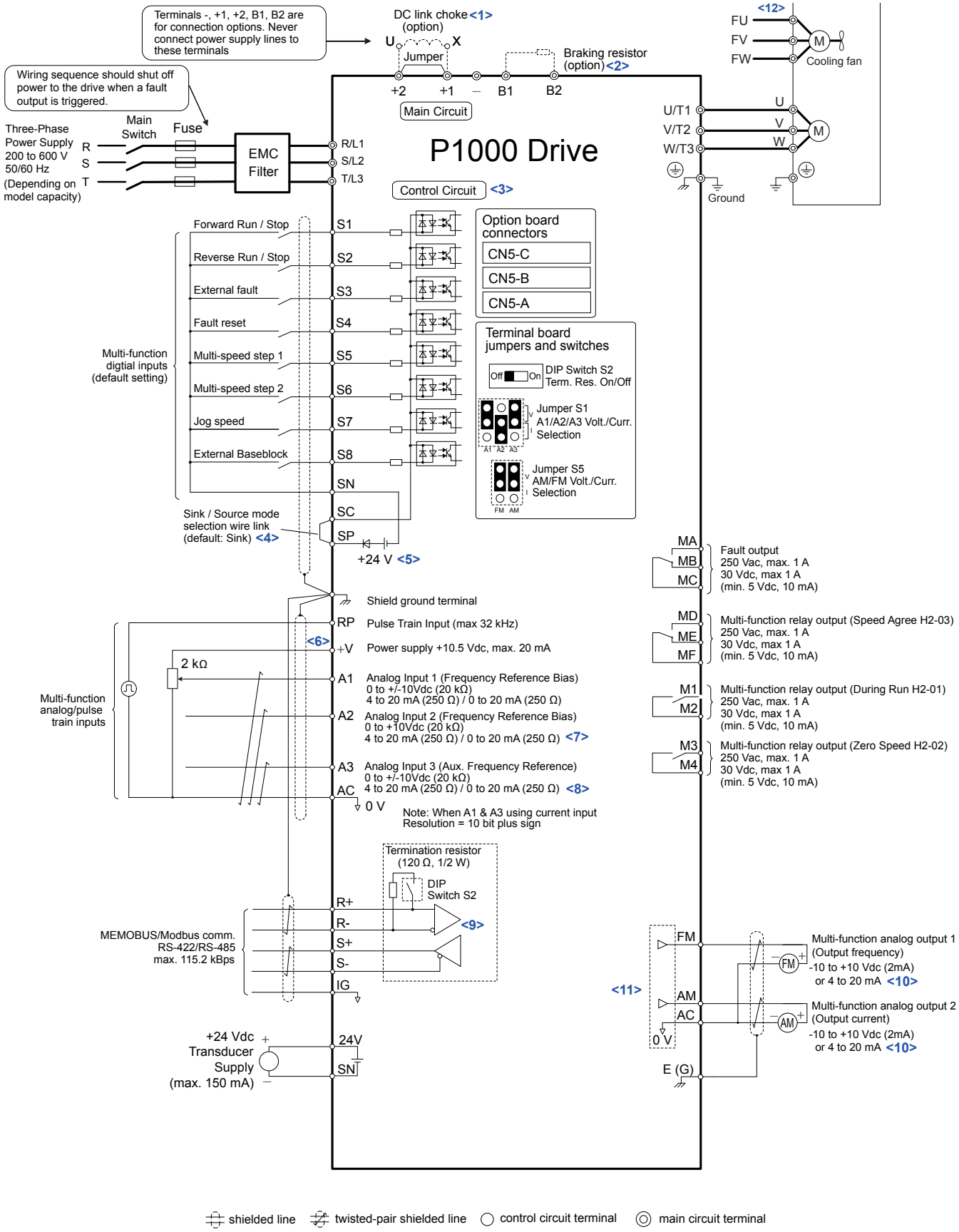


Figure 3.1 Drive Standard Connection Diagram (example: model 2A0040)

<1> Remove the jumper when installing a DC link choke. Models 2A0110 to 2A0415 and 4A0058 to 4A0675 come with a built-in DC link choke.

<2> Set L8-55 to 0 to disable the protection function of the built-in braking transistor of the drive when using an optional regenerative converter or dynamic braking option. Leaving L8-55 enabled may cause a braking resistor fault (rF). Additionally, disable Stall Prevention (L3-04 = 0) when using an optional regenerative converter, regenerative or braking units, or dynamic braking option. Leaving If L3-04 enabled may prevent the drive from stopping within the specified deceleration time.

<3> Supplying power to the control circuit separately from the main circuit requires 24 V power supply (option).

<4> This figure illustrates 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, between SC-SN for Source mode, or leave the link out for external power supply. Never short terminals SP and SN, as it will damage the drive.

<5> This voltage source supplies a maximum current of 150 mA.

<6> The maximum output current capacity for the +V terminal on the control circuit is 20 mA. Never short terminals +V and AC, as it can cause erroneous operation or damage the drive.

<7> Set jumper S1 to select between a voltage or current input signal to terminal A2. The default setting is for current input.

<8> Set jumper S1 to select between a voltage or current input signal to terminal A1 and A3. The default setting is for voltage input.

<9> Set DIP switch S2 to the ON position to enable the termination resistor in the last drive in a MEMOBUS/Modbus network.

<10> Monitor outputs work with devices such as analog frequency meters, ammeters, voltmeters, and wattmeters. They are not intended for use as a feedback-type signal.

<11> Use jumper S5 to select between voltage or current output signals at terminals AM and FM. Set parameters H4-07 and H4-08 accordingly.

<12> Self-cooling motors do not require the same wiring necessary for motors with cooling fans.

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! *Sudden Movement Hazard. When using a 3-Wire sequence, set the drive to 3-Wire sequence prior to wiring the control terminals and set parameter b1-17 to 0 so the drive will not accept a Run command at power up (default). If the drive is wired for a 3-Wire sequence but set up for a 2-Wire sequence (default), and parameter b1-17 is set to 1 so the drive accepts a Run command at power up, the motor will rotate in reverse direction at drive power up and may cause injury.*

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before executing the application preset function. Executing the application preset function or setting A1-03 ≠ 0 will change the drive I/O terminal functions and may cause unexpected equipment operation. Failure to comply may cause death or serious injury.*

NOTICE: *When using the automatic fault restart function with wiring designed to shut off the power supply upon drive fault, make sure the drive does not trigger a fault output during fault restart (L5-02 = 0, default). Failure to comply will prevent the automatic fault restart function from working properly.*

3.3 Main Circuit Connection Diagram

Refer to diagrams in this section when wiring the main circuit of the drive. 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.*

◆ Three-Phase 200 V Class Models 2A0004 to 2A0081
Three-Phase 400 V Class Models 4A0002 to 4A0044
Three-Phase 600 V Class Models 5A0003 to 5A0032

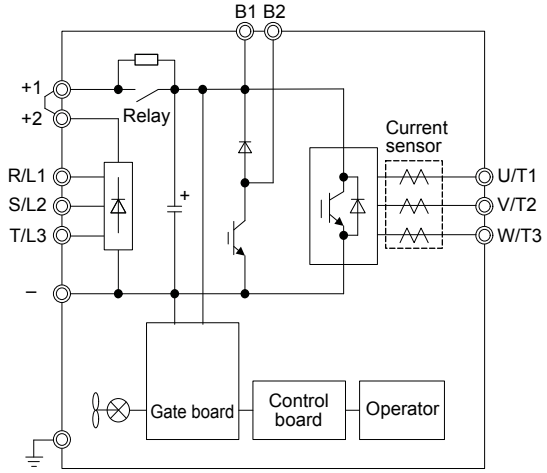


Figure 3.2 Connecting Main Circuit Terminals

◆ Three-Phase 200 V Class Models 2A0110, 2A0138
Three-Phase 400 V Class Models 4A0058, 4A0072
Three-Phase 600 V Class Models 5A0041, 5A0052

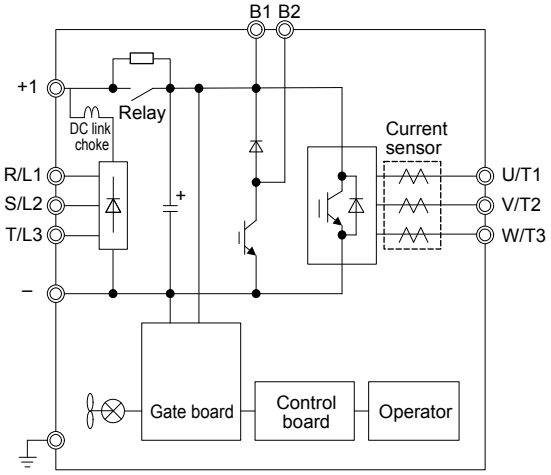


Figure 3.3 Connecting Main Circuit Terminals

◆ Three-Phase 200 V Class Models 2A0169 to 2A0211
Three-Phase 400 V Class Models 4A0088 to 4A0139
Three-Phase 600 V Class Models 5A0062 to 5A0099

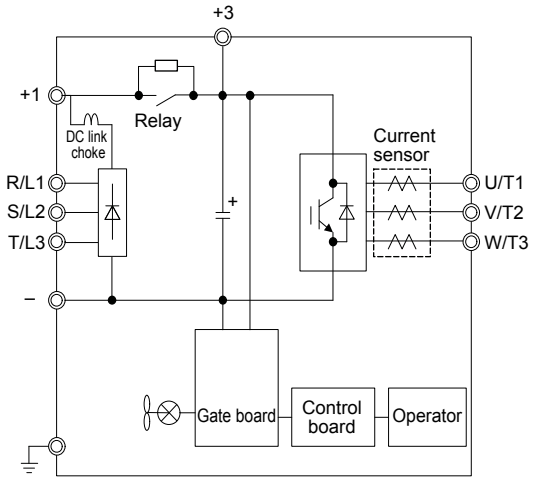


Figure 3.4 Connecting Main Circuit Terminals

◆ Three-Phase 200 V Class Models 2A0250 to 2A0415
Three-Phase 400 V Class Models 4A0165 to 4A0675
Three-Phase 600 V Class Models 5A0125 to 5A0242

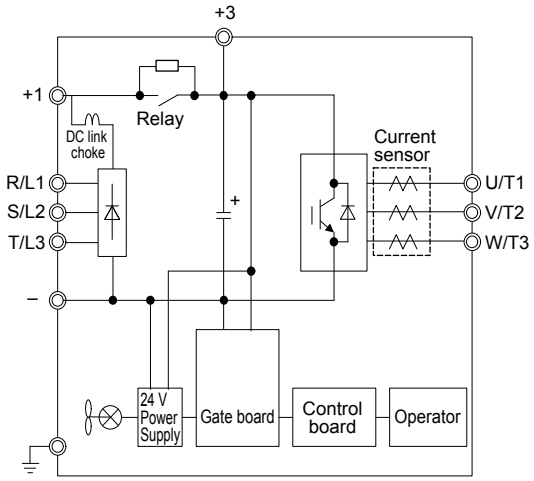


Figure 3.5 Connecting Main Circuit Terminals

3.4 Terminal Block Configuration

Figure 3.6 and *Figure 3.7* show the different main circuit terminal arrangements for the drive capacities.

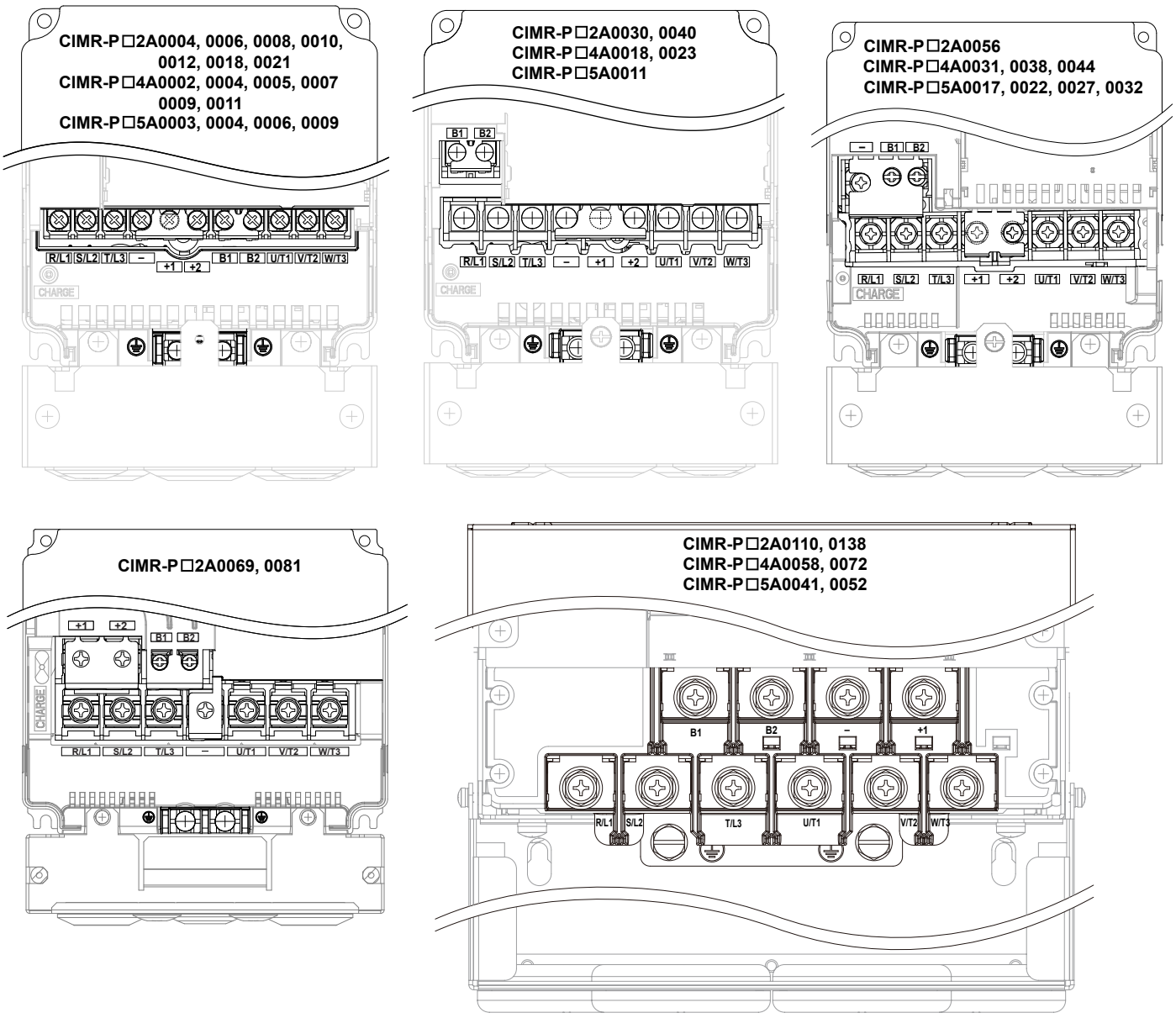


Figure 3.6 Main Circuit Terminal Block Configuration

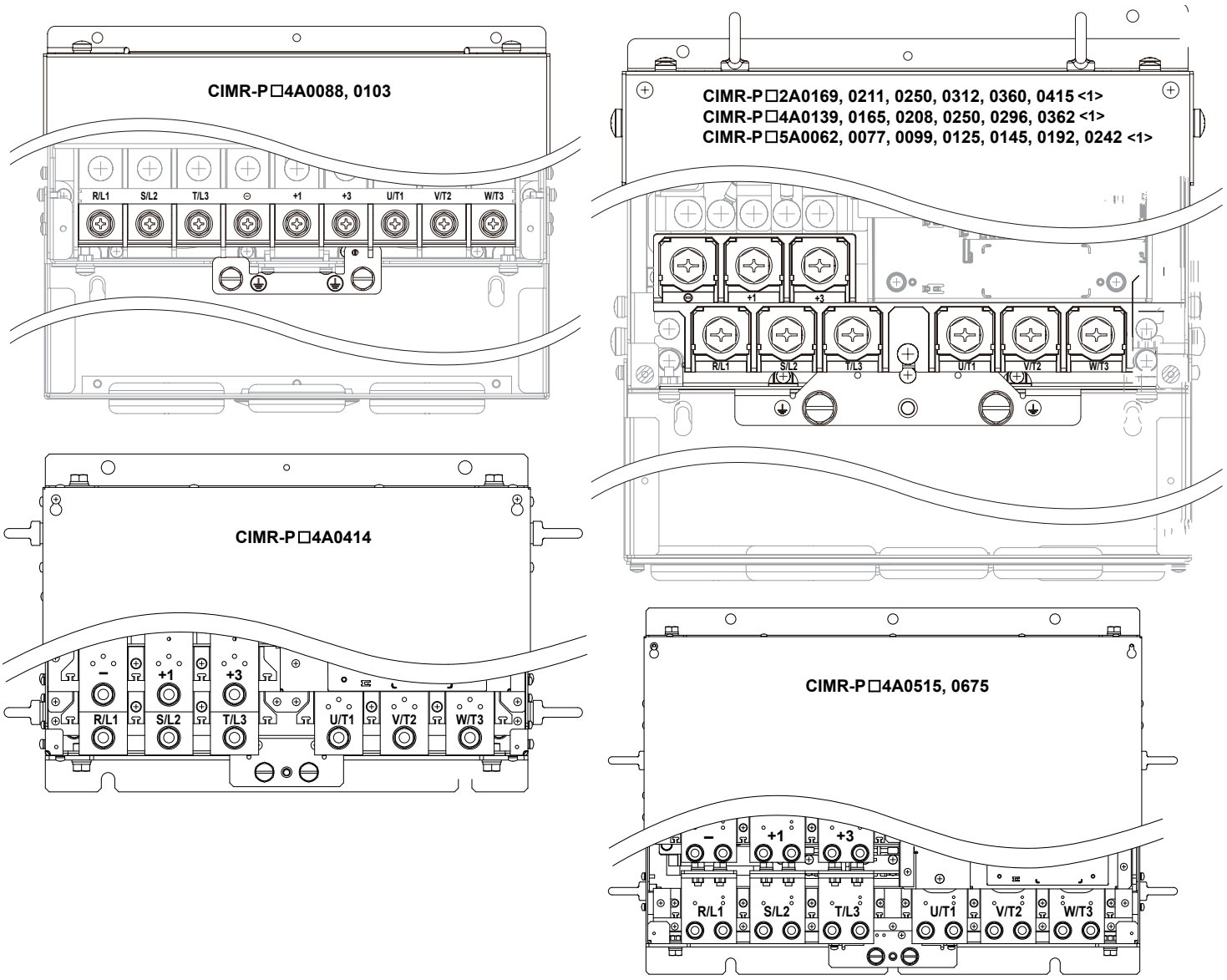


Figure 3.7 Main Circuit Terminal Block Configuration (continued)

<1> Terminal block design differs slightly for models 2A0250 to 2A0415, 4A0208 to 4A0362, and 5A0125 to 5A0242.

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.

◆ Models 2A0004 to 2A0081, 4A0002 to 4A0044, 5A0003 to 5A0032 (IP20/NEMA Type 1 Enclosure)

■ Removing the Terminal Cover

1. Loosen the terminal cover screw using a #2 Phillips screwdriver. Screw sizes vary by drive model.

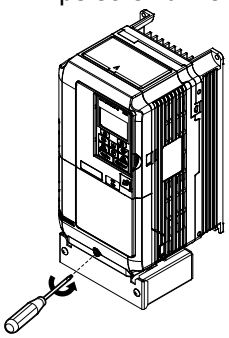


Figure 3.8 Removing the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive

2. Push in on the tab located on the bottom of the terminal cover and gently pull forward to remove the terminal cover.

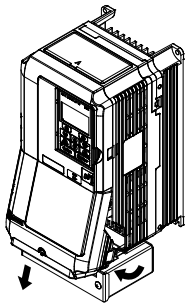


Figure 3.9 Removing the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive

■ Reattaching the Terminal Cover

Power lines and signal wiring should pass through the opening provided. *Refer to Wiring the Main Circuit Terminal on page 84* and *Wiring the Control Circuit Terminal* on page *89* for details on wiring.

Reattach the terminal cover after completing the wiring to the drive and other devices.

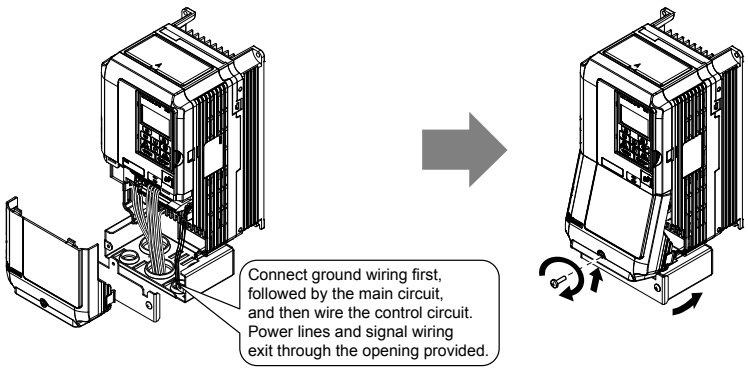


Figure 3.10 Reattaching the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive

◆ Models 2A0110 to 2A0250, 4A0208 to 4A0675, and 5A0125 to 5A0242 (IP00/Open Type Enclosure)

■ Removing the Terminal Cover

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

Note: The terminal cover and the number of terminal cover screws differ depending on the drive model. ***Refer to Component Names on page 34*** for details.

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.*

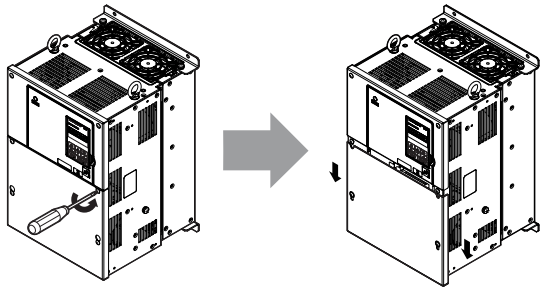


Figure 3.11 Removing the Terminal Cover on an IP00/Open Type Enclosure Drive

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

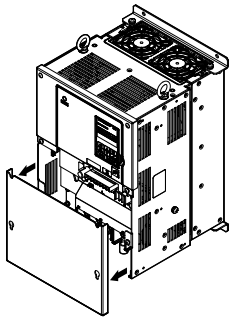


Figure 3.12 Removing the Terminal Cover on an IP00/Open Type Enclosure Drive

■ Reattaching the Terminal Cover

After wiring the terminal board and other devices, double-check connections and reattach the terminal cover. ***Refer to Wiring the Main Circuit Terminal on page 84*** and ***Wiring the Control Circuit Terminal*** on page ***89*** for details on wiring.

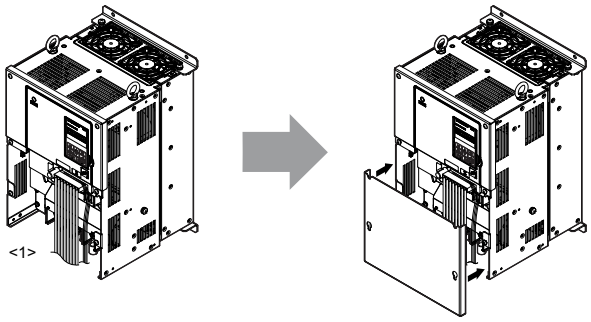


Figure 3.13 Reattaching the Terminal Cover on an IP00/Open Type Enclosure Drive

<1> Connect the ground wiring first, then the main circuit wiring, and finally the control circuit wiring.

3.6 Digital Operator and Front Cover

Detach the digital operator from the drive for remote operation or when opening the front cover to install an option card.

NOTICE: *Be sure to remove the digital operator prior to opening or reattaching the front cover. Leaving the digital operator plugged into the drive when removing the front cover can result in erroneous operation caused by a poor connection. Firmly fasten the front cover back into place before reattaching the digital operator.*

◆ Removing/Reattaching the Digital Operator

■ Removing the Digital Operator

While pressing on the tab located on the right side of the digital operator, pull the digital operator forward to remove it from the drive.

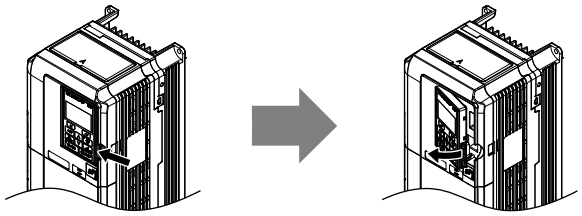


Figure 3.14 Removing the Digital Operator

■ 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.

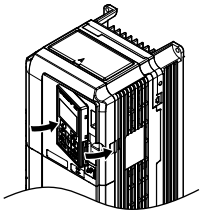


Figure 3.15 Reattaching the Digital Operator

◆ Removing/Reattaching the Front Cover

■ Removing the Front Cover

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032

After removing the terminal cover and the digital operator, loosen the screw that affixes the front cover (models 2A0056, 4A0038, 5A0022, and 5A0027 do not use a screw to affix the front cover) . Pinch in on the tabs found on each side of the front cover, then pull forward to remove it from the drive.

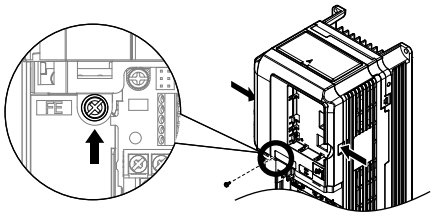


Figure 3.16 Remove the Front Cover (2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032)

Models 2A0110 to 2A0415 and 4A0058 to 4A0675

1. Remove the terminal cover and the digital operator.
2. Loosen the installation screw on the front cover.
3. Use a straight-edge screwdriver to loosen the hooks on each side of the cover that hold it in place.

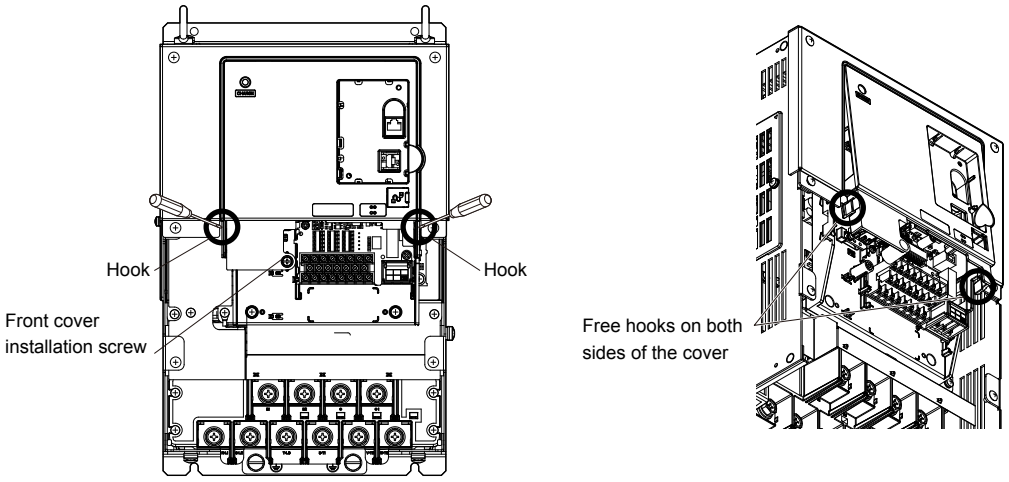


Figure 3.17 Remove the Front Cover (2A0010 to 2A0415 and 4A0058 to 4A0675)

4. Unhook the left side of the front cover then swing the left side towards you as shown in ***Figure 3.18*** until the cover comes off.

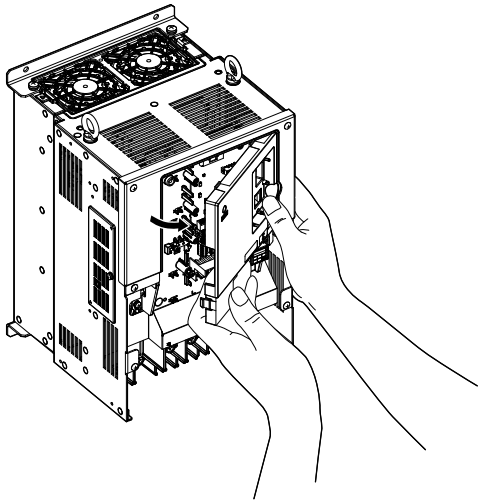


Figure 3.18 Remove the Front Cover (2A0010 to 2A0415 and 4A0058 to 4A0675)

■ Reattaching the Front Cover

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032

Reverse the instructions given in *Remove the Front Cover (2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032)* on page *71* 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.

Models 2A0110 to 2A0415 and 4A0058 to 4A0675

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

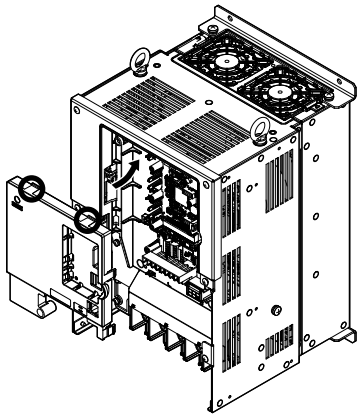


Figure 3.19 Reattach the Front Cover (2A0110 to 2A0415 and 4A0058 to 4A0675)

2. After connecting the hooks to the drive, press firmly on the cover to lock it into place.

3.7 Top Protective Cover

Drive models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 are designed to IP20/NEMA Type 1 specifications with a protective cover on the top. Removing this top protective cover or the bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids the NEMA Type 1 protection while maintaining IP20 conformity.

◆ Removing the Top Protective Cover

Insert the tip of a straight-edge screwdriver into the small opening located on the front edge of the top protective cover. Gently apply pressure as shown in the figure below to free the cover from the drive.

Note: Removing the top protective cover or the bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids the NEMA Type 1 protection while maintaining IP20 conformity.

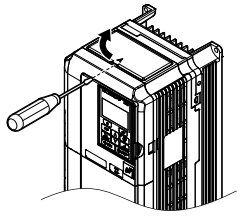


Figure 3.20 Removing the Top Protective Cover

◆ Reattaching the Top Protective Cover

Insert the two small protruding hooks on the rear side of the top protective cover into the provided mounting holes near the back of the drive, then press down on the front side of the top protective cover to fasten the cover into place.

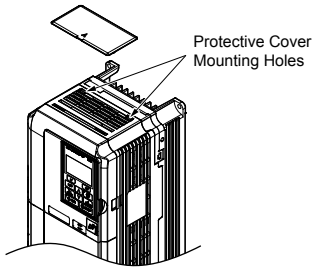


Figure 3.21 Reattaching the Protective Cover

3.8 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 life 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.*

Refer to Input Fuse Installation on page 518 for details on fuse selection.

◆ Main Circuit Terminal Functions

Table 3.1 Main Circuit Terminal Functions

Terminal		Type			Function	Page
200 V Class	Drive Model	2A0004 to 2A0081	2A0110 to 2A0138	2A0169 to 2A0415		
400 V Class		4A0002 to 4A0044	4A0058, 4A0072	4A0088 to 4A0675		
600 V Class		5A0003 to 5A0032	5A0041 to 5A0052	5A0062 to 5A0242		
R/L1		Main circuit power supply input			Connects line power to the drive	*63*
S/L2						
T/L3						
U/T1		Drive output			Connects to the motor	*63*
V/T2						
W/T3						
B1		Braking resistor		Not available	Available for connecting a braking resistor or a braking resistor unit option	*363*
B2						
+2		• DC link choke connection (+1, +2) (remove the shorting bar between +1 and +2) • DC power supply input (+1, −)	Not available		For connecting: • the drive to a DC power supply (terminals +1 and – are not EU/CE or UL approved) • dynamic braking options • a DC link choke	*367*
+1			DC power supply input (+1, −)	• DC power supply input (+1, −) • Braking unit connection (+3, −)		
–						
+3		Not available				
⏚		For 200 V class: 100 Ω or less For 400 V class: 10 Ω or less For 600 V class: 10 Ω or less			Grounding terminal	*84*

Note: Use terminals B1 and – when installing a CDBR-type braking unit on drives with built-in braking transistors (Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052).

◆ Protecting Main Circuit Terminals

■ Insulation Caps or Sleeves

Use insulation caps or sleeves when wiring the drive with crimp terminals. Take particular care to ensure that the wiring does not touch nearby terminals or the surrounding case.

■ Insulation Barrier

Insulation barriers are packaged with drive models 4A0414 through 4A0675 to provide added protection between terminals. Yaskawa recommends using the provided insulation barriers to ensure proper wiring. Refer to *Figure 3.22* for instructions on placement of the insulation barriers.

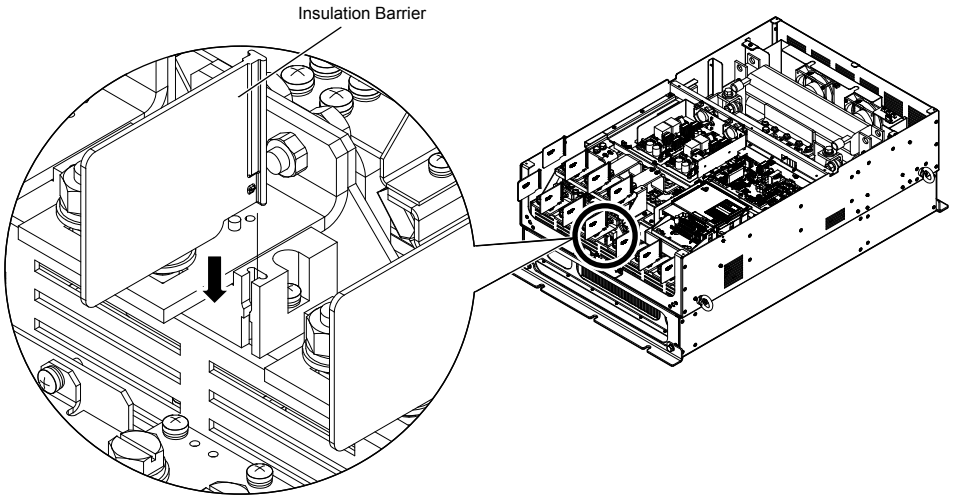


Figure 3.22 Installing Insulation Barriers

◆ Wire Gauges and Tightening Torque

Use the tables in this section to select the appropriate wires and crimp terminals.

Gauges listed in the tables are for use in the United States.

Note:
1. 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.
2. Terminals +1, +2, +3, –, B1 and B2 are for connecting optional devices such as a DC link choke 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) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3}
- Refer to instruction manual TOBP C720600 00 for braking transistor option or braking resistor option wire gauges.
- Use terminals +1 and – when connecting a regenerative converter or a regen unit.

NOTICE: *Do not connect a braking resistor to terminals +1 or –. Failure to comply may cause damage to the drive circuitry.*

- Use terminals B1 and – when installing a CDBR-type braking unit on drives with built-in braking transistors (models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052).

NOTICE: *Do not connect a braking resistor to terminals +1 or –. Failure to comply may cause damage to the drive circuitry.*

- ***Refer to UL Standards Compliance on page 507*** for information on UL compliance.

Yaskawa recommends using closed-loop crimp terminals on all drive models. UL/cUL approval requires the use of closed-loop crimp terminals when wiring the drive main circuit terminals on models 2A0110 to 2A0415 and 4A0058 to 4A0675. Use only the tools recommended by the terminal manufacturer for crimping. ***Refer to Closed-Loop Crimp Terminal Size on page 514*** for closed-loop crimp terminal recommendations.

The wire gauges listed in the following tables are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

■ Three-Phase 200 V Class

Table 3.2 Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0004 2A0006 2A0008 2A0010	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0012	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0018	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0021	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	12 to 10		
	–, +1, +2	–	12 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	12 to 10		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0030	R/L1, S/L2, T/L3	8	10 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	8	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	14 to 10		
	⏚	8 <1>	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0040	R/L1, S/L2, T/L3	6	8 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	8	8 to 6		
	–, +1, +2	–	6		
	B1, B2	–	12 to 10		
	⏚	8 <1>	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0056	R/L1, S/L2, T/L3	4	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	4	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	4 to 6 (35.4 to 53.1)
2A0069	R/L1, S/L2, T/L3	3	4 to 3	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	–, +1, +2	–	4 to 3		
	B1, B2	–	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
2A0081	R/L1, S/L2, T/L3	2	3 to 2	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 2		
	–, +1, +2	–	3 to 2		
	B1, B2	–	6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
2A0110 <2>	R/L1, S/L2, T/L3	1/0	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1/0	3 to 1/0		
	–, +1	–	2 to 1/0		
	B1, B2	–	6 to 1/0		
	⏚	6	6 to 4		
2A0138 <2>	R/L1, S/L2, T/L3	2/0	1 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 2/0		
	–, +1	–	1/0 to 3/0		
	B1, B2	–	4 to 2/0		
	⏚	4	4	M8	9 to 11 (79.7 to 97.4)
2A0169 <2>	R/L1, S/L2, T/L3	4/0	2/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	–, +1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 2		
2A0211 <2>	R/L1, S/L2, T/L3	1/0 × 2P	1/0 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1/0 × 2P	1/0 to 2/0		
	–, +1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 1/0		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0250 <2>	R/L1, S/L2, T/L3	3/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	–, +1	–	3/0 to 300		
	+3	–	2 to 300	M10	18 to 23 (159 to 204)
	⏚	3	3 to 300	M12	32 to 40 (283 to 354)
2A0312 <2>	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	–, +1	–	3/0 to 300		
	+3	–	3/0 to 300	M10	18 to 23 (159 to 204)
	⏚	2	2 to 300	M12	32 to 40 (283 to 354)
2A0360 <2>	R/L1, S/L2, T/L3	250 × 2P	4/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	4/0 to 600		
	–, +1	–	250 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
2A0415 <2>	R/L1, S/L2, T/L3	350 × 2P	250 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	300 to 600		
	–, +1	–	300 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

<1> When installing an EMC filter, additional measures must be taken to comply with IEC61800-5-1. *Refer to EMC Filter Installation on page 502* for details.

<2> Drive models 2A0110 to 2A0415 require the use of UL-Listed closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

■ Three-Phase 400 V Class

Table 3.3 Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0002 4A0004	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	12	14 to 12		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
4A0011	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0018	R/L1, S/L2, T/L3	10	12 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	10	12 to 6		
	–, +1, +2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10	14 to 10	M5	2 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	10	10 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10	12 to 10	M5	2 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	8	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	U/T1, V/T2, W/T3	8	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8	M5	
	⏚	8	10 to 8	M6	4 to 6 (35.4 to 53.1)
4A0038	R/L1, S/L2, T/L3	6	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	U/T1, V/T2, W/T3	8	8 to 6		
	–, +1, +2	–	6		
	B1, B2	–	10 to 8	M5	
	⏚	6	10 to 6	M6	4 to 6 (35.4 to 53.1)
4A0044	R/L1, S/L2, T/L3	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	4 to 6 (35.4 to 53.1)
4A0058 <*1*>	R/L1, S/L2, T/L3	4	6 to 4	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	4	6 to 4		
	–, +1	–	6 to 1		
	B1, B2	–	8 to 4		
	⏚	6	8 to 6		
4A0072 <*1*>	R/L1, S/L2, T/L3	3	4 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	–, +1	–	4 to 1		
	B1, B2	–	6 to 3		
	⏚	6	6		
4A0088 <*1*>	R/L1, S/L2, T/L3	2	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 1/0		
	–, +1	–	3 to 1/0		
	+3	–	6 to 1/0		
	⏚	4	6 to 4		
4A0103 <*1*>	R/L1, S/L2, T/L3	1/0	2 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1	2 to 1/0		
	–, +1	–	3 to 1/0		
	+3	–	4 to 1/0		
	⏚	4	6 to 4		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0139 <1>	R/L1, S/L2, T/L3	3/0	1/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1/0 to 4/0		
	–, +1	–	1/0 to 4/0		
	+3	–	3 to 4/0		
	⏚	4	4		
4A0165 <1>	R/L1, S/L2, T/L3	4/0	3/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	–,+1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 2		
4A0208 <1>	R/L1, S/L2, T/L3	300	2 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	300	2 to 300		
	–,+1	–	1 to 250		
	+3	–	3 to 3/0		
	⏚	4	4 to 300		
4A0250 <1>	R/L1, S/L2, T/L3	400	1 to 600	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	400	1/0 to 600		
	–,+1	–	3/0 to 600		
	+3	–	1 to 325		
	⏚	2	2 to 350		
4A0296 <1>	R/L1, S/L2, T/L3	500	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	500	2/0 to 600		
	–,+1	–	3/0 to 600		
	+3	–	1 to 325	M10	18 to 23 (159 to 204)
	⏚	2	2 to 350	M12	32 to 40 (283 to 354)
4A0362 <1>	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	3/0 to 600		
	–,+1	–	4/0 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
4A0414 <1> <2>	R/L1, S/L2, T/L3	300 × 2P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	4/0 to 300		
	–,+1	–	3/0 to 300		
	+3	–	3/0 to 300		
	⏚	1	1 to 3/0		
4A0515 <1> <2>	R/L1, S/L2, T/L3	3/0 × 4P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 4P	3/0 to 300		
	–,+1	–	1/0 to 300		
	+3	–	1/0 to 300		
	⏚	1/0	1/0 to 300		
4A0675 <1> <2>	R/L1, S/L2, T/L3	300 × 4P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 4P	4/0 to 300		
	–,+1	–	1/0 to 300		
	+3	–	1/0 to 300		
	⏚	2/0	2/0 to 300		

<1> Drive models 4A0058 to 4A0675 require the use of UL-Listed closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

<2> When installing an EMC filter, additional measures must be taken to comply with IEC61800-5-1. *Refer to EMC Filter Installation on page 502* for details.

■ Three-Phase 600 V Class

Table 3.4 Wire Gauge and Torque Specifications (Three-Phase 600 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0003 5A0004 5A0006	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
5A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	12 to 10		
5A0011	R/L1, S/L2, T/L3	10	14 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 6		
	–, +1, +2	–	14 to 6		
	B1, B2	–	14 to 10		
	⏚	8	12 to 8	M5	2 to 2.5 (17.7 to 22.1)
5A0017	R/L1, S/L2, T/L3	10	10 to 6	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8		
	⏚	8	12 to 8	M6	4 to 6 (35.4 to 53.1)
5A0022	R/L1, S/L2, T/L3	8	10 to 6	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8		
	⏚	8	10 to 6	M6	4 to 6 (35.4 to 53.1)
5A0027 5A0032	R/L1, S/L2, T/L3	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
	⏚	6	10 to 6	M6	4 to 6 (35.4 to 53.1)
5A0041	R/L1, S/L2, T/L3	6	10 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	–, +1	–	6 to 1		
	B1, B2	–	12 to 3		
	⏚	6	6		
5A0052	R/L1, S/L2, T/L3	4	10 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	–, +1	–	6 to 1		
	B1, B2	–	8 to 3		
	⏚	6	6		
5A0062	R/L1, S/L2, T/L3	4	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4	10 to 4/0		
	–, +1	–	4 to 4/0		
	+3	–	6 to 4/0		
	⏚	4	4		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0077	R/L1, S/L2, T/L3	3	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3	10 to 4/0		
	–, +1	–	3 to 4/0		
	+3	–	6 to 4/0		
	⏚	4	4		
5A0099	R/L1, S/L2, T/L3	1/0	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1	10 to 4/0		
	–, +1	–	2 to 4/0		
	+3	–	4 to 4/0		
	⏚	4	4		
5A0125	R/L1, S/L2, T/L3	2/0	1 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 300		
	–, +1	–	2/0 to 3/0		
	+3	–	1 to 1/0		
	⏚	3	4 to 300		
5A0145	R/L1, S/L2, T/L3	3/0	2/0 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3/0	2/0 to 300		
	–, +1	–	3/0 to 4/0		
	+3	–	1/0 to 2/0		
	⏚	3	4 to 300		
5A0192	R/L1, S/L2, T/L3	300	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	250	2/0 to 600		
	–, +1	–	2/0 to 400		
	+3	–	2/0 to 250	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
5A0242	R/L1, S/L2, T/L3	400	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	350	2/0 to 600		
	–, +1	–	2/0 to 500		
	+3	–	250 to 300	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

◆ Main Circuit Terminal and Motor Wiring

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

WARNING! *Electrical Shock Hazard. Do not connect the AC power line to the output 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.*

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.*

■ 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 171***.

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: When setting carrier frequency for drives running multiple motors, calculate cable length as the total wiring distance to all connected motors.

■ Ground Wiring

Follow the precautions below when wiring the ground for one drive or a series of drives.

WARNING! *Electrical Shock Hazard. Make sure the protective earthing conductor complies with technical standards and local safety regulations. Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.*

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 (200 V class: ground to 100 Ω or less; 400 V class: ground to 10 Ω or less; 600 V class: ground to 10 Ω or less). 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 3.23*** when using multiple drives. Do not loop the ground wire.

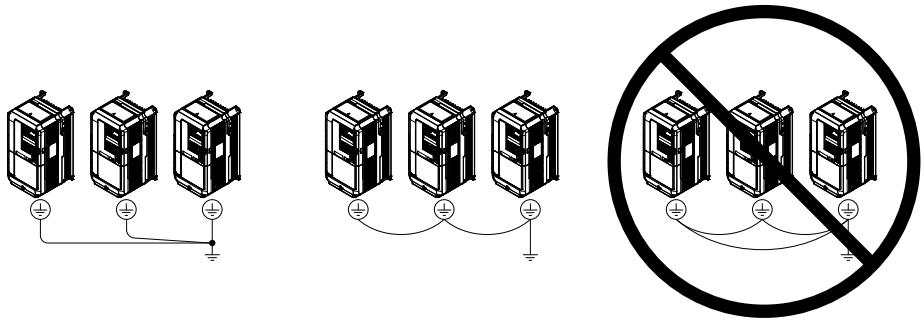


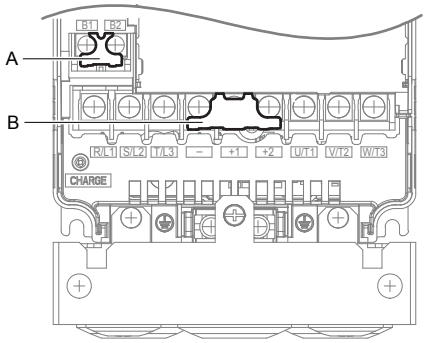
Figure 3.23 Multiple Drive Wiring

■ 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 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 have a cover placed over the DC bus and braking circuit terminals prior to shipment to help prevent miswiring. Use wire cutters to cut away covers as needed for terminals.



A – Braking circuit protective cover **B – DC bus protective cover**

Figure 3.24 Protecting Cover to Prevent Miswiring (Model 5A0011)

■ Main Circuit Connection Diagram

Refer to Main Circuit Connection Diagram on page 65 when wiring terminals on the main power circuit of the drive.

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.*

3.9 Control Circuit Wiring

◆ Control Circuit Connection Diagram

Refer to *Figure 3.1* on page *63* when wiring terminals on the drive 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 M4), 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 *63*.

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.*

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before starting test run. Setting parameter A1-03 may change the I/O terminal function automatically from the factory setting.* ***Refer to Application Selection on page 118****. Failure to comply may 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 • *Refer to Sinking/Sourcing Mode Switch for Digital Inputs on page 92*.	*196*
	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 command (N.O.))		
	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	*92*
	SN	Digital input power supply 0 V 24 V transducer power supply 0 V	**NOTICE:** *Do not jumper or short terminals SP and SN. Failure to comply will damage the drive.*	*92*

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	*140* *223*
	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)	*139*
	24 V	+24 Vdc transducer power supply for customer use	150 mA maximum capacity	–
	A1	Multi-function analog input 1 (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 jumper S1 and H3-01.	*139* *216*
	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 jumper S1 and H3-09.	*139* *139* *218*
	A3	Multi-function analog input 3 (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 jumper S1 and H3-05.	*139*
	AC	Frequency reference common	0 V	*139*
	E (G)	Ground for shielded lines and option cards	–	–

■ Output Terminals

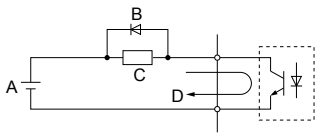
Table 3.7 lists the output terminals on the drive. Text in parenthesis indicates the default setting for each multi-function output.

Table 3.7 Control Circuit Output Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Fault Relay Output	MA	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	*206*
	MB	N.C. output		
	MC	Fault output common		
Multi-Function Digital Output <1>	MD	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	*206*
	ME	N.C. Output		
	MF	Common (Speed agree)		
	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	
	M2			
	M3	Multi-function digital output (Zero speed)		
	M4			
Monitor Output	FM	Analog monitor output 1 (Output frequency)	-10 to +10 Vdc, or 0 to +10 Vdc	*221*
	AM	Analog monitor output 2 (Output current)		
	AC	Monitor common	0 V	–

<1> Refrain from assigning functions to digital relay 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).

Connect a suppression diode as shown in *Figure 3.25* when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.



A – External power, 48 V max.
B – Suppression diode
C – Coil
D – 50 mA or less

Figure 3.25 Connecting a Suppression Diode

■ Serial Communication Terminals

Table 3.8 Control Circuit Terminals: Serial Communications

Type	No.	Signal Name	Function (Signal Level)	
MEMOBUS/Modbus Communication <1>	R+	Communications input (+)	MEMOBUS/Modbus communication: Use an RS-422 or RS-485 cable to connect the drive.	RS-422/RS-485 MEMOBUS/Modbus communication protocol 115.2 kbps (max.)
	R-	Communications input (-)		
	S+	Communications output (+)		
	S-	Communications output (-)		
	IG	Shield ground	0 V	

<1> Enable the termination resistor in the last drive in a MEMOBUS/Modbus network by setting DIP switch S2 to the ON position. *Refer to Control I/O Connections on page 92* for more information on the termination resistor.

◆ Terminal Configuration

The control circuit terminals are arranged as shown in *Figure 3.26*.

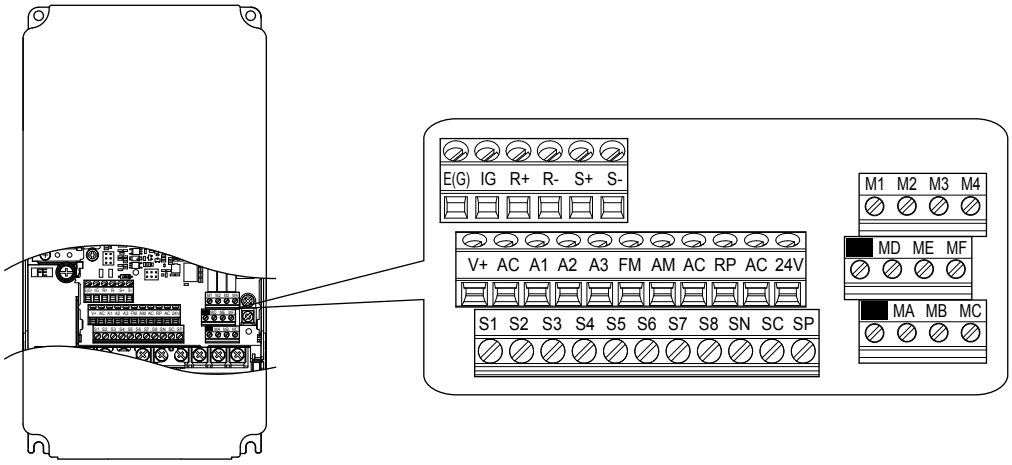


Figure 3.26 Control Circuit Terminal Arrangement

■ Wire Size and Torque Specifications

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	Screw Size	Tightening Torque N•m (lb. in)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
			Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	
S1-S8, SC, SN, SP	M3	0.5 to 0.6 (4.4 to 5.3)	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 wire, etc.
RP, V+, A1, A2, A3, AC, 24 V							
MA, MB, MC, MD, ME, MF							
M1-M4							
FM, AM, AC							
R+, R-, S+, S-, IG							

■ Ferrule-Type Wire Terminals

Yaskawa recommends using CRIMPFOX 6, a crimping tool manufactured by PHOENIX CONTACT, to prepare wire ends with insulated sleeves before connecting to the drive. See *Table 3.10* for dimensions.

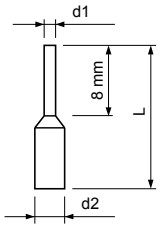


Figure 3.27 Ferrule Dimensions

Table 3.10 Ferrule Terminal Types and Sizes

Size mm² (AWG)	Type	L (mm)	d1 (mm)	d2 (mm)	Manufacturer
0.25 (24)	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, MD, ME, MF and M1 to M4 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 when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits for requirements concerning class 2 power supplies.*

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.*

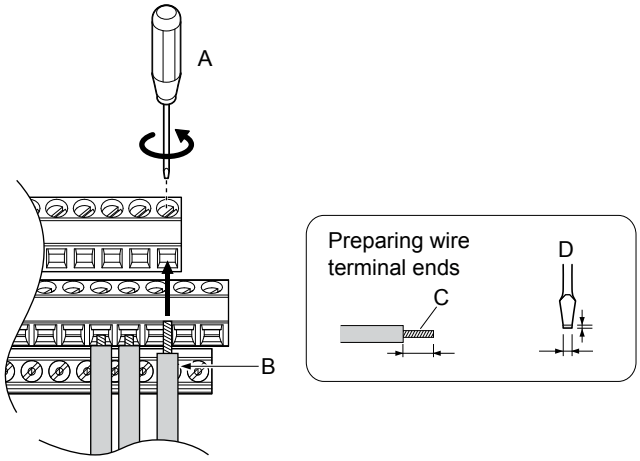
NOTICE: *Connect the shield of shielded cable to the appropriate ground terminal. Improper equipment grounding could result in drive or equipment malfunction or nuisance trips.*

Wire the control circuit only after terminals have been properly grounded and main circuit wiring is complete. *Refer to Terminal Board Wiring Guide on page 90* for details. Prepare the ends of the control circuit wiring as shown in *Figure 3.30*. *Refer to Wire Gauges on page 88*.

NOTICE: *Do not tighten screws beyond the specified tightening torque. Failure to comply may result in erroneous operation, damage to the terminal block, or cause a fire.*

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 *Figure 3.28* and *Figure 3.29*.



A – Loosen screw to insert wire.
B – Single wire or stranded wire
C – Avoid fraying wire strands when stripping insulation from wire. Strip length 5.5 mm.
D – Blade depth of 0.4 mm or less Blade width of 2.5 mm or less

Figure 3.28 Terminal Board Wiring Guide

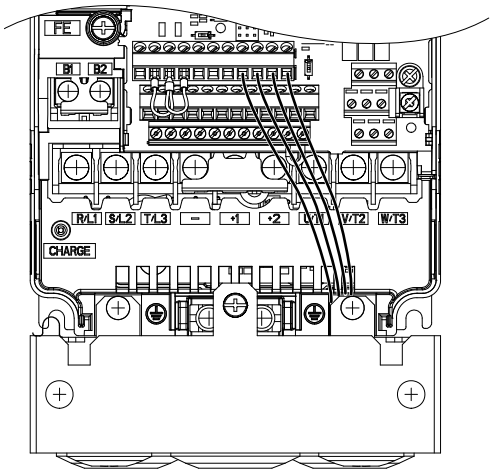
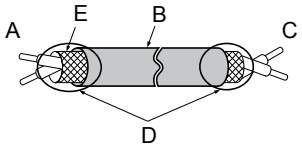


Figure 3.29 Terminal Board Location Inside the Drive

When setting the frequency by analog reference from an external potentiometer, use shielded twisted-pair wires (preparing wire ends as shown in ***Figure 3.30***) and connect the shield to the ground terminal of the drive.



A – Drive side
B – Insulation
C – Control device side
D – Shield sheath (insulate with tape)
E – Shield

Figure 3.30 Preparing the Ends of Shielded Cables

NOTICE: *The analog signal wiring 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 3.31*** shows the location of these switches. ***Refer to Control I/O Connections on page 92*** for setting instructions.

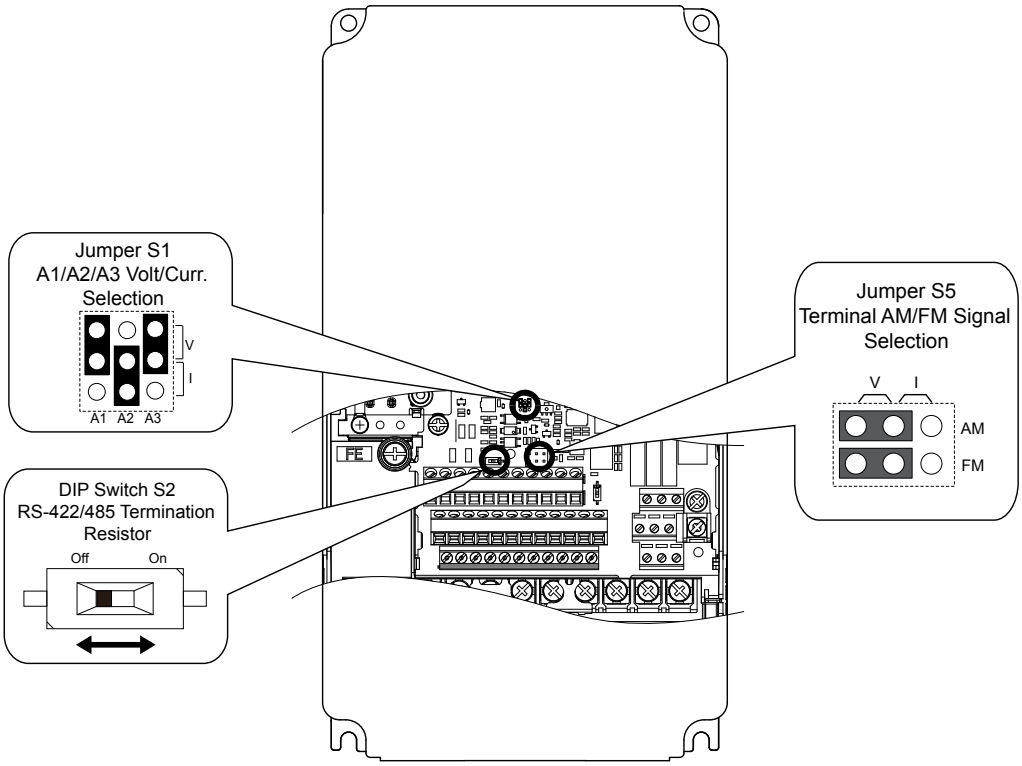


Figure 3.31 Locations of Jumpers and Switches on the Terminal Board

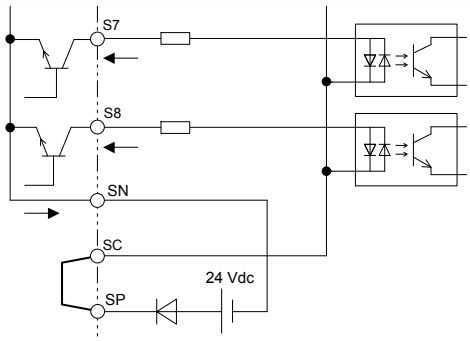
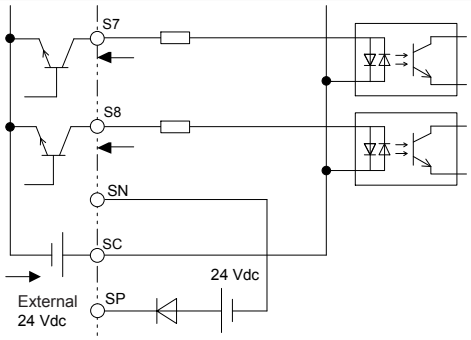
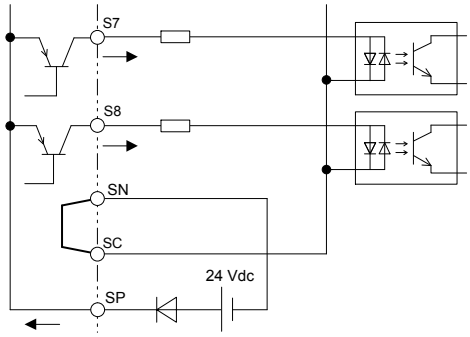
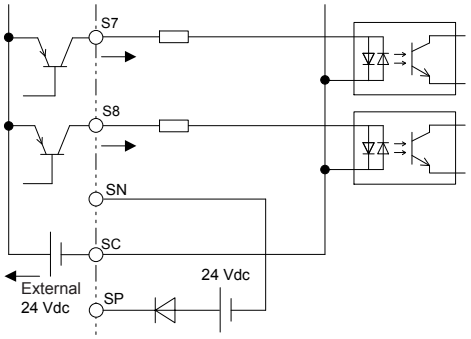
3.10 Control I/O Connections

◆ Sinking/Sourcing Mode Switch for Digital Inputs

Use the wire jumper 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).

NOTICE: *Do not short terminals SP and SN. Failure to comply will damage the drive.*

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

Mode	Drive Internal Power Supply (Terminals SN and SP)	External 24 Vdc Power Supply
Sinking Mode (NPN)		
Sourcing Mode (PNP)		

◆ Using the Pulse Train Output

The pulse train output terminal MP can supply power or be used with an external power supply.

NOTICE: *Connect peripheral devices in accordance with the specifications. Failure to comply may 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 (kΩ)	Output Voltage V_{MP} (V) (insulated)
1.5 kΩ	5 V
4 kΩ	8 V
10 kΩ	10 V

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

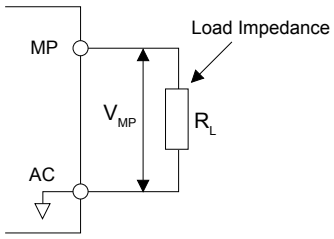


Figure 3.32 Pulse Output Connection Using Internal Voltage Supply

■ 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 (kΩ)
12 to 15 Vdc ±10%	1.0 kΩ or higher

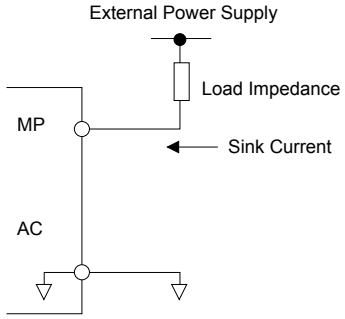


Figure 3.33 Pulse Output Connection Using External Voltage Supply

◆ Terminals A1, A2, and A3 Input Signal Selection

Terminals A1, A2, and A3 can be used to input either a voltage or a current signal. Select the signal type using jumper S1 as explained in ***Table 3.12***. Set parameters H3-01, H3-05, and H3-09 accordingly as shown in ***Table 3.13***. ***Refer to Switches and Jumpers on the Terminal Board on page 91*** for locating jumper 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.

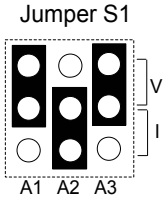


Figure 3.34 Terminal A2 Set to Current Input; A1 and A3 Set to Voltage Input

Table 3.12 Jumper S1 Settings

Setting	Description
V (top position)	Voltage input (-10 to +10 V or 0 to 10 V)
I (bottom position)	Current input (4 to 20 mA or 0 to 20 mA)

Table 3.13 Voltage/Current Selection Parameter Details

No.	Parameter Name	Description	Setting Range	Default Setting
H3-01	Terminal A1 signal level selection	Selects the signal level for terminal A1. 0: 0 to 10 Vdc 1: -10 to 10 Vdc 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	0
H3-05	Terminal A3 signal level selection	Selects the signal level for terminal A3. 0: 0 to 10 Vdc 1: -10 to 10 Vdc 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2
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	0

◆ 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 3.14***. 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 91*** for locating jumper S5.

Table 3.14 Jumper S5 Settings

Terminal	Voltage Output	Current Output
Terminal AM		
Terminal FM		

Table 3.15 Parameter H4-07 and 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 3.16***. 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 91*** to locate switch S2.

Table 3.16 MEMOBUS/Modbus Switch Settings

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

Note: ***Refer to MEMOBUS/Modbus Communications on page 463*** for details on MEMOBUS/Modbus.

3.11 Connect to a PC

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

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

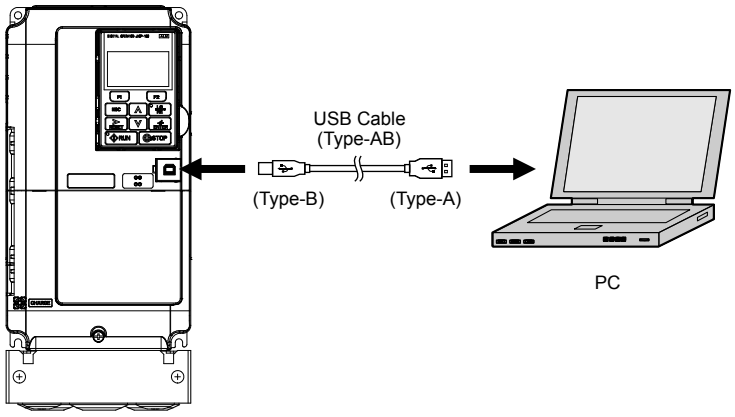


Figure 3.35 Connecting to a PC (USB)

3.12 External Interlock

Systems that may be affected during drive fault conditions should be interlocked with the drive 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. ***Figure 3.36*** 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

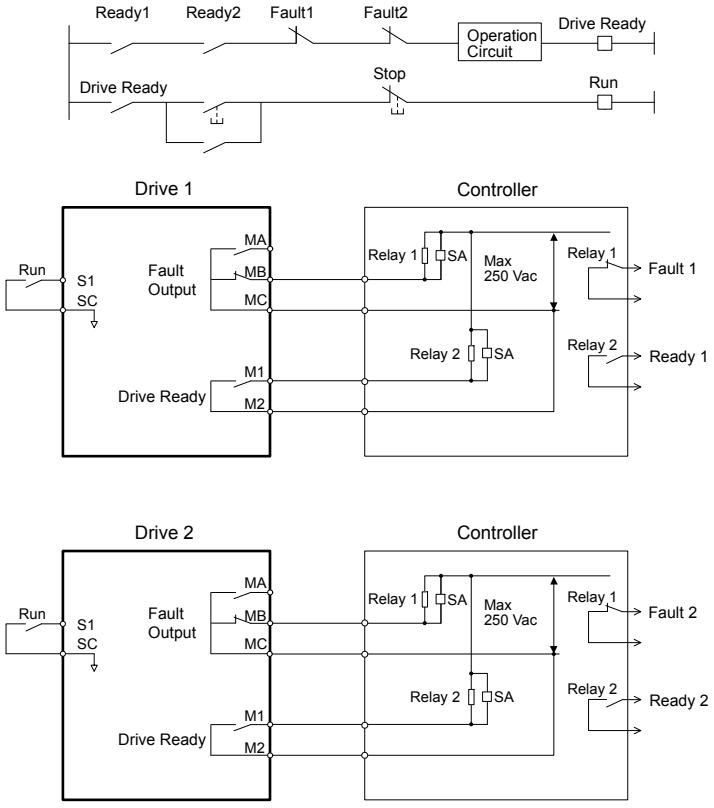
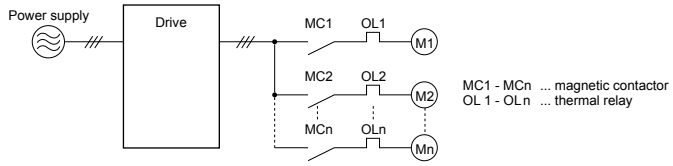


Figure 3.36 Interlock Circuit Example

3.13 Wiring Checklist

☑	No.	Item	Page(s)
		Drive, Peripherals, Option Cards	
☐	1	Check drive model number to ensure receipt of correct model.	*29*
☐	2	Make sure you have the correct braking resistors, DC link chokes, noise filters, and other peripheral devices.	*355*
☐	3	Check the option card model number.	*355*
		Installation Area and Physical Setup	
☐	4	Ensure that the area surrounding the drive complies with specifications.	*46*
		Power Supply Voltage, Output Voltage	
☐	5	The voltage from the power supply should be within the input voltage specification range of the drive.	*182*
☐	6	The voltage rating for the motor should match the drive output specifications.	*29* *272*
☐	7	Verify that the drive is properly sized to run the motor.	
		Main Circuit Wiring	
☐	8	Confirm proper branch circuit protection as specified by national and local codes.	*62*
☐	9	Properly wire the power supply to drive terminals R/L1, S/L2, and T/L3.	*65*
☐	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.	*83*
☐	11	Use 600 Vac vinyl-sheathed wire for the power supply and motor lines.	*77*
☐	12	Use the correct wire gauges for the main circuit. *Refer to Wire Gauges and Tightening Torque on page 77*. • 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) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3} • If the cable between the drive and motor exceeds 50 m, adjust the carrier frequency set to C6-02 accordingly.	*77* *84*
☐	13	Properly ground the drive. Review page *84*.	*84*
☐	14	Tighten control circuit and grounding terminal screws. *Refer to Wire Gauges and Tightening Torque on page 77*.	*77*
☐	15	Set up overload protection circuits when running multiple motors from a single drive.  **Note:** Close MC1 – MCn before operating the drive. MC1 – MCn cannot be switched off during run.	–
☐	16	Install a magnetic contactor when using a dynamic braking option. Properly install the resistor and ensure that overload protection shuts off the power supply using the magnetic contactor.	*363*
☐	17	Verify phase advancing capacitors, input noise filters, or GFCIs are NOT installed on the output side of the drive.	–
		Control Circuit Wiring	
☐	18	Use twisted-pair line for all drive control circuit wiring.	*89*
☐	19	Ground the shields of shielded wiring to the GND ⏚ terminal.	*89*
☐	20	For 3-Wire sequence, set parameters for multi-function contact input terminals S1 – S8, and wire control circuits.	–
☐	21	Properly wire any option cards.	*89*
☐	22	Check for any other wiring mistakes. Only use a multimeter to check wiring.	–
☐	23	Properly fasten drive control circuit terminal screws. *Refer to Wire Gauges and Tightening Torque on page 77*.	*77*
☐	24	Pick up all wire clippings.	–
☐	25	Ensure that no frayed wires on the terminal block are touching other terminals or connections.	–
☐	26	Properly separate control circuit wiring and main circuit wiring.	–
☐	27	Analog signal line wiring should not exceed 50 m.	–
☐	28	Safe Disable input wiring should not exceed 30 m.	–

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4

Start-Up Programming & Operation

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

4.1 SECTION SAFETY.....100
4.2 USING THE DIGITAL OPERATOR.....101
4.3 THE DRIVE, PROGRAMMING, AND CLOCK ADJUSTMENT MODES.....106
4.4 START-UP FLOWCHART.....116
4.5 POWERING UP THE DRIVE.....117
4.6 APPLICATION SELECTION.....118
4.7 AUTO-TUNING.....121
4.8 NO-LOAD OPERATION TEST RUN.....126
4.9 TEST RUN WITH LOAD CONNECTED.....128
4.10 VERIFYING PARAMETER SETTINGS AND BACKING UP CHANGES.....129
4.11 TEST RUN CHECKLIST.....131

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.

Prepare a separate holding brake.

Wire the holding brake so when a fault occurs, it is activated by an external sequence and shuts the power off or triggers an emergency switch. 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, edit parameters, and display data including fault and alarm information.

◆ Keys and Displays

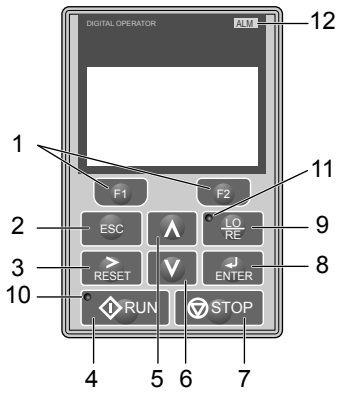


Figure 4.1 Keys and Displays on the Digital Operator

No.	Display	Name	Function
1	F1 F2	Function Key (F1, F2)	The functions assigned to F1 and F2 vary depending on the currently displayed menu. The name of each function appears in the lower half of the display window.
2	ESC	ESC Key	• Returns to the previous display. • Moves the cursor one space to the left. • Pressing and holding this button will return to the Frequency Reference display.
3	RESET	RESET Key	• Moves the cursor to the right. • Resets the drive to clear a fault situation.
4	RUN	RUN Key	Starts the drive in LOCAL mode.
5		Up Arrow Key	Scrolls up to display the next item, selects parameter numbers, and increments setting values.
6		Down Arrow Key	Scrolls down to display the previous item, selects parameter numbers, and decrements setting values.
7	STOP	STOP Key <1>	Stops drive operation.
8	ENTER	ENTER Key	• Enters parameter values and settings. • Selects a menu item to move between displays
9	LO RE	LO/RE Selection Key <2>	Switches drive control between the operator (LOCAL) and an external source (REMOTE) for the Run command and frequency reference.
10	RUN	RUN Light	Lit while the drive is operating the motor. Refer to page *103* for details.
11	LO RE	LO/RE Light	Lit while the operator is selected to run the drive (LOCAL mode). Refer to page *103* for details.
12	ALM	ALM LED Light	*Refer to ALARM (ALM) LED Displays on page 103*.

<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 o2-02 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.

◆ LCD Display

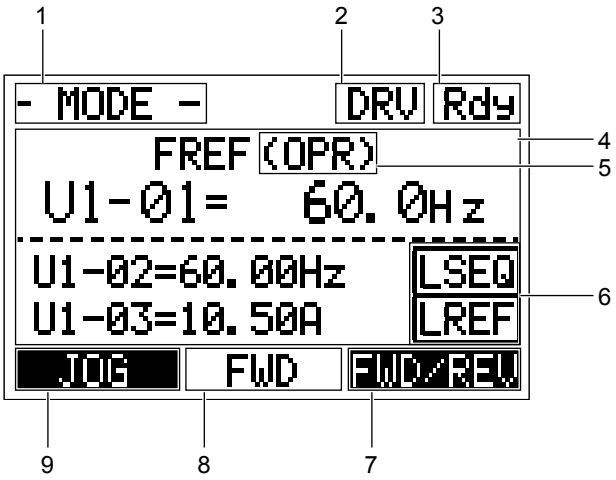


Figure 4.2 LCD Display

Table 4.1 Display and Contents

No.	Name	Display	Content
1	Operation Mode Menus	MODE	Displayed when in Mode Selection.
		MONITR	Displayed when in Monitor Mode.
		VERIFY	Indicates the Verify Menu.
		PRMSET	Displayed when in Parameter Setting Mode.
		A.TUNE	Displayed during Auto-Tuning.
		SETUP	Displayed when in Setup Mode.
2	Mode Display Area	DRV	Displayed when in Drive Mode.
		PRG	Displayed when in Programming Mode.
3	Ready	Rdy	Indicates the drive is ready to run.
4	Data Display	—	Displays specific data and operation data.
5	Frequency Reference Assignment <1>	OPR	Displayed when the frequency reference is assigned to the LCD Operator Option.
		AI	Displayed when the frequency reference is assigned to the Analog Input of the drive.
		COM	Displayed when the frequency reference is assigned to the MEMOBUS/Modbus Communication Inputs of the drive.
		OP	Displayed when the frequency reference is assigned to an Option Unit of the drive.
		RP	Displayed when the frequency reference is assigned to the Pulse Train Input of the drive.
6	LO/RE Display <2>	RSEQ	Displayed when the run command is supplied from a remote source.
		LSEQ	Displayed when the run command is supplied from the operator keypad.
		RREF	Displayed when the run command is supplied from a remote source.
		LREF	Displayed when the run command is supplied from the operator keypad.
7	Function Key 2 (F2)	FWD/REV	Pressing F2 switches between forward and reverse.
		DATA	Pressing F2 scrolls to the next display.
		→	Pressing F2 scrolls the cursor to the right.
		RESET	Pressing F2 resets the existing drive fault error.
8	FWD/REV	FWD	Indicates forward motor operation.
		REV	Indicates reverse motor operation.

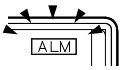
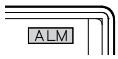
No.	Name	Display	Content
9	Function Key 1 (F1)	JOG	Pressing F1 executes the Jog function.
		HELP	Pressing F1 displays the Help menu.
		←	Pressing F1 scrolls the cursor to the left.
		HOME	Pressing F1 returns to the top menu (Frequency Reference).
		ESC	Pressing F1 returns to the previous display.

<1> Displayed when in Frequency Reference Mode.

<2> Displayed when in Frequency Reference Mode and Monitor Mode.

◆ ALARM (ALM) LED Displays

Table 4.2 ALARM (ALM) LED Status and Contents

State	Content	Display
Illuminated	When the drive detects an alarm or error.	
Flashing	• When an alarm occurs. • When an oPE is detected. • When a fault or error occurs during Auto-Tuning.	
Off	Normal operation (no fault or alarm).	

◆ 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 the operator is selected for Run command and frequency reference control (LOCAL)	—	—	When a device other than the operator is selected for Run command and frequency reference control (REMOTE)
	During run	• During deceleration to stop • When a Run command is input and frequency reference is 0 Hz	• While the drive was set to LOCAL, a Run command was entered to the input terminals then the drive was switched to REMOTE. • A Run command was entered via the input terminals while the drive was not in Drive Mode. • During deceleration when a Fast Stop command was entered. • The drive output is shut off by the Safe Disable function. • The STOP key was pressed while drive was running in REMOTE. • The drive was powered up with b1-17 = 0 (default) while the Run command is active.	During stop
Examples				

<1> Refer to ***Figure 4.3*** for the difference between “flashing” and “flashing quickly”.

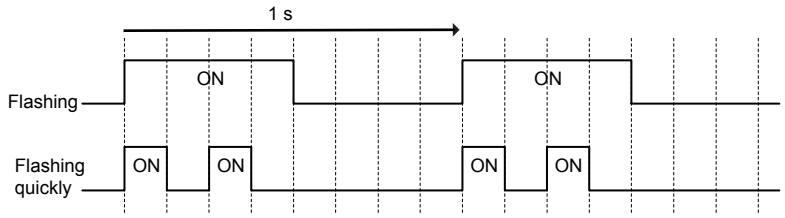


Figure 4.3 RUN LED Status and Meaning

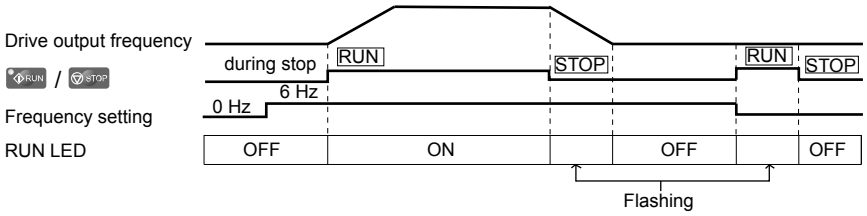


Figure 4.4 RUN LED and Drive Operation

◆ Menu Structure for Digital Operator

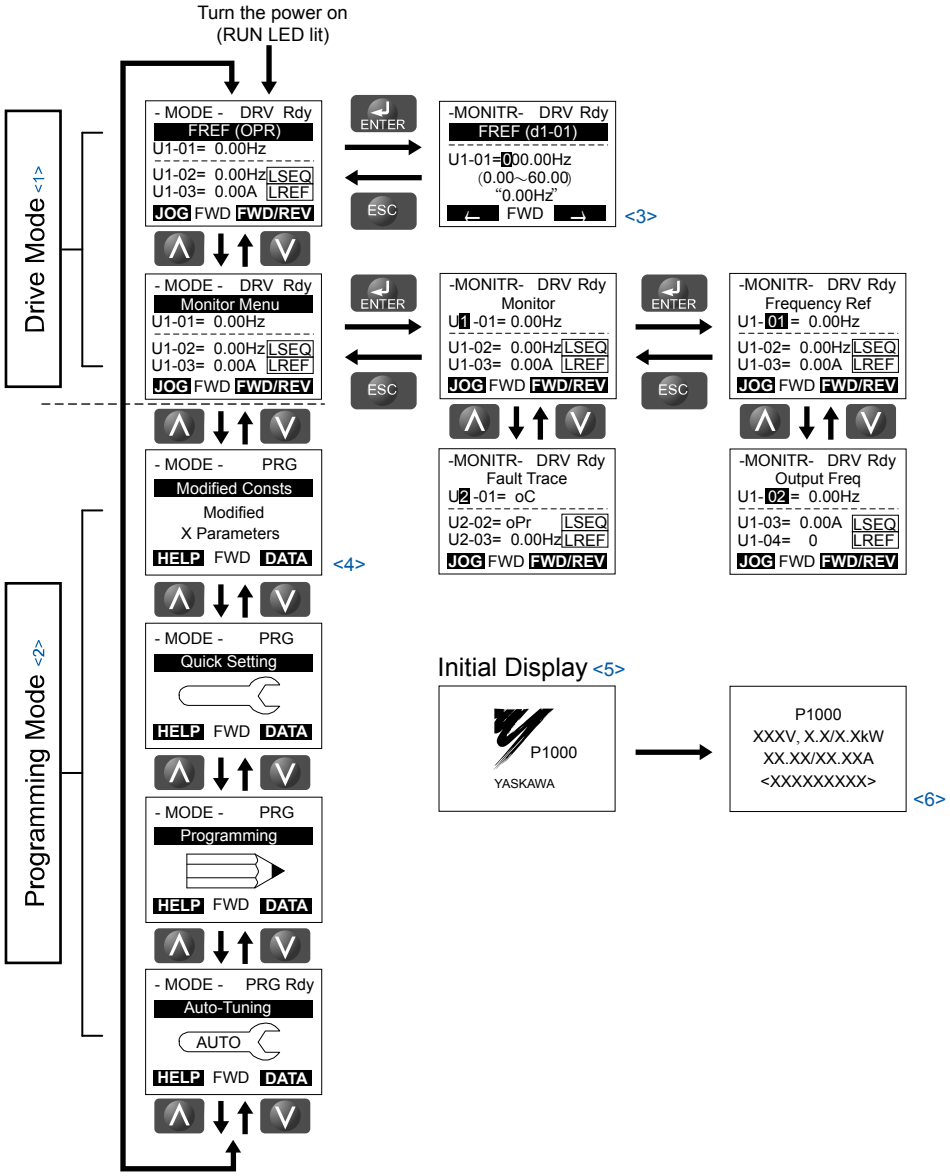


Figure 4.5 Digital Operator Menu and Screen Structure

<1> Pressing RUN will start the motor.
<2> Drive cannot operate motor.
<3> Flashing characters are shown as 0.
<4> "X" characters are used as examples in this manual. The LCD Operator will display the actual setting values.
<5> The Frequency Reference appears after the initial display that shows the product name.
<6> The information that appears on the display will vary depending on the drive.

4.3 The Drive, Programming, and Clock Adjustment Modes

The drive has a Drive Mode to operate the motor, a Programming Mode to edit parameter settings, and a Clock Adjustment Mode to adjust the Real Time Clock.

Drive Mode: In Drive Mode the user can operate the motor and observe U Monitor parameters. Parameter settings cannot be edited or changed when in Drive Mode.

Programming Mode: In Programming Mode the user can edit and verify parameter settings and perform Auto-Tuning. When the drive is in Programming Mode it will not accept a Run command unless b1-08 is set to 1.

Note:
1. If b1-08 is set to 0, the drive will only accept a Run command in Drive Mode. After editing parameters, the user must exit the Programming Mode and enter Drive Mode before operating the motor.
2. Set b1-08 to 1 to allow motor operation from the drive while in Programming Mode.

◆ Real-Time Clock (RTC)

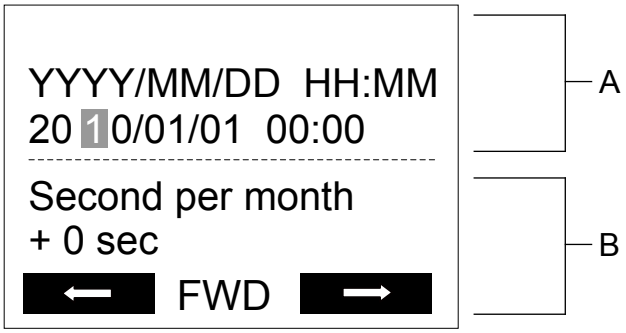
The drive has a Clock Adjustment Mode to set and adjust the Real-Time Clock.

Clock Adjustment Mode: When o4-17 is set to 1, the digital operator will show the Clock Adjustment display. In Clock Adjustment Mode, the user can adjust the Real-Time Clock. When the drive is in Clock Adjustment Mode, it will not accept a Run command.

◆ Clock Adjustment

The digital operator will display the Real Time Clock Adjustment Display in ***Figure 4.6*** when the drive is powered up for the first time. ***Refer to Manual Clock Adjustment Procedure by Setting o4-17 to 1 on page 107*** for the Real-Time Clock setting procedure.

Note: Setting the Real-Time Clock will clear a “TIM” alarm.



A – Real Time Clock Setting Display **B – Gain/Loss Adjustment Display**

Figure 4.6 Real Time Clock Adjustment Display

Display	Description
YYYY	Set the year with the last two digits.
MM	Set the month with two digits.
DD	Set the day with two digits.
HH:MM	Set the hours and minutes, with two digits for each.
Second per month	Set the gain or loss in seconds per month.

Moving the Cursor

Pressing the F2 key or the RESET key will move the cursor to the digit on the right. Pressing the F1 key will move the cursor to the left.

Changing Settings

- **Changing YYYY/MM/DD HH:MM:** Pressing the up arrow key will increase the number selected by the cursor from 0 to 9. Pressing the down arrow key will decrease the number selected by the cursor from 0 to 9.
- **Setting the Seconds per Month:** Pressing the up arrow key will increase the number selected by the cursor from -504 to +488 in increments of 8. Pressing the down arrow key will decrease the number selected by the cursor from -504 to +488 in increments of 8.

Verifying the New Time Setting

After pressing ENTER , the display will indicate “Entry accepted” and the new time value will be saved to the Real-Time Clock (RTC).

If there is a problem with the entered time, the operator will indicate “Input error” and the screen will return to the time setting display.

Canceling the Input

Pressing the ESC key will display “Aborted” on the operator, and no value will be saved to the RTC. Pressing OFF will abort the setting process without any display, and no setting changes will be saved to the RTC.

Exiting from the Time Setting Screen Without Making Any Changes

If no changes are entered, the display will exit Real Time Clock Adjustment Display after a few seconds and no changes will be saved.

■ Real-Time Clock Setting at Initial Power-up of a New Drive

Setting the Real-time clock is required at power-up of a new drive or after digital operatr battery replacement.

Table 4.4 illustrates how to set the Real-Time Clock at initial power-up of a new drive.

Table 4.4 Clock Adjustment Procedure at Power-up of a New Drive

Procedure			Display
1	Turn the power on. The Real Time Clock Adjustment Display will appear. Use the right arrow key to select the desired digit, then set the correct date and time using the up and down arrow keys.	→	ALM YYYY/MM/DD HH:MM 20**1**0/01/01 00:00 Second per month + 0 sec ← →
2	After entering the Real-Time Clock data, press the ENTER key to save the changes. The display will indicate “Entry Accepted” and return to the initial display in step 3 and the alarm LED will be OFF.	→	ALM Entry accepted
3	Initial display.	→	- MODE - DRV Rdy Freq Ref (AI) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF JOG FWD

■ Manual Clock Adjustment by Setting o4-17 to 1

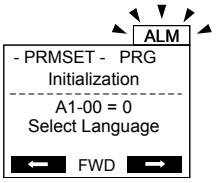
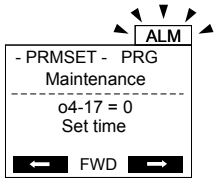
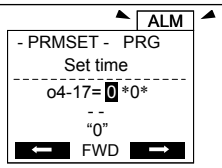
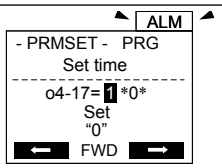
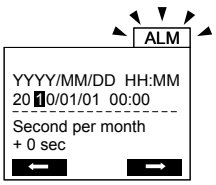
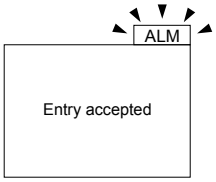
The following actions are possible in the Clock Adjustment Mode:

- Set the current time
- Check the time set to the drive Real-Time Clock

Table 4.5 illustrates how to set the Real-Time Clock manually.

Table 4.5 Manual Clock Adjustment Procedure by Setting o4-17 to 1

Procedure			Display
1	The “Time Not Set” (TIM) display will appear if the Real-Time Clock data is not entered within 30 seconds of power-up on a new drive. Refer to *294* for details on the TIM display.	→	ALM - MODE - DRV TIM Time Not Set FWD RESET
2	Use the up and down arrow keys to scroll through display menu until the screen shows “Programming”.	→	ALM - MODE - PRG Programming HELP FWD DATA

Procedure			Display
3	Press the ENTER key to enter select the parameter setting mode.	→	
4	Use the up and down arrow keys to scroll through display menu until parameter o4-17 appears.	→	
5	Press the ENTER key until “0” flashes.	→	
6	Press the up arrow key so that the display changes to “1”.	→	
7	Press the ENTER key and the time setting screen will appear. Use the right arrow key to select the desired digit, then set the correct date and time using the up and down arrow keys.	→	
8	After entering the correct time, press the ENTER key to save the changes. The display will return to the display shown in step 5 and the alarm LED will be OFF.	→	

■ o4-17: Real-Time Clock Setting

No. (Addr. Hex)	Name	Description	Values
o4-17 (3100)	Set/Reset Real-time Clock Set Time	Sets the current date and time for the Real-Time Clock. 0: — — No Setting[0: — —] 1: Real-Time Clock Set [1: Set] 2: Real-Time Clock Reset[2: Reset]	Default: 0 Range: 0 to 2

Setting 0: — —

No Setting (Default)

Setting 1: Set

When o4-17 is set to 1, the digital operator will show the Clock Adjustment display. In Clock Adjustment Mode the user can adjust the Real-Time Clock.

Setting 2: Reset

When o4-17 is set to 2, the Real-Time Clock data is cleared. A TIM fault will occur until o4-17 is set to 1 and the Real-Time Clock is set.

◆ 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)	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV	This display screen allows the user to monitor and change the frequency reference while the drive is running. *Refer to The Drive, Programming, and Clock Adjustment Modes on page 106*. **Note:** The user can select the data displayed when the drive is first powered up with parameter o1-02.
Drive Mode		∧ ∨	
	Monitor Display	- MODE - DRV Rdy Monitor Menu U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV	Lists the monitor parameters (U□-□□ parameters) available in the drive. Press the Enter Key and then use the Up, Down, ESC, and Reset keys to navigate through the drive monitors.
Programming Mode		∧ ∨	
	Verify Menu	- MODE - PRG Modified Consts Modified X Parameters HELP FWD DATA	Lists all parameters that have been edited or changed from default settings. ➡ *Refer to Verifying Parameter Changes: Verify Menu on page 112*.
		∧ ∨	
	Setup Group	- MODE - PRG Quick Setting HELP FWD DATA	A select list of parameters necessary to get the drive operating quickly. ➡ *Refer to Using the Setup Groups on page 113*. **Note:** Parameters listed in the Setup Group differ depending the Application Preset in parameter A1-06. *Refer to Application Selection on page 118*.
		∧ ∨	
	Parameter Setting Mode	- MODE - PRG Programming HELP FWD DATA	Allows the user to access and edit all parameter settings. ➡ *Refer to Parameter List on page 391*.
		∧ ∨	
	Auto-Tuning Mode	- MODE - PRG Rdy Auto-Tuning AUTO HELP FWD DATA	Motor parameters are calculated and set automatically. ➡ *Refer to Auto-Tuning on page 121*.
		∧ ∨	
Drive Mode	Frequency Reference	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV	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 4.7 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.

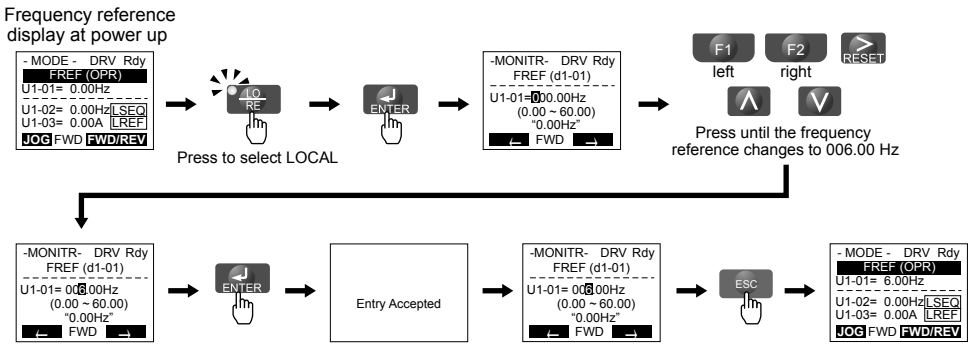


Figure 4.7 Setting the Frequency Reference while in the Drive Mode

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:** View a list of parameters that have been changed from the default values.
- **Setup Group:** Access a list of commonly used parameters to simplify setup (*Refer to Simplified Setup Using the Setup Groups on page 113*).
- **Auto-Tuning Mode:** Automatically calculate and set 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.	→	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
2.	Press ∧ or ∨ until the Parameter Setting Mode screen appears.	→	- MODE - PRG Programming HELP FWD DATA
3.	Press ENTER to enter the parameter menu tree.	→	-PRMSET- PRG Initialization A1-00= 0 Select Language FWD
4.	Press ∧ or ∨ to select the C parameter group.	→	-PRMSET- PRG Basic Setup C1-01= 10.0 sec Accel Time 1 FWD
5.	Press ENTER two times.	→	-PRMSET- PRG Accel/Decel C1-01= 10.0 sec Accel Time 1 FWD → -PRMSET- PRG Accel Time 1 C1-01= 10.0Sec (0.0~6000.0) "10.0 sec" FWD

Step			Display/Result
6.	Press ∧ or ∨ to select parameter C1-02.	→	-PRMSET- PRG Decel Time 1 C1-02= 10.0Sec (0.0~6000.0) "10.0 sec" ← FWD →
7.	Press ENTER to view the current setting value (10.0 s). The leftmost digit flashes.	→	-PRMSET- PRG Decel Time 1 C1-02=0010.0Sec (0.0~6000.0) "10.0 sec" ← FWD →
8.	Press F1, F2, or RESET until the desired number is selected. "1" flashes.	→	-PRMSET- PRG Decel Time 1 C1-02=0010.0Sec (0.0~6000.0) "10.0 sec" ← FWD →
9.	Press ∧ and enter 0020.0.	→	-PRMSET- PRG Decel Time 1 C1-02=0020.0Sec (0.0~6000.0) "10.0 sec" ← FWD →
10.	Press ENTER to confirm the change.	→	Entry Accepted
11.	The display automatically returns to the screen shown in Step 4.	→	-PRMSET- PRG Decel Time 1 C1-02= 20.0Sec (0.0~6000.0) "10.0 sec" ← FWD →
12.	Press ESC as many times as necessary to return to the initial display.	→	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV

◆ 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 “None”. The Verify Menu also allows users to quickly access and re-edit any parameter settings that have been changed.

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

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.	→	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
2.	Press ∧ or ∨ until the display shows the top of the Verify Menu.	→	- MODE - PRG Modified Consts Modified X Parameters HELP FWD DATA
3.	Press ENTER 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 ∧ or ∨ to scroll until C1-02 appears.	→	- VERIFY - PRG Rdy Accel Time 1 C1-02 = 20.0sec (0.0~6000.0) “10.0sec” Home FWD DATA
4.	Press ENTER to access the setting value. Left digit flashes.	→	- VERIFY - PRG Rdy Accel Time 1 C1-01=020.0sec (0.0~6000.0) “10.0sec” Home FWD DATA

◆ Simplified Setup Using the Setup Groups

The Setup Groups list the basic parameters necessary to set up the drive for a given application. Setup groups expedite the startup process for an application by showing only the most important parameters for the application.

■ Using the Setup Groups

Figure 4.8 illustrates how to enter and how to change parameters in the Setup Group.

The default setting for the Setup Group is a group of parameters most commonly use in general-purpose applications. *Refer to Application Selection on page 118* to select an Application Preset and change the Setup Group to parameters optimal for the application selected. .

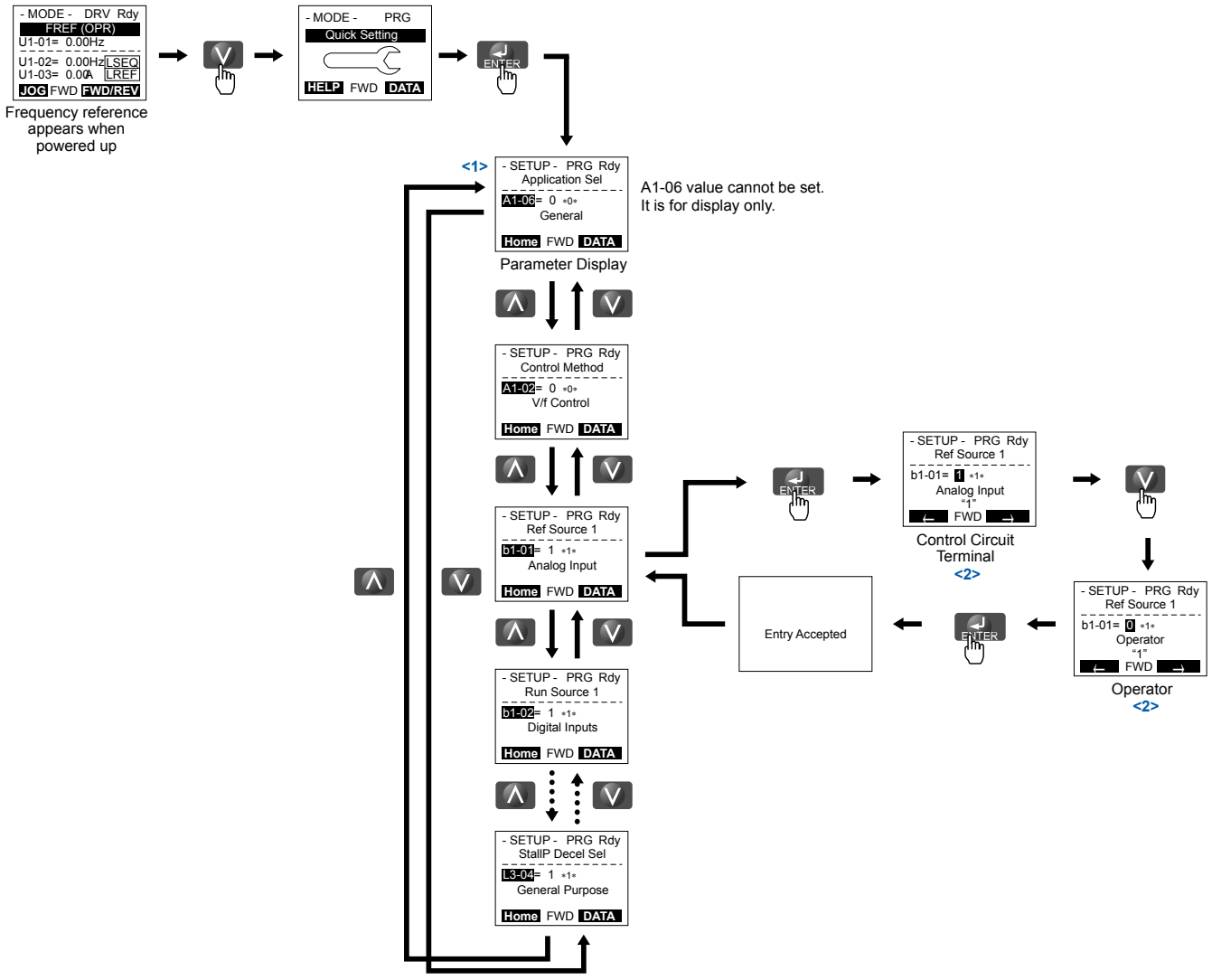


Figure 4.8 Setup Group Example

<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.

■ Setup Group Parameters

Table 4.6 lists the parameters available by default in the Setup Group. Selecting an Application Preset in through initialization in parameter A1-03 automatically changes the parameters selected for the Setup Group. *Refer to Application Selection on page 118* for details on parameters and default values for the fan and pump Setup Groups.

No.	Parameter Name	Setting Range	Default
A1-03	Initialize Parameters	0, 1110, 2220, 3330, 5550, 8008, 8009, 8010, 8011	0

Setting 0: No initialization (default)

Setting 1110: User Initialize (parameter values must be stored using parameter o2-03)

Setting 2220: 2-Wire Initialize

Setting 3330: 3-Wire Initialize

Setting 5550: Terminal/Control Initialize

Setting 8008: Pump

Setting 8009: Pump w/ PI

Setting 8010: Fan

Setting 8011: Fan w/ PI

Use the Programming Mode to access parameters not displayed in the Setup Group.

Table 4.6 General Purpose Application Setup Group Parameters (A1-03 = 0)

Parameter	Name
A1-06	Application Preset Selection (Monitor only)
b1-01	Frequency Reference Selection 1
b1-02	Run Command Selection 1
b1-03	Stopping Method Selection
b1-04	Reverse Operation Selection
C1-01	Acceleration Time 1
C1-02	Deceleration Time 1
d1-01	Frequency Reference 1
d2-01	Frequency Reference Upper Limit
d2-02	Frequency Reference Lower Limit

Parameter	Name
E2-01	Motor Rated Current
L2-01	Momentary Power Loss Operation Selection
L5-01	Number of Auto Restart Attempts
L6-01	Torque Detection 1 Selection
L6-02	Torque Detection 1 Level
L6-03	Torque Detection 1 Time
o1-06	User Monitor Selection Mode
o1-07	Second Line Monitor Selection
o1-08	Third Line Monitor Selection

◆ Switching Between LOCAL and REMOTE

LOCAL mode is when the drive is set to accept the Run command from the digital operator RUN key. REMOTE mode is when the drive is set to accept the Run command from an external device (i.e., input terminals or serial communications).

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.*

Switch the operation between LOCAL and REMOTE using the LO/RE key on the digital operator or via 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 LO/RE. The LO/RE light will light up. The drive is now in LOCAL. To set the drive for REMOTE operation, press the LO/RE key again.	→	

■ Using Input Terminals S1 through S8 to Switch between LOCAL and REMOTE

It is possible to switch between LOCAL and REMOTE modes using one of the digital input terminals S1 through S8 (set the corresponding parameter H1-☐☐ to “1”).

Setting H1-☐☐ to 1 disables the LO/RE key on the digital operator. *Refer to H1: Multi-Function Digital Inputs on page 196* for details.

4.4 Start-Up Flowchart

Figure 4.9 summarizes steps required to start the drive and gives quick references to help familiarize the user with start-up procedures.

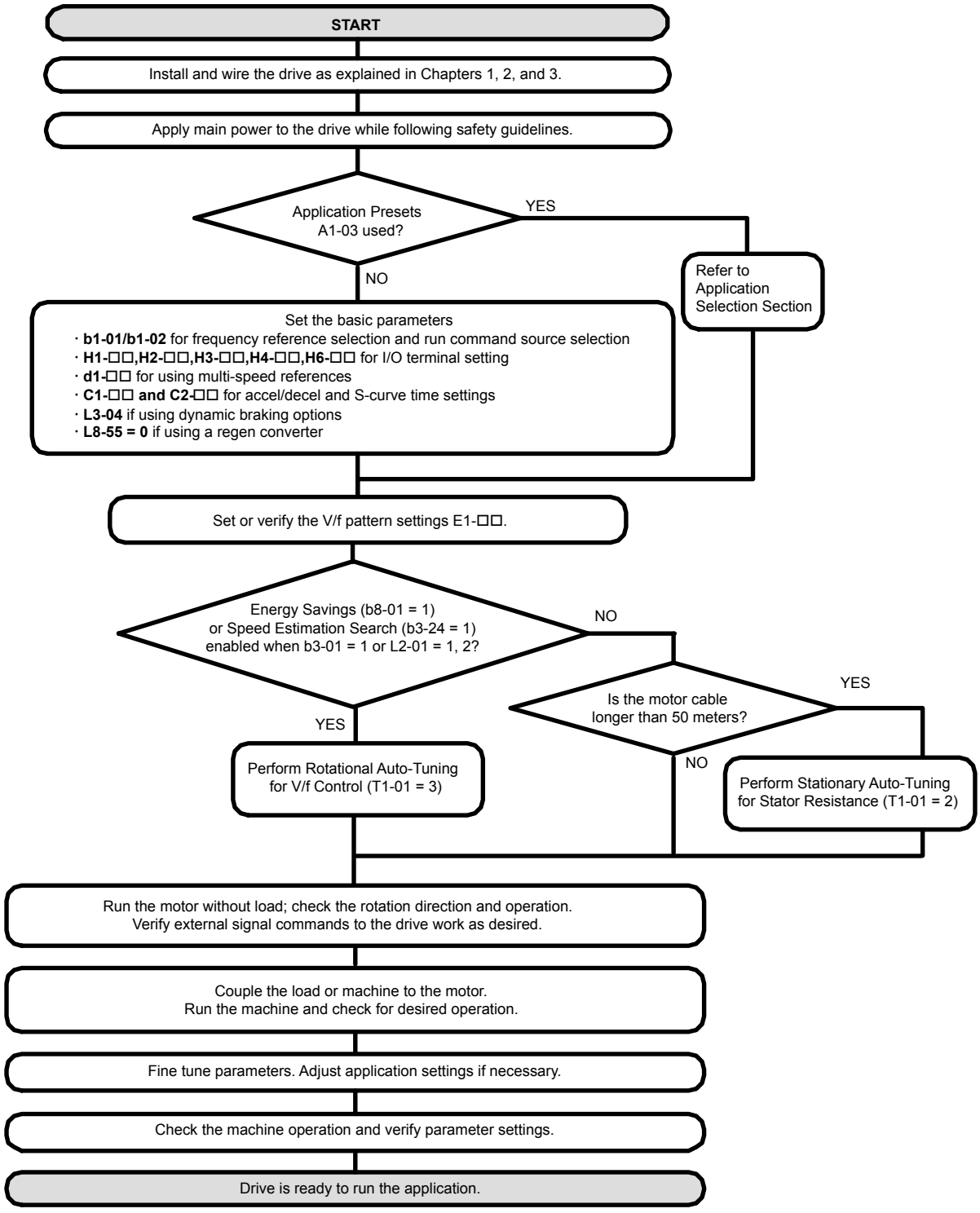


Figure 4.9 Simple Setup with Energy Savings or Speed Search

Note:
1. Execute Stationary Auto-Tuning for Line-to-Line Resistance if the drive has been Auto-Tuned and then moved to a different location where the motor cable length exceeds 50 m.
2. Perform Auto-Tuning again after installing an AC reactor or other such components to the output side of the drive.

4.5 Powering Up the Drive

◆ Powering Up the Drive and Operation Status Display

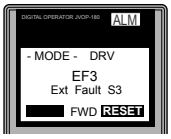
■ Powering Up the Drive

Review the following checklist before turning the power on.

Item to Check	Description
Power supply voltage	200 V class: Three-phase 200 to 240 Vac 50/60 Hz 400 V class: Three-phase 380 to 480 Vac 50/60 Hz 600 V class: Three-phase 500 to 600 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:

Status	Name	Description
Normal Operation		The data display area displays the frequency reference. DRV is lit.
Fault	 External fault (example)	Data displayed varies by the type of fault. *Refer to Fault Displays, Causes, and Possible Solutions on page 283* for more information. ALM and DRV are lit.

4.6 Application Selection

Application Presets are available to facilitate drive setup for commonly used applications. Selecting one of these Application Presets automatically assigns functions to the input and output terminals and sets a predefined group of parameters to values appropriate for the selected application.

In addition, the parameters most likely to be changed are assigned to the group of User Parameters, A2-01 through A2-16. User Parameters are part of the Setup Group, which provides quicker access by eliminating the need to scroll through multiple menus.

Note:
1. Application Presets can only be selected if all drive parameters are at their original default settings.
2. Entering a value to A1-03 to enable an Application Preset will fix that value to the parameter. The value cannot be changed without first setting A1-03 to 2220 or 3330 to initialize the drive.

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before performing a test run. Setting parameter A1-03 may automatically change the I/O terminal function from the default setting. Failure to comply may result in death or serious injury.*

No.	Parameter Name	Settings	Default
A1-03	Initialize Parameters	0: No initialization (default) 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialize 3330: 3-Wire Initialize 5550: Terminal/Control Initialize 8008: Pump 8009: Pump w/ PI 8010: Fan 8011: Fan w/ PI	0
A1-06	Application Presets (monitor only)	0: Disabled 8: Pump 9: Pump w/ PI 10: Fan 11: Fan w/ PI	0

◆ A1-03 = 8008: Pump

Table 4.7 Pump Application Parameters

Parameter	Name	Page
A1-06	Application Preset Selection (monitor only)	*118*
b1-01	Frequency Reference Selection	*139*
b1-02	Run Command Selection	*140*
b1-03	Stopping Method Selection	*141*
b1-04	Reverse Operation Selection	*143*
C1-01	Acceleration Time 1	*168*
C1-02	Deceleration Time 1	*168*
d1-01	Frequency Reference 1	*173*
E2-01	Motor Rated Current	*186*
L2-01	Momentary Power Loss Operation Selection	*229*
L5-01	Number of Auto Restart Attempts	*243*
L5-04	Fault Reset Interval Time	*243*
o1-06	User Monitor Selection Mode	*254*
o1-07	Second Line Monitor Selection	*255*
o1-08	Third Line Monitor Selection	*255*

◆ A1-03 = 8009: Pump w/ PI

Table 4.8 Pump w/ PI Application Parameters

Parameter	Name	Page
A1-06	Application Preset Selection (monitor only)	*118*
b1-02	Run Command Selection	*140*

Parameter	Name	Page
b1-03	Stopping Method Selection	*141*
b1-04	Reverse Operation Selection	*143*
b5-19	PID Setpoint Value	*159*
b5-38	PID Setpoint User Display	*161*
b5-39	PID Setpoint Display Digits	*161*
b5-46	PID Unit Selection	*161*
b5-90	EZ Sleep Unit	*162*
b5-91	EZ Minimum Speed	*162*
b5-92	EZ Sleep Level	*162*
b5-94	EZ Wake-up Level	*162*
C1-01	Acceleration Time 1	*168*
C1-02	Deceleration Time 1	*168*
E2-01	Motor Rated Current	*186*
H3-09	Terminal A2 Signal Level Selection	*218*
L5-01	Number of Auto Restart Attempts	*243*
L5-04	Fault Reset Interval Time	*243*
o1-07	Second Line Monitor Selection	*255*
o1-08	Third Line Monitor Selection	*255*

◆ A1-03 = 8010: Fan

Table 4.9 Fan Application Parameters

Parameter	Name	Page
A1-06	Application Preset Selection (monitor only)	*118*
b1-01	Frequency Reference Selection	*139*
b1-02	Run Command Selection	*140*
b1-03	Stopping Method Selection	*141*
b1-04	Reverse Operation Selection	*143*
C1-01	Acceleration Time 1	*168*
C1-02	Deceleration Time 1	*168*
d1-01	Frequency Reference 1	*173*
d2-01	Frequency Reference Upper Limit	*175*
d2-02	Frequency Reference Lower Limit	*175*
E2-01	Motor Rated Current	*186*
L5-01	Number of Auto Restart Attempts	*243*
L5-04	Fault Reset Interval Time	*243*
o1-06	User Monitor Selection Mode	*254*
o1-07	Second Line Monitor Selection	*255*
o1-08	Third Line Monitor Selection	*255*

◆ A1-03 = 8011: Fan w/ PI

Table 4.10 Fan Application Parameters

Parameter	Name	Page
A1-06	Application Preset Selection (monitor only)	*118*
b1-02	Run Command Selection	*140*
b1-03	Stopping Method Selection	*141*
b1-04	Reverse Operation Selection	*143*
b5-12	PI Feedback Loss Detection Selection	*157*
b5-19	PID Setpoint Value	*159*
b5-38	PID Setpoint User Display	*161*

Parameter	Name	Page
b5-39	PID Setpoint Display Digits	*161*
b5-46	PID Unit Selection	*161*
b5-90	EZ Sleep Unit	*162*
b5-91	EZ Minimum Speed	*162*
b5-92	EZ Sleep Level	*162*
b5-94	EZ Wake-up Level	*162*
C1-01	Acceleration Time 1	*168*
C1-02	Deceleration Time 1	*168*
E2-01	Motor Rated Current	*186*
H3-09	Terminal A2 Signal Level Selection	*218*
L5-01	Number of Auto Restart Attempts	*243*
L5-04	Fault Reset Interval Time	*243*
o1-07	Second Line Monitor Selection	*255*
o1-08	Third Line Monitor Selection	*255*

◆ Default Values for Fan and Pump Applications

Table 4.11 Fan and Pump Application Defaults

	A1-03 Setting			
Parameter	8008	8009	8010	8011
A1-02	0: V/f Control	0: V/f Control	0: V/f Control	0: V/f Control
b1-04	–	–	1: Reverse Disabled	1: Reverse Disabled
b3-05	–	–	10.0 s	10.0 s
b5-01	–	1: PID Enabled	–	1: PID Enabled
b5-03	–	–	–	5.0 s
b5-08	–	–	–	2.00 s
b5-13	–	–	–	2%
b5-14	–	–	–	25.0 s
b5-18	–	1: Enabled (b5-19)	–	1: Enabled (b5-19)
b5-20	–	3: User Set	–	3: User Set
b5-46	–	–	–	1: PSI
b5-89	–	1: EZ Sleep/Wake Up	–	1: EZ Sleep/Wake Up
C1-01	–	–	90.0 s	60.0 s
C1-02	–	–	90.0 s	60.0 s
C2-01	–	–	5.00 s	5.00 s
C2-02	–	–	5.00 s	5.00 s
C2-03	–	–	5.00 s	5.00 s
C2-04	–	–	5.00 s	5.00 s
H3-10	–	B: PID Feedback		B: PID Feedback
L2-01	2: CPU Active	2: CPU Active	2: CPU Active	2: CPU Active
L3-02	–	–	110%	110%
L3-06	–	–	100%	100%
L4-05	–	–	0: Stop	–
L5-04	–	–	180.0 s	180.0 s
L5-05	1: L5-04 Interval	1: L5-04 Interval	1: L5-04 Interval	1: L5-04 Interval
o1-06	–	1: Selectable	–	1: Selectable
o1-07	–	102: Output Frequency	–	102: Output Frequency
o1-08	–	501: Feedback	–	501: Feedback

4.7 Auto-Tuning

◆ Types of Auto-Tuning

The drive offers different types of Auto-Tuning for induction motors. Refer to the tables below to select the type of Auto-Tuning that bests suits the application. *Refer to Start-Up Flowchart on page 116* for directions on executing Auto-Tuning.

■ Auto-Tuning for Induction Motors

This feature automatically sets the V/f pattern and motor parameters E1-☐☐ and E2-☐☐ for an induction motor.

Table 4.12 Types of Auto-Tuning for Induction Motors

Type	Setting	Application Conditions and Benefits
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	• The drive is used in V/f Control and other Auto-Tuning selections are not possible. • Perform when entering motor data manually while using motor cables longer than 50 m. • Drive and motor capacities differ. • 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.
Rotational Auto-Tuning for V/f Control	T1-01 = 3	• Recommended for applications using Speed Estimation Speed Search or using the Energy Saving function in V/f Control. • Assumes motor can rotate while Auto-Tuning is executed. Increases accuracy for certain functions like torque compensation, slip compensation, Energy Saving, and Speed Search.

Table 4.13 lists the data that must be entered for Auto-Tuning. Make sure this data is available before starting Auto-Tuning. The necessary information is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer. *Refer to Start-Up Flowchart on page 116* for details on the Auto-Tuning process.

Table 4.13 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01)	
			2 Line-to-Line Resistance	3 Rotational for V/f Control
Motor rated power	T1-02	kW	YES	YES
Motor rated voltage	T1-03	Vac	–	YES
Motor rated current	T1-04	A	YES	YES
Motor rated frequency	T1-05	Hz	–	YES
Number of motor poles	T1-06	-	–	YES
Motor rated Speed	T1-07	r/min	–	YES
Motor iron loss	T1-11	W	–	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 lower than the input supply voltage (20 V for 200 V class models, 40 V for 400 V class models, and 60 V for 600 V class models). 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.

Table 4.14 describes digital input and output terminal operation while Auto-Tuning is executed.

Table 4.14 Auto-Tuning Input Data

Motor Type	Auto-Tuning Type	Digital Input	Digital Output
IM Motor	Stationary Auto-Tuning for Line-to-Line Resistance	Digital input functions are disabled.	Digital input functions are disabled.
	Rotational Auto-Tuning for V/f Control		Functions the same as during normal operation

■ Notes on Rotational Auto-Tuning

- Decouple the load from the motor to achieve optimal performance from Rotational Auto-Tuning. Rotational Auto-Tuning is best suited for applications requiring high performance over a wide speed range.
- If it is not possible to decouple the motor and load, reduce the load so it is less 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

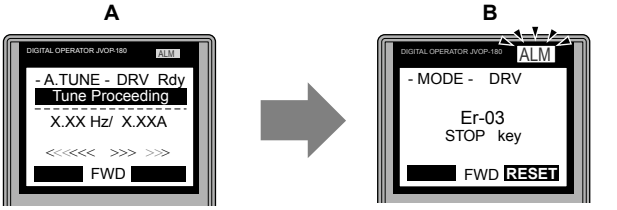
Stationary Auto-Tuning modes analyze motor characteristics by injecting current into the motor for approximately one minute.

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

◆ 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.



A – During Auto-Tuning **B – Auto-Tuning Aborted**

Figure 4.10 Auto-Tuning Aborted Display

◆ Auto-Tuning Operation Example

The following example demonstrates Stationary Auto-Tuning for Line-to-Line Resistance.

■ Selecting the Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
2.	Press ∧ or ∨ until the Auto-Tuning display appears.	→	- MODE - PRG Auto-Tuning AUTO HELP FWD DATA
3.	Press ENTER to begin setting parameters.	→	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance ESC FWD DATA

Step			Display/Result
4.	Press ENTER to display the value for T1-01.	→	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance "2" ← FWD →
5.	Save the setting by pressing ENTER.	→	Entry Accepted
6.	The display automatically returns to the display shown in Step 3.	→	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance ESC FWD DATA

■ 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.	→	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 0.75kW (0.00 ~ 650.00) "0.75kW" ESC FWD DATA
2.	Press ENTER to view the default setting.	→	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 000.75kW (0.00 ~ 650.00) "0.75kW" ← FWD →
3.	Press F1 left, F2 right, RESET, ∧, and ∨ to enter the motor power nameplate data in kW.	→	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 000.40kW (0.00 ~ 650.00) "0.75kW" ← FWD →
4.	Press ENTER to save the setting.	→	Entry Accepted
5.	The display automatically returns to the display in Step 1.	→	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 0.40kW (0.00 ~ 650.00) "0.75kW" ESC FWD DATA
6.	Repeat Steps 1 through 5 to set the following parameters: • T1-03, Motor Rated Voltage (Rotational Auto-Tuning for V/f Control only) • T1-04, Motor Rated Current • T1-05, Motor Base Frequency (Rotational Auto-Tuning for V/f Control only) • T1-06, Number of Motor Poles (Rotational Auto-Tuning for V/f Control only) • T1-07, Motor Base Frequency (Rotational Auto-Tuning for V/f Control only)	→	- A.TUNE - PRG Rated Voltage T1-03= 200.0VAC (0.0 ~ 255.0) "200.0VAC" ESC FWD DATA ⋮ - A.TUNE - PRG Rated Current T1-04= X.XX A (0.35 ~ 7.00) "X.XX A" ESC FWD DATA

■ 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 6 in “Enter Data from the Motor Nameplate”.

Step			Display/Result
1.	After entering the data listed on the motor nameplate, press to confirm.	→	- A.TUNE - DRV Rdy Auto-Tuning 0.00 Hz/ 0.00A Tuning Ready ? Press RUN key ESC FWD
2.	Press to activate Auto-Tuning. DRV flashes. The drive begins by injecting current into the motor for about 1 min, and then starts to rotate the motor. **Note:** The first digit on the display indicates which motor is undergoing Auto-Tuning. The second digit indicates the type of Auto-Tuning being performed.	→	- A.TUNE - DRV Rdy Tune Proceeding X.XX Hz/ X.XXA <<<<<< >>> >>> FWD
3.	Auto-Tuning finishes in approximately one to two minutes.	→	- MODE - DRV End Tune Successful FWD RESET

◆ T1: Parameter Settings during Induction Motor Auto-Tuning

The T1-☐☐ parameters set the Auto-Tuning input data for induction motor tuning.

Note: For motors operating in the field weakening range, first perform the Auto-Tuning with the base data. After Auto-Tuning is complete, change E1-04, Maximum Output Frequency, to the desired value.

■ T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used. *Refer to Auto-Tuning for Induction Motors on page 121* for details on the different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2, 3	2

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

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

■ 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	0.00 to 650.00 kW	Determined by o2-04

■ T1-03: Motor Rated Voltage (T1-01 = 3)

Sets the motor rated voltage according to the motor nameplate value. Enter the voltage base speed here if the motor is operating above base speed.

Enter the voltage needed to operate the motor under no-load conditions at rated speed to T1-03 for better control precision around rated speed when using a vector control mode. The no-load voltage can usually be found in the motor test report available from the manufacturer. If the motor test report is not available, enter approximately 90% of the rated voltage printed on the motor nameplate. This may increase the output current and reduce the overload margin.

No.	Name	Setting Range	Default
T1-03	Motor Rated Voltage	0.0 to 255.5 V <1>	200.0 V <1>

<1> Values shown are specific to 200 V class drives. Double value for 400 V class drives. Multiply value by 2.875 for 600 V class drives.

■ T1-04: Motor Rated Current

Sets the motor rated current according to the motor nameplate value. 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	o2-04

■ T1-05: Motor Base Frequency (T1-01 = 2)

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 after Auto-Tuning is complete.

No.	Name	Setting Range	Default
T1-05	Motor Base Frequency	0.0 to 400.0 Hz	60.0 Hz

■ T1-06: Number of Motor Poles (T1-01 = 3)

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: Motor Base Speed (T1-01 = 3)

Sets the motor rated speed according to the motor nameplate value. Enter the speed at base frequency when using a motor with an extended speed range or if using the motor in the field weakening area.

No.	Name	Setting Range	Default
T1-07	Motor Base Speed		1750 r/min

■ T1-11: Motor Iron Loss (T1-01 = 3)

Provides iron loss information to determine the Energy Saving coefficient. T1-11 will first display the value for the motor iron loss that the drive automatically calculated the when motor capacity was entered to T1-02. Enter the motor iron loss value listed to T1-11 if the motor test report is available.

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	14 W Differs depending on motor code and motor parameter settings.

4.8 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.

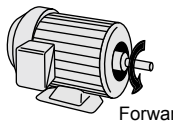
■ During Operation

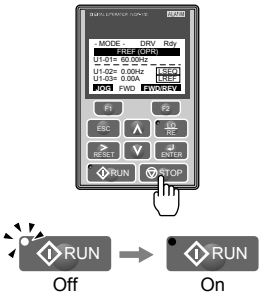
Check the following items during operation:
- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

■ 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.	→	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
2.	Press LO/RE to select LOCAL. The LO/RE light will turn on.	→	 LO/RE Off → LO/RE On
3.	Press RUN to give the drive a Run command. RUN will light and the motor will rotate at 6 Hz.	→	 RUN Off → RUN On
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.	–	–

Step			Display/Result
6.	The drive should operate normally. Press STOP to stop the motor. RUN flashes until the motor comes to a complete stop.	➡	

4.9 Test Run with Load Connected

◆ 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.

■ Precautions for Connected Machinery

WARNING! *Sudden Movement Hazard. Clear all personnel from the drive, motor, and machine area before applying power. System may start unexpectedly upon application of power, causing death or serious injury.*

WARNING! *Sudden Movement Hazard. Always check the operation of any fast stop circuits after they are wired. Fast stop circuits are required to provide safe and quick shutdown of the drive. Prepare to initiate an emergency stop during the test run. Operating a drive with untested emergency circuits could result in death or serious injury.*

- The motor should come to a complete stop without problems.
- Connect the load and machinery to the motor.
- Fasten all installation screws properly and check that the motor and connected machinery are held in place.

■ 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.

- Monitor U1-03 for overcurrent during operation.
- If the application permits running the load in the reverse direction, change the motor direction and the frequency reference while watching for abnormal motor oscillation or vibration.
- Correct any problems that occur with hunting, oscillation, and other control-related issues.

4.10 Verifying Parameter Settings and Backing Up Changes

Use the Verify Menu to check all changes to parameter settings. *Refer to Verifying Parameter Changes: Verify Menu on page 112*.

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

Setting o2-03 to 1 saves all parameter settings before resetting o2-03 to 0. The drive can now recall all the saved parameters by performing a User Initialization (A1-03 = 1110).

No.	Parameter Name	Description	Setting Range	Default Setting
o2-03	User Defaults	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 Initialization) 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 initialization 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialize (parameter initialized prior to shipment) 3330: 3-Wire Initialize 5550: Terminal/Control Initialize 8008: Pump 8009: Pump w/ PI 8010: Fan 8011: Fan w/ PI	0 to 8011	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	1: User Parameters. Only recently changed parameters from 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, including recently viewed parameters and 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, 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 group 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, etc.	0, 1	0

◆ Password Settings: A1-04, A1-05

The user can set a password in parameter A1-05 to restrict access to the drive. 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, A1-03, A1-06, and A2-01 through A2-33.

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

◆ 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:

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

  The LCD operator used to operate the drive supports copying, importing, and verifying parameter settings and contains a Real Time Clock.*Refer to o3: Copy Function on page 259* for details.

- **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 Industrial**

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

4.11 Test Run Checklist

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

☑	No.	Checklist	Page
☐	1	Thoroughly read the manual before performing a test run.	–
☐	2	Turn the power on.	*117*
☐	3	Set the voltage for the power supply to E1-01.	*182*

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

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.*

☑	No.	Checklist	Page
☐	4	Select the best V/f pattern according to the application and motor characteristics.	–
☐	5	Select Stationary Auto-Tuning for Line-to-Line Resistance or Rotational Auto-Tuning for V/f Control if using Energy Saving functions.	*121*
☐	6	Decouple the motor for Rotational Auto-Tuning for V/f Control.	*121*
☐	7	Enter the following data depending on Auto-Tuning method according to the information listed on the motor nameplate: • Motor rated power to T1-02 (kW) • Motor rated voltage to T1-03 (V) • Motor rated current to T1-04 (A) • Motor base frequency to T1-05 (Hz) • Number of motor poles to T1-06 • Motor base speed to T1-07 (r/min)	–
☐	8	The DRV should light after giving a Run command.	–
☐	9	To give Run command and frequency reference from the digital operator, press “LO/RE” key to set to LOCAL.	*114*
☐	10	If the motor rotates in the opposite direction during test run, switch two of U/T1, V/T2, W/T3, or change b1-14.	*117*
☐	11	Set motor rated current (E2-01) and motor protection (L1-01) values for motor thermal protection.	–
☐	12	Set the drive for REMOTE when control circuit terminals provide the Run command and frequency reference.	*114*
☐	13	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).	*139*
☐	14	Set the proper signal level to terminals A1, A2, A3 (0 to 20 mA, 4to 20 mA, 0 to +10 V or -10 to +10 V).	*139*
☐	15	For A1, A2, and A3, when current input is used, switch the jumper on S1 from the V-side to I-side. Set the level for current signal used with parameter H3-01 for terminal A1, H3-09 for terminal A2, H3-05 for terminal A3, (set “2” for 4 to 20 mA, or “3” for 0 to 20 mA). V = Voltage, I = Current analog input signal.	*139*
☐	16	If an analog input supplies the frequency reference, make sure it produces the desired frequency reference. Make the following adjustments if the drive does not operate as expected: Gain adjustment: Set the maximum voltage/current signal and adjust the analog input gain (H3-03 for A1, H3-11 for A2, H3-07 for A3) until the frequency reference value reaches the desired value. Bias adjustment: Set the minimum voltage/current signal and adjust the analog input bias (H3-04 for A1, H3-12 for A2, H3-08 for A3) until the frequency reference value reaches the desired minimum value.	–

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Parameter Details

5.1 A: INITIALIZATION....134
5.2 B: APPLICATION....139
5.3 C: TUNING....168
5.4 D: REFERENCE SETTINGS....173
5.5 E: MOTOR PARAMETERS....182
5.6 F: OPTION SETTINGS....189
5.7 H: TERMINAL FUNCTIONS....196
5.8 L: PROTECTION FUNCTIONS....225
5.9 N: SPECIAL ADJUSTMENTS....251
5.10 O: OPERATOR RELATED SETTINGS....254
5.11 S: SPECIAL APPLICATION....262
5.12 U: MONITOR PARAMETERS....273

5.1 A: Initialization

The initialization group contains parameters associated with initial drive setup, including parameters involving the display language, access levels, initialization, and password.

◆ 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 to only parameters A1-01, A1-04, 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, A1-06, and all A2 parameters 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, it will not be possible to edit or change parameter settings with the digital operator until an Enter command is issued to the drive from the serial communication.

■ A1-03: Initialize Parameters

Resets parameters to default values or performs an Application Preset for fan or pump applications. 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, 8008, 8009, 8010, 8011	0

Setting 1110: User Initialize

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

Note: User Initialization resets all parameters to a user-defined set of default values previously saved to the drive. Set parameter o2-03 to 2 to clear the user-defined default values.

Setting 2220: 2-Wire Initialization

Resets parameters to default settings with digital inputs S1 and S2 configured as Forward run and Reverse run, respectively. *Refer to Setting 40, 41: Forward Run, Reverse Run Command for 2-Wire Sequence on page 203* for more information on digital input functions.

Setting 3330: 3-Wire Initialization

Resets parameters to default settings with digital inputs S1, S2, and S5 configured as Run, Stop, and Forward/Reverse respectively. *Refer to Setting 0: 3-Wire Sequence on page 197* for more information on digital input functions.

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
A1-00	Language Selection
E1-03	V/f Pattern Selection
F6-08	Communication Parameter Reset
L8-35	Installation Selection
o2-04	Drive/kVA Selection

Setting 5550: Terminal/Control Initialize

An oPE04 error appears on the digital operator when a terminal block with settings saved to its built-in memory is installed in a drive that has edited parameters. Set A1-03 to 5550 to use the parameter settings saved to the terminal block memory.

Setting 8008: Pump

Application Preset for pump applications. *Refer to Application Selection on page 118* for a list of parameters and default values for this Application Preset.

Setting 8009: Pump w/ PI

Application Preset for pump applications. *Refer to Application Selection on page 118* for a list of parameters and default values for this Application Preset.

Setting 8010: Fan

Application Preset for pump applications. *Refer to Application Selection on page 118* for a list of parameters and default values for this Application Preset.

Setting 8011: Fan w/ PI

Application Preset for pump applications. *Refer to Application Selection on page 118* for a list of parameters and default values for this Application Preset.

■ A1-04, A1-05: Password and Password Setting

Parameter A1-04 enters the password when the drive is locked; parameter A1-05 is a hidden parameter that sets 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 in parameter A1-05 to restrict access to the drive. 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,A1-03, A1-06, and A2-01 through A2-33.

The instructions below demonstrate how to set password "1234". An explanation follows on how to enter that 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.	→	- MODE - DRV Rdy Freq Ref (AI) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF JOG FWD
2.	Press ∧ or ∨ until the Parameter Setting Mode screen appears.	→	- MODE - PRG Programming HELP FWD DATA
3.	Press ENTER to enter the parameter menu tree.	→	-PRMSET- PRG Initialization A1-00= 0 Select Language ← FWD →
4.	Select the flashing digits by pressing F1, F2, or RESET.	→	-PRMSET- PRG Select Language A1-00= 0 *0* English ← FWD →
5.	Select A1-04 by pressing ∧.	→	-PRMSET- PRG Enter Password A1-04 = 0 (0~9999) "0" ← FWD →
6.	Press ∧ while holding down OFF at the same time. A1-05 will appear. **Note:** A1-05 is hidden and will not display by pressing only ∧.	→	-PRMSET- PRG Select Password A1-05 = 0 (0~9999) "0" ← FWD →
7.	Press ENTER.	→	-PRMSET- PRG Select Password A1-05 = 0000 (0~9999) "0" ← FWD →
8.	Use F1, F2, RESET, ∨ and ∧ to enter the password.	→	-PRMSET- PRG Select Password A1-05 = 1234 (0~9999) "0" ← FWD →
9.	Press ENTER to save what was entered.	→	Entry Accepted
10.	The display automatically returns to the display shown in step 6.	→	-PRMSET- PRG Select Password A1-05 = 0 (0~9999) "0" ← FWD →

Table 5.3 Check if A1-03 Init Parameters is Locked (continuing from step 10 above)

Step			Display/Result
1.	Press ∨ to display A1-03.	→	-PRMSET- PRG Init Parameters A1-03= 0 *0* No Initialize ← FWD →
2.	Press ENTER, making sure that the setting values cannot be changed.		

Step			Display/Result
3.	Press ESC to return to the first display.	→	- MODE - PRG Programming HELP FWD DATA

Table 5.4 Enter the Password to Unlock Parameters (continuing from step 3 above)

Step			Display/Result
1.	Press ENTER to enter the parameter setup display.	→	-PRMSET- PRG Initialization A1-00= 0 Select Language ← FWD →
2.	Press F1, F2, RESET to select the flashing digits as shown.	→	-PRMSET- PRG Select Language A1-00= 0 *0* English ← FWD →
3.	Press ∧ to scroll to A1-04 and ENTER.	→	-PRMSET- PRG Enter Password A1-04 = 0 (0~9999) "0" ← FWD →
4.	Enter the password "1234".	→	-PRMSET- PRG Enter Password A1-04= 1234 V/f Control ← FWD →
5.	Press ENTER to save the new password.	→	Entry Accepted
6.	Drive returns to the parameter display.	→	-PRMSET- PRG Enter Password A1-04 = 0 (0~9999) "0" ← FWD →
7.	Press ∨ and scroll to A1-03.	→	-PRMSET- PRG Init Parameters A1-03= 0 *0* No Initialize ← FWD →
8.	Press ENTER to display the value set to A1-03. If the first "0" blinks, parameter settings are unlocked.	→	-PRMSET- PRG Init Parameters A1-03= 0 *0* No Initialize ← FWD →
9.	Use RESET and ∧ to change the value if desired (though changing the Init Parameters at this point is not typically done).	→	-PRMSET- PRG Init Parameters A1-03= 2220 *0* 2-Wire Initial "0" ← FWD →
10.	Press ENTER to save the setting, or press ESC to return to the previous display without saving changes.	→	Entry Accepted
11.	The display automatically returns to the parameter display.	→	-PRMSET- PRG Init Parameters A1-03= 0 *0* No Initialize ← FWD →

Note: **1.** Parameter settings can be edited after entering the correct password.
2. Performing a 2-Wire or 3-Wire initialization resets the password to "0000".

■ A1-06: Application Preset

Several Application Presets are available to facilitate drive setup for commonly used applications. Selecting one of these Application Presets automatically assigns functions to the input and output terminals and sets a predefined group of parameters to values appropriate for the selected application.

In addition, the parameters most likely to be changed are assigned to the group of User Parameters, A2-01 through A2-16. User Parameters are part of the Setup Group, which provides quicker access by eliminating the need to scroll through multiple menus.

◆ A2: User Parameters

■ A2-01 to A2-32: User Parameters 1 to 32

The user can select up to 32 parameters and assign them to parameters A2-01 through A2-32 to provide quicker access by eliminating the need to scroll through multiple menus. The User Parameter list can also save the most recently edited parameters.

No.	Parameter Name	Setting Range	Default
A2-01 to A2-32	User Parameters 1 to 32	b1-01 to s6–07	Determined by A1-03

Saving User Parameters

To save specific parameters to A2-01 through A2-32, set parameter A1-01 to 2 to allow access to all parameters, then enter the parameter number to one of the A2-☐☐ parameters to assign it to the list of User Parameters. Finally, set A1-01 to 1 to restrict access so users can only set and refer to the parameters saved as User Parameters.

■ A2-33: User Parameter Automatic Selection

Determines whether recently edited parameters are saved to the second half of the User Parameters (A2-17 to A2-32) for quicker access.

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

Setting 0: Do not save list of recently edited parameters

Set A2-33 to 0 to manually select the parameters listed in the User Parameter group.

Setting 1: Save list of recently edited parameters

Set A2-33 to 1 to automatically save recently edited parameters 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. Access the User Parameters using the Setup Mode of the digital operator.

5.2 b: Application

◆ b1: Operation Mode Selection

■ b1-01: Frequency Reference Selection 1

Selects 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 light and the STOP indicator 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 Selection 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	
A1	0 to 10 Vdc	H3-01 = 0	H3-02 = 0 (Frequency Reference Bias)	H3-03	H3-04	–
	-10 to +10 Vdc	H3-01 = 1				
A2	0 to 10 Vdc	H3-09 = 0	H3-10 = 0 (Frequency Reference Bias)	H3-11	H3-12	Set jumper S1 on the terminal board to "V" for voltage input.
	-10 to +10 Vdc	H3-09 = 1				
A3	0 to 10 Vdc	H3-05 = 0	H3-06 = 0 (Frequency Reference Bias)	H3-07	H3-08	Set DIP switch S4 on the terminal board to "AI".
	-10 to +10 Vdc	H3-05 = 1				

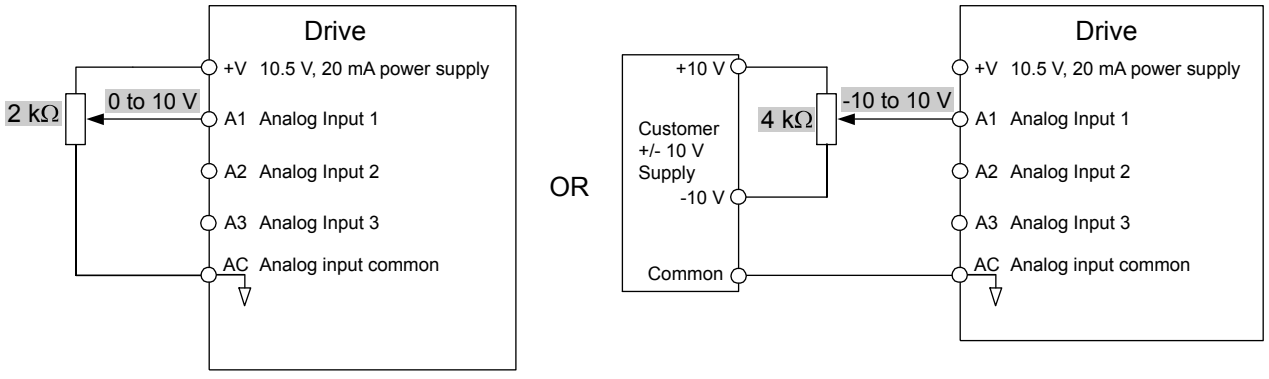


Figure 5.1 Setting the Frequency Reference as a Voltage Signal at Terminal A1

Current Input

Input terminals, A1, A2, and A3 can accept a current input signal. Refer to *Table 5.6* for an example 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	
A2	4 to 20 mA	H3-09 = 2	H3-10 = 0 (Frequency Bias)	H3-11	H3-12	Make sure to set jumper S1 on the terminal board to "I" for current input.
	0 to 20 mA	H3-09 = 3				

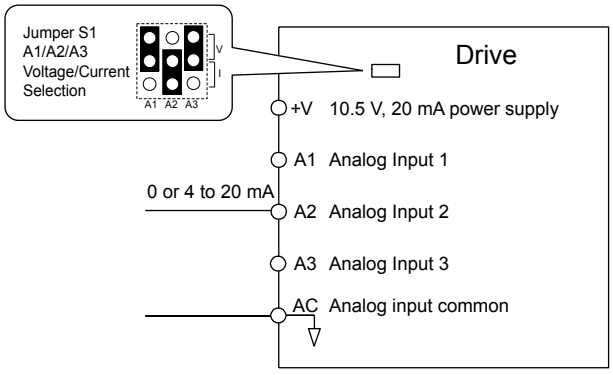


Figure 5.2 Setting the Frequency Reference as a Current Signal to Terminal A2

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 173* for details on using this function.

Setting 2: MEMOBUS/Modbus Communications

This setting requires entering the frequency reference via the RS-485/422 serial communications port (control terminals R+, R-, S+, S-). *Refer to MEMOBUS/Modbus Configuration on page 464* for instructions.

Setting 3: Option card

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

Note: If the frequency reference source is set for 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

This setting requires a pulse train signal to terminal RP to provide the frequency reference. Follow the directions below to verify that the pulse signal is working properly.

Verifying the Pulse Train is Working Properly

- Set b1-04 to 4 and set H6-01 to 0.
- Set the 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 for the correct frequency reference on the display.

■ b1-02: Run Command Selection 1

Determines the Run command source 1 in the REMOTE mode.

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

Setting 0: Operator

This setting requires entering the Run command via the digital operator RUN key and also illuminates the LO/RE indicator on the digital operator.

Setting 1: Control Circuit Terminal

This setting requires entering the Run command via the digital input terminals using one of following sequences:

- 2-Wire sequence 1:

Two inputs (FWD/Stop-REV/Stop). Set A1-03 to 2220 to initialize the drive and preset terminals S1 and S2 to these functions. This is the default setting of the drive. *Refer to Setting 40, 41: Forward Run, Reverse Run Command for 2-Wire Sequence on page 203*.

- 2-Wire sequence 2:

  Two inputs (Start/Stop-FWD/REV). *Refer to Setting 42, 43: Run and Direction Command for 2-Wire Sequence 2 on page 203*.

- 3-Wire sequence:

  Three inputs (Start-Stop-FWD/REV). Set A1-03 to 3330 to initialize the drive and preset terminals S1, S2, and S5 to these functions. *Refer to Setting 0: 3-Wire Sequence on page 197*.

Setting 2: MEMOBUS/Modbus Communications

This setting requires entering the Run command via serial communications by connecting the RS-485/422 serial communication cable to control terminals R+, R-, S+, and S- on the removable terminal block. *Refer to MEMOBUS/Modbus Configuration on page 464* for instructions.

Setting 3: Option Card

This setting requires entering the Run command via the communication option board by plugging a communication option board into the CN5-A port on the control PCB. Refer to the option board manual 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

Selects 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. *Refer to b2-01: DC Injection Braking Start Frequency on page 144* 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.

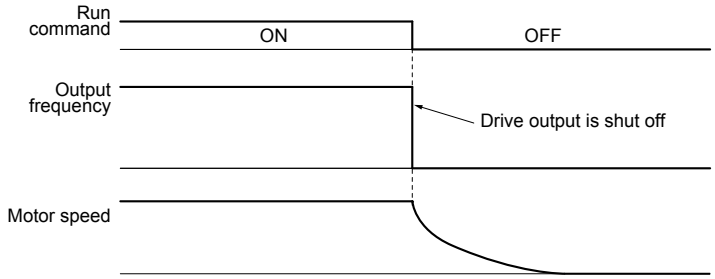


Figure 5.3 Coast to Stop

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. Use DC Injection at Start (*Refer to b2-03: DC Injection Braking Time at Start on page 145*) or Speed Search (*Refer to b3: Speed Search on page 145*) to restart the motor before it has completely stopped.

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). When the minimum baseblock time has expired, the drive will inject the amount DC Injection Braking is set in parameter b2-02 into the motor windings to brake the motor. The stopping time in DC Injection Braking to Stop is significantly faster compared to Coast to Stop.

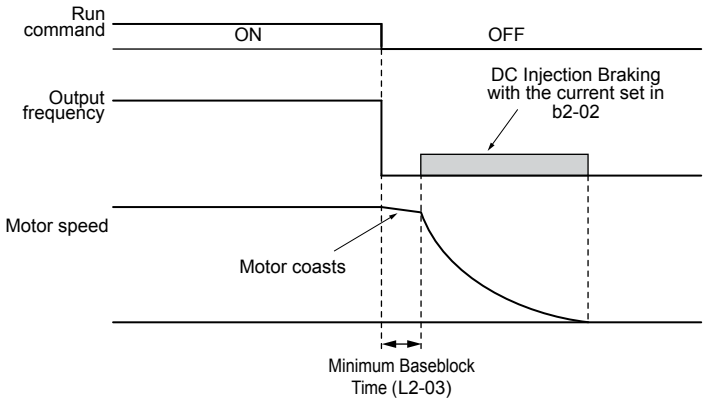


Figure 5.4 DC Injection Braking to Stop

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

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

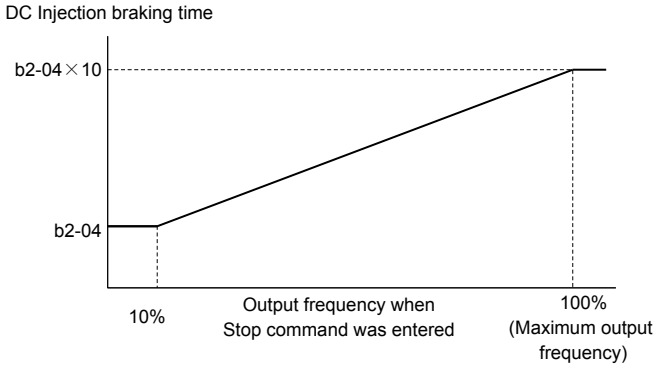


Figure 5.5 DC Injection Braking Time Depending on Output Frequency

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. The drive will not start if a Run command is input before the time t (C1-02) has expired. Cycle the Run command that was activated during time t after t has expired to start the drive.

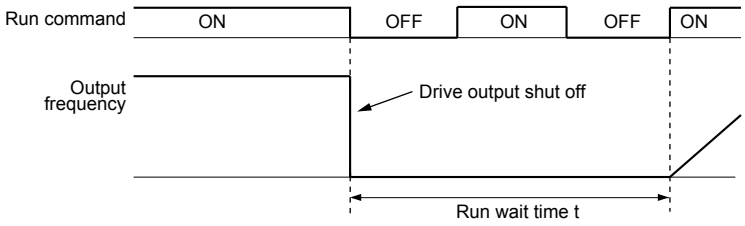


Figure 5.6 Coast to Stop with Timer

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

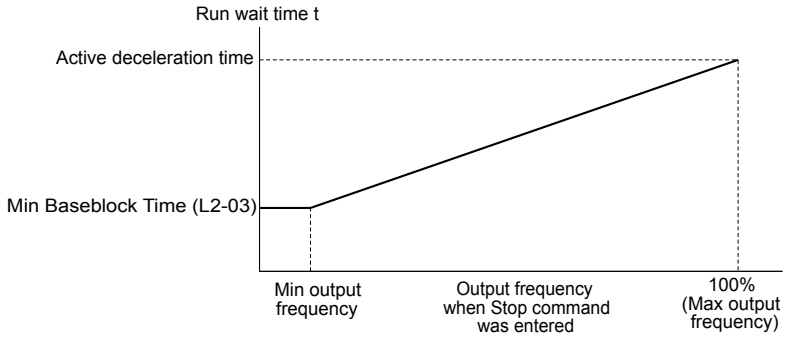


Figure 5.7 Run Wait Time Depending on Output Frequency

■ b1-04: Reverse Operation Selection

Enables and disables Reverse operation. For some applications, reverse motor rotation is not appropriate and may cause problems (e.g., air handling units, pumps, etc.).

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

■ b1-07: 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 197*, *Refer to Setting 2: External Reference 1/2 Selection on page 198* and *Refer to o2-01: LO/RE (LOCAL/REMOTE) Key Function Selection on page 256* for details.

- LOCAL: Digital operator. The digital operator sets 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 at which the source is being switched. In this case, use parameter b1-07 to determine how the Run command is treated.

No.	Parameter Name	Setting Range	Default
b1-07	LOCAL/REMOTE Run Selection	0, 1	0

Setting 0: Run command must be cycled

When the Run command source differs between the old source and the 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 switchover occurs, the drive will not start or the drive will stop operation if it was previously running. The Run command must be cycled at the new source to restart the drive.

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 previously running.

WARNING! *Sudden Movement Hazard. The drive may start unexpectedly if switching control sources when b1-07 = 1. Clear all personnel 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 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 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 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.

■ b1-11: Drive Delay Time Setting

If a time is set to b1-11, the drive will delay executing a Run command until the set time has expired. During Drive Delay Time execution, the digital operator keypad will display "WrUn". Both Alarm and Run indicators will blink while the drive waits to execute the Run command.

No.	Parameter Name	Setting Range	Default
b1-11	Drive Delay Time Setting	0 to 600 s	0

■ 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, 1	0

■ b1-15: Frequency Reference Selection 2

Enabled when H1-☐☐ = 2 and the terminal is closed. *Refer to Setting 2: External Reference 1/2 Selection on page 198* and *Refer to b1-02: Run Command Selection 1 on page 140* for details.

No.	Parameter Name	Setting Range	Default
b1-15	Frequency Reference Selection 2	0 to 4	0

■ b1-16: Run Command Selection 2

Enabled when H1-☐☐ = 2 and the terminal is closed. *Refer to Setting 2: External Reference 1/2 Selection on page 198* and *Refer to b1-01: Frequency Reference Selection 1 on page 139* for details.

No.	Parameter Name	Setting Range	Default
b1-16	Run Command Selection 2	0 to 3	0

■ b1-17: Run Command at Power Up

Determines whether an external Run command that is active during power up will start the drive.

No.	Parameter Name	Setting Range	Default
b1-17	Run Command at Power Up	0, 1	

◆ b2: DC Injection Braking and Short Circuit Braking

These parameters determine operation of the DC Injection Braking, Zero Speed Control, and Short Circuit Braking features.

■ b2-01: DC Injection Braking Start Frequency

Active when "Ramp to Stop" is selected as the stopping method (b1-03 = 0).

No.	Name	Setting Range	Default
b2-01	DC Injection Braking Start Frequency	0.0 to 10.0 Hz	0.5

V/f Control

Sets the starting frequency for DC Injection Braking at Stop. When the output frequency falls below the setting of b2-01, DC Injection Braking is enabled for the time set in parameter b2-04.

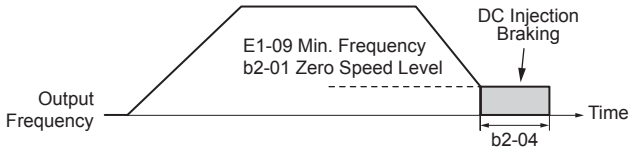


Figure 5.8 DC Injection Braking at Stop for V/f

Note: If b2-01 is set to a smaller value than E1-09 (Minimum Frequency), then DC Injection Braking will begin when the frequency falls to the E1-09 value.

■ b2-02: DC Injection Braking Current

Sets the DC Injection Braking current as a percentage of the drive rated current. The carrier frequency is automatically reduced to 1 kHz when this parameter is set to more than 50%.

No.	Name	Setting Range	Default
b2-02	DC Injection Braking Current	0 to 100%	50%

■ b2-03: DC Injection Braking Time at Start

Sets DC Injection Braking time 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

■ b2-04: DC Injection Braking Time at Stop

Sets DC Injection Braking time at stop.

No.	Name	Setting Range	Default
b2-04	DC Injection Braking Time at Stop	0.00 to 10.00 s	0.50 s

◆ 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 and start the motor operation directly from the detected speed without first stopping the machine.

Example: When a momentary loss of power occurs, the drive output shuts off and the motor coasts. When power returns, the drive can find the speed of the coasting motor and restart it directly.

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 and followed by a description of all relevant parameters.

■ Current Detection Speed Search (b3-24 = 0)

Current Detection Speed Search detects the motor speed by looking at motor current in IM motors. When Speed Search is started it reduces the output frequency starting from either 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 to b3-02, the output frequency is lowered using the time constant set to 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.

Figure 5.9 illustrates Current Detection Speed Search operation after a momentary power loss (L2-01 must be set to 1 or 2):

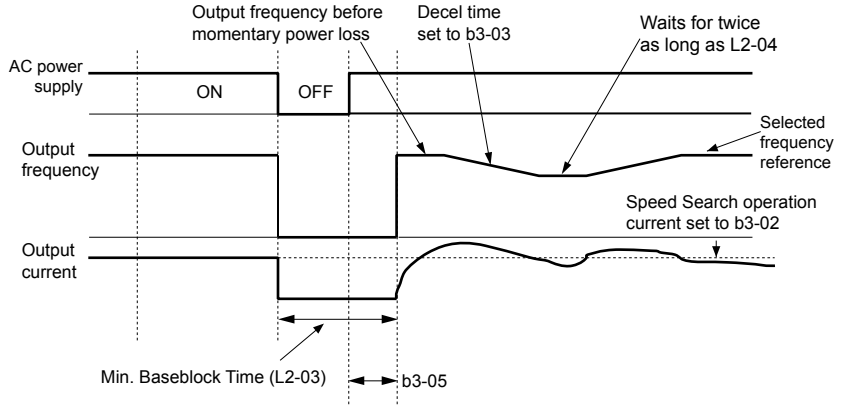


Figure 5.9 Current Detection Speed Search after Power Loss

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 set to L2-03 before starting Speed Search. If L2-03 is lower than the time set to parameter b3-05, then b3-05 is used as the wait time.

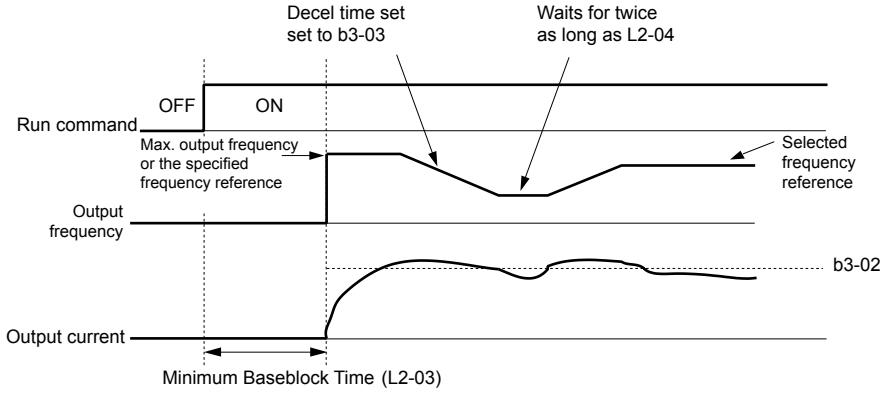


Figure 5.10 Current Detection Speed Search at Start or Speed Search Command by Digital Input

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.
- 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. Do not use this method if the motor is one or more frame size 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 the two steps described below:

Step 1: Back EMF Voltage Estimation

This method is used by Speed Search after baseblock (e.g., a power loss where the drive CPU continued to run and the Run command was kept active). Here, the drive estimates the motor speed by analyzing the back EMF voltage and 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, the drive will automatically proceed to step 2.

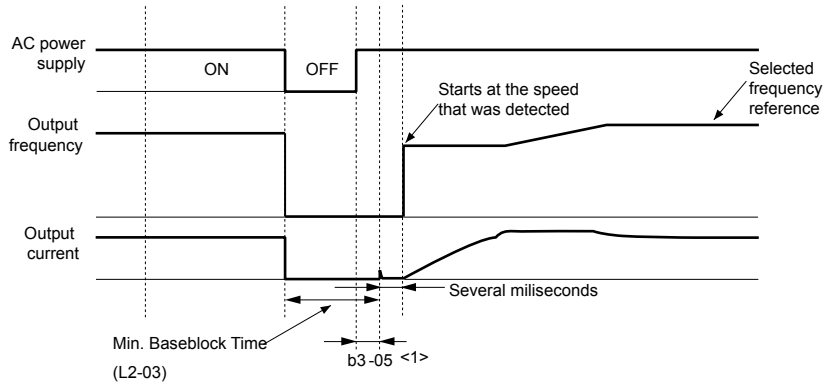


Figure 5.11 Speed Search after Baseblock

<1> After 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 insufficient residual voltage in the motor after extended power losses, when Speed Search is applied with the Run command (b3-01 = 1), or when an External search command is used.

This feature injects the amount of DC current set to b3-06 to the motor and detects the speed by measuring the current feedback. The drive then outputs the detected frequency and increases the voltage using the time constant set to parameter L2-04 while looking at the motor current.

The output frequency is reduced if the current is higher than the level in b3-02. 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.

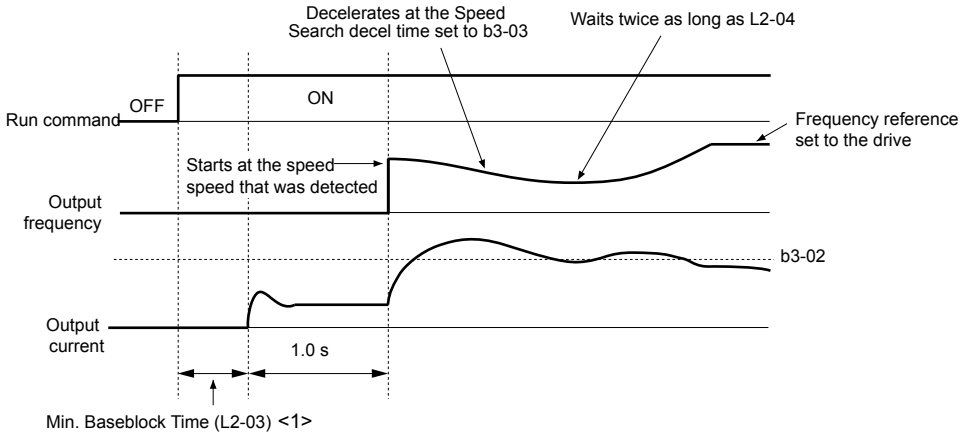


Figure 5.12 Speed Search at Start

<1> The wait time for Speed Search (b3-05) determines the lower limit.

Notes on Using Speed Estimation Speed Search

- Perform Rotational Auto-Tuning for V/f Control (T1-01 = 3) prior to using Speed Estimation in V/f Control and perform Stationary Auto-Tuning for Line-to-Line Resistance (T1-01 = 2) again if the 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. Use Current Detection in these instances.
- Use Current Detection instead of Speed Estimation when operating motors smaller than 1.5 kW because Speed Estimation might not be able to detect the speed or rotation of these smaller motors, in which case Speed Estimation would stop the motor.

■ Speed Search Activation

Speed Search can be activated using any of the methods 1 through 5 described below. The Speed Search type must be selected in parameter b3-24 independent of the activation method.

Method 1. Automatically activate Speed Search with every Run command. External Speed Search commands are ignored.

Method 2. Activate Speed Search using the digital input terminals.

Use the input functions for H1-☐☐ in *Table 5.7*.

Table 5.7 Speed Search Activation by Digital Inputs

Setting	Description	b3-24 = 0	b3-24 = 1
61	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 be set together with the Run command or the Run command must be entered after giving the Speed Search command.

Method 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.

Method 4. After momentary power loss.

This mode requires that the Power Loss Ride-Thru function is enabled during CPU operation (L2-01 = 1 or 2). *Refer to L2-01: Momentary Power Loss Operation Selection on page 229*.

Method 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 (H1-☐☐ = 8 or 9) is released. For this operation mode, set the operation during an external Baseblock command to hold the output frequency (H1-13 = 0).

■ b3-01: Speed Search Selection at Start

Determines if Speed Search is automatically performed when a Run command is issued.

No.	Parameter Name	Setting Range	Default
b3-01	Speed Search Selection at Start	0, 1	0

Setting 0: Disabled

This setting starts operating the drive at the minimum output frequency when the Run command is entered. 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

This setting performs Speed Search when the Run command is entered. The drive begins running the motor after 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. Lower this value if the drive has trouble restarting.

No.	Name	Setting Range	Default
b3-02	Speed Search Deactivation Current	0 to 200%	120%

■ b3-03: Speed Search Deceleration Time

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 this value. Changing this value can help 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

■ 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 coefficient for the motor rated current.

No.	Name	Setting Range	Default
b3-06	Output Current 1 during Speed Search	0.0 to 2.0	Determined by o2-04

■ b3-07: Output Current 2 during Speed Search (Speed Estimation Type)

Sets the amount of output current during Speed Estimation Speed Search as a coefficient for the no-load current. Output current during Speed Search is automatically limited by the drive rated current. Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation

No.	Name	Setting Range	Default
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	0.0 to 5.0	Determined by o2-04

■ b3-08: Current Control Gain during Speed Search (Speed Estimation Type)

Sets the proportional gain for the current controller during Speed Search.

No.	Name	Setting Range	Default
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	0.00 to 6.00	0.8

■ b3-10: Speed Search Detection Compensation Gain

Sets the gain for the detected motor speed of the Speed Estimation Speed Search. Increase the setting 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

■ b3-12: Minimum Current Detection Level during Speed Search

Sets the minimum current detection level during Speed Search. Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.

No.	Name	Setting Range	Default
b3-12	Minimum Current Detection Level during Speed Search	2.0 to 10.0	6.0

■ 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, 1	1

Setting 0: Disabled

The drive uses the frequency reference to determine the direction of motor rotation to restart the motor.

Setting 1: Enabled

The drive detects the motor rotation direction to restart the motor.

■ b3-17: Speed Search Restart Current Level

Sets the current level at which Speed Estimation is restarted as a percentage of drive rated current to avoid overcurrent and overvoltage problems since a large current can flow into the drive if the difference between the estimated frequency and the actual motor speed is too big when performing Speed Estimation.

No.	Name	Setting Range	Default
b3-17	Speed Search Restart Current Level	0 to 200%	

■ b3-18: Speed Search Restart Detection Time

Sets the time for which the current must be above the level set in b3-17 before restarting Speed Search.

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	0

■ 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

■ b3-26: Direction Determining Level

Sets the level that determines the direction of motor rotation. Increase this value if the drive fails to detect the direction of the motor correctly.

No.	Name	Setting Range	Default
b3-26	Direction Determining Level	40 to 60000	Determined by o2-04

■ 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, 1	0

Setting 0: Triggered when a Run Command Is Issued (Normal)
Setting 1: Triggered when an External Baseblock Is Released

◆ b4: Delay Timers

The timer function is independent of drive operation and can delay the switching of a digital output triggered by a digital input signal and help eliminate chattering switch noise from sensors. An on-delay and off-delay can be set separately.

To enable the timer function, set a multi-function input to "Timer input" (H1-☐☐ = 18) and set a multi-function output to "Timer output" (H2-☐☐ = 12). Only one timer can be used.

■ 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

The timer function switches on when the timer function input closes for longer than the value set to b4-01. The timer function switches off when the timer function input is open for longer than the value set to b4-02. ***Figure 5.13*** illustrates the timer function operation:

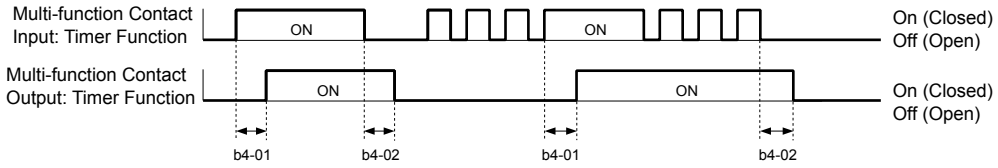


Figure 5.13 Timer Operation

◆ b5: PID Control

The drive has a built-in Proportional + Integral + Derivative (PID) controller that uses the difference between the target value and the feedback value to adjust the drive output frequency to minimize deviation and provide accurate closed loop control of system variables such as pressure or temperature.

■ 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.

D control tends to amplify noise on the deviation signal, which can result in control instability. Only use D control when absolutely necessary.

■ PID Operation

To better demonstrate PID functionality, ***Figure 5.14*** illustrates how the PID output changes when the PID input (deviation) jumps from 0 to a constant level.

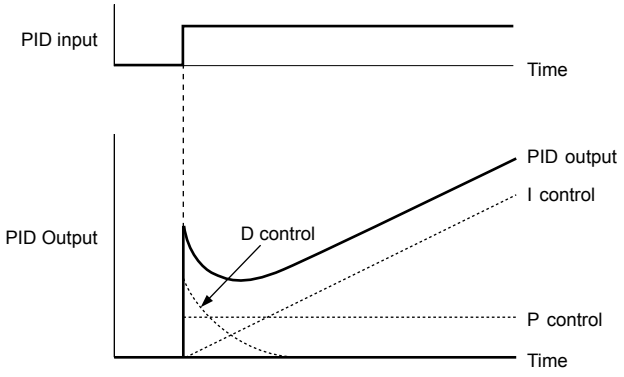


Figure 5.14 PID Operation

■ Using PID Control

Applications for PID control are listed in *Table 5.8*.

Table 5.8 Using PID Control

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 5.9* 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 5.9*.

Table 5.9 PID Setpoint Sources

PID Setpoint Source	Settings
Analog Input A1	Set H3-02 = C
Analog Input A2	Set H3-10 = C
Analog Input A3	Set H3-06 = C
MEMOBUS/Modbus Register 0006 H	Set bit 1 in register 000F H to 1 and input the setpoint to register 0006 H
Pulse Input RP	Set H6-01 = 2
Parameter b5-19	Set parameter b5-18 = 1 and input the PID setpoint to b5-19

Note: A duplicate allocation of the PID setpoint input will cause an oPE alarm.

■ PID Feedback Input Methods

Input one feedback signal for normal PID control or input two feedback signals can for controlling a differential process value.

Normal PID Feedback

Input the PID feedback signal from one of the sources listed in *Table 5.10*:

Table 5.10 PID Feedback Sources

PID Feedback Source	Settings
Analog Input A1	Set H3-02 = B
Analog Input A2	Set H3-10 = B
Analog Input A3	Set H3-06 = B

PID Feedback Source	Settings
Pulse Input RP	Set H6-01 = 1

Note: A duplicate allocation of the PID feedback input will cause an oPE alarm.

Differential Feedback

The second PID feedback signal for differential feedback can come from the sources listed in *Table 5.11*. The differential feedback function is automatically enabled when a differential feedback input is assigned.

Table 5.11 PID Differential Feedback Sources

PID Differential Feedback Source	Settings
Analog Input A1	Set H3-02 = 16
Analog Input A2	Set H3-10 = 16
Analog Input A3	Set H3-06 = 16

Note: A duplicate allocation of the PID differential feedback input will cause an oPE alarm.

■ PID Block Diagram

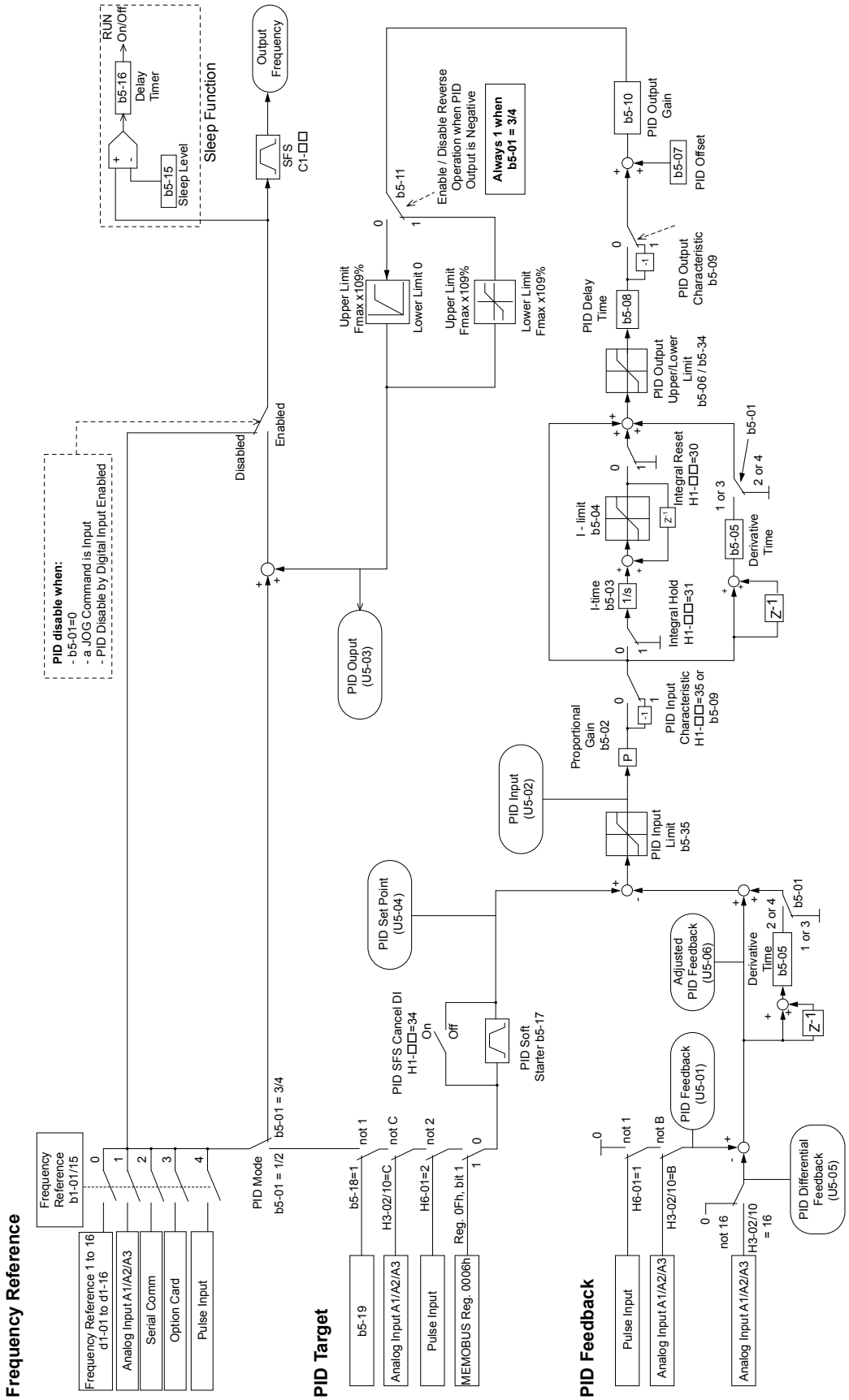


Figure 5.15 PID Block Diagram

■ b5-01: PID Function Setting

Enables and disables the PID operation and selects the PID operation mode.

No.	Parameter Name	Setting Range	Default
b5-01	PID Function Setting	0, 1	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. The PID input is D controlled.

■ b5-02: Proportional Gain Setting (P)

Sets the P gain applied to the PID input. Larger values will tend to reduce the error but may cause oscillations if set too high, while lower values 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 used to calculate the integral of the PID input. The shorter the integral time set to b5-03, the faster the offset will be eliminated. If the integral time is set too short, however, overshoot or oscillation may occur. To turn off the integral time, set b5-03 to 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 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. Program b5-04 to apply a limit to the integral output and suppress this oscillation.

■ 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 improve the response but can cause vibrations, while shorter time settings reduce the overshoot but reduce 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

■ b5-06: PID Output Limit

Sets the maximum output possible from the entire PID controller 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 as a percentage of the maximum frequency (E1-04).

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

Reverses the sign of the PID controller output signal. Normally a positive PID input (feedback smaller than setpoint) leads to positive PID output.

No.	Parameter Name	Setting Range	Default
b5-09	PID Output Level Selection	0, 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. This parameter has no effect when the PID function trims the frequency reference (b5-01 = 3 or 4) and the PID output will not be limited (same as b5-11 = 1).

Note: When using setting 1, make sure reverse operation is permitted by b1–04.

No.	Parameter Name	Setting Range	Default
b5-11	PID Output Reverse Selection	0, 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 detects broken sensors or broken sensor wiring. It should be used when 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 above 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 illustrates the working principle of feedback loss detection when the feedback signal is too low. Feedback high detection works in the same way.

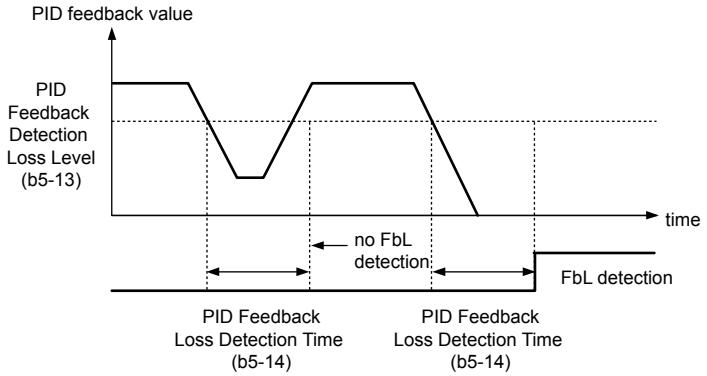


Figure 5.16 PID Feedback Loss Detection

■ 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 time set to b5-37. Neither a fault nor an alarm is displayed on the digital operator and the drive will continue operation. The output resets when the feedback value leaves the loss detection range.

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. The alarm and outputs reset when the feedback value leaves the loss detection range.

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.

Setting 3: Digital output only, even if PID is disabled by digital input

Same as b5-12 = 0. Detection remains active when 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 remains active when 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 remains active when 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 must fall below this level for longer than the time set to 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 Loss 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 must exceed this level for longer than the time set to 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 that the PID feedback must exceed the value set to 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 when the PID output or frequency reference rise above the PID Sleep operation level for the specified time. An example of PID Sleep operation appears in the figure below.

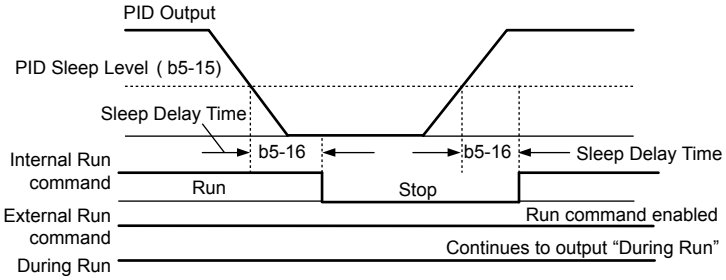


Figure 5.17 PID Sleep Operation

Notes on using the PID Sleep function

- The PID Sleep function is active even when PID control is disabled.
- The PID Sleep function stops the motor according to the stopping method set to b1-03.

The parameters necessary to 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 to b5-16. The drive resumes operation when the PID output or frequency reference is above b5-15 for longer than the time set to b5-16.

No.	Name	Setting Range	Default
b5-15	PID Sleep Function Start Level	0.0 to 400.0 Hz	0.0 Hz

■ 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.

When the setpoint changes quickly, the normal C1-☐☐ acceleration times reduce the responsiveness of the system as they are applied after the PID output. The PID accel/decel time helps avoid the hunting and overshoot and undershoot that can result from the reduced responsiveness.

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.

Refer to *Figure 5.18* for the digital operator home screen display when PID is enabled and b5-18 is set to 1, enabling PID Setpoint Selection.

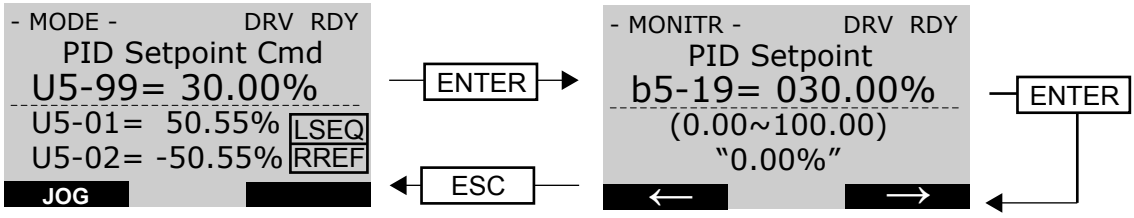


Figure 5.18 PID Setpoint Selection Display

No.	Parameter Name	Setting Range	Default
b5-18	PID Setpoint Selection	0, 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.

Note: Values set above b5–38 will be internally limited to b5–38.

No.	Name	Setting Range	Default
b5-19	PID Setpoint Value	0.00 to 600.00%	0.00%

◆ EZ Sleep/Wake-up Function

To enable EZ Sleep/Wake-up functionality on the drive, first set parameter b5-89 to 1. The default setting for b5-89 is 0, which disables the EZ Sleep functionality and related parameters, except for parameter b5-91, EZ Sleep Minimum Speed.

Setting b5-89 to 1 disables the existing PID Sleep function (b5-15) and enables the EZ Sleep/Wake-up functionality.

EZ Sleep and Minimum Speed Units

Parameter b5-90, EZ Sleep Unit, determines the unit, range, and resolution of parameters b5-92 and b5-93. When set to Hz, the range is 0.1 to 400.0 Hz. When set to RPM, the range is 0 to 24000 RPM. Changing b5-90 will NOT automatically re-scale the values of b5-92 and b5-93.

Minimum Speed

Parameter b5-91, EZ Minimum Speed, acts as a lower limit on the PID output. This value is internally limited to the higher value between b5-34 or d2-02 and is active regardless of the b5-89 setting. When this limit is active, the PID integrator will be held to avoid integral wind-up. Parameter b5-90 determines whether the value is input in Hz or RPM.

Sleep

When the output frequency (or speed) is at or below the EZ Sleep Level (b5-92) for the time set in EZ Sleep Time (b5-93), the drive will sleep. The EZ Sleep Level is internally lower limited to the b5-92 setting.

Wake-up using Absolute Level (b5-95 = 0)

For Normal Acting PID, the PID Feedback must drop below the EZ Wake-up Level (b5-94) for the time set in EZ Wake-up Time (b5-96) in order for the drive to wake-up.

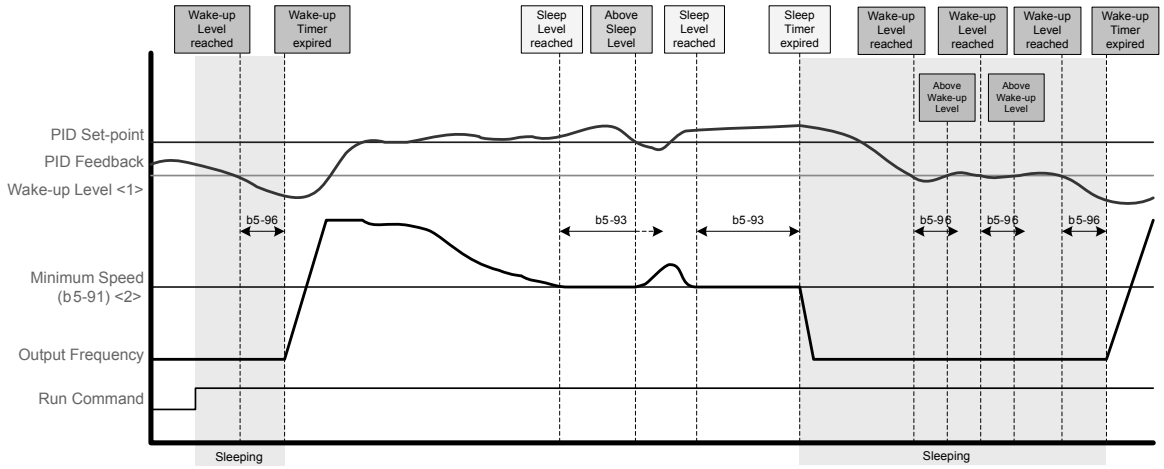
For Reverse Acting PID, the PID Feedback must rise above the b5-94 level for the time set in b5-96 in order for the drive to wake-up.

Wake-up using Setpoint Delta Level (b5-95 = 1)

For Normal Acting PID, the wake-up level is determined by the PID Setpoint minus the b5-94 level. The PID Feedback must drop below the wake-up level for the time set in b5-96 in order for the drive to wake-up

For Reverse Acting PID, the wake-up level is determined by the PID Setpoint plus the b5-94 level. The PID Feedback must rise above the wake-up level for the time set in b5-96 in order for the drive to wake-up.

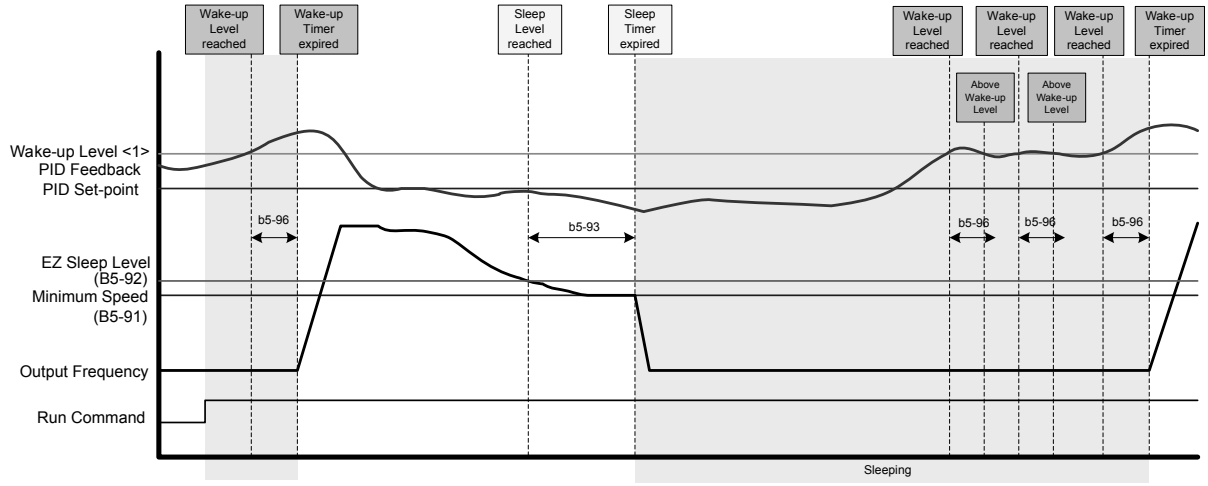
Refer to ***Figure 5.19*** and ***Figure 5.20*** for detailed diagrams of EZ Sleep/Wake-up functions.



<1> Determined by EZ Wake-up Level (b5-94) and EZ Wake-up Mode (b5-95)

<2> EZ Sleep Level (b5-92) is left at default (0.0 Hz), thus effectively making b5-91 the Sleep Level

Figure 5.19 EZ Sleep/Wake-up with Normal Acting PID and b5-92 = 0.0 Hz



<1> Determined by EZ Wake-up Level (B5-94) and EZ Wake-up Mode (B5-95)

Figure 5.20 EZ Sleep/Wake-up with Reverse Acting PID and b5-92 > b5-91

■ b5-20: PID Setpoint Scaling

Determines the units for the PID Setpoint Value (b5-19) and 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

The setpoint and PID monitors are displayed in Hz with a resolution of 0.01 Hz.

Setting 1: 0.01% (100.00%: Maximum Frequency)
The setpoint and PID monitors are displayed as a percentage with a resolution of 0.01%.

Setting 2: r/min (Set the Motor Poles)
The setpoint and PID monitors are displayed in r/min with a resolution of 1 r/min.

Setting 3: User Defined (Determined by b5-38 and b5-39)
Parameters b5-38 and b5-39 determine the units based on b5-46 setting.

■ b5-38, b5-39: PID Setpoint User Display, PID Setpoint Display Digits

When parameter b5-20 is set to 3, parameters b5-38 and b5-39 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 and 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	10000
b5-39	PID Setpoint Display Digits	0 to 3	2

Setting 0: No decimal places
Setting 1: One decimal place
Setting 2: Two decimal places
Setting 3: Three decimal places

■ b5-46: PID Setpoint Monitor Unit Selection

Sets the digital operator display units in U5-01 and U5-04 when b5-20 is set to 3.

No.	Name	Setting Range	Default
b5-46	PI Setpoint Monitor Unit Selection	0 to 15; 25	0

Setting 0: WC (Inch of Water)
Setting 1: PSI (Pounds per Square Inch)
Setting 2: GPM (Gallons per Minute)
Setting 3: F (Degrees Fahrenheit)
Setting 4: CFM (Cubic Feet per Minute)
Setting 5: CMH (Cubic Meters per Hour)
Setting 6: LPH (Liters per Hour)
Setting 7: LPS (Liters per Second)
Setting 8: Bar (Bar)
Setting 9: Pa (Pascal)
Setting 10: C (Degrees Celsius)
Setting 11: Mtr (Meters)
Setting 12: Ft (Feet)
Setting 13: LPN (Liters per Minute)
Setting 14: CMM (Cubic Meters per Minute)
Setting 15: “Hg (Inches of Mercury)
Setting 25: None

■ b5-89: Sleep Method Selection

Determines how the drive sleeps and wakes-up when using PID.

No.	Name	Setting Range	Default
b5-89	Sleep Method Selection	0, 1	0

Setting 0: Standard

Setting 1: EZ Sleep/Wake-up

■ b5-90: EZ Sleep Unit

Sets the unit, range, and resolution of parameters b5-91 and b5-92.

No.	Name	Setting Range	Default
b5-90	EZ Sleep Unit	0, 1 <1>	0

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

Setting 0: Hz

Setting 1: RPM (number of motor poles must be entered)

■ b5-91: EZ Minimum Speed

Sets the PID minimum speed and integral lower limit.

The lower limit of the internal value is the higher of b5-34 and d2-02.

No.	Name	Setting Range	Default
b5-91	EZ Minimum Speed	0.0 to 400.0 Hz <1> or 0 to 24000 RPM	0.0

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

■ b5-92: EZ Sleep Level

When the drive output frequency (or speed) is at or below this level for the time set in b5-93, the drive will go to sleep.

The internal lower limit of this parameter is b5-91 (EZ Min Speed) + 1 Hz.

No.	Name	Setting Range	Default
b5-92	EZ Sleep Level	0.0 to 400.0 Hz <1> or 0 to 24000 RPM	0.0

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

■ b5-93: EZ Sleep Time

The drive will go to sleep when the drive output frequency is at or below the level set to b5-92 for the time set in this parameter.

No.	Name	Setting Range	Default
b5-93	EZ Sleep Tim	0.0 to 10000.0 <1>	5.0 s

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

■ b5-94: EZ Wake-up Level

If b5-95 is set to 0 (Absolute), the drive wakes-up when the PID Feedback (H3-☐☐ = 20) drops below this level for the time set in b5-96. For reverse-acting, the PID Feedback has to be above this level for the time set in b5-96.

If b5-95 is set to 1 (Setpoint Delta), the drive wakes-up when the PID Feedback (H3-☐☐ = 20) drops below the PID Setpoint minus this level (for normal acting PID) for the time set in b5-96. For reverse-acting, Wake-up level is PID Setpoint plus this level. The PID Feedback has to be above the wake-up level for the time set in b5-96.

No.	Name	Setting Range	Default
b5-94	EZ Wake-up Level	0.00 to 600.00% <1>	0.00

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

■ b5-95: EZ Wake-up Mode

Sets how the wake-up level is determined.

No.	Name	Setting Range	Default
b5-95	EZ Wake-up Mode	0, 1 <1>	0

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

Setting 0: Absolute

Setting 1: Setpoint Data

■ b5-96: EZ Wake-up Time

The drive will wake up when the PID Feedback drops below the b5–94, EZ Wake-up Level for the time set in this parameter.

No.	Name	Setting Range	Default
b5-96	EZ Wake-up Time	0.0 to 1000.0 <1>	1.0 s

<1> Unit and resolution are determined by b5-20, b5-39, and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

Setting 0: Absolute

Setting 1: Setpoint Data

■ 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%

■ b5-40: 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, 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.

■ b5-41: PI Unit Selection

Sets the display units in U5-14 and U5-15.

No.	Name	Setting Range	Default
b5-41	PI Output 2 Unit Selection	0 to 15; 25	0

Setting 0: WC (Inch of Water)
Setting 1: PSI (Pounds per Square Inch)
Setting 2: GPM (Gallons per Minute)
Setting 3: F (Degrees Fahrenheit)
Setting 4: CFM (Cubic Feet per Minute)
Setting 5: CMH (Cubic Meters per Hour)
Setting 6: LPH (Liters per Hour)
Setting 7: LPS (Liters per Second)
Setting 8: Bar (Bar)
Setting 9: Pa (Pascal)
Setting 10: C (Degrees Celsius)
Setting 11: Mtr (Meters)
Setting 12: Ft (Feet)
Setting 13: LPM (Liters per Minute)
Setting 14: CMM (Cubic Meters per Minute)
Setting 15: Hg (Inches of Mercury)
Setting 25: None

■ b5-42: PI Output Monitor Calculation Method

No.	Name	Setting Range	Default
b5-42	PI Output Monitor Calculation Method	0 to 3	0

Setting 0: Linear
The monitor displays PID output.

Setting 1: Square Root
The monitor displays square root PID output.

Setting 2: Quadratic
The monitor displays 1/(PID output)^2

Setting 3: Cubic
The monitor displays 1/(PID output)^3

Note: Used for U5-14 and U5-15 only.

■ b5-43/b5-44: Custom PI Output Monitor Setting 1/2

Set the maximum monitor value at maximum frequency. U5-14 and U5-15 show Custom PI output. U5-14 shows the upper 4 digits and U5-15 shows the lower 4 digits. It shows 999999.99 maximum.

No.	Name	Setting Range	Default
b5-43	PI Output 2 Monitor Max Upper 4 Digits	0 to 9999	0
b5-44	PI Output 2 Monitor Max Lower 4 Digits	0 to 99.99	0

Note: Used for U5-14 and U5-15 only.

■ b5-45: PI Output 2 Monitor Minimum

b5-14 shows Custom PI Output. b5-45 sets the minimum display value at zero speed. This function is effective when b5-42 is set to 0 (Linear).

No.	Name	Setting Range	Default
b5-45	PI Output 2 Monitor Minimum	0 to 999.9	0

Note: Used for U5-14 and U5-15 only.

■ b5-47: PID Output Reverse Selection 2

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	PID Output Reverse Selection 2	0, 1	1

Setting 0: Reverse Disabled

Negative PID output will be limited to 0 and the drive output will be stopped.

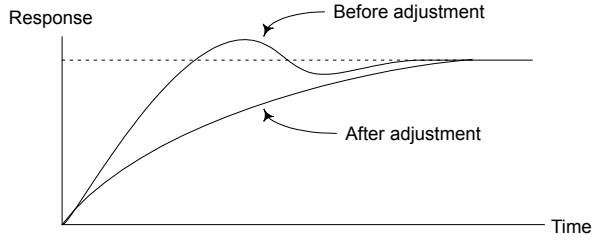
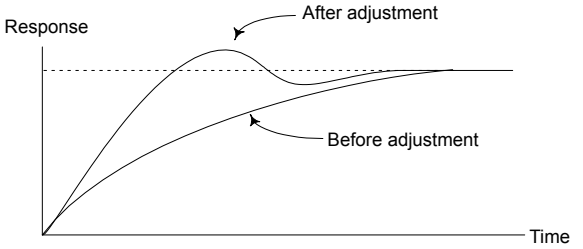
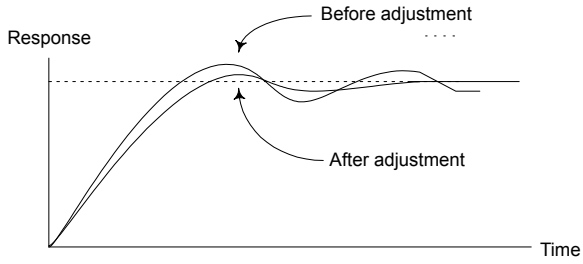
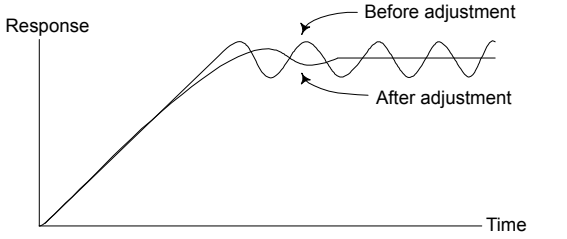
Setting 1: Reverse Enabled

Negative PID output will cause the drive to run in the opposite direction.

■ Fine-Tuning PID

Follow the directions below to fine tune PID control parameters:

Table 5.12 PID Fine Tuning

Goal	Tuning Procedure	Result
Suppress overshoot	• Reduce the derivative time (b5-05) • Increase the integral time (b5-03)	
Achieve stability quickly while allowing some overshoot	• Decrease the integral time (b5-03) • Increase the derivative time (b5-05)	
Suppress long cycle oscillations (longer than the integral time setting)	Increase the integral time (b5-03)	
Suppress short cycle oscillations	• If oscillation cycle time is close to the derivative time, reduce the derivative time (b5-05). • If the derivative time is set to 0.00 s and oscillations are still a problem, reduce the proportional gain (b5-02) or increase the PID primary delay time (b5-08)	

◆ b6: Dwell Function

The Dwell function temporarily holds the frequency reference at a predefined value for a set time then continues accelerating or decelerating.

The Dwell function helps prevent speed loss when starting and stopping a heavy load with induction motors.

Figure 5.21 illustrates how the Dwell function works.

Note: Set the stopping method to "Ramp to Stop" (b1-03 = 0) to use the Dwell function.

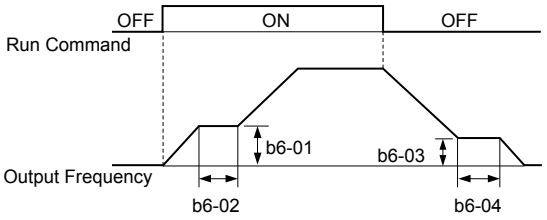


Figure 5.21 Dwell Function at Start and Stop

■ b6-01, b6-02: Dwell Reference, Dwell Time at Start

Parameter b6-01 determines the frequency that is held for 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	0.0 Hz
b6-02	Dwell Time at Start	0.0 to 10.0 s	0.0 s

■ 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	0.0 Hz
b6-04	Dwell Time at Stop	0.0 to 10.0 s	0.0 s

◆ 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. Energy Saving is designed for applications with variable torque (Normal Duty) and is not appropriate for applications where the load may suddenly increase.
3. The performance of the Energy Saving function depends on the accuracy of the motor data. Always perform Auto-Tuning and correctly enter the motor data 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, 1	0

Setting 0: Disabled

Setting 1: Enabled

■ b8-04: Energy Saving Coefficient Value

Determines the level of maximum motor efficiency. Setting range is 0.0 to 2000.0 for drives 3.7 kW and smaller. The display resolution depends on the rated output power of the drive.

No.	Name	Setting Range	Default
b8-04	Energy Saving Coefficient Value	0.00 to 655.00	Determined by E2-11, and o2-04

Note: The 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 121*).

■ b8-05: Power Detection Filter Time

Determines how often in milliseconds the output power is measured. The Energy Saving function continuously searches out the lowest output voltage to achieve minimum output power.

Reducing this setting increases 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

Sets the voltage limit for the Speed Search optimal output voltage detection as a percentage of the maximum output voltage. The drive will keep the output voltage above this level during the search operation to prevent motor stalling.

No.	Name	Setting Range	Default
b8-06	Search Operation Voltage Limit	0 to 100%	0%

5.3 C: Tuning

C parameters set the characteristics for acceleration, deceleration, and S-curves. Other parameters in the C group cover settings for slip compensation, torque compensation, and carrier frequency.

◆ C1: Acceleration and Deceleration Times

■ C1-01 to C1-04: Accel, Decel Times 1 and 2

Two different sets of acceleration and deceleration times can be set in the drive by digital inputs, motor selection, or 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		

<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 time 1 is active by default if no input is set. Activate accel/decel times 2, 3, and 4 by digital inputs (H1-☐☐ = 7 and 1A) as explained in *Table 5.13*.

Table 5.13 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	0	C1-01	C1-02
1	0	C1-03	C1-04

Figure 5.22 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).

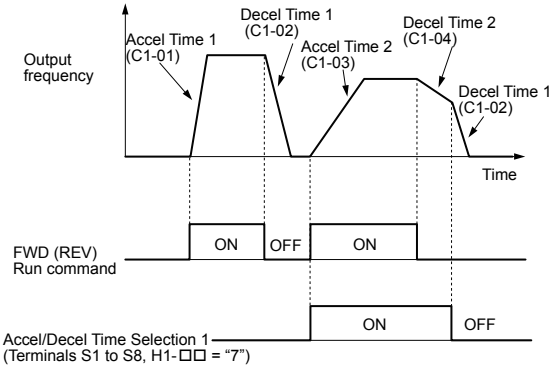


Figure 5.22 Timing Diagram of Accel/Decel Time Change

■ C1-11: Accel/Decel Time Switching Frequency

Sets the frequency at which the drive switches between accel/decel time settings.

No.	Parameter Name	Setting Range	Default
C1-11	Accel/Decel Time Switching Frequency	0.0 to 400.0 Hz	0.0 Hz

■ C1-09: Fast Stop Time

Sets a special deceleration used when a select group of faults occur (e.g., L8-03 Overheat Pre-Alarm Operation Selection) or when closing a digital input configured as H1-☐☐ = 15 (N.O. input) or 17 (N.C. input). A momentary closure of the digital input will trigger the Fast Stop operation; it does not have to be closed continuously.

The drive cannot be restarted after initiating a Fast Stop operation until after completing deceleration, clearing the Fast Stop input, and cycling the Run command.

A digital output programmed for "During Fast Stop" (H2-☐☐ = 4C) will be closed as long as Fast Stop is active.

No.	Parameter Name	Setting Range	Default
C1-09	Fast Stop Time	0.0 to 6000.0 s <1>	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. The drive output shuts off when faulted and the motor coasts. Set an appropriate Fast Stop time to C1-09 to avoid this uncontrolled motor state and to ensure that the motor stops quickly and safely.*

■ 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, 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. C1-10 cannot be set to 0 if any of the parameters C1-01 to C1-09 are set to 600.1 seconds or more.

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 minimize abrupt shock to the load. Set S-curve characteristic time during acceleration/deceleration at start and acceleration/deceleration at stop.

■ 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	0.20 s
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 5.23 illustrates S-curve application.

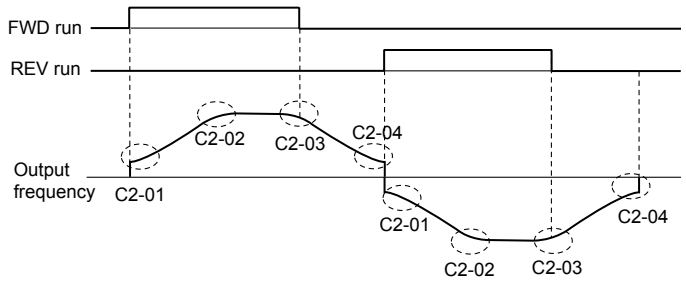


Figure 5.23 S-Curve Timing Diagram - FWD/REV Operation

Setting the S-curve will increase the acceleration and deceleration times.

- Actual accel time = accel time setting + (C2-01 + C2-02) / 2
- Actual decel time = 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

Sets the gain for the motor slip compensation function. Although this parameter rarely needs to be changed, adjustments may be necessary under the following circumstances:

- Increase the setting if the motor at constant speed is slower than the frequency reference.
- Decrease the setting if the motor at constant speed is faster than the frequency reference.

No.	Parameter Name	Setting Range	Default
C3-01	Slip Compensation Gain	0.0 to 2.5	0.0

■ 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, adjustments may be necessary 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	2000 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 ≤ 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.

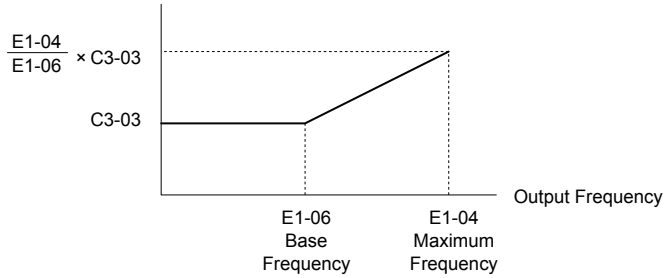


Figure 5.24 Slip Compensation Limit

■ 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 dynamic braking option (braking resistor, braking resistor unit, or braking unit).

This function does not operate when the output frequency is too low, regardless of whether it has been enabled.

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.

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 to E2-02 to automatically calculate the frequency range where compensation will be disabled.

◆ C4: Torque Compensation

The torque compensation function compensates for insufficient torque production at start-up or when a load is applied.

Note: Set the motor parameters and V/f pattern 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	1.00

■ C4-02: Torque Compensation Primary Delay Time 1

Sets the delay time used for applying torque compensation.

No.	Parameter Name	Setting Range	Default
C4-02	Torque Compensation Primary Delay Time 1	0 to 60000 ms	200 ms

◆ C6: Carrier Frequency

■ C6-02: Carrier Frequency Selection

Sets the switching frequency of the drive output transistors. Changes to the switching frequency lower audible noise and reduce leakage current.

No.	Parameter Name	Setting Range	Default
C6-02	Carrier Frequency Selection	1 to 9; A, F	7

Settings:

C6-02	Carrier Frequency	C6-02	Carrier Frequency	C6-02	Carrier Frequency
1	2.0 kHz	5	12.5 kHz	9	Swing PWM 3
2	5.0 kHz	6	15.0 kHz	A	Swing PWM 4
3	8.0 kHz	7	Swing PWM 1	B to E:	No setting possible
4	10.0 kHz	8	Swing PWM 2	F	User defined (C6-03 to C6-05)

Note: Swing PWM uses a carrier frequency of 2.0 kHz as a base, then applies a special PWM pattern to reduce the audible noise.

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 *Table 5.14*.

<2> The default carrier frequency is Swing PWM (C6-02 = 7), using a 2 kHz base. Increasing the carrier frequency is permissible , however the drive rated current is reduced when the carrier frequency is increased.

Table 5.14 Wiring Distance and Carrier Frequency

Wiring Distance	Up to 50 m	Up to 100 m	Greater than 100 m
Recommended setting value for C6-02	1 to F (up to 15 kHz)	1 to 2 (up to 5 kHz), 7 (Swing PWM)	1 (up to 2 kHz), 7 (Swing PWM)

■ C6-03, C6-04, C6-05: Carrier Frequency Upper Limit, Lower Limit, Proportional Gain

These parameters set a user-defined or a variable carrier frequency. Set C6-02 to F to set the upper and lower limits and the carrier frequency proportional gain.

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	1.0 to 15.0 kHz	
C6-05	Carrier Frequency Proportional Gain	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, adjust parameter C6-04 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 by setting 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 5.25***.

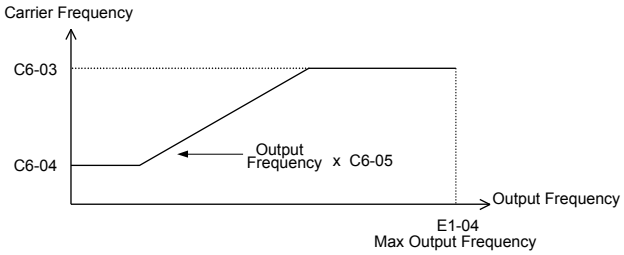


Figure 5.25 Carrier Frequency Changes Relative to Output Frequency

Note: 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.

5.4 d: Reference Settings

The figure below gives an overview of the reference input, selections, and priorities.

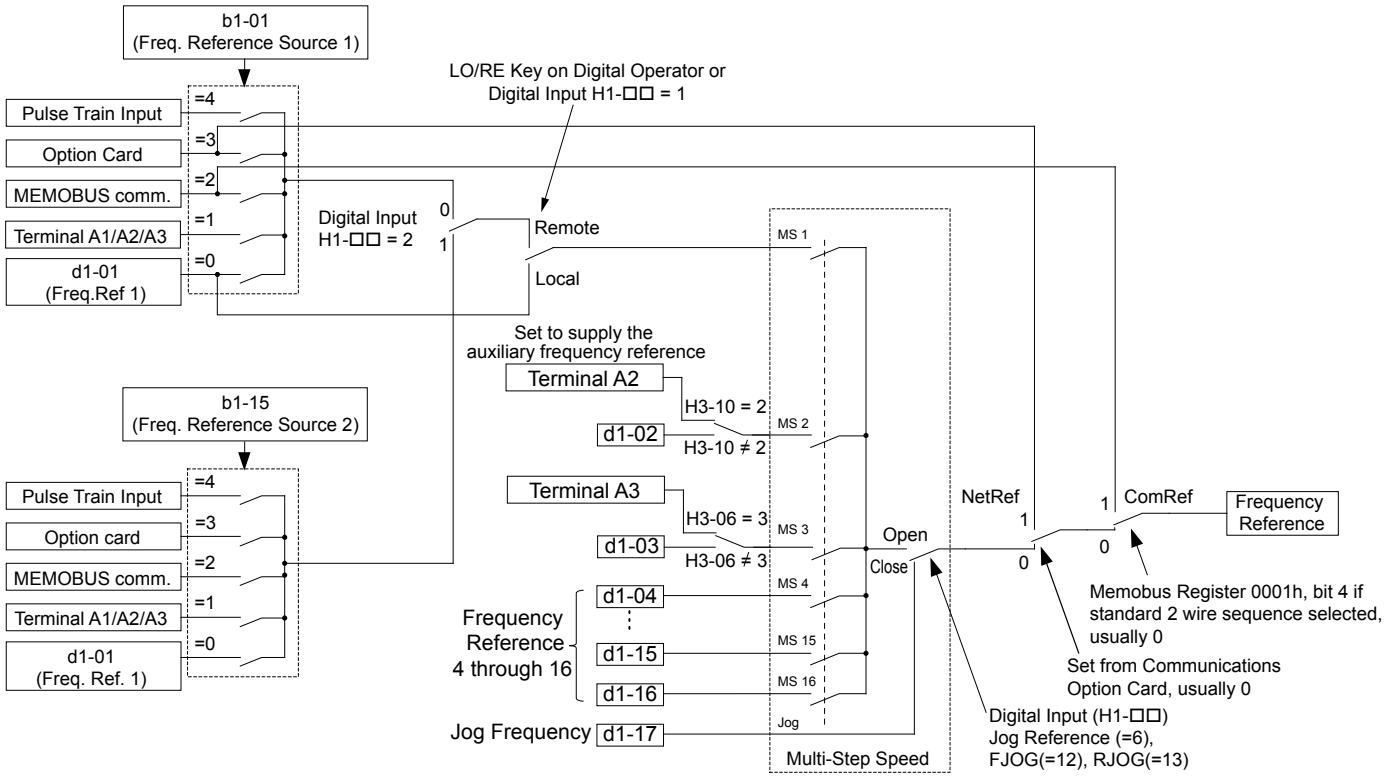


Figure 5.26 Frequency Reference Setting Hierarchy

◆ d1: Frequency Reference

■ d1-01 to d1-17: Frequency Reference 1 to 16 and Jog Frequency Reference

The drive lets the user switch between up to 17 preset frequency references during run (including the Jog reference) through 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 overrides all other frequency references and must be selected by a separate digital input.

The multi-speed references 1, 2, and 3 can be provided by analog inputs.

No.	Parameter Name	Setting Range	Default
d1-01 to d1-16	Frequency Reference 1 to 16	0.00 to 400.00 Hz <1>	0.00 Hz
d1-17	Jog Frequency Reference	0.00 to 400.00 Hz <1>	6.00 Hz

<1> The upper limit is determined by the maximum output frequency (E1-04) and upper limit for the frequency reference (d2-01).

Multi-Step Speed Selection

To use several speed references for a multi-step speed sequence, set the H1-□□ parameters to 3, 4, 5, and 32. 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**

  Set b1-01 to 1 to set terminal A1 analog input to Multi-Step Speed 1.

  Set b1-01 to 0 when setting d1-01, Frequency Reference 1, to Multi-Step Speed 1.

- **Multi-Step Speed 2**

  Set H3-06, Terminal A3 Function Selection, to 2 (Auxiliary Frequency Reference 1) when setting terminal A3 analog input to Multi-Step Speed 2.

Set H3-06 to F (Through mode) when setting d1-02, Frequency Reference 2, to Multi-Step Speed 2.

- **Multi-Step Speed 3**

  Set H3-10, Terminal A2 Function Selection, to 3 (Auxiliary Frequency Reference 2) when setting terminal A2 analog input to Multi-Step Speed 3.

  Set H3-10 to F (Through mode) when setting d1-03, Frequency Reference 3, to Multi-Step Speed 3.

  Set H3-09 to 0 and set jumper S1 on the control circuit terminal board to V (voltage) for A2 when inputting 0 to 10 V to terminal A2 analog input.

Select the different speed references as shown in ***Table 5.15***. ***Figure 5.27*** illustrates the multi-step speed selection.

Table 5.15 Multi-Step Speed Reference and Terminal Switch Combinations

Reference	Multi-Step Speed H1-□□ = 3	Multi-Step Speed 2 H1-□□ = 4	Multi-Step Speed 3 H1-□□ = 5	Multi-Step Speed 4 H1-□□ = 32	Jog Reference H1-□□ = 6
Frequency Reference 1 (set in b1-01)	OFF	OFF	OFF	OFF	OFF
Frequency Reference 2 (d1-02 or input terminal A1, A2, A3)	ON	OFF	OFF	OFF	OFF
Frequency Reference 3 (d1-03 or input terminal A1, A2, A3)	OFF	ON	OFF	OFF	OFF
Frequency Reference 4 (d1-04)	ON	ON	OFF	OFF	OFF
Frequency Reference 5 (d1-05)	OFF	OFF	ON	OFF	OFF
Frequency Reference 6 (d1-06)	ON	OFF	ON	OFF	OFF
Frequency Reference 7 (d1-07)	OFF	ON	ON	OFF	OFF
Frequency Reference 8 (d1-08)	ON	ON	ON	OFF	OFF
Frequency Reference 9 (d1-09)	OFF	OFF	OFF	ON	OFF
Frequency Reference 10 (d1-10)	ON	OFF	OFF	ON	OFF
Frequency Reference 11 (d1-11)	OFF	ON	OFF	ON	OFF
Frequency Reference 12 (d1-12)	ON	ON	OFF	ON	OFF
Frequency Reference 13 (d1-13)	OFF	OFF	ON	ON	OFF
Frequency Reference 14 (d1-14)	ON	OFF	ON	ON	OFF
Frequency Reference 15 (d1-15)	OFF	ON	ON	ON	OFF
Frequency Reference 16 (d1-16)	ON	ON	ON	ON	OFF
Jog Frequency Reference (d1-17) <1>	–	–	–	–	ON

<1> The Jog frequency overrides all other frequency references.

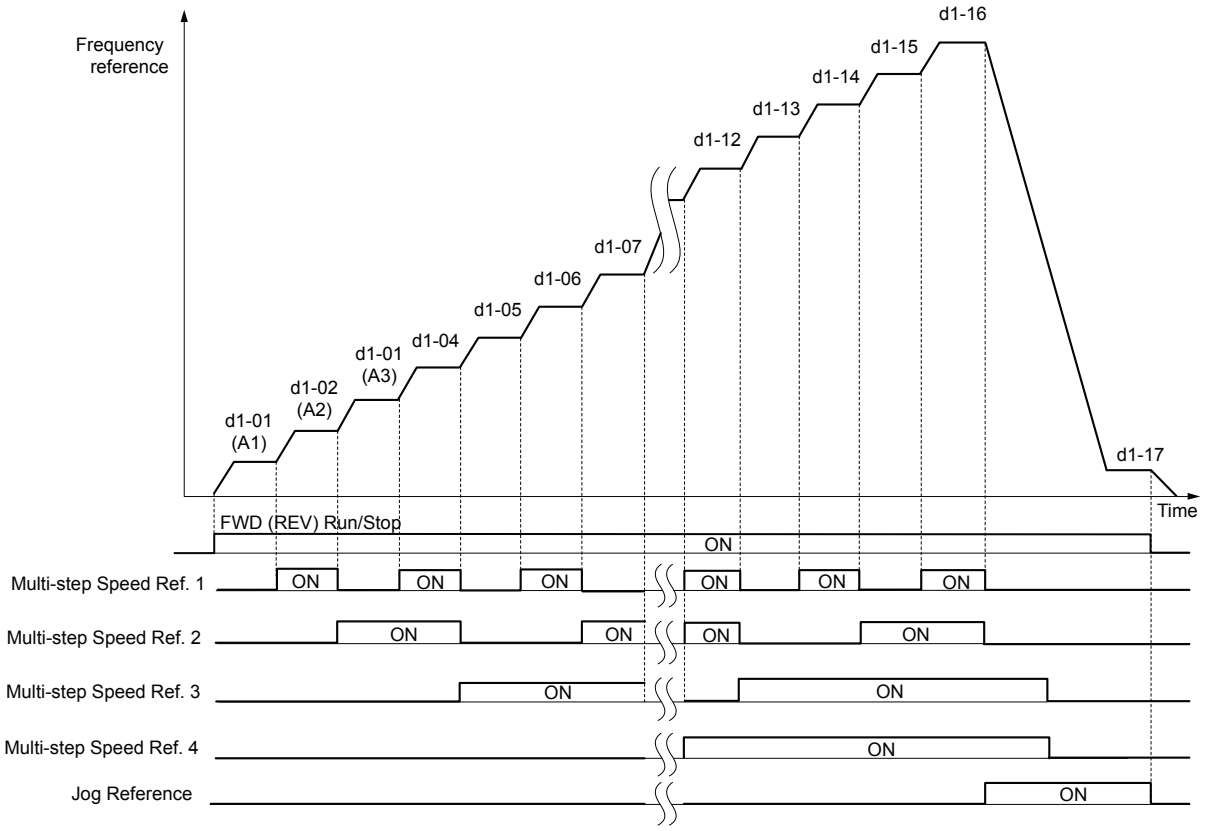


Figure 5.27 Preset Reference Timing Diagram

◆ d2: Frequency Upper/Lower Limits

Upper and lower frequency limits prevent motor speed from going above or below levels that may cause resonance or equipment damage.

■ d2-01: Frequency Reference Upper Limit

Sets the maximum frequency reference as a percentage of the maximum output frequency. This limit applies to all frequency references.

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 minimum frequency reference as a percentage of the maximum output frequency. This limit applies to all frequency references.

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%

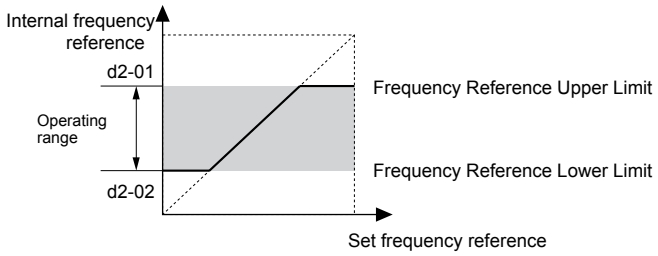


Figure 5.28 Frequency Reference: Upper and Lower Limits

■ d2-03: Master Speed Reference Lower Limit

Sets a lower limit as a percentage of the maximum output frequency that will only affect a frequency reference entered from the analog input terminals (A1, A2, or A3). This is unlike parameter d2-02, which affects all frequency references regardless of their source.

Note: When lower limits are set to both parameters d2-02 and 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%

◆ d3: Jump Frequency

■ d3-01 to d3-04: Jump Frequencies 1, 2, 3 and Jump Frequency Width

The Jump frequencies are frequency ranges at which the drive will not operate. The drive can be programmed with three separate Jump frequencies to avoid operating at speeds that cause resonance in driven machinery. If the speed reference falls within a Jump frequency dead band, the drive will clamp the frequency reference just below the dead band and only accelerate past it when the frequency reference rises above the upper end of the dead band.

Setting parameters d3-01 through d3-03 to 0.0 Hz disables the Jump frequency function.

No.	Parameter Name	Setting Range	Default
d3-01	Jump Frequency 1	0.0 to 400.0 Hz	0.0 Hz
d3-02	Jump Frequency 2	0.0 to 400.0 Hz	0.0 Hz
d3-03	Jump Frequency 3	0.0 to 400.0 Hz	0.0 Hz
d3-04	Jump Frequency Width	0.0 to 20.0 Hz	1.0 Hz

Figure 5.29 shows the relationship between the Jump frequency and the output frequency.

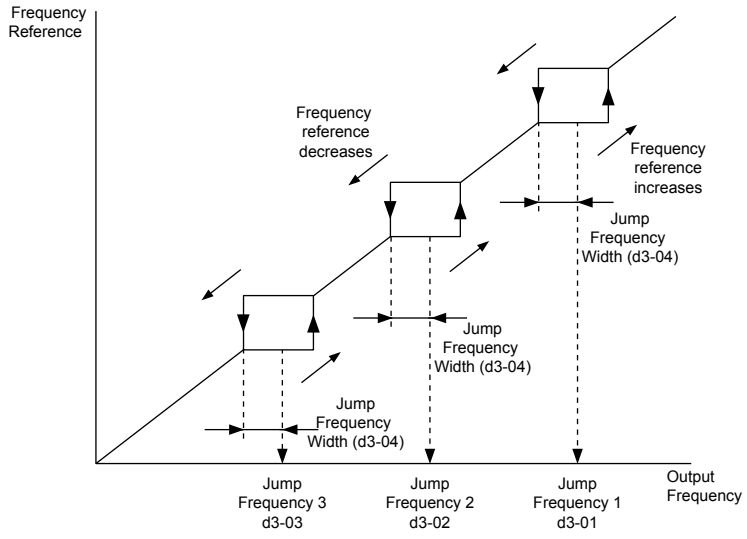


Figure 5.29 Jump Frequency Operation

Note: 1. The drive will use the active accel/decel time to pass through the specified dead band range, but will not allow continuous operation in that range.

2. When setting more than one Jump frequency, make sure that the parameters do not overlap.

◆ d4: Frequency Reference Hold and Up/Down 2 Function

■ d4-01: Frequency Reference Hold Function Selection

Determines whether the frequency reference or the frequency bias (Up/Down 2) value is saved when the Stop command is entered or the power supply is shut down. This parameter is effective when either of the digital input functions listed below are used:

- Accel/decel ramp hold function (H1-□□= A)
- Up/Down function (H1-□□ = 10 and 11)
- Up/Down 2 function (H1-□□ = 75 and 76)

No.	Parameter Name	Setting Range	Default
d4-01	Frequency Reference Hold Function Selection	0, 1	0

The operation depends on the function used with parameter d4-01.

Setting 0: Disabled

- Acceleration hold

  The hold value will be reset to 0 Hz when the Stop command is entered or the drive power is switched off. The active frequency reference will be the value the drive uses when it restarts.
- Up/Down

  The frequency reference value will be reset to 0 Hz when the Stop command is entered or the drive power is switched off. The drive will start from 0 Hz when it is restarted.
- Up/Down 2

  The frequency bias is not saved when the Stop command is entered, or 5 s after the Up/Down 2 command has been released. The Up/Down 2 function will start with a bias of 0% when the drive is restarted.

Setting 1: Enabled

- Acceleration hold

  The last hold value will be saved when the Run command or the drive power is switched off and the drive will use the saved value as the frequency reference when it restarts. Make sure to continuously enable the multi-function input terminal set for "Accel/decel ramp hold" (H1-□□ = A) or the hold value will be cleared when the power is switched on.

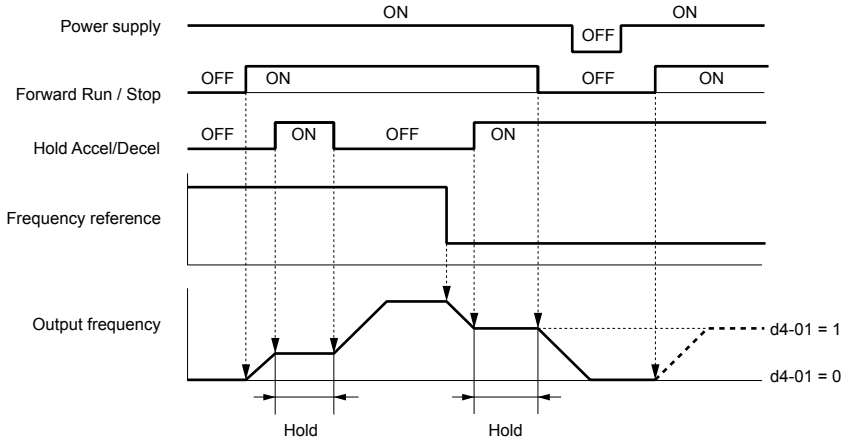


Figure 5.30 Frequency Reference Hold with Accel/Decel Hold Function

- Up/Down

  The frequency reference value will be saved when the Run command or the drive power is switched off. The drive will use the frequency reference that was saved when it restarts.
- Up/Down 2 with frequency reference from digital operator

  When a Run command is active and the Up/Down 2 command is released for longer than 5 s, the Up/Down 2 bias value is added to the frequency reference and then reset to 0. This new frequency reference is saved and will also be used to restart the drive after the power is cycled.

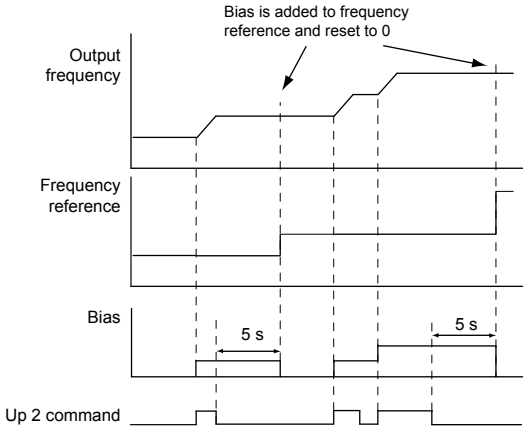


Figure 5.31 Up/Down 2 Example with Reference from Digital Operator and d4-01 = 1

- Up/Down 2 with frequency reference from input sources other than the digital operator

  When a Run command is active and the Up/Down 2 command is released for longer than 5 s, the bias value will be saved in parameter d4-06. When restarting after the power is switched off, the drive will add the value saved in d4-06 as a bias to the frequency reference.

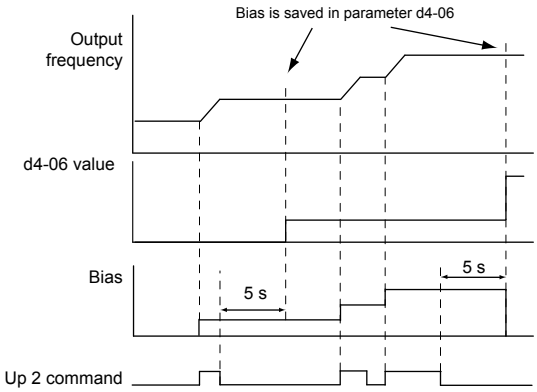


Figure 5.32 Up/Down 2 Example with Other Reference than Digital Operator and d4-01 = 1

Note: Set the limits for Up/Down 2 properly when using d4-01 = 1 in combination with the Up/Down 2 function. *Refer to d4-08: Frequency Reference Bias Upper Limit (Up/Down 2) on page 180* and *Refer to d4-09: Frequency Reference Bias Lower Limit (Up/Down 2) on page 180* for details on the limit settings.

Clearing the Saved Value

Depending on which function is used, it is possible to clear the saved frequency reference value by:

- Releasing the input programmed for Acceleration hold.
- Setting an Up or Down command while no Run command is active.
- Resetting parameter d4-06 to zero. *Refer to d4-06: Frequency Reference Bias (Up/Down 2) on page 180* for details.

■ d4-03: Frequency Reference Bias Step (Up/Down 2)

Sets the bias added to or subtracted from the frequency reference by the Up/Down 2 function.

No.	Parameter Name	Setting Range	Default
d4-03	Frequency Reference Bias Step (Up/Down 2)	0.00 to 99.99 Hz	0.00 Hz

The operation depends on the set value:

Setting d4-03 = 0.00 Hz

While the Up 2 or Down 2 command is enabled, the bias value is increased or decreased using the accel/decel times determined by parameter d4-04.

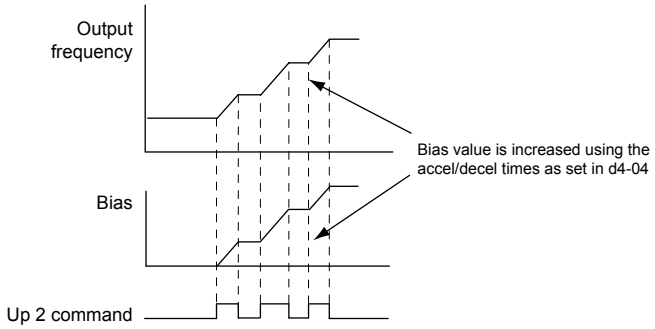


Figure 5.33 Up/Down 2 Bias when d4-03 = 0.00 Hz

Setting d4-03 ≠ 0.00 Hz

When an Up 2 or Down 2 command is enabled, the bias is increased or decreased in steps for the value set in d4-03. The frequency reference changes with the accel/decel times determined by parameter d4-04.

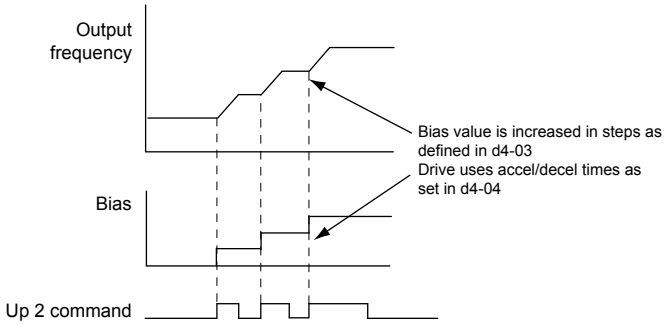


Figure 5.34 Up/Down 2 Bias when d4-03 > 0.00 Hz

■ d4-04: Frequency Reference Bias Accel/Decel (Up/Down 2)

Determines the accel/decel times used to increase or decrease the frequency reference or bias when using the Up/Down 2 function.

No.	Parameter Name	Setting Range	Default
d4-04	Frequency Reference Bias Accel/Decel (Up/Down 2)	0, 1	0

Setting 0: Current Accel/Decel Time

The drive uses the currently active accel/decel time.

Setting 1: Accel/Decel Time 4

The drive uses accel/decel time 4 set to parameters C1-07 and C1-08.

Note: The functionality of setting 1 is only accessible via MEMOBUS/Modbus communications.

■ d4-05: Frequency Reference Bias Operation Mode Selection (Up/Down 2)

Determines if the bias value is held when the Up/Down 2 inputs are both released or both enabled. The parameter is effective only when parameter d4-03 is set to 0.00.

No.	Parameter Name	Setting Range	Default
d4-05	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	0, 1	0

Setting 0: Hold Bias Value

The bias value will be held if no input Up 2 or Down 2 is active.

Setting 1: Reset Bias Value

The bias is reset to 0% when inputs Up 2 and Down 2 are both on or both off. The drive will use the accel/decel time as selected in d4-04 to accelerate or decelerate to the frequency reference value.

■ d4-06: Frequency Reference Bias (Up/Down 2)

Saves the frequency reference bias value set by the Up/Down 2 function as a percentage of the maximum output frequency. The function of this parameter depends on the Up/Down 2 function configuration. This parameter is not normally used when the digital operator sets the frequency reference.

- The value set to d4-06 will be applied during run, however the value is reset when the frequency reference changes (including multi-step references) and is disabled when d4-01 = 0 and the Run command is removed.
- When d4-01 = 0 and the frequency reference is set by a source other than the digital operator, the value set in d4-06 is added to or subtracted from the frequency reference.
- When d4-01 = 1 and the frequency reference is set by a source other than the digital operator, the bias value adjusted with the Up/Down 2 inputs is stored in d4-06 when 5 s have passed after releasing the Up 2 or Down 2 command. The frequency reference will return to the value without the Up/Down 2 command.

No.	Parameter Name	Setting Range	Default
d4-06	Frequency Reference Bias (Up/Down 2)	-99.9 to 100.0%	0.0%

Conditions that Reset or Disable d4-06

- The Up/Down 2 function has not been assigned to the multi-function terminals.
- The frequency reference source has been changed (including LOCAL/REMOTE or External reference 1/2 switch over by digital inputs).
- d4-03 = 0 Hz, d4-05 = 1, and the Up/Down 2 commands are both open or both closed.
- Any changes to the maximum frequency set to E1-04.

■ d4-07: Analog Frequency Reference Fluctuation Limit (Up/Down 2)

Handles frequency reference changes while the Up 2 or Down 2 terminal is enabled. If the frequency reference changes for more than the level set to d4-07, then the bias value will be held,and the drive will accelerate or decelerate following the frequency reference. When the frequency reference is reached, the bias hold is released and the bias follows the Up/Down 2 input commands.

This parameter is applicable only if the frequency reference is set by an analog or pulse input.

No.	Parameter Name	Setting Range	Default
d4-07	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	0.1 to 100.0%	0.01.%

■ d4-08: Frequency Reference Bias Upper Limit (Up/Down 2)

Sets the upper limit of the Up/Down 2 bias (monitor U6-20) and the value that can be saved in parameter d4-06. Set this parameter to an appropriate value before using the Up/Down 2 function.

Note: When the frequency reference is set by the digital operator (b1-01 = 0) and d4-01 = 1, the bias value will be added to the frequency reference if no Up/Down 2 command is received for 5 s, and will be reset to 0 afterwards. From that point, the bias can be increased up to the limit set in d4-08 again.

No.	Parameter Name	Setting Range	Default
d4-08	Frequency Reference Bias Upper Limit (Up/Down 2)	0.0 to 100.0%	1.0%

■ d4-09: Frequency Reference Bias Lower Limit (Up/Down 2)

Sets the lower limit of the Up/Down 2 bias (monitor U6-20) and the value that can be saved in parameter d4-06. Set this parameter to an appropriate value before using the Up/Down 2 function.

Note: When the frequency reference is set by the digital operator (b1-01 = 0) and d4-01 = 1, the bias value will be added to the frequency reference if no Up/Down 2 command is received for 5 s, and will be reset to 0 afterwards. If the bias is increased using the Up 2 command, it cannot be reduced with a Down 2 command when the limit set in d4-09 is 0. Set a negative lower limit in d4-09 to allow speed reduction in this situation.

No.	Parameter Name	Setting Range	Default
d4-09	Frequency Reference Bias Lower Limit (Up/Down 2)	-99.9 to 0.0%	0.0%

■ d4-10: Up/Down Frequency Reference Limit Selection

Selects how the lower frequency limit is set when using the Up/Down function. *Refer to Setting 10, 11: Up/Down Function on page 199* for details on the Up/Down function in combination with frequency reference limits.

No.	Parameter Name	Setting Range	Default
d4-10	Up/Down Frequency Reference Limit Selection	0, 1	0

Setting 0: Lower Limit is Determined by d2-02 or Analog Input

The higher value between d2-02 and an analog input programmed for Frequency bias (A1, A2, A3) determines the lower frequency reference limit.

Note: When using the External Reference 1/2 (H1-□□ = 2) to switch between the Up/Down function and an analog input as the reference source, the analog value becomes the lower reference limit when the Up/Down command is active. Set d4-10 to 1 to make the Up/Down function independent of the analog input value.

Setting 1: Lower Limit is Determined by d2-02

Only parameter d2-02 sets the lower frequency reference limit.

◆ d6: Field Weakening and Field Forcing

Field Weakening

The Field Weakening function reduces the output voltage to a predefined level to reduce the energy consumption of the motor. To activate the Field Weakening function, use a digital input programmed for H1-□□ = 63. Only use Field Weakening 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.

■ d6-01: Field Weakening Level

Sets the level to which the output voltage is reduced when Field Weakening is activated. Set as percentage of the 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 at which field weakening can be activated. Field Weakening cannot be activated for frequencies below d6-02.

No.	Parameter Name	Setting Range	Default
d6-02	Field Weakening Frequency Limit	0 to 400.0 Hz	0.0 Hz

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

Adjusts the levels of some protective features of the drive (overvoltage, Stall Prevention, etc.). Set this parameter to the nominal voltage of the AC power supply.

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	Input Voltage Setting	155 to 255 V <1>	230 V <1>

<1> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

E1-01 Related Values

The input voltage setting determines the overvoltage and undervoltage detection levels, the operation levels of the braking transistor, the KEB function, and the overvoltage suppression function.

Voltage	Setting Value of E1-01	ov Detection Level/Dynamic Braking Transistor Detection Level <1> (rr Detection Level)	(Approximate Values)		
			Uv Detection Level (L2-05)	Desired DC Bus Voltage during KEB (L2-11)	ov Suppression / Stall Prevention Level (L3-17)
200 V Class	All settings	410 V / 394 V	190 V	260 V	375 V
400 V Class	setting ≥ 400 V	820 V / 788 V	380 V	500 V	750 V
	setting < 400 V	820 V / 788 V	350 V	460 V	750 V
600 V Class	All settings	1178 V / 1132 V	475 V	635 V	930 V

<1> The braking transistor operation levels are valid for the drive internal braking transistor. When using a CDBR braking unit, refer to instruction manual TOBPC72060000 or TOBPC72060001.

■ V/f Pattern Settings (E1-03)

The drive uses a V/f pattern to adjust the output voltage relative to the frequency reference. There are 15 different predefined V/f patterns (setting 0 to E) from which to select, each with varying voltage profiles, saturation levels (frequency at which maximum voltage is reached), and maximum frequencies. Additionally, one custom V/f pattern is available (setting F) that requires the user to create the pattern using parameters E1-04 through E1-10.

■ E1-03: V/f Pattern Selection

Selects the V/f pattern for the drive and motor from 15 predefined patterns or creates a custom V/f pattern.

No.	Parameter Name	Setting Range	Default
E1-03	V/f Pattern Selection	0 to F	F <1>

<1> Parameter is not reset to the default value when the drive is initialized using A1-03.

Setting a Predefined V/f Pattern (Setting 0 to E)

Choose the V/f pattern that best meets the application demands from ***Table 5.16***. These settings are available only in V/f Control modes. Set the correct value to E1-03. Parameters E1-04 to E1-13 can only be monitored, not changed.

Note:
1. Setting an improper V/f pattern may result in low motor torque or increased current due to overexcitation.
2. Drive initialization does not reset parameter E1-03.

Table 5.16 Predefined V/f Patterns

Setting	Specification	Characteristic	Application
0	50 Hz	Constant torque	For general purpose applications. Torque remains constant regardless of changes to speed.
1	60 Hz		
2	60 Hz (with 50 Hz base)		
3	72 Hz (with 60 Hz base)		
4	50 Hz, Heavy Duty 2	Variable torque	For fans, pumps, and other applications where the required torque changes as a function of the speed.
5	50 Hz, Heavy Duty 1		
6	50 Hz, Heavy Duty 1		
7	50 Hz, Heavy Duty 2		
8	50 Hz, mid starting torque	High starting torque	Select high starting torque when: • Wiring between the drive and motor exceeds 150 m. • A large amount of starting torque is required. • An AC reactor is installed.
9	50 Hz, high starting torque		
A	60 Hz, mid starting torque		
B	60 Hz, high starting torque		
C	90 Hz (with 60 Hz base)	Constant output	Output voltage is constant when operating at greater than 60 Hz.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		
F <1>	60 Hz	Constant torque	For general purpose applications. Torque remains constant regardless of changes to speed.

<1> Setting F enables a custom V/f pattern by changing parameters E1-04 to E1-13. When the drive is shipped, the default values for parameters E1-04 to E1-13 are the same as those of setting 1.

The following tables show details on predefined V/f patterns.

Predefined V/f Patterns for Models 2A0004 to 2A0021, 4A0002 to 4A0011, and 5A0003 to 5A0009

The values in the following graphs are specific to 200 V class drives. Double the values for 400 V class drives. Multiply the values by 2.875 for 600 V drives.

Table 5.17 Constant Torque Characteristics, Settings 0 to 3

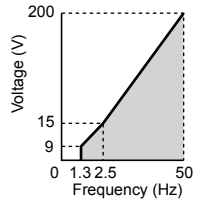
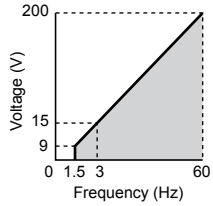
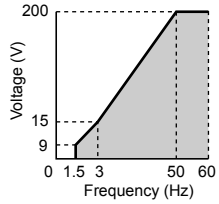
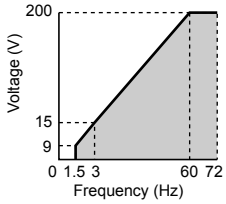
Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz
							

Table 5.18 Derated Torque Characteristics, Settings 4 to 7

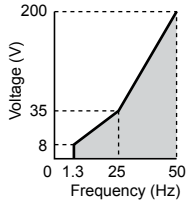
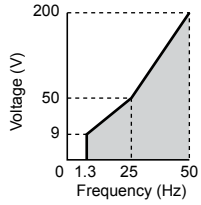
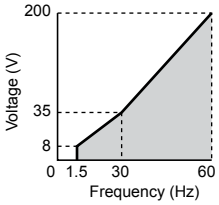
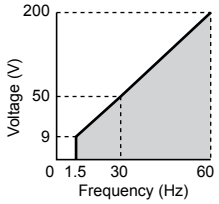
Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
							

Table 5.19 High Starting Torque, Settings 8 to B

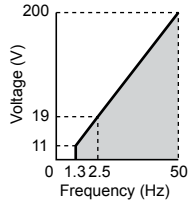
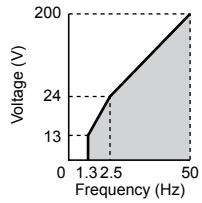
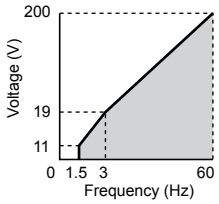
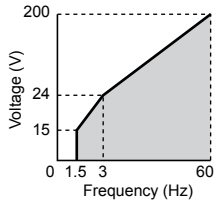
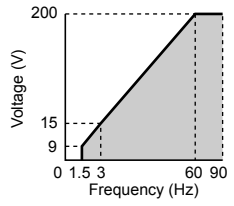
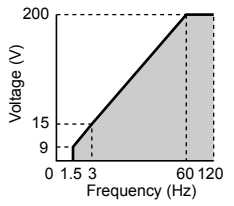
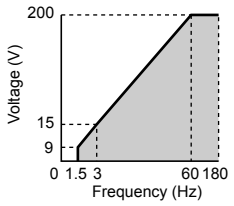
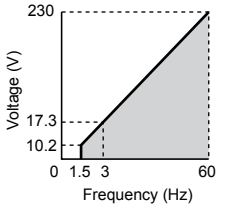
Setting = 8	50 Hz	Setting = 9	50 Hz	Setting = A	60 Hz	Setting = B	60 Hz
							

Table 5.20 Rated Output Operation, Settings C to F

Setting = C	90 Hz	Setting = D	120 Hz	Setting = E	180 Hz	Setting = F	60 Hz
							

Predefined V/f Patterns for Models 2A0030 to 2A0211, 4A0018 to 4A0103, and 5A0011 to 5A0077

The values in the following graphs are specific to 200 V class drives. Double the values for 400 V class drives. Multiply the values by 2.875 for 600 V class drives.

Table 5.21 Rated Torque Characteristics, Settings 0 to 3

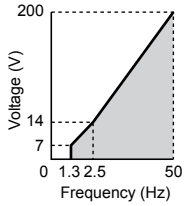
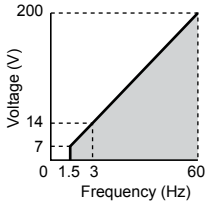
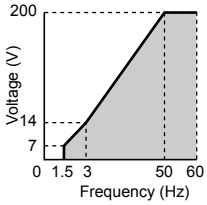
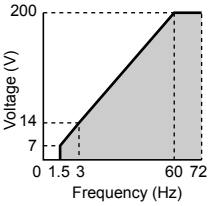
Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz
							

Table 5.22 Derated Torque Characteristics, Settings 4 to 7

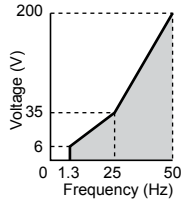
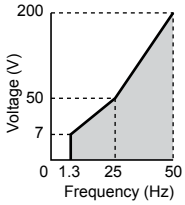
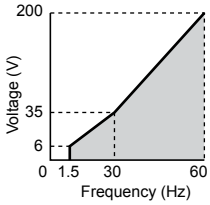
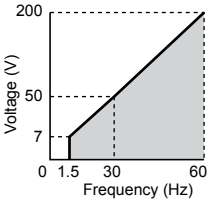
Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
							

Table 5.23 High Starting Torque, Settings 8 to B

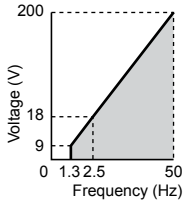
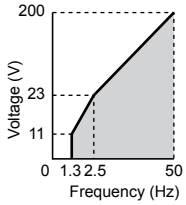
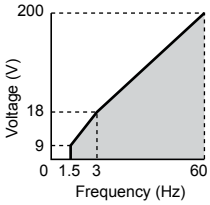
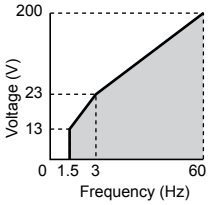
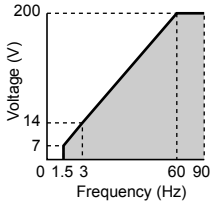
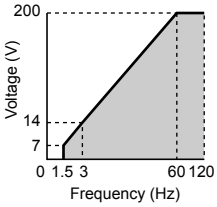
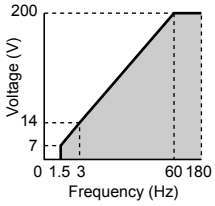
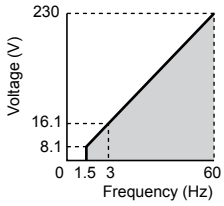
Setting = 8	50 Hz	Setting = 9	50 Hz	Setting = A	60 Hz	Setting = B	60 Hz
							

Table 5.24 Constant Output, Settings C to F

Setting = C	90 Hz	Setting = D	120 Hz	Setting = E	180 Hz	Setting = F	60 Hz
							

Predefined V/f Patterns for Models 2A0250 to 2A0415, 4A0139 to 4A0675, and 5A0099 to 5A0242

The values in the following graphs are specific to 200 V class drives. Double the values for 400 V class drives. Multiply the values by 2.875 for 600 V class drives.

Table 5.25 Rated Torque Characteristics, Settings 0 to 3

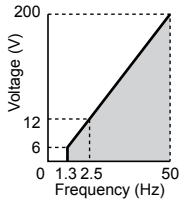
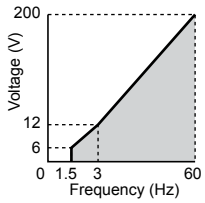
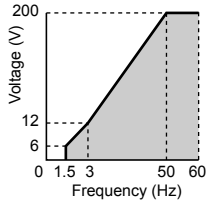
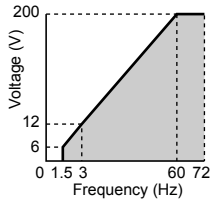
Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz
							

Table 5.26 Derated Torque Characteristics, Settings 4 to 7

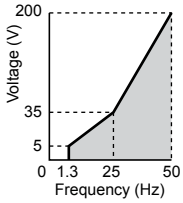
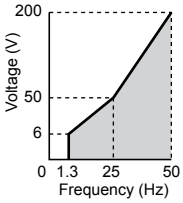
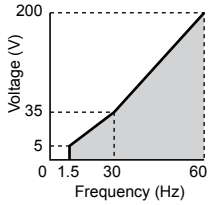
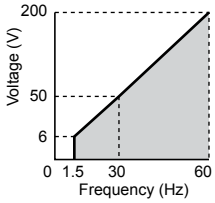
Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
							

Table 5.27 High Starting Torque, Settings 8 to B

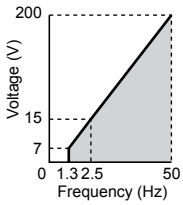
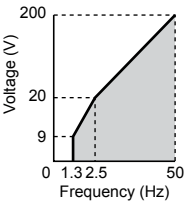
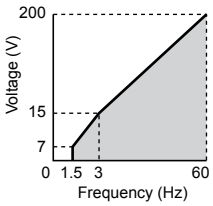
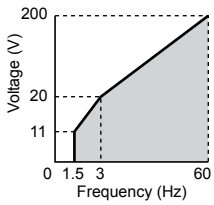
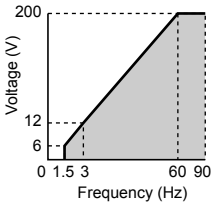
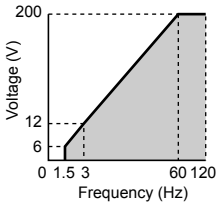
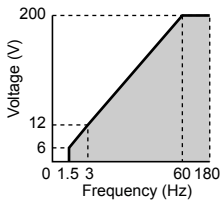
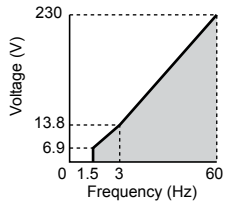
Setting = 8	50 Hz	Setting = 9	50 Hz	Setting = A	60 Hz	Setting = B	60 Hz
							

Table 5.28 Constant Output, Settings C to F

Setting = C	90 Hz	Setting = D	120 Hz	Setting = E	180 Hz	Setting = F	60 Hz
							

Setting a Custom V/f Pattern (Setting F: Default)

Setting parameter E1-03 to F allows the user to set up a custom V/f pattern by changing parameters E1-04 to E1-13.

When initialized, the default values for parameters E1-04 to E1-13 will be equal to Predefined V/f pattern 1.

■ V/f Pattern Settings E1-04 to E1-13

If E1-03 is set to a preset V/f pattern (i.e., a value other than F), the user can monitor the V/f pattern in parameters E1-04 through E1-13. To create a new V/f pattern, set E1-03 to F. *Refer to V/f Pattern on page 186* for an example custom V/f pattern.

No.	Parameter Name	Setting Range	Default
E1-04	Maximum Output Frequency	40.0 to 400.0 Hz	60.0 Hz
E1-05	Maximum Voltage	0.0 to 255.0 V <4>	575.0 V
E1-06	Base Frequency	0.0 to [E1-04]	60.0 Hz
E1-07	Middle Output Frequency	0.0 to [E1-04]	3.0 Hz
E1-08	Middle Output Frequency Voltage	0.0 to 255.0 V <4>	15.0 V
E1-09	Minimum Output Frequency	0.0 to [E1-04]	1.5 Hz
E1-10	Minimum Output Frequency Voltage	0.0 to 255.0 V <4>	9.0 V

No.	Parameter Name	Setting Range	Default
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 <5> <6>
E1-13	Base Voltage	0.0 to 255.0 V <4>	0.0 V <5> <7>

<4> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

<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> E1-13 and E1-05 are set to the same value when Auto-Tuning is performed.

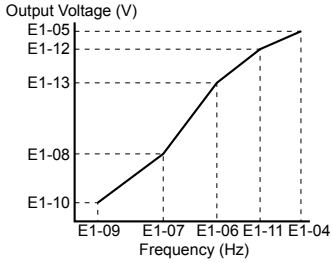


Figure 5.35 V/f Pattern

Note:
1. The following condition must be true when setting up the V/f pattern: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04
2. To make the V/f pattern a straight line below E1-06, set E1-09 equal to E1-07. In this case the E1-08 setting is disregarded.
3. E1-03 is unaffected when the drive is initialized, but E1-04 through E1-13 return to their default values.
4. Only use E1-11, E1-12, and E1-13 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. Performing Auto-Tuning (including Rotational Auto-Tuning and Stationary Auto-Tuning 1 and 2) automatically sets these parameters. *Refer to Auto-Tuning Fault Detection on page 307* for details if Auto-Tuning cannot be performed.

■ E2-01: Motor Rated Current

Provides motor control, protects the motor, and calculates torque limits. Set E2-01 to the full load amps (FLA) stamped on the motor nameplate. 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 o2-04

Note:
1. The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW. *Refer to Power Ratings on page 374* for details.
2. An oPE02 error will occur if the motor rated current in E2-01 is set lower than the motor no-load current in E2-03. Set E2-03 correctly to prevent this error.

■ E2-02: Motor Rated Slip

Sets the motor rated slip in Hz to provide motor control, protect the motor, and 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 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:

$E2\text{-}02 = f - (n \times p)/120$

(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 o2-04

Note: The number of decimal places in the parameter value depends on the drive model 1. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW. *Refer to Power Ratings on page 374* for details.

■ 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. Enter this value as line-to-line and not for each motor phase.

If Auto-Tuning is not possible, 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 one of the formulas below:

- E-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- B-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- F-type insulation: Multiply 0.87 times the resistance value (Ω) 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 mΩ	Determined by 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 o2-04

■ E2-10: Motor Iron Loss for Torque Compensation

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 o2-04

■ E2-11: Motor Rated Power

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

■ Setting Motor Parameters Manually

Follow the instructions below when setting motor-related parameters manually instead of Auto-Tuning. Refer to the motor test report included with the motor to ensure the correct data is entered into the drive.

Set the Motor Rated Current

Enter the motor rated current listed on the nameplate of the motor to E2-01.

Set the Motor Rated Slip

Calculate the motor rated slip using the base speed listed on the motor nameplate. 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

Set the No-Load Current

Enter the no-load current at rated frequency and rated voltage to E2-03. This information 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.

Set the Line-to-Line Resistance

E2-05 is normally set during Auto-Tuning. If Auto-Tuning cannot be performed, contact the motor manufacturer to determine the correct resistance between motor lines. The motor test report can also be used to calculate this value using the formulas below:

- E-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- B-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- F-type insulation: Multiply 0.87 times the resistance value (Ω) listed on the test report at 115 °C.

Set the Motor Leakage Inductance

The motor leakage inductance set to E2-06 determines the amount of voltage drop relative to the motor rated voltage. Enter this value for motors with a low degree of inductance, such as high-speed motors. This information is usually not listed on the motor nameplate. Contact the motor manufacturer if the data cannot be found.

Set the Motor Iron-Core Saturation Coefficient 1, 2

E2-07 and E2-08 are set when Auto-Tuning is performed.

Set the Motor Iron Loss for Torque Compensation

Enter this value in watts to E2-10. The drive uses this setting to improve the precision of torque compensation.

5.6 F: Option Settings

◆ F4: Analog Monitor Card Settings

These parameters set the drive for operation with the analog output option card AO-A3. 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

The output signal is adjustable while the drive is stopped.

Terminal V1

1. View the value set to F4-02 (Terminal V1 Monitor Gain) on the digital operator. A voltage equal to 100% of the parameter being set in F4-01 will be output from terminal V1.
2. Adjust F4-02 viewing the monitor connected to the terminal V1.
3. View the value set to F4-05 on the digital operator, terminal V1 will output a voltage equal to 0% of the parameter being set in F4-01.
4. Adjust F4-05 viewing the output signal on the terminal V1.

Terminal V2

1. View the value set to F4-02 (Terminal V2 Monitor Gain) on the digital operator. A voltage equal to 100% of the parameter being viewed in F4-03 will be output from terminal V2.
2. Adjust F4-04 viewing the monitor connected to the terminal V2.
3. View the value set to F4-06 on the digital operator, terminal V2 will output a voltage equal to 0% of the parameter being set in F4-03.
4. Adjust F4-06 viewing the output signal on the terminal V2.

■ 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

◆ F6: Communication Option Card

These parameters configure communication option cards and communication fault detection methods.

Some parameters apply to all communication option cards and some parameters apply to certain network options only. The option cards are applicable to the parameter rows marked with an "O".

Parameter	Communication Protocol				
	CC-Link	MECHATROLINK-II	PROFIBUS-DP	CANopen	DeviceNet
F6-01 to F6-03, F6-06 to F6-08	O	O	O	O	O
F6-04, F6-10, F6-11, F6-14	O	–	–	–	–
F6-20 to F6-26	–	O	–	–	–
F6-30 to F6-32	–	–	O	–	–
F6-35 to F6-36	–	–	–	O	–
F6-50 to F6-63	–	–	–	–	O

■ F6-01: Communications Error Operation Selection

Determines drive operation when 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, 1	0

Setting 0: Always detected

Setting 1: Detection during Run only

■ F6-03: External Fault from Comm. Option Operation Selection

Determines drive 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)

■ F6-07: NetRef/ComRef Function Selection

Selects the treatment of multi-step speed inputs when the NetRef command is set.

No.	Parameter Name	Setting Range	Default
F6-07	NetRef/ComRef Function Selection	0, 1	0

Setting 0: Multi-step speed operation disabled

Multi-step speed input frequency references are disabled when the NetRef command is selected.

Setting 1: Multi-step speed operation enabled

Multi-step speed inputs are still active and can override the frequency reference from the communications option even when the NetRef command is selected.

■ F6-08: Reset Communication Parameters

Determines whether F6-☐☐ communication-related parameters are reset after initialization.

No.	Parameter Name	Setting Range	Default
F6-08	Reset Communication Parameters	0, 1	0

Setting 0: Do not reset F6-☐☐ parameters after initialization using A1-03

Setting 1: Reset F6-☐☐ parameters after initialization using 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 the drive to operate on a CC-Link network.

■ F6-04: bUS Error Detection Time

Sets the delay time for bUS error detection.

No.	Parameter Name	Setting Range	Default
F6-04	bUS Error Detection Time	0.0 to 5.0 s	2.0 s

■ F6-10: CC-Link Node Address

Sets the node address of a CC-Link option board.

No.	Parameter Name	Setting Range	Default
F6-10	CC-Link Node Address	0 to 64	0

■ F6-11: CC-Link Communication Speed

Sets the communication speed for a CC-Link option card.

No.	Parameter Name	Setting Range	Default
F6-11	CC-Link Communication Speed	0 to 4	0

Settings:

F6-11	Communication Speed	F6-11	Communication Speed
0	156 kbps	3	5 Mbps
1	625 kbps	4	10 Mbps
2	2.5 Mbps	–	–

■ F6-14: CC-Link bUS Error Auto Reset

Selects whether a bUS error can be automatically reset if automatic fault retry is enabled.

No.	Parameter Name	Setting Range	Default
F6-14	CC-Link bUS Error Auto Reset	0, 1	0

Setting 0: Disabled, auto reset not possible

Setting 1: Enabled, auto reset possible

◆ MECHATROLINK Parameters

Parameters F6-20 through F6-26 run the MECHATROLINK options.

■ F6–20: MECHATROLINK Station Address

No.	Parameter Name	Setting Range	Default
F6–20	MECHATROLINK Station Address	20, 3F	21

■ F6-21: MECHATROLINK Frame Size

No.	Parameter Name	Setting Range	Default
F6–21	MECHATROLINK Frame Size	0, 1	0

Setting 0: 32 byte
Setting 1: 17 byte

■ F6-22: MECHATROLINK Link Speed

No.	Parameter NamMECHATROLINK Frame Size	Setting Range	Default
F6–22	MECHATROLINK Link Speed	0, 1	0

Setting 0: 10 Mbps
Setting 1: 4 Mbps

■ F6-23 – F6-24: MECHATROLINK Monitor Selection

Sets the output signal level for terminals V1 and V2.

No.	Parameter Name	Setting Range	Default
F6–23	MECHATROLINK –II Monitor Selection (E)	0, FFFF	0
F6–24	MECHATROLINK –II Monitor Selection (F)	0, FFFF	0

■ F6-25: Operation Selection at Watchdog Timer Error

No.	Parameter Name	Setting Range	Default
F6–25	Operation Selection at Watchdog Timer Error (E5)	0 to 3	1

Setting 0: Ramp to stop. Decelerate using the deceleration time in C1-02.
Setting 1: Coast to stop.
Setting 2: Fast stop. Decelerate using the deceleration time in C1-09.
Setting 3: Alarm only

■ F6-26: MECHATROLINK bUS Errors Detected

Sets the number of option communicaiton errors (bUS).

No.	Parameter Name	Setting Range	Default
F6-26	MECHATROLINK bUS Errors Detected	2 to 10	2

◆ PROFIBUS-DP Parameters

Parameters F6-30 through F6-32 set the drive to run on a PROFIBUS-DP network.

■ F6-30: PROFIBUS-DP Node Address

Sets the node address of a PROFIBUS-DP option card.

No.	Parameter Name	Setting Range	Default
F6-30	PROFIBUS-DP Node Address	0 to 125	0

■ F6-31: PROFIBUS-DP Clear Mode Selection

Determines the operation when a Clear Mode command is received.

No.	Parameter Name	Setting Range	Default
F6-31	PROFIBUS-DP Clear Mode Selection	0, 1	0

Setting 0: Reset
Resets the drive operation (frequency reference, inputs, outputs etc.).

Setting 1: Maintain the previous state

Returns the drive status to the state prior to receiving the command.

■ F6-32: PROFIBUS-DP Data Format Selection

Selects the data format used for PROFIBUS-DP communication.

No.	Parameter Name	Setting Range	Default
F6-32	PROFIBUS-DP Data Format Selection	0, 1	0

Setting 0: PPO-type data format

Setting 1: Conventional data format

◆ CANopen Parameters

Parameters F6-35 and F6-36 set the drive to operate on a CANopen network.

■ F6-35: CANopen Node ID Selection

Selects the node ID of a CANopen option board.

No.	Parameter Name	Setting Range	Default
F6-35	CANopen Node ID Selection	0 to 126	0

■ F6-36: CANopen Communication Speed

Sets the communication speed for a CANopen option card.

No.	Parameter Name	Setting Range	Default
F6-36	CANopen Communication Speed	0 to 8	6

Settings:

F6-36	Communication Speed	F6-36	Communication Speed
0	Auto detection	5	250 kbps
1	10 kbps	6	500 kbps
2	20 kbps	7	800 kbps
3	50 kbps	8	1 Mbps
4	125 kbps	–	–

◆ DeviceNet Parameters

Parameters F6-50 through F6-63 set the drive to operate on a DeviceNet network.

■ F6-50: DeviceNet MAC Address

Sets the MAC address for a DeviceNet option card.

No.	Parameter Name	Setting Range	Default
F6-50	DeviceNet MAC Address	0 to 64	64

■ F6-51: DeviceNet Communication Speed

Sets the communication speed for a DeviceNet option card.

To assign the baud rate for the drive from the upper controller, set F6-51 = 3.

To make the drive detect the network speed, set F6-51 = 4. The drive will automatically adjust itself after detecting the network speed.

No.	Parameter Name	Setting Range	Default
F6-51	DeviceNet Communication Speed	0 to 4	4

Settings:

F6-51	Communication Speed	F6-51	Communication Speed
0	125 kbps	3	Adjustable from Network
1	250 kbps	4	Auto detection
2	500 kbps	–	–

■ F6-52: DeviceNet PCA Setting

Defines the format for data the drive receives from the DeviceNet master.

No.	Parameter Name	Setting Range	Default
F6-52	DeviceNet PCA Setting	0 to 255	21

■ F6-53: DeviceNet PPA Setting

Defines the format for data sent from the drive to the DeviceNet master.

No.	Parameter Name	Setting Range	Default
F6-53	DeviceNet PPA Setting	0 to 255	71

■ F6-54: DeviceNet Idle Mode Fault Detection

Determines whether the drive triggers an EF0 fault when no data is received from the master (e.g., when the master is idling).

No.	Parameter Name	Setting Range	Default
F6-54	DeviceNet Idle Mode Fault Detection	0, 1	0

Setting 0: Enabled

Setting 1: Disabled, no fault detection

■ F6-55: DeviceNet Baud Rate Monitor

Displays the baud rate currently being used for network communications. F6-55 is used only as a monitor.

No.	Parameter Name	Setting Range	Default
F6-55	DeviceNet Baud Rate Monitor	0 to 2 (read only)	0

Settings:

F6-55	Communication Speed	F6-55	Communication Speed
0	125 kbps	2	500 kbps
1	250 kbps	–	–

■ F6-56 to F6-61: DeviceNet Scaling Factors

These parameters define scaling factors for drive monitors in the DeviceNet Class ID 2AH - AC/DC Drive Object.

No.	Parameter Name	Setting Range	Default
F6-56	DeviceNet Speed Scaling	-15 to 15	0
F6-57	DeviceNet Current Scaling	-15 to 15	0
F6-58	DeviceNet Torque Scaling	-15 to 15	0
F6-59	DeviceNet Power Scaling	-15 to 15	0
F6-60	DeviceNet Voltage Scaling	-15 to 15	0
F6-61	DeviceNet Time Scaling	-15 to 15	0

Setting

The monitor value in the AC/DC Drive Object 2AH is calculated by:
AC/DC Drive Object 2AH Monitor = Drive Value × 2^{Scaling}

Example:

If the drive output frequency monitor (U1-02) is 5.00 and the scaling is set to F6-56 = 6, then the value in the AC/DC Drive Object 2AH, Instance 1, Attribute 7 would be 500 × 2^6 = 32000.

■ F6-62: DeviceNet Heartbeat Interval

Sets the heartbeat interval for DeviceNet communications. A setting of 0 disables the heartbeat function.

No.	Parameter Name	Setting Range	Default
F6-62	DeviceNet Heartbeat Interval	0 to 10	0

■ F6-63: DeviceNet Network MAC ID

Displays the MAC ID assigned to the drive. F6-63 is used only as a monitor.

No.	Parameter Name	Setting Range	Default
F6-63	DeviceNet Network MAC ID	0 to 63 (read only)	63

■ F6-64 to F6-71: Dynamic Assembly Parameters (Reserved)

5.7 H: Terminal Functions

H parameters 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 settings are listed in *Table 5.29*.

No.	Parameter Name	Setting Range	Default
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	1 to 9F	40 (F) <1> : Forward Run Command (2-Wire sequence)
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	1 to 9F	41 (F) <1> : Reverse Run Command (2-Wire sequence)
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	0 to 9F	24: External Fault
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	0 to 9F	14: Fault Reset
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	0 to 9F	3 (0) <1> : Multi-Step Speed Reference 1
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	0 to 9F	4 (3) <1> : Multi-Step Speed Reference 2
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	0 to 9F	6 (4) <1> : Jog Reference Selection
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	0 to 9F	8: (6) <1> : External Baseblock Command

<1> Number appearing in parenthesis is the default value after performing a 3-Wire initialization (A1-03 = 3330).

Table 5.29 Multi-Function Digital Input Terminal Settings

Setting	Function	Page
0	3-Wire Sequence	*197*
1	LOCAL/REMOTE Selection	*197*
2	External Reference 1/2 Selection	*198*
3	Multi-Step Speed Reference 1	*198*
4	Multi-Step Speed Reference 2	
5	Multi-Step Speed Reference 3	
6	Jog reference Selection	*198*
7	Accel/Decel Time Selection 1	*198*
8	Baseblock Command (N.O.)	*198*
9	Baseblock Command (N.C.)	
A	Accel/Decel Ramp Hold	*198*
B	Drive Overheat Alarm (oH2)	*199*
C	Analog Terminal Input Selection	*199*
F	Through Mode	*199*
10	Up Command	*199*
11	Down Command	
12	Forward Jog	*200*
13	Reverse Jog	
14	Fault Reset	*200*
15	Fast Stop (N.O.)	*200*
17	Fast Stop (N.C.)	*200*
18	Timer Function Input	*201*
19	PID Disable	*201*
1A	Accel/Decel Time Selection 2	*201*
1B	Program Lockout	*201*
1E	Reference Sample Hold	*201*
20 to 2F	External Fault	*202*
30	PID Integral Reset	*202*
31	PID Integral Hold	*202*
32	Multi-Step Speed Reference 4	*202*
34	PID Soft Starter Cancel	*202*
35	PID Input Level Selection	*202*
40	Forward Run Command (2-Wire sequence)	*203*
41	Reverse Run Command (2-Wire sequence)	
42	Run Command (2-Wire sequence 2)	*203*
43	FWD/REV Command (2-Wire sequence 2)	
47	Node Setup	*203*
51	Disable Sequence Timers	*203*
52	Cancel Active Sequence Timer	*203*
60	DC Injection Braking Command	*203*
61	External Speed Search Command 1	*204*
62	External Speed Search Command 2	*204*
63	Field Weakening	*204*
65	KEB Ride-Thru 1 (N.C.)	*204*
66	KEB Ride-Thru 1 (N.O.)	
67	Communications Test Mode	*204*
68	High Slip Braking (HSB)	*204*
6A	Drive Enabled	*204*
75	Up 2 Command	*204*
76	Down 2 Command	
7A	KEB Ride-Thru 2 (N.C.)	*205*
7B	KEB Ride-Thru 2 (N.O.)	
A8	Secondary PI Disable (N.O.)	*206*
A9	Secondary PI Disable (N.C.)	*206*
AA	Secondary PI Inverse Operation	*206*
AB	Secondary PI Integral Reset	*206*
AC	Secondary PI Integral Hold	*206*
AD	Select Secondary PI Parameters	*206*

Setting	Function	Page
AF	Emergency Override Forward Run	*206*

Setting	Function	Page
B0	Emergency Override Reverse Run	*206*

Setting 0: 3-Wire Sequence

The digital input programmed for 3-Wire control becomes the forward/reverse directional input, S1 becomes the Run command input, and S2 becomes the Stop command input.

The drive starts the motor when the input S1 set for the Run command closes for longer than 2 ms. The drive stops the operation when the Stop input S2 releases for 2 ms. When the digital input programmed for a forward/reverse operation is open, the drive is set for forward operation. When the digital input is closed, the drive is set for reverse operation.

Note: Input the Run and Stop commands via S1 and S2 when selecting a 3-Wire sequence.

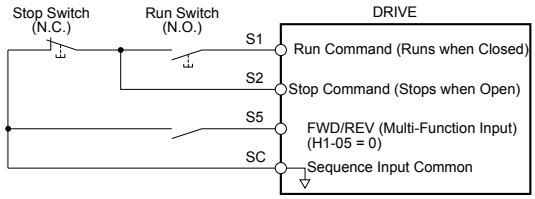


Figure 5.36 3-Wire Sequence Wiring Diagram

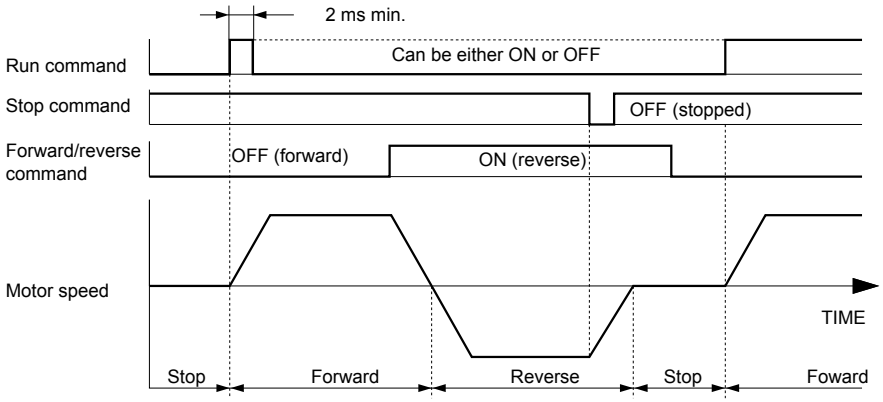


Figure 5.37 3-Wire Sequence

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 automatically issue the Run command upon drive power up.

WARNING! *Sudden Movement Hazard. Ensure start/stop and safety circuits are wired properly and in the correct state before applying power to the drive. Failure to comply could result in death or serious injury from moving equipment.*

WARNING! *Sudden Movement Hazard. 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
Closed	LOCAL: Frequency reference and Run command are input from the digital operator.
Open	REMOTE: Frequency reference and Run command are input from the selected external reference. If a digital input set to H1-☐☐ = 2 is active, they will be read from external reference source 2 (b1-15 and b1-16). In all other cases they will be read from external reference source 1 (b1-01 and b1-02).

Note:
1. The LO/RE key on the digital operator is disabled when one of the multi-function input terminals is set to for LOCAL/REMOTE.
2. When the drive is set to LOCAL, the LO/RE LED will light.
3. The default setting of the drive does not 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 143*.

Setting 2: External Reference 1/2 Selection

This function switches 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: Default drive settings do not allow switching between External reference 1 and 2 during run. *Refer to b1-07: LOCAL/REMOTE Run Selection on page 143* if this feature is required by the application.

Setting 3 to 5: Multi-Step Speed Reference 1 to 3

Switches multi-step speed frequency references d1-01 to d1-08 by digital inputs. *Refer to d1: Frequency Reference on page 173* 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 173* for details.

Setting 7: Accel/Decel Time Selection 1

Switches between accel/decel times 1 (C1-01 and C1-02) and 2 (C1-03 and C1-04). *Refer to C1-01 to C1-04: Accel, Decel Times 1 and 2 on page 168* for details.

Setting 8, 9: Baseblock Command (N.O., N.C.)

When the drive receives a baseblock command, the output transistors stop switching, the motor coasts to stop, and a bb alarm flashes on the digital operator to indicate baseblock. When baseblock ends while a Run command is active, the drive performs Speed Search to restart the motor.

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)

WARNING! *Sudden Movement Hazard. When using a mechanical holding brake with the drive in a lifting application, close the brake when the drive output is cut off by a baseblock command triggered by one of the input terminals. Failure to comply will result in a slipping load from the motor suddenly coasting when the baseblock command is entered and may cause serious injury or death.*

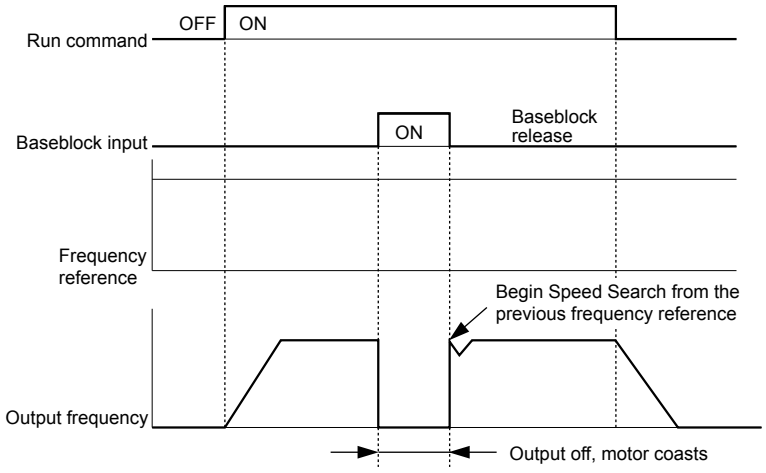


Figure 5.38 Baseblock Operation During Run

Setting A: Accel/Decel Ramp Hold

When the digital input programmed for the Accel/decel ramp hold function closes, the drive locks (holds) the output frequency. Acceleration or deceleration resumes when the input is reopened.

If the Accel/decel ramp hold function is enabled (d4-01 = 1), the drive saves the output frequency to memory when the Ramp Hold input is closed. When the drive is restarted after stop or after power supply interruption, the saved output frequency becomes the frequency reference (provided that the Accel/decel ramp hold input is still closed). *Refer to d4-01: Frequency Reference Hold Function Selection on page 177* for details.

Setting B: Drive Overheat Alarm (oH2)

Triggers an oH2 alarm when the contact closes. Drive operation is not affected because this is an alarm.

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 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 Function

The Up/Down function allows the frequency reference to be set by two push buttons when one digital input is programmed as the Up input (H1-☐☐= 10) to increase the frequency reference and the other digital input is programmed as the Down input (H1-☐☐= 11) to decrease the frequency reference.

The Up/Down function takes priority over the frequency references from the digital operator, the analog inputs, and the pulse input (b1-01 = 0, 1, 4). When using the Up/Down function, references provided by these sources will be disregarded.

The inputs operate as shown in ***Table 5.30***:

Table 5.30 Up, Down Command

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 occurs when only one of the Up/Down functions is programmed to a digital input.
2. An oPE03 alarm occurs when the Up/Down function is assigned to the terminals and a different digital input is programmed for the Accel/decel ramp hold function. For more information on alarms, ***Refer to Drive Alarms, Faults, and Errors on page 279***.
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 Hold (d4-01)

- If the frequency reference hold function is disabled (d4-01 = 0), the Up/Down frequency reference will be reset to 0 when the Run command is cleared or the power is cycled.
- When d4-01 = 1, the drive will save the frequency reference set by the Up/Down function. When the Run command or the power is cycled, the drive will restart with the saved reference value. Close the Up or Down input without an active Run command to reset the saved value. ***Refer to d4-01: Frequency Reference Hold Function Selection on page 177***.

Using the Up/Down Function with Frequency Reference Limits

Parameter d2-01 determines the upper frequency reference limit.

The value for the lower frequency reference limit depends on the parameter d4-10 setting. This value can be set by an analog input or parameter d2-02. ***Refer to d4-10: Up/Down Frequency Reference Limit Selection on page 180*** for details. When a Run command is applied, the lower limits function as follows:

- If the lower limit is set by d2-02 only, the drive accelerates to this limit as soon as a Run command is entered.
- If the lower limit is determined by an analog input only, the drive accelerates to the limit when both the Run command and an Up or Down command are active. The drive will not start running if only the Run command is active.
- 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, the drive accelerates to the d2-02 value when a Run command is input. When the d2-02 value is reached, the drive accelerates to the analog limit only if an Up or Down command is set.

Figure 5.39 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.

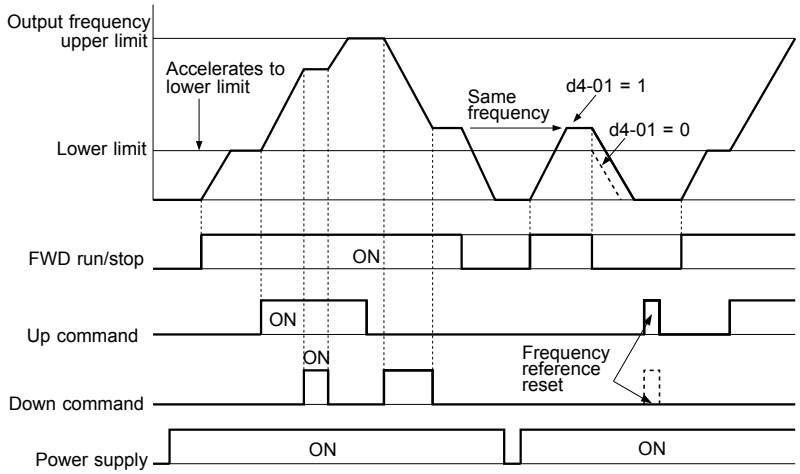


Figure 5.39 Up/Down Command Operation

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), activating Reverse Jog will have no effect. Inputting both the Forward Jog and Reverse Jog are simultaneously for 500 ms or longer will trigger an alarm will and the drive will ramp to stop.

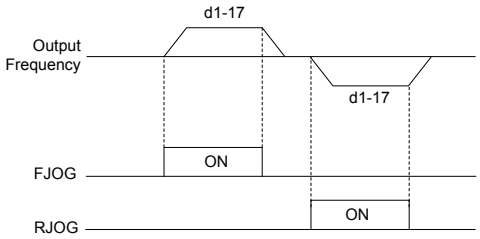


Figure 5.40 FJOG/RJOG Operation

Setting 14: Fault Reset

When the drive detects a fault condition, the fault output contact closes, the drive output shuts off, and the motor coasts to stop (specific stopping methods can be selected for some faults such as L1-04 for motor overheat). After removing the Run command, clear the fault either by pressing the RESET key on the digital operator or closing a digital input configured as a Fault Reset (H1-☐☐ = 14).

Note: Remove the Run command prior to resetting a fault. Fault Reset commands are ignored while the Run command is present.

Setting 15, 17: Fast Stop (N.O., N.C.)

The Fast Stop function operates similar to an emergency stop input to the drive. If a Fast Stop command is input while the drive is running, the drive decelerates to a stop in the deceleration time set to C1-09 (*Refer to C1-09: Fast Stop Time on page 169*). The drive can only be restarted after bringing the drive to a complete stop, turning off the Fast Stop input, and switching off the Run command.

- To trigger the Fast Stop function with an N.O. switch, set H1-☐☐ = 15.
- To trigger the Fast Stop function with an N.C. switch, set H1-☐☐ = 17.

Figure 5.41 shows an operation example of Fast Stop.

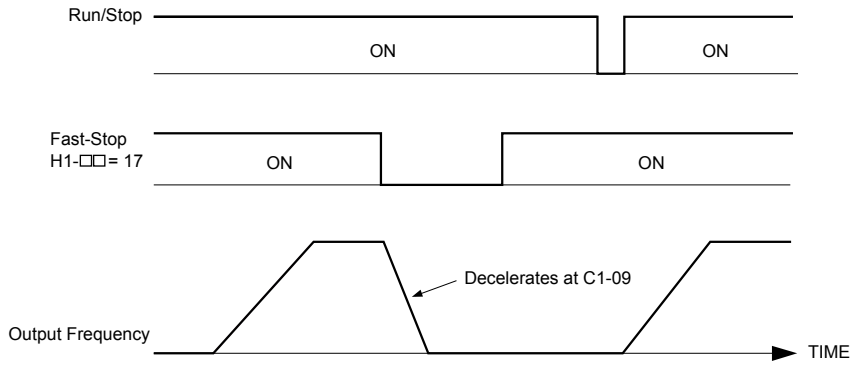


Figure 5.41 Fast Stop Sequence

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 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 151*** for details.

Setting 19: PID Disable

Close a digital input to indefinitely disable the PID function. When the input is released, the drive resumes PID operation. ***Refer to PID Block Diagram on page 154***.

Setting 1A: Accel/Decel Time Selection 2

Selects accel/decel times 1 to 4 in combination with the Accel/decel time selection 1 command. ***Refer to C1-01 to C1-04: Accel, Decel Times 1 and 2 on page 168*** for details.

Setting 1B: Program Lockout

Parameter values cannot be changed when an input is programmed for Program Lockout and the input is open. It is still possible, however, to view and monitor parameter settings.

Setting 1E: Reference Sample Hold

This function allows the user to sample an analog frequency reference signal being input to terminal A1, A2, or A3 and hold the frequency reference at the sampled level. When the Analog Frequency Reference Sample/Hold function is held for at least 100 ms, the drive reads the analog input and changes the frequency reference to the newly sampled speed as illustrated in ***Figure 5.42***.

When the power is shut off and the sampled analog frequency reference is cleared, the frequency reference is reset to 0.

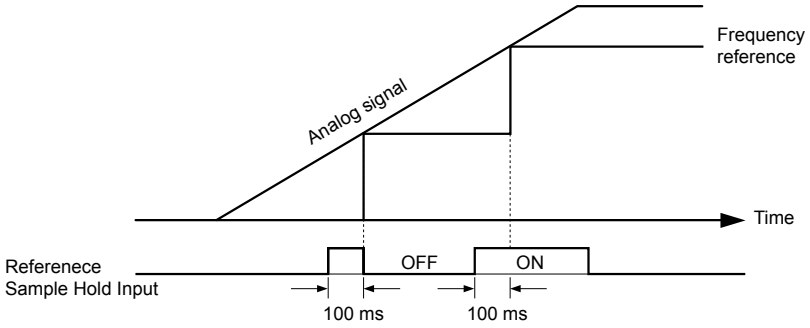


Figure 5.42 Analog Frequency Reference Sample/Hold

An oPE03 error will occur when one of the following functions is used simultaneously with the Analog frequency reference sample/hold command:

- Hold accel/decel stop (setting: A)
- Up command, Down command (setting: 10, 11)
- Offset frequency (setting: 44 to 46)
- Up or Down functions (setting: 75, 76)

Setting 20 to 2F: External Fault

The External fault command stops the drive when problems occur with external devices.

To use the External fault command, set one of the multi-function digital inputs to a value between 20 and 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

Table 5.31 shows the relationship between the conditions and the value set to H1-☐☐:

Terminal statuses, detection conditions, and stopping methods marked with an “O” are applicable to the corresponding settings.

Table 5.31 Stopping Method for External Fault

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

Configuring one of the digital inputs for PID integral reset (H1-☐☐ = 30) resets the value of the integral component in PID control to 0 when the terminal is closed. *Refer to PID Block Diagram on page 154* for more details.

Setting 31: PID Integral Hold

Configuring a digital input for Integral Hold (H1-0☐ = 31) locks the value of the integral component of the PID control 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 154* for more information on this function.

Setting 32: Multi-Step Speed Reference 4

Selects the multi-step speeds d1-09 to d1-16 in combination with the input terminal set for Multi-Step Speed 1, 2 and 3. *Refer to d1-01 to d1-17: Frequency Reference 1 to 16 and Jog Frequency Reference on page 173*.

Setting 34: PID Soft Starter Cancel

A digital input configured as a PID soft starter cancel input (H1-0☐ = 34) enables or disables the PID soft starter and cancels the PID accel/decel time (b5-17). *Refer to PID Block Diagram on page 154*.

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 154* 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 operates in reverse. Closing both inputs simultaneously 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.

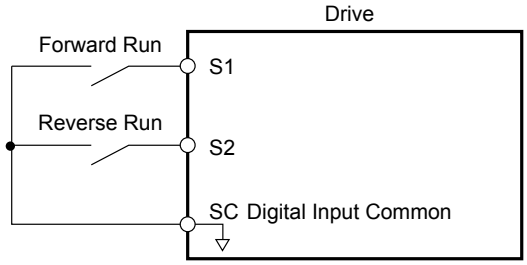


Figure 5.43 Example Wiring Diagram for 2-Wire Sequence

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 closes, the drive will operate in the selected direction. The drive will stop when the input opens.

The input programmed for 43 selects the direction. If the input is open, forward direction is selected. If the input is closed, reverse direction is selected.

Note: This function cannot be used simultaneously with settings 40 and 41.

Setting 47: Node Setup

If the SI-S3 option card is connected, closing this terminal sets a node address for operation on a CANopen network.

Setting 51: Sequence Timer Disable

Drive ignores sequence timers and runs normally (based on b1-02/b1-16 source).

Setting 52: Sequence Timer Cancel

The sequence timers are canceled.

Setting 60: DC Injection Braking Command

DC Injection Braking is activated when a DC Injection Braking command is input while the drive is stopped. DC Injection Braking is released when a Run command or a Jog command is input. *Refer to b2: DC Injection Braking and Short Circuit Braking on page 144* for details on setting up the DC Injection Braking function.

The diagram below illustrates DC Injection Braking:

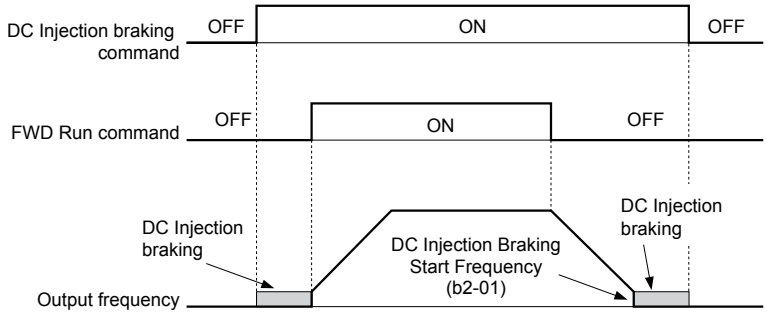


Figure 5.44 DC Injection Braking Input Timing Diagram

Setting 61, 62: External Speed Search Command 1, 2

These input functions enable Speed Search even if parameter b3-01 = 0 (no Speed Search at start). *Refer to Speed Search Activation on page 148* for details on how to use the input signals. *Refer to b3: Speed Search on page 145* for more about Speed Search.

Note: Simultaneously assigning Speed Search 1 and Speed Search 2 to the input terminals will trigger an oPE03 error.

Setting 63: Field Weakening

Enabled in V/f Control. When this input is closed, Field Weakening is performed. For details, see *d6: Field Weakening and Field Forcing*.

Setting 65, 66: KEB Ride-Thru 1 (N.C.), 2 (N.O.)

Enables the KEB Ride-Thru function selected in parameter L2-29. *Refer to KEB Ride-Thru Function on page 229* for more information on this function.

DIgital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 65 (N.C.)	KEB Ride-Thru Deceleration	Normal operation
Setting 66 (N.O.)	Normal operation	KEB Ride-Thru Deceleration

Note: Simultaneously assigning KEB Ride-Thru 1 and KEB Ride-Thru 2 to the input terminals will trigger an oPE03 error.

Setting 67: Communication Test Mode

The drive has a built-in function to self-diagnose serial communications operation. The test involves wiring the send and receive terminals of the RS-422/RS-485 port together. The drive transmits data and then confirms that the communications are received normally. *Refer to Self-Diagnostics on page 495* for details on how to use this function.

Setting 68: High Slip Braking (HSB)

Closing an input programmed for this function triggers High Slip Braking. After starting HSB, bring the drive to a complete stop and remove the HSB command before restarting. *Refer to n3: High Slip Braking (HSB) and Overexcitation Braking on page 251*.

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 141*).

Setting 75, 76: Up 2/Down 2 Function

The Up/Down 2 function adds a bias to the frequency reference. The input programmed for 75 will increase the bias and the input programmed for 76 will decrease the bias. *Table 5.32* explains how the Up/Down 2 function works depending on the frequency reference source and parameters d4-01, d5-03, and d4-05. *Refer to d4: Frequency Reference Hold and Up/Down 2 Function on page 177* for detailed explanations of these and other Up/Down 2 related parameters.

Note:
1. The Up/Down 2 functions must be set as a pair.
2. When using the Up/Down 2 function, set appropriate bias limit values to parameters d4-08 and d4-09.

Table 5.32 Up/Down 2 Operations

Condition	Freq. Ref. Source	d4-03	d4-05	d4-01	Operation	Frequency Saved
1	Multi-Step Speed Reference	0	0	0	• Accelerates (increases the bias) while the Up 2 terminal is closed. • Decelerates (decreases the bias) while Down 2 is closed. • Holds output frequency (holds the bias) when no Up 2 or Down 2 input or both active. • Resets the bias when the reference changes. • Operates with the frequency reference in all other situations.	Not saved
2				1		If the bias and frequency reference are constant for 5 s, the bias is added to the active frequency reference and reset afterwards.
3			1	--	• Accelerates (increases the bias) while the Up 2 terminal is closed. • Decelerates (decreases the bias) while Down 2 is closed. • Otherwise operates at the frequency reference.	Not saved
4	Multi-Step Speed Reference	Value other than 0	--	0	• When the Up 2 is enabled, the drive accelerates to the frequency reference plus d4-03 (bias is increased for d4-03). • When Down 2 is enabled, the drive decelerates to the frequency reference minus d4-03 (bias is decreased for d4-03). • Holds output frequency (holds the bias) when neither Up/Down 2 inputs are active or both inputs are active. • Resets the bias when the reference changes. • Operates with the frequency reference in all other situations.	Not saved
5				1		If the bias and frequency reference are constant for 5 s, the bias is added to the active frequency reference and reset afterwards.
6	Other (analog comm., etc.)	0	0	0	• Accelerates (increases the bias) while the Up 2 terminal is closed. • Decelerates (decreases the bias) while Down 2 is closed. • Holds output frequency (holds the bias) when neither Up/Down 2 inputs are active or both inputs are active. • If the frequency reference changes for more than the time set to d4-07 during accel/decel, bias value is held until the output frequency meets the reference (speed agree).	Not saved
7				1		If the bias is constant for 5 s, it is saved to parameter d4-06. The frequency reference cannot be overwritten, so only the bias is saved.
8	Other (analog comm, etc.)	0	1	--	• Accelerates (increases the bias) while the Up 2 terminal is closed. • Decelerates (decreases the bias) while Down 2 is closed. • Otherwise operates at the frequency reference	Not saved
9		Value other than 0	--	0	• When Up 2 is enabled, drive accelerates to the frequency reference plus d4-03 (increases the bias for d4-03). • When Down 2 is enabled, drive decelerates to the frequency reference minus d4-03 (decreases the bias for d4-03). • If the frequency reference changes for more than d4-07 during accel/decel, bias value is held until the output frequency meets the reference (speed agree).	Not saved
10				1		If the bias is constant for 5 s, it is saved to parameter d4-06. The frequency reference cannot be overwritten, so only the bias is saved.

Setting 7A, 7B: KEB Ride-Thru 2 (N.C., N.O.)

An input terminal set to 7A or 7B can trigger Single Drive KEB Ride-Thru during deceleration. L2-29 is disregarded if this is enabled. *Refer to KEB Ride-Thru Function on page 229* for details.

Digital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 7A (N.C.)	Single Drive KEB Ride-Thru 2	Normal operation
Setting 7B (N.O.)	Normal operation	Single Drive KEB Ride-Thru 2

Note: Simultaneously assigning KEB Ride-Thru 1 and KEB Ride-Thru 2 to the input terminals will trigger an oPE03 error.

Setting A8: PI2 Disable (N.O.)

Disables the secondary PI controller. Output behavior depends on the setting of S3-12

Setting A9: PI2 Disable (N.C.)

Enables the secondary PI controller (when open, output behavior depends on the setting of S3-12).

Setting AA: PI2 Inverse Operation

Changes the sign of the secondary PI controller input (reverse acting PI control).

Setting AB: PI2 Integral Reset

Resets the secondary PI controller integral value.

Setting AC: PI2 Integral Hold

Locks the value of the secondary PI controller integral value.

Setting AD: Select PI2 Parameters

Uses the secondary PI controller Proportional and Integral adjustments (S3-06 and S3-07) instead of the primary PI controller Proportional and Integral adjustments (b5-02 and b5-03). Only valid when S3-01 = 0 (secondary PI controller disabled).

Note: This multi-function input has no effect on the secondary PI controller. It is only used for the primary PI controller (b5-☐☐).

Emergency Override Function

The Emergency Override function is activated by closing the digital input programmed for Emergency Override Forward Run (H1-☐☐ = AF) or Emergency Override Reverse Run (H1-☐☐ = B0).

If H1-☐☐ = 6A (Drive Enable) is programmed, it must be opened to disable the drive for Emergency Override to take effect. Closing both Emergency Override digital inputs at the same time will trigger an External Fault (EF) error.

When the drive is in Emergency Override, the frequency reference source is dependent on parameter S6-02, Emergency Override Reference Selection. When S6-02 is set to 0 (Use S6-01 Reference), the drive will run at the S6-01 setting. When S6-02 is set to 1 (Use Frequency Ref), the drive will use the currently selected frequency reference (based on b1-01 and LOCAL/REMOTE) as the run speed.

An alarm will flash during Emergency Override indicating that the function is active and the direction the drive is commanded to run.

Resettable faults occurring when Emergency Override is activated will be cleared.

The drive will perform unlimited speed search retries during Emergency Override.

When Emergency Stop is active and Emergency Override is activated, the drive will run in Emergency Override mode.

The CALL (Serial Communication Error) mechanism is deactivated when Emergency Override is activated.

The Emergency Override function has priority over the PID Sleep feature (b5-15/b5-16).

Setting AF: Emergency Override Forward Run

Enables Emergency Override Forward Run (Enabled when S6-01 = 1).

Setting B0: Emergency Override Reverse Run

Enables Emergency Override Reverse Run (Enabled when S6-01 = 1).

◆ H2: Multi-Function Digital Outputs

■ H2-01 to H2-03: Terminal M1-M2, M3-M4, and MD-ME-MF Function Selection

The drive has three multi-function output terminals. ***Table 5.33*** lists the functions available for theses terminals using H2-01, H2-02, and H2-03.

No.	Parameter Name	Setting Range	Default
H2-01	Terminal M1-M2 Function Selection (relay)	0 to 192	0: During Run
H2-02	Terminal M3-M4 Function Selection (relay)	0 to 192	1: Zero Speed
H2-03	Terminal MD-ME-MF Function Selection (relay)	0 to 192	2: Speed agree 1

Table 5.33 Multi-Function Digital Output Terminal Settings

Setting	Function	
0	During Run	*207*
1	Zero Speed	*207*

Setting	Function	
2	Speed Agree 1	*208*
3	User-Set Speed Agree 1	*208*

Setting	Function	
4	Frequency Detection 1	*209*
5	Frequency Detection 2	*209*
6	Drive Ready	*209*
7	DC Bus Undervoltage	*210*
8	During Baseblock (N.O.)	*210*
9	Frequency Reference Source	*210*
A	Run Command Source	*210*
B	Torque Detection 1 (N.O.)	*210*
C	Frequency Reference Loss	*210*
D	Braking Resistor Fault	*210*
E	Fault	*210*
F	Through Mode	*211*
10	Minor Fault	*211*
11	Fault Reset Command Active	*211*
12	Timer Output	*211*
13	Speed Agree 2	*211*
14	User-Set Speed Agree 2	*211*
15	Frequency Detection 3	*212*
16	Frequency Detection 4	*212*
17	Torque Detection 1 (N.C.)	*210*
18	Torque Detection 2 (N.O.)	
19	Torque Detection 2 (N.C.)	*210*
1A	During Reverse	*213*
1B	During Baseblock (N.C.)	*213*
1E	Restart Enabled	*213*
1F	Motor Overload Alarm (oL1)	*213*

Setting	Function	
20	Drive Overheat Pre-Alarm (oH)	*213*
22	Mechanical Weakening Detection	*214*
2F	Maintenance Period	*214*
37	During Frequency Output	*214*
38	Drive Enabled	*214*
39	Watt Hour Pulse Output	*214*
3C	LOCAL/REMOTE Status	*214*
3D	During Speed Search	*214*
3E	PID Feedback Low	*214*
3F	PID Feedback High	*214*
4A	During KEB Operation	*214*
4C	During Fast Stop	*214*
4D	oH Pre-Alarm Time Limit	*215*
4E <2>	Braking Transistor Fault (rr)	*215*
4F <2>	Braking Resistor Overheat (rH)	*215*
50	Waiting to Run	*215*
51	Sequence timer 1	*215*
52	Sequence timer 2	*215*
53	Sequence timer 3	*215*
54	Sequence timer 4	*215*
58	UL6 Detected	*215*
60	Internal Cooling Fan Alarm	*215*
71	Secondary PI Feedback Low	*215*
72	Secondary PI Feedback High	*215*
100 to 192	Functions 0 to 92 with Inverse Output	*215*

<2> Not available in models 2A0169 to 2A0415 and 4A0088 to 4A0675.

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 in deceleration or DC injection.

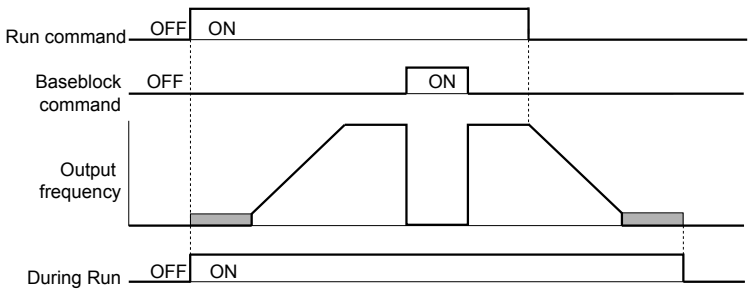


Figure 5.45 During Run Time Chart

Setting 1: Zero Speed

Terminal closes when the output frequency 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

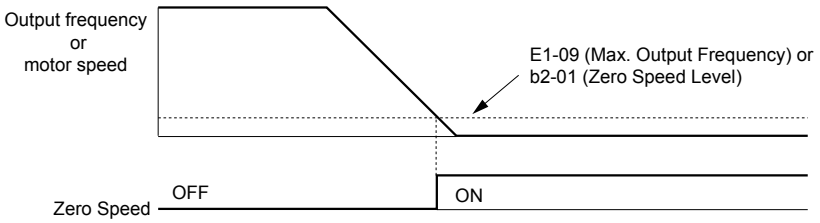


Figure 5.46 Zero-Speed Time Chart

Setting 2: Speed Agree 1 (f_{ref}/f_{out} Agree 1)

Closes when the actual output frequency 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 ±L4-02.

Note: Detection works in forward and reverse.

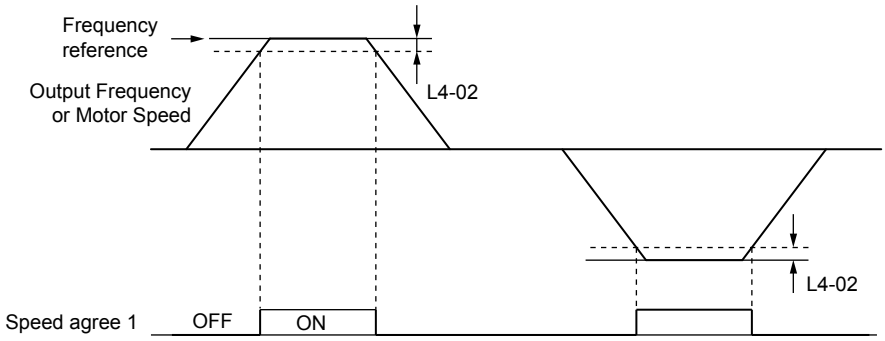


Figure 5.47 Speed Agree 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 241 for more details.

Setting 3: User-Set Speed Agree 1 (f_{ref}/f_{set} Agree 1)

Closes when the actual output frequency and the frequency reference are within the speed agree width (L4-02) of the programmed speed agree level (L4-01).

Status	Description
Open	Output frequency or motor speed and frequency reference are not both within the range of L4-01 ±L4-02.
Closed	Output frequency or motor speed and the frequency reference are both within the range of L4-01 ±L4-02.

Note: Frequency detection works in forward and reverse. The value of L4-01 is used as the detection level for both directions.

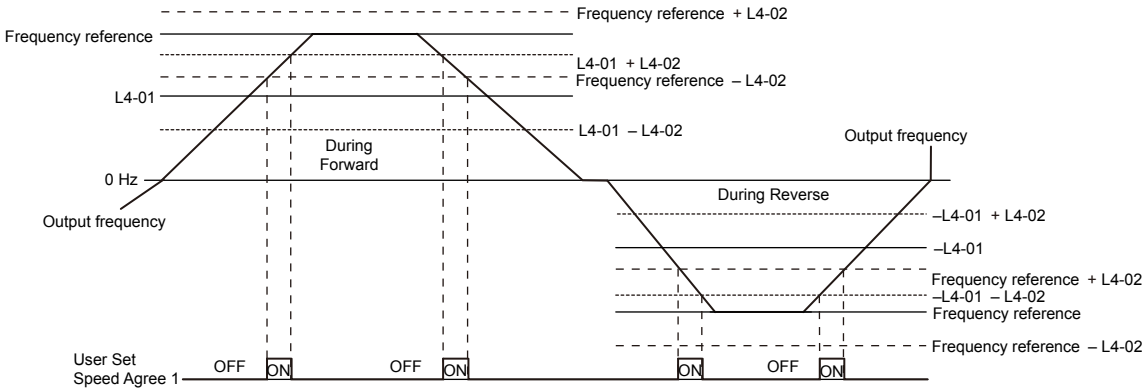


Figure 5.48 User Set Speed Agree 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 241 for more instructions.

Setting 4: Frequency Detection 1

The output opens when the output frequency 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 fall 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 forward and reverse. The value of L4-01 is used as the detection level for both directions.

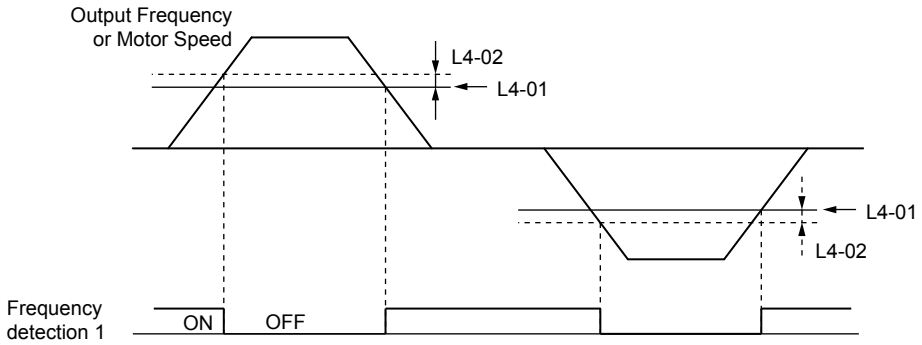


Figure 5.49 Frequency Detection 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 241 for more details.

Setting 5: Frequency Detection 2

The output closes when the output frequency is above the detection level set in L4-01. The terminal remains closed until the output frequency or motor speed fall 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 forward and reverse. The value of L4-01 is used as the detection level for both directions.

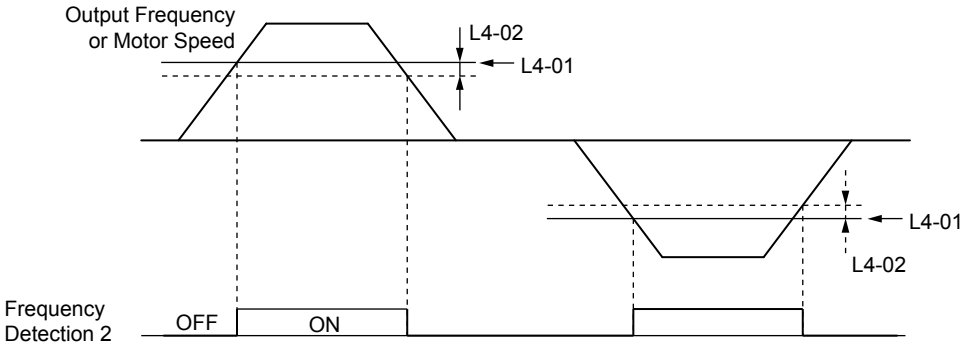


Figure 5.50 Frequency Detection 2 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 241 for more details.

Setting 6: Drive Ready

The output closes when 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 internal power supply of the drive 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

The output closes when 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 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.)

The 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

Displays the currently selected frequency reference source.

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

Displays the currently selected Run command source.

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 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 243* 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 closes when frequency reference loss is detected. *Refer to L4-05: Frequency Reference Loss Detection Selection on page 241* for details.

Setting D: Braking Resistor Fault

An output programmed for this function closes when the dynamic braking resistor (DB) overheats or the braking transistor is in a fault condition.

Setting E: Fault

The output closes when the drive faults (excluding CPF00 and CPF01 faults).

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

The output closes when a minor fault condition is present.

Setting 11: Fault Reset Command Active

The output closes when 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 the output for the timer function. *Refer to b4: Delay Timers on page 151* for details.

Setting 13: Speed Agree 2 (f_{ref} /f_{out} Agree 2)

The output closes when the actual output frequency 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 ±L4-04.

Note: Detection works in forward and reverse.

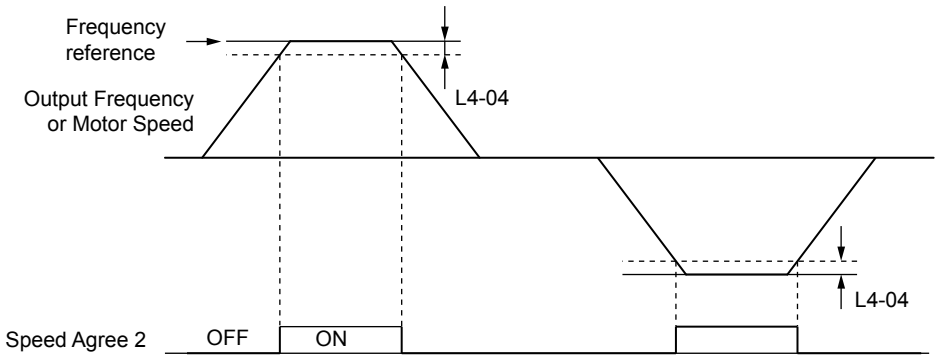


Figure 5.51 Speed Agree 2 Time Chart

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 241 for more details.

Setting 14: User-Set Speed Agree 2 (f_{ref} /f_{set} Agree 2)

The output closes when the actual output frequency and the frequency reference are within the speed agree width (L4-04) of the programmed speed agree level (L4-03).

Status	Description
Open	Output frequency or motor speed and frequency reference are both outside the range of L4-03 ±L4-04.
Closed	Output frequency or motor speed and the frequency reference are both within the range of L4-03 ±L4-04.

Note: The detection level L4-03 is a signed value; detection works in the specified direction only.

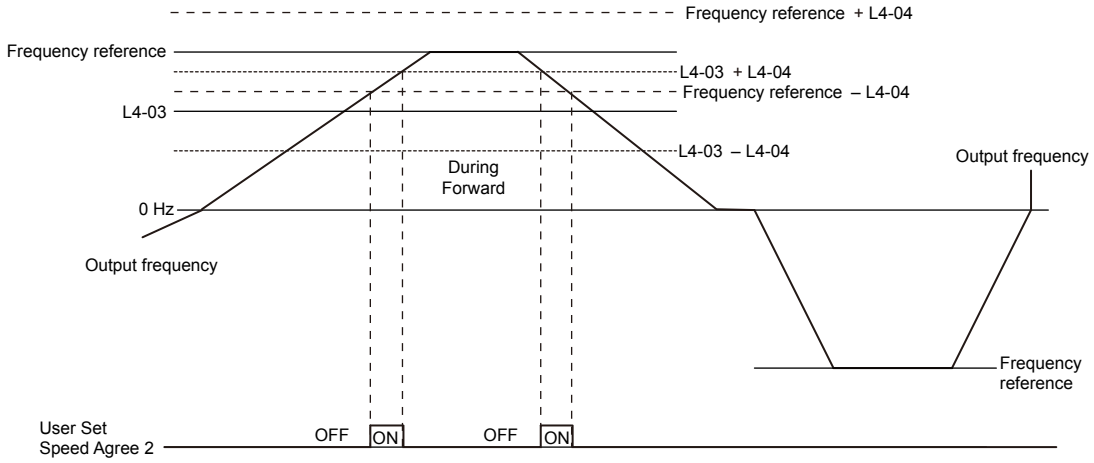


Figure 5.52 User-Set Speed Agree 2 Example with a Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 241 for more details.

Setting 15: Frequency Detection 3

The output opens when the output frequency 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. The detection level L4-03 is a signed value; 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.

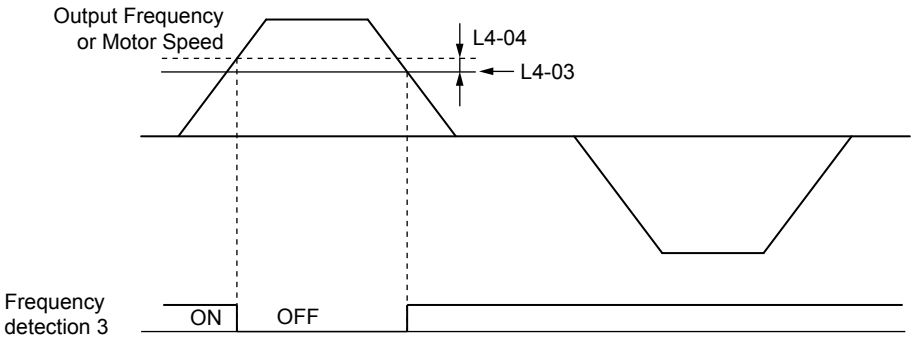


Figure 5.53 Frequency Detection 3 Example with a Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 241 for more details.

Setting 16: Frequency Detection 4

The output closes when the output frequency 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.

Status	Description
Open	Output frequency or motor speed is below L4-03 minus L4-04 or has not exceeded L4-03.
Closed	Output frequency or motor speed exceeded L4-03.

Note: The detection level L4-03 is a signed value; detection works in the specified direction only.

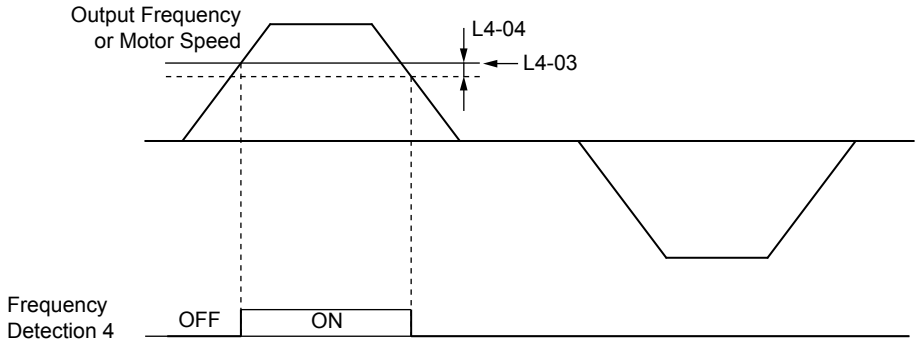


Figure 5.54 Frequency Detection 4 Example with Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 241 for more details.

Setting 1A: During Reverse

A digital output set for "During reverse" closes when 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.

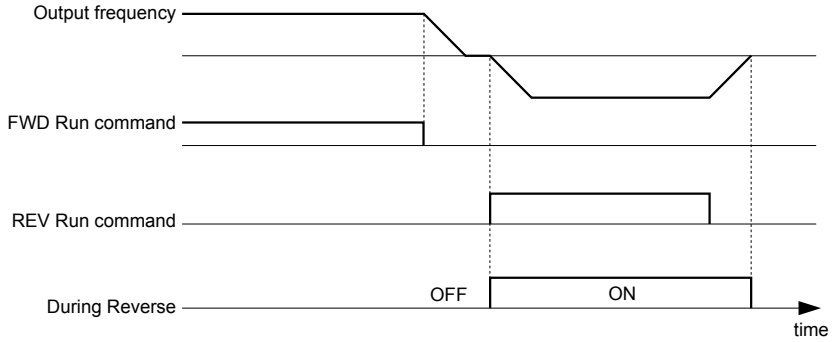


Figure 5.55 Reverse Direction Output Example Time Chart

Setting 1B: During Baseblock (N.C.)

The 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 1E: Restart Enabled

An output set for "Restart enabled" closes when the drive attempts 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 attempted to restart. If the drive cannot successfully restart within the number of attempts permitted by L5-01, a fault will be triggered and the terminal set to 1E will open. *Refer to L5: Fault Restart on page 242* for details on automatic restart.

Setting 1F: Motor Overload Alarm (oL1)

The output closes when the motor overload level estimated by the oL1 fault detection exceeds 90% of the oL1 detection level. *Refer to L1-01: Motor Overload Protection Selection on page 225*.

Setting 20: Drive Overheat Pre-Alarm (oH)

The output closes when the drive heatsink temperature reaches the level specified by parameter L8-02. *Refer to L8-02: Overheat Alarm Level on page 245* for details on drive overheat detection.

Setting 22: Mechanical Weakening Detection

The output closes when a mechanical weakening situation is detected.

Setting 2F: Maintenance Period

The 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 329*.

Setting 37: During Frequency Output

The 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.

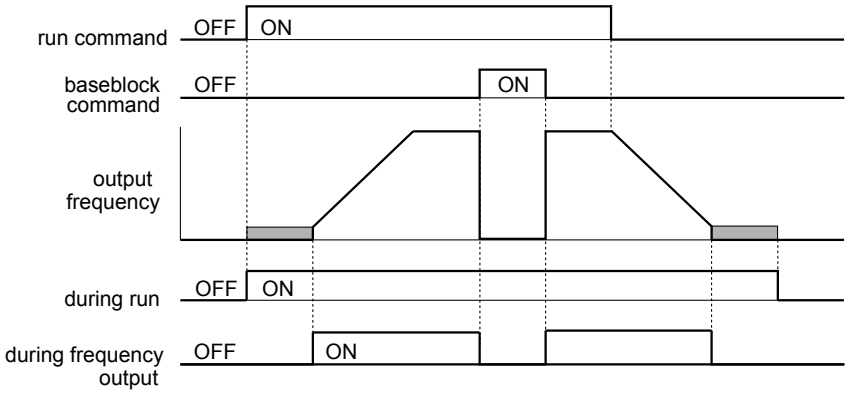


Figure 5.56 During Frequency Output Time Chart

Setting 38: Drive Enable

Reflects 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 215* for details.

Setting 3C: LOCAL/REMOTE Status

The 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

The output terminal closes while Speed Search is being performed. *Refer to b3: Speed Search on page 145* 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 156* for details.

Setting 3F: PID Feedback High

Output terminal closes when a PID feedback loss (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 156* for details.

Setting 4A: During KEB Operation

The output terminal closes while KEB is being performed. *Refer to KEB Ride-Thru Function on page 229* for a KEB function description.

Setting 4C: During Fast Stop

The output terminal closes when a Fast Stop is being executed. *Refer to Setting 15, 17: Fast Stop (N.O., N.C.) on page 200*.

Setting 4D: oH Pre-Alarm Time Limit

The output terminal closes when the drive is reducing the speed due to a drive overheat alarm (L8-03 = 4) and the overheat alarm has not disappeared after 10 frequency reduction operation cycles. *Refer to L8-03: Overheat Pre-Alarm Operation Selection on page 246* for a more detailed description.

Setting 4E: Braking Transistor Fault (rr)

The output closes if the internal braking transistor reaches the overheat level.

Setting 4F: Braking Resistor Overheat (rH)

The output closes when the braking resistor exceeds the overheat level. The braking resistor may overheat due to motor regeneration or short deceleration time setting.

Setting 50: Waiting to Run (WrUn)

The drive will delay executing a Run command until the time set to b1-11 has expired.

Setting 51: Sequence Timer 1 Active

Sequence Timer 1 is active.

Setting 52: Sequence Timer 2 Active

Sequence Timer 2 is active.

Setting 53: Sequence Timer 3 Active

Sequence Timer 3 is active.

Setting 54: Sequence Timer 4 Active

Sequence Timer 4 is active.

Setting 58: Underload Detection

Underload is detected when the output current falls below the underload detection level defined by L6-14 and L6-02.

Setting 60: Internal Cooling Fan Alarm

The output closes when the drive internal cooling fan has failed.

Setting 71: Secondary PI Feedback Low

The PI2 feedback level is too low.

Setting 72: Secondary PI Feedback High

The PI2 feedback level is too high.

Setting 100 to 192: Functions 0 to 92 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.

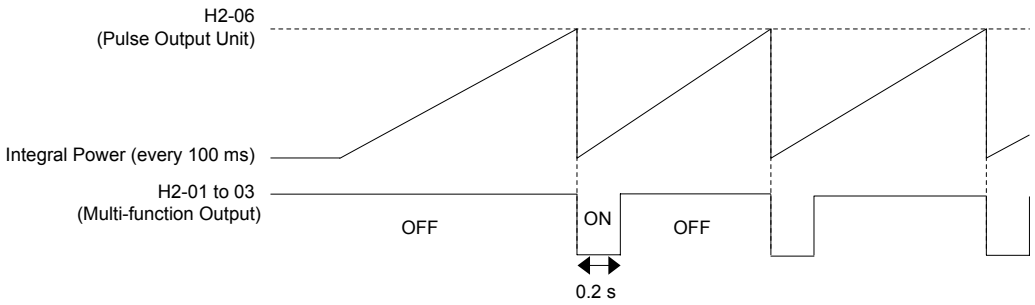


Figure 5.57 Watt Hour Output Example

◆ H3: Multi-Function Analog Inputs

The drive is equipped with three multi-function analog input terminals: A1, A2, and A3. *Refer to Multi-Function Analog Input Terminal Settings on page 219* 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 to 3	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 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.

Setting 2: 4 to 20 mA

Setting 3: 0 to 20 mA

■ H3-02: Terminal A1 Function Selection

Selects the input signal level for analog input A3. *Refer to Multi-Function Analog Input Terminal Settings on page 219* for instructions on adjusting the signal level.

No.	Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 32	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).

Use both parameters 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):

  A 10 Vdc input is equivalent to a 200% frequency reference and 5 Vdc is 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.

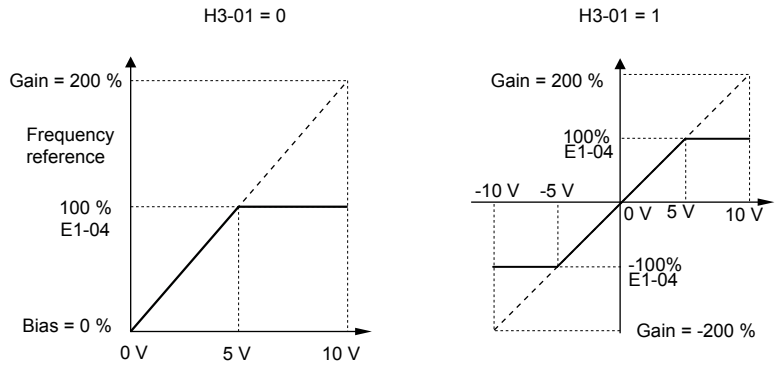


Figure 5.58 Frequency Reference Setting by Analog Input with Increased Gain

- 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.

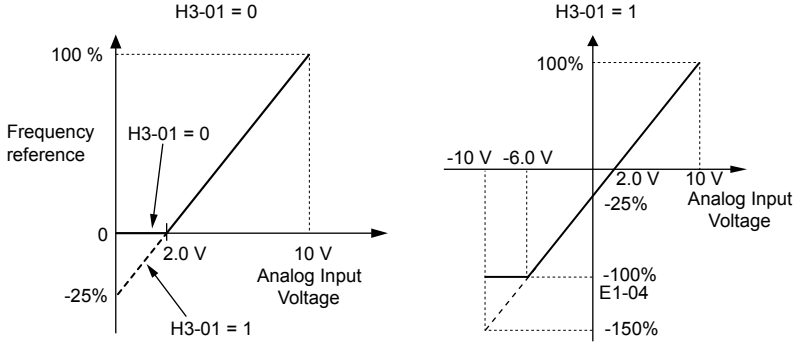


Figure 5.59 Frequency Reference Setting by Analog Input with Negative Bias

■ H3-05: Terminal A3 Signal Level Selection

Determines the function assigned to analog input terminal A3. *Refer to Multi-Function Analog Input Terminal Settings on page 219* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-05	Terminal A3 Signal Level Selection	0 to 3	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 216*.

Setting 1: -10 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 216*.

Setting 2: 4 to 20 mA

Setting 3: 0 to 20 mA

■ 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 219* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-06	Terminal A3 Function Selection	0 to 31	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. Set jumper 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 216*.

Setting 1: -10 to 10 Vdc

The input level is -10 to 10 Vdc. *Refer to Setting 1: -10 to 10 Vdc on page 216*.

Setting 2: 4 to 20 mA

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

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 219* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-10	Terminal A2 Function Selection	0 to 32	0

■ 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.

Use both parameters 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 prevents erratic drive control when using a “noisy” analog reference. Drive operation becomes more stable as the programmed time becomes longer, but it also 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

Set the offset level of the selected input value to terminals A1, A2, or A3 that is equal to 0 Vdc input. These parameters rarely require 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 5.34* 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 5.34 Multi-Function Analog Input Terminal Settings

Setting	Function	Page
0	Frequency Bias	*219*
1	Frequency Gain	*219*
2	Auxiliary Frequency Reference 1	*219*
3	Auxiliary Frequency Reference 2	*220*
4	Output Voltage Bias	*220*
5	Accel/Decel Time Gain	*220*
6	DC Injection Braking Current	*220*
7	Torque Detection Level	*220*
8	Stall Prevention Level During Run	*220*
9	Output Frequency Lower Limit Level	*221*

Setting	Function	Page
B	PID Feedback	*221*
C	PID Setpoint	*221*
D	Frequency Bias	*221*
E	Motor Temperature (PTC Input)	*221*
16	Differential PID Feedback	*221*
17	Motor Thermistor (NTC)	*221*
1F	Through Mode	*221*
25	Secondary PI Setpoint	*221*
26	Secondary PI Feedback	*221*

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. Simultaneously using A1 and A2 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 173* 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 173* 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 (E1-05). Available only when using V/f Control.

Setting 5: Accel/Decel Time Gain

Adjusts the gain level for the acceleration and deceleration times set to parameters C1-01 through C1-04.

The drive acceleration time is calculated by multiplying the gain level to C1-☐☐ as follows:

C1-☐☐ × Accel/decel time gain = Drive accel/decel time

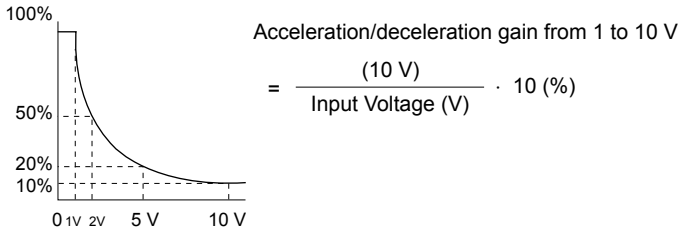


Figure 5.60 Accel/Decel Time Gain with Analog Input Terminal

Setting 6: DC Injection Braking Current

The current level used for DC Injection Braking is set as a percentage of the drive rated current.

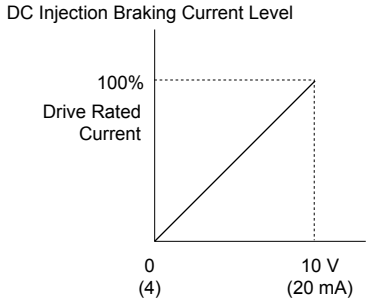


Figure 5.61 DC Injection Braking Current Using an Analog Input Terminal

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 replaces the level set to L6-02. An analog input of 100% (10 V or 20 mA) sets 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 243* for details on torque detection.

Setting 8: Stall Prevention Level

Allows an analog input signal to adjust the Stall Prevention level. ***Figure 5.62*** shows the setting characteristics. The drive will use the lower value of the Stall Prevention level set to L3-06 or the level coming from the selected analog input terminal.

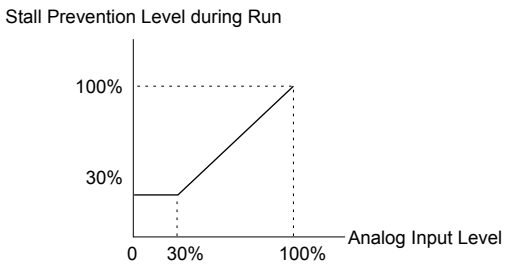


Figure 5.62 Stall Prevention During Run Using an Analog Input Terminal

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

Supplies the PID feedback value. This setting requires PID operation to be enabled in b5-01. *Refer to PID Feedback Input Methods on page 152*.

Setting C: PID Setpoint

Supplies the PID setpoint value and makes the frequency reference selected in parameter b1-01 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 152*.

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 Positive Temperature Coefficient (PTC) thermistor for motor insulation protection. *Refer to Motor Protection Using a Positive Temperature Coefficient (PTC) Thermistor on page 227* for a detailed explanation.

Setting 16: Differential PID Feedback

If an analog value is set for this function, the PID controller is set for differential feedback. The difference of the PID feedback input value and the differential feedback input value builds the feedback value used to calculate the PID input. *Refer to PID Feedback Input Methods on page 152*.

Setting 17: Motor Thermistor (NTC)

Used as a complement or a substitution for oL1. *Refer to Motor Protection Using an NTC Thermistor Input on page* for details.

Setting 1F: Through Mode

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 25: Secondary PI Setpoint

10 V = S3-02 (maximum output frequency)

Setting 26: Secondary PI Feedback

10 V = S3-02 (maximum output frequency)

◆ 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: Monitor Parameters on page 273* for a list of all monitors. The “Analog Output Level” column indicates whether 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

Parameters H4-02 and H4-05 set the terminal FM and AM output signal level when the value of the selected monitor is at 100%. Parameters 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 or -10 to +10 Vdc, or 4 to 20 mA using parameter H4-07 and H4-08. *Figure 5.63* 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

The output signal is adjustable while the drive is stopped.

Terminal FM

1. View the value set to H4-02 (Terminal FM Monitor Gain) on the digital operator. A voltage equal to 100% of the parameter being set in H4-01 will be output from terminal FM.
2. Adjust H4-02 viewing the monitor connected to the terminal FM.
3. View the value set to H4-03 on the digital operator; terminal FM will output a voltage equal to 0% of the parameter being set in H4-01.
4. Adjust H4-03 viewing the output signal on the terminal FM.

Terminal AM

1. View the value set to H4-05 (Terminal AM Monitor Gain) on the digital operator. A voltage equal to 100% of the parameter being set in H4-04 will be output from terminal AM.
2. Adjust H4-05 viewing the monitor connected to the terminal AM.
3. View the value set to H4-06 on the digital operator; terminal AM will output a voltage equal to 0% of the parameter being set in H4-04.
4. Adjust H4-06 viewing the output signal on the terminal AM.

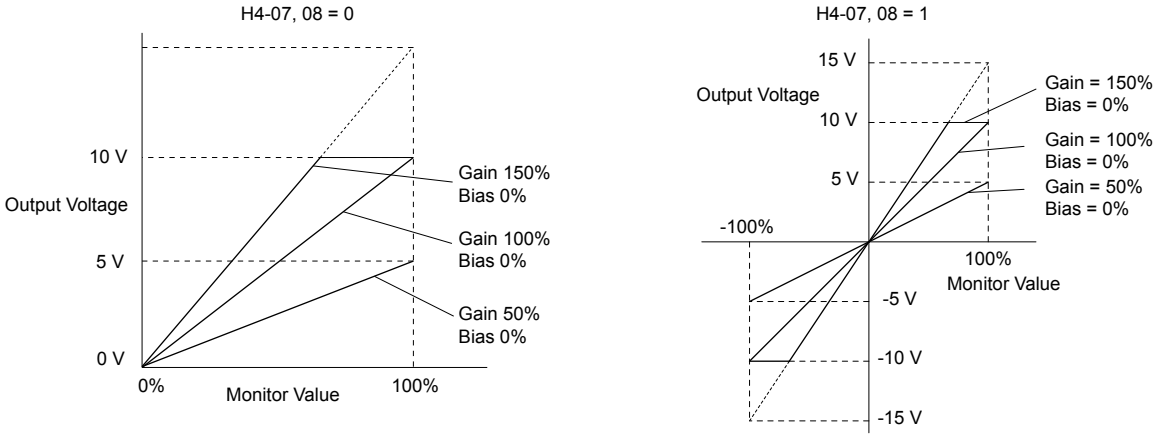


Figure 5.63 Analog Output Gain and Bias Setting Example 1 and 2

Set H4-03 to 30% for an output signal of 3 V at terminal FM when the monitored value is at 0%.

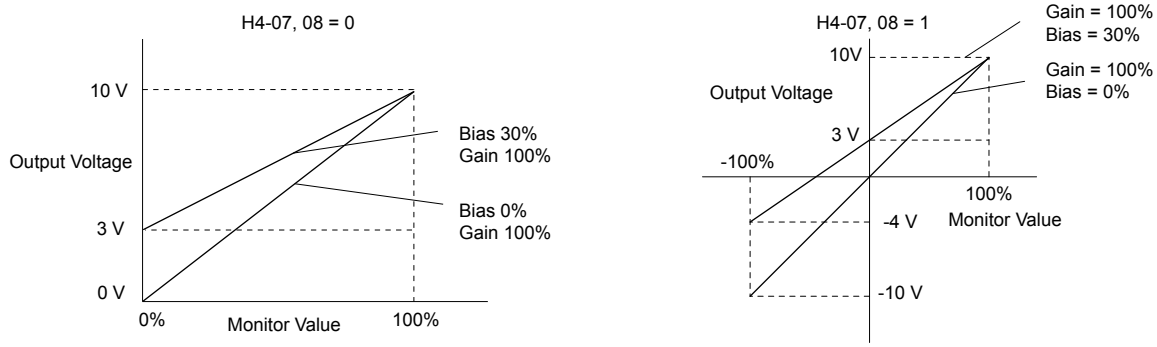


Figure 5.64 Analog Output Gain and Bias Setting Example 3

■ 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.

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

Serial communication is possible in the drive using the built-in RS-422/485 port (terminals R+, R-, S+, S-) and programmable logic controllers (PLCs) or similar devices running the MEMOBUS/Modbus protocol.

The H5-☐☐ parameters set the drive for MEMOBUS/Modbus Communications. *Refer to MEMOBUS/Modbus Serial Communication on page 468* 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 in sinking or sourcing mode. *Refer to Using the Pulse Train Output on page 92* 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 2	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. *Refer to b5: PID Control on page 151* 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. *Refer to b5: PID Control on page 151* for details on PID control.

■ H6-02: Pulse Train Input Scaling

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%

■ 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

■ H6-08: Pulse Train Input Minimum Frequency

Sets the minimum output frequency detected by the pulse train input. Increasing this setting reduces the time the drive needs to react to changes in the input signal.

- The pulse input value becomes 0 when the pulse input frequency falls below this level.
- 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. When the drive detects a motor overload an oL1 fault is triggered and the drive output shuts 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	1

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 closes when the motor overload level reaches 90% of the oL1 detection level.
2. Set L1-01 to a value between 1 and 6 when running a single motor from the drive to select a method to protect the motor from overheat. An external thermal relay is not necessary.

Setting 0: Disabled (motor overload protection is not provided)

Use this setting if no motor overheat protection is desired or if multiple motors are connected to a single drive. If multiple motors are connected to a single drive, install a thermal relay for each motor as shown in ***Figure 5.65***.

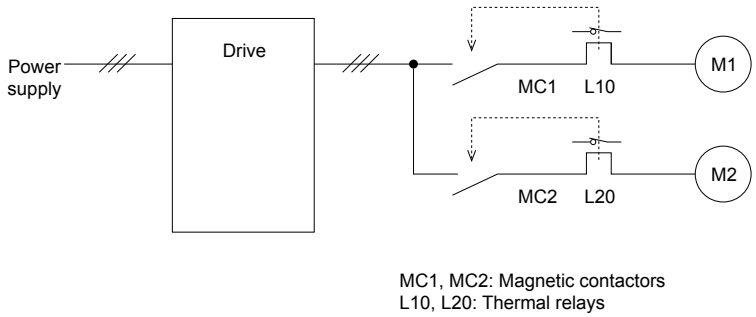


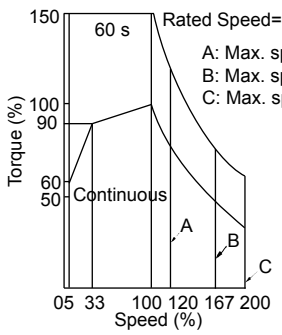
Figure 5.65 Example of Protection Circuit Design for Multiple Motors

NOTICE: *Thermal protection cannot be provided when running multi-motors simultaneously with the same drive, or when using motors with a relatively high current rating compared to 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.*

Note: Close MC1 and MC2 before operating the drive. MC1 and MC2 cannot be switched off during run.

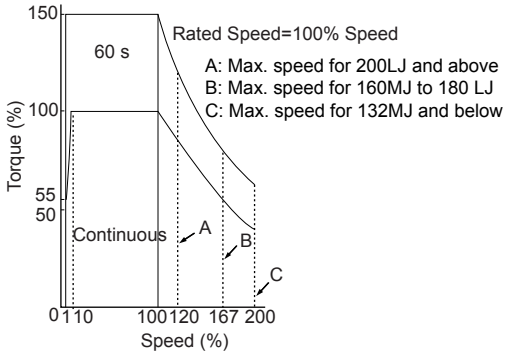
Setting 1: General-purpose motor (standard self-cooled)

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
	Motor designed to operate from line power. Motor cooling is most effective when running at rated base frequency (check the motor nameplate or specifications).	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.

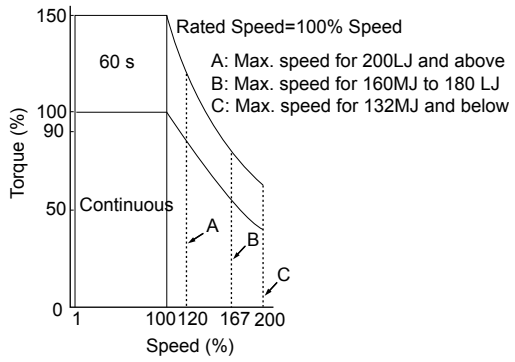
Setting 2: Drive dedicated motor (speed range for constant torque: 1:10)

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 6 Hz to E1-06, Motor Base Frequency.

Setting 3: Vector motor (speed range for constant torque: 1:100)

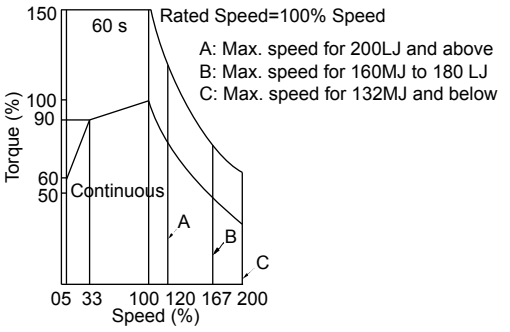
Use this setting when operating a drive-dedicated motor that allows constant torque in a speed range of 1:100. This motor type is allowed to run with 100% load from 1% up to 100% speed. Running slower speeds with full load can trigger an overload fault.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor is designed to effectively cool itself at speeds near 0.6 Hz.	Continuous operation with 100% load from 0.6 Hz to E1-06, Motor Base Frequency. Continuous operation below 0.6 Hz may cause an oL1 or oL2 fault.

Setting 6: General-purpose motor

Note: General-purpose motors are designed with a base speed that operates at line frequency (50/60 Hz depending on geographic region).

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 and protects the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor designed to operate from line power. Motor cooling is most effective when running at rated base frequency (check the motor nameplate or specifications)	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.

■ L1-02: Motor Overload Protection Time

Sets the detection time of motor overheat 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 5.66 illustrates an example of the electrothermal protection operation time using a general-purpose motor operating at the value of E1-06, Motor Base Speed, 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.

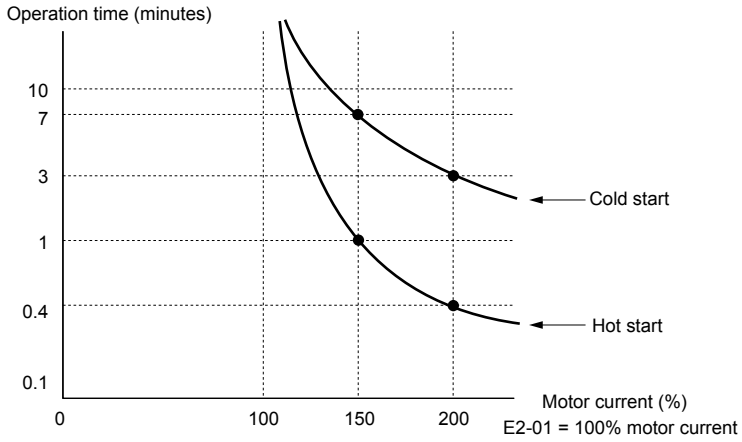


Figure 5.66 Motor Protection Operation Time

■ Motor Protection Using a Positive Temperature Coefficient (PTC) Thermistor

Connect a motor PTC can to an analog input of the drive for motor overheat protection.

The motor overheat alarm level triggers an oH3 alarm and the drive continues the operation selected in L1-03. The overheat fault level triggers an oH4 fault, outputs a fault signal, and the drive stops the motor using the stop method selected in L1-04.

Connect the PTC between terminals AC and A3 and set jumper S4 on the terminal board to “PTC” as shown in *Figure 5.67*. Set H3-05 to 0 and H3-06 to E.

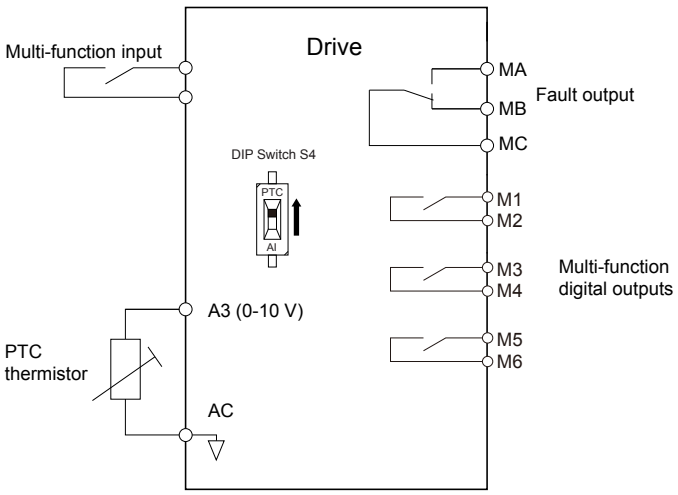


Figure 5.67 Connection of a Motor PTC

The PTC must exhibit the characteristics shown in ***Figure 5.68*** in one motor phase. The motor overload protection of the drive expects 3 of these PTCs to be connected in a series.

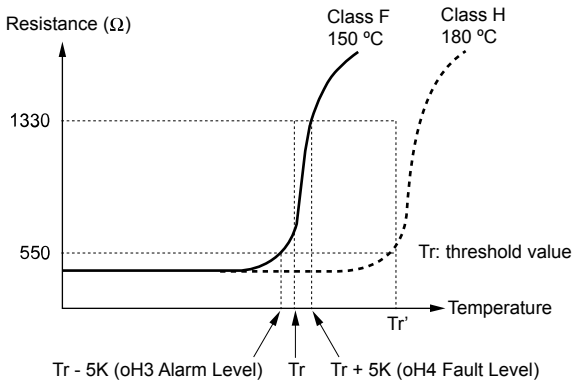


Figure 5.68 Motor PTC Characteristics

Set up overheat detection using a PTC using parameters L1-03, L1-04, and L1-05 as explained in the following sections.

■ 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)

Sets a filter on the PTC input signal to prevent erroneous detection of a motor overheat fault.

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 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 to 2	1

Setting 0: Disabled

Setting 1: Enabled

Setting 2: Enabled (RTC)

◆ 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 automatically return to the operation it was performing prior to the power loss based on certain conditions.

No.	Name	Setting Range	Default
L2-01	Momentary Power Loss Operation Selection	0 to 5	2

Setting 0: Disabled (default)

If power is not restored within 15 ms, a Uv1 fault will result and the motor coasts to stop.

Setting 1: Recover within L2-02

When a momentary power loss occurs, the drive output will be shut off. If the power returns 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 this time (i.e., DC bus voltage level remains below Uv1 detection level L2-05), then a Uv1 fault is triggered and the drive will stop.

Setting 2: Recover as long as CPU has power

When a momentary power loss occurs, the drive output will be shut off. If the power returns and the drive control circuit has power, the drive will attempt to perform Speed Search and resume the operation. This will not trigger a Uv1 fault.

Setting 3: Kinetic Energy Backup (KEB) Ride-Thru operation within L2-02

The drive decelerates using regenerative energy from the motor until the time set in L2-02 has expired. It then tries to accelerate back to the frequency reference. If the power does not return within the time set to L2-02, it will trigger a Uv1 fault and the drive output will shut off. The type of KEB operation is determined by the L2-29 setting.

Setting 4: KEB Ride-Thru as long as CPU has power

The drive decelerates using regenerative energy from the motor until the power returns and then restarts. If the motor comes to a stop before the power returns, the drive loses control power and the drive output shuts off. A Uv1 fault is not triggered. The type of KEB operation is determined by the L2-29 setting.

Setting 5: Ramp to stop with KEB deceleration

The drive ramps to stop using the regenerative energy from the motor. Even if the power is restored, the drive will continue to decelerate until the motor comes to a complete stop. The type of KEB operation is determined by the L2-29 setting. If an input terminal set for KEB 1 (H1-□□ = 65, 66) is triggered while the drive is decelerating, it will accelerate back up to speed when the input is released.

Notes on Settings 1 through 5

- "Uv" will flash on the operator while the drive is attempting to recover from a momentary power loss. A fault signal is not output at this time.
- A Momentary Power Loss Unit is available to allow for a longer momentary power loss ride through time in models 2A0004 to 2A0056 and 4A0002 to 4A0031. This option makes it possible to continue running the drive after up to two seconds of power loss.
- When using a magnetic contactor between the motor and the drive, keep the magnetic contactor closed as long as the drive performs KEB operation or attempts to restart with Speed Search.
- Keep the Run command active during KEB operation or the drive cannot accelerate back to the frequency reference when the power returns.
- When L2-01 is set to 3, 4, or 5, KEB Ride-Thru will be executed as specified in L2-29.

■ KEB Ride-Thru Function

When the drive detects a power loss, KEB Ride-Thru decelerates the motor and uses regenerative energy to keep the main circuit operating. Despite power loss, the drive output is not interrupted.

Choose between Single Drive KEB Ride-Thru 1 and 2 (L2-29 = 0 or 1 for applications driven by a single drive.

Choose between System KEB Ride-Thru 1 and 2, (L2-29 = 2 or 3) for applications where multiple drives have to perform KEB operation while keeping a certain speed ratio.

Single Drive KEB Ride-Thru 1 (L2-29 = 0)

After KEB Ride-Thru begins, the drive uses regenerative energy from the motor to keep the DC bus voltage at the level set to L2-11 while adjusting the rate of deceleration based on the time set to L2-06. The user must set L2-06 properly to prevent Uv1 and ov faults.

Note: Shorten the KEB deceleration time (L2-06) if undervoltage (Uv1) occurs in the DC bus. Increase the KEB deceleration time if overvoltage (ov) occurs.

Single Drive KEB Ride-Thru 2 (L2-29 = 1)

The drive uses information about the inertia of the connected machinery to determine the deceleration rate necessary to keep the DC bus voltage at the level set in parameter L2-11. The resulting deceleration time is calculated based on the system inertia and cannot be adjusted.

System KEB Ride-Thru 1 (L2-29 = 2)

The drive decelerates at the KEB deceleration time set to L2-06. L2-06 is the time required to decelerate from the current frequency reference to 0. Using this setting, multiple drives can decelerate while keeping the speed ratio constant between those drives. This function requires a braking resistor and disregards the voltage level in the DC bus.

System KEB Ride-Thru 2 (L2-29 = 3)

The drive decelerates based on the KEB deceleration time set to L2-06 while monitoring the DC bus voltage. If the voltage level rises, the drive briefly holds the frequency before continuing to decelerate.

■ KEB Ride-Thru Start

KEB operation is triggered independently of the selected KEB operation mode. When the KEB function is selected as the function to be executed when power loss operation occurs (L2-01 = 3, 4, or 5), then KEB Ride-Thru will be activated if one of the following conditions becomes true:

- A digital input programmed for H1-☐☐ = 65 or 66 is activated. This will start KEB operation using the mode selected in parameter L2-29.
- A digital input programmed for H1-☐☐ = 7A or 7B is activated. This will automatically select Single KEB Ride-Thru 2, disregarding the setting of L2-29.
- The DC bus voltage fell below the level specified in L2-05. The KEB operation will start as specified in L2-29.

Note: Attempting to simultaneously assign KEB Ride-Thru 1 and 2 to input terminals will trigger an oPE3 error.

When using a digital input to trigger KEB operation and the device controlling the input acts relatively slow, set a minimum KEB operation time in parameter L2-10. In the example below, the DC bus voltage triggers KEB operation and a digital input triggers the Hold command.

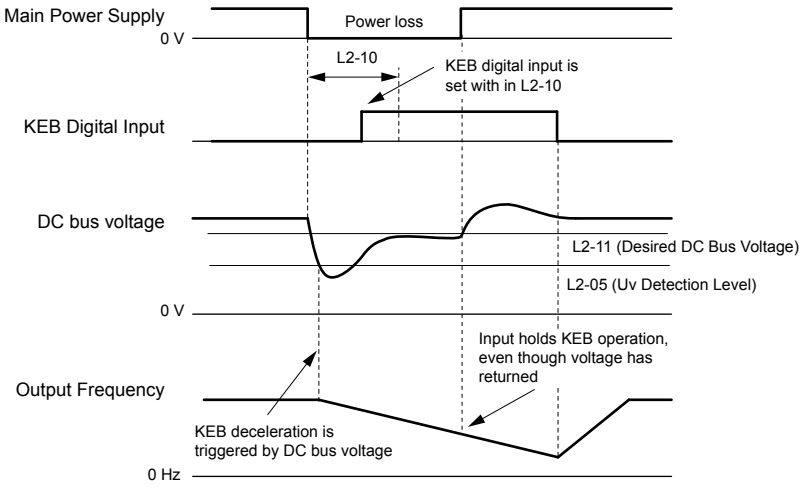


Figure 5.69 KEB Operation Using a KEB Input

■ KEB Ride-Thru End Detection

The KEB function end detection depends on the setting of parameter L2-01 and whether a digital input programmed for KEB (H1-☐☐ = 65, 66, 7A, 7B) is used.

KEB Ride-Thru Operation in L2-02, Input Terminals Not Used

Here, L2-01 = 3 and the input terminals have not been set for KEB Ride-Thru (H1-□□ does not equal 65, 66, 7A, 7B). After decelerating for the time set in parameter L2-02, the drive ends KEB operation and attempts to accelerate back to the frequency reference. A Uv1 fault occurs and the drive output shuts off if the power does not return within the time set to L2-02.

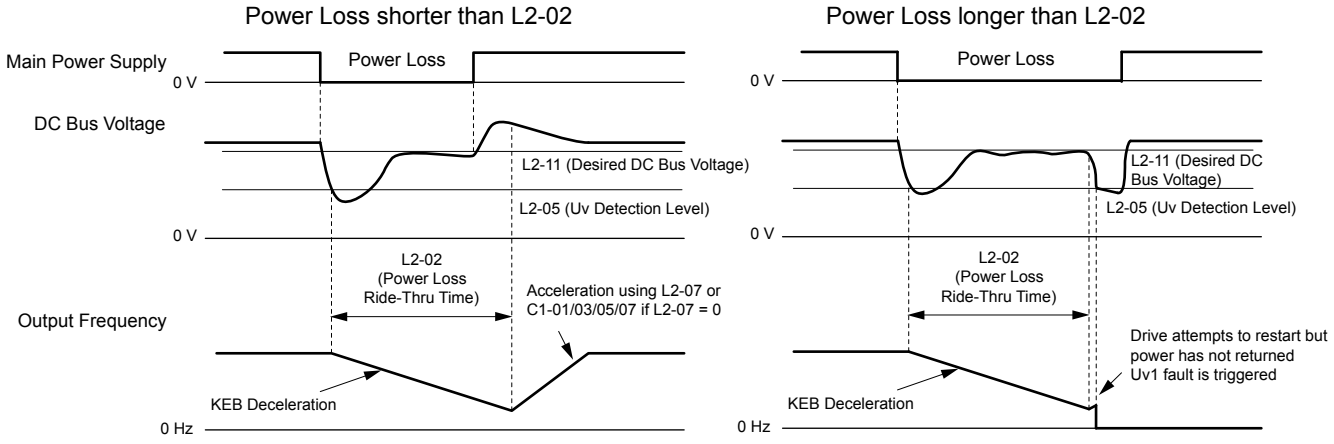


Figure 5.70 KEB Operation Using L2-02, Without KEB Input

KEB Ride-Thru Operation Within L2-02, Input Terminals Used

Here, L2-01 = 3 and an input terminal is set to issue KEB Ride-Thru (H1-□□ = 65, 66, 7A, 7B). After decelerating for the time set in parameter L2-02, the drive checks the DC bus voltage and the status of the digital input. If the DC bus voltage is still below the level set in L2-11 or if the KEB digital input is still active, KEB deceleration continues. If the voltage level has risen above the value set to L2-11, then normal operation is resumed.

Note: If L2-10 is set to a longer time than L2-02, the drive checks the DC bus voltage level and the status of the terminal assigned to KEB Ride-Thru after the time set to L2-02 passes. The drive will then try to restart.

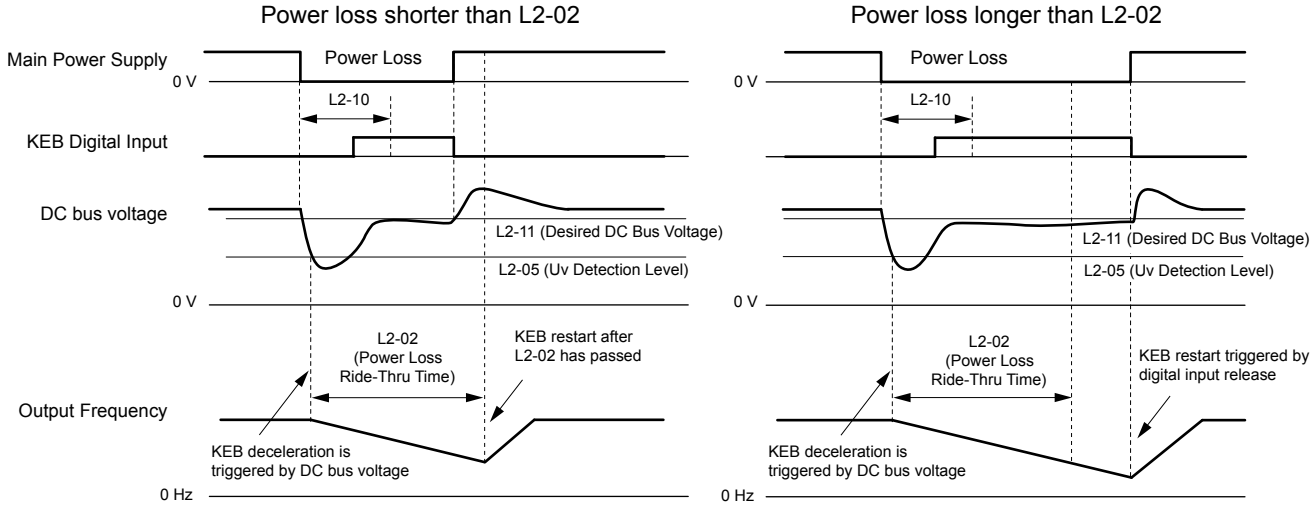


Figure 5.71 KEB Operation Using L2-02 and KEB Input

KEB Ride-Thru Operation as Long as CPU Has Power, KEB Input Not Used

Here, L2-01 = 4 and the input terminals have not been set for KEB Ride-Thru (H1-□□ does not equal 65, 66, 7A, 7B). After decelerating for the time set to parameter L2-10, the drive checks the DC bus voltage level. Deceleration continues if the DC bus voltage is lower than the level set in L2-11. Normal operation resumes when the DC bus voltage rises above the value of L2-11.

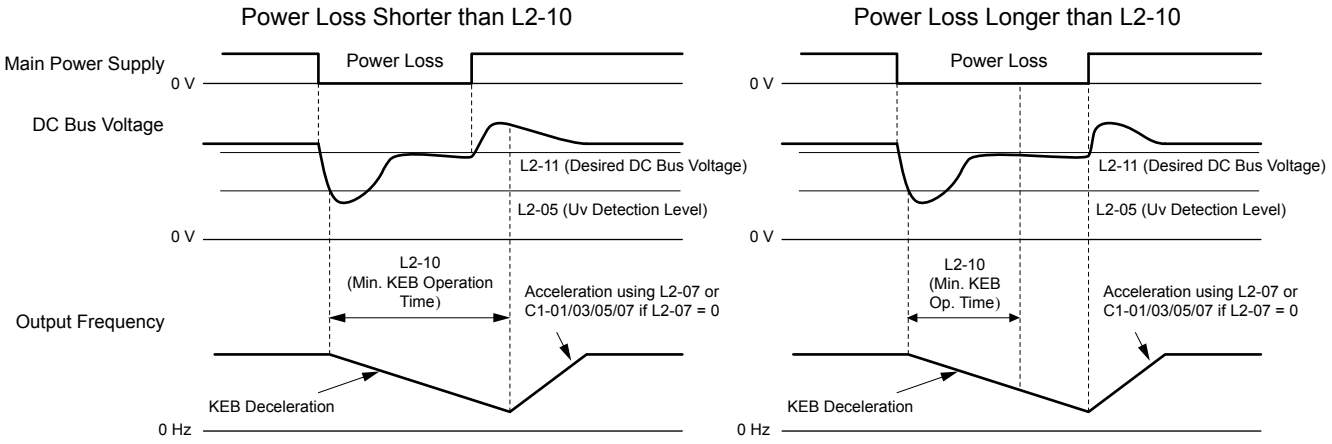


Figure 5.72 KEB Operation Using L2-10, Without KEB Input

KEB Ride-Thru Operation as Long as CPU Has Power, KEB Input Used

Here, L2-01 = 3 and an input terminal is set to issue KEB Ride-Thru (H1-□□ = 65, 66, 7A, 7B). After decelerating for the time set to parameter L2-10, the drive checks the DC bus voltage and the status of the digital input. Deceleration continues if the DC bus voltage is still below the level set in L2-11 or if the digital input assigned to KEB Ride-Thru is still active. Normal operation resumes when the DC bus voltage rises above the value of L2-11 and the terminal that initiated KEB Rid-Thru is released.

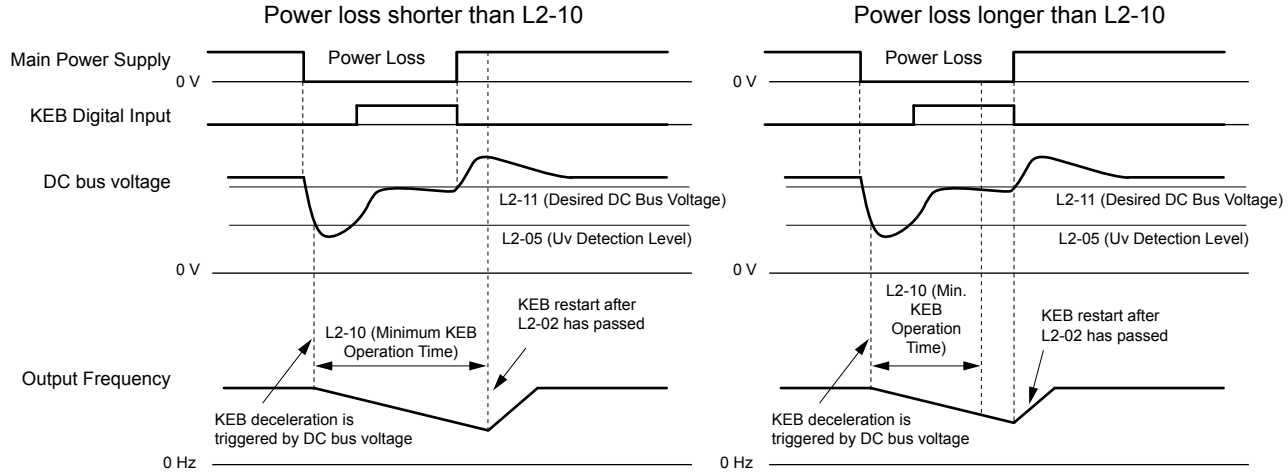


Figure 5.73 KEB Operation Using L2-10 and KEB Input

L2-01 = 5

KEB operation ends when the motor has come to a stop, even if the power returns and the digital input terminal that initiated KEB Ride-Thru is cleared.

■ KEB Operation Wiring Example

Figure 5.74 shows a wiring example to trigger the KEB Ride-Thru at power loss using an undervoltage relay. When a power loss occurs, the undervoltage relay triggers KEB Ride-Thru at terminal S6 (H1-06 = 65, 66, 7A, 7B). Note that using System KEB Ride-Thru requires an additional dynamic braking option.

Note:
1. Do not switch off the Run command during momentary power loss. If the Run command is shut off, the drive will not accelerate back to speed when the power is restored.
2. A dynamic braking option is required to use System KEB 1 (L2-29 = 2).

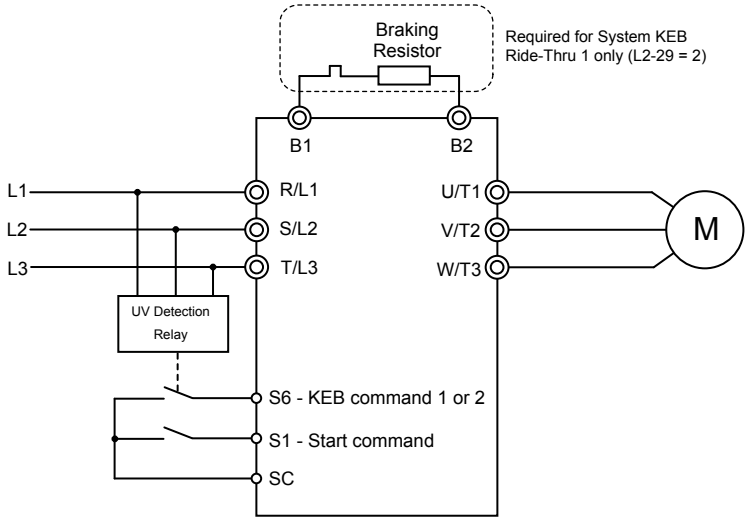


Figure 5.74 KEB Function Wiring Example

■ Parameters for KEB Ride-Thru

Table 5.35 lists parameters needed to set up KEB Ride-Thru depending on the type of KEB Ride-Thru selected in L2-29.

Table 5.35 KEB Function Related Adjustments

Parameter	Name	Setting Instructions	KEB Mode (L2-29)			
			0	1	2	3
C1-09	Fast Stop Time	• Increase if an overvoltage fault occurs during KEB deceleration. • Decrease if an undervoltage fault occurs during KEB deceleration.	YES	NO	NO	NO
C2-03	S-Curve at Deceleration Start	• Shorten if undervoltage occurs immediately after KEB Ride-Thru is triggered. • Lengthen this setting if overvoltage occurs immediately after KEB operation starts.	YES	NO	YES	YES
L2-05	Undervoltage Detection Level	Increase if an undervoltage fault occurs at KEB operation start to let the drive detect power loss more quickly.	YES	YES	YES	YES
L2-06	KEB Deceleration Time	• Increase if an overvoltage fault occurs during KEB deceleration • Decrease if an undervoltage fault occurs during KEB deceleration	NO	NO	YES	YES
L2-07	KEB Acceleration Time	Adjust to the desired acceleration time. If set to 0, standard acceleration times are used (C1-01, C1-03, C1-05, C1-07).	YES	YES	YES	YES
L2-08	Frequency Gain at KEB Start	• Increase if an undervoltage fault occurs immediately after KEB operation starts. • Decrease if an overvoltage fault occurs immediately after KEB operation starts.	YES	NO	YES	YES
L2-10	KEB Detection Time	• Increase when a digital input is set for KEB Ride-Thru and an undervoltage fault occurs after power was lost because the device controlling the input does not react quickly enough. • If the DC bus voltage overshoots after KEB Ride-Thru begins (and no input terminal is set to KEB Ride-Thru), increase L2-10 to longer than the overshoot.	YES	YES	YES	YES
L2-11	Desired DC Bus Voltage during KEB	• Set to approximately 1.22 times the input voltage for Single Drive KEB Ride-Thru 2. • Set to approximately 1.4 times the input voltage for Single Drive KEB Ride-Thru 1 and System KEB Ride-Thru modes.	YES	YES	YES	YES
L3-20	Main Circuit Adjustment Gain	• Increase this setting in steps of 0.1 if overvoltage or undervoltage occurs at the beginning of deceleration • Reduce if torque ripple occurs during deceleration while executing KEB Ride-Thru.	NO	YES	NO	NO

Parameter	Name	Setting Instructions	KEB Mode (L2-29)			
			0	1	2	3
L3-21	Accel/Decel Rate Calculation Gain	• Reduce L3-21 in steps of 0.05 if there is a fairly large speed or current ripple. • Decreasing this setting too much can cause a slow DC bus voltage control response, and may lead to problems with overvoltage or undervoltage.	NO	YES	NO	NO
L3-24	Motor Acceleration Time	Set the motor acceleration time as described on page *240*.	NO	YES	NO	NO
L3-25	Load Inertia Ratio	Set the load/inertia ratio as described on page *240*.	NO	YES	NO	NO

■ 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 the frequency reference. This parameter is valid if L2-01 = 1 or 3.

Note: 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 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 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 o2-04

■ L2-05: Undervoltage Detection Level (Uv)

Determines the voltage at which a Uv1 fault is triggered or at which the KEB function is activated. This setting rarely needs to be changed.

No.	Name	Setting Range	Default
L2-05	Undervoltage Detection Level	150 to 210 Vdc <1>	Determined by E1-01 <2>

<1> Values are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

<2> The default setting for 400 V class drives depends on whether the drive input voltage is over 400 V or under 400 V.

Note:
1. Install an AC reactor option on the input side of the power supply when setting L2-05 below the default value to prevent damage to drive circuitry.
2. If using KEB Ride-Thru and L2-05 is set too low, then undervoltage in the DC bus (Uv1) will be triggered before KEB Ride-Thru can be executed. Take caution not to set this value too low.

■ L2-06: KEB Deceleration Time

Sets the time to decelerate from the frequency reference at the time KEB Ride-Thru was initiated to zero speed. This setting can be used only when L2-29 = 2 (System KEB Ride-Thru 1).

No.	Name	Setting Range	Default
L2-06	KEB Deceleration Time	0.00 to 6000.0 s <1>	0.00 s

<1> Setting range is determined by the accel/decel time units set in C1-10. If the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s.

■ L2-07: KEB Acceleration Time

Sets the time to reaccelerate from the speed when KEB was deactivated to the frequency reference.

When set to 0.0 s, the drive will accelerate to speed according to the active acceleration time set in C1-01 or C1-03.

No.	Name	Setting Range	Default
L2-07	KEB Acceleration Time	0.00 to 6000.0 s <1>	0.00 s

<1> Setting range is determined by the accel/decel time units set in C1-10. If the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s.

■ L2-08: Frequency Gain at KEB Start

When the KEB Ride-Thru command is input, the output frequency is reduced in a single step to quickly get the motor into a regenerative state. Calculate the amount of this frequency reduction using the formula below. L2-08 can only be used with induction motors.

Amount of reduction = Slip frequency prior to KEB × (L2-08) × 2

No.	Name	Setting Range	Default
L2-08	Frequency Gain at KEB Start	0 to 300%	100%

■ L2-10: KEB Detection Time (Minimum KEB Time)

No.	Name	Setting Range	Default
L2-10	KEB Detection Time	0 to 2000 ms	50 ms

■ L2-11: DC Bus Voltage Setpoint during KEB

Determines the setpoint (target value) for the DC bus voltage during Single KEB Ride-Thru 2. For Single KEB Ride-Thru 1 and System KEB Ride-Thru, parameter L2-11 defines the voltage level to end KEB Ride-Thru.

No.	Name	Setting Range	Default
L2-11	DC Bus Voltage Setpoint during KEB	150 to 400 Vdc <1>	[E1-01] × 1.22

<1> Values are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives, but set the value below 1040 Vdc (overvoltage protection level).

■ L2-29: KEB Method Selection

Selects the way the Kinetic Energy Buffering function operates.

Note: If a multi function input is set for Single KEB Ride-Thru 2 (H1-□□ = 7A, 7B), the setting of L2-29 is disregarded and the KEB mode equal to L2-29 = 1 is automatically selected.

No.	Name	Setting Range	Default
L2-29	KEB Method Selection	0 to 3	0

Setting 0: Single Drive KEB Ride-Thru 1

Setting 1: Single Drive KEB Ride-Thru 2

Setting 2: System KEB Ride-Thru 1

Setting 3: System KEB Ride-Thru 2

Refer to KEB Ride-Thru Function on page 229 for detailed explanations.

◆ L3: Stall Prevention

The motor may experience excessive slip because it cannot keep up with the frequency reference when the load is too high or acceleration and deceleration times are too short. If the motor slips during acceleration, it usually causes an overcurrent fault (oC), drive overload (oL2), or motor overload (oL1). If the motor slips during deceleration, it can cause excessive regenerative power to flow back into the DC bus capacitors, and eventually cause the drive to fault out from overvoltage (oV). The Stall Prevention Function prevents the motor from stalling and while allowing the motor to reach the desired speed without requiring the user 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.

L3-01 determines the type of Stall prevention the drive should use during acceleration.

No.	Name	Setting Range	Default
L3-01	Stall Prevention Selection during Acceleration	0 to 2	1

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, causing an overload fault.

Setting 1: Enabled

Enables Stall Prevention during acceleration.

Acceleration is reduced when the output current value exceeds 85% of the level set to parameter L3-02 for a longer than the time set to L3-27. The acceleration stops when the current exceeds L3-02. Acceleration continues when the current falls below L3-02 for longer than the time set to L3-27.

The Stall Prevention level is automatically reduced in the constant power range. *Refer to L3-03: Stall Prevention Limit during Acceleration on page 236*.

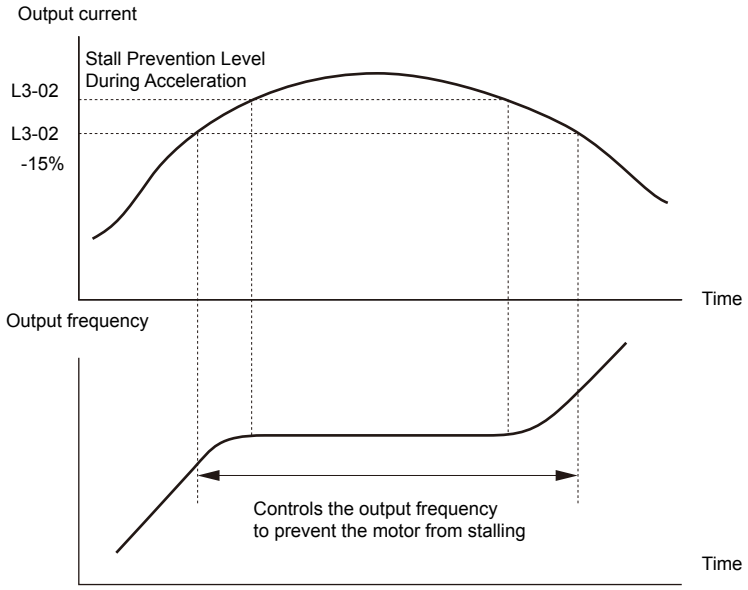


Figure 5.75 Stall Prevention During Acceleration for Induction Motors

Setting 2: Intelligent Stall Prevention

The drive disregards the selected acceleration time and attempts to accelerate in the minimum time. The acceleration rate is adjusted so the current does not exceed the value set to 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% <1>	<1>

<1> The upper limit and default value is determined by parameter L8-38, Carrier Frequency Reduction.

- Lower L3-02 if stalling occurs when using a motor that is relatively small compared to the drive.
- Also set parameter L3-03 when operating the motor in the constant power range.

■ 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%

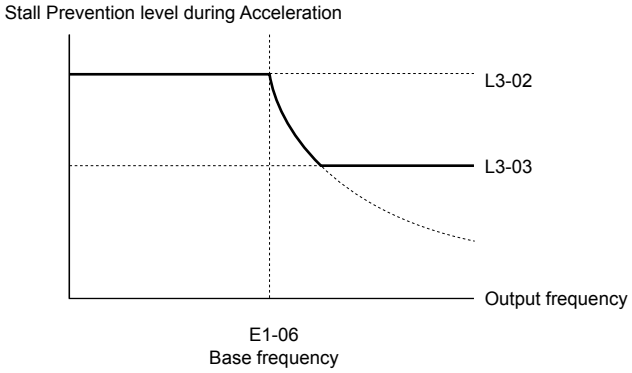


Figure 5.76 Stall Prevention Level and Limit During Acceleration

■ L3-04: Stall Prevention Selection during Deceleration

Stall Prevention during deceleration controls the deceleration based on the DC bus voltage and prevents 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	1

Setting 0: Disabled

The drive decelerates according to the set deceleration time. With high inertia loads or rapid deceleration, an overvoltage fault may occur. If an overvoltage fault occurs, use dynamic braking options or switch to another L3-04 selection.

Setting 1: General-purpose Stall Prevention

The drive tries to decelerate within the set deceleration time. The drive pauses deceleration when the DC bus voltage exceeds the Stall Prevention level and then continues deceleration when 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
600 V Class	1084 Vdc

Note:
1. Do not use this setting in combination with a Dynamic Braking Resistor or other dynamic 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 dynamic braking option.

Figure 5.77 illustrates the function of Stall Prevention during deceleration.

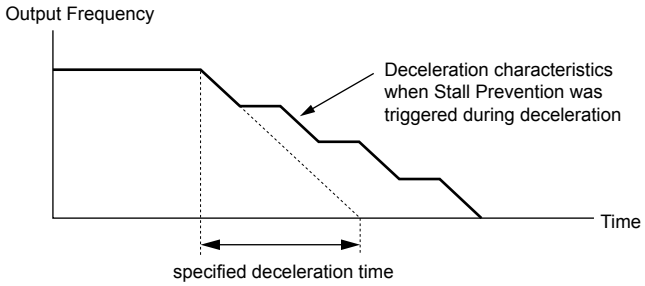


Figure 5.77 Stall Prevention During Deceleration

Setting 2: Intelligent Stall Prevention

The drive adjusts the deceleration rate so the DC bus voltage is kept at the level set to parameter L3-17. This produces the shortest possible deceleration time while protecting the motor from stalling. The selected deceleration time is disregarded and the achievable deceleration time cannot be smaller than 1/10 of the set deceleration time.

This function uses the following parameters for adjusting the deceleration rate:

- DC bus voltage gain (L3-20)
- Deceleration rate calculations gain (L3-21)
- Inertia calculations for motor acceleration time (L3-24)
- Load inertia ratio (L3-25)

Note: The deceleration time is not constant. Do not use Intelligent Stall Prevention in applications where stopping accuracy is a concern. Use dynamic braking options instead.

Setting 3: Stall Prevention with dynamic braking option

Enables the Stall Prevention function while using a dynamic braking resistor.

Setting 4: Overexcitation Deceleration 1

Overexcitation Deceleration 1 (increasing the motor flux) is faster than deceleration with no Stall Prevention (L3-04 = 0). Setting 4 changes the selected decel time and functions to provide protection from an overvoltage trip. *Refer to Overexcitation Deceleration (Induction Motors) on page 252* 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 to parameter L3-17. This function shortens the achievable deceleration time more than by using Overexcitation Deceleration 1. Setting 5 will shorten/lengthen the decel time to maintain the L3-17 bus level. *Refer to Overexcitation Deceleration (Induction Motors) on page 252* for details.

■ L3-05: Stall Prevention Selection during Run

Determines how Stall Prevention works during Run. Stall Prevention during run prevents the motor from stalling by automatically reducing the speed when a transient overload occurs while the motor is running at constant speed.

No.	Name	Setting Range	Default
L3-05	Stall Prevention Selection During Run	0 to 2	1

Note: Stall Prevention during run is disabled when the output frequency is 6 Hz or lower regardless of the L3-05 and L3-06 settings.

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, the drive will decelerate at decel time 1 (C1-02). When 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). A setting of 100% is equal to the drive rated current.

The Stall Prevention level can be adjusted using an analog input. *Refer to Multi-Function Analog Input Terminal Settings on page 219* for details.

No.	Name	Setting Range	Default
L3-06	Stall Prevention Level During Run	30 to 150% <1>	<1>

<1> The upper limit and default for this setting is determined by L8-38.

■ Overvoltage Suppression Function

Suppresses overvoltage faults by decreasing the regenerative torque limit and slightly increasing the output frequency when the DC bus voltage rises. This function can drive loads with cyclic regenerative operation, such as a punch press or other applications that involve repetitive crank movements.

The regenerative torque limit and the output frequency are adjusted during ov suppression so that the DC bus voltage does not exceed the level set to parameter L3-17. In addition to the parameters explained below, ov suppression also uses these settings for frequency adjustment:

- DC bus voltage gain (L3-20)
- Deceleration rate calculations gain (L3-21)
- Inertia calculations for motor acceleration time (L3-24)
- Load inertia ratio (L3-25)

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 the application requires this, 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, 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 dynamic 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 level used by the overvoltage suppression function (L3-11 = 1), 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 specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives, but set the value below 1040 Vdc (overvoltage protection level).

<2> This value is initialized when E1-01 is changed.

■ L3-20: DC Bus Voltage Adjustment Gain

Determines the proportional gain used by overvoltage suppression (L3-11 = 1), Single Drive KEB 2 (L2-29 = 1), KEB Ride-Thru 2 (H1-☐☐ = 7A or 7B) ,and Intelligent Stall Prevention during deceleration (L3-04 = 2) to control the DC bus voltage.

No.	Name	Setting Range	Default
L3-20	DC Bus Voltage Adjustment Gain	0.00 to 5.00	1.00

Adjustment for Single Drive KEB 2 (L2-29 = 1) and Intelligent Stall Prevention During Deceleration

- Increase this setting slowly in steps of 0.1 if overvoltage or undervoltage occurs at the beginning of deceleration.
- Decrease this setting if there is a fair amount of speed or torque ripple.

Adjustment for Overvoltage Suppression

- Increase this setting slowly in steps of 0.1 if overvoltage suppression is enabled (L3-11 = 1) and a sudden increase in a regenerative load causes an overvoltage fault.
- Decrease this setting if there is a fair amount of speed or torque ripple.

■ L3-21: Accel/Decel Rate Calculation Gain

Determines the proportional gain used by overvoltage suppression (L3-11 = 1), Single Drive KEB 2 (L2-29 = 1), and Intelligent Stall Prevention during deceleration (L3-04 = 2) to calculate acceleration and deceleration rates.

No.	Name	Setting Range	Default
L3-21	Accel/Decel Rate Calculation Gain	0.10 to 10.00	1.00

Adjustment for Single Drive KEB 2 (L2-29 = 1) and Intelligent Stall Prevention During Deceleration

- Reduce L3-21 in steps of 0.05 if there is a fairly large speed or current ripple.
- Small reductions of L3-21 can help solve problems with overvoltage and overcurrent.
- Decreasing this setting too much can cause slow DC bus voltage control response and may also lengthen deceleration times beyond optimal levels.

Adjustment for Overvoltage Suppression

- Increase this setting in steps of 0.1 if overvoltage occurs as a result of a regenerative load when overvoltage suppression is enabled (L3-11 = 1).
- Decrease L3-21 in steps of 0.05 if there is a fairly large speed ripple when overvoltage suppression is enabled.

■ L3-23: Automatic Reduction Selection for Stall Prevention during Run

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, 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.

■ L3-24: Motor Acceleration Time for Inertia Calculations

Sets the time to accelerate the motor from stop to the maximum speed at motor rated torque. Set this parameter when using Single Drive KEB 2 (L2-29 = 1), Intelligent Stall Prevention during Deceleration (L3-04 = 2), or the Overvoltage Suppression function (L3-11 = 1).

No.	Name	Setting Range	Default
L3-24	Motor Acceleration Time for Inertia Calculations	0.001 to 10.000 s	Determined by o2-04 <1>

<1> Parameter L3-24 is defaulted for a Yaskawa standard 4-pole motor. During Auto-Tuning, L3-24 will be initialized to a Yaskawa standard 4-pole motor if parameter E2-11 is changed.

Manual Parameter Setup

Make the calculations in the formula below:

$$\text{L3-24} = \frac{2 \cdot \pi \cdot J\ [\text{kgm}^2] \cdot n_{rated}[\text{r/min}]}{60 \cdot T_{rated}[\text{Nm}]}$$

Calculate the rated torque in the formula below:

$$T_{rated}[\text{Nm}] = \frac{60 \cdot P_{Motor}[\text{kW}] \cdot 10^3}{2 \cdot \pi \cdot n_{rated}[\text{r/min}]}$$

■ L3-25: Load Inertia Ratio

Determines the ratio between the rotor inertia and the load. Set this parameter when using Single Drive KEB 2 (L2-29 = 1), Intelligent Stall Prevention during deceleration (L3-04 = 2), or the overvoltage suppression function (L3-11 = 1).

No.	Name	Setting Range	Default
L3-25	Load Inertia Ratio	1.0 to 1000.0	1.0

When set incorrectly, a fairly large current ripple can result during Single Drive KEB 2 (L2-29 = 1). This may cause overvoltage suppression (L3-11 = 1) or other faults such as ov, Uv1, and oC.

Manual Parameter Setup

Calculate parameter L3-25 in the formula below:

$$L3\text{-}25 = \frac{\text{Machine Inertia}}{\text{Motor Inertia}}$$

■ L3-26: Additional DC Bus Capacitors

Sets the capacity of any additionally installed DC bus capacitors. This data is used in calculations for Single Drive KEB Ride-Thru 2. Adjust this setting only if external capacity is connected to the DC bus and Single Drive KEB 2 is used.

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 that can be assigned to the multi-function output terminals.

■ 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.

No.	Name	Setting Range	Default
L4-01	Speed Agreement Detection Level	0.0 to 400.0 Hz	0.0 Hz
L4-02	Speed Agreement Detection Width	0.0 to 20.0 Hz	2.0 Hz

Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and MD-ME-MF Function Selection on page 206, Settings 2, 3, 4, and 5.

■ 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.

No.	Name	Setting Range	Default
L4-03	Speed Agreement Detection Level (+/-)	-400.0 to 400.0 Hz	0.0 Hz
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0 Hz	2.0 Hz

Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and MD-ME-MF Function Selection on page 206, Settings 13, 14, 15, and 16.

■ 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 or below 5% of the maximum output frequency within 400 ms.

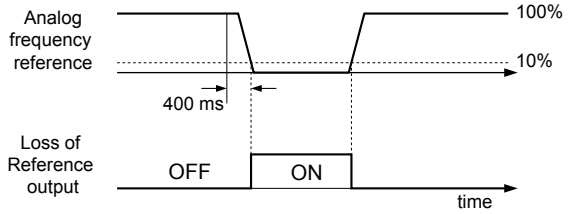


Figure 5.78 Loss of Reference Function

Set H2-01, H2-02, or H2-03 to C for a digital output to trigger when frequency reference loss occurs. *Refer to Setting C: Frequency Reference Loss on page 210* 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, 1	0

Setting 0: Stop

Drive follows the frequency reference (which is no longer present) and stops the motor.

Setting 1: Continue operation with reduced frequency reference

The drive will continue operation at the frequency reference value set to 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 at which the drive runs when L4-05 = 1 and when detecting a reference loss. The value is set as a percentage of the frequency reference before 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 active using parameters L4-01 through L4-04.

No.	Name	Setting Range	Default
L4-07	Speed Agreement Detection Selection	0, 1	0

Setting 0: No Detection during Baseblock

Setting 1: Detection always Enabled

◆ L5: Fault Restart

After a fault has occurred, Fault Restart attempts to automatically restart the motor and continue operation instead of stopping.

The drive can 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 145* for details).

Note:
1. The wiring sequence should remove the Forward/Reverse command when a fault is triggered and output is shut off.
2. When the Forward/Reverse command is removed, the drive can perform a self-diagnostic check and attempt to restart the fault automatically.

WARNING! *Sudden Movement Hazard. Do not use the fault restart function in lifting applications. Fault restart may cause the machine to drop the load, which could result in death or serious injury.*

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		

<1> When L2-01 is set to 1 through 4 (continue operation during momentary power loss)

Use parameters L5-01 to L5-05 to set up automatic fault restart.

Set H2-01, H2-02, or H2-03 to 1E. to output a signal during fault restart.

■ L5-01: Number of Auto Restart Attempts

Sets the number of times that the drive may attempt to restart itself.

Parameter L5-05 determines the method of incrementing the restart counter. When the counter reaches the number set to L5-01, the operation stops and the fault must be manually cleared and reset.

The restart counter is incremented at each restart attempt, regardless of whether the attempt was successful. When the counter reaches the number set to L5-01, the operation stops and the fault must be manually cleared and reset.

The number of fault restarts is reset to zero when:
- The drive operates normally for 10 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 Times

■ 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, 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, 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 to L5-01.

Setting 1: Count Restart Attempts

The drive will attempt to restart using the time interval set to parameter L5-04. A record is kept of the number of attempts to restart to the drive, regardless of whether those attempts were successful. When the number of attempted restarts exceeds the value set to L5-01, the drive stops attempting to restart.

◆ L6: Torque Detection

The drive provides two independent torque detection functions that trigger an alarm or fault signal when the load is too heavy (oL), or suddenly drops (UL). These functions are set up using the L6-☐☐ parameters. Program the digital outputs as shown below to indicate the underload or overload condition to an external device:

Note: When overtorque occurs in the application, the drive may stop due to overcurrent (oC) or overload (oL1). To prevent the drive from stopping, use torque detection to indicate an overload situation to the controller before oC or oL1 occur. Use undertorque detection to discover application problems like a torn belt, a pump shutting off, or other similar trouble.

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 closes when overload or underload is detected)
19	Torque detection 2, N.C. (output opens when overload or underload is detected)

Figure 5.79 and *Figure 5.80* illustrate the functions of overtorque and undertorque detection.

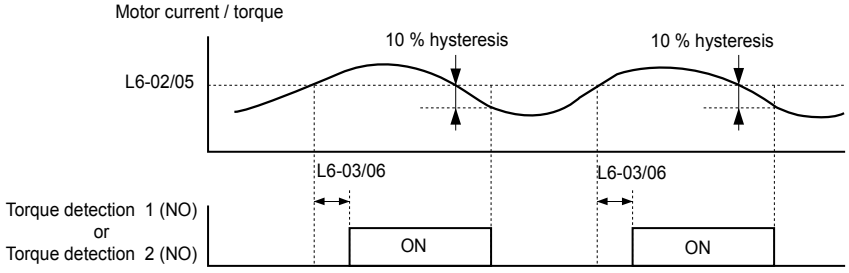


Figure 5.79 Overtorque Detection Operation

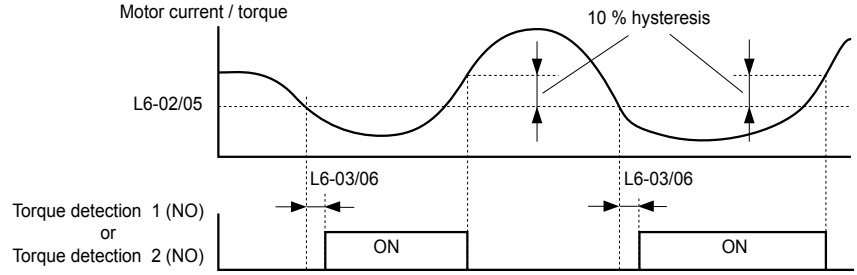


Figure 5.80 Undertorque Detection Operation

Note: **1.** The torque detection function uses a hysteresis of 10% of the drive rated output current and motor rated torque.
2. The level is set as a percentage of the drive rated output current. .

■ L6-01, L6-04: Torque Detection Selection 1, 2

The torque detection function is triggered when the current or torque exceed the levels set to L6-02 and L6-05 for longer than the times set to 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 12	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 detecting overtorque and triggering an oL3/oL4 alarm.

Setting 2: oL3, oL4 at run (Alarm)
Overtorque detection works as long as the Run command is active. The operation continues after detecting overtorque and triggering an oL3/oL4 alarm.

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 stops and triggers an oL3/oL4 fault.

Setting 4: oL3, oL4 at run (Fault)
Overtorque detection works as long as a Run command is active. The operation stops and triggers an oL3/oL4 fault.

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 detecting overtorque and triggering a UL3/UL4 alarm.

Setting 6: UL3, UL4 at Run (Alarm)
Undertorque detection works as long as the Run command is active. The operation continues after detecting overtorque and triggering a UL3/UL4 alarm.

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 stops and triggers a UL3/UL4 fault.

Setting 8: UL3, UL4 at run (Fault)

Undertorque detection works as long as a Run command is active. The operation stops and triggers a UL3/UL4 fault.

Setting 9: UL6 at speed agree (Alarm)

Setting 10: UL6 during run (Alarm)

Setting 11: UL6 at speed agree (Fault)

Setting 12: UL6 during run (Fault)

■ L6-02, L6-05: Torque Detection Level 1, 2

These parameters set the detection levels for torque detection functions 1 and 2 as a percentage of the drive rated output current.

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

■ L6-13: Motor Underload Protection Selection

Sets the motor underload protection (UL6) based on motor load.

No.	Name	Setting Range	Default
L6-13	Motor Underload Protection Selection	0, 1	0

Setting 0: Base frequency enable

Setting 1: Max frequency enable

■ L6-14: Motor Underload Protection Level at Minimum Frequency

Sets the motor underload protection (UL6) based on motor load.

No.	Name	Setting Range	Default
L6-14	Motor Underload Protection Level at Minimum Frequency	0 to 300%	15%

◆ L8: Drive Protection

■ L8-01: Internal Dynamic Braking Resistor Protection Selection (ERF type)

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, 1	0

Setting 0: Disabled

Disables braking resistor protection. Use this setting for any dynamic braking option other than the Yaskawa ERF-type resistor.

Setting 1: Enabled

Enables protection for Yaskawa ERF-type resistors.

■ L8-02: Overheat Alarm Level

Sets the overheat alarm (oH) detection level.

The drive outputs an alarm when the heatsink temperature exceeds the overheat alarm level. If the drive is set to continue operation after this alarm occurs (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 o2-04

■ L8-03: Overheat Pre-Alarm Operation Selection

Sets the operation when an overheat pre-alarm is detected.

Note: Change L8-03 setting only when necessary.

No.	Name	Setting Range	Default
L8-03	Overheat Pre-Alarm Operation Selection	0 to 4	3

Setting 0: Ramp to stop

If an overheat alarm occurs, the drive decelerates to stop using the currently selected deceleration time. If a digital output is programmed for "fault" (H2-☐☐ = E), this output will be triggered.

Setting 1: Coast to stop

If an overheat alarm 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.

Setting 4: Operation with reduced speed

If an overheat alarm occurs, the operation continues with the speed reduced to the level set to parameter L8-19. If the oH alarm is still present after 10 s, the speed is reduced again. The amount of speed reduction depends on how often the alarm repeats. If the oH alarm disappears while the drive is operating at a reduced speed, the drive will switch to the previous speed in 10 s increments until reaching base frequency. ***Figure 5.81*** explains the operation with reduced speed during an oH alarm. A digital output programmed for 4D is switched when the oH alarm is still active after ten reduction cycles.

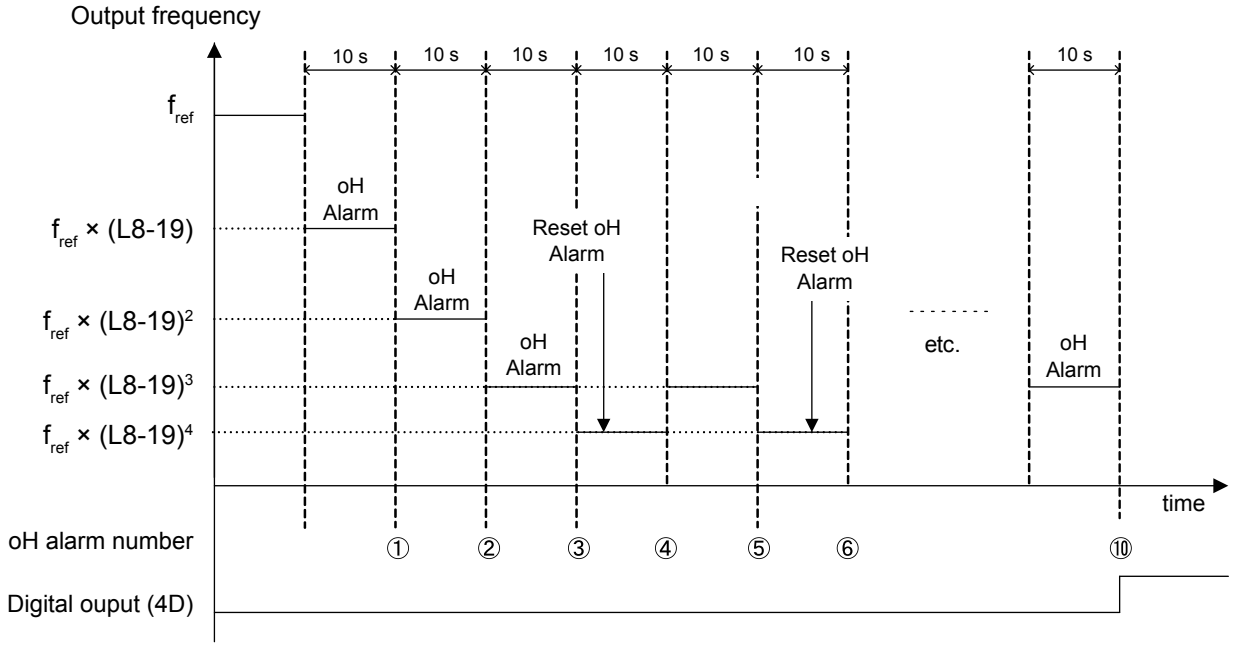


Figure 5.81 Output Frequency Reduction During Overheat Alarm

■ L8-19: Frequency Reduction Rate during Overheat Pre-Alarm

Specifies the output frequency reduction when L8-03 is set to 4 and an oH alarm is present. Set as a factor of the maximum output frequency.

No.	Name	Setting Range	Default
L8-19	Frequency Reduction Rate During Overheat Pre-Alarm	0.1 to 0.9	0.8

■ 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	1

Setting 0: Disabled

Setting 1: Enabled

Enables input phase loss detection. Since measuring the DC bus ripple detects input phase loss, a power supply voltage imbalance or main circuit capacitor deterioration may also trigger a phase loss fault (PF).

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 triggered when the output current falls below 5% of the drive rated current.

Note: 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.

No.	Name	Setting Range	Default
L8-07	Output Phase Loss Protection Selection	0 to 2	1

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 or more output phases are lost. The output shuts off and the motor coasts to stop.

■ 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, 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, 1	0

Setting 0: Run with timer

The fan is switched on when a Run command is active and switched off with the delay set to parameter L8-11 after releasing the Run command. This setting extends the fan lifetime.

Setting 1: Run always

The fan runs when 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

Automatically adapts the drive rated current to safe values when used with parameter L8-35. This eliminates the need to reduce the drive rated current when the temperature where the drive is mounted is above the specified values. *Refer to Temperature Derating on page 389* for details.

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 to prevent premature output transistor failures.

Note: Contact Yaskawa for consultation before disabling this function. Disabling this function may shorten the operating life of the power transistors.

No.	Name	Setting Range	Default
L8-15	oL2 Characteristics Selection at Low Speed	0, 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. At zero speed, the overload is derated by 50%.

■ L8-18: Software Current Limit Selection

Enables or disables the Software Current Limit (CLA) protection function to prevent main circuit transistor failures caused by high current.

Note: Do not change this setting unless absolutely necessary. Leave the Software CLA enabled for proper drive protection and operation.

No.	Name	Setting Range	Default
L8-18	Software Current Limit Selection	0, 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 Software CLA current level is reached, the drive reduces the output voltage to reduce the current. Normal operation continues when the current level drops below the Software CLA level.

■ 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 4	1

Setting 0: Ramp to stop

The drive stops the motor using the deceleration time set in parameter C1-02.

Setting 1: Coast to stop

The drive output is switched off and the motor coasts to a 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.

Setting 4: Operation with reduced speed

The operation is continued, but the speed is reduced to the level set in parameter L8-19.

Note: "FAn" is detected as an error when Settings 0 or 2 are selected; it is detected as an alarm when Settings 3 or 4 are selected.

■ L8-35: Installation Method Selection

Selects the type of installation for the drive and changes the drive overload (oL2) limits accordingly. *Refer to Temperature Derating on page 389* for details.

Note:
1. Initialization does not reset this parameter.
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	<1>

<1> Default setting is determined by drive model.
Setting 2: Model code 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242
Setting 0: Model code 2A0250 to 2A0415 and 4A0208 to 4A1200.

Setting 0: IP00/Open-Chassis enclosure

For an Open Type 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 Side-by-Side specifications (requires 2 mm between drives).

Setting 2: IP20/NEMA Type 1 enclosure

For drives compliant with IP20/NEMA Type 1 enclosure specifications.

Setting 3: Finless drive 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

Selects the operation of the carrier frequency reduction function. Reduces 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.

No.	Name	Setting Range	Default
L8-38	Carrier Frequency Reduction Selection	0 to 2	2

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 the 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 when 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	0.50 s

■ L8-41: High Current Alarm Selection

Triggers a high current alarm (HCA) when the output current exceeds 150% of the drive rated current.

No.	Name	Setting Range	Default
L8-41	High Current Alarm Selection	0, 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.

■ L8-55: Internal Braking Transistor Protection

Enables or disables protection for the internal braking transistor.

Note: This parameter is not available in models 4A0930 and 4A1200.

No.	Name	Setting Range	Default
L8-55	Internal Braking Transistor Protection	0, 1	0

Setting 0: Disabled

Disable braking transistor protection when not using the internal braking transistor, including the following instances:

- 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 using the drive in common DC bus applications and the internal braking unit is not installed.

Enabling L8-55 under such conditions can incorrectly trigger a braking transistor fault (rr).

Setting 1: Enabled

Enable L8-55 when connecting a braking resistor or a braking resistor unit to the drive built-in braking transistor.

Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052 come with a built-in braking transistor.

■ L8-93: LSo Detection Time at Low Speed

Sets the amount of time until baseblock is executed after LSo has been detected at low speed.

A setting of 0.0 s disables this parameter.

No.	Name	Setting Range	Default
L8-93	LSo Detection Time at Low Speed	0.0 to 10.0 s	1.0 s

■ L8-94: LSo Detection Level at Low Speed

Determines the detection level of Sto at low speed. Set as a percentage of the maximum frequency (E1-04).

No.	Name	Setting Range	Default
L8-94	LSo Detection Level at Low Speed	0 to 10%	3%

■ L8-95: Average LSo Frequency at Low Speed

Sets the average number of times LSo can occur at low speed.

No.	Name	Setting Range	Default
L8-95	Average LSo Frequency at Low Speed	1 to 50 times	10 times

5.9 n: Special Adjustments

These parameters control a variety of specialized adjustments and functions, including Hunting Prevention, High Slip Braking, and Overexcitation Braking.

◆ n1: Hunting Prevention

Hunting Prevention prevents 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. Disable Hunting Prevention when drive response is more important than suppressing motor oscillation. This function may be disabled without problems in applications with high inertia loads or relatively heavy loads.

No.	Name	Setting Range	Default
n1-01	Hunting Prevention Selection	0, 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

Although this parameter rarely needs to be changed, it may require adjustment in the following situations:
- 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 the responsiveness of the Hunting Prevention function (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

Although this parameter rarely needs to be changed, it may require adjustment in the following situations:
- Increase this value for applications with a large load inertia. A higher setting leads to slower response, 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 functions the same as n1-02, except it is used when rotating in reverse. See the explanation for n1-02.

Note: n1-02 is enabled for forward and reverse operation when n1-05 = 0.0 ms.

No.	Name	Setting Range	Default
n1-05	Hunting Prevention Gain while in Reverse	0.00 to 2.50	0.00

◆ n3: High Slip Braking (HSB) and Overexcitation Braking

■ High Slip Braking (V/f)

HSB works in V/f Control only and decreases the stopping time compared to normal deceleration without using dynamic braking options. HSB reduces the output frequency in large steps to stop the motor and produce a high slip, which dissipates the regenerative energy created from decelerating the load in the motor windings. Due to the increased temperature of the motor windings, do not use HSB to frequently stop the motor. The duty cycle should be around 5% or lower.

Notes on using High Slip Braking

- The set deceleration time is ignored during HSB. Use Overexcitation Deceleration 1 (L3-04 = 4) or a dynamic braking option to stop the motor within a specified time.
- Braking time varies based on the load inertia and motor characteristics.
- Enabling HSB and KEB Ride-Thru simultaneously will trigger an oPE03 error.
- HSB must be triggered by a digital input set to H1-□□ = 68. After the HSB command is given, the drive will not restart until the motor is completely stopped and the Run command is cycled.
- Use parameters n3-01 through n3-04 to adjust HSB.

■ n3-01: High Slip Braking Deceleration Frequency Width

Sets the step width for frequency reduction during HSB. Increase n3-01 if DC bus overvoltage (ov) occurs during HSB.

No.	Name	Setting Range	Default
n3-01	High Slip Braking Deceleration Frequency Width	1 to 20%	5%

■ n3-02: High Slip Braking Current Limit

Sets the maximum current to be output during an HSB stop as a percentage of motor rated current (E2-01). Reducing the current limit increases the deceleration time. This value must not exceed the drive overload capacity.

- Lower this setting if overvoltage occurs during HSB.
- Lower this setting if motor current is too high during HSB. High current can damage the motor due to overheat.
- The default setting is 120% when the drive is set for Normal Duty.

No.	Name	Setting Range	Default
n3-02	High Slip Braking Current Limit	100 to 200%	Determined by L8-38

■ n3-03: High Slip Braking Dwell Time at Stop

When the motor reaches a relatively low speed at the end of HSB, the output frequency is kept at the minimum output frequency set to E1-09 for the time set to n3-03. Increase this time if the inertia is very high and the motor coasts after HSB is complete.

No.	Name	Setting Range	Default
n3-03	High Slip Braking Dwell Time at Stop	0.0 to 10.0 s	1.0 s

■ n3-04: High Slip Braking Overload Time

Sets the time required for an HSB overload fault (oL7) to occur when the drive output frequency does not change during an HSB stop due to excessive load inertia or the load rotating the motor. To protect the motor from overheat, the drive trips with an oL7 fault if these conditions last longer than the time set in n3-04.

No.	Name	Setting Range	Default
n3-04	High Slip Braking Overload Time	30 to 1200 s	40 s

■ Overexcitation Deceleration (Induction Motors)

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. *Refer to L3-04: Stall Prevention Selection during Deceleration on page 237*.

Notes on Overexcitation Deceleration

- Frequently applying Overexcitation Deceleration raises the motor temperature because regenerative energy is mainly dissipated as heat in the motor. In cases where frequent application is required, make sure the motor temperature does not exceed the maximum allowable value or consider using a braking resistor option in lieu of Overexcitation Deceleration.
- During Overexcitation Deceleration 2, Hunting Prevention in V/f Control is disabled.
- Do not use Overexcitation Deceleration in combination with a braking resistor option.

Parameter Adjustments

- Use parameters n3-13 through n3-23 to adjust Overexcitation Deceleration.
- When repetitive or long Overexcitation Deceleration causes motor overheat, 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 and C1-04). Set this time so 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 to keep the DC bus voltage at the level set to 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. Increase the deceleration time if overvoltage occurs (ov).
- Entering a Run command during Overexcitation Deceleration cancels overexcitation operation and the drive reaccelerates to the specified speed.

■ n3-13: Overexcitation Deceleration Gain

Multiplies a gain to the V/f pattern output value during Overexcitation Deceleration to determine 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.

- Gradually increase the gain to 1.25 to 1.30 to improve the braking power of Overexcitation Deceleration.
- Lower n3-13 when flux saturation characteristics cause overcurrent. 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 and shortens deceleration time. This function tends to increase audible noise from the motor, and may 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, 1	0

Setting 0: Disabled

Setting 1: Enabled

■ n3-21: High Slip Suppression Current Level

If the motor current exceeds the value set to n3-21 during Overexcitation Deceleration due to flux saturation, the drive automatically reduces the overexcitation gain. Parameter n3-21 is set as a percentage of the drive rated current.

Set this parameter to a relatively low value to optimize deceleration. If overcurrent, oL1, or oL2 occur during Overexcitation Deceleration, reduce the high slip suppression current level.

No.	Name	Setting Range	Default
n3-21	High Slip Suppression Current Level	0 to 150%	100%

■ n3-23: Overexcitation Operation Selection

Limits 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

5.10 o: Operator Related Settings

These parameters control the various functions, features, and display of the digital operator.

◆ o1: Digital Operator Display Selection

These parameters determine the data display on the digital operator.

■ o1-01: Drive Mode Unit Monitor Selection

The frequency reference display appears when the drive is powered up. Pressing the up arrow key will display the following data: frequency reference → rotational direction → output frequency → output current → o1-01 selection.

Parameter o1-01 selects the content of the last monitor in this sequence.

No.	Name	Setting Range	Default
o1-01	Drive Mode Unit Monitor Selection	104 to 809	106 (U1-06)

■ o1-02: User Monitor Selection after Power Up

Selects which monitor parameter is displayed upon power up by entering the 1- ☐☐ part of U1-☐☐. Certain monitors are not available in some control modes. *Refer to U: Monitor Parameters on page 273* 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 before setting parameters o1-10 and o1-11.

No.	Name	Setting Range	Default
o1-03	Digital Operator Display Selection	0 to 3	0

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 (set by o1-09, o1-10, o1-11)

Set the value used for the maximum frequency reference to o1-10. Set the placement of the decimal point in this number to o1-11.

For example, to have the maximum output frequency displayed as “100.00”, set o1-10 to 1000 and o1-11 to 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
   U1-16: output frequency after softstarter (accel/decel ramp generator)
   d1-01 to d1-17: frequency references
2. Setting o1-03 to 2 requires entering the number of motor poles to E2-04.

■ o1-06: User Monitor Selection Mode

Select between standard sequential monitors or selectable monitors to be displayed on the 2nd and 3rd lines of the digital operator display.

Use parameters o1-07 and o1-08 to select and fix the second and third monitors shown in the Home (Frequency Reference) and Monitor screen to ensure that those monitors are always visible when scrolling through the monitor list.

No.	Name	Setting Range	Default
o1-06	User Monitor Selection Mode	0, 1	0

Setting 0: 3 Mon Sequential (displays the next 2 sequential monitors)
Setting 1: 3 Mon Selectable (set by o1-07 and o1-08)

■ o1-07: Second Line User Monitor Selection

Selects the monitor that is shown in the second line. Effective only when o1-06 is set to 1.

Enter the last three digits of the monitor parameter number to be displayed: U☐-☐☐. For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-07	Second Line User Monitor Selection	101 to 799	102

■ o1-08: Third Line User Monitor Selection

Selects the monitor that is shown in the third line. Effective only when o1-06 is set to 1.

Enter the last three digits of the monitor parameter number to be displayed: U☐-☐☐. For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-07	Second Line User Monitor Selection	101 to 799	103

■ o1-09: Frequency Reference Display Units

Selects the monitor that is shown in the third line. Enter the last three digits of the monitor parameter number to be displayed: U☐-☐☐. For example, set "403" to display monitor parameter U4-03.

Note: Parameter is effective only when o1-06 is set to 1.

No.	Name	Setting Range	Default
o1-09	Frequency Reference Display Units	0 to 15; 24, 25	25

Setting 0: Inch of Water (WC)
Setting 1: Pounds per Square Inch (PSI)
Setting 2: Gallons per Minute (GPM)
Setting 3: Degrees Fahrenheit (F)
Setting 4: Cubic Feet per Minute (CFM)
Setting 5: Cubic Meters per Hour (CMH)
Setting 6: Liters per Hour (LPH)
Setting 7: Liters per Second (LPS)
Setting 8: Bar (Bar)
Setting 9: Pascals (Pa)
Setting 10: Degrees Celsius (C)
Setting 11: Meters (Mtr)
Setting 12: Feet (Ft)
Setting 13: Liters per Minute (LPN)
Setting 14: Cubic Meters per Minute (CMM)
Setting 15: Inches of Mercury (Hg)
Setting 24: Custom Units (determined by o1-13 to o1-15)
Setting 25: None

■ 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

■ o1-13: Frequency Reference and Frequency Related Monitor Custom Units 1

Sets the first character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.

No.	Name	Setting Range	Default
o1-13	Frequency Reference and Frequency Related Monitor Custom Units 1	30 to 7A	41

■ o1-14: Frequency Reference and Frequency Related Monitor Custom Units 2

Sets the second character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.

No.	Name	Setting Range	Default
o1-14	Frequency Reference and Frequency Related Monitor Custom Units 2	30 to 7A	41

■ o1-15: Frequency Reference and Frequency Related Monitor Custom Units 3

Sets the third character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.

No.	Name	Setting Range	Default
o1-14	Frequency Reference and Frequency Related Monitor Custom Units 3	30 to 7A	41

◆ o2: Digital Operator Keypad Functions

These parameters determine the functions assigned to the operator keys.

■ o2-01: LO/RE (LOCAL/REMOTE) Key Function Selection

Determines whether the LO/RE key on the digital operator will be enabled for switching between LOCAL and REMOTE.

No.	Name	Setting Range	Default
o2-01	LO/RE Key Function Selection	0, 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 5.36*** *lists the setting combinations for o2-01 and b1-07.*

Table 5.36 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
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 will stop drive operation when the drive is controlled from a remote source (i.e., not from digital operator).

No.	Name	Setting Range	Default
o2-02	STOP Key Function Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

The STOP key will terminate drive operation even if the Run command source is not assigned to the digital operator. Cycle the Run command to restart the drive if the drive has been stopped by pressing the STOP key.

■ o2-03: User Parameter Default Value

After completely setting up drive parameters, save the values as user-set defaults with parameter o2-03. After saving the values, parameter A1-03 (Initialize Parameters) will offer the choice of "1110: User Initialize". Selecting 1110 resets all parameters to the user-set default values. *Refer to A1-03: Initialize Parameters on page 134* 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 Initialization. Setting o2-03 to 1 and pressing the ENTER key saves the values and returns the display to 0.

Setting 2: Clear User Initialize Values

All user-set defaults for “User Initialize” are cleared. Setting o2-03 to 2 and pressing the ENTER key erases the values and returns the display to 0.

■ o2-04: Drive Model Selection

Set this parameter when replacing the control board or the terminal board. *Refer to Defaults by Drive Model on page 446* for information on drive model selection.

NOTICE: *Drive performance will suffer and protective functions will not operate properly if the correct drive capacity is not set to o2-04.*

No.	Name	Setting Range	Default
o2-04	Drive Model Selection	-	Determined by drive capacity

Note: Change o2-04 setting 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, 1	0

Setting 0: ENTER key required

The ENTER key must be pressed every time the frequency reference is changed using the digital operator 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 (Fref) is saved to memory after remaining unchanged for 5 seconds.

■ o2-06: Operation Selection when Digital Operator is Disconnected

Determines whether 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, 1	1

Setting 0: Continue operation

The operation continues.

Setting 1: Trigger a fault

The operation stops and triggers an oPr fault. 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, 1	0

Setting 0: Forward

Setting 1: Reverse

■ o2-20: Operator Run Save at Power Loss

When running during a power loss, the Run command is issued via the digital operator and the Run state is saved to the EEPROM.

When power is restored, the Run command is automatically applied if the LOCAL/REMOTE or FREF conditions have not changed in the drive.

When this parameter is set to 0 (disabled) the drive will ignore the Run state of the drive when power is lost. When this parameter is set to 1 (enabled), and the active Run source is from the digital operator, the drive will save the Run status during power-down.

When power is restored, and the drive is still in operator mode, the previous Run status will be loaded and will apply the Run command.

If the Run command was issued while the drive was running in LOCAL mode (triggered through the operator key) and power was cycled, the drive will not automatically run, as the default starting state is REMOTE operation.

Note: The Run Status is saved on the terminal board and on the control card. If the Run Status does not match (e.g., if the terminal board was replaced), the Run Status is reset and the drive will not run on the next power-up.

WARNING! *Sudden Movement Hazard. If o2-20 is set to 1 and o2-06 is set to 0, the drive will continue running when the digital operator is removed and may run automatically when power is cycled, 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.*

No.	Name	Setting Range	Default
o2-20	Operator Run Save at Power Loss	0, 1	0

Setting 0: Disabled
Setting 1: Enabled

◆ o3: Copy Function

These parameters control the Copy function of the digital operator. The Copy function stores parameter settings into the memory of the digital operator to facilitate the transfer of those settings to other drives that are the same model, capacity, and same control mode setting. *Refer to Copy Function Related Displays on page 310* for a description of errors and displays.

■ o3-01: Copy Function Selection

Instructs the drive to Read, Write, or Verify parameter 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
Copies all parameters from the drive to the digital operator.

Note: The copy protection for the digital operator is enabled by default. Set o3-01 to 1 to unlock copy protection.

Setting 2: OP --> INV WRITE
Copies all parameters from the digital operator to the drive.

Setting 3: OP<-->INV VERIFY
Compares the parameters in the drive with the parameter settings saved on the digital operator for matches.

■ o3-02: Copy Allowed Selection

Allows and restricts the use of the Copy function.

No.	Name	Setting Range	Default
o3-02	Copy Allowed Selection	0, 1	0

Setting 0: Disabled
Setting 1: Enabled

◆ o4: Maintenance Monitor Settings

■ o4-01: Cumulative Operation Time Setting

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 monitor U4-01.

No.	Name	Setting Range	Default
o4-02	Cumulative Operation Time Selection	0, 1	0

Setting 0: Power on time
The drive logs the time it is connected to a power supply, regardless of whether the motor is running.

Setting 1: Run time
The drive logs the time that the output is active including when 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. Reset this parameter to 0 after replacing the cooling fan.

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. Reset this value to 0 after replacing the DC bus capacitors.

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%

■ 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. Reset this value to 0 after replacing the bypass relay.

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. Reset this value to 0 after replacing the IGBTs.

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

Resets the fault trace and fault history monitors (U2-☐☐ and U3-☐☐). Initializing the drive using A1-03 does not reset these monitors.

No.	Name	Setting Range	Default
o4-11	U2, U3 Initialization	0, 1	0

Setting 0: No Action

The drive keeps the previously saved record concerning fault trace and fault history.

Setting 1: Reset Fault Data

Resets the data for the U2-☐☐ and U3-☐☐ monitors. Setting o4-11 to 1 and pressing the ENTER key erases fault data and returns the display to 0.

■ o4-12: kWh Monitor Initialization

Resets the kWh monitors U4-10 and U4-11. Initializing the drive or cycling the power does not reset these monitors.

No.	Name	Setting Range	Default
o4-12	kWh Monitor Initialization	0, 1	0

Setting 0: No Action

The kWh data are maintained.

Setting 1: Reset kWh Data

Resets the kWh counter. The monitors U4-10 and U4-11 will display "0" after they are initialized. Setting o4-12 to 1 and pressing the ENTER erases kWh data and returns the display to 0.

■ o4-13: Number of Run Commands Counter Initialization

Resets the Run command counter displayed in U4-02. Initializing the drive or cycling the power does not reset this monitor.

No.	Name	Setting Range	Default
o4-13	Number of Run Commands Counter Initialization	0, 1	0

Setting 0: No Action

The Run command data are kept.

Setting 1: Number of Run Commands Counter

Resets the Run command counter. The monitor U4-02 will show 0. Setting o4-13 to 1 and pressing the ENTER key erases the counter value and returns the display to 0.

■ o4-17: Real-Time Clock Setting

No.	Name	Setting Range	Default
o4-17	Set/Reset Real-Time Clock	0 to 2	0

Setting 0: — —

No Setting (Default)

Setting 1: Set

When o4-17 is set to 1, the digital operator will show the Clock Adjustment display. In Clock Adjustment Mode the user can adjust the Real-Time Clock.

Setting 2: Reset

When o4-17 is set to 2, the Real-Time Clock data is cleared. A TIM fault will occur until o4-17 is set to 1 and the Real-Time Clock is set.

■ o4-20: Time Display Format

No.	Name	Setting Range	Default
o4-20	Time Display Format	0, 1	0

Sets the time display format.

Setting 0: 12-Hour

Setting 1: 24-Hour

5.11 S: Special Application

◆ S1: Dynamic Audible Noise Control Function

The Dynamic Audible Noise Control Function reduces audible noise by suppressing the output voltage.

This function is available when using V/f Control mode and can help to quickly restore output voltage after an impact has caused a sudden increase in the time constant. Dynamic Audible Noise Control is useful in applications where load impact is common.

Energy Saving (b8-01 = 1) and Dynamic Audible Noise Control (S1-01 = 1) cannot be used simultaneously.

Procedure

1. Set S1-01 to 1 to enable Dynamic Audible Noise Control.

Note:
1. When S1-01 is set to 1, the tolerance to impact loading is reduced when compared to V/f Control (without Energy Saving).
2. Disable Dynamic Audible Noise Control for applications without an impact load.

2. Responsiveness is increased because the addition of a load causes the level of the current to rise.

   Increase the value of S1-02. The flux will become stronger and the torque will rise, but load movement will be minimized by the Dynamic Audible Noise Control function.

   Set S1-03 and S1-04 to a small value. Voltage is recovered quicker during impact load conditions. Under certain conditions voltage stability may become poor.

   Lower the value of S1-05. The voltage level will drop and speed up voltage restoration when the load is increased.
3. Increase the value of S1-03 to increase the effectiveness of Dynamic Audible Noise Control if the output voltage remains high.
4. Decrease the value of S1-06 to increase drive response to an impact load.
5. When the output voltage is unstable, increase the difference between S1-03 and S1-04 and increase S1-05 and S1-06 to slow the load response.

■ S1-01: Dynamic Audible Noise Control Selection

Reduces audible noise by decreasing the output voltage in variable torque applications with light loads.

Note: Setting b8-01 to 1 and S1-01 to 1 will trigger an oPE16 error.

No.	Name	Setting Range	Default
S1-01	Dynamic Audible Noise Control Selection	0 or 1	1

Setting 0: Disabled

Setting 1: Enabled

■ S1-02: Voltage Reduction Rate

Sets the rate at which the output voltage will be reduced as a percentage of the V/f pattern when operating with no load.

No.	Name	Setting Range	Default
S1-02	Voltage Reduction Rate	50.0 to 100.0%	50.0%

■ S1-03: Voltage Restoration Level

Sets the level when the drive should start restoring the voltage as a percentage of the drive rated torque.

The voltage is reduced when the torque output has decreased to the level set in S1-03.

The method used to reduce the voltage level is selected in accordance with the characteristics of the voltage reduction rate defined by the S1-03 and S1-04 settings.

Note: Setting S1-04 to a value less than that of S1-03 + 10.0 will trigger an oPE02 error.

No.	Name	Setting Range	Default
S1-03	Voltage Restoration Level	0.0 to 90.0%	20.0%

■ S1-04: Voltage Restoration Complete Level

Sets the level at which voltage restoration for the V/f pattern is complete as a percentage of the drive rated torque. If the output torque rises above the value of S1-04, then the voltage will be controlled in a manner specified by the V/f pattern setting.

Note: Setting S1-04 to a value less than that of S1-03 + 10.0 will trigger an oPE02 error.

No.	Name	Setting Range	Default
S1-04	Voltage Restoration Complete Level	S1-03 + 10.0 to 100.0%	50.0%

■ S1-05: Voltage Restoration Sensitivity Time Constant

Sets the level of sensitivity of the output torque as well as that of the LPF time constant for the voltage reduction rate. The level of sensitivity can be adjusted in accordance with the load response.

The LPF time constant is used to calculate the value of the output torque sensitivity time constant.

The voltage reduction rate is based on the torque output. Select LPF to prevent voltage fluctuation.

The Dynamic Audible Noise Control Function outputs the rate of voltage reduction as a percentage within the allowable range (Max: 100%, Min: S1-02 value).

No.	Name	Setting Range	Default
S1-05	Voltage Restoration Sensitivity Time Constant	0.000 to 3.000 s	1.000 s

■ S1-06: Voltage Restoration Time Constant at Impact

Sets the voltage restoration time constant if an impact load is added.

Sets the time constant that enables the voltage level to rise if the speed suddenly changes upon impact.

No.	Name	Setting Range	Default
S1-06	Voltage Restoration Time Constant at Impact	0.000 to 1.000 s	0.050 s

■ S1-07: Output Phase Loss Level for Dynamic Noise Control

Reduces the output phase loss level when Dynamic Noise Control is active.

No.	Name	Setting Range	Default
S1-07	Output Phase Loss Level for Dynamic Noise Control	10.0 to 100.0%	100.0%

◆ S2: Programmable Run Timers

■ Programmable Run Timers for Real Time Clock (RTC)

Programmable run timers allow the drive to start and stop automatically at specified times. The timers can be configured to run daily, on weekdays, on weekends, or only on specific days of the week.

Sequence Timer 1

When the current time reaches the value set in parameter S2-01 (Sequence Timer 1 Start Time), the drive will execute the action set in parameter S2-04 (Sequence Timer 1 Selection), provided the current day is selected via S2-03 (Sequence Timer 1 Day Selection). The drive will stop executing the S2-04 action when the S2-02 (Sequence Timer 1 Stop Time) is reached.

When S2-04 = 0 or the Disable Sequence Timers multi-function input (H1-□□= 51) is closed, Sequence Timer 1 has no effect on the drive Run command. The drive runs normally based on the status of the selected run source (b1-02/b1-16). If S2-04 = 1 or 2 and the Disable Sequence Timers input is open, the drive will run during the Sequence Timer 1 active time, provided the drive has a valid Run command. The frequency reference that is used is set by S2-05 (Sequence Timer 1 Reference Source). When S2-04 = 2, PI control is disabled.

If the Cancel Active Sequence Timer multi-function input (H1-□□ = 52) transitions from open to closed while Sequence Timer 1 is active, the timer will be disabled until the next scheduled sequence timer occurrence. Sequence Timer 1 can be re-enabled by cycling the drive Run command. The Sequence Timer 1 multi-function output (H2-□□ = 50) will close while Sequence Timer 1 is active regardless of the S2-04 selection.

When S2-01 = S2-02, Sequence Timer 1 is active continuously for the days selected in S2-03. The timer will start at the S2-01/S2-02 time on the first day and stop at the same time on the last day. If only one day is selected in S2-03, the timer will stop at 24:00 on that day. If "daily" is selected in S2-03, the timer will run from the start/stop time until 24:00 every day.

An S2-01 or S2-02 setting of 24:00 corresponds to midnight on the following day. For example, if S2-01 = 8:00, S2-02 = 24:00, and S2-03 = 9 (Saturday), Sequence Timer 1 will be active from 8:00 AM Saturday until 12:00 AM Sunday.

When S2-04 = 1 or 2, Sequence Timer 1 is active and the drive is running, the digital operator screen will appear as shown in *Figure 5.82*.

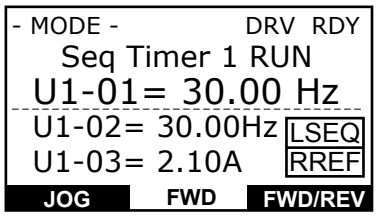


Figure 5.82 Sequence Timer 1 Run

When the drive has a run command, S2-04 = 1 or 2 and Sequence Timer 1 is not active, the digital operator will appear as shown in *264*.

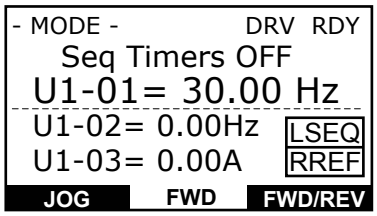


Figure 5.83 Sequence Timers Off

Sequence Timers 2 to 4

These timers operate identically to Sequence Timer 1. Parameters S2-06 to S2-20 configure Sequence Timers 2 to 4.

Priority

If multiple sequence timers overlap, the timer with the lowest number has priority.

Sequence Timer 1 = highest priority

Sequence Timer 4 = lowest priority

Note: Jog Forward/Reverse has higher priority than any of the Sequence Timers.

Examples of Sequence Timers

If multiple sequence timers overlap, the timer with the lowest number has priority.

Sequence Timer 1 = highest priority

Sequence Timer 4 = lowest priority

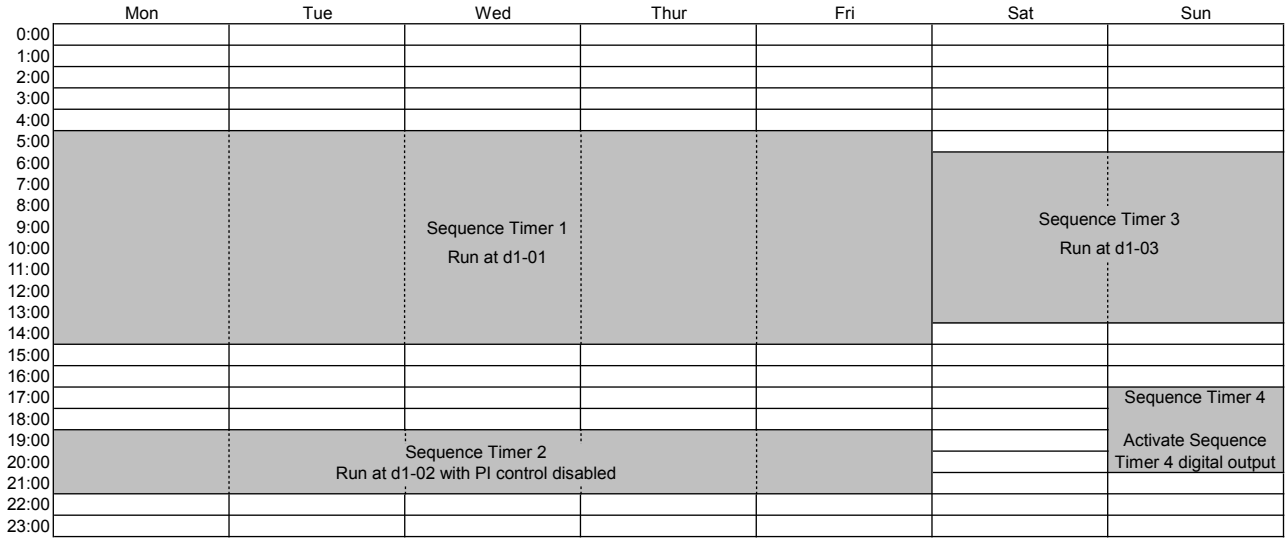


Figure 5.84 Sequence Timer Example 1

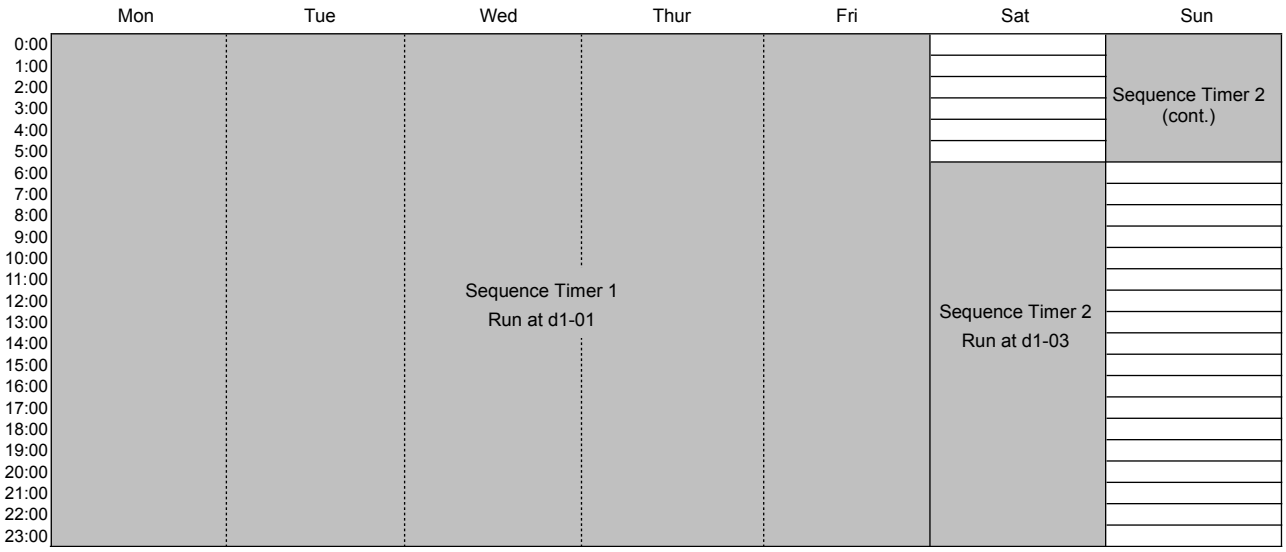


Figure 5.85 Sequence Timer Example 2

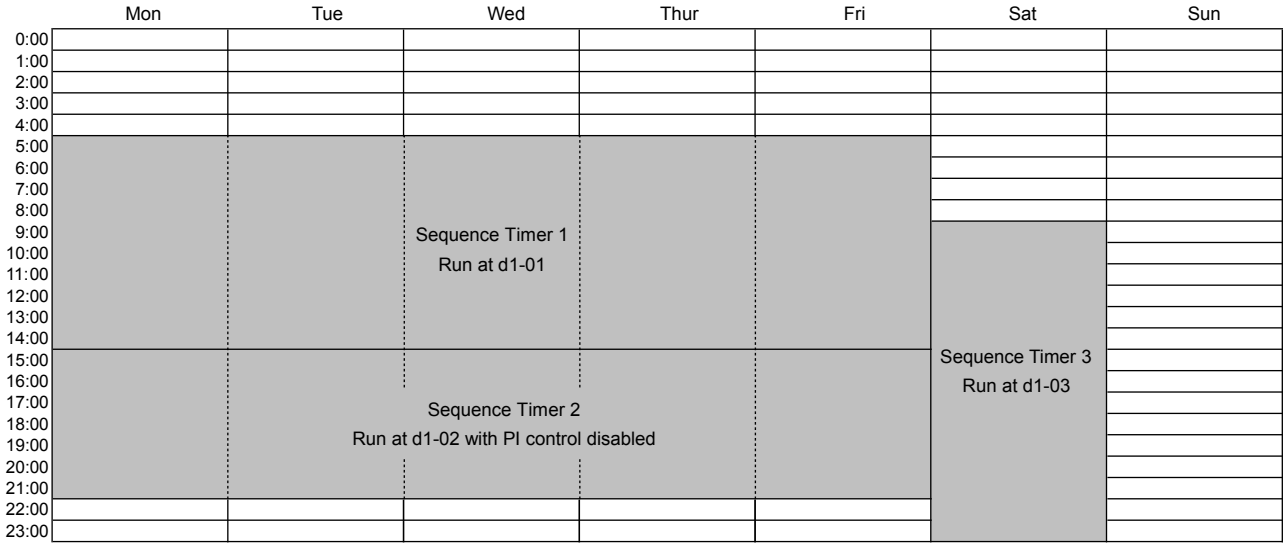


Figure 5.86 Sequence Timer Example 3

Timing Charts

In ***Figure 5.87*** S2-04 = 1, S2-05 = 0, S2-09 = 2, S2-10 = 1. It shows the effect of Run command and sequence timer disable input.

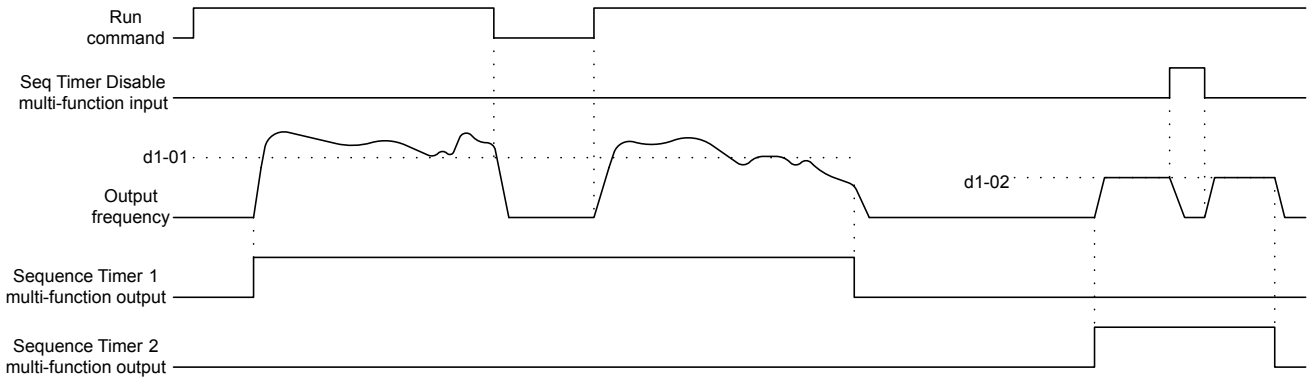


Figure 5.87 Timing Chart 1

In *Figure 5.88* S2-04 = 1, S2-05 = 0, S2-09 = 2, S2-10 = 1. It shows the effect of sequence timer disable input.

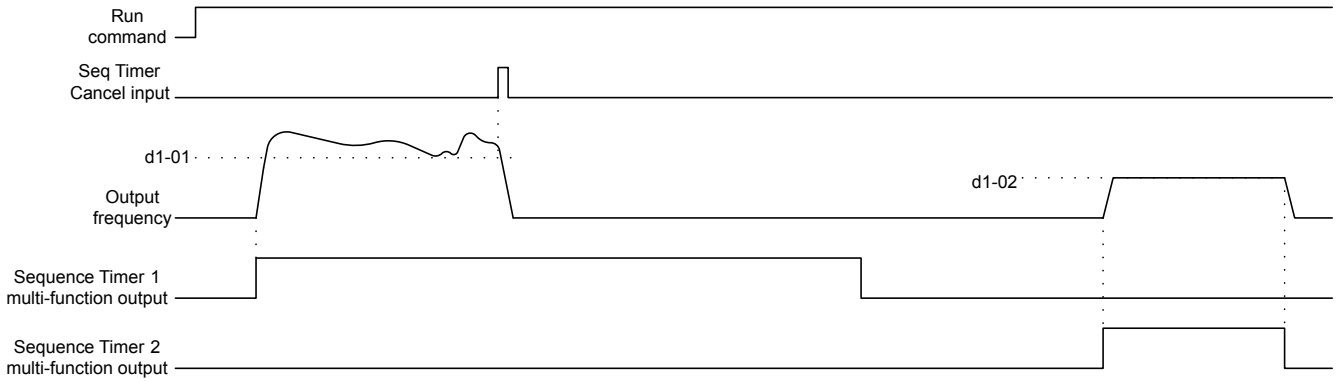


Figure 5.88 Timing Chart 2

In *Figure 5.89* S2-04 = 1, S2-05 = 0, S2-09 = 2, S2-10 = 1. It shows the effect of sequence timer cancel input with run re-cycle.

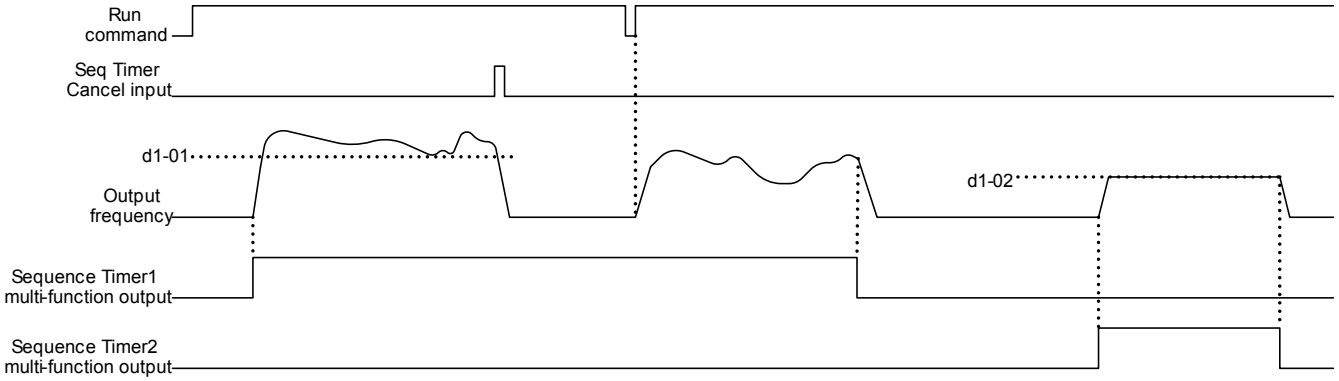


Figure 5.89 Timing Chart 3

In *Figure 5.90* S2-04 = 1, S2-05 = 0, S2-09 = 2, S2-10 = 1. It shows the effect of HAND mode.

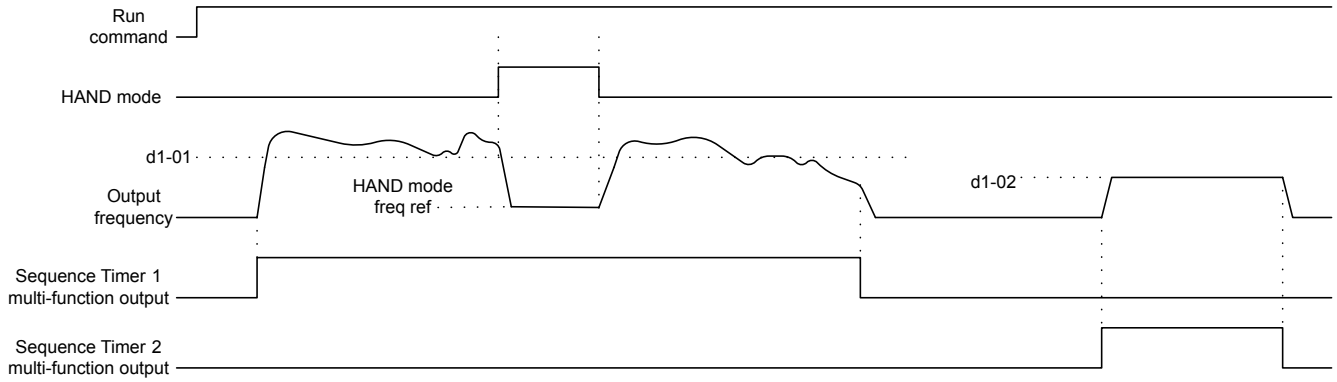


Figure 5.90 Timing Chart 4

■ S2-01/S2-06/S2-11/S2-16: Sequence Timers 1 to 4 Start Time

Sets the start times for timers 1 to 4. The values must be set less than or equal to S2-02/S2-07/S2-12/S2-17.

No.	Name	Setting Range	Default
S2-01	Sequence Timer 1 Start Time	00:00 to 24:00	00:00
S2-06	Sequence Timer 2 Start Time	00:00 to 24:00	00:00
S2-11	Sequence Timer 3 Start Time	00:00 to 24:00	00:00
S2-16	Sequence Timer 4 Start Time	00:00 to 24:00	00:00

■ S2-02/S2-07/S2-12/S2-17: Sequence Timers 1 to 4 Stop Time

Sets the stop times for timers 1 to 4. The values must be set greater than or equal to S2-01/S2-06/S2-11/S2-16.

No.	Name	Setting Range	Default
S2-02	Sequence Timer 1 Stop Time	00:00 to 24:00	00:00
S2-07	Sequence Timer 2 Stop Time	00:00 to 24:00	00:00
S2-12	Sequence Timer 3 Stop Time	00:00 to 24:00	00:00
S2-17	Sequence Timer 4 Stop Time	00:00 to 24:00	00:00

■ S2-03/S2-08/S2-13/S2-18: Sequence Timers 1 to 4 Day Selection

Sets the days for which sequence timers 1 to 4 are active.

No.	Name	Setting Range	Default
S2-03	Sequence Timer 1 Day Selection	0 to 10	0
S2-08	Sequence Timer 2 Day Selection	0 to 10	0
S2-13	Sequence Timer 3 Day Selection	0 to 10	0
S2-18	Sequence Timer 4 Day Selection	0 to 10	0

Setting 0: Timer Disabled
Setting 1: Daily
Setting 2: Mon - Fri
Setting 3: Sat - Sun
Setting 4: Monday
Setting 5: Tuesday
Setting 6: Wednesday
Setting 7: Thursday
Setting 8: Friday
Setting 9: Saturday
Setting 10: Sunday

■ S2-04/S2-09/S2-14/S2-19: Sequence Timers 1/2/3/4 Selection

Sets the action that occurs when sequence timers 1 to 4 are active.

No.	Name	Setting Range	Default
S2-04	Sequence Timer 1 Selection	0 to 2	0
S2-09	Sequence Timer 2 Selection	0 to 2	0
S2-14	Sequence Timer 3 Selection	0 to 2	0
S2-19	Sequence Timer 4 Selection	0 to 2	0

Setting 0: Digital Output Only
Setting 1: Run
Setting 2: Run - PI Disable

■ S2-05/S2-10/S2-15/S2-20: Sequence Timers 1/2/3/4 Reference Source

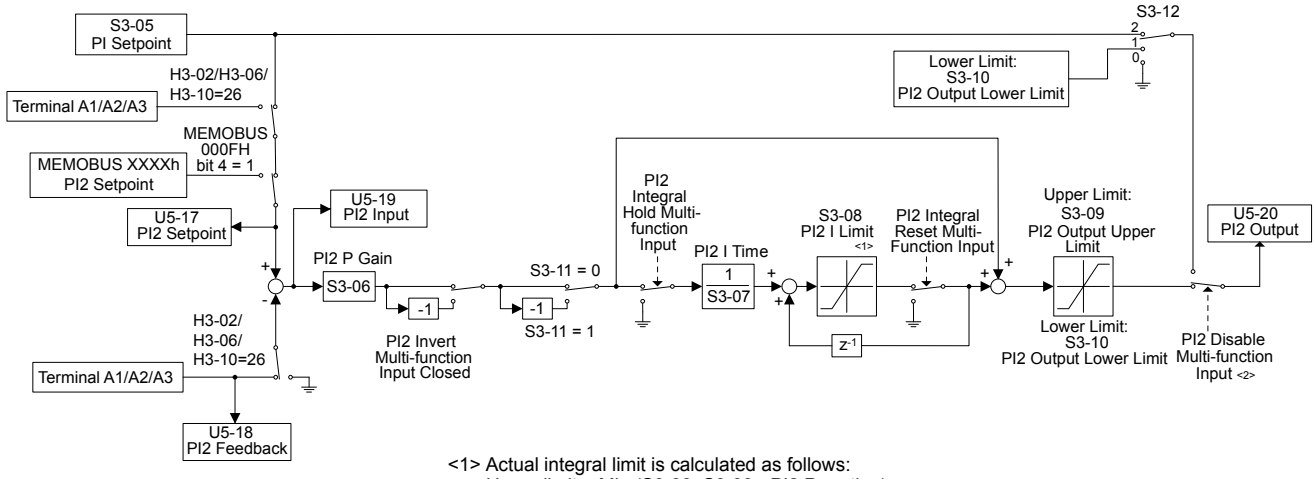
Selects the frequency reference source used for running the drive when sequence timers 1 to 4 are active (only applicable when S2-04/S2-09/S2-14/S2-19 are set to 1 or 2).

No.	Name	Setting Range	Default
S2-05	Sequence Timer 1 Reference Source	0 to 6	0
S2-10	Sequence Timer 2 Reference Source	0 to 6	0
S2-15	Sequence Timer 3 Reference Source	0 to 6	0
S2-20	Sequence Timer 4 Reference Source	0 to 6	0

Setting 0: Operator (d1-01)
Setting 1: Operator (d1-02)
Setting 2: Operator (d1-03)
Setting 3: Operator (d1-04)
Setting 4: Terminals
Setting 5: Serial Communication
Setting 6: Option Card
Setting 7: Pulse Input

◆ S3: Secondary PI (PI2) Control

The drive has a built in PI (Proportional + Integral) controller that can be used for closed loop control of system variables such as pressure or temperature. The difference between the target and the feedback value (deviation) is fed into the PI controller and the PI controller outputs the frequency to U5-☐☐ for monitoring. *Refer to b5: PID Control on page 151* for details.



<1> Actual integral limit is calculated as follows:
Upper limit = Min (S3-08, S3-09 - PI2 P portion)
Lower limit = Min (-S3-08, S3-10 - PI2 P portion)

<2> When PI2 Disable multi-function input is closed, set PI Integrator as follows:
S3-12 = 1: PI I Value = S3-10
S3-12 = 2: PI I Value = S3-05

Figure 5.91 PI2 Block Diagram

■ S3-01: Secondary PI Enable Selection

Determines when the secondary PI controller is enabled.

No.	Name	Setting Range	Default
S3-01	Secondary PI Enable Selection	0 to 3	0

Setting 0: Secondary PI Disabled
Setting 1: Always
Setting 2: Drive Running
Setting 3: Motor Running
Available when the drive is not at zero speed, not in base block, and not in DC injection.

■ S3-02: Secondary PI User Display

Sets the scale value of 100% PI input. The decimal place shifts based on S3-03.

No.	Name	Setting Range	Default
S3-02	Secondary PI User Display	0 to 60000	10000 <1>

<1> Unit is determined by S3-03.

■ S3-03: Secondary PI Display Digits

Sets the decimal place display for secondary PI units.

No.	Name	Setting Range	Default
S3-03	Secondary PI Display Digits	0 to 3	2

Setting 0: No Decimal Places
Setting 1: One Decimal Place
Setting 2: Two Decimal Places
Setting 3: Three Decimal Places

■ S3-04: Secondary PI Unit Selection

Sets units for secondary PI control function.

No.	Name	Setting Range	Default
S3-04	Secondary PI Unit Selection	0 to 15	15

Setting 0: Inch of Water (WC)
Setting 1: Pounds per Square Inch (PSI)
Setting 2: Gallons per Minute (GPM)
Setting 3: Degrees Fahrenheit (F)
Setting 4: Cubic Feet per Minute (CFM)
Setting 5: Cubic Meters per Hour (CMH)
Setting 6: Liters per Hour (LPH)
Setting 7: Liters per Second (LPS)
Setting 8: Bar (Bar)
Setting 9: Pascals (Pa)
Setting 10: Degrees Celsius (C)
Setting 11: Meters (Mtr) (Ft: Feet)
Setting 12: Liters per Minute (LPN)
Setting 13: Cubic Meters per Minute (CMM)
Setting 14: No Unit
Setting 15: Percentage (%)

■ S3-05: Secondary PI Setpoint Value

Sets the secondary PI controller target value

No.	Name	Setting Range	Default
S3-05	Secondary PI Setpoint Value	0.00 to 600.00 <1>	0.00 <2>

<1> Upper limit is S3-02, decimal place holder is determined by S3-03.
<2> Unit is determined by S3-04.

■ S3-06: Secondary PI Proportional Gain Setting

Sets the proportional gain of the secondary PI controller. A setting of 0.00 disables P control.

No.	Name	Setting Range	Default
S3-06	Secondary PI Proportional Gain Setting	0.00 to 25.00	1.00

■ S3-07: Secondary PI Integral Time Setting

Sets the integral time for the secondary PI controller. A setting of 0.0s disables integral control.

No.	Name	Setting Range	Default
S3-07	Secondary PI Integral Time Setting	0.0 to 360.0 s	1.0 s

■ S3-08: Secondary PI Integral Limit Setting

Sets the maximum output possible from the integrator.

No.	Name	Setting Range	Default
S3-08	Secondary PI Integral Limit Setting	0.0 to 100.0%	100.0%

■ S3-09: Secondary PI Output Upper Limit

Sets the maximum output possible from the secondary PI controller.

No.	Name	Setting Range	Default
S3-09	Secondary PI Output Upper Limit	0 to 100.0%	100.0%

■ S3-10: Secondary PI Output Lower Limit

Sets the minimum output possible from the secondary PI controller.

No.	Name	Setting Range	Default
S3-10	Secondary PI Output Lower Limit	-100.00 to 100.00	0.00%

■ S3-11: Secondary PI Output Level Selection

Sets the secondary PI controller output direction.

No.	Name	Setting Range	Default
S3-11	Secondary PI Output Level Selection	0 or 1	0

Setting 0: Normal Output (Direct Acting)

Setting 1: Reverse Output (Reverse Acting)

■ S3-12: Secondary PI Disable Mode

Selects the secondary PI controller output when disabled.

No.	Name	Setting Range	Default
S3-12	Secondary PI Disable Mode	0 to 2	0

Setting 0: No Output (0%)

Setting 1: Lower Limit (S3-10)

Setting 2: Setpoint

■ S3-13: Secondary PI Low Feedback Detection Level

Sets the secondary PI low feedback detection level.

No.	Name	Setting Range	Default
S3-13	Secondary PI Low Feedback Detection Level	0.00 to 600.00 <1>	0.00 <2>

<1> Upper limit is S3-02, decimal place holder is determined by S3-03.

<2> Unit is determined by S3-04.

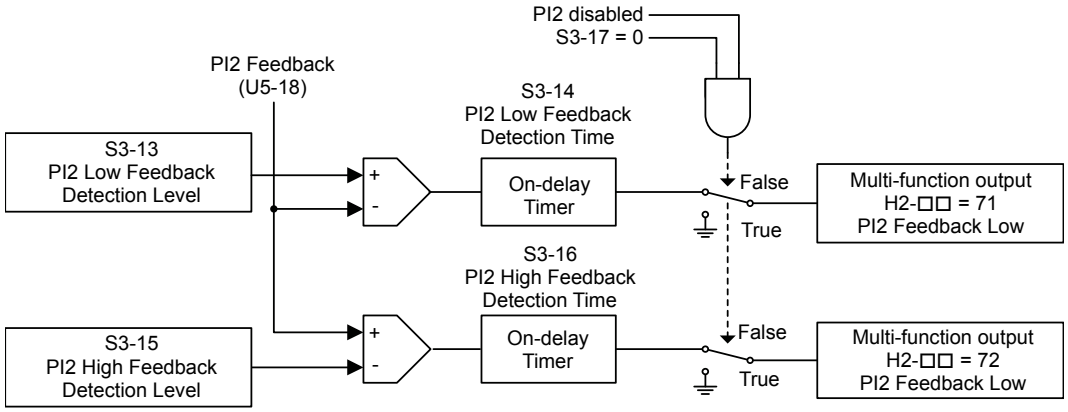


Figure 5.92 PI Low Feedback Detection Level

■ S3-14: Secondary PI Low Feedback Detection Time

Sets the secondary PI low feedback detection delay time in seconds.

No.	Name	Setting Range	Default
S3-14	Secondary PI Low Feedback Detection Time	0.0 to 25.5 s	1.0 s

■ S3-15: Secondary PI High Feedback Level

Sets the secondary PI high feedback detection level.

No.	Name	Setting Range	Default
S3-15	Secondary PI High Feedback Level	0.00 to 600.00 <1>	300.0 <2>

<1> Upper limit is S3-02, decimal place holder is determined by S3-03.

<2> Unit is determined by S3-04.

■ S3-16: Secondary PI High Feedback Detection Time

Sets the secondary PI high feedback detection delay time in seconds.

No.	Name	Setting Range	Default
S3-16	Secondary PI High Feedback Detection Time	0.0 to 25.5 s	1.0 s

■ S3-17: Secondary PI Feedback Detection Selection

Selects when secondary PI controller low and high feedback detection is active.

No.	Name	Setting Range	Default
S3-17	Secondary PI Feedback Detection Selection	0 or 1	0

Setting 0: Secondary PI Enabled

Setting 1: Always

◆ S6: P1000 Protection

■ S6-01: Emergency Override Speed

Sets the sped command used in emergency override mode when S6-02 = 0.

No.	Name	Setting Range	Default
S6-01	Emergency Override Speed	0.00 to 240.00 Hz	0.00 Hz

■ S6-02: Emergency Override Reference Selection

Selects the emergency override speed source.

No.	Name	Setting Range	Default
S6-02	Emergency Override Reference Selection	0, 1	0

Setting 0: Use S6-01 Reference

Setting 1: Use Frequency Reference

■ S6-07: Output Phase Loss Detection Level for Dynamic Audible Noise Control

Sets the output phase loss detection level for Dynamic Audible Noise Control. Decrease the setting in steps of 10% when output phase loss is detected erroneously. This setting rarely needs to be changed.

No.	Name	Setting Range	Default
S6-07	Output Phase Loss Detection Level for Dynamic Audible Noise Control	10.0 to 100.0%	100.0%

◆ T: Motor Tuning

Auto-Tuning automatically sets and tunes parameters required for optimal motor performance.

Refer to Auto-Tuning on page 121 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 221* for details on assigning functions to an analog output.

◆ 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 437* for a complete list of U1-☐☐ monitors and descriptions.

◆ U2: Fault Trace

Use these monitor parameters to view the status of various drive aspects when a fault occurs.

This information is helpful for determining the cause of a fault. *Refer to U2: Fault Trace on page 439* 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 260* for instructions on how to reset these monitor values.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ 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 440* 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 260* for instructions on how to reset these monitor values.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ 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 441 for a complete list of U4-☐☐ monitors and descriptions.

◆ U5: PID Monitors

These monitors display various aspects of PID control. *Refer to PID Block Diagram on page 154* for details on how these monitors display PID data.

Refer to U5: PID Monitors on page 443 for a complete list of U5-☐☐ monitors and descriptions.

◆ U6: Operation Status Monitors

U6 Control monitors show motor secondary current data.

Refer to U6: Operation Status Monitors on page 444 for a complete list of U6-☐☐ monitors and descriptions.

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6

Troubleshooting

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.

6.1 SECTION SAFETY....276
6.2 MOTOR PERFORMANCE FINE-TUNING....278
6.3 DRIVE ALARMS, FAULTS, AND ERRORS....279
6.4 FAULT DETECTION....283
6.5 ALARM DETECTION....297
6.6 OPERATOR PROGRAMMING ERRORS....304
6.7 AUTO-TUNING FAULT DETECTION....307
6.8 COPY FUNCTION RELATED DISPLAYS....310
6.9 DIAGNOSING AND RESETTING FAULTS....312
6.10 TROUBLESHOOTING WITHOUT FAULT DISPLAY....314

6.1 Section Safety

⚠ WARNING

Electrical Shock Hazard

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

Failure to comply could 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; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

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 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; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

After blowing a fuse or tripping a GFCI, do not attempt to restart the drive or operate peripheral devices until five minutes pass and CHARGE lamp is OFF.

Failure to comply could result in death, serious injury, and damage to the drive.

Check wiring and peripheral device ratings to identify the cause of trips.

Contact your supplier if the cause cannot be identified.

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 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, and 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 commonly edited parameters that may be set incorrectly. Consult Yaskawa for more information on detailed settings and for fine-tuning the drive.

◆ Fine-Tuning V/f Control

Table 6.1 Parameters for Fine-Tuning Performance in V/f Control

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
Motor hunting and oscillation at speeds between 10 and 40 Hz	Hunting Prevention Gain (n1-02)	• Reduce the setting if insufficient motor torque relative to the size of the load causes hunting. • Increase the setting when motor hunting and oscillation occur with a light load. • Reduce the 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.	1.00	0.10 to 2.00
• Motor noise • Motor hunting and oscillation at speeds up to 40 Hz	Carrier Frequency Selection (C6-02)	• Increase the carrier frequency If the motor noise is too loud. • Lower the carrier frequency when motor hunting and oscillation occur at speeds up to 40 Hz. • The default setting for the carrier frequency depends on the drive capacity (o2-04).	1 (2 kHz)	1 to max. setting
• Poor torque or speed response • Motor hunting and oscillation	Torque Compensation Primary Delay Time (C4-02)	• Reduce the setting if motor torque and speed response are too slow. • Increase the setting if motor hunting and oscillation occur.	200 ms	100 to 1000 ms
• Poor motor torque at speeds below 10 Hz • Motor hunting and oscillation	Torque Compensation Gain (C4-01)	• Increase the setting if motor torque is insufficient at speeds below 10 Hz. • Reduce the setting if motor hunting and oscillation with a relatively light load.	1.00	0.50 to 1.50
• Poor motor torque at low speeds • Motor instability at motor start	Mid Output Voltage A (E1-08) Minimum Output Voltage (E1-10)	• Increase the setting if motor torque is insufficient at speeds below 10 Hz. • Reduce the setting If motor instability occurs at motor start.	Depends on o2-04, Drive Model Selection	Default setting ±5 V
Poor speed precision (V/f control)	Slip Compensation Gain (C3-01)	Set the motor-rated current (E2-01), motor-rated slip (E2-02), and motor no-load current (E2-03), then adjust the slip compensation gain (C3-01).	0.0 (no slip compen-sation)	0.5 to 1.5

◆ Parameters to Minimize Motor Hunting and Oscillation

In addition to the parameters discussed in table *Table 6.1*, parameters in *Table 6.2* indirectly affect motor hunting and oscillation.

Table 6.2 Parameters that Affect Control Performance in Applications

Name (Parameter No.)	Application
Dwell Function (b6-01 through b6-04)	Prevents motor speed loss by maintaining the output frequency when working with heavy loads or when there is powerful backlash on the machine side.
Accel/Decel Time (C1-01 through C1-11)	Adjusting accel and decel times will affect the torque presented to the motor during acceleration or deceleration.
S-Curve Characteristics (C2-01 through C2-04)	Prevents shock at the beginning and end of acceleration and deceleration.
Jump Frequency (d3-01 through d3-04)	Skips over the resonant frequencies of connected machinery.
Analog Filter Time Constant (H3-13)	Prevents fluctuation in the analog input signal due to noise.
Stall Prevention (L3-01 through L3-06, L3-11)	• Prevents motor speed loss and overvoltage when the load is too heavy or during sudden acceleration/deceleration. • Adjustment is not normally necessary because Stall Prevention is enabled as a default. Set L3-04 to 0 to disable Stall Prevention during deceleration when using a braking resistor.

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 101*.

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 6.3 contains descriptions of the various types of alarms, faults, and errors that may occur while operating the drive.

Table 6.3 Types of Alarms, Faults, and Errors

Type	Drive Response
Faults	When the drive detects a fault: • The digital operator displays text indicating the specific fault and the ALM indicator LED remains lit until the fault is reset. • The fault interrupts drive output and the motor coasts to a stop. • Some faults allow the user to select the stopping method when the fault occurs. • Fault output terminals MA-MC will close, and MB-MC will open. The drive will remain inoperable until the fault is cleared. *Refer to Fault Reset Methods on page 313*.
Minor Faults and Alarms	When the drive detects an alarm or a minor fault: • The digital operator displays text indicating the specific alarm or minor fault, and the ALM indicator LED flashes. • The drive continues running the motor, although some alarms allow the user to select a stopping method when the alarm occurs. • A multi-function contact output set to be tripped by a minor fault (H2- □□ = 10) closes. If the output is set to be tripped by an alarm, the contact will not close. • The digital operator displays text indicating a specific alarm and the ALM indicator LED flashes. Remove the cause of the problem to reset a minor fault or alarm.
Operation Errors	An operation error occurs when parameter settings conflict or do not match hardware settings (such as with an option card). When the drive detects an operation error: • The digital operator displays text indicating the specific error. • Multi-function contact outputs do not operate. 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.
Tuning Errors	Tuning errors occur while performing Auto-Tuning. When the drive detects a tuning error: • The digital operator displays text indicating the specific error. • Multi-function contact outputs do not operate. • Motor coasts to stop. Remove the cause of the error and repeat the Auto-Tuning process.
Copy Function Errors	Copy Function Errors occur when using the digital operator or the USB Copy Unit to copy, read, or verify parameter settings. • The digital operator displays text indicating the specific error. • Multi-function contact outputs do not operate. Pressing any key on the digital operator will clear the fault. Investigate the cause of the problem (such as model incompatibility) and try again.

◆ Alarm and Error Displays

■ Faults

Table 6.4 gives an overview of possible fault codes. Conditions such as overvoltages can trip faults and alarms. It is important to distinguish between faults and alarms to determine the proper corrective actions.

When the drive detects a fault, the ALM indicator LED lights, the fault code appears on the digital operator, and the fault contact MA-MB-MC triggers. An alarm is present if the ALM LED blinks and the fault code on the digital operator flashes. *Refer to Minor Faults and Alarms on page 281* for a list of alarm codes.

Table 6.4 Fault Displays

Digital Operator Display	Name	Page
bAT	Digital Operator Battery Voltage Low	283
boL	Braking Transistor Overload Fault	283
bUS	Option Communication Error	283
CE	MEMOBUS/Modbus Communication Error	283
CPF11 to CPF14 <1> <3>	Control Circuit Error	283
CPF16 to CPF19 <1> <3>	Control Circuit Error	283
CPF02	A/D Conversion Error	284
CPF03	Control Board Connection Error	284
CPF06 <3>	EEPROM Memory Data Error	284
CPF07, CPF08	Terminal Board Connection Error	284
CPF20, CPF21 <2>	Control Circuit Error	284
CPF22	Hybrid IC Error	284
CPF23	Control Board Connection Error	285
CPF24 <3>	Drive Unit Signal Fault	285
CPF25	Terminal Board Not Connected	285
CPF26 to CPF35, CPF40 to CPF43	Control Circuit Error	285
E5	SI-T3 Watchdog Timer Error	285
EF0	Option Card External Fault	285
EF1 to EF8	External Fault (input terminal S1 to S8)	285
Err	EEPROM Write Error	286
FAn	Internal Fan Fault	285
FbH	Excessive PID Feedback	286
FbL	PID Feedback Loss	287
GF	Ground Fault	287
LF	Output Phase Loss	287
nSE	Node Setup Error	287
oC	Overcurrent	287
oFA00 <3>	Option Card Connection Error (CN5-A)	288
oFA01	Option Card Fault (CN5-A)	288
oFA03 to oFA06	Option Card Error (CN5-A)	288
oFA10, oFA11	Option Card Error (CN5-A)	288
oFA12 to oFA17	Option Card Connection Error (CN5-A)	288
oFA30 to oFA43	Comm Option Card Connection Error (CN5-A)	288
oFb00 <3>	Option Card Connection Error (CN5-B)	289
oFb01	Option Card Fault (CN5-B)	289
oFb02	Option Card Fault (CN5-B)	289
oFb03, oFb11	Option Card Error (CN5-B)	289
oFb12 to oFb17	Option Card Connection Error (CN5-B)	289
oFC00 <3>	Option Card Connection Error (CN5-C)	289
oFC01	Option Card Fault (CN5-C)	289
oFC02	Option Card Fault (CN5-C)	290
oFC03, oFC11	Option Card Error (CN5-C)	290
oFC12 to oFC17	Option Card Connection Error (CN5-C)	290
oFC50 to oFC55	Option Card Error (CN5-C)	290
oH	Heatsink Overheat	290
oH1	Heatsink Overheat	290
oH4	Motor Overheat Fault (PTC input)	301
oL1	Motor Overload	291
oL2	Drive Overload	291
oL3	Overtorque Detection 1	291
oL4	Overtorque Detection 2	292
oL7	High Slip Braking oL	292
oPr	Operator Connection Fault	292
ov	Overvoltage	292
PF	Input Phase Loss	293
rF	Braking Resistor Fault	293
rH	Dynamic Braking Resistor	293
rr	Dynamic Braking Transistor	294
SC	IGBT Short Circuit or Ground Fault	294
SEr	Too Many Speed Search Restarts	294
TdE	Time Data Error	294

Digital Operator Display	Name	Page
TIE	Time Interval Error	294
TIM	Time Not Set	294
UL3	Undertorque Detection 1	295
UL4	Undertorque Detection 2	295
UL6	Motor Underload	295
Uv1 <3>	Undervoltage	295

Digital Operator Display	Name	Page
Uv2 <3>	Control Power Supply Undervoltage	296
Uv3 <3>	Soft Charge Circuit Fault	296
voF	Output Voltage Detection Fault	296
vToL	VT Overload	296

<1> Displayed as CPF00 when occurring at drive power up. When one of the faults occurs after successfully starting the drive, the display will show CPF01.

<2> Displayed as CPF20 when occurring at drive power up. When one of the faults occurs after successfully starting the drive, the display will show CPF21.

<3> Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

■ Minor Faults and Alarms

Refer to *Table 6.5* for an overview of possible alarm codes. Conditions such as overvoltages can trip faults and alarms. It is important to distinguish between faults and alarms to determine the proper corrective actions.

When the drive detects an alarm, the ALM indicator LED blinks and the alarm code display flashes. Most alarms trigger a digital output programmed for alarm output (H2-□□ = 10). A fault (not an alarm) is present if the ALM LED lights without blinking. *Refer to Faults on page 280* for information on fault codes.

Table 6.5 Minor Fault and Alarm Displays

Digital Operator Display	Name	Minor Fault Output (H2-□□ = 10)	Page
AEr	SI-T Station Number Setting Error (CC-Link, CANopen, MECHATROLINK-II)	YES	297
bAT	HOA Keypad Battery Voltage Low	YES	283
bb	Drive Baseblock	No output	297
boL	Braking Transistor Overload Fault	YES	297
bUS	Option Card Communications Error	YES	297
CALL	Serial Communication Transmission Error	YES	297
CE	MEMOBUS/Modbus Communication Error	YES	298
CrST	Cannot Reset	YES	298
dnE	Drive Disabled	YES	298
E5	SI-T3 Watchdog Timer Error	YES	285
EoF	Emergency Override Forward Run	YES	299
Eor	Emergency Override Reverse Run	YES	299
EF	Run Command Input Error	YES	298
EF0	Option Card External Fault	YES	298
EF1 to EF8	External Fault (input terminal S1 to S8)	YES	299
FbH	Excessive PID Feedback	YES	299
FbL	PID Feedback Loss	YES	300
HCA	Current Alarm	YES	300

Digital Operator Display	Name	Minor Fault Output (H2-□□ = 10)	Page
LT-1	Cooling Fan Maintenance Time	No output <1>	300
LT-2	Capacitor Maintenance Time	No output <1>	300
LT-3	Soft Charge Bypass Relay Maintenance Time	No output <1>	300
LT-4	IGBT Maintenance Time (50%)	No output <1>	301
oH	Heatsink Overheat	YES	301
oH2	Drive Overheat	YES	301
oH3	Motor Overheat	YES	301
ov	Overvoltage	YES	302
PASS	MEMOBUS/Modbus Test Mode Complete	No output	302
rUn	During Run 2, Motor Switch Command Input	YES	302
SE	MEMOBUS/Modbus Test Mode Fault	YES	302
TdE	Time Data Error	YES	294
TIE	Time Interval Error	YES	294
TrPC	IGBT Maintenance Time (90%)	YES	302
UL6	Motor Underload	YES	295
Uv	Undervoltage	YES	303
wRUn	Run Delay Timer is Active	YES	303

<1> Output when H2-□□ = 2F.

■ Operation Errors

Table 6.6 Operation Error Displays

Digital Operator Display	Name	Page
oPE01	Drive Unit Setting Error	*304*
oPE02	Parameter Setting Range Error	*304*
oPE03	Multi-Function Input Setting Error	*304*
oPE04	Terminal Board Mismatch Error	*305*
oPE05	Run Command Selection Error	*305*
oPE07	Multi-Function Analog Input Selection Error	*305*
oPE09	PID Control Selection Error	*306*
oPE10	V/f Data Setting Error	*306*
oPE11	Carrier Frequency Setting Error	*306*
oPE13	Pulse Train Monitor Selection Error	*306*
oPE28	Sequence Timer Error	*306*

■ Auto-Tuning Errors

Table 6.7 Auto-Tuning Error Displays

Digital Operator Display	Name	Page
End1	Excessive V/f Setting	*307*
End2	Motor Iron Core Saturation Coefficient Error	*307*
End3	Rated Current Setting Alarm	*307*
End4	Adjusted Slip Value Fell Below Lower Limit	*307*
End5	Resistance Between Lines Error	*307*
End6	Leakage Inductance Alarm	*307*
End7	No-Load Current Alarm	*308*
Er-01	Motor Data Error	*308*
Er-02	Alarm	*308*
Er-03	STOP Button Input	*308*
Er-04	Line-to-Line Resistance Error	*308*
Er-05	No-Load Current Error	*308*
Er-08	Rated Slip Error	*309*
Er-09	Acceleration Error	*309*
Er-11	Motor Speed Error	*309*
Er-12	Current Detection Error	*309*
Er-13	Leakage Inductance Error	*309*
Er-17	Reverse Prohibited Error	*309*

■ Errors and Displays When Using the Copy Function

Table 6.8 Copy Errors

Digital Operator Display	Name	Page
CoPy	Writing parameter settings (flashing)	*310*
CPyE	Error writing data	*310*
CSEr	Copy unit error	*310*
dFPS	Drive model mismatch	*310*
End	Task complete	*310*
iFEr	Communication error	*310*
ndAT	Model, voltage class, capacity mismatch	*310*
rdEr	Error reading data	*311*
rEAd	Reading parameter settings (flashing)	*311*
vAEr	Voltage class, capacity mismatch	*311*
vFyE	Parameter setting mismatch	*311*
vrFy	Comparing parameter settings (flashing)	*311*

6.4 Fault Detection

◆ Fault Displays, Causes, and Possible Solutions

Faults are detected for drive protection, and cause the drive to stop while triggering the fault output terminal MA-MB-MC. Remove the cause of the fault and manually clear the fault before attempting to run the drive again.

Table 6.9 Detailed Fault Displays, Causes, and Possible Solutions

Digital Operator Display		Fault Name
bAT	bAT	Digital Operator Battery Voltage Low
Cause		**Possible Solution**
The digital operator battery is low		Replace the digital operator battery.

Digital Operator Display		Fault Name
boL	boL	Braking Transistor Overload Fault
		The braking transistor reached its overload level.
Cause		**Possible Solution**
The wrong braking resistor is installed		Select the correct braking resistor.

Digital Operator Display		Fault Name
bUS	bUS	Option Communication Error
		• The connection was lost after establishing initial communication. • Only detected when the run command frequency reference is assigned to an option card.
Cause		**Possible Solution**
No signal was received from the PLC		• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Faulty communications wiring or an existing short circuit		
Communication data error occurred due to noise		• Check the various options available to minimize the effects of noise. • 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 absorbers if necessary. • Use only recommended cables or other shielded line. Ground the shield on the controller side or 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 do not line up properly 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 an existing short circuit		• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Communication data error occurred due to noise		• Check the various options available to minimize the effects of noise. • 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 the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise. 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
CPF00 or CPF01	CPF11 to CPF14 CPF16 to CPF19	Control Circuit Error

Cause	Possible Solution
There is a self-diagnostic error in the control circuit	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Connector on the operator is damaged	Replace the operator.

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		• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

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		• Turn off the power and check the connection between the control board and the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Drive fails to operate properly due to noise interference		• Check the various options available to minimize the effects of noise. • 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 the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise. 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
CPF06	CPF06	EEPROM Memory Data Error
		Error in the data saved to EEPROM
Cause		**Possible Solution**
There is an error in EEPROM control circuit		• Turn off the power and check the connection between the control board and the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
The power supply was switched off while parameters were being saved to the drive		Reinitialize the drive (A1-03 = 2220, 3330).

Digital Operator Display		Fault Name
CPF07	CPF07	Terminal Board Connection Error
CPF08	CPF08	
Cause		**Possible Solution**
There is a faulty connection between the terminal board and the control board		• Turn off the power and reconnect the terminal board. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
CPF20 or CPF21	CPF20 or CPF21	Control Circuit Error
Cause		**Possible Solution**
Hardware is damaged		• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
CPF22	CPF22	Hybrid IC Failure
Cause		**Possible Solution**

Hybrid IC failure on the power board	• Cycle power to the drive. • If the problem continues, replace the power board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the power board.

Digital Operator Display		Fault Name
CPF23	CPF23	Control Board Connection Error
		Connection error between the control board and the drive
Cause		**Possible Solution**
Hardware is damaged		• Turn off the power and check the connection between the control board and the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
CPF24	CPF24	Drive Unit Signal Fault
		The drive capacity cannot be detected correctly (drive capacity is checked when the drive is powered up).
Cause		**Possible Solution**
Hardware is damaged		If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
CPF25	CPF25	Terminal Board Not Connected
Cause		**Possible Solution**
Terminal board is not connected correctly		Reconnect the terminal board to the connector on the drive, then cycle the power to the drive.

Digital Operator Display		Fault Name
CPF26 to CPF35 CPF40 to CPF43	CPF26 to CPF35 CPF40 to CPF43	Control Circuit Error
		CPU error
Cause		**Possible Solution**
Hardware is damaged		If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
E5	E5	SI-T3 Watchdog Timer Error
		The watchdog timed out.
Cause		**Possible Solution**
Data has not been received from the PLC		Execute DISCONNECT or ALM_CLR, then issue a CONNECT command or SYNC_SET command and proceed to phase 3. Refer to the SI-T3 Option Technical Manual for more details on troubleshooting.

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 and F6-03 is set to a value other than 3.		• Remove the cause of the external fault. • Remove the external fault input from the PLC.
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 tripped an alarm function		Remove the cause of the external fault and reset the fault.
Wiring is incorrect		• Properly connect the signal lines to the terminals assigned for external fault detection (H1-□□ = 20 to 2B). • Reconnect the signal line.
Multi-function contact input setting is incorrect		• Check for unused terminals set for H1-□□ = 20 to 2B (External Fault). • Change the terminal settings.

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		• Press “ENTER” on the digital operator. • Correct the parameter setting. • Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Hardware problem		If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
FAn	FAn	Internal Fan Fault
		Fan or magnetic contactor failure
Cause		**Possible Solution**
Internal cooling fan has malfunctioned		• Cycle power to the drive. • Check for fan operation. • Verify the cumulative operation time of the fan with monitor U4-03, and verify the cumulative operation time of the fan maintenance timer with U4-04. • If the cooling fan has exceeded its expected performance life or is damaged in any other way, follow the replacement instructions in the *Peripheral Devices & Options* chapter.
Fault detected in the internal cooling fan or magnetic contactor to the power supply.		• Cycle power to the drive. • If the fault continues to occur, replace the power board/gate drive board or the entire drive. • Contact Yaskawa or a Yaskawa representative for instructions on replacing the power board/gate drive board.

Digital Operator Display		Fault Name
FbH	FbH	Excessive PID Feedback
		PID feedback input is greater than the level set to b5-36 for longer than the time set to b5-37. Set b5-12 to 2 or 5 to enable fault detection.
Cause		**Possible Solution**
Parameters are set inappropriately		Check b5-36 and b5-37 settings.
Incorrect PID feedback wiring		Correct the wiring.
There is a problem with the feedback sensor		• Check the sensor on the control side. • Replace the sensor if damaged.

Digital Operator Display		Fault Name
FbL	FbL	PID Feedback Loss
		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 set inappropriately		Check b5-13 and b5-14 settings.
Incorrect PID feedback wiring		Correct the wiring.
There is a problem with the feedback sensor		• Check the sensor on the control side. • Replace the sensor if damaged.

Digital Operator Display		Fault Name
GF	GF	Ground Fault
		• A current short to ground exceeded 50% of rated current on the output side of the drive. • Setting L8-09 to 1 enables ground fault detection.
Cause		**Possible Solution**
Motor insulation is damaged		• Check the insulation resistance of the motor. • Replace the motor.
A damaged motor cable is creating a short circuit		• Check the motor cable. • Remove the short circuit and reapply power to the drive
		• Check the resistance between the cable and the ground terminal ⏚. • Replace the cable.
Excessive leakage current at the drive output		• Reduce the carrier frequency. • Reduce the amount of stray capacitance.
The drive started to run during a current offset fault or while coasting to a stop		• Set b3-01 to 1 to enable Speed Search at Start. • Perform Speed Search 1 or 2 (H1-□□ = 61 or 62) via one of the external terminals.
Hardware problem		If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
LF	LF	Output Phase Loss
		• Phase loss on the output side of the drive. • Setting L8-07 to 1 or 2 enables Phase Loss Detection.
Cause		**Possible Solution**
The output cable is disconnected		• Check for wiring errors and properly connect the output cable. • Correct the wiring.
The motor winding is damaged		• Check the resistance between motor lines. • Replace the motor if the winding is damaged.
The output terminal is loose		• Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauges and Tightening Torque on page 77*** for details.
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		If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
A single-phase motor is being used		The drive cannot operate a single phase motor.

Digital Operator Display		Fault Name
nSE	nSE	Node Setup Error
		A terminal assigned to the node setup function closed during run.
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 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	• Check the insulation resistance. • Replace the motor.
One of the motor cables has shorted out or there is a grounding problem	• Check the motor cables. • Remove the short circuit and reapply power to the drive.
	• Check the resistance between the motor cables and the ground terminal ⏚. • Replace damaged cables.
The load is too heavy	• Measure the current flowing into the motor. • Replace the drive with a larger capacity drive if the current value exceeds the rated current. • Determine if there is sudden fluctuation in the current level. • Reduce the load to avoid sudden changes in the current level or switch to a larger drive.
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 it is not possible to set the proper amount of torque, make the following changes: • Increase the acceleration time (C1-01, C1-03). • Increase the S-curve characteristics (C2-01 through C2-04). • Increase the capacity of the drive.
The drive is attempting to operate a specialized motor or a motor larger than the maximum size allowed	• Check the motor capacity. • Ensure that the rated capacity of the drive is greater than or equal to the capacity rating found on the motor nameplate.
Magnetic contactor (MC) on the output side of the drive has turned on or off	Set up the operation sequence so the MC does not trip while the drive is outputting current.
V/f setting is not operating as expected	• Check the ratios between the voltage and frequency. • Set parameters E1-04 through E1-10 appropriately. • Lower the voltage if it is too high relative to the frequency.
Excessive torque compensation	• Check the amount of torque compensation. • Reduce the torque compensation gain (C4-01) until there is no speed loss and less current.
Drive fails to operate properly due to noise interference	• Review the possible solutions provided for handling noise interference. • Review the section on handling noise interference on page *319* and check the control circuit lines, main circuit lines, and ground wiring.
Overexcitation gain is set too high	• Check if the fault occurs simultaneously with overexcitation function operation. • Consider motor flux saturation and reduce the value of n3-13 (Overexcitation Deceleration Gain).
Run command was applied while motor was coasting	• Set b3-01 to 1 to enable Speed Search at Start. • Program the Speed Search command input through one of the multi-function contact input terminals (H1-□□ = 61 or 62).
The rated output current of the drive is too small	Use a larger drive.

Digital Operator Display		Fault Name
oFA00	oFA00	Option Card Connection Error at Option Port CN5-A
		Option compatibility error
Cause		**Possible Solution**
The option card installed into port CN5-A is incompatible with the drive		Check if the drive supports the option card to be installed. Contact Yaskawa for assistance.

Digital Operator Display		Fault Name
oFA01	oFA01	Option Card Fault at Option Port CN5-A
		Option not properly connected
Cause		**Possible Solution**
The option card connection to port CN5-A is faulty		• Turn off the power and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • If the option is not a communication option card, try to use the card in a different option port. If the option card works properly in a different option port, CN5-A is damaged, and the drive requires replacement. If the error persists (oFb01 or oFC01 occur), replace the option card.

Digital Operator Display		Fault Name
oFA03 to oFA06	oFA03 to oFA06	Option Card Error Occurred at Option Port CN5-A
oFA10, oFA11	oFA10, oFA11	

oFA12 to oFA17	oFA12 to oFA17	Option Card Connection Error (CN5-A)
oFA30 to oFA43	oFA30 to oFA43	Communication Option Card Connection Error (CN5-A)
Cause		**Possible Solution**
Option card or hardware is damaged		• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
oFb00	oFb00	Option Card Fault at Option Port CN5-B
		Option compatibility error
Cause		**Possible Solution**
The option card installed into port CN5-B is incompatible with the drive		Make sure the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-B		Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.

Digital Operator Display		Fault Name
oFb01	oFb01	Option Card Fault at Option Port CN5-B
		Option not properly connected
Cause		**Possible Solution**
The option card connection to port CN5-B is faulty		• Turn off the power and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • Try to use the card in a different option port. If the option card works properly in a different option port, CN5-B is damaged, and the drive requires replacement. If the error persists (oFA01 or oFC01 occur), replace the option card.

Digital Operator Display		Fault Name
oFb02	oFb02	Option Card Fault at Option Port CN5-B
		Same type of option card is currently connected
Cause		**Possible Solution**
An option card of the same type is already installed in option port CN5-A		Only one of each option card type can only be installed simultaneously. Make sure only one type of option card is connected.
An input option card is already installed in option port CN5-A		Install a communication option. More than one of the same type of card cannot be installed simultaneously.

Digital Operator Display		Fault Name
oFb03 to oFb11	oFb03 to oFb11	Option card error occurred at Option Port CN5-B
oFb12 to oFb17	oFb12 to oFb17	
Cause		**Possible Solution**
Option card or hardware is damaged		• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

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		Confirm that the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-C		Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.

Digital Operator Display		Fault Name
oFC01	oFC01	Option Card Fault at Option Port CN5-C
		Option not properly connected
Cause		**Possible Solution**

The option card connection to port CN5-C is faulty.	• Turn the power off and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • Try to use the card in a different option port. If the option card works properly in a different option port, CN5-C is damaged, and the drive requires replacement. If the error persists (oFA01 or oFb01 occur), replace the option card.

Digital Operator Display		Fault Name
oFC02	oFC02	Option Card Fault at Option Port CN5-C
		Same type of option card is currently connected
Cause		**Possible Solution**
An option card of the same type is already installed in option port CN5-A or CN5-B.		Only one of each option card type can only be installed simultaneously. Make sure only one type of option card is connected.
An input option card is already installed in option port CN5-A or CN5-B.		Install a communication option, a digital input option, or an analog input option. More than one of the same type of card cannot be installed simultaneously.

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		• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

Digital Operator Display		Fault Name
oFC50 to oFC55	oFC50 to oFC55	Option Card Error Occurred at Option Port CN5-C
Cause		**Possible Solution**
Option card or hardware is damaged		Refer to the option manual for details.

Digital Operator Display		Fault Name
oH	oH	Heatsink Overheat
		The heatsink temperature exceeded the overheat pre-alarm level set to L8-02. The default value for L8-02 is determined by drive capacity (o2-04).
Cause		**Possible Solution**
Surrounding temperature is too high		• Check the temperature surrounding the drive. Verify temperature is within drive specifications. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy		• Measure the output current. • Decrease the load. • Lower the carrier frequency (C6-02).
Internal cooling fan is stopped		• Replace the cooling fan. ***Refer to Cooling Fan Replacement: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032 on page 333***. • After replacing the cooling fan, set parameter o4-03 to 0 to reset the cooling fan maintenance.

Digital Operator Display		Fault Name
oH1	oH1	Overheat 1 (Heatsink Overheat)
		The heatsink temperature exceeded the drive overheat level. Overheat level is determined by drive capacity (o2-04).
Cause		**Possible Solution**
Surrounding temperature is too high		• Check the temperature surrounding the drive. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy		• Measure the output current. • Lower the carrier frequency (C6-02). • Reduce the load.

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 C1-04).
A general-purpose motor is driven below the rated speed with a high load		• Reduce the load. • Increase the speed. • 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.
The output voltage is too high		• Adjust the user-set V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not set E1-08 and E1-10 too low. This reduces load tolerance at low speeds.
The wrong motor rated current is set to E2-01		• Check the motor-rated current. • Enter the motor rated current to parameter E2-01 as indicated on the motor nameplate.
The base frequency is set incorrectly		• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).
The electrical thermal protection characteristics and motor overload characteristics do not match		• Check the motor characteristics. • Correct the type of motor protection that has been selected (L1-01). • Install an external thermal relay.
The electrical thermal relay is operating at the wrong level		• Check the current rating listed on the motor nameplate. • Check the value set for the motor rated current (E2-01).
Motor overheated by overexcitation operation		• Overexcitation increases the motor loss and the motor temperature. Excessive duration of overexcitation may cause motor damage. Prevent excessive overexcitation operation or apply proper cooling to the motor. • Reduce the excitation deceleration gain (n3-13). • Set L3-04 (Stall Prevention during Deceleration) to a value other than 4.
Parameters related to Speed Search are set incorrectly		• Check values set to Speed Search related parameters. • Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.
Output current fluctuation due to power supply 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 time is too short		Increase the settings for the acceleration and deceleration times (C1-01 through C1-04).
The output voltage is too high		• Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not lower E1-08 and E1-10 excessively. This reduces load tolerance at low speeds.
Drive capacity is too small		Replace the drive with a larger model.
Overload occurred when operating at low speeds		• Reduce the load when operating at low speeds. • Replace the drive with a model that is one frame size larger. • Lower the carrier frequency (C6-02).
Excessive torque compensation		Reduce the torque compensation gain in parameter C4-01 until there is no speed loss but less current.
Parameters related to Speed Search are set incorrectly		• Check the settings for all Speed Search related parameters. • Adjust the current used during Speed Search (b3-03) and the Speed Search deceleration time (b3-02). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.
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 L6-02 and L6-03 settings.
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
oL7	oL7	High Slip Braking oL
		The output frequency stayed constant for longer than the time set to n3-04 during High Slip Braking.
Cause		**Possible Solution**
Excessive load inertia		• Reduce deceleration times in parameters C1-02 and C1-04 for applications that do not use High Slip Braking. • Use a braking resistor to shorten deceleration time.
Motor is driven by the load		
Something on the load side is restricting deceleration		
The overload time during High Slip Braking is too short		• Increase parameter n3-04 (High-slip Braking Overload Time). • Install a thermal relay and increase the setting of n3-04 to maximum value.

Digital Operator Display		Fault Name
oPr	oPr	External Digital Operator Connection Fault
		The external operator has been disconnected from the drive. **Note:** An oPr fault will occur when all of the following conditions are true: • Output is interrupted when the operator is disconnected (o2-06 = 1). • The Run command is assigned to the operator (b1-02 = 0 and LOCAL has been selected).
Cause		**Possible Solution**
External operator is not properly connected to the drive		• Check the connection between the operator and the drive. • Replace the cable if damaged. • Turn off the drive input power and disconnect the operator. Reconnect the operator and reapply drive input power.

Digital Operator Display		Fault Name
ou	ov	Overvoltage
		Voltage in the DC bus has exceeded the overvoltage detection level. • For 200 V class drives: approximately 410 V • For 400 V class drives: approximately 820 V (740 V when E1-01 is less than 400) • For 600 V class drives: approximately 1040 V
Cause		**Possible Solution**
Deceleration time is too short and regenerative energy is flowing from the motor into the drive		• Increase the deceleration time (C1-02 and C1-04). • Install a dynamic braking resistor or a dynamic braking resistor unit. • Set L3-04 to 1 to enable stall prevention during deceleration. Stall Prevention is enabled as the default setting.
Fast acceleration time causes the motor to overshoot the speed reference		• Check if sudden drive acceleration triggers an overvoltage alarm. • Increase the acceleration time. • Use longer S-curve acceleration and deceleration times. • Enable the Overvoltage Suppression function (L3-11 = 1). • Lengthen the S-curve at acceleration end.
Excessive braking load		The braking torque was too high, causing regenerative energy to charge the DC bus. Reduce the braking torque, use a dynamic braking option, or lengthen decel time.

Surge voltage entering from the drive input power	Install a DC link choke. **Note:** Voltage surge can result from a thyristor convertor and phase advancing capacitor using the same input power supply.
Ground fault in the output circuit causes the DC bus capacitor to overcharge	• Check the motor wiring for ground faults. • Correct grounding shorts and reapply power.
Improper parameters related to Speed Search (including Speed Search after a momentary power loss and after a fault restart)	• Check the settings for Speed Search-related parameters. • Enable Speed Search restart function (b3-19 greater than or equal to 1 to 10). • Adjust the current level during Speed Search and the deceleration time (b3-02 and b3-03 respectively). • Perform Stationary Auto-Tuning for line-to-line resistance and then set b3-14 to 1 to enable Speed Estimation Speed Search.
Drive input power voltage is too high	• Check the voltage. • Lower drive input power voltage within the limits listed in the specifications.
The braking transistor or braking resistor are wired incorrectly	• Check braking transistor and braking resistor wiring for errors. • Properly rewire the braking resistor device.
Drive fails to operate properly due to noise interference	• Review the list of possible solutions provided for controlling noise. • Review the section on handling noise interference on page *319* and check the control circuit lines, main circuit lines, and ground wiring.
Load inertia is set incorrectly	• Check the load inertia settings when using KEB, overvoltage suppression, or Stall Prevention during deceleration. • Adjust the load inertia ratio in L3-25 to better match the load.
Motor hunting occurs	• Adjust the parameters that control hunting. • Set the gain for Hunting Prevention (n1-02). • Adjust the AFR time constant (n2-02 and n2-03).

Digital Operator Display		Fault Name
PF	PF	Input Phase Loss
		Drive input power has an open phase or has a large imbalance of voltage between phases. Detected when L8-05 is set 1 (enabled).
Cause		**Possible Solution**
There is phase loss in the drive input power		• Check for wiring errors in the main circuit drive input power. • Correct the wiring.
There is loose wiring in the drive input power terminals		• Ensure the terminals are tightened properly. • Apply the tightening torque as specified in this manual. *Refer to Wire Gauges and Tightening Torque on page 77* for details.
There is excessive fluctuation in the drive input power voltage		• Check the voltage from the drive input power. • Review the possible solutions for stabilizing the drive input power.
There is poor balance between voltage phases		Stabilize drive input power or disable phase loss detection.
The main circuit capacitors are worn		• Check the maintenance time for the capacitors (U4-05). • Replace the capacitor if U4-05 is greater than 90%. For instructions on replacing the capacitor, contact Yaskawa or a Yaskawa representative.
		Check for 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 a Yaskawa representative.

Digital Operator Display		Fault Name
rF	rF	Braking Resistor Fault
		The resistance of the braking resistor is too low.
Cause		**Possible Solution**
The proper braking resistor option has not been installed		Select a braking resistor option that it fits the drive braking transistor specification.
A regenerative converter, regenerative unit, or braking unit is being used		Set L8-55 to 0 to disable the braking transistor protection selection.

Digital Operator Display		Fault Name
rH	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	• Check the load, deceleration time, and speed. • Reduce the load inertia. • Increase the deceleration times (C1-01 to C1-04). • Replace the dynamic braking option with a larger device that can handle the power that is discharged.
The duty cycle is too high	Check the duty cycle. Maximum of 3% duty cycle is available when L8-01 = 1.
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	• Check the specifications and conditions for the braking resistor device. • Select the optimal braking resistor.
Note: The magnitude of the braking load trips the braking resistor overheat alarm, NOT the surface temperature. Using the braking resistor more frequently than its rating permits will trip the alarm even when the braking resistor surface is not very hot.	

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		• Cycle power to the drive and check for reoccurrence of the fault. • Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
The control circuit is damaged		

Digital Operator Display		Fault Name
SC	SC	IGBT Short Circuit or Ground Fault
Cause		**Possible Solution**
IGBT fault		• Check motor wiring. • Turn off the power supply, then turn it on. If the problem continues, contact your Yaskawa representative or the nearest Yaskawa sales office.
IGBT short circuit detection circuit fault		
The drive is damaged		• Check the drive output side short circuit for a broken output transistor B1 and U/T1, V/T2, W/T3 – and U/T1, V/T2, W/T3 • Contact your Yaskawa representative or nearest Yaskawa sales office.

Digital Operator Display		Fault Name
SEr	SEr	Too Many Speed Search Restarts
		The number of Speed Search restarts exceeded the value set to b3-19.
Cause		**Possible Solution**
Parameters related to Speed Search are set to the wrong values		• Reduce the detection compensation gain during Speed Search (b3-10). • Increase the current level when attempting Speed Search (b3-17). • Increase the detection time during Speed Search (b3-18). • Repeat Auto-Tuning.
The motor is coasting in the opposite direction of the Run command		Set b3-14 to 1 to enable Bi-Directional Speed Search.

Digital Operator Display		Fault Name
TdE	TdE	Time Data Error
Cause		**Possible Solution**
An error has occurred in the Real-Clock Time function of the digital operator		Replace the digital operator. For instructions on replacing the digital operator, contact Yaskawa or your nearest sales representative.

Digital Operator Display		Fault Name
TIE	TIE	Time Interval Error
Cause		**Possible Solution**
An error has occurred in the Real-Clock Time function of the digital operator		Replace the digital operator. For instructions on replacing the digital operator, contact Yaskawa or your nearest sales representative.

Digital Operator Display		Fault Name
TIM	TIM	Time Not Set

Cause	Possible Solution
The Real-Time Clock for the digital operator is not set in parameter o4-17 • The drive is a new drive, first power-up condition • o4-17 was set to 2, Reset, by the user, manually clearing the Real-Time Clock data.	Set o4-17 to 1 to set the time for the digital operator. The drive will display the "TIM" alarm (Time Not Set) when the Real time Clock is not set . Additionally, at power up, if the "TIM" condition is present, the drive will automatically switch to the time setting screen (o4-17 = 1) for 30 seconds to prompt the user to set the Real-Time Clock.
The user did not set the Real Time Clock when prompted following power-up.	Cycle power to the drive and set the Real Time Clock within 30 seconds of power-up, or set the clock manually via parameter o4-17.
The digital operator battery is low or the battery has been replaced	Replace the digital operator battery and set the Real-Time Clock.
An error has occurred in the Real-Time Clock function of the digital operator	Replace the digital operator. For instructions on replacing the digital operator, contact Yaskawa or your nearest sales representative.

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 L6-05 and L6-06 settings
There is a fault on the machine side		Check the load for any problems.

Digital Operator Display		Fault Name
UL6	UL6	Motor Underload
		The weight of the load has fallen below the underload curve defined in L6-14.
Cause		**Possible Solution**
The output current has fallen below the motor underload curve defined in L6-14 for longer than the time set to L6-03		Adjust the value set to L6-14 so that output current remains above the motor underload curve during normal operation.

Digital Operator Display		Fault Name
Uv1	Uv1	DC Bus Undervoltage
		One of the following conditions occurred while the drive was running: • Voltage in the DC bus fell below the undervoltage detection level (L2-05). • For 200 V class drives: approximately 190 V • For 400 V class drives: approximately 380 V (350 V when E1-01 is less than 400) • For 600 V class drives: approximately 475 V The fault is output only if L2-01 is set to 0 or 1 and the DC bus voltage has fallen below the level set to L2-05 for longer than the time set to L2-02.
Cause		**Possible Solution**
Input power phase loss		• The main circuit drive input power is wired incorrectly. • Correct the wiring.
One of the drive input power wiring terminals is loose		• Ensure there are no loose terminals. • Apply the tightening torque specified in this manual to fasten the terminals. *Refer to Wire Gauges and Tightening Torque on page 77* for details.

There is a problem with the voltage from the drive input power	• Check the voltage. • Correct the voltage to be within the range listed in drive input power specifications. • If there is no problem with the power supply to the main circuit, check for problems with the main circuit magnetic contactor.
The power has been interrupted	Correct the drive input power.
The main circuit capacitors are worn	• Check the maintenance time for the capacitors (U4-05). • Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
The relay or contactor on the soft-charge bypass circuit is damaged	• Cycle power to the drive and see if the fault reoccurs. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative. • Check monitor U4-06 for the performance life of the soft-charge bypass. • Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

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**
In drive models 2A0004 to 2A0056 or 4A0002 to 4A0031, L2-02 was changed from its default value without installing a Momentary Power Loss Ride-Thru unit		Correct the setting to L2-02 or install an optional Momentary Power Loss Ride-Thru unit.
Control power supply wiring is damaged		• Cycle power to the drive. Check if the fault reoccurs. • If the problem continues, replace the control board, the entire drive, or the control power supply. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
Internal circuitry is damaged		• Cycle power to the drive. Check if the fault reoccurs. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

Digital Operator Display		Fault Name
Uv3	Uv3	Undervoltage 3 (Soft-Charge Bypass Circuit Fault)
		The soft-charge bypass circuit failed.
Cause		**Possible Solution**
The relay or contactor on the soft-charge bypass circuit is damaged		• Cycle power to the drive and see if the fault reoccurs. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative. • Check monitor U4-06 for the performance life of the soft-charge bypass. • Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

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. Internal drive module MC / FAN overheat protection circuit board is due to abnormal ambient operating power.		• Lower ambient temperature. • Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

Digital Operator Display		Fault Name
vtoL	vToL	VT Overload
Cause		**Possible Solution**
The output current of the drive has been elevated for a set length of time.		The application may not be suited for the drive • The application may not be suited for the drive • The drive is undersized for the load

6.5 Alarm Detection

◆ Alarm Codes, Causes, and Possible Solutions

Alarms are drive protection functions that do not necessarily cause the drive to stop. After removing the cause of an alarm, the drive will return to the same status is 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 6.10 Alarm Codes, Causes, and Possible Solutions

Digital Operator Display		Minor Fault Name
AEr	AEr	Communication Option Station Number Setting Error (CC-Link, CANopen, MECHATROLINK-II)
		Option card node address is outside of the acceptable setting range.
Cause		**Possible Solutions**
Station number is set outside the possible setting range.		• Set parameter F6-10 to the proper value when using a CC-Link option. • Set parameter F6-35 to the proper value when using a CANopen option.

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 proper braking resistor.

Digital Operator Display		Minor Fault Name
bUS	bUS	Option Communication Error
		• The connection was lost after initial communication was established. • Assign a Run command frequency reference to the option.
Cause		**Possible Solutions**
Connection is broken or master controller stopped communicating.		• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits. Repair as needed.
Option is damaged.		If there are no problems with the wiring and the fault continues to occur, replace the option.
The option is not properly connected to the drive.		• The connector pins on the option are not properly lined up with the connector pins on the drive. • Reinstall the option.
A data error occurred due to noise.		• Check options available to minimize the effects of noise. • Take steps to counteract noise in the control circuit wiring, main circuit lines and ground wiring. • Try to reduce noise on the controller side. • Use surge absorbers on magnetic contactors or other equipment causing the disturbance. • Use recommended cables or some other type of shielded line. Ground the shield to the controller side or on the input power side. • Separate the wiring for communication devices from the drive input power lines. Install an EMC noise filter to the drive input power.

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.	• Check for wiring errors. • Correct the wiring. • Check for disconnected cables and short circuits. Repair as needed.
Programming error on the master side.	Check communications at start-up and correct programming errors.
Communications circuitry is damaged.	• Perform a self-diagnostics check. • 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.
Termination resistor setting is incorrect.	Install a termination resistor at both ends of a communication line. Set the internal termination resistor switch correctly on slave drives. 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.		• Check options available to minimize the effects of noise. • Take steps to counteract noise in the control circuit wiring, main circuit lines, and ground wiring. • Reduce noise on the controller side. • Use surge absorbers for the magnetic contactors or other components that may be causing the disturbance. • Use only recommended shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all wiring for communication devices from drive input power lines. Install an EMC noise filter to the drive input power supply.
Communication protocol is incompatible.		• Check the H5 parameter settings and the protocol setting in the controller. • Ensure settings are compatible.
The CE detection time (H5-09) is set shorter than the time required for a communication cycle to take place.		• Check the PLC. • Change the software settings in the PLC. • Set a longer CE detection time using parameter H5-09.
Incompatible PLC software settings or there is a hardware problem.		• Check the PLC. • Remove the cause of the error on the controller side.
Communications cable is disconnected or damaged.		• Check the connector to make sure the cable has a signal. • Replace the communications cable.

Digital Operator Display		Minor Fault Name
CrST	CrST	Cannot Reset
Cause		**Possible Solutions**
Fault reset was being executed when a Run command was entered.		• Ensure that a Run command cannot be entered from the external terminals or option during fault reset. • Turn off the Run command.

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 longer than 0.5 s.
Cause		**Possible Solutions**
Sequence error		Check the forward and reverse command sequence and correct the problem. **Note:** 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 set to 3, which allows the drive to continue running after an external fault occurs.	• Remove the cause of the external fault. • Remove the external fault input from the PLC.
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.
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.		• Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-□□ = 2C to 2F). • Reconnect the signal line.
Multi-function contact inputs are set incorrectly.		• Check if the unused terminals have been set for H1-□□ = 2C to 2F (External Fault). • Change the terminal settings.

Digital Operator Display		Minor Fault Name
EoF	EoF	Emergency Override Forward Run
Cause		**Possible Solution**
The multi-function digital input for EmergOverrideFWD (H1-□□ = AF) has been closed.		Open H1-□□ = AF if the emergency condition is no longer present

Digital Operator Display		Minor Fault Name
Eor	Eor	Emergency Override Reverse Run
Cause		**Possible Solution**
The multi-function digital input for EmergOverrideREV (H1-□□ = B0) has been closed.		Open H1-□□ = B0 if the emergency condition is no longer present

Digital Operator Display		Minor Fault Name
FbH	FbH	Excessive PID Feedback
		The PID feedback input is higher than the level set to b5-36 for longer than the time set to b5-37, and b5-12 is set to 1 or 4.
Cause		**Possible Solutions**
Parameter 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 to b5-13 for longer than the time set to b5-14.
Cause		**Possible Solutions**
Parameter 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
HCA	HCA	Current Alarm
		Drive current exceeded overcurrent warning level (150% of the rated current).
Cause		**Possible Solutions**
Load is too heavy.		Reduce the load for applications with repetitive operations (i.e., stops and starts), or replace the drive.
Acceleration and deceleration times are too short.		• Calculate the torque required during acceleration and for the inertia moment. • If the torque level is not right for the load, take the following steps: • Increase the acceleration and deceleration times (C1-01 through C1-04). • Increase the capacity of the drive.
A special-purpose motor is being used, or the drive is attempting to run a motor greater than the maximum allowable capacity.		• Check the motor capacity. • Use a motor appropriate for the drive. Ensure the motor is within the allowable capacity range.
The current level increased due to Speed Search after a momentary power loss or while attempting to perform a fault restart.		The alarm will only appear 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. **Note:** An alarm output (H2-☐☐ = 10) will only be triggered if both (H2-☐☐ = 2F and H2-☐☐ = 10) are set.
Cause		**Possible Solutions**
The cooling fan has reached 90% of its expected performance life.		Replace the cooling fan and set o4-03 to 0 to reset the Maintenance Monitor.

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. **Note:** 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 lives.		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. **Note:** 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 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. **Note:** 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.

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		• Check the surrounding temperature. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool surrounding area. • Remove anything near drive that may cause extra heat.
Internal cooling fan has stopped.		• Replace the cooling fan. ***Refer to Cooling Fan Replacement: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032 on page 333***. • After replacing the drive, set parameter o4-03 to 0 to reset the cooling fan operation time.
Airflow around the drive is restricted.		• Provide proper installation space around the drive as indicated in the manual. ***Refer to Installation Orientation and Spacing on page 46*** for details. • Allow for the proper space and ensure that there is sufficient circulation around the control panel.
		• Check for dust or other foreign materials clogging the cooling fan. • Clear debris caught in the fan that restricts air circulation.

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.		Search for the device that tripped the overheat warning. Remove the cause of the problem.

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 faulty (PTC input).		Repair the PTC input wiring.
There is a fault on the machine side (e.g., the machine is locked up).		• Check the status of the machine. • Remove the cause of the fault.
Motor has overheated.		• Check the load size, accel/decel times, and cycle times. • Decrease the load. • Increase accel and decel times (C1-01 to C1-04). • Adjust the preset V/f pattern (E1-04 through E1-10). This involves reducing E1-08 and E1-10. **Note:** Refrain from lowering E1-08 and E1-10 excessively to prevent a reduction in load tolerance at low speeds. • Check the motor-rated current. • Enter motor-rated current on motor nameplate (E2-01). • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.

Digital Operator Display		Fault Name
oH4	oH4	Motor Overheat Fault (PTC Input)
		• The motor overheat signal to analog input terminal A1, A2, or A3 exceeded the fault detection level. • Detection requires setting multi-function analog inputs H3-02, H3-10, or H3-06 to E.

Cause	Possible Solution
Motor has overheated	• Check the size of the load, the accel/decel times, and the cycle times. • Decrease the load. • Increase the acceleration and deceleration times (C1-01 through C1-04).
	• Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not set E1-08 and E1-10 too low. This reduces load tolerance at low speeds.
	• Check the motor rated current. • Enter the motor rated current to parameter E2-01 as indicated on the motor nameplate. • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.

Digital Operator Display		Minor Fault Name
ou	ov	DC Bus Overvoltage
		The DC bus voltage exceeded the trip point. • For 200 V class drives: approximately 410 V • For 400 V class drives: approximately 820 V (740 V when E1-01 is less than 400) • For 600 V class drives: approximately 1040 V
Cause		**Possible Solutions**
Surge voltage present in the drive input power.		• Install a DC link choke or an AC reactor. • Voltage surge can result from a thyristor convertor and a phase advancing capacitor operating on the same drive input power system.
The motor is short-circuited.		• Check the motor power cable, relay terminals and motor terminal box for short circuits. • Correct grounding shorts and turn the power back on.
Ground current has overcharged the main circuit capacitors via the drive input power.		
Noise interference causes the drive to operate incorrectly.		• Review possible solutions for handling noise interference. • Review section on handling noise interference and check control circuit lines, main circuit lines and ground wiring. • If the magnetic contactor is identified as a source of noise, install a surge protector to the MC coil.
		Set number of fault restarts (L5-01) to a value other than 0.

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
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 **Note:** 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
Uu	Uv	Undervoltage
		One of the following conditions was true when the drive was stopped and a Run command was entered: • DC bus voltage dropped below the level specified in L2-05. • Contactor to suppress inrush current in the drive was opened. • 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.
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.		• Ensure the terminals have been properly tightened. • Apply the tightening torque to the terminals as specified. ***Refer to Wire Gauges and Tightening Torque on page 77***.
There is a problem with the drive input power voltage.		• Check the voltage. • Lower the voltage of the drive input power so that it is within the limits listed in the specifications.
Drive internal circuitry is worn.		• Check the maintenance time for the capacitors (U4-05). • 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.
The drive input power transformer is too small and voltage drops when the power is switched on.		• Check for an alarm when the magnetic contactor, line breaker, and leakage breaker are closed. • Check the capacity of the drive input power transformer.
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.

Digital Operator Display		Minor Fault Name
bUrUn	WrUn	Waiting for Run
Cause		**Possible Solutions**
The Run command has been applied and the b1-11 timer is active.		Adjust b1-11 to the desired delay time. The drive sill start normally after the b1-11 timer expires.

6.6 Operator Programming Errors

◆ Operator Programming Error 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 *Table 6.11* for the appropriate action. When an oPE appears on the operator display, press the ENTER button to view U1-18 and see which parameter is causing the oPE.

Table 6.11 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 simultaneously, 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).		Properly set the functions that required for use in combination with other functions.
The Up 2 command was set but the Down 2 command was not, or vice versa (settings 75 vs. 76).		
• 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).		Properly set the functions that required for use in combination with other functions.
Two of the following functions are set simultaneously: • Up/Down Command (10 vs. 11) • Up 2/Down 2 Command (75 vs. 76) • Hold Accel/Decel Stop (A) • Analog Frequency Reference Sample/Hold (1E) • Offset Frequency 1, 2, 3 Calculations (44, 45, 46)		• Check if contradictory settings have simultaneously been assigned to the multi-function input terminals. • Correct setting errors.
The Up/Down command (10, 11) and PID control (b5-01) are enabled simultaneously.		Set b5-01 to 0 to disable control PID or disable the Up/Down command.

Settings for N.C. and N.O. input for the following functions were selected simultaneously: • External Search Command 1 and External Search Command 2 (61 vs. 62) • Fast Stop N.O. and Fast Stop N.C. (15 vs. 17) • KEB for Momentary Power Loss and High Slip Braking (65, 66, 7A, 7B vs. 68) • Motor Switch Command and Accel/Decel Time 2 (16 vs. 1A) • KEB Command 1 and KEB Command 2 (65, 66 vs. 7A, 7B) • 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) • Motor Switch Command and Up 2/Down 2 Command (16 vs. 75, 76)	• Check if contradictory settings have simultaneously been assigned to the multi-function input terminals. • Correct setting errors.
One of the following settings was entered while H1-□□ = 2 (External Reference 1/2): • b1-15 = 4 (Pulse Train Input) but the pulse train input selection is not set for the frequency reference (H6-01 > 0) • b1-15 or b1-16 set to 3 but no option card is connected • Although b1-15 = 1 (Analog Input) and H3-02 or H3-10 are set to 0 (Frequency Bias)	Correct the settings for the multi-function input terminal parameters.
H2-□□ is set to 38 (Drive Enabled) and H1-□□ is not set to 6A (Drive Enable).	

Digital Operator Display		Error Name
oPE04	oPE04	Initialization Required, Term <–> Ctrl Chg
Cause		**Possible Solutions**
The drive, control board, or terminal board have been replaced and the parameter settings between the control board and the terminal board no longer match.		Set A1-03 to 5550 to load the parameter settings stored in the terminal board to the drive. Initialize parameters after drive replacement by setting A1-03 to 1110 or 2220.

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) and 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) and an input option card is not connected to the drive.		
Frequency reference is assigned to the pulse train input (b1-01 = 4) and terminal RP is not set for frequency reference input (H6-01 > 0)		Set H6-01 to 0.

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, H3-10, or H3-06 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 have the same setting: H3-02, H3-10, or H3-06).		Change the settings to H3-02, H3-10, and H3-06 so that functions no longer conflict. **Note:** Both 0 (Frequency Reference Bias) and F (Not Used) can be set to H3-02, H3-10, or H3-06 simultaneously.
The following simultaneous contradictory settings: • H3-02, H3-10, or H3-06 = B (PID Feedback) while H6-01 (Pulse Train Input) = 1 (PID Feedback) • H3-02, H3-10, or H3-06 = C (PID Target Value) while H6-01 = 2 (pulse train input sets the PID target value) • H3-02, H3-10, or H3-06 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value) • H6-01 = 2 (PID target) while b5-18 = 1 (enables b5-19 as the target PID value)		Disable one of the PID selections.

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: • b5-15 is not set to 0.0 (PID Sleep Function Operation Level) • The stopping method is set to either DC Injection Braking or coast to stop with a timer (b1-03 = 2 or 3).		• Set b5-15 to a value other than 0.0. • Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).
b5-01 is set to 1 or 2, enabling PID control, but the lower limit for the frequency reference (d2-02) is not set to 0 while reverse output is enabled (b5-11 = 1).		Correct the parameter settings.
b5-01 is set to 3 or 4, enabling PID control, but the lower limit for the frequency reference (d2-01) is not 0.		Correct the parameter settings.

Digital Operator Display		Error Name
oPE10	oPE10	V/f Data Setting Error
		One of the following setting errors has occurred: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04
Cause		**Possible Solutions**
V/f pattern setting error.		Correct the settings for E1-04, E1-06, E1-07, E1-09, and E1-11.

Digital Operator Display		Error Name
oPE11	oPE11	Carrier Frequency Setting Error
		Correct the setting for the carrier frequency.
Cause		**Possible Solutions**
The following simultaneous contradictory settings have occurred: C6-05 > 6 and C6-04 > C6-03 (carrier frequency lower limit is greater than the upper limit). If C6-05 ≤ 6, the drive operates at C6-03.		Correct the parameter settings.
The upper and lower limits between C6-02 and C6-05 are contradictory.		

Digital Operator Display		Error Name
oPE28	oPE28	Sequence Timer Error
		One or more of the sequence timers is not set in the correct order.
Cause		**Possible Solutions**
One of the following contradictory settings is true: • S2-01 > S2-02 • S2-06 > S2-07 • S2-11 > S2-12 • S2-16 > S2-17		Correct the parameter settings.

6.7 Auto-Tuning Fault Detection

When the Auto-Tuning faults shown below are detected, the fault is displayed on the operator and the motor coasts to a stop. Auto-Tuning faults do not trigger a multi-function terminal set for fault or alarm output.

An End□ error indicates that although Auto-Tuning has successfully completed, there is some discrepancy in the calculations. If an End□ error occurs, check for the cause of the error using the table in this section, and perform Auto-Tuning again or manually set the motor parameters after fixing the problem. Start the application if no problem can be diagnosed despite the existence of the End□ error.

◆ Auto-Tuning Codes, Causes, and Possible Solutions

Table 6.12 Auto-Tuning Codes, Causes, and Possible Solutions

Digital Operator Display		Error Name
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.		• Prior to Auto-Tuning, verify the information on the motor nameplate. • Enter proper values from motor nameplate to parameters T1-02 and T1-04 and repeat Auto-Tuning.
The results from Auto-Tuning the no-load current exceeded 80%.		• If possible, disconnect the motor from the load and perform Auto-Tuning. If the load cannot be uncoupled, use the current Auto-Tuning results.

Digital Operator Display		Error Name
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.		• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range, assigning the iron-core saturation coefficients (E2-07 and E2-08) to temporary values.		• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.

Digital Operator Display		Error Name
End3	End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete)
Cause		**Possible Solutions**
The correct current rating printed on the motor nameplate was not entered into T1-04.		• Check the setting of parameter T1-04. • Check the motor data and repeat Auto-Tuning.

Digital Operator Display		Error Name
End4	End4	Adjusted Slip Calculation Error
Cause		**Possible Solutions**
The calculated slip is outside the allowable range.		• Make sure the data entered for Auto-Tuning is correct. • If possible, perform Rotational Auto-Tuning. If not possible, perform Stationary Auto-Tuning 2.

Digital Operator Display		Error Name
End5	End5	Resistance Tuning Error
Cause		**Possible Solutions**
The calculated resistance value is outside the allowable range.		• Double-check the data entered for the Auto-Tuning process. • Check the motor and motor cable connection for faults.

Digital Operator Display		Error Name
End6	End6	Leakage Inductance Alarm
Cause		**Possible Solutions**
The calculated leakage inductance value is outside the allowable range.		Double-check the data entered for the Auto-Tuning process.

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 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 .		• Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning. • Restart Auto-Tuning and enter the correct information.
Motor output power and motor-rated current settings (T1-02 and T1-04) do not match.		• Check the drive and motor capacities. • Correct the settings of parameters T1-02 and T1-04.
Motor rated current and detected no-load current are inconsistent.		• Check the motor rated current and no-load current. • Correct the settings of parameters T1-04 and E2-03.

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. Restart Auto-Tuning.

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.		• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.		Check and correct faulty motor wiring.
Faulty motor cable or cable connection.		

Digital Operator Display		Error Name
Er-05	Er-05	No-Load Current Error
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.		• Check and correct faulty motor wiring. • Perform Rotational Auto-Tuning.
The load was too high during Rotational Auto-tuning.		• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.

Digital Operator Display		Error Name
Er-08	Er-08	Rated Slip Error
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.		• Check and correct faulty motor wiring. • Perform Rotational Auto-Tuning.
The load was too high during rotational Auto-tuning.		• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.

Digital Operator Display		Error Name
Er-09	Er-09	Acceleration Error
Cause		**Possible Solutions**
The motor did not accelerate for the specified acceleration time.		• Increase the acceleration time (C1-01). • Disconnect the machine from the motor if possible.
The load was too high during Rotational Auto-Tuning.		• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.

Digital Operator Display		Error Name
Er-11	Er-11	Motor Speed Fault
Cause		**Possible Solutions**
Torque reference is too high.		• Increase the acceleration time (C1-01). • Disconnect the machine from the motor if possible.

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.
The current exceeded the current rating of the drive.		• Check motor wiring for a short between motor lines. • Close any magnetic contactors used between motors. • Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
The current is too low.		
Attempted Auto-Tuning without motor connected to the drive.		Connect the motor and restart Auto-Tuning.
Current detection signal error.		Replace 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.		• Check all wiring and correct any mistakes. • Check the motor rated current value written on the motor nameplate and enter the correct value to T1-04.

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.		• Inertia Auto-Tuning cannot be performed if the drive is restricted from rotating in reverse. • Assuming it is acceptable for the application to rotate in reverse, set b1-04 to 0 and then perform Inertia Tuning.

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 6.13 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 6.13 Copy Function Task and Error Displays

Digital Operator Display		Task
CoPy	CoPy	Writing Parameter Settings (flashing)
Cause		**Possible Solutions**
Parameters are being written to the drive.		This is not an error.

Digital Operator Display		Task
CPyE	CPyE	Error Writing Data
Cause		**Possible Solutions**
Failed writing parameters		Attempt to write parameters again.

Digital Operator Display		Task
CSEr	CSEr	Copy Unit Error
Cause		**Possible Solutions**
Hardware fault		Replace the operator or the USB Copy Unit.

Digital Operator Display		Task
dFPS	dFPS	Drive Model Mismatch
Cause		**Possible Solutions**
The drives used in the copy and write process are not the same model. • The drive from which the parameters were copied is a different model. • The drive to be written to is a different model.		• Verify the model number of the drive from which the parameters were copied and the model of the drive to which those parameters will be written. • Make sure the two drives are the same model and have the same software version.

Digital Operator Display		Task
End	End	Task Complete
Cause		**Possible Solutions**
Finished reading, writing, or verifying parameters.		This is not an error.

Digital Operator Display		Task
iFEr	iFEr	Communication Error
Cause		**Possible Solutions**
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.

Digital Operator Display		Task
ndAT	ndAT	Model, Voltage Class, Capacity Mismatch
Cause		**Possible Solutions**

The drive from which the parameters were copied and the drive to which the parameters will be written have different electrical specifications, capacities, are set to different control modes, or are different models.	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.	Make 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.		This is not an error.

Digital Operator Display		Task
vAEr	vAEr	Voltage Class, Capacity Mismatch
Cause		**Possible Solutions**
The drive from which the parameters were copied and the drive on which the Verify mode is being performed 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 synchronize parameters, either write the parameters saved on the USB Copy Unit or 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.		This is 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.

Note: An oC/SC fault will be displayed in the event of an IGBT failure. It may not be possible to reset this fault until the IGBT problem is corrected.

◆ 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 312*** 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

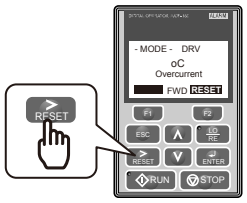
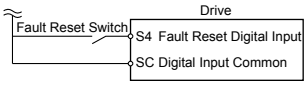
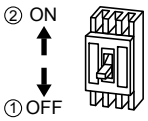
1. Look at the digital operator for information on the fault that occurred.
2. ***Refer to Fault Displays, Causes, and Possible Solutions on page 283***.
3. Reset the fault. ***Refer to Fault Reset Methods on page 313***.

◆ Viewing Fault Trace Data After Fault

	Step		Display/Result
1.	Turn on the drive input power. The first screen displays.	→	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
2.	Press ∧ or ∨ until the monitor screen is displayed.	→	- MODE - DRV Rdy Monitor Menu U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
3.	Press ENTER to display the parameter setting screen.	→	-MONITR- DRV Rdy Monitor U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
4.	Press ∧ and RESET to scroll to monitor U2-02. The fault code shown in U2-02 is the fault that occurred most recently.	→	- MONITR - DRV Rdy Last Fault U2-02= oC U2-03= 0.00Hz LSEQ U2-04= 0.00Hz LREF JOG FWD FWD/REV
5.	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.	→	- MONITR - DRV Rdy Frequency Ref U2-03= 0.00Hz U2-04= 0.00Hz LSEQ U2-05= 0.00A LREF JOG FWD FWD/REV ⋮ - MONITR - DRV Rdy Heatsink Temp U2-20= XX °C U2-01= ----- LSEQ U2-02= ----- LREF JOG FWD FWD/REV

◆ 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	Press RESET on the digital operator when the error code is displayed.	
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).	
Turn off the main power supply if the above methods do not reset the fault. Reapply power after the digital operator display has turned off.		

Note: If the Run command is present, the drive will disregard any attempts to reset the fault. Remove the Run command before attempting to clear a fault situation.

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 278* 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		*314*
Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command	Motor Does Not Rotate	*315*
	Motor Rotates in the Opposite Direction from the Run Command	*316*
	Motor Rotates in One Direction Only	*316*
Motor is Too Hot		*316*
oPE02 Error Occurs When Lowering the Motor Rated Current Setting		*317*
Motor Stalls During Acceleration or With Large Loads		*317*
Drive Frequency Reference Differs from the Controller Frequency Reference Command		*318*
Excessive Motor Oscillation and Erratic Rotation		*318*
Deceleration Takes Longer Than Expected with Dynamic Braking Enabled		*318*
Noise From Drive or Motor Cables When the Drive is Powered On		*319*
Ground Fault Circuit Interrupter (GFCI) Trips During Run		*319*
Connected Machinery Vibrates When Motor Rotates	Unexpected Noise from Connected Machinery	*319*
	Oscillation or Hunting	*319*
PID Output Fault		*320*
Insufficient Starting Torque		*320*
Motor Rotates After the Drive Output is Shut Off (Motor Rotates During DC Injection Braking)		*320*
Output Frequency is not as High as Frequency Reference		*320*
Buzzing Sound from Motor at 2 kHz		*320*
Motor Does Not Restart after Power Loss		*321*

◆ Cannot Change Parameter Settings

Cause	Possible Solutions
The drive is running the motor (i.e., the Run command is present).	• Stop the drive and switch over to the Programming Mode. • Most parameters cannot be edited during run.
The Access Level is set to restrict access to parameter settings.	• Set the Access Level to allow parameters to be edited (A1-01 = 2).
The operator is not in the Parameter Setup Mode (the screen will display “PAr”).	• See what mode the operator is currently set for. • Parameters cannot be edited when in the Setup Mode (“STUP”). Switch modes so that “PAr” appears on the screen. *Refer to The Drive, Programming, and Clock Adjustment Modes on page 106*.
A multi-function contact input terminal is set to allow or restrict parameter editing (H1-01 through H1-08 = 1B).	• When the terminal is open, parameters cannot be edited. • Turn on the multi-function contact input set to 1B.

Cause	Possible Solutions
The wrong password was entered.	• If the password entered to A1-04 does not match the password saved to A1-05, then drive settings cannot be changed. • Reset the password. If you cannot remember the password: • Scroll to A1-04. Press STOP and ∧ simultaneously. Parameter A1-05 will appear. • Set a new password to parameter A1-05.
Undervoltage was detected.	• Check the drive input power voltage by looking at the DC bus voltage (U1-07). • Check all main circuit wiring.

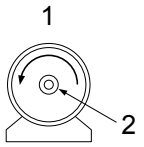
◆ Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command

■ Motor Does Not Rotate

Cause	Possible Solutions
The drive is not in the Drive Mode.	• Check if the DRV light on the digital operator is lit. • Enter the Drive Mode to begin operating the motor. *Refer to The Drive, Programming, and Clock Adjustment Modes on page 106*.
LO/RE was pushed.	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: • Push LO/RE. • If o2-01 is set to 0, then the LO/RE button will be disabled.
Auto-Tuning has just completed.	• 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. • Use the digital operator to enter the Drive Mode. *Refer to The Drive, Programming, and Clock Adjustment Modes on page 106*.
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.	Check parameter b1-02 (Run Command Selection). Set b1-02 so that it corresponds with the correct Run command source. 0: Digital operator 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card
There is faulty wiring in the control circuit terminals.	• Check the wiring for the control terminal. • Correct wiring mistakes. • Check the input terminal status monitor (U1-10).
The drive has been set to accept the frequency reference from the incorrect source.	Check parameter b1-01 (Frequency Reference Selection 1). Set b1-01 to the correct source of the frequency reference. 0: Digital operator 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card 4: Pulse train input (RP)
The terminal set to accept the main speed reference is set to the incorrect voltage and/or current.	*Refer to Terminals A1, A2, and A3 Input Signal Selection on page 93*.
Selection for the sink/source mode and the internal/external power supply is incorrect.	Check jumper S3. *Refer to Sinking/Sourcing Mode Switch for Digital Inputs on page 92*.
Frequency reference is too low.	• Check the frequency reference monitor (U1-01). • Increase the frequency by changing the maximum output frequency (E1-09).
Multi-function analog input is set up to accept gain for the frequency reference, but no voltage (current) has been provided.	• Check the multi-function analog input settings. • 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. • Check if H3-02, H3-10, and H3-06 have been set to the proper values. • Check if the analog input value has been set properly. (U1-13 to U1-15)

Cause	Possible Solutions
STOP was pressed when the drive was started from a REMOTE source.	• Pressing STOP will decelerate the drive to stop. • Switch off the Run command and then re-enter a new Run command. • Set o2-02 to 0 to disable STOP.
Motor starting torque is too low.	*Refer to Motor Performance Fine-Tuning on page 278*.
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.	• 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. • 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.

■ Motor Rotates in the Opposite Direction from the Run Command

Cause	Possible Solutions
Phase wiring between the drive and motor is incorrect.	• Check the motor wiring. • Switch two motor cables (U, V, and W) to reverse motor direction. • Connect drive output terminals U/T1, V/T2, and W/T3 in the right order to match motor terminals U, V, and W. • Change the setting of parameter b1-14.
The forward direction for the motor is set up incorrectly.	Typically, forward is designated as being counterclockwise when looking from the motor shaft (see figure below).  1. Forward Rotating Motor (looking down the motor shaft) 2. Motor Shaft
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.	• Check parameter b1-04. • Set parameter b1-04 to 0 to allow the motor to rotate in reverse.
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.	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: • Reduce the load. • Increase the acceleration and deceleration times. • Check the values set for the motor protection (L1-01, L1-02) as well as the motor rated current (E2-01). • Increase motor capacity.
The air around the motor is too hot.	• Check the ambient temperature. • Cool the area until it is within the specified temperature range.
The drive is operating in a vector control mode but Auto-Tuning has not yet been performed.	• Perform Auto-Tuning. • Calculate the motor value and reset the motor parameters.

Cause	Possible Solutions
Insufficient voltage insulation between motor phases.	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. • Use a motor with a voltage tolerance higher than the max voltage surge. • Use an inverter-duty motor rated for use with AC drives when using the motor on drives rated higher than 200 V class. • 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.
The motor fan has stopped or is clogged.	Check the motor fan.
The carrier frequency is too low.	Increase the carrier frequency to lower the current harmonic distortion and lower the motor temperature.

◆ 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.	• 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. • Make sure that value set in E2-01 is higher than E2-03. • 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.

◆ 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: • Reduce the load. • Increase motor capacity. **Note:** Although the drive has a Stall Prevention function and a Torque Compensation Limit function, accelerating too quickly or trying to drive an excessively large load can exceed the capabilities of the motor.
Load is too heavy.	
Torque limit is not set properly.	Check the torque limit setting.
Frequency reference is too low.	• Check the maximum output frequency (E1-04). • Increase E1-04 if it is set too low.
	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. • In extruder and mixer applications, the load will sometimes increase as the temperature drops.
	• Increase the acceleration time. • Check if the mechanical brake is fully releasing as it should.
Acceleration time has been set too long.	Check if the acceleration time parameters have been set too long (C1-01, C1-03).
Motor characteristics and drive parameter settings are incompatible with one another.	• Set the correct V/f pattern so that it matches the characteristics of the motor being used. • Check the V/f pattern set to E1-03. • Execute Rotational Auto-Tuning.
Incorrect frequency reference setting.	• 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. • Make sure H3-02, H3-10, and H3-06 are set to the proper values. • See if the analog input value is set to the right value (U1-13 to U1-15).
The Stall Prevention level during acceleration and deceleration set too low.	• Check the Stall Prevention level during acceleration (L3-02). • If L3-02 is set too low, acceleration may be taking too long. • Increase L3-02.
The Stall Prevention level during run has been set too low.	• Check the Stall Prevention level during run (L3-06). • If L3-06 is set too low, speed will drop as the drive outputs torque. • Increase the setting value.

Cause	Possible Solutions
Drive reached the limitations of the V/f motor control method.	• The motor cable may be long enough (over 50 m) to require Auto-Tuning for line-to-line resistance. • Be aware that V/f Control is comparatively limited when it comes to producing torque at low speeds.

◆ 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.	• 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. • Set these parameters to the appropriate values.
A frequency bias signal is being entered via analog input terminals A1 to A3.	• 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. • Make sure that H3-02, H3-10, and H3-06 are set appropriately. • Check the input level set for terminals A1 to A3 (U1-13 to U1-15).
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.	• Enable Hunting Prevention (n1-01 = 1). • Increase the AFR gain (n2-01) or the AFR time constant (n2-02).

◆ Deceleration Takes Longer Than Expected with Dynamic Braking Enabled

Cause	Possible Solutions
L3-04 is set incorrectly.	• Check the Stall Prevention level during deceleration (L3-04). • If a dynamic braking option has been installed, disable Stall Prevention during deceleration (L3-04 = 0).
The deceleration time is set too long.	Set deceleration to more appropriate time (C1-02, C1-04).
Insufficient motor torque.	• 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. • Use a larger motor.
Reaching the torque limit.	• Check the settings for the torque limit (L7-01 through L7-04). • 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. • Increase the torque limit setting.
	• 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. • Ensure H3-02, H3-10, and H3-06 are set to the right levels. • Ensure the analog input is set to the correct value (U1-13 to U1-15).
Load exceeded the internal torque limit determined by the drive rated current.	Switch to a larger capacity drive.

◆ Noise From Drive or Motor Cables When the Drive is Powered On

Cause	Possible Solutions
Relay switching in the drive generates excessive noise.	• Lower the carrier frequency (C6-02). • Install a noise filter on the input side of drive input power. • Install a noise filter on the output side of the drive. • Place the wiring inside a metal conduit to shield it from switching noise. • Ground the drive and motor properly. • Separate the main circuit wiring and the control lines. • Make sure wires and the motor have been properly grounded.

◆ Ground Fault Circuit Interrupter (GFCI) Trips During Run

Cause	Possible Solutions
Excessive leakage current trips GFCI.	• Check the wiring and rating of peripheral devices. • Increase the GFCI sensitivity or use GFCI with a higher threshold. • Lower the carrier frequency (C6-02). • Reduce the length of the cable used between the drive and the motor. • Install a noise filter or reactor on the output side of the drive. Set the carrier frequency to 2 kHz when connecting a reactor. • Disable the internal EMC filter.

◆ 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.	• Adjust the parameters used for the Jump frequency function (d3-01 through d3-04) to skip the problem-causing bandwidth. • Place the motor on a rubber pad to reduce vibration.

Note: The drive may have trouble assessing the status of the load due to white noise generated from using Swing PWM (C6-02 = 7 to A).

■ Oscillation or Hunting

Cause	Possible Solutions
Insufficient tuning.	Perform Auto-Tuning. *Refer to Motor Performance Fine-Tuning on page 278*.
Gain is too low when using PID control.	*Refer to b5: PID Control on page 151* for details.
The frequency reference is assigned to an external source and the signal is noisy.	• Ensure that noise is not affecting the signal lines. • Separate main circuit wiring and control circuit wiring. • Use twisted-pair cables or shielded wiring for the control circuit. • Increase the analog input time filter constant (H3-13).
The cable between the drive and motor is too long.	• Perform Auto-Tuning. • Reduce the length of the cable.

◆ PID Output Fault

Cause	Possible Solutions
No PID feedback input.	• Check the multi-function analog input terminal settings. • Set multi-function analog input terminal A1, A2, or A3 for PID feedback (H3-02, H3-10, or H3-06 = "B"). • A signal input to the terminal selection for PID feedback is needed. • Check the connection of the feedback signal. • Check the various PID-related parameter settings. • 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.
The level of detection and the target value do not correspond with each other.	• PID control keeps the difference between target and detection values at 0. Set the input level for the values relative to one another. • Use analog input gains H3-03 and H3-11 to adjust PID target and feedback signal scaling.
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 151* for details.

◆ Insufficient Starting Torque

Cause	Possible Solutions
Auto-Tuning has not yet been performed.	Perform Auto-Tuning. *Refer to Motor Performance Fine-Tuning on page 278*.
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.	• Adjust the DC Injection braking settings. • Increase the current level for DC Injection Braking (b2-02). • Increase the DC Injection Braking time at stop (b2-04).
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
Frequency reference is set within the range of the Jump frequency.	• Adjust the parameters used for the Jump frequency function (d3-01, d3-02, d3-03). • Enabling the Jump frequency prevents the drive from outputting the frequencies specified in the Jump range.
Upper limit for the frequency reference has been exceeded.	• Set the maximum output frequency and the upper limit for the frequency reference to more appropriate values (E1-04, d2-01). • The following calculation yields the upper value for the output frequency: E1-04 x d2-01 / 100
Large load triggered Stall Prevention function during acceleration.	• Reduce the load. • Adjust the Stall Prevention level during acceleration (L3-02).

◆ Sound from Motor

Cause	Possible Solutions
Exceeded 110% of the rated output current of the drive while operating at low speeds.	• If the output current rises too high at low speeds, the carrier frequency is automatically reduced and causes a whining or buzzing sound. • If the sound is coming from the motor, disable carrier frequency derating (L8-38 = 0). • 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.

◆ Motor Does Not Restart after Power Loss

Cause	Possible Solutions
The Run command was not issued again when power was restored.	• Check the sequence and wiring that has been set up to enter the Run command. • A relay should be set up to make sure the Run command remains enabled throughout any power loss.
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.

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7

Periodic Inspection & Maintenance

This chapter describes the periodic inspection and maintenance of the drive to ensure that it receives the proper care to maintain overall performance.

7.1 SECTION SAFETY.....324
7.2 INSPECTION.....326
7.3 PERIODIC MAINTENANCE.....329
7.4 DRIVE COOLING FANS.....331
7.5 DRIVE REPLACEMENT.....350

7.1 Section Safety

⚠ WARNING

Electrical Shock Hazard

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

Failure to comply could 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; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

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 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; after all indicators are OFF, measure the DC bus voltage level to confirm it has reached a safe level.

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.

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
Motor	Inspect for abnormal oscillation or noise coming from the motor.	• Check the load coupling. • Measure motor vibration. • Tighten all loose components.	
Cooling	Inspect for abnormal heat generated from the drive or motor and visible discoloration.	Check for the following: • Excessive load. • Loose connections. • Dirty heatsink or motor. • Ambient temperature.	
	Inspect drive cooling fan and circulation fan operation.	Check for the following: • Clogged or dirty fan. • Correct Fan operation parameter setting.	
Environment	Verify the drive environment complies with the specifications listed in *Installation Environment* on page *46*.	Eliminate the source of contaminants or correct poor environment.	
Load	The drive output current should not be higher than the motor or drive rating for an extended period of time.	Check for the following: • Excessive load. • Correct motor parameter settings.	
Power Supply Voltage	Check main power supply and control voltages.	• Correct the voltage or power supply to within nameplate specifications. • Verify all main circuit phases.	

◆ 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, 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; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

Table 7.2 Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Main Circuit Periodic Inspection			
General	• Inspect equipment for discoloration from overheating or deterioration. • Inspect for damaged or deformed parts.	• Replace damaged components as required. • The drive has few serviceable parts and may require complete drive replacement.	
	Inspect for dirt, foreign particles, or dust collection on components.	• Inspect enclosure door seal if used. • Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi). • Replace components if cleaning is not possible.	
Conductors and Wiring	• Inspect wiring and connections for discoloration, damage, or heat stress. • Inspect wire insulation and shielding for wear.	Repair or replace damaged wiring.	
Terminals	Inspect terminals for stripped, damaged, or loose connections.	Tighten loose screws and replace damaged screws or terminals.	
Relays and Contactors	• Inspect contactors and relays for excessive noise during operation. • Inspect coils for signs of overheating such as melted or cracked insulation.	• Check coil voltage for overvoltage or undervoltage conditions. • Replace damaged removable relays, contactors, or circuit board.	
Braking Resistors	Inspect for discoloration of heat stress on or around resistors.	• Minor discoloration may be acceptable. • Check for loose connections if discoloration exists.	
Electrolytic Capacitor	• Inspect for leaking, discoloration, or cracks. • Check if the cap has come off, for any swelling, or if the sides have burst open.	The drive has few serviceable parts and may require complete drive replacement.	
Diode, IGBT (Power Transistor)	Inspect for dust or other foreign material collected on the surface.	Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi).	
Motor Periodic Inspection			
Operation Check	Check for increased vibration or abnormal noise.	Stop the motor and contact qualified maintenance personnel as required.	
Control Circuit Periodic Inspection			
General	• Inspect terminals for stripped, damaged, or loose connections. • Make sure all terminals have been properly tightened.	• Tighten loose screws and replace damaged screws or terminals. • If terminals are integral to a circuit board, then board or drive replacement may be required.	
Circuit Boards	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.	• Fix any loose connections. • If an antistatic cloth or vacuum plunger cannot be used, replace the board. • Do not use any solvents to clean the board. • Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi). The drive has few serviceable parts and may require complete drive replacement.	

Inspection Area	Inspection Points	Corrective Action	Checked
Cooling System Periodic Inspection			
Cooling Fan, Circulation Fan, Control Board Cooling Fan	• Check for abnormal oscillation or unusual noise. • Check for damaged or missing fan blades.	• Replace as required. • *Refer to Drive Cooling Fans on page 331* for information on cleaning or replacing the fan.	
Heatsink	Inspect for dust or other foreign material collected on the surface.	Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa ($4 - 6$ kg•cm^2) (57 to 85 psi).	
Air Duct	Inspect air intake and exhaust openings. They must be free from obstruction and properly installed.	• Visually inspect the area. • Clear obstructions and clean air duct as required.	
Display Periodic Inspection			
Digital Operator	• Make sure data appears on the display properly. • Inspect for dust or other foreign material that may have collected on surrounding components.	• Contact the nearest sales office if there is any trouble with the display or keypad. • Clean the digital operator.	

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, Control Board Cooling Fan
- Electrolytic Capacitors
- Inrush Prevention Circuit
- IGBTs

For replacement parts, contact the distributor where the drive was purchased or contact Yaskawa directly.

◆ 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>

<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 (IP00/Open Type enclosure)
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.

Refer to Recommended Periodic Inspection on page 327 for more details.

Table 7.4 Performance Life Monitors Used for Component Replacement

Parameter	Component	Contents
U4-03	Cooling Fan Circulation Fan Control Board Cooling Fan	Displays the accumulated operation time of the fan from 0 to 99999 hours. This value is automatically reset to 0 after 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, DC bus capacitors, or DC bus pre-charge relay reach 90% of the expected performance life, or when the IGBTs have reached 50% of their expected 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

Digital Operator Alarm Display		Function	Corrective Action
LT-1 <1>	LT-1	The cooling fans have reached 90% of their designated life time.	Replace the cooling fan.
LT-2 <1>	LT-2	The DC bus capacitors have reached 90% of their designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.
LT-3 <1>	LT-3	The DC bus charge circuit has reached 90% of its designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.
LT-4 <1>	LT-4	The IGBTs have reached 50% of their designated life time.	Check the load, carrier frequency, and output frequency.
TrPC <2>	TrPC	The IGBTs have reached 90% of their designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.

<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

Use parameters o4-03, o4-05, o4-07, and o4-09 to reset a Maintenance Monitor to zero after replacing a specific component. *Refer to Parameter List on page 391* 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 Drive Cooling Fans

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 a Yaskawa representative or the nearest Yaskawa sales office to order replacement cooling fans as required.

For drives with multiple cooling fans, replace all the fans when performing maintenance to ensure maximum product performance life.

◆ Number of Cooling Fans

Drive Model	Cooling Fans	Circulation Fans	Control Board Cooling Fans	Page
Three-Phase 200 V Class				
2A0004	–	–	–	–
2A0006	–	–	–	–
2A0008	–	–	–	–
2A0010	–	–	–	–
2A0012	–	–	–	–
2A0018	1	–	–	*333*
2A0021	1	–	–	
2A0030	2	–	–	
2A0040	2	–	–	
2A0056	2	–	–	
2A0069	2	–	–	
2A0081	2	–	–	
2A0110	2	–	–	*336*
2A0138	2	–	–	
2A0169	2	–	–	*340*
2A0211	2	–	–	
2A0250	2	–	–	
2A0312	2	–	–	
2A0360	3	1	–	
2A0415	3	1	–	
Three-Phase 400 V Class				
4A0002	–	–	–	–
4A0004	–	–	–	–
4A0005	–	–	–	–
4A0007	1	–	–	*333*
4A0009	1	–	–	
4A0011	1	–	–	
4A0018	2	–	–	
4A0023	2	–	–	
4A0031	2	–	–	
4A0038	2	–	–	
4A0044	2	–	–	
4A0058	2	–	–	*336*
4A0072	2	–	–	
4A0088	2	–	–	*338*
4A0103	2	–	–	

Drive Model	Cooling Fans	Circulation Fans	Control Board Cooling Fans	Page
4A0139	2	–	–	*340*
4A0165	2	–	–	
4A0208	2	–	–	
4A0250	3	–	–	
4A0296	3	–	–	
4A0362	3	1	–	
4A0414	3	1	–	*344*
4A0515	3	2	2	*346*
4A0675	3	2	2	
Three-Phase 600 V Class				
5A0003	–	–	–	–
5A0004	–	–	–	–
5A0006	1	–	–	*333*
5A0009	1	–	–	
5A0011	2	–	–	
5A0017	2	–	–	
5A0022	2	–	–	
5A0027	2	–	–	
5A0032	2	–	–	
5A0041	2	–	–	*336*
5A0052	2	–	–	
5A0062	2	–	–	*340*
5A0077	2	–	–	
5A0099	2	–	–	
5A0125	2	–	–	
5A0145	2	–	–	
5A0192	3	–	–	
5A0242	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.*

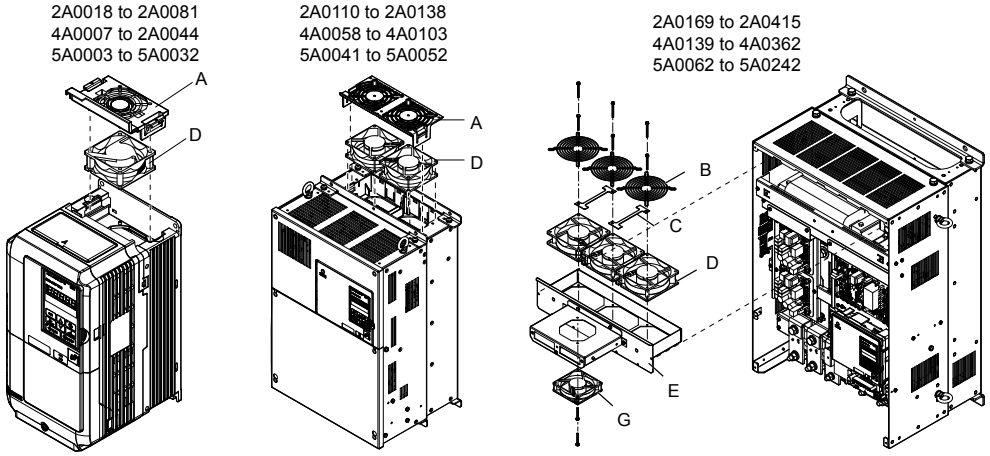
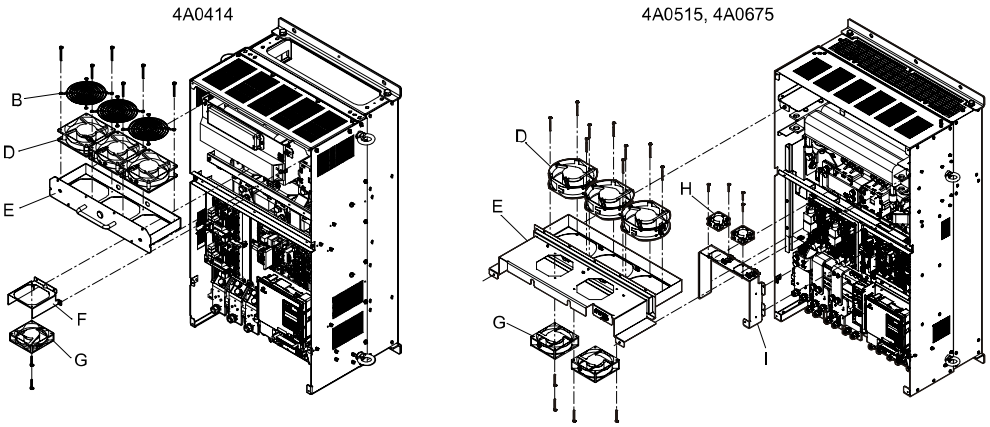


Figure 7.1 Cooling Fan Component Names



A – Fan finger guard
B – Fan guard
C – Cable cover
D – Cooling fan
E – Fan bracket
F – Circulation fan base
G – Circulation fan
H – Circuit board cooling fan
I – Circuit board cooling fan unit case

Figure 7.2 Cooling Fan Component Names (Continued)

◆ Cooling Fan Replacement: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032

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: *Follow cooling fan replacement instructions. Improper fan replacement could cause damage to equipment. Make sure the fan is facing upwards when installing the replacement fan into the drive. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Cooling Fan Finger Guard and Cooling Fan

1. Depress the right and left sides of the fan cover tabs and pull upward. Remove the fan cover from the top of the drive. The following figure illustrates a drive with a single cooling fan.

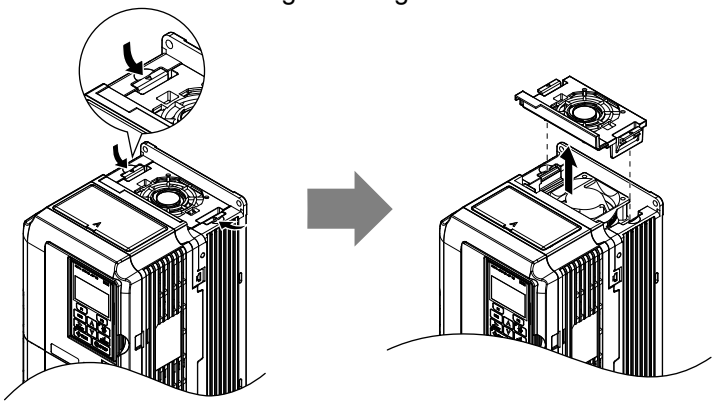


Figure 7.3 Remove the Cooling Fan Finger Guard: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032

2. Remove the cooling fan cartridge. Disconnect the pluggable connector and remove the fan.

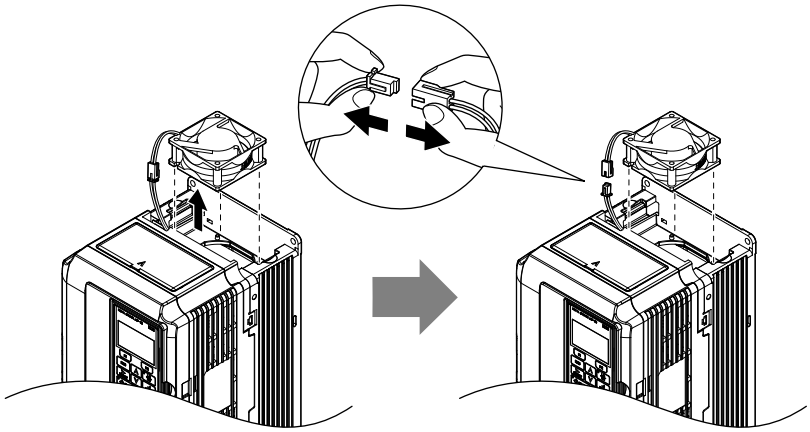


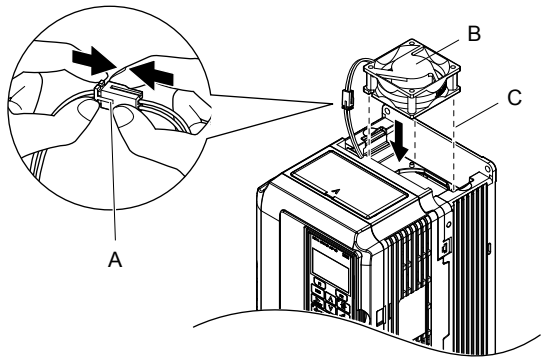
Figure 7.4 Remove the Cooling Fan: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032

■ Installing the Cooling Fan

NOTICE: *Prevent Equipment Damage. Follow cooling fan replacement instructions. Improper cooling fan replacement could result in damage to equipment. When installing the replacement cooling fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all cooling fans when performing maintenance.*

Reverse the procedure described above to reinstall the cooling fan.

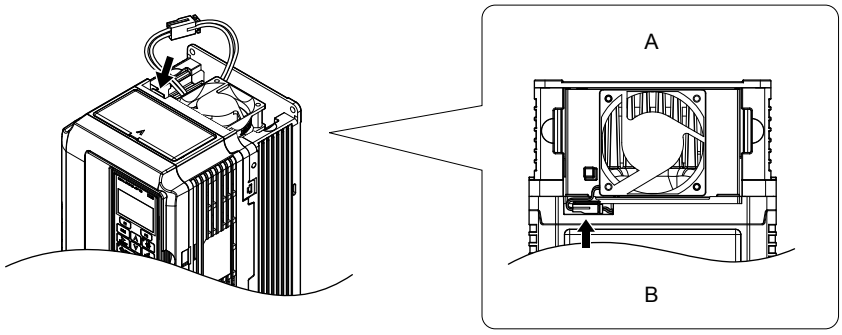
1. Install the replacement cooling fan into the drive, ensuring the alignment pins line up as shown in the figure below.



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 7.5 Install the Cooling Fan: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032

2. Properly connect the fan power lines, then place the cable back into the recess of the drive.



A – Back
B – Front

Figure 7.6 Connect the Cooling Fan Power Supply Connectors: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032

3. While pressing in on the hooks on the left and right sides of the fan finger guard, guide the fan finger guard until it clicks back into place.

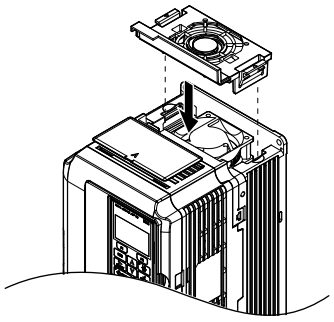


Figure 7.7 Reattach the Fan Finger Guard: 2A0018 to 2A0081, 4A0007 to 4A0044, and 5A0006 to 5A0032

4. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

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: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Cooling Fan Finger Guard and Cooling Fan

1. While pressing in on the hooks located on the left and right sides of the fan finger guard, free the fan finger guard leading by lifting the back end first.

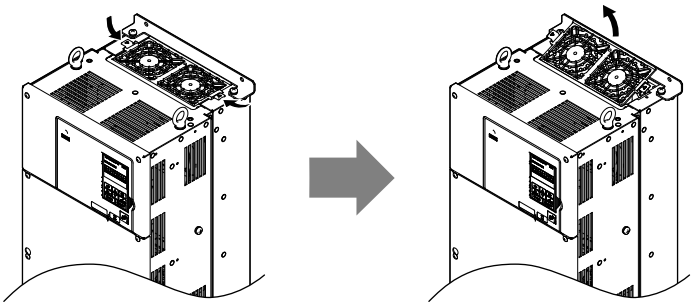


Figure 7.8 Remove the Cooling Fan Finger Guard: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

2. Lift out the back end of the fan finger guard first. Unplug the replay connector and free the fan finger guard from the drive.

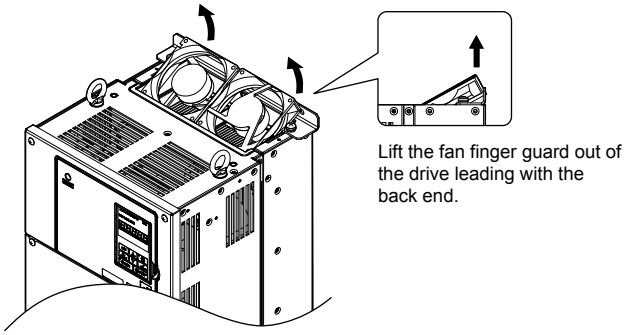


Figure 7.9 Remove the Cooling Fan: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

■ Installing the Cooling Fan

Reverse the procedure described above to reinstall the cooling fan.

1. Properly connect the fan power lines.
2. Place the power supply connectors and cable back into the recess of the drive.

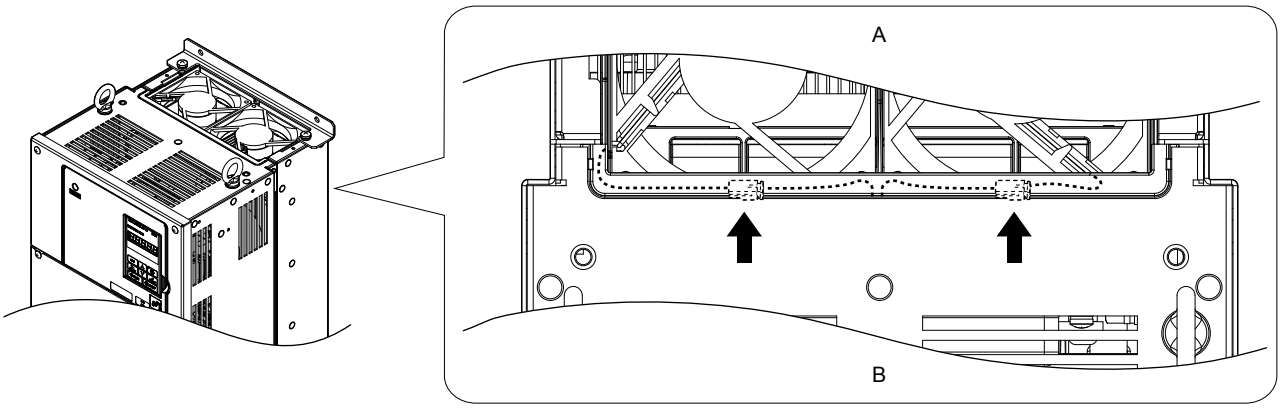


Figure 7.10 Cooling Fan Power Supply Connectors: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

3. Install the replacement fan into the drive.

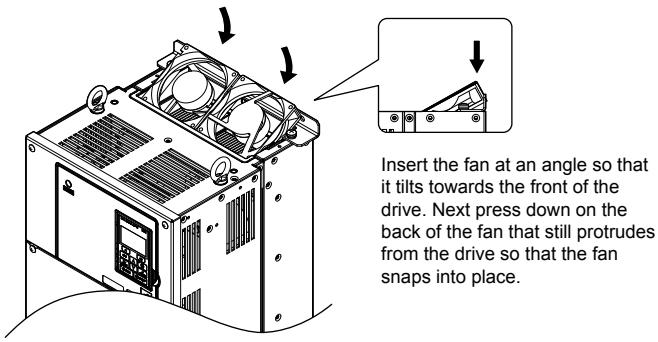


Figure 7.11 Install the Cooling Fan: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

4. Tilt up the back end of the fan finger guard and slide the fan finger guard into the opening near the front of the drive, then guide the fan finger guard into place.

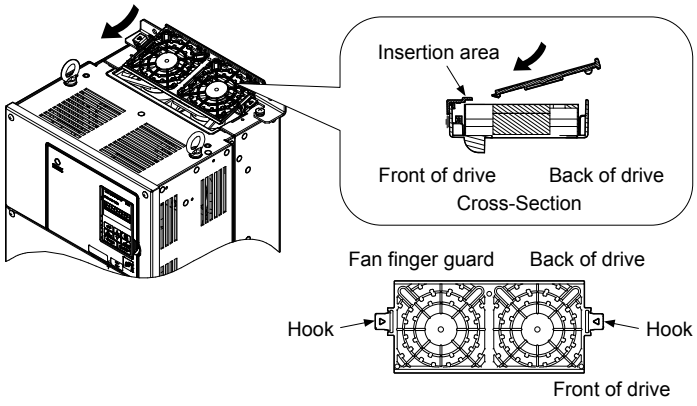


Figure 7.12 Reattach the Fan Cover: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

5. Press in on the hooks of the left and right sides of the fan cover and guide the fan finger guard until it clicks into place.

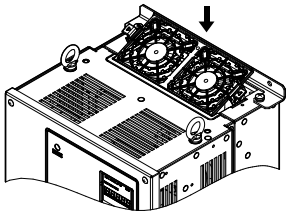


Figure 7.13 Reattach the Fan Finger Guard: 2A0110, 2A0138, 4A0058, 4A0072, 5A0041, and 5A0052

6. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ 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: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Cooling Fan Finger Guard and Cooling Fan

1. While pressing in on the hooks located on the left and right sides of the fan finger guard, free the fan finger guard by lifting the back end first.

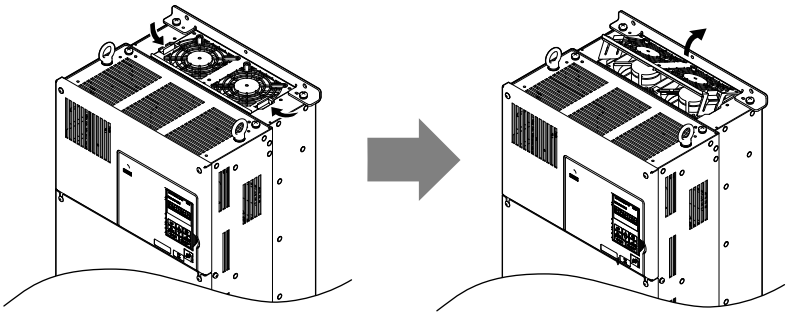


Figure 7.14 Remove the Cooling Fan Finger Guard: 4A0088 and 4A0103

2. Lift up directly on the cooling fan as shown in ***Figure 7.15***. Unplug the relay connector and release the fan from the drive.

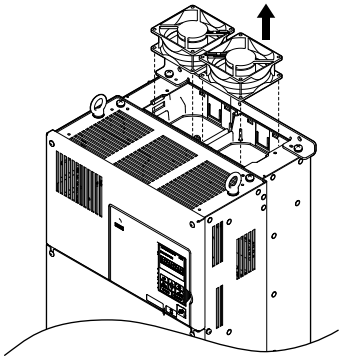


Figure 7.15 Remove the Cooling Fan: 4A0088 and 4A0103

■ Installing the Cooling Fan

Reverse the procedure describe above to reinstall the cooling fan.

1. Install the replacement fan into the drive. Align the pins as shown in ***Figure 7.16***.

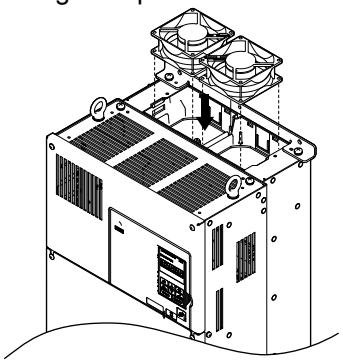
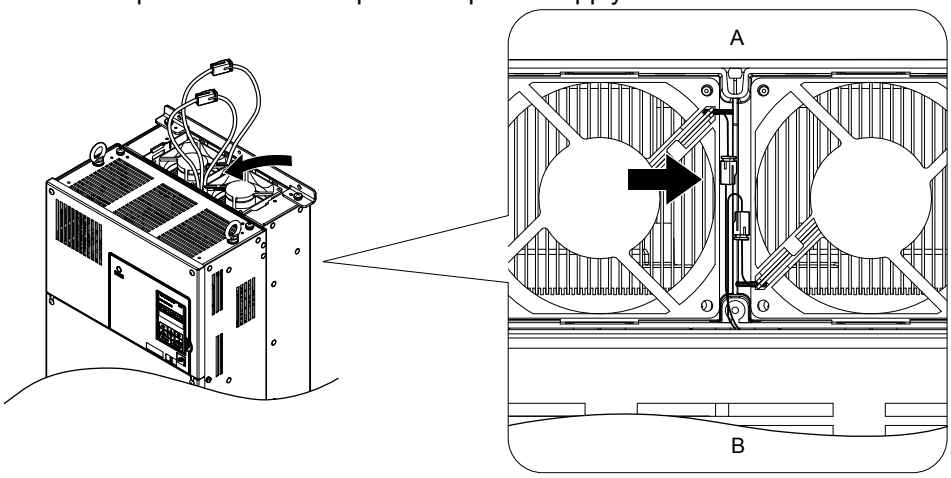


Figure 7.16 Install the Cooling Fan: 4A0088 and 4A0103

2. Properly connect the fan power lines then replace the power supply connectors and cables into the recess of the drive.



A – Back **B – Front**

Figure 7.17 Cooling Fan Power Supply Connectors: 4A0088 and 4A0103

3. Angle the fan finger guard as shown in ***Figure 7.18*** and insert the connector tabs into the corresponding holes on the drive.

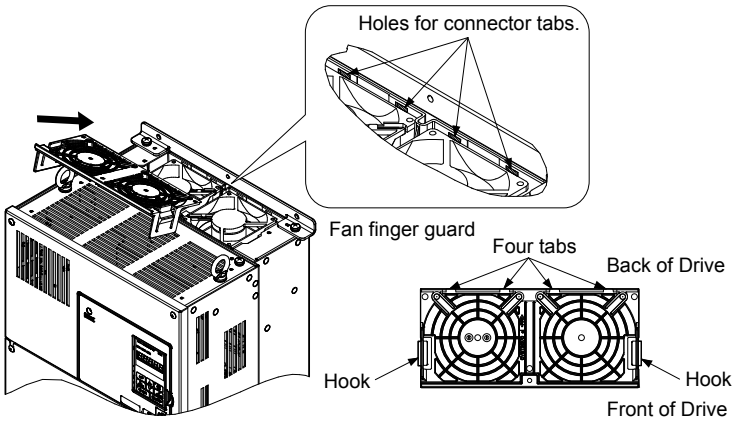


Figure 7.18 Reattach the Fan Finger Guard: 4A0088 and 4A0103

4. While pressing in on the hooks of the left and right sides of the fan finger guard, guide the fan finger guard until it clicks back into place.

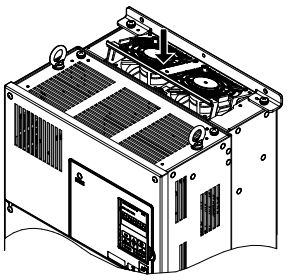


Figure 7.19 Reattach the Fan Finger Guard: 4A0088 and 4A0103

5. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 2A0169 to 2A0415, 4A0139 to 4A0362, and 5A0062 to 5A0242

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.*

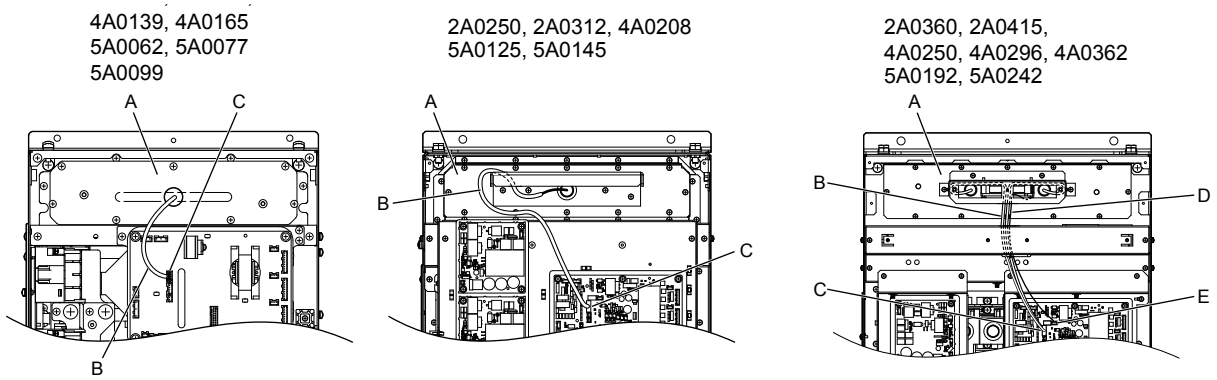
NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit

1. Remove the terminal cover and front cover.

2. Remove the fan connector (CN6).

Remove the fan connectors (CN6, CN7) in models 2A0360, 2A0415, 4A0362, and 5A0242.



A – Fan unit
B – Fan relay cable
C – Fan connector (CN6)
D – Circulation fan relay cable
E – Fan connector (CN7)

Figure 7.20 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.

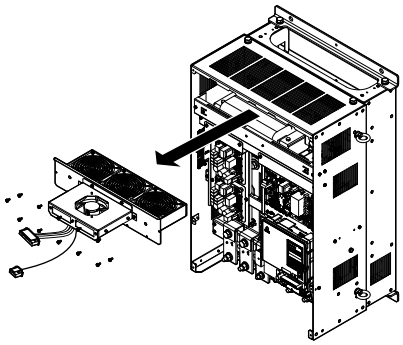
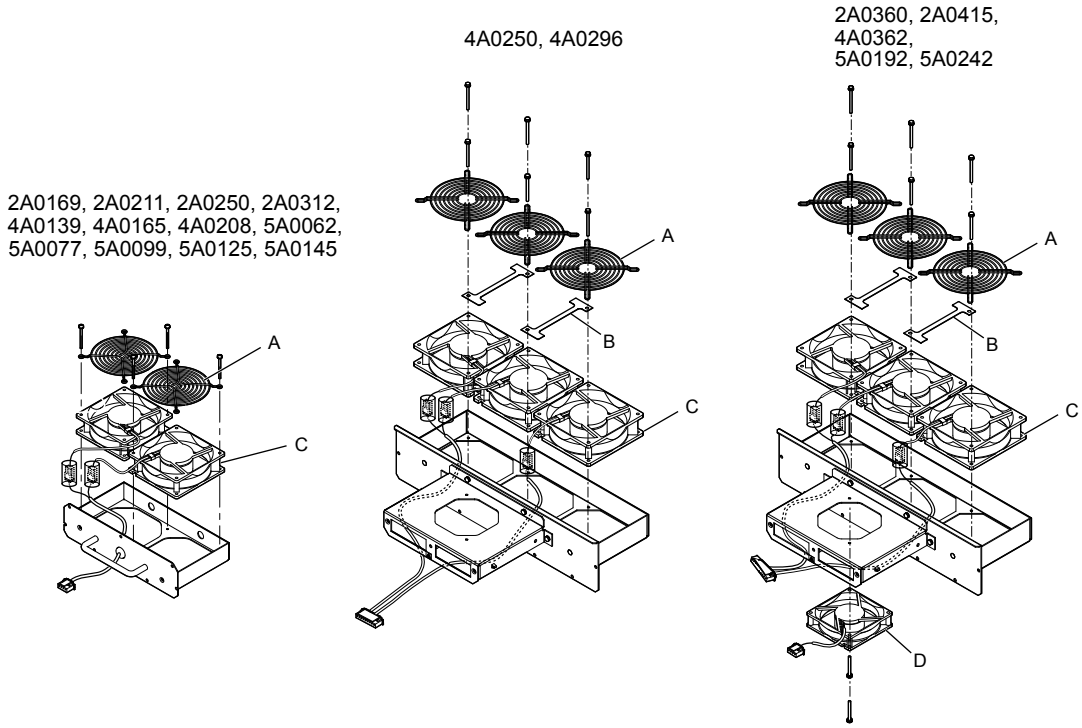


Figure 7.21 Remove the Fan Unit: 2A0169 to 2A0415, 4A0139 to 4A0362, and 5A0062 to 5A0242

4. Remove the fan guard and replace the cooling fans.

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

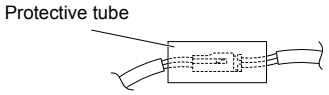


A – Fan guard
B – Cable cover
C – Cooling fan
D – Circulation fan

Figure 7.22 Fan Unit Disassembly: 2A0169 to 2A0415, 4A0139 to 4A0362, and 5A0062 to 5A0242

■ Cooling Fan Wiring: 2A0169, 2A0211, 4A0139, 4A0165, and 5A0062 to 5A0099

1. Position the protective tube so the fan connector sits in the center of the protective tube.



2. Place the fan connector covered by the tube as shown in ***Figure 7.23***.

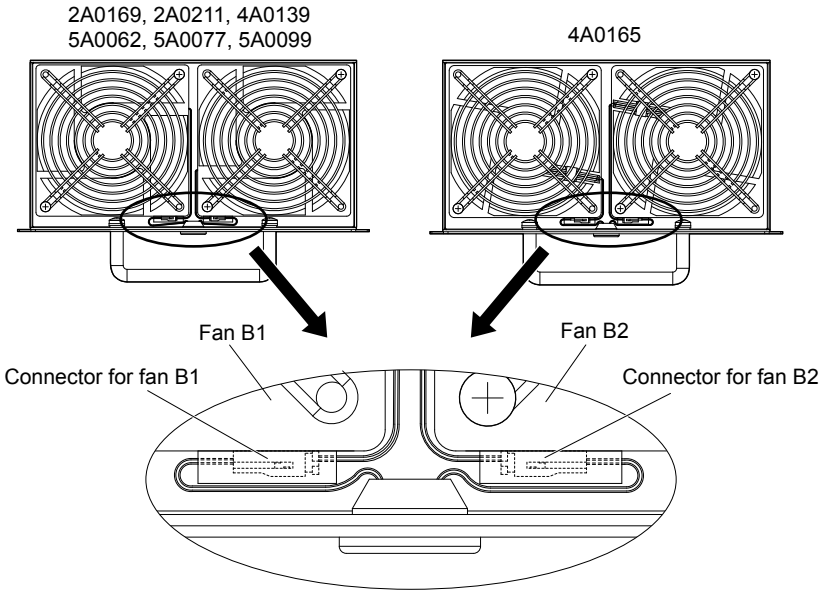
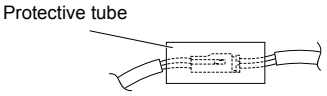


Figure 7.23 Cooling Fan Wiring: 2A0169, 2A0211, 4A0139, 4A0165, and 5A0062 to 5A0099

3. Make sure that the protective tube does not stick out beyond the fan guard.

■ Cooling Fan Wiring: 2A0250, 2A0312, 4A0208, 5A0125, and 5A0145

1. Position the protective tube so the fan connector sits in the center of the protective tube.



2. Insert the connector for fan B2 and guide the lead wire for fan B2 so the cable hook holds it in place. Insert the connector for fan B1.

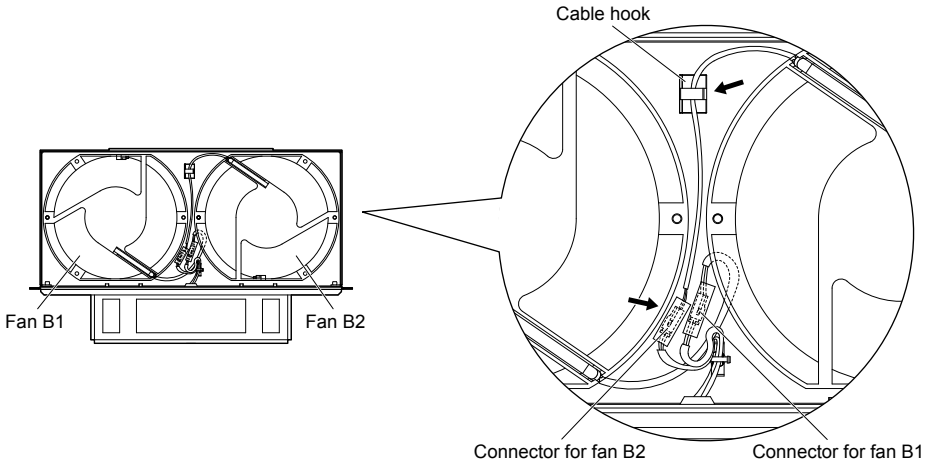
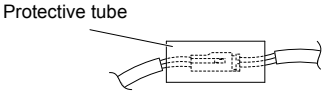


Figure 7.24 Cooling Fan Wiring: 2A0250, 2A0312, 4A0208, 5A0125, and 5A0145

3. Make sure that the protective tube does not stick out beyond the fan guard.

■ Cooling Fan Wiring: 2A0360, 2A0415, 4A0250 to 4A0362, 5A0192, and 5A0242

1. Position the protective tube so the fan connector sits in the center of the protective tube.



2. In the space between fans 1 and 2, place the fan connector for fan B2 in front of the fan connector for fan B1.
3. Place the connector for fan B3 between fans B2 and B3.

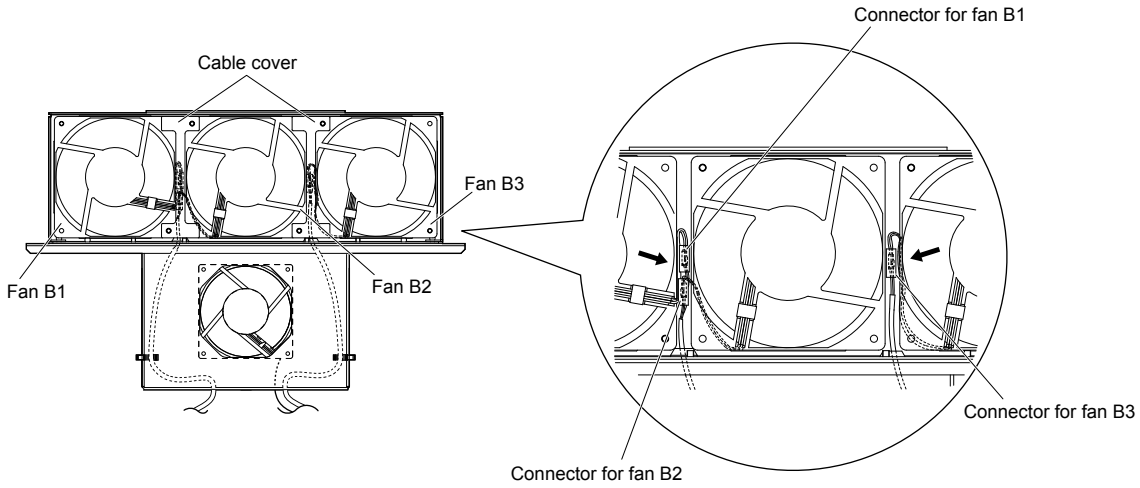


Figure 7.25 Cooling Fan Wiring: 2A0360, 2A0415, 4A0250 to 4A0362, 5A0192, and 5A0242

4. Double-check the relay connector to ensure it is properly connected.
5. Reattach the cable cover to its original position and tighten the screws so the fan guard holds the cable cover in place.

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

■ Installing the Cooling Fan Unit

1. Reverse the procedure described above to reinstall the cooling fan unit.

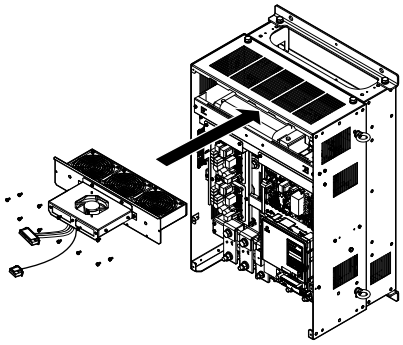


Figure 7.26 Install the Cooling Fan Unit: 2A0169 to 2A0415 and 4A0139 to 4A0362, and 5A0062 to 5A0242

2. Reattach the covers and digital operator.
3. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 4A0414

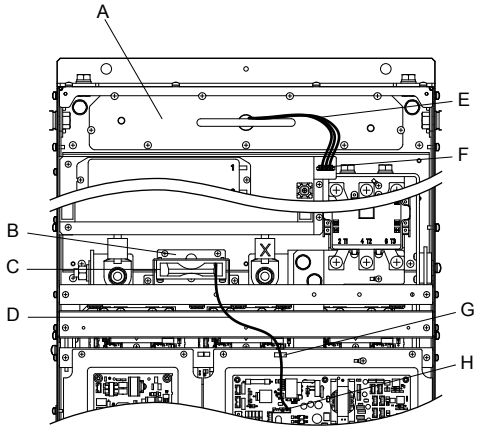
WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After 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: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit

1. Remove the terminal cover and front covers 1 and 2.
2. Remove the fan connector (CN6).



A – Fan unit
B – Circulation fan unit
C – Circulation fan
D – Circulation fan relay cable
E – Fan relay cable
F – Fan connector (CN6)
G – Hook
H – Fan connector (CN7)

Figure 7.27 Component Names: 4A0414

3. Remove the circulation fan relay cable from the hook. Remove the fan connector (CN7).
4. Remove the screws holding the fan units in place and slide the fan units out of the drive.

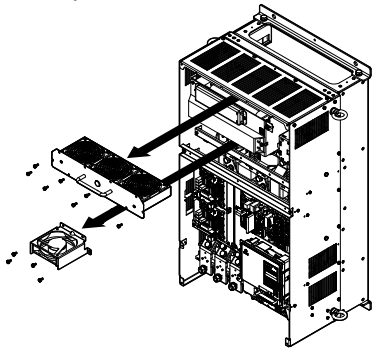
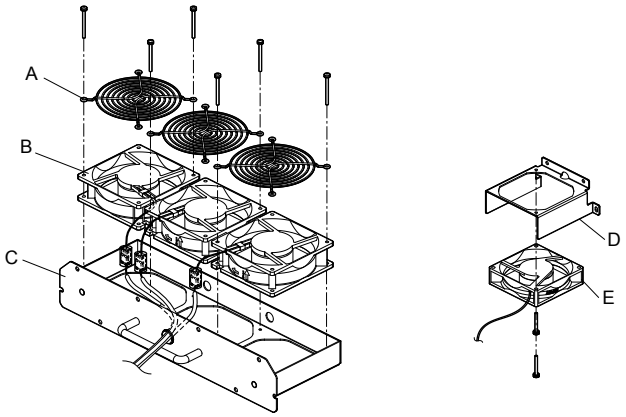


Figure 7.28 Remove the Fan Unit: 4A0414

5. Remove the fan guard and circulation fan casing. Replace the cooling fans.

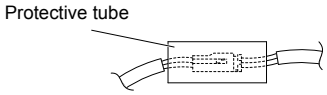


A – Fan guard
B – Cooling fan
C – Fan unit case
D – Circulation fan base
E – Circulation fan

Figure 7.29 Fan Unit Disassembly: 4A0414

■ Cooling Fan Wiring

1. Position the protective tube so the fan connector sits in the center of the protective tube.



2. Place the fan connector covered by the tube as shown in ***Figure 7.30***.

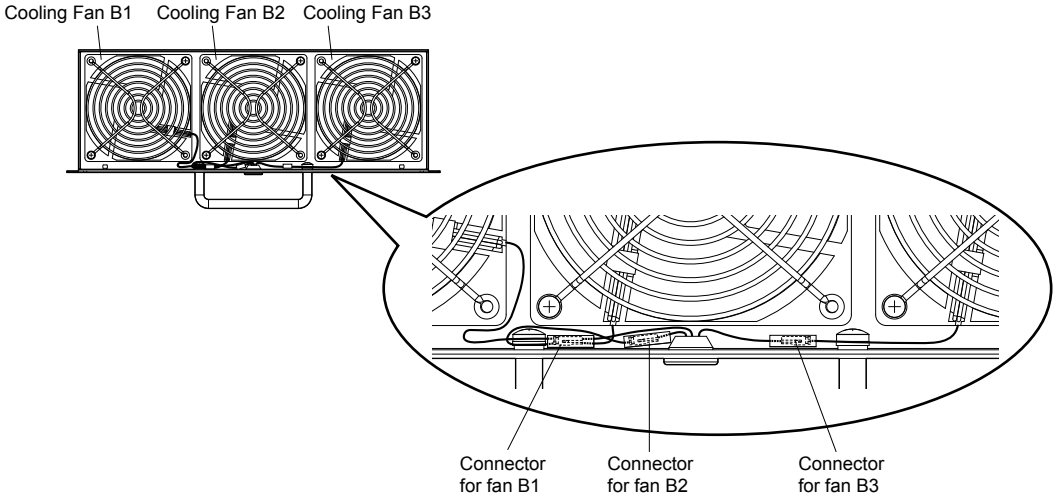


Figure 7.30 Cooling Fan Wiring: 4A0414

3. Double-check the relay connector to ensure that it is properly connected.

■ Installing the Cooling Fan Unit

1. Reverse the procedure described above to reinstall the cooling fan unit.

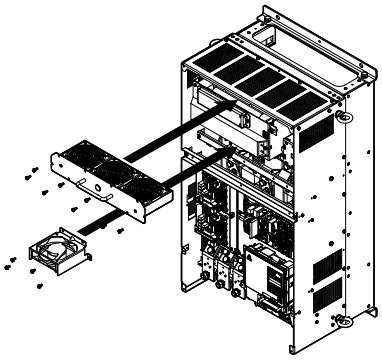


Figure 7.31 Install the Cooling Fan Unit: 4A0414

2. Reattach the covers and digital operator.
3. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 4A0515 and 4A0675

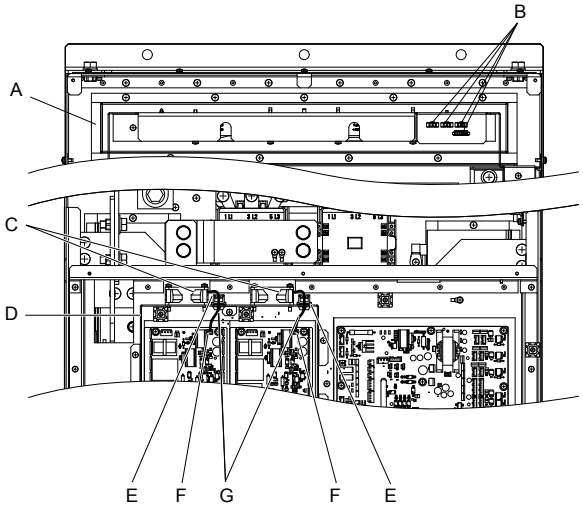
WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After 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: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit

1. Remove the terminal cover and front covers 1 and 2.
2. Remove the connectors for the cooling fan relay and the circuit board cooling fan.



A – Fan unit
B – Fan relay connector
C – Circuit board cooling fan
D – Circuit board cooling fan case
E – Hook
F – Circuit board cooling fan connector
G – Circuit board cooling fan cable

Figure 7.32 Component Names: 4A0515 and 4A0675

3. Loosen all nine screws and slide the panel to the right.

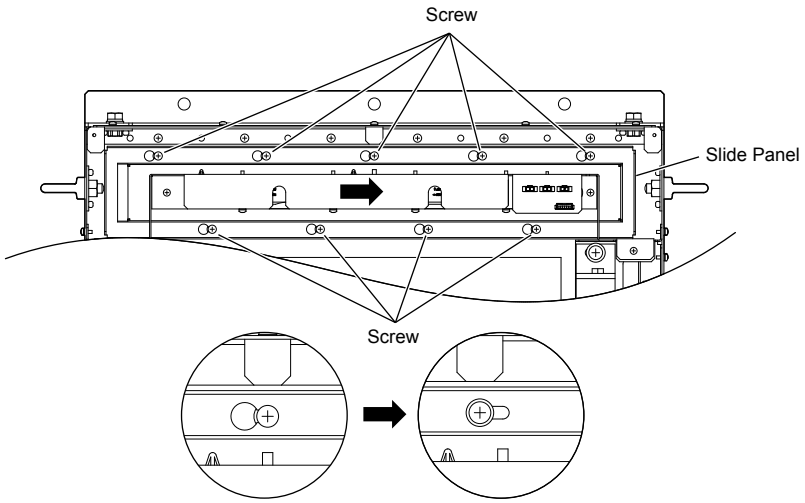


Figure 7.33 Remove the Fan Unit: 4A0515 and 4A0675

4. Remove the slide panel, fan unit, and circuit board cooling fan unit.

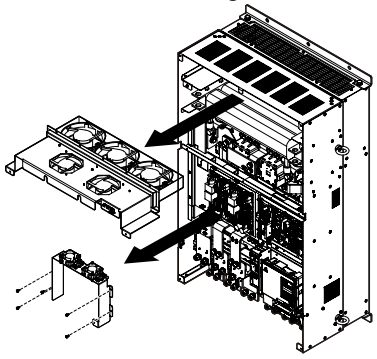
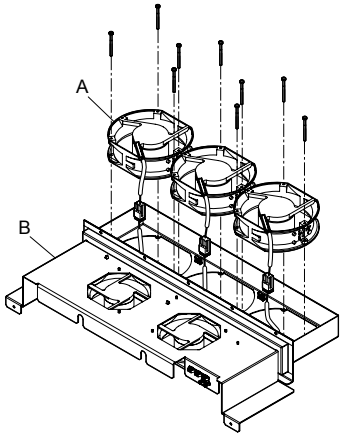


Figure 7.34 Remove the Fan Unit: 4A0515 and 4A0675

5. Replace the cooling fans.

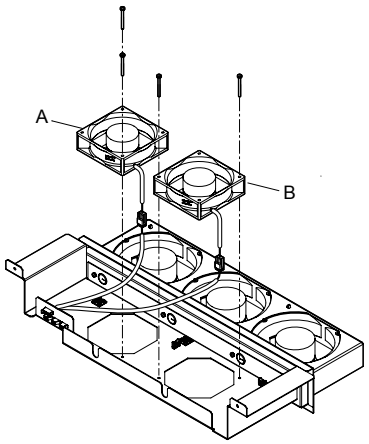
Note: Do not pinch the fan cable between parts when reassembling the fan unit.



A – Cooling fan **B – Fan unit case**

Figure 7.35 Fan Unit Disassembly: 4A0515 and 4A0675

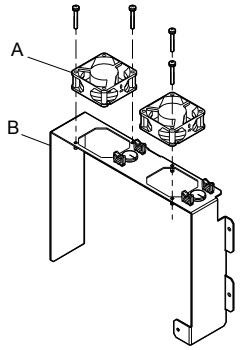
6. Turn the fan unit over and replace the circulation fans.



A – Circulation fan 1 **B – Circulation fan 2**

Figure 7.36 Fan Unit Disassembly: 4A0515 and 4A0675

7. Replace the cooling fans.



A – Circuit board cooling fan **B – Circuit board cooling fan case**

Figure 7.37 Fan Unit Disassembly: 4A0515 and 4A0675

■ Cooling Fan Wiring

1. Place the cooling fan connectors and guide the lead wires so they are held in place by the cable hooks.

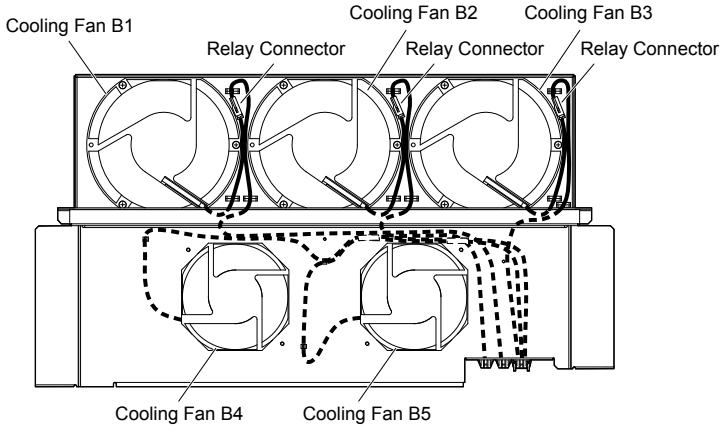


Figure 7.38 Cooling Fan Wiring: 4A0515 and 4A0675

2. Guide the lead wires so that they are held in place by the cable hooks and place the circulation fan connectors between the fan and the fan unit.

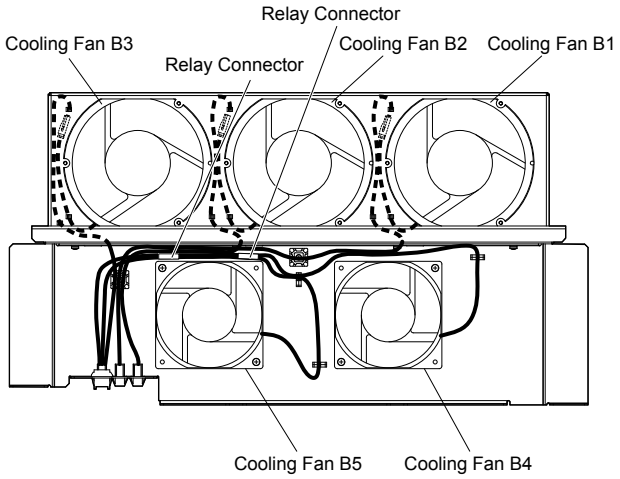
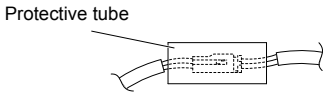


Figure 7.39 Cooling Fan Wiring: 4A0515 and 4A0675

3. Position the protective tube so the fan connector sits in the center of the protective tube. (Circuit board cooling fans only)



4. Guide the lead wires through the provided hooks so the wires are held in place.

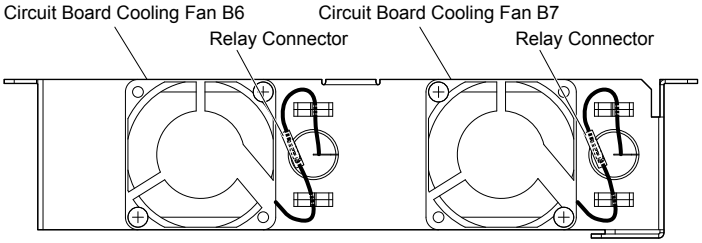


Figure 7.40 Cooling Fan Wiring: 4A0515 and 4A0675

5. Double-check the relay connector to ensure that it is properly connected.

■ Installing the Cooling Fan Unit

1. Reverse the procedure described above to reinstall the cooling fan unit.

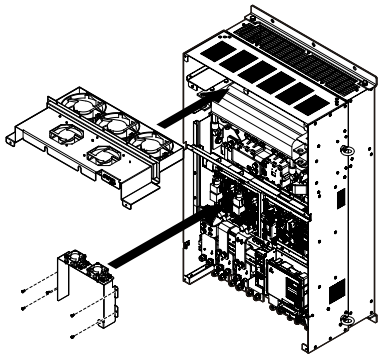


Figure 7.41 Install the Cooling Fan Unit: 4A0515 and 4A0675

2. Reattach the covers and digital operator.
3. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

7.5 Drive Replacement

◆ Serviceable Parts

The drive contains some serviceable parts. The following parts can be replaced over the life span of the drive:

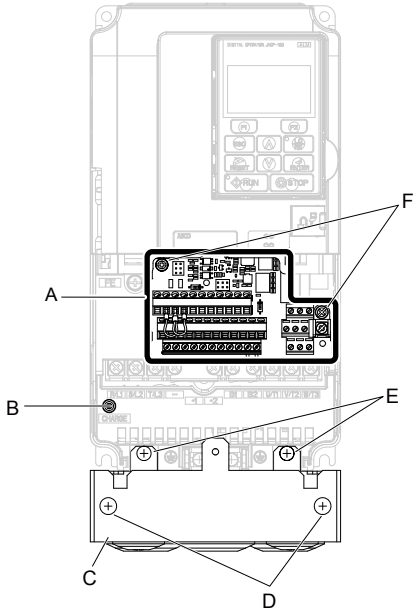
- Terminal board I/O PCBs
- Cooling fan(s)
- Front cover

Replace the drive if the main power circuitry is damaged. Contact your local Yaskawa representative before replacing parts 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 and reconnect it to the replacement drive. There is no need to manually reprogram the replacement drive after transferring the terminal board.

Note: If the damaged drive and the new replacement drive are 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 – Conduit bracket
D – Conduit bracket cover screws
E – Conduit bracket mounting screws
F – Terminal board locking screws

Figure 7.42 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: *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, 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 it is working properly before reconnecting it to the new drive. Replace broken options to prevent immediate breakdown of the replacement drive.*

1. Remove the terminal cover.

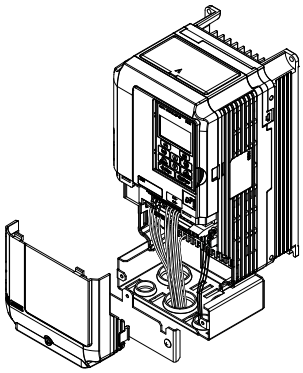


Figure 7.43 Remove the Terminal Cover

2. Loosen the screws holding the terminal board in place. Remove the screw securing the bottom cover and remove the bottom cover from the drive.

Note: IP00/Open Type enclosure drives do not have a bottom cover or conduit.

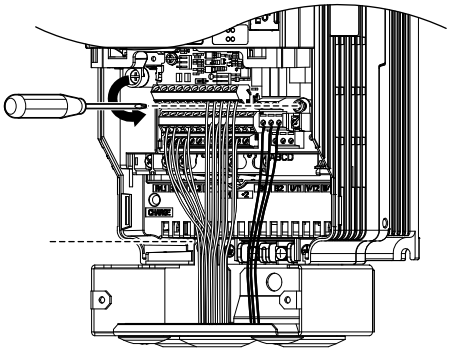


Figure 7.44 Unscrew the Terminal Board and Remove the Bottom Cover

3. Slide the terminal board as illustrated by the arrows to remove it from the drive along with the bottom cover.

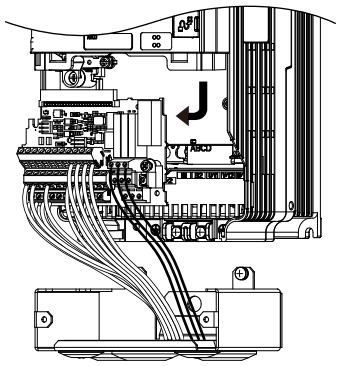


Figure 7.45 Remove the Terminal Board

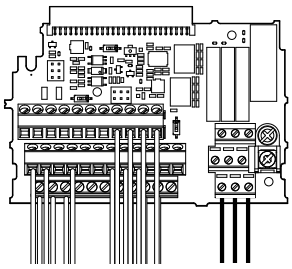


Figure 7.46 Disconnected Removable Terminal Board

4. Disconnect all option cards and options, making sure they are intact before reusing.
5. Replace the drive and wire the main circuit.

■ Installing the Drive

1. After wiring the main circuit, connect the terminal block to the drive as shown in ***Figure 7.47***. Use the installation screw to fasten the terminal block into place.

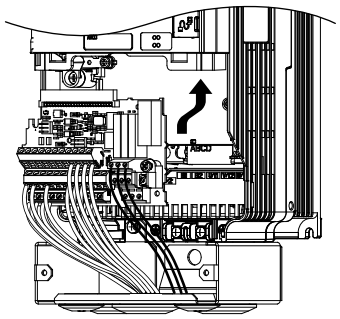


Figure 7.47 Install the Terminal Board

2. Reconnect options for the new drive the same way the options were connected in the old drive. Connect option boards to the same option ports in the new drive that were used in the old drive.
3. Replace the terminal cover.
4. After powering on the drive, all parameter settings are transferred from the terminal board to the drive memory. If an oPE04 error occurs, load the parameter settings saved on the terminal board to the new drive by setting parameter A1-03 to 5550. Reset the Maintenance Monitor function timers by setting parameters o4-01 through o4-12 to 0, and parameter o4-13 to 1.

8

Peripheral Devices & Options

This chapter explains the installation of peripheral devices and options available for the drive.

8.1 SECTION SAFETY.....354
8.2 DRIVE OPTIONS AND PERIPHERAL DEVICES.....355
8.3 CONNECTING PERIPHERAL DEVICES.....356
8.4 OPTION INSTALLATION.....357
8.5 INSTALLING PERIPHERAL DEVICES.....363

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.

If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices.

Contact your supplier if the cause cannot be identified after checking the above.

Do not restart the drive or immediately operate the peripheral devices if a fuse is blown or a GFCI is tripped.

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

Table 8.1 lists the names of the various peripheral devices, 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
Power Options		
DC link choke	–	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	–	For use with systems that require dynamic braking with up to 3% ED. If higher ED is required, use a Braking Resistor Unit. **Note:** Not rated for 600 V class drive models.
Input/Output Option Cards		
Analog Monitor	AO-A3	• Provides extra multi-function analog output terminals • Output channels: 2 • Output voltage: -10 to 10 V, 11-bit (signed)
Communication Option Cards		
EtherNet/IP	SI-EN3	Connects to an EtherNet/IP network.
Modbus TCP/IP	SI-EM3	Connects to a Modbus TCP/IP network.
DeviceNet	SI-N3	Connects to a DeviceNet network
PROFIBUS-DP	SI-P3	Connects to a PROFIBUS-DP network.
MECHATROLINK-II	SI-T3	Connects to a MECHATROLINK-II network.
BACnet	SI-B3	Connects to a BACnet network.
CC-Link <1>	SI-C3	Connects to a CC-Link network
CANopen <1>	SI-S3	Connects to a CANopen network.
Interface Options		
Remote Operator Cable	UWR000051, 1 m cable UWR000052, 2 m cable	RJ-45, 8-pin straight through, UTP CAT5e, extension cable (1 m or 2 m) to connect the digital operator for remote operation.
USB Copy Unit	JVOP-181	• Allows the user to copy and verify parameter settings between drives. • Functions as an adapter to connect the drive to a USB port on a PC.
Mechanical Options		
Attachment for External Heatsink	EZZ020800A/B/C/D	Installation kit for mounting the drive with the heatsink outside of the panel (Side-by-Side mounting possible)
IP20/NEMA Type 1 Kit	100-054-503 100-054-504	Parts to make the drive conform to IP20/NEMA Type 1 enclosure requirements.
IP20/NEMA Type 1, 4, 12 Blank Keypad Kit	UUX0000526	Provides digital operator (JVOP-180, JVOP-182) functionality on an enclosure designed for IP20/NEMA Type 1, 3R, 4, 4X, 12, or IP□6 environment. This keypad has a blank label on the front.
IP20/NEMA Type 1, 4, 12 Yaskawa Logo Keypad Kit	UUX0000527	Provides digital operator (JVOP-180, JVOP-182) functionality on an enclosure designed for IP20/NEMA Type 1, 3R, 4, 4X, 12, or IP□6 environment. This keypad has a Yaksawa brand label on the front.
Others		
24 V Power Supply	200 V Class: PS-A10LB 400 V Class: PS-A10HB 600 V Class: PS-A10HB	Supplies the drive controller with 24 Vdc power during main power loss.
PC Software Tools		
DriveWizard Industrial	Contact Yaskawa	PC tool for drive setup and parameter management

<1> Limited support. Contact a Yaskawa representative or the nearest Yaskawa sales office for assistance.

8.3 Connecting Peripheral Devices

Figure 8.1 illustrates how to configure the drive and motor to operate with various peripheral devices.

Refer to the specific manual for the devices shown below for more detailed installation instructions.

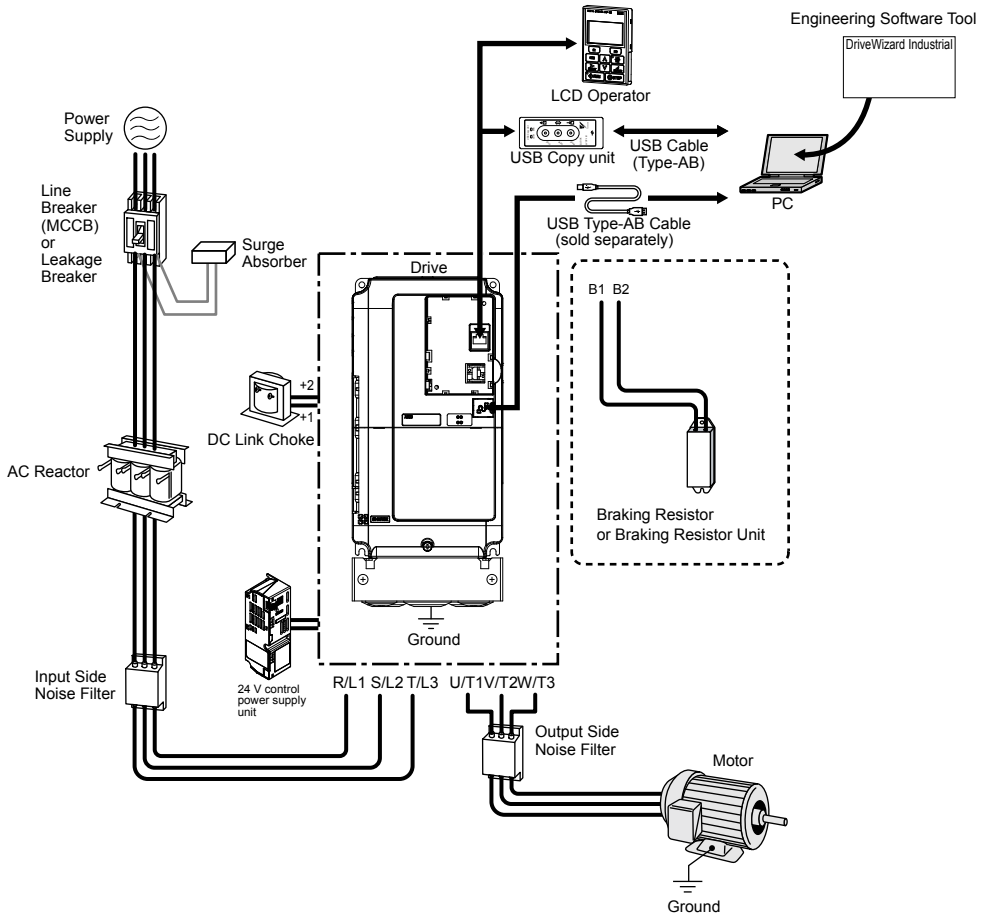


Figure 8.1 Connecting Peripheral Devices

Note: If the drive is set to trigger a fault output when the fault restart function is activated (L5-02 = 1), then a sequence to interrupt power when a fault occurs will turn off the power to the drive while the drive attempts to restart. The default setting for L5-02 is 0 (fault output active during restart).

8.4 Option Installation

This section provides instructions on installing the options in *Table 8.2*.

◆ Prior to Installing the Option

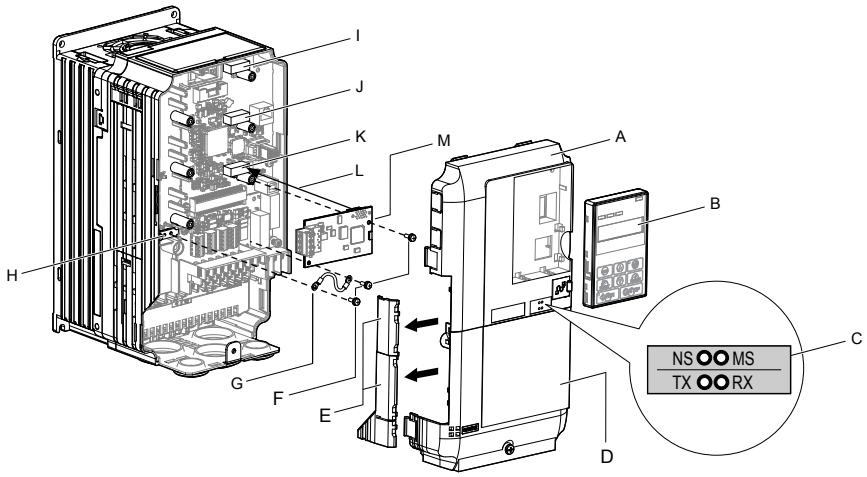
Prior to installing the option, wire the drive, make necessary connections to the drive terminals, and verify that the drive functions normally without the option installed.

Table 8.2 below lists the number of options that can be connected to the drive and the drive ports for connecting those options.

Table 8.2 Option Installation

Option	Port/Connector	Number of Options Possible
SI-B3, SI-EN3, SI-EM3, SI-N3, SI-P3, SI-T3, SI-C3, SI-S3	CN5-A	1
AO-A3	CN5-A, B, C	1

Figure 8.2 shows an exploded view of the drive with the option and related components for reference.



A – Drive front cover
B – Digital operator
C – LED label (for communication options)
D – Drive terminal cover
E – Removable tabs for wire routing
F – Included screws
G – Ground wire
H – Drive grounding terminal (FE)
I – Connector CN5-C
J – Connector CN5-B
K – Connector CN5-A
L – Insertion point for CN5 connector
M – Option

Figure 8.2 Drive Components with Option

◆ Communication Option Installation Example

Remove the front covers of the drive before installing the option. Communication options can inserted only into the CN5-A connector located on the drive control board.

Preparing the Drive

1. Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the digital operator (B) and front covers (A, D). Front cover removal varies by model.

   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 installing the option, disconnect all power to the drive. 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 five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.*

   NOTICE: *Damage to Equipment. Observe proper electrostatic discharge procedures (ESD) when handling the option, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.*

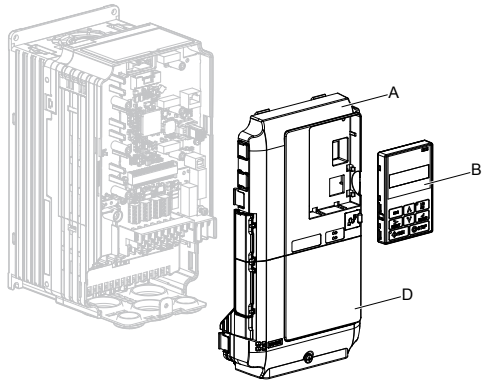


Figure 8.3 Remove the Front Covers and Digital Operator

2. With the front covers and digital operator removed, apply the LED label (C) in the appropriate position on the drive top front cover (A).

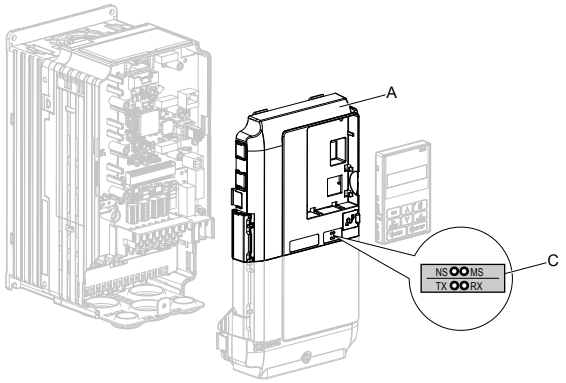


Figure 8.4 Apply the LED Label

Connecting Option and Ground Wire

1. Insert the option (M) into the **CN5-A** connector (K) located on the drive and fasten it using one of the included screws (F).

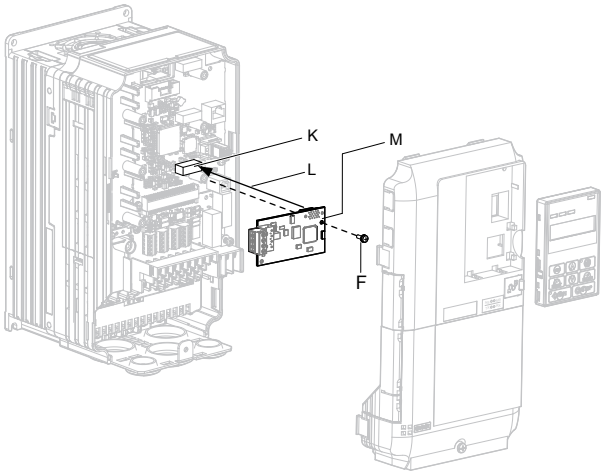


Figure 8.5 Insert the Option

2. Connect the ground wire (G) to the ground terminal (H) using one of the remaining provided screws (F). Connect the other end of the ground wire (G) to the remaining ground terminal and installation hole on the option (M) using the last remaining provided screw (F) and tighten both screws to 0.5 ~ 0.6 N m or (4.4 ~ 5.3 in lbs).

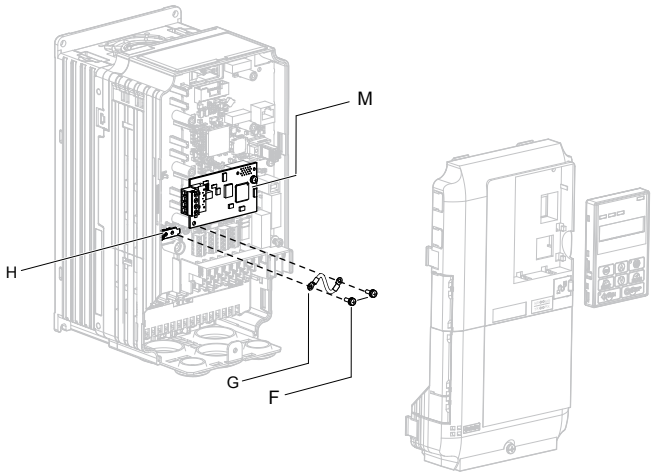


Figure 8.6 Connect the Ground Wire

Note: There are two screw holes on the drive for use as ground terminals. When connecting three options, two ground wires will need to share the same drive ground terminal.

Wiring the Option

1. 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 to provide adequate space for the wiring. In these cases, using diagonal cutting pliers, cut out the perforated openings on the left side of the drive front cover. Sharp edges along the cut out should be smoothed down with a file or sand paper to prevent any damage to the wires.

When installing option cards to models 2A0004 to 2A0040, 4A0002 to 4A0023, and 5A0003 to 5A0011, it may be necessary to route the cables connected to the option through the top cover to the outside. Models 2A0056 to 2A0415, 4A0031 to 4A1200, and 5A0017 to 5A0242 have enough space to keep all wiring inside the unit.

2. Connect the communication cables to the option terminal block (TB1).

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use properly grounded shielded cables for the communication cables to prevent problems caused by electrical interference.

Replacing the Drive Covers and Digital Operator

1. Replace and secure the front covers of the drive (A, D) and replace the digital operator (B).

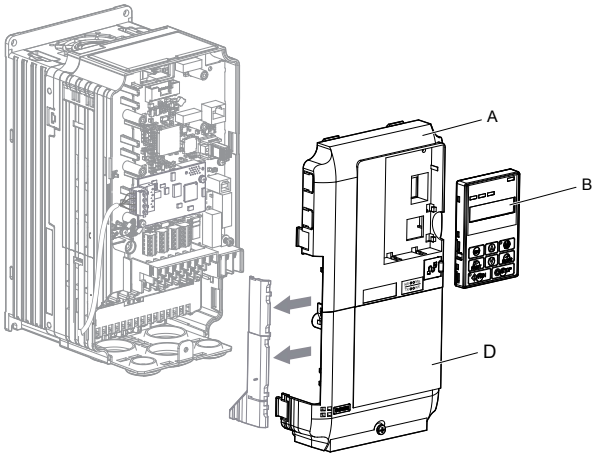


Figure 8.7 Replace the Front Covers and Digital Operator

Note: Take proper precautions when wiring the option so that the front covers will easily fit back onto the drive. Make sure no cables are pinched between the front covers and the drive when replacing the covers.

◆ Communication Option Installation Example

Remove the front covers of the drive before installing the option. Communication options can inserted only into the CN5-A connector located on the drive control board.

Preparing the Drive

1. Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the digital operator (B) and front covers (A, D). Front cover removal varies by model.

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 installing the option, disconnect all power to the drive. 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 five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.*

NOTICE: *Damage to Equipment. Observe proper electrostatic discharge procedures (ESD) when handling the option, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.*

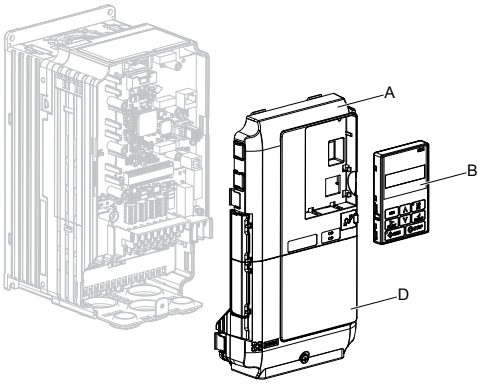


Figure 8.8 Remove the Front Covers and Digital Operator

2. With the front covers and digital operator removed, apply the LED label (C) in the appropriate position on the drive top front cover (A).

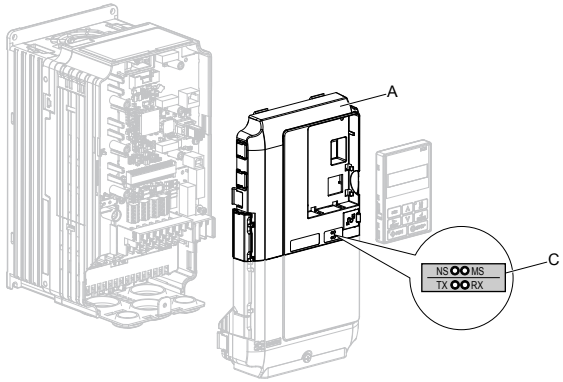


Figure 8.9 Apply the LED Label

Connecting Option and Ground Wire

1. Insert the option (M) into the **CN5-A** connector (K) located on the drive and fasten it using one of the included screws (F).

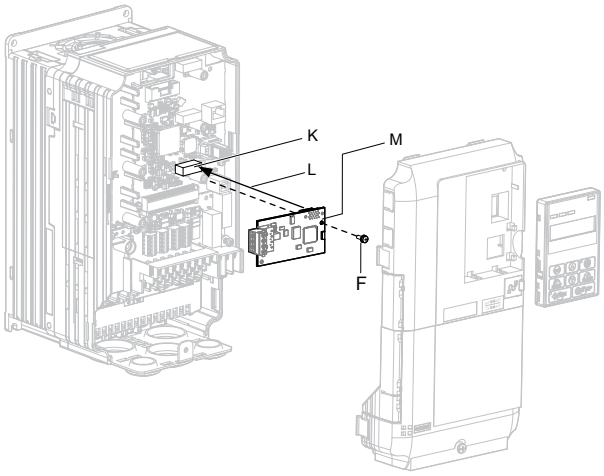


Figure 8.10 Insert the Option

2. Connect the ground wire (G) to the ground terminal (H) using one of the remaining provided screws (F). Connect the other end of the ground wire (G) to the remaining ground terminal and installation hole on the option (M) using the last remaining provided screw (F) and tighten both screws to 0.5 ~ 0.6 N m or (4.4 ~ 5.3 in lbs).

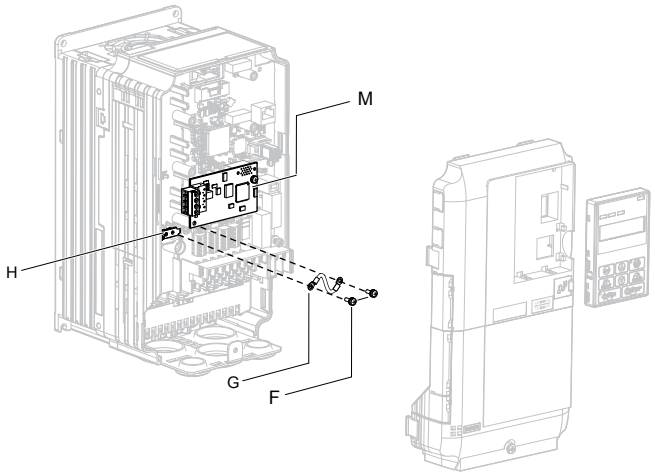


Figure 8.11 Connect the Ground Wire

Note: There are two screw holes on the drive for use as ground terminals. When connecting three options, two ground wires will need to share the same drive ground terminal.

Wiring the Option

1. 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 to provide adequate space for the wiring. In these cases, using diagonal cutting pliers, cut out the perforated openings on the left side of the drive front cover. Sharp edges along the cut out should be smoothed down with a file or sand paper to prevent any damage to the wires.

   When installing option cards to models 2A0004 to 2A0040, 4A0002 to 4A0023, and 5A0003 to 5A0011, it may be necessary to route the cables connected to the option through the top cover to the outside. Models 2A0056 to 2A0415, 4A0031 to 4A1200, and 5A0017 to 5A0242 have enough space to keep all wiring inside the unit.
2. Connect the communication cables to the option terminal block (TB1).

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use properly grounded shielded cables for the communication cables to prevent problems caused by electrical interference.

Replacing the Drive Covers and Digital Operator

1. Replace and secure the front covers of the drive (A, D) and replace the digital operator (B).

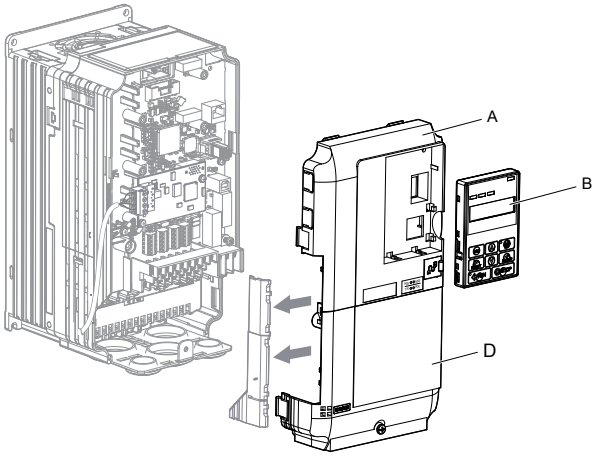


Figure 8.12 Replace the Front Covers and Digital Operator

Note: Take proper precautions when wiring the option so that the front covers will easily fit back onto the drive. Make sure no cables are pinched between the front covers and the drive when replacing the covers.

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 when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits for requirements concerning class 2 power supplies.*

◆ 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. Properly size the braking circuit 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. Set L8-55 to 0 to disable the internal braking transistor of the drive protection when using braking resistor options.
3. Set L3-04 to 0 to disable Stall Prevention during deceleration when using a regenerative converter, a regenerative unit, a braking resistor, or the Braking Resistor Unit. The default setting for the Stall Prevention function (enabled) 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

ERF type braking resistors provide dynamic braking capability with up to 3% ED. They can be directly connected to the B1 and B2 terminals of the drive as shown in ***Figure 8.13***.

Enable the drive braking resistor overload protection by setting L8-01 to 1 when using ERF type resistors.

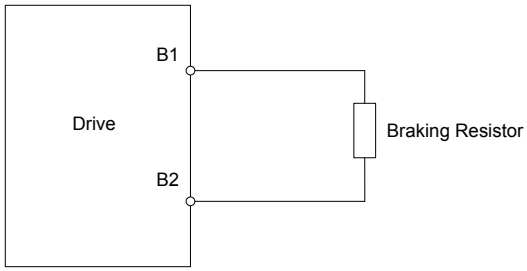


Figure 8.13 Connecting a Braking Resistor: ERF Type

■ 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 8.14***. The LKEB unit has a thermal overload contact that should be utilized in order to switch off the drive in case braking resistor overheat occurs.

The internal braking resistor overload protection of the drive cannot protect LKEB resistors. Set L8-01 to 0 to disable this function.

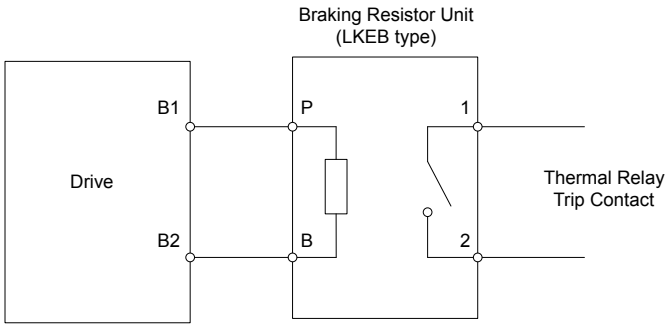


Figure 8.14 Connecting a Braking Resistor Unit: LKEB Type (Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052)

■ 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 overheat.

■ Braking Resistor Overload Protection

If using a braking resistor option, a sequence such as the one shown in ***Figure 8.15*** should be set up to interrupt the power supply in case the braking resistor overheats.

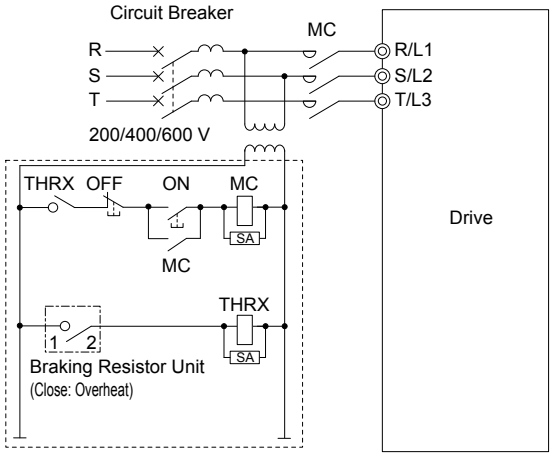


Figure 8.15 Power Supply Interrupt for Overheat Protection (Example)

■ Installing a Braking Unit: CDBR Type

To install a CDBR type braking unit, connect the +3 terminal of the drive to the positive terminal on the braking unit.

Next, wire together the negative terminals on the drive and braking unit. Terminal +2 is not used.

Connect the braking resistor to CDBR 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.

Set L8-55 to 0 to disable dynamic braking transistor protection.

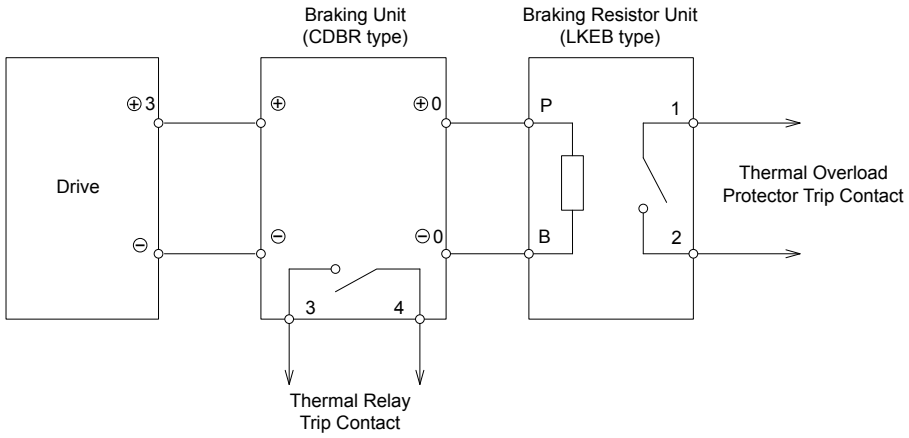


Figure 8.16 Connecting a Braking Unit (CDBR type) and Braking Resistor Unit (LKEB type) (Models 2A0169 to 2A0415 and 4A0088 to 4A1200)

Note: To install a CDBR type braking unit to the drive with a built-in dynamic braking transistor (models 2A0004 to 2A0138 and 4A0002 to 4A0072), connect the drive B1 terminal to the positive terminal on the braking unit. Next, wire the negative terminals on the drive and braking unit together. Terminal B2 is not used.

■ 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 8.17*** illustrates how to wire braking units in parallel.

Wire the thermal overload contact 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.

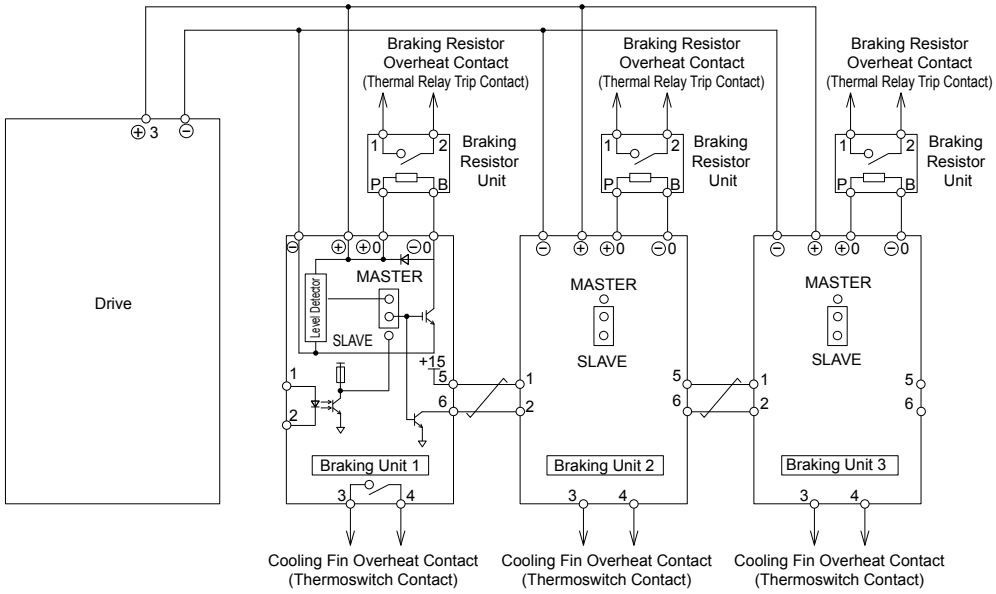


Figure 8.17 Connecting Braking Units in Parallel

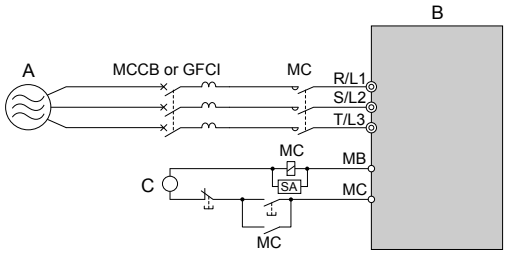
◆ Installing a Molded Case Circuit Breaker (MCCB) or Ground Fault Circuit Interrupter (GFCI)

Install an MCCB or GFCI 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.

NOTICE: *Prevent Equipment Damage. Install a fuse and a GFCI to models 4A0930 and 4A1200, Failure to comply may result in damage to the power supply in the event of a short circuit.*

Consider the following when selecting and installing an MCCB or GFCI:

- The capacity of the MCCB or GFCI should be 1.5 to 2 times the rated output current of the drive. Use an MCCB or GFCI to keep the drive from faulting out instead of using overheat protection (150% for one minute at the rated output current).
- If several drives are connected to one MCCB or GFCI that is shared with other equipment, use a sequence that shuts the power OFF when errors are output by using magnetic contactor (MC) as shown in ***Figure 8.18***.



A – Power supply
B – Drive
C – Control power supply

Figure 8.18 Power Supply Interrupt Wiring (Example)

WARNING! *Electrical Shock Hazard. Disconnect the MCCB (or GFCI) and MC before wiring terminals. Failure to comply may result in serious injury or death.*

■ Application Precautions when Installing a GFCI

Drive outputs generate high-frequency leakage current as a result of high-speed switching. Install a GFCI on the input side of the drive to switch off potentially harmful leakage current.

Factors in determining leakage current:

- Size of the AC drive
- AC drive carrier frequency
- Motor cable type and length
- EMI/RFI filter

If the GFCI trips spuriously, consider changing these items or use a GFCI with a higher trip level.

Note: Choose a GFCI designed specifically for an AC drive. The operation time should be at least 0.1 s with sensitivity amperage of at least 200 mA per drive. The output waveform of the drive and built-in EMC filter may cause an increase in leakage current. This may in turn cause the leakage breaker to malfunction. Increase the sensitivity amperage or lower the carrier frequency to correct the problem.

◆ Installing a Magnetic Contactor at the Power Supply Side

Install a magnetic contactor (MC) to the drive input for the purposes explained below.

■ Disconnecting the Power Supply

Shut off the drive with an MC when a fault occurs in any external equipment such as braking resistors.

NOTICE: *Do not connect electromagnetic switches or MCs to the output motor circuits without proper sequencing. Improper sequencing of output motor circuits could result in damage to the drive.*

NOTICE: *Install an 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. Install an MC to the drive input side to prevent the drive from restarting automatically when power is restored after momentary power loss.
2. Set up a delay that prevents the MC from opening prematurely to continue operating the drive through a momentary power loss.

■ 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 Reactor or DC Link Choke

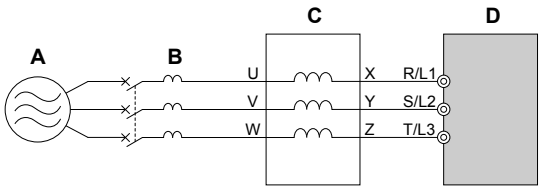
AC reactors and DC link chokes suppress surges in current and improve the power factor on the input side of the drive.

Use an AC reactor, a DC link choke, or both in the following situations:

- 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 reactor or DC link choke 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

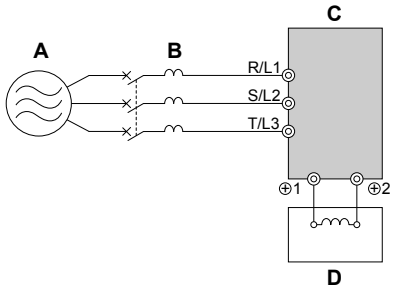


A – Power supply
B – MCCB
C – AC reactor
D – Drive

Figure 8.19 Connecting an AC Reactor

■ Connecting a DC Link Choke

A DC link choke can be installed to drive models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032. When installing a DC link choke, remove the jumper between terminals +1 and +2 (terminals are jumpered for shipment). The jumper must be installed if not using a DC link choke. Refer to ***Figure 8.20*** for an example of DC link choke wiring.



A – Power supply
B – MCCB
C – Drive
D – DC link choke

Figure 8.20 Connecting a DC Link Choke

◆ Connecting a Surge Absorber

A surge absorber suppresses surge voltage generated from switching an inductive load near the drive. Inductive loads include magnetic contactors, relays, valves, solenoids, and brakes. Always use a surge absorber or diode when operating with an inductive load.

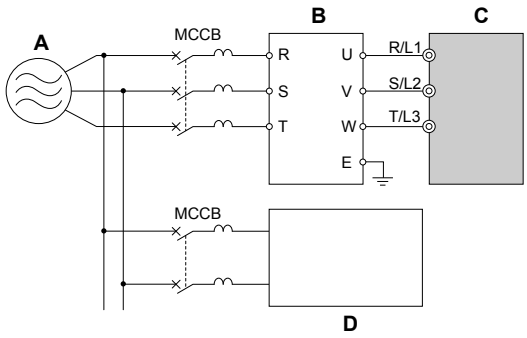
WARNING! *Fire Hazard. Due to surge absorber short circuit on drive output terminals U/T1, V/T2, and W/T3, do not connect surge absorbers to the drive output power terminals. Failure to comply may result in serious injury or death by fire or flying debris.*

◆ Connecting a Noise Filter

■ 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.



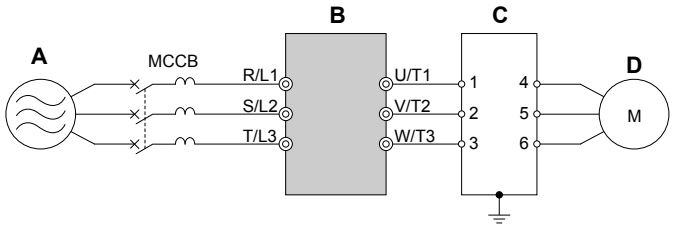
A – Power supply
B – Input-side noise filter (model LNFD-☐☐)
C – Drive
D – Other control device

Figure 8.21 Input-Side Noise Filter (Three-Phase 200/400 V)

■ Output-Side Noise Filter

A noise filter on the output side of the drive reduces inductive noise and radiated noise. ***Figure 8.22*** 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.*



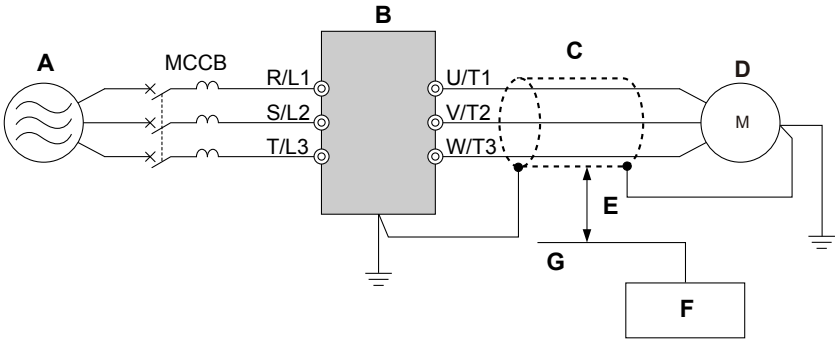
A – Power supply
B – Drive
C – Output-side noise filter
D – Motor

Figure 8.22 Output-Side Noise Filter

- **Radiated Noise:** Electromagnetic waves radiated from the drive and cables create noise throughout the radio bandwidth that can affect surrounding devices.
- **Induced Noise:** Noise generated by electromagnetic induction can affect the signal line and may cause the controller to malfunction.

Preventing Induced Noise

Use a noise filter on the output side or use shielded cables. Lay the cables at least 30 cm away from the signal line to prevent induced noise.



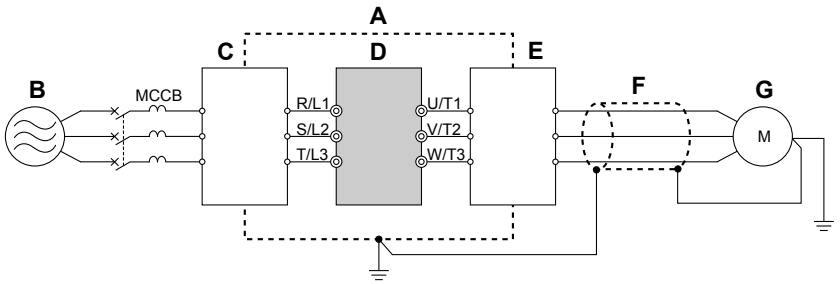
A – Power supply
B – Drive
C – Shielded motor cable
D – Motor
E – Separate at least 30 cm
F – Controller
G – Signal line

Figure 8.23 Preventing Induced Noise

Reducing Radiated and Radio Frequency Noise

The drive, input lines, and output lines generate radio frequency noise. Use noise filters on input and output sides and install the drive in a metal enclosure panel to reduce radio frequency noise.

Note: The cable running between the drive and motor should be as short as possible.



A – Metal enclosure
B – Power supply
C – Noise filter
D – Drive
E – Noise filter
F – Shielded motor cable
G – Motor

Figure 8.24 Reducing Radio Frequency Noise

◆ Installing Input Fuses

NOTICE: *If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices. Check the wiring and the selection of peripheral devices to identify the cause. Contact Yaskawa before restarting the drive or the peripheral devices if the cause cannot be identified*

■ Factory Recommended Branch Circuit Protection

Yaskawa recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in ***Table 8.3***.

Table 8.3 Factory Recommended P1000 AC Drive Branch Circuit Protection

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
200 V Class						
2A0004	0.75	3.9	15	6.25	10	FWH-70B (70)
2A0006	1 - 1.5	7.3	15	12	20	FWH-70B (70)
2A0008	2	8.8	15	15	25	FWH-70B (70)
2A0010	3	10.8	20	17.5	30	FWH-70B (70)
2A0012	3	13.9	25	20	40	FWH-70B (70)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
2A0018	5	18.5	35	30	50	FWH-90B(90)
2A0021	7.5	24	45	40	70	FWH-90B(90)
2A0030	10	37	60	60	110	FWH-100B (100)
2A0040	15	52	100	90	150	FWH-200B (200)
2A0056	20	68	125	110	200	FWH-200B (200)
2A0069	25	80	150	125	225	FWH-200B (200)
2A0081	30	96	175	150	275	FWH-300A (300)
2A0110	40	111	200	175	300	FWH-300A (300)
2A0138	50	136	250	225	400	FWH-350A (350)
2A0169	60	164	300	250	450	FWH-400A (400)
2A0211	75	200	400	350	600	FWH-400A (400)
2A0250	100	271	500	450	800	FWH-600A (600)
2A0312	125	324	600	500	800	FWH-700A (700)
2A0360	150	394	700	600	1000 <5>	FWH-800A (800)
2A0415	175	471	900	800	1400 <5>	FWH-1000A (1000)
400 V Class						
4A0002	1	2.1	15	3.5	6	FWH-40B (40)
4A0004	2	4.3	15	7.5	12	FWH-50B (50)
4A0005	3	5.9	15	10	17.5	FWH-70B (70)
4A0007	3	8.1	15	12	20	FWH-70B (70)
4A0009	5	9.4	15	15	25	FWH-90B (90)
4A0011	7.5	14	25	20	40	FWH-90B (90)
4A0018	10	20	40	35	60	FWH-80B (80)
4A0023	15	24	45	40	70	FWH-100B (100)
4A0031	20	38	75	60	110	FWH-125B (125)
4A0038	25	44	75	75	125	FWH-200B (200)
4A0044	30	52	100	90	150	FWH-250A (250)
4A0058	40	58	100	100	150	FWH-250A (250)
4A0072	50	71	125	110	200	FWH-250A (250)
4A0088	60	86	150	150	250	FWH-250A (250)
4A0103	75	105	200	175	300	FWH-250A (250)
4A0139	100	142	250	225	400	FWH-350A (350)
4A0165	125	170	300	250	500	FWH-400A (400)
4A0208	150	207	400	350	600	FWH-500A (500)
4A0250	200	248	450	400	700	FWH-600A (600)
4A0296	250	300	600	500	800	FWH-700A (700)
4A0362	300	346	600	600	1000 <5>	FWH-800A (800)
4A0414	350	410	800	700	1200 <5>	FWH-800A (800)
4A0515	400 - 450	465	900	800	1350 <5>	FWH-1000A (1000)
4A0675	500 - 600	657	1200	1100 <5>	1800 <5>	FWH-1200A (1200)
600 V Class						
5A0003	2	3.6	15	6.25	10	FWP-50B (50)
5A0004	3	5.1	15	8	15	FWP-50B (50)
5A0006	5	8.3	15	12	20	FWP-60B (60)
5A0009	7.5	12	20	20	35	FWP-60B (60)
5A0011	10	16	30	25	45	FWP-70B (70)
5A0017	15	23	40	40	60	FWP-100B (100)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
5A0022	20	31	60	50	90	FWP-100B (100)
5A0027	25	38	75	60	110	FWP-125A (125)
5A0032	30	45	75	75	125	FWP-125A (125)
5A0041	40	44	75	75	125	FWP-175A (175)
5A0052	50	54	100	90	150	FWP-175A (175)
5A0062	60	66	125	110	175	FWP-250A (250)
5A0077	75	80	150	125	225	FWP-250A (250)
5A0099	100	108	175	175	300	FWP-250A (250)
5A0125	125	129	225	225	350	FWP-350A (350)
5A0145	150	158	300	275	450	FWP-350A (350)
5A0192	200	228	400	350	600	FWP-600A (600)
5A0242	250	263	500	450	700	FWP-600A (600)

<1> Maximum MCCB Rating is 15 A, or 200 % of drive input current rating, whichever is larger. MCCB voltage rating must be 600 VAC or greater.

<2> Maximum Time Delay fuse is 175% of drive input current rating. This covers any Class CC, J or T class fuse.

<3> Maximum Non-time Delay fuse is 300% of drive input current rating. This covers any CC, J or T class fuse.

<4> When using semiconductor fuses, Bussman FWH and FWP are required for UL compliance. Select FWH for 200 V Class and 400 V Class models and FWP fuses for 600 V models.

<5> Class L fuse is also approved for this rating.

◆ Attachment for External Heatsink Mounting

An external attachment can be used to project the heatsink outside of an enclosure to ensure that there is sufficient air circulation around the heatsink.

Contact a Yaskawa sales representative or Yaskawa directly for more information on this attachment.

◆ 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

Consider the following application precautions when using motor thermal overload relays on the output of AC drives 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.

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. Motor overheating may occur even when the load current is within the motor rated value. 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 to disable thermal overload protection for the drive.

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. Failure to comply could result in death or serious injury.*

Appendix: A

Specifications

A.1 POWER RATINGS.....374
A.2 DRIVE SPECIFICATIONS.....383
A.3 DRIVE WATT LOSS DATA.....385
A.4 DRIVE DERATING DATA.....387

A.1 Power Ratings

◆ Three-Phase 200 V Class Drive Models 2A0004 to 2A0030

Table A.1 Power Ratings (Three-Phase 200 V Class)

Item			Specification							
Drive Model			2A0004	2A0006	2A0008	2A0010	2A0012	2A0018	2A0021	2A0030
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	0.75	1	2	3	3	5	7.5	10
Input	Input Current (A) <2>	ND Rating	3.9	7.3	8.8	10.8	13.9	18.5	24	37
	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)	ND Rating	2.2	3.1	4.1	5.8	7.8	9.5	14	18
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	1.3	2.3	3	3.7	4.6	6.7	8	11.4
	Rated Output Current (A)	ND Rating <5>	3.5	6	8	9.6	12	17.5	21	30
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)							
	Carrier Frequency		User adjustable between 2 to 15 kHz							
	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)							
	Maximum Output Frequency (Hz)		400 Hz (user-set)							

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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.

◆ Three-Phase 200 V Class Drive Models 2A0040 to 2A0211

Table A.2 Power Ratings Continued (Three-Phase 200 V Class)

Item			Specification							
Drive Model			2A0040	2A0056	2A0069	2A0081	2A0110	2A0138	2A0169	2A0211
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	15	20	25	30	40	50	60	75
Input	Input Current (A) <2>	ND Rating	52	68	80	96	111	136	164	200
	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)	ND Rating	27	36	44	52	51	62	75	91
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	15.2	21	26	31	42	53	64	80
	Rated Output Current (A)	ND Rating <5>	40	56	69	81	110	138	169	211
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)							
	Carrier Frequency		User adjustable between 2 to 15 kHz						User adjustable between 2 and 10 kHz	
	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)							
	Maximum Output Frequency (Hz)		400 Hz (user-set)							

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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.

◆ Three-Phase 200 V Class Drive Models 2A0250 to 2A0415

Table A.3 Power Ratings Continued (Three-Phase 200 V Class)

Item			Specification			
Drive Models			2A0250	2A0312	2A0360	2A0415
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	100	125	150	175
Input	Input Current (A) <2>	ND Rating	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)	ND Rating	124	148	180	215
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	95	119	137	158
	Rated Output Current (A)	ND Rating <5>	250	312	360	415
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)			
	Carrier Frequency		User adjustable between 2 to 10 kHz			
	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)			
	Maximum Output Frequency (Hz)		400 Hz (user-set)			

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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.

◆ Three-Phase 400 V Class Drive Models 4A0002 to 4A0031

Table A.4 Power Ratings (Three-Phase 400 V Class)

Item			Specification								
Drive Models			4A0002	4A0004	4A0005	4A0007	4A0009	4A0011	4A0018	4A0023	4A0031
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	0.75	2	3	3	5	7.5	10	15	20
Input	Input Current (A) <2>	ND Rating	2.1	4.3	5.9	8.1	9.4	14	20	24	38
	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)	ND Rating	2.3	4.3	6.1	8.1	10.0	14.5	19.4	28.4	37.5
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	1.6	3.1	4.1	5.3	6.7	8.5	13.3	17.5	24
	Rated Output Current (A)	ND Rating <5>	2.1	4.1	5.4	6.9	8.8	11.1	17.5	23	31
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)								
	Carrier Frequency		User adjustable between 2 to 15 kHz								
	Maximum Output Voltage (V)		Three-phase: 380 to 480 V (proportional to input voltage)								
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)								

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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.

◆ Three-Phase 400 V Class Drive Models 4A0038 to 4A0165

Table A.5 Power Ratings Continued (Three-Phase 400 V Class)

Item			Specification							
Drive Models			4A0038	4A0044	4A0058	4A0072	4A0088	4A0103	4A0139	4A0165
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	25	30	40	50	60	75	100	125
Input	Input Current (A) <2>	ND Rating	44	52	58	71	86	105	142	170
	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)	ND Rating	46.6	54.9	53.0	64.9	78.6	96.0	130	156
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	29	34	44	55	67	78	106	126
	Rated Output Current (A)	ND Rating <5>	38	44	58	72	88	103	139	165
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)							
	Carrier Frequency		User adjustable between 2 to 15 kHz						User adjustable between 2 to 10 kHz	
	Maximum Output Voltage (V)		Three-phase: 380 to 480 V (proportional to input voltage)							
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)							

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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.

◆ Three-Phase 400 V Class Drive Models 4A0208 to 4A0675

Table A.6 Power Ratings Continued (Three-Phase 400 V Class)

Item			Specification						
Drive Models			4A0208	4A0250	4A0296	4A0362	4A0414	4A0515	4A0675
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	150	200	250	300	350	400-450	500-550
Input	Input Current (A) <2>	ND Rating	207	248	300	346	410	465	657
	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)	ND Rating	189	227	274	316	375	425	601
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	159	191	226	276	316	392	514
	Rated Output Current (A)	ND Rating <5>	208	250	296	362	414	515	675
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)						
	Carrier Frequency		User-adjustable between 2 and 10 kHz				User-adjustable between 2 and 5 kHz		
	Maximum Output Voltage (V)		Three-phase: 380 to 480 V (proportional to input voltage)						
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)						

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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.

◆ Three-Phase 600 V Class Drive Models 5A0003 to 5A0032

Table A.7 Power Ratings (Three-Phase 600 V Class)

Item			Specification								
Drive Models			5A0003	5A0004	5A0006	5A0009	5A0011	5A0017	5A0022	5A0027	5A0032
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	2	3	5	7.5	10	15	20	25	30
Input	Input Current (A) <2>	ND Rating	3.6	5.1	8.3	12	16	23	31	38	45
	Rated Voltage Rated Frequency		Three-phase 500 to 600 Vac 50/60 Hz								
	Allowable Voltage Fluctuation		-10 (-15) to +10%								
	Allowable Frequency Fluctuation		±5%								
	Input Power (kVA)	ND Rating	4.1	5.8	9.5	14	18	26	35	43	51
Output	Rated Output Capacity (kVA) <3>	ND Rating <4>	2.7	3.9	6.1	9	11	17	22	27	32
	Rated Output Current (A)	ND Rating <4>	2.7	3.9	6.1	9	11	17	22	27	32
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)								
	Carrier Frequency		User adjustable between 2 and 15 kHz					User adjustable between 2 and 10 kHz			
	Maximum Output Voltage (V)		Three-phase 500 to 600 V (proportional to input voltage)								
	Maximum Output Frequency (Hz)		400 Hz (user-set)								

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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> Rated motor capacity is calculated with a rated output voltage of 575 V.

<4> Carrier frequency is set to 2 kHz. Current derating is required to raise the carrier frequency.

◆ Three-Phase 600 V Class Drive Models 5A0041 to 5A0099

Table A.8 Power Ratings Continued (Three-Phase 600 V Class)

Item			Specification				
Drive Models			5A0041	5A0052	5A0062	5A0077	5A0099
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	40	50	60	75	100
Input	Input Current (A) <2>	ND Rating	44	54	66	80	108
	Rated Voltage Rated Frequency		Three-phase 500 to 600 Vac 50/60 Hz				
	Allowable Voltage Fluctuation		-10 (-15) to +10%				
	Allowable Frequency Fluctuation		±5%				
	Input Power (kVA)	ND Rating	50	62	75	91	123
Output	Rated Output Capacity (kVA) <3>	ND Rating <4>	41	52	62	77	99
	Rated Output Current (A)	ND Rating <4>	41	52	62	77	99
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)				
	Carrier Frequency		User adjustable between 2 and 10 kHz				User adjustable between 2 and 8 kHz
	Maximum Output Voltage (V)		Three-phase 500 to 600 V (proportional to input voltage)				
	Maximum Output Frequency (Hz)		400 Hz (user-set)				

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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> Rated motor capacity is calculated with a rated output voltage of 575 V.

<4> Carrier frequency can be increased to 2 kHz while keeping this current derating. Higher carrier frequency settings require derating.

◆ Three-Phase 600 V Class Drive Models 5A0125 to 5A0242

Table A.9 Power Ratings Continued (Three-Phase 600 V Class)

Item			Specification			
Drive Models			5A0125	5A0145	5A0192	5A0242
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	125	150	200	250
Input	Input Current (A) <2>	ND Rating	129	158	228	263
	Rated Voltage Rated Frequency		Three-phase 500 to 600 Vac 50/60 Hz			
	Allowable Voltage Fluctuation		-10 (-15) to +10%			
	Allowable Frequency Fluctuation		±5%			
	Input Power (kVA)	ND Rating	147	181	261	301
Output	Rated Output Capacity (kVA) <3>	ND Rating <4>	124	144	191	241
	Rated Output Current (A)	ND Rating <4>	125	145	192	242
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)			
	Carrier Frequency		User adjustable between 2 and 3 kHz			
	Maximum Output Voltage (V)		Three-phase 500 to 600 V (proportional to input voltage)			
	Maximum Output Frequency (Hz)		400 Hz (user-set)			

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate 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> Rated motor capacity is calculated with a rated output voltage of 575 V.

<4> Carrier frequency can be increased to 2 kHz while keeping this current derating. Higher carrier frequency settings require derating.

A.2 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	V/f Control (V/f)
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within ±0.01% of the max output frequency (-10 to +40 °C) Analog input: within ±0.1% of the max output frequency (25 °C ±10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign) Resolution of analog inputs A1 and A3 is 10 bit + sign in current mode
	Output Frequency Resolution	0.001 Hz
	Frequency Setting Signal	Main speed frequency reference: DC -10 to +10 V (20 kΩ), DC 0 to +10 V (20 kΩ), 4 to 20 mA (250 Ω), 0 to 20 mA (250 Ω) Main speed reference: Pulse train input (max. 32 kHz)
	Starting Torque <1>	V/f: 150% at 3 Hz
	Speed Control Range <1>	V/f: 1:40
	Accel/Decel Time	0.0 to 6000.0 s (2 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Approx. 20% (approx. 125% when using braking resistor) <2> • Short-time decel torque <3> : 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 <4> (overexcitation braking/High Slip Braking: approx. 40%) • Continuous regenerative torque: approx. 20% <4> (approx. 125% with dynamic braking resistor option <2> : 10% ED, 10s)
	Braking Transistor	Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052 have a built-in braking transistor.
	V/f Characteristics	User-selected programs and V/f preset patterns possible
	Main Control Functions	Droop Control, Feed Forward Control, Momentary Power Loss Ride-Thru, Speed Search, Overtorque/ Undertorque Detection, Torque Limit, 17 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, Frequency Jump, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Braking, High Slip Braking, PI Control (with sleep function), Energy Saving Control, MEMOBUS/Modbus Comm. (RS-422/RS-485 max, 115.2 kbps), Fault Restart, Application Presets, Removable Terminal Block with Parameter Backup Function, Online Tuning, KEB, Overexcitation Deceleration, Overvoltage Suppression, High Frequency Injection, Dynamic Noise Control
Protection Functions	Motor Protection	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when output current exceeds 170% of rated output current
	Overload Protection	Drive stops when rated output current is 120% for 60 s <5>
	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 600 V class: Stops when DC bus voltage exceeds approx. 1040 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 600 V class: Stops when DC bus voltage falls below approx. 475 V

Item		Specification
Protection Functions	Momentary Power Loss Ride-Thru	Immediately stop after 15 ms or longer power loss <6>. Continuous operation during power loss than 2 s (standard) <7>
	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 <8>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	Area of Use	Indoors
	Ambient Temperature	-10 to +40 °C (IP20/NEMA Type 1 enclosure), -10 to +50 °C (IP00/Open Type enclosure)
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 to +60 °C (short-term temperature during transportation)
	Altitude	Up to 1000 meters without derating, up to 3000 m with output current and voltage derating. *Refer to Altitude Derating on page 390* for details.
	Vibration/Shock	10 to 20 Hz: 9.8 m/s^2 20 to 55 Hz: 5.9 m/s^2 (2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) 2.0 m/s^2 (2A0250 to 2A0415, 4A0208 to 4A0675, and 5A0125 to 5A0242)
Safety Standard		UL 508C (Power Conversion), UL/cUL listed, CSA 22.2 No. 14-05 (Industrial Control Equipment), CE marked, RoHS compliant, EN 61800-5-1 (LVD), EN 61800-3 (EMC), IEC60529
Protection Design		IP00/Open Type enclosure, IP20/NEMA Type 1 enclosure <9>

<1> 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.

<2> Disable Stall Prevention 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.

<3> 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.

<4> Actual specifications may vary depending on motor characteristics.

<5> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<6> May be shorter due to load conditions and motor speed.

<7> A separate Momentary Power Loss Ride-Thru Unit is required for models 2A0004 to 2A0056 and 4A0002 to 4A0031 if the application needs to continue running for up to 2 seconds during a momentary power loss.

<8> 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.

<9> Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity. This is applicable to models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242.

A.3 Drive Watt Loss Data

Table A.10 Watt Loss 200 V Class Three-Phase Models

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
2A0004	3.5	18.4	47	66
2A0006	6.0	31	51	82
2A0008	8.0	43	52	95
2A0010	9.6	57	58	115
2A0012	12.0	77	64	141
2A0018	17.5	101	67	168
2A0021	21	138	83	222
2A0030	30	262	117	379
2A0040	40	293	145	437
2A0056	56	371	175	546
2A0069	69	491	205	696
2A0081	81	527	257	785
2A0110	110	719	286	1005
2A0138	138	842	312	1154
2A0169	169	1014	380	1394
2A0211	211	1218	473	1691
2A0250	250	1764	594	2358
2A0312	312	2020	665	2686
2A0360	360	2698	894	3591
2A0415	415	2672	954	3626

<1> Value assumes the carrier frequency is set to 2 kHz.

Table A.11 Watt Loss 400 V Class Three-Phase Models

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4A0002	2.1	20	48	68
4A0004	4.1	32	49	81
4A0005	5.4	45	53	97
4A0007	6.9	62	59	121
4A0009	8.8	66	60	126
4A0011	11.1	89	73	162
4A0018	17.5	177	108	285
4A0023	23	216	138	354
4A0031	31	295	161	455
4A0038	38	340	182	521
4A0044	44	390	209	599
4A0058	58	471	215	686
4A0072	72	605	265	870
4A0088	88	684	308	993
4A0103	103	848	357	1205
4A0139	139	1215	534	1749
4A0165	165	1557	668	2224
4A0208	208	1800	607	2408
4A0250	250	2379	803	3182
4A0296	296	2448	905	3353
4A0362	362	3168	1130	4298

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4A0414	414	3443	1295	4738
4A0515	515	4850	1668	6518
4A0675	675	4861	2037	6898

<1> Value assumes the carrier frequency is set to 2 kHz.

Table A.12 Watt Loss Three-Phase 600 V Class Three-Phase Models

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
5A0003	2.7	21.5	23.3	44.8
5A0004	3.9	27.5	33.6	61.1
5A0006	6.1	28.1	43.7	71.8
5A0009	9.0	43.4	68.9	112.3
5A0011	11	56.1	88.0	144.0
5A0017	17	96.6	146.7	243.2
5A0022	22	99.4	178.3	277.7
5A0027	27	132.1	227.2	359.3
5A0032	32	141.6	279.9	421.5
5A0041	41	330.8	136.2	467.0
5A0052	52	427.8	166.2	594.0
5A0062	62	791.2	279.0	1070.2
5A0077	77	959.1	329.4	1288.6
5A0099	99	1253.2	411.7	1664.9
5A0125	125	1641	537	2178
5A0145	145	1860	603	2463
5A0192	192	2420	769	3189
5A0242	242	3100	1131	4231

<1> Value assumes the carrier frequency is set to 2 kHz.

A.4 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 table below shows the drive output current depending on the carrier frequency settings.

■ Normal Duty Rating (ND)

The 2 kHz values shown for ND in *Table A.15* are equal to the drive rated current shown on the drive nameplate. Increasing the carrier frequency above 2 kHz will reduce the ND rated output current of the drive as shown in *Table A.15*.

Table A.13 Three-Phase 200 V Class Carrier Frequency and Current Derating

Three-Phase 200 V Class			
Drive Model	Rated Current [A]		
	Normal Duty Rating (ND)		
	2 kHz	8 kHz	15 kHz
2A0004	3.5	3.2	2.56
2A0006	6	5	4
2A0008	8	6.9	5.5
2A0010	9.6	8	6.4
2A0012	12	11	8.8
2A0018	17.5	14	11.2
2A0021	21	17.5	14
2A0030	30	25	20
2A0040	40	33	26.4
2A0056	56	47	37.6
2A0069	69	60	48
2A0081	81	75	53
2A0110	110	85	60
2A0138	138	115	81

Three-Phase 200 V Class			
Drive Model	Rated Current [A]		
	Normal Duty Rating (ND)		
	2 kHz	5 kHz	10 kHz
2A0169	169	145	116
2A0211	211	180	144
2A0250	250	215	172
2A0312	312	283	226
2A0360	360	346	277
2A0415	415	415	332

Table A.14 Three-Phase 400 V Class Carrier Frequency and Current Derating

Three-Phase 400 V Class			
Drive Model	Rated Current [A]		
	Normal Duty Rating (ND)		
	2 kHz	8 kHz	15 kHz
4A0002	2.1	1.8	1.1
4A0004	4.1	3.4	2
4A0005	5.4	4.8	2.9
4A0007	6.9	5.5	3.3
4A0009	8.8	7.2	4.3

Three-Phase 400 V Class			
Drive Model	Rated Current [A]		
	Normal Duty Rating (ND)		
	2 kHz	8 kHz	15 kHz
4A0011	11.1	9.2	5.5
4A0018	17.5	14.8	8.9
4A0023	23	18	10.8
4A0031	31	24	14.4
4A0038	38	31	18.6
4A0044	44	39	23.4
4A0058	58	45	27
4A0072	72	60	36
4A0088	88	75	45
4A0103	103	91	55

Three-Phase 400 V Class			
Drive Model	Rated Current [A]		
	Normal Duty Rating (ND)		
	2 kHz	5 kHz	10 kHz
4A0139	139	112	78
4A0165	165	150	105
4A0208	208	180	126
4A0250	250	216	151
4A0296	296	260	182
4A0362	362	304	213
4A0414	414	370	–
4A0515	515	397	–
4A0675	675	528	–

Table A.15 Carrier Frequency and Current Derating

Three-Phase 600 V Class				
Drive Model	Rated Current [A]			
	Normal Duty Rating (ND)			
	2 kHz	8 kHz	10 kHz	15 kHz
5A0003	2.7	2.2	2.0	1.3
5A0004	3.9	3.4	3.1	2.1
5A0006	6.1	4.9	4.3	2.9
5A0009	9	7.5	6.6	4.5
5A0011	11	9.3	8.2	5.6
5A0017	17	13.3	11.8	–
5A0022	22	17.0	15.1	–
5A0027	27	22.0	19.5	–
5A0032	32	27.3	24.4	–

Three-Phase 600 V Class				
Drive Model	Rated Current [A]			
	Normal Duty Rating (ND)			
	2 kHz	5 kHz	8 kHz	10 kHz
5A0041	41.0	39.7	33.5	29.4
5A0052	52.0	50.3	42.5	37.3
5A0062	62.0	61.3	49.7	41.9
5A0077	77.0	76.2	61.7	52.0

Three-Phase 600 V Class				
Drive Model	Rated Current [A]			
	Normal Duty Rating (ND)			
	2 kHz	5 kHz	8 kHz	10 kHz
5A0099	99.0	80.0	55.1	–

Three-Phase 600 V Class		
Drive Model	Rated Current [A]	
	Normal Duty Rating (ND)	
	2 kHz	3 kHz
5A0125	125.0	93.0
5A0145	145.0	108.0
5A0192	192.0	148.0
5A0242	242.0	187.0

◆ Temperature Derating

To ensure the maximum performance life, the drive output current must be derated as shown in *Figure A.1* when the drive is installed in areas with high ambient temperature or if drives are mounted side-by-side in a cabinet. In order to ensure reliable drive overload protection, set parameters L8-12 and L8-35 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: IP00/Open-Chassis Enclosure 1: Side-by-Side Mounting 2: IP20/NEMA Type 1 Enclosure 3: Finless Drive or External Heatsink Installation	0 to 3	<1>

<1> Default setting is determined by drive model.
Setting 0: (Models 2A0250 to 2A0415 and 4A0208 to 4A0675)
Setting 2: (Models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242).

IP00/Open-Chassis Enclosure

Drive operation between -10 °C and +50 °C allows 100% continuous current without derating.

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.

IP20/NEMA Type 1 Enclosure

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.

External Heatsink Installation, Finless Drive

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.

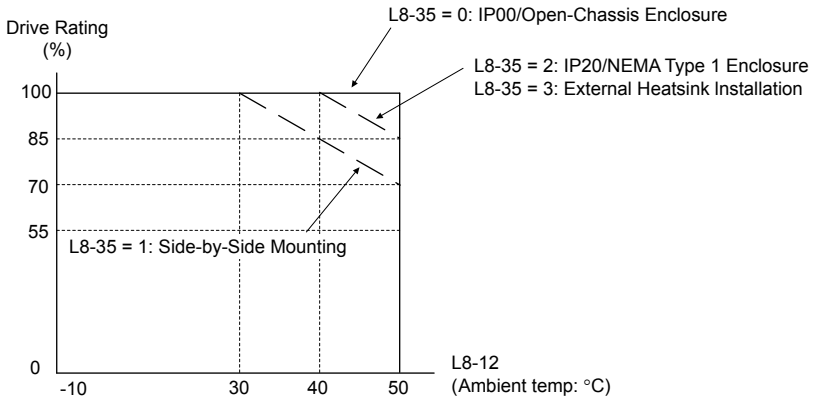


Figure A.1 Ambient Temperature and Installation Method Derating

◆ Altitude Derating

The drive standard ratings are valid for installation altitudes up to 1000 m. For installations from 1000 m to 3000 m, the drive rated voltage and the rated output current must be derated for 0.2% per 100 m.

Appendix: B

Parameter List

This appendix contains a full listing of all parameters and settings available in the drive.

B.1 UNDERSTANDING PARAMETER DESCRIPTIONS....392
B.2 A: INITIALIZATION PARAMETERS....393
B.3 B: APPLICATION....394
B.4 C: TUNING....400
B.5 D: REFERENCES....402
B.6 E: MOTOR PARAMETERS....405
B.7 H PARAMETERS: MULTI-FUNCTION TERMINALS....411
B.8 L: PROTECTION FUNCTION....420
B.9 N: SPECIAL ADJUSTMENT....427
B.10 O: OPERATOR-RELATED SETTINGS....428
B.11 S: SPECIAL APPLICATION....431
B.12 T: MOTOR TUNING....436
B.13 U: MONITORS....437
B.14 V/F PATTERN DEFAULT VALUES....445
B.15 DEFAULTS BY DRIVE MODEL....446

B.1 Understanding Parameter Descriptions

◆ Parameter Icons

The table below lists icons used in this section.

Table B.1 Icons Used in Parameter Descriptions

Symbol	Description
	Parameter can be changed during run.

◆ Parameter Groups

Table B.2 P1000 Parameter Groups

Parameter Group	Name	Page
A1	Initialization Parameters	*393*
A2	User Parameters	*393*
b1	Operation Mode Selection	*394*
b2	DC Injection Braking and Short Circuit Braking	*394*
b3	Speed Search	*395*
b4	Timer Function	*396*
b5	PID Control	*396*
b6	Dwell Function	*399*
b8	Energy Saving	*399*
C1	Acceleration and Deceleration Times	*400*
C2	S-Curve Characteristics	*400*
C3	Slip Compensation	*401*
C4	Torque Compensation	*401*
C6	Carrier Frequency	*401*
d1	Frequency Reference	*402*
d3	Jump Frequency	*403*
d6	Field Weakening and Field Forcing	*404*
E2	Motor 1 Parameters	*406*
F4	Analog Monitor Card (AO-A3)	*406*
H1	Multi-Function Digital Inputs	*411*
H2	Multi-Function Digital Outputs	*414*
H3	Multi-Function Analog Inputs	*416*
H4	Multi-Function Analog Outputs	*417*
H5	MEMOBUS/Modbus Serial Communication	*418*
H6	Pulse Train Input/Output	*419*

Parameter Group	Name	Page
L1	Motor Protection	*420*
L2	Momentary Power Loss Ride-Thru	*420*
L3	Stall Prevention	*421*
L4	Speed Detection	*422*
L5	Fault Restart	*423*
L6	Torque Detection	*423*
L8	Drive Protection	*425*
n1	Hunting Prevention	*427*
n3	High Slip Braking (HSB) and Overexcitation Braking	*427*
o1	Digital Operator Display Selection	*428*
o2	Digital Operator Keypad Functions	*429*
o3	Copy Function	*429*
o4	Maintenance Monitor Settings	*430*
S1	Dynamic Noise Control Function	*431*
S2	Programmable Run Timers	*431*
S3	Secondary PI (PI2) Control	*434*
S6	P1000 Protection	*435*
T1	Induction Motor Auto-Tuning	*436*
U2	Fault Trace	*439*
U3	Fault History	*440*
U4	Maintenance Monitors	*441*
U5	PID Monitors	*443*
U6	Operation Status Monitors	*444*

B.2 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

No. (Addr. Hex)	Name	Description	Values	Page
A1-00 (100) RUN <1>	Language Selection	0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portuguese 7: Chinese	Default: 0 Range: 0 to 7	*134*
A1-01 (101) RUN <2>	Access Level Selection	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 Range: 0 to 2	*134*
A1-03 (103)	Initialize Parameters	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 8008 Pump 8009: Pump w/ PI 8010: Fan 8011: Fan w/ PI	Default: 0 Range: 0 to 5550; 8008 to 8011	*134*
A1-04 (104)	Password	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 A2-33 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	*135*
A1-05 (105)	Password Setting	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 A2-33 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	*135*
A1-06 (127)	Application Preset	0: General-purpose 8: Pump 9: Pump w/PI 10: Fan 11: Fan w/PI **Note:** This parameter is not settable. It is used as a monitor only.	Default: 0 Range: 0; 8 to 11	*138*

<1> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Default setting value is dependent on the Initialization parameter A1-03.

◆ A2: User Parameters

No. (Addr. Hex)	Name	Description	Values	Page
A2-01 to A2-32 (106 to 125)	User Parameters 1 to 32	Recently edited parameters are listed here. The user can also select parameters to appear here for quicker access.	Default: <1> Range: b1-01 to S6-07	*138*
A2-33 (126)	User Parameter Automatic Selection	0: Parameters A2-01 to 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 quicker access.	Default: 0 Range: 0, 1	*138*

<1> Default setting value is dependent on the Initialization parameter A1-03.

B.3 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. Hex)	Name	Description	Values	Page
b1-01 (180)	Frequency Reference Selection 1	0: Digital operator 1: Analog input terminals 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse input (terminal RP)	Default: 1 Range: 0 to 4	*139*
b1-02 (181)	Run Command Selection 1	0: Digital operator 1: Digital input terminals 2: MEMOBUS/Modbus communications 3: Option PCB	Default: 1 Range: 0 to 3	*140*
b1-03 (182)	Stopping Method Selection	0: Ramp to stop 1: Coast to stop 2: DC Injection Braking to stop 3: Coast with timer	Default: 0 Range: 0 to 3	*141*
b1-04 (183)	Reverse Operation Selection	0: Reverse enabled. 1: Reverse disabled.	Default: 0 Range: 0, 1	*143*
b1-07 (186)	LOCAL/REMOTE Run Selection	0: An external Run command must be cycled at the new source in order to be activated. 1: An external Run command at the new source is accepted immediately.	Default: 0 Range: 0, 1	*143*
b1-08 (187)	Run Command Selection in Programming Mode	0: Run command is not accepted while in Programming Mode. 1: Run command is accepted while in Programming Mode. 2: Prohibit entering Programming Mode during run.	Default: 0 Range: 0 to 2	*143*
b1-11 (1DF)	Run Delay Time Setting Run Delay Time	After a Run command is entered, the drive output waits until this delay time has passed before starting.	Default: 0 s Min.: 0 Max.: 600	*144*
b1-14 (1C3)	Phase Order Selection	0: Standard 1: Switch phase order (reverses the direction of the motor)	Default: 0 Range: 0, 1	*144*
b1-15 (1C4)	Frequency Reference Selection 2	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 Range: 0 to 4	*144*
b1-16 (1C5)	Run Command Selection 2	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 Range: 0 to 3	*144*
b1-17 (1C6)	Run Command at Power Up	0: Disregarded. A new Run command must be issued after power up. 1: Allowed. Motor will start immediately after power up if a Run command is already enabled.	Default: 0 Range: 0, 1	*144*

◆ b2: DC Injection Braking and Short Circuit Braking

No. (Addr. Hex)	Name	Description	Values	Page
b2-01 (189)	DC Injection Braking Start Frequency	Sets the frequency at which DC Injection Braking starts when “Ramp to stop” (b1-03 = 0) is selected.	Default: 0.5 Hz Min.: 0.0 Max.: 10.0	*144*
b2-02 (18A)	DC Injection Braking Current	Sets the DC Injection Braking current as a percentage of the drive rated current.	Default: 50% Min.: 0 Max.: 100	*145*
b2-03 (18B)	DC Injection Braking Time at Start	Sets DC Injection Braking time at start. Disabled when set to 0.00 seconds.	Default: 0.00 s Min.: 0.00 Max.: 10.00	*145*

No. (Addr. Hex)	Name	Description	Values	Page
b2-04 (18C)	DC Injection Braking Time at Stop	Sets DC Injection Braking time at stop.	Default: 0.50 s Min.: 0.00 Max.: 10.00	*145*

◆ b3: Speed Search

No. (Addr Hex.)	Name	Description	Values	Page
b3-01 (191)	Speed Search Selection at Start	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*148*
b3-02 (192)	Speed Search Deactivation Current	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.	Default: 120% Min.: 0 Max.: 200	*148*
b3-03 (193)	Speed Search Deceleration Time	Sets output frequency reduction time during Speed Search.	Default: 2.0 s Min.: 0.1 Max.: 10.0	*148*
b3-04 (194)	V/f Gain during Speed Search	Determines how much to lower the V/f ratio during Speed Search. Output voltage during Speed Search equals the V/f setting multiplied by b3-04.	Default: <1> Min.: 10% Max.: 100%	*149*
b3-05 (195)	Speed Search Delay Time	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.	Default: 0.2 s Min.: 0.0 Max.: 100.0	*149*
b3-06 (196)	Output Current 1 during Speed Search	Sets the current injected to the motor at the beginning of Speed Estimation Speed Search. Set as a coefficient for the motor rated current.	Default: <1> Min.: 0.0 Max.: 2.0	*149*
b3-07 (197)	Output Current 2 during Speed Search (Speed Estimation Type)	Sets the amount of output current during Speed Estimation Speed Search as a coefficient for the no-load current.	Default: <1> Min.: 0.0 Max.: 5.0	*149*
b3-08 (198)	Current Control Gain during Speed Search (Speed Estimation Type)	Sets the proportional gain for the current controller during Speed Search.	Default: 0.8 Min.: 0.00 Max.: 6.00	*149*
b3-10 (19A)	Speed Search Detection Compensation Gain	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.	Default: 1.05 Min.: 1.00 Max.: 1.20	*149*
b3-12 (19C)	Minimum Current Detection Level during Speed Search	Sets the minimum current detection level during Speed Search.	Default: 6.0 Min.: 2.0 Max.: 10.0	*149*
b3-14 (19E)	Bi-Directional Speed Search Selection	0: Disabled (uses the direction of the frequency reference) 1: Enabled (drive detects which way the motor is rotating)	Default: 1 Range: 0, 1	*149*
b3-17 (1F0)	Speed Search Restart Current Level	Sets the Speed Search restart current level as a percentage of the drive rated current.	Default: 150% Min.: 0 Max.: 200	*150*
b3-18 (1F1)	Speed Search Restart Detection Time	Sets the time to detect Speed Search restart.	Default: 0.10 s Min.: 0.00 Max.: 1.00	*150*
b3-19 (1F2)	Number of Speed Search Restarts	Sets the number of times the drive can attempt to restart when performing Speed Search.	Default: 3 Min.: 0 Max.: 10	*150*
b3-24 (1C0)	Speed Search Method Selection	0: Current Detection 1: Speed Estimation	Default: 0 Range: 0, 1	*150*
b3-25 (1C8)	Speed Search Wait Time	Sets the time the drive must wait between each Speed Search restart attempt.	Default: 0.5 s Min.: 0.0 Max.: 30.0	*150*
b3-26 (1C7)	Direction Determining Level	Sets the level that determines the direction of motor rotation.	Default: <1> Min.: 40 Max.: 60000	*150*
b3-27 (1C9)	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. 0: Triggered when a Run command is issued (normal). 1: Triggered when an external baseblock is released.	Default: 0 Range: 0, 1	*150*

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ b4: Timer Function

No. (Addr. Hex)	Name	Description	Values	Page
b4-01 (1A3)	Timer Function On-Delay Time	Sets 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).	Default: 0.0 s Min.: 0.0 Max.: 3000.0	*151*
b4-02 (1A4)	Timer Function Off-Delay Time		Default: 0.0 s Min.: 0.0 Max.: 3000.0	*151*

◆ b5: PID Control

No. (Addr. Hex)	Name	Description	Values	Page
b5-01 (1A5)	PID Function Setting	0: Disabled 1: Enabled (PID output becomes output frequency reference, deviation D controlled)	Default: 0 Range: 0, 1	*155*
b5-02 (1A6) RUN	Proportional Gain Setting (P)	Sets the proportional gain of the PID controller.	Default: 1.00 Min.: 0.00 Max.: 25.00	*155*
b5-03 (1A7) RUN	Integral Time Setting (I)	Sets the integral time for the PID controller.	Default: 1.0 s Min.: 0.0 Max.: 360.0	*155*
b5-04 (1A8) RUN	Integral Limit Setting	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	*155*
b5-05 (1A9) RUN	Derivative Time (D)	Sets D control derivative time.	Default: 0.00 s Min.: 0.00 Max.: 10.00	*155*
b5-06 (1AA) RUN	PID Output Limit	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	*155*
b5-07 (1AB) RUN	PID Offset Adjustment	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	*155*
b5-08 (1AC) RUN	PID Primary Delay Time Constant	Sets a low pass filter time constant on the output of the PID controller.	Default: 0.00 s Min.: 0.00 Max.: 10.00	*155*
b5-09 (1AD)	PID Output Level Selection	0: Normal output (direct acting) 1: Reverse output (reverse acting)	Default: 0 Range: 0, 1	*156*
b5-10 (1AE) RUN	PID Output Gain Setting	Sets the gain applied to the PID output.	Default: 1.00 Min.: 0.00 Max.: 25.00	*156*
b5-11 (1AF)	PID Output Reverse Selection	0: Negative PID output triggers zero limit. 1: Rotation direction reverses with negative PID output. **Note:** When using setting 1, make sure reverse operation is permitted by b1-04.	Default: 0 Range: 0, 1	*156*
b5-12 (1B0)	PID Feedback Loss Detection Selection	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 Range: 0 to 5	*157*
b5-13 (1B1)	PID Feedback Loss Detection Level	Sets the PID feedback loss detection level as a percentage of the maximum output frequency.	Default: 0% Min.: 0 Max.: 100	*157*

No. (Addr. Hex)	Name	Description	Values	Page
b5-14 (1B2)	PID Feedback Loss Detection Time	Sets a delay time for PID feedback loss.	Default: 1.0 s Min.: 0.0 Max.: 25.5	*157*
b5-15 (1B3)	PID Sleep Function Start Level	Sets the frequency level that triggers the sleep function.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*158*
b5-16 (1B4)	PID Sleep Delay Time	Sets a delay time before the sleep function is triggered.	Default: 0.0 s Min.: 0.0 Max.: 25.5	*158*
b5-17 (1B5)	PID Accel/Decel Time	Sets the acceleration and deceleration time to PID setpoint.	Default: 0.0 s Min.: 0.0 Max.: 6000.0	*158*
b5-18 (1DC)	PID Setpoint Selection	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*159*
b5-19 (1DD) RUN *<1>*	PID Setpoint Value	Sets the PID target value as a percentage of the maximum output frequency when b5-18 is set to 1. **Note:** Values set above b5-38 will be internally limited to b5-38	Default: 0.00% Min.: 0.00 Max.: 600.00	*159*
b5-20 (1E2)	PID Setpoint Scaling PID Disp Scaling	0: 0.01 Hz units 1: 0.01% units (100% = max output frequency) 2: RPM (number of motor poles must entered) 3: User-set (set scaling to b5-38 and b5-39, units based on b5-46 setting)	Default: 1 Range: 0 to 3	*160*
b5-34 (19F) RUN	PID Output Lower Limit	Sets the minimum output possible from the PID controller as a percentage of the maximum output frequency.	Default: 0.00% Min.: -100.00 Max.: 100.00	*163*
b5-35 (1A0) RUN	PID Input Limit	Limits the PID control input (deviation signal) as a percentage of the maximum output frequency. Acts as a bipolar limit.	Default: 1000.0% Min.: 0.0 Max.: 1000.0	*163*
b5-36 (1A1)	PID Feedback High Detection Level	Sets the PID feedback high detection level as a percentage of the maximum output frequency.	Default: 100% Min.: 0 Max.: 100	*158*
b5-37 (1A2)	PID Feedback High Detection Time	Sets the PID feedback high level detection delay time.	Default: 1.0 s Min.: 0.0 Max.: 25.5	*158*
b5-38 (1FE)	PID Setpoint User Display PID UsrDspMaxVal	Scales the PID units to the maximum output frequency.	Default: 10000 Min.: 1 Max.: 60000	*161*
b5-39 (1FF)	PID Setpoint Display Digits PID UsrDspDigits	0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places	Default: 2 Range: 0 to 3	*161*
b5-40 (17F)	Frequency Reference Monitor Content during PID	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 Range: 0, 1	*163*
b5-41 (160)	PI Output 2 Unit Selection PI Out2 Unit Sel	0: WC $_{0:\ WC}$ (Inch of water) 1: PSI $_{1:\ PSI}$ (Pounds per square inch) 2: GPM $_{2:\ GPM}$ (Gallons per minute) 3: F $_{3:\ °F}$ (Degrees Fahrenheit) 4: CFM $_{4:\ CFM}$ (Cubic feet per minute) 5: CMH $_{5:\ CMH}$ (Cubic meters per hour) 6: LPH $_{6:\ LPH}$ (Liters per hour) 7: LPS $_{7:\ LPS}$ (Liters per second) 8: Bar $_{8:\ Bar}$ (Bar) 9: Pa $_{9:\ Pa}$ (Pascal) 10: C $_{10:\ °C}$ (Degrees Celsius) 11: Mtr $_{11:\ Mtr}$ (Meters) 12: Ft $_{12:\ Ft}$ (Feet) 13: LPM $_{13:\ LPM}$ (Liters per minute) 14: CMM $_{14:\ CMM}$ (Cubic meters per minute) 15: “Hg $_{15:\ Hg}$(Inches of Mercury) 25: None$_{25:\ None}$	Default: 0 Range: 0 to 15; 25	*163*

No. (Addr. Hex)	Name	Description	Values	Page
b5-42 (161) RUN	PI Output 2 Calculation Mode PI Out2 Calc Mode	0: Linear - the monitor displays PID output 0: Linear 1: Square root - the monitor displays square root PID output 1: Square root 2: Quadratic - the monitor displays 1/(PID output) 2: 1/f2 3: Cubic - the monitor displays 1/(PID output) 3: 1/f3 **Note:** Used for U5-14 and U5-15 only.	Default: 0 Range: 0 to 3	*164*
b5-43 (162) RUN	PI Output 2 Monitor Max Upper 4 Digits PI Out2 MonMax U	Sets the upper 4 digits of the maximum monitor value. Used with b5-44 to set maximum monitor value of U5-14 and U5-15 at maximum frequency. **Note:** Used for U5-14 and U5-15 only.	Default: 0 Min.: 0 Max.: 9999	*164*
b5-44 (163) RUN	PI Output 2 Monitor Max Lower 4 Digits PI Out2 MonMax L	Sets the lower 4 digits of the maximum monitor value. Used with b5-43 to set maximum monitor value of U5-14 and U5-15 at maximum frequency. **Note:** Used for U5-14 and U5-15 only.	Default: 0 Min.: 0 Max.: 99.99	*164*
b5-45 (164) RUN	PI Output 2 Monitor Minimum PI Out2 MonMin	Sets the minimum display value at zero speed. This function is effective when b5-42 is set to 0 (Linear output mode). **Note:** Used for U5-14 and U5-15 only.	Default: 0 Min.: 0 Max.: 999.9	*164*
b5-46 (165)	PID Units Selection PID Unit Sel	Sets the display units for parameter b5-19, and monitors U5-01, U5-04 and U5-99 0: WC 0: WC (Inch of water) 1: PSI 1: PSI (Pounds per square inch) 2: GPM 2: GPM (Gallons per minute) 3: F 3: °F (Degrees Fahrenheit) 4: CFM 4: CFM (Cubic feet per minute) 5: CMH 5: CMH (Cubic meters per hour) 6: LPH 6: LPH (Liters per hour) 7: LPS 7: LPS (Liters per second) 8: Bar 8: Bar (Bar) 9: Pa 9: Pa (Pascal) 10: C 10: °C (Degrees Celsius) 11: Mtr 11: Mtr (Meters) 12: Ft 12: Ft (Feet) 13: LPM 13: LPM (Liters per minute) 14: CMM 14: CMM (Cubic meters per minute) 15: “Hg 15: Hg(Inches of Mercury) 25: None25: None	Default: 0 Range: 0 to 15; 25	*161*
b5-47 (17D)	Reverse Operation Selection 2 by PID Output Output Rev Sel2	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 Range: 0, 1	*163*
b5-89 (B89) RUN	Sleep Method Selection Sleep Method Sel	Determines how the drive sleeps and wakes-up when using PID. 0: Standard 1: EZ Sleep/Wake-up	Default: 0 Range: 0, 1	*161*
b5-90 (B90) *<1>*	EZ Sleep Unit EZ Sleep Unit	Sets the unit, range, and resolution of parameters b5-91 and b5-92. 0: Hz 1: RPM (number of motor poles must be entered)	Default: 0 Range: 0, 1	*162*
b5-91 (B91) RUN *<1>*	EZ Minimum Speed EZ Min Speed	Sets the PID minimum speed and integral lower limit. The internal value is lower limited to the higher setting between b5-34 and d2-02.	Default: 0.0 Hz Range: 0.0 to 400.0 Hz or 0 to 24000 RPM *<2>*	*162*
b5-92 (B92) RUN *<1>*	EZ Sleep Level EZ Sleep Level	The drive will go to sleep when the drive output frequency (or speed) is at or below this level for the time set in b5-93. This parameter is internally lower limited to b5-91 (EZ Min Speed) + 1Hz.	Default: 0.0 Hz Range: 0.0 to 400.0 Hz or 0 to 24000 RPM *<2>*	*162*
b5-93 (B93) RUN *<1>*	EZ Sleep Time EZ Sleep Time	The drive will go to sleep when the drive output frequency is at or below the level set to b5-92 for the time set in this parameter.	Default: 5.0 s Min.: 0.0 Max.: 1000.0	*162*

No. (Addr. Hex)	Name	Description	Values	Page
b5-94 (B94) RUN <1>	EZ Wake-up Level EZ Wake-up Lvl	When b5-95 is set to 0 (Absolute), the drive wakes-up when the PID Feedback (H3-☐☐ = 20) drops below this level for the time set in b5-96. For reverse-acting, the PID Feedback must be above this level for the time set in b5-96. When b5-95 is set to 1 (Setpoint Delta), the drive wakes-up when the PID Feedback (H3-☐☐ = 20) drops below the PID Setpoint minus this level (for normal acting PID) for the time set in b5-96. For reverse-acting, Wake-up level is PID Setpoint plus this level. The PID Feedback must be above the wake-up level for the time set in b5-96.	Default: 0.00% Min.: 0.00 Max.: 600.00	*162*
b5-95 (B95) <1>	EZ Wake-up Mode EZ Wake-up Mode	Sets how the wake-up level is determined. 0: Absolute 1: Setpoint Delta	Default: 0 Range: 0, 1	*162*
b5-96 (B96) RUN <1>	EZ Wake-up Time EZ Wake-up Time	The drive will wake up when the PID Feedback drops below the b5-94, EZ Wake-up Level for the time set in this parameter.	Default: 1.0 s Min.: 0.0 Max.: 1000.0	*163*

<1> Unit and resolution are determined by b5-20, b5-39 and b5-46. Internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of this parameter.

<2> Parameter is only effective when EZ Sleep is enabled by setting b5-89 to 1.

<3> Unit, range and resolution is determined by b5-90. Changing b5-90 will not automatically update the value of this parameter.

◆ b6: Dwell Function

No. (Addr. Hex)	Name	Description	Values	Page
b6-01 (1B6)	Dwell Reference at Start	Parameters b6-01 and b6-02 set the frequency to hold and the time to maintain that frequency at start.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*166*
b6-02 (1B7)	Dwell Time at Start		Default: 0.0 s Min.: 0.0 Max.: 10.0	*166*
b6-03 (1B8)	Dwell Reference at Stop	Parameters b6-03 and b6-04 set the frequency to hold and the time to maintain that frequency at stop.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*166*
b6-04 (1B9)	Dwell Time at Stop		Default: 0.0 s Min.: 0.0 Max.: 10.0	*166*

◆ b8: Energy Saving

No. (Addr. Hex)	Name	Description	Values	Page
b8-01 (1CC)	Energy Saving Control Selection	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*166*
b8-04 (1CF)	Energy Saving Coefficient Value	Determines the level of maximum motor efficiency. Setting range is 0.0 to 2000.0 for drives 3.7 kW and smaller. The display resolution depends on the rated output power of the drive.	Default: <1> <2> Min.: 0.00 Max.: 655.00	*166*
b8-05 (1D0)	Power Detection Filter Time	Sets a time constant filter for output power detection.	Default: 20 ms Min.: 0 Max.: 2000	*166*
b8-06 (1D1)	Search Operation Voltage Limit	Sets the limit for the voltage search operation as a percentage of the motor rated voltage.	Default: 0% Min.: 0 Max.: 100	*167*

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

B.4 C: Tuning

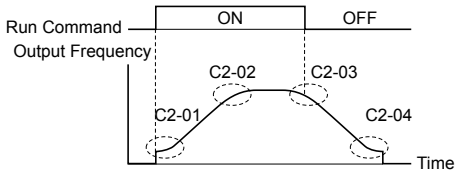
C parameters are used to adjust the acceleration and deceleration times, S-curves, torque compensation, and carrier frequency selections.

◆ C1: Acceleration and Deceleration Times

No. (Addr. Hex)	Name	Description	Values	Page
C1-01 (200) RUN	Acceleration Time 1	Sets the time to accelerate from 0 to maximum frequency.	Default: 10.0 s Min.: 0.0 Max.: 6000.0 <1>	*168*
C1-02 (201) RUN	Deceleration Time 1	Sets the time to decelerate from maximum frequency to 0.		*168*
C1-03 (202) RUN	Acceleration Time 2	Sets the time to accelerate from 0 to maximum frequency.	Default: 10.0 s Min.: 0.0 Max.: 6000.0 <1>	*168*
C1-04 (203) RUN	Deceleration Time 2	Sets the time to decelerate from maximum frequency to 0.		*168*
C1-09 (208) RUN	Fast Stop Time	Sets the time for the Fast Stop function.	Default: 10.0 s Min.: 0.0 Max.: 6000.0 <1>	*169*
C1-10 (209)	Accel/Decel Time Setting Units	0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	Default: 1 Range: 0, 1	*169*
C1-11 (20A)	Accel/Decel Time Switching Frequency	Sets the frequency to switch between accel/decel time settings	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*168*

<1> 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. Hex)	Name	Description	Values	Page
C2-01 (20B)	S-Curve Characteristic at Accel Start	The S-curve can be controlled at the four points shown below.  	Default: 0.20 s Min.: 0.00 Max.: 10.00	*169*
C2-02 (20C)	S-Curve Characteristic at Accel End		Default: 0.20 s Min.: 0.00 Max.: 10.00	*169*
C2-03 (20D)	S-Curve Characteristic at Decel Start		Default: 0.20 s Min.: 0.00 Max.: 10.00	*169*
C2-04 (20E)	S-Curve Characteristic at Decel End		Default: 0.00 s Min.: 0.00 Max.: 10.00	*169*

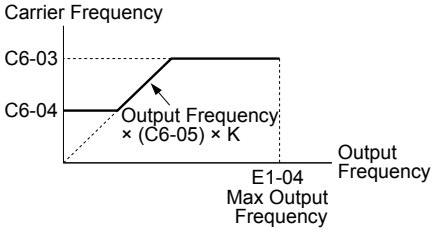
◆ C3: Slip Compensation

No. (Addr. Hex)	Name	Description	Values	Page
C3-01 (20F) RUN	Slip Compensation Gain	Sets the gain for the motor slip compensation function used for motor 1.	Default: 0.0 Min.: 0.0 Max.: 2.5	*170*
C3-02 (210) RUN	Slip Compensation Primary Delay Time	Adjusts the slip compensation function delay time used for motor 1.	Default: 2000 ms Min.: 0 Max.: 10000	*170*
C3-03 (211)	Slip Compensation Limit	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	*170*
C3-04 (212)	Slip Compensation Selection during Regeneration	0: Disabled. 1: Enabled above 6 Hz. 2: Enabled whenever slip compensation is possible.	Default: 0 Range: 0 to 2	*170*

◆ C4: Torque Compensation

No. (Addr. Hex)	Name	Description	Values	Page
C4-01 (215) RUN	Torque Compensation Gain	Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Used for motor 1.	Default: 1.00 Min.: 0.00 Max.: 2.50	*171*
C4-02 (216) RUN	Torque Compensation Primary Delay Time 1	Sets the torque compensation filter time.	Default: 200 ms Min.: 0 ms Max.: 60000 ms	*171*

◆ C6: Carrier Frequency

No. (Addr. Hex)	Name	Description	Values	Page
C6-02 (224)	Carrier Frequency Selection	1: 2.0 kHz 2: 5.0 kHz (4.0 kHz) 3: 8.0 kHz (6.0 kHz) 4: 10.0 kHz (8.0 kHz) 5: 12.5 kHz (10.0 kHz) 6: 15.0 kHz (12.0 kHz) 7: Swing PWM1 (Audible sound 1) 8: Swing PWM2 (Audible sound 2) 9: Swing PWM3 (Audible sound 3) A: Swing PWM4 (Audible sound 4) B to E: No setting possible F: User-defined (determined by C6-03 through C6-05)	Default: 7 Range: 1 to 9; A, F	*171*
C6-03 (225)	Carrier Frequency Upper Limit	Determines the upper and lower limits for the carrier frequency. 	Default: *<1>* Min.: 1.0 kHz Max.: 15.0 kHz	*172*
C6-04 (226)	Carrier Frequency Lower Limit		Default: *<1>* Min.: 1.0 kHz Max.: 15.0 kHz	*172*
C6-05 (227)	Carrier Frequency Proportional Gain		Default: *<1>* Min.: 0 Max.: 99	*172*

<1> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection.

B.5 d: References

Reference parameters set the various frequency reference values during operation.

◆ d1: Frequency Reference

No. (Addr. Hex)	Name	Description	Values	Page
d1-01 (280) RUN	Frequency Reference 1	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-02 (281) RUN	Frequency Reference 2	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-03 (282) RUN	Frequency Reference 3	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-04 (283) RUN	Frequency Reference 4	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-05 (284) RUN	Frequency Reference 5	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-06 (285) RUN	Frequency Reference 6	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-07 (286) RUN	Frequency Reference 7	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-08 (287) RUN	Frequency Reference 8	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-09 (288) RUN	Frequency Reference 9	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-10 (28B) RUN	Frequency Reference 10	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-11 (28C) RUN	Frequency Reference 11	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-12 (28D) RUN	Frequency Reference 12	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-13 (28E) RUN	Frequency Reference 13	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-14 (28F) RUN	Frequency Reference 14	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-15 (290) RUN	Frequency Reference 15	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173
d1-16 (291) RUN	Frequency Reference 16	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	173

No. (Addr. Hex)	Name	Description	Values	Page
d1-17 (292) RUN	Jog Frequency Reference	Sets the Jog frequency reference. Setting units are determined by parameter o1-03.	Default: 6.00 Hz Min.: 0.00 Max.: 400.00 <1>	173

<1> Range upper limit is determined by parameters d2-01, Frequency Reference Upper Limit, and E1-04, Maximum Output Frequency.

◆ d2: Frequency Upper/Lower Limits

No. (Addr. Hex.)	Name	Description	Setting	Page
d2-01 (289)	Frequency Reference Upper Limit	Sets the frequency reference upper limit as a percentage of the maximum output frequency.	Default: 100.0% Min.: 0.0 Max.: 110.0	175
d2-02 (28A)	Frequency Reference Lower Limit	Sets the frequency reference lower limit as a percentage of the maximum output frequency.	Default: 0.0% Min.: 0.0 Max.: 110.0	175
d2-03 (293)	Master Speed Reference Lower Limit	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	176

◆ d3: Jump Frequency

No. (Addr. Hex)	Name	Description	Values	Page
d3-01 (294)	Jump Frequency 1	Eliminates problems with resonant vibration of the motor/machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	176
d3-02 (295)	Jump Frequency 2	Eliminates problems with resonant vibration of the motor/machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	176
d3-03 (296)	Jump Frequency 3	Eliminates problems with resonant vibration of the motor/machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	176
d3-04 (297)	Jump Frequency Width	Sets the dead-band width around each selected prohibited frequency reference point.	Default: 1.0 Hz Min.: 0.0 Max.: 20.0	176

◆ d4: Frequency Reference Hold and Up/Down 2 Function

No. (Addr. Hex)	Name	Description	Values	Page
d4-01 (298)	Frequency Reference Hold Function Selection	0: Disabled. Drive starts from zero when the power is switched on. 1: Enabled. At power up, the drive starts the motor at the Hold frequency that was saved.	Default: 0 Range: 0, 1	177
d4-03 (2AA) RUN	Frequency Reference Bias Step (Up/Down 2)	Sets the bias added to the frequency reference when the Up 2 and Down 2 digital inputs are enabled (H1-□□ = 75, 76).	Default: 0.00 Hz Min.: 0.00 Max.: 99.99	178
d4-04 (2AB) RUN	Frequency Reference Bias Accel/Decel (Up/Down 2)	0: Use selected accel/decel time. 1: Use accel/decel time 4 (C1-07 and C1-08). **Note:** The functionality of setting 1 is only accessible via MEMOBUS/Modbus communication.	Default: 0 Range: 0, 1	179

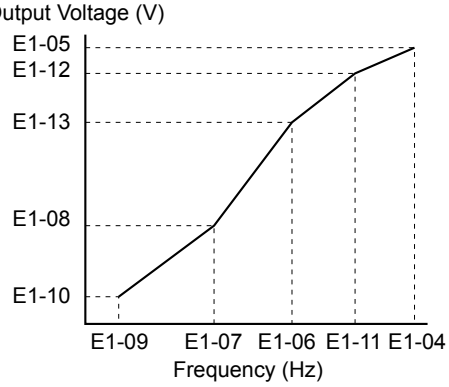
No. (Addr. Hex)	Name	Description	Values	Page
d4-05 (2AC) RUN	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	0: Bias value is held if no input Up 2 or Down 2 is active. 1: When the Up 2 reference and Down 2 reference are both on or both off, the applied bias becomes 0. The specified accel/decel times are used for acceleration or deceleration.	Default: 0 Range: 0, 1	*179*
d4-06 (2AD)	Frequency Reference Bias (Up/Down 2)	The Up/Down 2 bias value is saved in d4-06 when the frequency reference is not input by the digital operator. Set as a percentage of the maximum output frequency.	Default: 0.0% Min.: -99.9 Max.: 100.0	*180*
d4-07 (2AE) RUN	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	Limits how much the frequency reference is allowed to change while an input terminal set for Up 2 or Down 2 is enabled. If the frequency reference changes for more than the set value, then the bias value is held and the drive accelerates or decelerates to the frequency reference. Set as a percentage of the maximum output frequency.	Default: 0.01% Min.: 0.01 Max.: 100.0	*180*
d4-08 (2AF) RUN	Frequency Reference Bias Upper Limit (Up/Down 2)	Sets the upper limit for the bias and the value that can be saved in d4-06. Set as a percentage of the maximum output frequency.	Default: 1.0% Min.: 0.0 Max.: 100.0	*180*
d4-09 (2B0) RUN	Frequency Reference Bias Lower Limit (Up/Down 2)	Sets the lower limit for the bias and the value that can be saved in d4-06. Set as a percentage of the maximum output frequency.	Default: 0.0% Min.: -99.9 Max.: 0.0	*180*
d4-10 (2B6)	Up/Down Frequency Reference Limit Selection	0: The lower limit is determined by d2-02 or an analog input. 1: The lower limit is determined by d2-02.	Default: 0 Range: 0, 1	*180*

◆ d6: Field Weakening and Field Forcing

No. (Addr Hex.)	Name	Description	Values	Page
d6-01 (2A0)	Field Weakening Level	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).	Default: 80% Min.: 0 Max.: 100	*181*
d6-02 (2A1)	Field Weakening Frequency Limit	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).	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*181*

B.6 E: Motor Parameters

◆ E1: V/f Pattern

No. (Addr. Hex)	Name	Description	Values	Page
E1-01 (300)	Input Voltage Setting	This parameter must be set to the power supply voltage. **WARNING!** *Electrical Shock Hazard. 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: 230 V <1> Min.: 155 Max.: 255 <1>	182
E1-03 (302)	V/f Pattern Selection	0: 50 Hz, Constant torque 1 1: 60 Hz, Constant torque 2 2: 60 Hz, Constant torque 3 (50 Hz base) 3: 72 Hz, Constant torque 4 (60 Hz base) 4: 50 Hz, Variable torque 1 5: 50 Hz, Variable torque 2 6: 60 Hz, Variable torque 3 7: 60 Hz, Variable torque 4 8: 50 Hz, High starting torque 1 9: 50 Hz, High starting torque 2 A: 60 Hz, High starting torque 3 B: 60 Hz, High starting torque 4 C: 90 Hz (60 Hz base) D: 120 Hz (60 Hz base) E: 180 Hz (60 Hz base) F: Custom V/f, E1-04 through E1-13 settings define the V/f pattern	Default: F <2> Range: 0 to 9; A to FF	182
E1-04 (303)	Maximum Output Frequency	These parameters are only applicable when E1-03 is set to F. 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 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04  	Default: 60.0 Hz Min.: 40.0 Max.: 400.0	185
E1-05 (304)	Maximum Voltage		Default: 575 V <1> Min.: 0.0 Max.: 255.0	185
E1-06 (305)	Base Frequency		Default: 60.0 Hz Min.: 0.0 Max.: E1-04	185
E1-07 (306)	Middle Output Frequency		Default: 3.0 Hz Min.: 0.0 Max.: E1-04	185
E1-08 (307)	Middle Output Frequency Voltage		Default: 15.0 V <1> Min.: 0.0 V Max.: 255.0 V	185
E1-09 (308)	Minimum Output Frequency		Default: 1.5 Hz Min.: 0.0 Max.: E1-04	185
E1-10 (309)	Minimum Output Frequency Voltage		Default: 9.0 V <1> Min.: 0.0 V Max.: 255.0 V	185
E1-11 (30A) <4>	Middle Output Frequency 2		Default: 0.0 Hz Min.: 0.0 Max.: E1-04	185
E1-12 (30B) <4>	Middle Output Frequency Voltage 2		Default: 0.0 V Min.: 0.0 Max.: 255.0 V <1>	185
E1-13 (30C)	Base Voltage		Default: 0.0 V <3> Min.: 0.0 Max.: 255.0 V <1>	185

<1> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

<2> Parameter setting value is not reset to the default value when the drive is initialized.

<3> When Auto-Tuning is performed, E1-13 and E1-05 will be set to the same value.

<4> 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.

◆ E2: Motor 1 Parameters

No. (Addr. Hex)	Name	Description	Values	Page
E2-01 (30E)	Motor Rated Current	Sets the motor nameplate full load current in amps. Automatically set during Auto-Tuning.	Default: <1> Min.: 10% of drive rated current Max.: 200% of drive rated current <2>	186
E2-02 (30F)	Motor Rated Slip	Sets the motor rated slip. Automatically set during Auto-Tuning.	Default: <1> Min.: 0.00 Hz Max.: 20.00 Hz	186
E2-03 (310)	Motor No-Load Current	Sets the no-load current for the motor. Automatically set during Auto-Tuning.	Default: <1> Min.: 0 A Max.: E2-01 <2>	187
E2-04 (311)	Number of Motor Poles	Sets the number of motor poles. Automatically set during Auto-Tuning.	Default: 4 Min.: 2 Max.: 48	187
E2-05 (312)	Motor Line-to-Line Resistance	Sets the phase-to-phase motor resistance. Automatically set during Auto-Tuning.	Default: <1> Min.: 0.000 Ω Max.: 65.000 Ω	187
E2-06 (313)	Motor Leakage Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. Automatically set during Auto-Tuning.	Default: <1> Min.: 0.0% Max.: 40.0%	187
E2-10 (317)	Motor Iron Loss for Torque Compensation	Sets the motor iron loss.	Default: <1> Min.: 0 W Max.: 65535 W	187
E2-11 (318)	Motor Rated Power	Sets the motor rated power in kilowatts (1 HP = 0.746 kW). Automatically set during Auto-Tuning.	Default: <1> Min.: 0.00 kW Max.: 650.00 kW	187

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> The number of decimal places in the parameter value depends on the drive model 1. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

◆ F4: Analog Monitor Card (AO-A3)

No. (Addr. Hex)	Name	Description	Values	Page
F4-01 (391)	Terminal V1 Monitor Selection	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 Range: 000 to 999	189
F4-02 (392) RUN	Terminal V1 Monitor Gain	Sets the gain for voltage output via terminal V1.	Default: 100.0% Min.: -999.9 Max.: 999.9	189
F4-03 (393)	Terminal V2 Monitor Selection	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 Range: 000 to 999	189
F4-04 (394) RUN	Terminal V2 Monitor Gain	Sets the gain for voltage output via terminal V2.	Default: 50.0% Min.: -999.9 Max.: 999.9	189
F4-05 (395) RUN	Terminal V1 Monitor Bias	Sets the amount of bias added to the voltage output via terminal V1.	Default: 0.0% Min.: -999.9 Max.: 999.9	189
F4-06 (396) RUN	Terminal V2 Monitor Bias	Sets the amount of bias added to the voltage output via terminal V2.	Default: 0.0% Min.: -999.9 Max.: 999.9	189
F4-07 (397)	Terminal V1 Signal Level	0: 0 to 10 V 1: -10 to 10 V	Default: 0 Range: 0, 1	189

No. (Addr. Hex)	Name	Description	Values	Page
F4-08 (398)	Terminal V2 Signal Level	0: 0 to 10 V 1: -10 to 10 V	Default: 0 Range: 0, 1	*189*

◆ F6, F7: Communication Option Card

Parameters F6-01 through F6-03 and F6-06 through F6-08 are used for CC-Link, CANopen, DeviceNet, PROFIBUS-DP, and MECHATROLINK-II options. Other parameters in the F6 group are used for communication-protocol-specific settings. F7 parameters are used for EtherNet/IP, Modbus TCP/IP, and PROFINET options.

No. (Addr. Hex)	Name	Description	Values	Page
F6-01 (3A2)	Communications Error Operation Selection	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 Range: 0 to 3	*190*
F6-02 (3A3)	External Fault from Comm. Option Detection Selection	0: Always detected. 1: Detection during run only.	Default: 0 Range: 0, 1	*190*
F6-03 (3A4)	External Fault from Comm. Option Operation Selection	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 Range: 0 to 3	*190*
F6-04 (3A5)	bUS Error Detection Time	Sets the delay time for error detection if a bus error occurs.	Default: 2.0 s Min.: 0.0 Max.: 5.0	*191*
F6-07 (3A8)	Multi-Step Speed Enable/ Disable Selection when NefRef/ComRef is Selected	0: Multi-step reference disabled (same as F7) 1: Multi-step reference enabled (same as V7)	Default: 0 Range: 0, 1	*190*
F6-08 (36A) <1>	Reset Communication Parameters	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 Range: 0, 1	*191*
F6-10 (3B6)	CC-Link Node Address	Sets the node address if a CC-Link option is installed.	Default: 0 Min.: 0 Max.: 64	*191*
F6-11 (3B7)	CC-Link Communication Speed	0: 156 Kbps 1: 625 Kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	Default: 0 Range: 0 to 4	*191*
F6-14 (3BB)	CC-Link bUS Error Auto Reset	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*191*
F6-20 (36B)	MECHATROLINK Station Address	Sets the station address when the MECHATROLINK-II option has been installed.	Default: 21 Min.: 20 Max.: 3F	—
F6-21 (36C)	MECHATROLINK Frame Size	0: 32 byte 1: 17 byte	Default: 0 Range: 0, 1	—
F6-22 (36D)	MECHATROLINK Link Speed	0: 10 Mbps 1: 4 Mbps	Default: 0 Range: 0, 1	—
F6-23 (36E)	MECHATROLINK Monitor Selection (E)	Sets the MECHATROLINK-II monitor (E).	Default: 0 Min.: 0 Max.: FFFF	—
F6-24 (36F)	MECHATROLINK Monitor Selection (F)	Sets the MECHATROLINK-II monitor (F).	Default: 0 Min.: 0 Max.: FFFF	—
F6-25 (3C9)	Operation Selection at Watchdog Timer Error (E5)	0: Ramp to stop. Decelerate using the deceleration time in C1-02. 1: Coast to stop 2: Fast stop. Decelerate using the deceleration time in C1-09. 3: Alarm only	Default: 1 Range: 0 to 3	—
F6-26 (3CA)	MECHATROLINK bUS Errors Detected	Sets the number of option communication errors (bUS).	Default: 2 Min.: 2 Max.: 10	—

No. (Addr. Hex)	Name	Description	Values	Page
F6-30 (3CB)	PROFIBUS-DP Node Address	Sets the node address.	Default: 0 Min.: 0 Max.: 125	*192*
F6-31 (3CC)	PROFIBUS-DP Clear Mode Selection	0: Resets drive operation with a Clear mode command. 1: Maintains the previous operation state when Clear mode command is given.	Default: 0 Range: 0, 1	*192*
F6-32 (3CD)	PROFIBUS-DP Data Format Selection	0: PPO Type 1: Conventional	Default: 0 Range: 0, 1	*193*
F6-35 (3D0)	CANopen Node ID Selection	Sets the node address.	Default: 0 Min.: 0 Max.: 126	*193*
F6-36 (3D1)	CANopen Communication Speed	0: Auto-detection 1: 10 kbps 2: 20 kbps 3: 50 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1 Mbps	Default: 6 Range: 0 to 8	*193*
F6-50 (3C1)	DeviceNet MAC Address	Selects the drive MAC address.	Default: 64 Min.: 0 Max.: 64	*193*
F6-51 (3C2)	DeviceNet Communication Speed	0: 125 kbps 1: 250 kbps 2: 500 kbps 3: Adjustable from network 4: Detect automatically	Default: 4 Range: 0 to 4	*193*
F6-52 (3C3)	DeviceNet PCA Setting	Sets the format of the data set from the DeviceNet master to the drive.	Default: 21 Min.: 0 Max.: 255	*194*
F6-53 (3C4)	DeviceNet PPA Setting	Sets the format of the data set from the drive to the DeviceNet master.	Default: 71 Min.: 0 Max.: 255	*194*
F6-54 (3C5)	DeviceNet Idle Mode Fault Detection	0: Enabled 1: Disabled, no fault detection	Default: 0 Range: 0, 1	*194*
F6-55 (3C6)	DeviceNet Baud Rate Monitor	Verifies the baud rate running on the network. 0: 125 kbps 1: 250 kbps 2: 500 kbps	Default: 0 Range: 0 to 2	*194*
F6-56 (3D7)	DeviceNet Speed Scaling	Sets the scaling factor for the speed monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	*194*
F6-57 (3D8)	DeviceNet Current Scaling	Sets the scaling factor for the output current monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	*194*
F6-58 (3D9)	DeviceNet Torque Scaling	Sets the scaling factor for the torque monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	*194*
F6-59 (3DA)	DeviceNet Power Scaling	Sets the scaling factor for the power monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	*194*
F6-60 (3DB)	DeviceNet Voltage Scaling	Sets the scaling factor for the voltage monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	*194*
F6-61 (3DC)	DeviceNet Time Scaling	Sets the scaling factor for the time monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	*194*
F6-62 (3DD)	DeviceNet Heartbeat Interval	Sets the heartbeat interval for DeviceNet communications.	Default: 0 Min.: 0 Max.: 10	*195*
F6-63 (3DE)	DeviceNet Network MAC ID	Saves and monitors settings 0 to 63 of F6-50 (DeviceNet MAC Address).	Default: 63 Min.: 0 Max.: 63	*195*

No. (Addr. Hex)	Name	Description	Values	Page
F6-64 to F6-71 (3DF to 3C8)	Reserved	Reserved for Dynamic I/O Assembly Parameters.	–	–
F7-01 (3E5) <2>	IP Address 1	Sets the most significant octet of network static IP address.	Default: 192 Range: 0 to 255	–
F7-02 (3E6) <2>	IP Address 2	Sets the second most significant octet of network static IP address.	Default: 168 Range: 0 to 255	–
F7-03 (3E7) <2>	IP Address 3	Sets the third most significant octet of network static IP address.	Default: 1 Range: 0 to 255	–
F7-04 (3E8) <2>	IP Address 4	Sets the fourth most significant octet of network static IP address.	Default: 20 Range: 0 to 255	–
F7-05 (3E9)	Subnet Mask 1	Sets the most significant octet of network static Subnet Mask.	Default: 255 Range: 0 to 255	–
F7-06 (3EA)	Subnet Mask 2	Sets the second most significant octet of network static Subnet Mask.	Default: 255 Range: 0 to 255	–
F7-07 (3EB)	Subnet Mask 3	Sets the third most significant octet of network static Subnet Mask.	Default: 255 Range: 0 to 255	–
F7-08 (3EC)	Subnet Mask 4	Sets the fourth most significant octet of network static Subnet Mask.	Default: 0 Range: 0 to 255	–
F7-09 (3ED)	Gateway Address 1	Sets the most significant octet of network Gateway address.	Default: 192 Range: 0 to 255	–
F7-10 (3EE)	Gateway Address 2	Sets the second most significant octet of network Gateway address.	Default: 168 Range: 0 to 255	–
F7-11 (3EF)	Gateway Address 3	Sets the third most significant octet of network Gateway address.	Default: 1 Range: 0 to 255	–
F7-12 (3E0)	Gateway Address 4	Sets the fourth most significant octet of network Gateway address.	Default: 1 Range: 0 to 255	–
F7-13 (3F1)	Address Mode at Startup	Select the option address setting method 0: Static <3> 1: BOOTP 2: DHCP	Default: 2 Range: 0 to 2	–
F7-14 (3F2)	Duplex Mode Selection	Selects duplex mode setting. 0: Half duplex forced 1: Auto-negotiate duplex mode and communication speed 2: Full duplex forced	Default: 1 Range: 0 to 2	–
F7-15 (3F3)	Communication Speed Selection	Sets the communication speed 10: 10 Mbps 100: 100 Mbps	Default: 10 Range: 10, 100	–
F7-16 (3F4)	Communication Loss Timeout	Sets the timeout value for communication loss detection in tenths of a second. A value of 0 disables the connection timeout. Example: An entered value of 100 represents 10.0 seconds.	Default: 0 Min.: 0 Max.: 300	–
F7-17 (3F5)	EtherNet/IP Speed Scaling Factor	Sets the scaling factor for the speed monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-18 (3F6)	EtherNet/IP Current Scaling Factor	Sets the scaling factor for the output current monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-19 (3F7)	EtherNet/IP Torque Scaling Factor	Sets the scaling factor for the torque monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-20 (3F8)	EtherNet/IP Power Scaling Factor	Sets the scaling factor for the power monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-21 (3F9)	EtherNet/IP Voltage Scaling Factor	Sets the scaling factor for the voltage monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–

No. (Addr. Hex)	Name	Description	Values	Page
F7-22 (3FA)	EtherNet/IP Time Scaling	Sets the scaling factor for the time monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-23 to F7-32 (3FB to 374)	Dynamic Output Assembly Parameters	Parameters used in Output Assembly 116. Each parameter contains a MEMOBUS/Modbus address. The value received for Output Assembly 116 will be written to this corresponding MEMOBUS/Modbus address. A MEMOBUS/Modbus address value of 0 means that the value received for Output Assembly 116 will not be written to any MEMOBUS/Modbus register.	Default: 0	–
F7-33 to F7-42 (375 to 37E)	Dynamic Input Assembly Parameters	Parameters used in Input Assembly 166. Each parameter contains a MEMOBUS/Modbus address. The value sent for Input Assembly 166 will be read from this corresponding MEMOBUS/Modbus address. A MEMOBUS/Modbus address value of 0 means that the value sent for Input Assembly 166 is not defined by the user, therefore the option default register value will be returned.	Default: 0	–

<1> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Cycle power for setting changes to take effect.

<3> If F7-13 is set to 0, all IP addresses (F7-01 to F7-04) must be unique.

B.7 H Parameters: Multi-Function Terminals

H parameters assign functions to the multi-function input and output terminals.

◆ H1: Multi-Function Digital Inputs

No. (Addr. Hex)	Name	Description	Values	Page
H1-01 (438)	Multi-Function Digital Input Terminal S1 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 40 (F) <1> Min.: 1 Max.: 9F	*196*
H1-02 (439)	Multi-Function Digital Input Terminal S2 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 41 (F) <1> Min.: 1 Max.: 9F	*196*
H1-03 (400)	Multi-Function Digital Input Terminal S3 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 24 Min.: 0 Max.: 9F	*196*
H1-04 (401)	Multi-Function Digital Input Terminal S4 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 14 Min.: 0 Max.: 9F	*196*
H1-05 (402)	Multi-Function Digital Input Terminal S5 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 3 (0) <1> Min.: 0 Max.: 9F	*196*
H1-06 (403)	Multi-Function Digital Input Terminal S6 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 4 (3) <1> Min.: 0 Max.: 9F	*196*
H1-07 (404)	Multi-Function Digital Input Terminal S7 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 6 (4) <1> Min.: 0 Max.: 9F	*196*
H1-08 (405)	Multi-Function Digital Input Terminal S8 Function Selection	Assigns a function to the multi-function digital inputs. Refer to pages *411* to *414* for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 8 (6) <1> Min.: 0 Max.: 9F	*196*

<1> 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	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.	*197*
1	LOCAL/REMOTE selection	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, Frequency reference and Run command are input from the digital operator.	*197*
2	External reference 1/2 selection	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)	*198*
3	Multi-Step Speed Reference 1	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.	*198*
4	Multi-Step Speed Reference 2	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.	*198*
5	Multi-Step Speed Reference 3	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.	*198*
6	Jog reference selection	Closed: Jog frequency reference (d1-17) selected. Jog has priority over all other reference sources.	*198*
7	Accel/decel time selection 1	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).	*198*
8	Baseblock command (N.O.)	Closed: No drive output	*198*

H1 Multi-Function Digital Input Selections			
H1-☐☐ Setting	Function	Description	Page
9	Baseblock command (N.C.)	Open: No drive output	*198*
A	Accel/decel ramp hold	Open: Accel/decel is not held Closed: The drive pauses during acceleration or deceleration and maintains the output frequency.	*198*
B	Drive overheat alarm (oH2)	Closed: Closes when an oH2 alarm occurs	*199*
C	Analog terminal input selection	Open: Function assigned by H3-14 is disabled. Closed: Function assigned by H3-14 is enabled.	*199*
F	Through mode	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.	*199*
10	Up command	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.	*199*
11	Down command	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.	*199*
12	Forward Jog	Closed: Runs forward at the Jog frequency d1-17.	*200*
13	Reverse Jog	Closed: Runs reverse at the Jog frequency d1-17.	*200*
14	Fault reset	Closed: Resets faults if the cause is cleared and the Run command is removed.	*200*
15	Fast Stop (N.O.)	Closed: Decelerates at the Fast Stop time set to C1-09.	*200*
17	Fast Stop (N.C.)	Open: Decelerates to stop at the Fast Stop time set to C1-09.	*200*
18	Timer function input	Triggers the timer set up by parameters b4-01 and b4-02. Must be set in conjunction with the timer function output (H2-☐☐ = 12).	*201*
19	PID disable	Open: PID control enabled Closed: PID control disabled	*201*
1A	Accel/decel time selection 2	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.	*201*
1B	Program lockout	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.	*201*
1E	Reference sample hold	Closed: Samples the analog frequency reference and operates the drive at that speed.	*201*
20 to 2F	External fault	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)	*202*
30	PID integral reset	Closed: Resets the PID control integral value.	*202*
31	PID integral hold	Open: Performs integral operation. Closed: Maintains the current PID control integral value.	*202*
32	Multi-Step Speed Reference 4	Used in combination with input terminals set to Multi-Step Speed Reference 1, 2, and 3. Use parameters d1-09 to d1-16 to set reference values.	*202*
34	PID soft starter cancel	Open: PID soft starter is enabled. Closed: Disables the PID soft starter b5-17.	*202*
35	PID input level selection	Closed: Inverts the PID input signal.	*202*
40	Forward run command (2-Wire sequence)	Open: Stop Closed: Forward run **Note:** Cannot be set together with settings 42 or 43.	*203*

H1 Multi-Function Digital Input Selections			
H1-□□ Setting	**Function**	**Description**	**Page**
41	Reverse run command (2-Wire sequence)	Open: Stop Closed: Reverse run **Note:** Cannot be set together with settings 42 or 43.	*203*
42	Run command (2-Wire sequence 2)	Open: Stop Closed: Run **Note:** Cannot be set together with settings 40 or 41.	*203*
43	FWD/REV command (2-Wire sequence 2)	Open: Forward Closed: Reverse **Note:** Determines motor direction, but does not issue a Run command. Cannot be set together with settings 40 or 41.	*203*
47	Node setup	Closed: Node setup for SI-S3 enabled.	*203*
51	Sequence Timer Disable SeqTimer Disable	Closed: Drive ignores sequence timers and runs normally (based on b1-02/b1-16 source).	*203*
52	Sequence Timer Cancel SeqTimer Cancel	Closed: When the input changes from open to closed, the currently active sequence timer is disabled. Operation will resume with the next scheduled sequence timer. Cycling the Run command after the current sequence timer has been canceled will re-enable the sequence timer.	*203*
60	DC Injection Braking command	Closed: Triggers DC Injection Braking.	*203*
61	External Speed Search command 1	Closed: Activates Current Detection Speed Search from the maximum output frequency (E1-04).	*204*
62	External Speed Search command 2	Closed: Activates Current Detection Speed Search from the frequency reference.	*204*
63	Field weakening	Closed: The drive performs Field Weakening control as set for d6-01 and d6-02.	*204*
65	KEB Ride-Thru 1 (N.C.)	Open: KEB Ride-Thru 1 enabled.	*204*
66	KEB Ride-Thru 1 (N.O.)	Closed: KEB Ride-Thru 1 enabled.	*204*
67	Communications test mode	Tests the MEMOBUS/Modbus RS-422/RS-485 interface. Displays “PASS” if the test completes successfully.	*204*
68	High Slip Braking (HSB)	Closed: Activates High Slip Braking to stop the drive during a Run command.	*204*
6A	Drive enable	Open: Drive disabled. If this input is opened during run, the drive will stop as specified by b1-03. Closed: Ready for operation.	*204*
75	Up 2 command	Used to control the bias added to the frequency reference by the Up/Down 2 function. The Up 2 and Down 2 commands must always be used in conjunction with one another.	*204*
76	Down 2 command	Used to control the bias added to the frequency reference by the Up/Down 2 function. The Up 2 and Down 2 commands must always be used in conjunction with one another.	*204*
7A	KEB Ride-Thru 2 (N.C.)	Open: KEB Ride-Thru 2 enabled. Drive disregards L2-29 and performs Single Drive KEB Ride-Thru 2.	*205*
7B	KEB Ride-Thru 2 (N.O.)	Closed: KEB Ride-Thru 2 enabled. Drive disregards L2-29 and performs Single Drive KEB Ride-Thru 2.	*205*
A8	Secondary PI Disable (N.O.) PI2 Disable N.O.	Closed: Disables the secondary PI controller. Output behavior depends on the setting of S3-12.	*206*
A9	Secondary PI Disable (N.C.) PI2 Disable N.C.	Closed: Enables the secondary PI controller. Output behavior depends on the setting of S3-12 when open.	*206*
AA	Secondary PI Inverse Operation PI2 Invert	Closed: Changes the sign of the secondary PI controller input (reverse acting PI control).	*206*
AB	Secondary PI Integral Reset PI2 Intgrl Reset	Closed: Resets the secondary PI controller integral value.	*206*
AC	Secondary PI Integral Hold PI2 Intgrl Hold	Closed: Locks the value of the secondary PI controller integral value.	*206*
AD	Select Secondary PI Parameters Select PI2 Parms	Closed: Uses the secondary PI controller Proportional and Integral adjustments (S3-06 and S3-07) instead of the primary PI controller Proportional and Integral adjustments (b5-02 and b5-03). Only valid when S3-01 = 0 (secondary PI controller disabled). **Note:** This multi-function input has no effect on the secondary PI controller. It is only used for the primary PI controller (b5-□□).	*206*
AF	Emergency Override Forward Run EmergOverrideFWD	Closed: Run the drive forward using the speed set in S6-02.	*206*

H1 Multi-Function Digital Input Selections			
H1-□□ Setting	Function	Description	Page
B0	Emergency Override Reverse Run EmergOverrideREV	Closed: Run the drive in reverse using the speed set in S6-02.	*206*

◆ H2: Multi-Function Digital Outputs

No. (Addr. Hex)	Name	Description	Values	Page
H2-01 (40B)	Terminal M1-M2 function selection (relay)	Refer to H2 Multi-Function Digital Output Settings on pages *414* to *415* for descriptions of setting values.	Default: 0 Range: 0 to 192	*206*
H2-02 (40C)	Terminal M3-M4 function selection (relay)		Default: 1 Range: 0 to 192	*206*
H2-03 (40D)	Terminal MD-ME-MF Function Selection		Default: 2 Range: 0 to 192	*206*
H2-06 (437)	Watt Hour Output Unit Selection	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 Range: 0 to 4	*215*

H2 Multi-Function Digital Output Settings			
H2-□□ Setting	Function	Description	Page
0	During run	Closed: A Run command is active or voltage is output.	*207*
1	Zero speed	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.	*207*
2	Speed agree 1	Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	*208*
3	User-set speed agree 1	Closed: Output frequency and speed reference equal L4-01 (plus or minus the hysteresis set to L4-02).	*208*
4	Frequency detection 1	Closed: Output frequency is less than or equal to the value in L4-01 with hysteresis determined by L4-02.	*209*
5	Frequency detection 2	Closed: Output frequency is greater than or equal to the value in L4-01 with hysteresis determined by L4-02.	*209*
6	Drive ready	Closed: Power up is complete and the drive is ready to accept a Run command.	*209*
7	DC bus undervoltage	Closed: DC bus voltage is below the Uv trip level set in L2-05.	*210*
8	During baseblock (N.O.)	Closed: Drive has entered the baseblock state (no output voltage).	*210*
9	Frequency reference source	Open: External Reference 1 or 2 supplies the frequency reference (set in b1-01 or b1-15). Closed: Digital operator supplies the frequency reference.	*210*
A	Run command source	Open: External Reference 1 or 2 supplies the Run command (set in b1-02 or b1-16). Closed: Digital operator supplies the Run command.	*210*
B	Torque detection 1 (N.O.)	Closed: An overtorque or undertorque situation has been detected.	*210*
C	Frequency reference loss	Closed: Analog frequency reference has been lost. Frequency reference loss is detected when the frequency reference drops below 10% of the reference within 400 ms.	*210*
D	Braking resistor fault	Closed: Braking resistor or transistor is overheated or faulted out.	*210*
E	Fault	Closed: Fault occurred.	*210*
F	Through mode	Set this value when using the terminal in the pass-through mode.	*211*
10	Minor fault	Closed: An alarm has been triggered, or the IGBTs have reached 90% of their expected life span.	*211*
11	Fault reset command active	Closed: A command has been entered to clear a fault via the input terminals or from the serial network.	*211*
12	Timer output	Closed: Timer output.	*211*
13	Speed agree 2	Closed: When drive output frequency equals the frequency reference ±L4-04.	*211*
14	User-set speed agree 2	Closed: When the drive output frequency is equal to the value in L4-03 ±L4-04.	*211*
15	Frequency detection 3	Closed: When the drive output frequency is less than or equal to the value in L4-03 ±L4-04.	*212*

H2 Multi-Function Digital Output Settings			
H2-□□ Setting	**Function**	**Description**	**Page**
16	Frequency detection 4	Closed: When the output frequency is greater than or equal to the value in L4-03 ±L4-04.	*212*
17	Torque detection 1 (N.C.)	Open: Overtorque or undertorque has been detected.	*210*
18	Torque detection 2 (N.O.)	Closed: Overtorque or undertorque has been detected.	
19	Torque detection 2 (N.C.)	Open: Overtorque or undertorque has been detected.	*210*
1A	During reverse	Closed: Drive is running in the reverse direction.	*213*
1B	During baseblock (N.C.)	Open: Drive has entered the baseblock state (no output voltage).	*213*
1E	Restart enabled	Closed: An automatic restart is performed	*213*
1F	Motor overload alarm (oL1)	Closed: oL1 is at 90% of its trip point or greater. An oH3 situation also triggers this alarm.	*213*
20	Drive overheat pre-alarm (oH)	Closed: Heatsink temperature exceeds the parameter L8-02 value.	*213*
22	Mechanical weakening detection	Closed: Mechanical weakening detected.	*214*
2F	Maintenance period	Closed: Cooling fan, electrolytic capacitors, IGBTs, or the soft charge bypass relay may require maintenance.	*214*
37	During frequency output	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).	*214*
38	Drive enabled	Closed: Multi-function input set for “Drive enable” is closed (H1-□□ = 6A)	*214*
39	Watt hour pulse output	Output units are determined by H2-06. Outputs a pulse every 200 ms to indicate the kWh count.	*214*
3C	LOCAL/REMOTE status	Open: REMOTE Closed: LOCAL	*214*
3D	During speed search	Closed: Speed Search is being executed.	*214*
3E	PID feedback low	Closed: PID feedback level is too low.	*214*
3F	PID feedback high	Closed: The PID feedback level is too high.	*214*
4A	During KEB Ride-Thru	Closed: KEB Ride-Thru is being performed.	*214*
4C	During fast stop	Closed: A Fast Stop command has been entered from the operator or input terminals.	*214*
4D	oH Pre-alarm time limit	Closed: oH pre-alarm time limit has passed.	*215*
4E	Braking transistor fault (rr)	Closed: The built-in dynamic braking transistor failed.	*215*
4F	Braking resistor overheat (oH)	Closed: The dynamic braking resistor has overheated.	*215*
50	Waiting to Run	Closed: b1-11 Timer is active.	*215*
51	Sequence timer 1 SeqTimer Disable	Closed: Sequence timer 1 is active.	*215*
52	Sequence timer 2 SeqTimer Cancel	Closed: Sequence timer 2 is active.	*215*
53	Sequence timer 3 Sequence timer 3	Closed: Sequence timer 3 is active.	*215*
54	Sequence timer 4 Sequence Timer 4	Closed: Sequence timer 4 is active.	*215*
58	Underload detection UL6	Closed: Underload is detected.	*215*
60	Internal cooling fan alarm	Closed: Internal cooling fan alarm	*215*
71	Secondary PI Feedback Low PI2 Feedback Low	Closed: PI2 feedback level is too low.	*215*
72	Secondary PI Feedback High PI2 FeedbackHigh	Closed: The PI2 feedback level is too high.	*215*
100 to 192	Function 0 to 92 with inverse output	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.	*215*

◆ H3: Multi-Function Analog Inputs

No. (Addr. Hex)	Name	Description	Values	Page
H3-01 (410)	Terminal A1 Signal Level Selection	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use Jumper S1 to set input terminal A1 for a current or voltage input signal.	Default: 0 Range: 0 to 3	*216*
H3-02 (434)	Terminal A1 Function Selection	Sets the function of terminal A1.	Default: 0 Range: 0 to 32	*216*
H3-03 (411) RUN	Terminal A1 Gain Setting	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	*216*
H3-04 (412) RUN	Terminal A1 Bias Setting	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	*216*
H3-05 (413)	Terminal A3 Signal Level Selection	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use Jumper S1 to set input terminal A3 for a current or voltage input signal.	Default: 0 Range: 0 to 3	*217*
H3-06 (414)	Terminal A3 Function Selection	Sets the function of terminal A3.	Default: 2 Range: 0 to 32	*217*
H3-07 (415) RUN	Terminal A3 Gain Setting	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	*217*
H3-08 (416) RUN	Terminal A3 Bias Setting	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	*217*
H3-09 (417)	Terminal A2 Signal Level Selection	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use Jumper S1 to set input terminal A2 for a current or voltage input signal.	Default: 2 Range: 0 to 3	*218*
H3-10 (418)	Terminal A2 Function Selection	Sets the function of terminal A2.	Default: 0 Range: 0 to 32	*218*
H3-11 (419) RUN	Terminal A2 Gain Setting	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	*218*
H3-12 (41A) RUN	Terminal A2 Bias Setting	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	*218*
H3-13 (41B)	Analog Input Filter Time Constant	Sets a primary delay filter time constant for terminals A1, A2, and A3. Used for noise filtering.	Default: 0.03 s Min.: 0.00 Max.: 2.00	*218*
H3-14 (41C)	Analog Input Terminal Enable Selection	Determines which analog input terminals will be enabled 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 Range: 1 to 7	*218*
H3-16 (2F0)	Terminal A1 Offset	Adds an offset when the analog signal to terminal A1 is at 0 V.	Default: 0 Min.: -500 Max.: 500	*219*

No. (Addr. Hex)	Name	Description	Values	Page
H3-17 (2F1)	Terminal A2 Offset	Adds an offset when the analog signal to terminal A2 is at 0 V.	Default: 0 Min.: -500 Max.: 500	*219*
H3-18 (2F2)	Terminal A3 Offset	Adds an offset when the analog signal to terminal A3 is at 0 V.	Default: 0 Min.: -500 Max.: 500	*219*

H3 Multi-Function Analog Input Settings			
H3-☐☐ Setting	Function	Description	Page
0	Frequency bias	10 V = E1-04 (maximum output frequency)	*219*
1	Frequency gain	0 to 10 V signal allows a setting of 0 to 100%. -10 to 0 V signal allows a setting of -100 to 0%.	*219*
2	Auxiliary frequency reference 1	10 V = E1-04 (maximum output frequency)	*219*
3	Auxiliary frequency reference 2	10 V = E1-04 (maximum output frequency)	*220*
4	Output voltage bias	10 V = E1-05 (motor rated voltage)	*220*
5	Accel/decel time gain	10 V = 100%	*220*
6	DC Injection Braking current	10 V = Drive rated current	*220*
7	Overtorque/undertorque detection level	10 V = Drive rated current (V/f)	*220*
8	Stall Prevention level during run	10 V = Drive rated current	*220*
9	Output frequency lower limit level	10 V = E1-04 (maximum output frequency)	*221*
B	PID feedback	10 V = 100%	*221*
C	PID setpoint	10 V = 100%	*221*
D	Frequency bias	10 V = E1-04 (maximum output frequency)	*221*
E	Motor Temperature (PTC Input)	10 V = 100% **Note:** A 12 kΩ resistor must be connected between terminals A1, A2, or A3 and V+ for PTC functionality.	*221*
16	Differential PID feedback	10 V = 100%	*221*
17	Motor Thermistor (NTC)	10 V = -9 °C 0 V = 234 °C	*221*
1F	Through mode	Set this value when using the terminal in the pass-through mode.	*221*
25	Secondary PI Setpoint PI2 Setpoint	10 V = S3-02 (maximum output frequency)	*221*
26	Secondary PI Feedback PI2 Feedback	10 V = S3-02 (maximum output frequency)	*221*

◆ H4: Analog Outputs

No. (Addr. Hex)	Name	Description	Values	Page
H4-01 (41D)	Multi-Function Analog Output Terminal FM Monitor Selection	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 Range: 000 to 999	*221*
H4-02 (41E) RUN	Multi-Function Analog Output Terminal FM Gain	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	*221*
H4-03 (41F) RUN	Multi-Function Analog Output Terminal FM Bias	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	*221*
H4-04 (420)	Multi-Function Analog Output Terminal AM Monitor Selection	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 Range: 000 to 999	*221*

No. (Addr. Hex)	Name	Description	Values	Page
H4-05 (421) RUN	Multi-Function Analog Output Terminal AM Gain	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	*221*
H4-06 (422) RUN	Multi-Function Analog Output Terminal AM Bias	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	*221*
H4-07 (423)	Multi-Function Analog Output Terminal FM Signal Level Selection	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20mA	Default: 0 Range: 0 to 2	*223*
H4-08 (424)	Multi-Function Analog Output Terminal AM Signal Level Selection	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA	Default: 0 Range: 0 to 2	*223*

◆ H5: MEMOBUS/Modbus Serial Communication

No. (Addr. Hex)	Name	Description	Values	Page
H5-01 (425) *<1>*	Drive Node Address	Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	Default: 1F (Hex) Min.: 0 Max.: FF	*468*
H5-02 (426)	Communication Speed Selection	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 Range: 0 to 8	*468*
H5-03 (427)	Communication Parity Selection	0: No parity 1: Even parity 2: Odd parity Cycle power for the setting to take effect.	Default: 0 Range: 0 to 2	*468*
H5-04 (428)	Stopping Method after Communication Error (CE)	0: Ramp to stop 1: Coast to stop 2: Fast Stop 3: Alarm only	Default: 3 Range: 0 to 3	*468*
H5-05 (429)	Communication Fault Detection Selection	0: Disabled 1: Enabled. If communication is lost for more than two seconds, a CE fault will occur.	Default: 1 Range: 0, 1	*468*
H5-06 (42A)	Drive Transmit Wait Time	Set the wait time between receiving and sending data.	Default: 5 ms Min.: 5 Max.: 65	*469*
H5-07 (42B)	RTS Control Selection	0: Disabled. RTS is always on. 1: Enabled. RTS turns on only when sending.	Default: 1 Range: 0, 1	*469*
H5-09 (435)	CE Detection Time	Sets the time required to detect a communications error. Adjustment may be needed when networking several drives.	Default: 2.0 s Min.: 0.0 Max.: 10.0	*469*
H5-10 (436)	Unit Selection for MEMOBUS/Modbus Register 0025H	0: 0.1 V units 1: 1 V units	Default: 0 Range: 0, 1	*469*
H5-11 (43C)	Communications ENTER Function Selection	0: Drive requires an Enter command before accepting any changes to parameter settings. 1: Parameter changes are activated immediately without the Enter command.	Default: 1 Range: 0, 1	*470*
H5-12 (43D)	Run Command Method Selection	0: FWD/Stop, REV/Stop 1: Run/Stop, FWD/REV	Default: 0 Range: 0, 1	*470*

<1> 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. Hex)	Name	Description	Values	Page
H6-01 (42C)	Pulse Train Input Terminal RP Function Selection	0: Frequency reference 1: PID feedback value 2: PID setpoint value	Default: 0 Range: 0 to 2	*223*
H6-02 (42D) RUN	Pulse Train Input Scaling	Sets the terminal RP input signal frequency that is equal to 100% of the value selected in H6-01.	Default: 1440 Hz Min.: 100 Max.: 32000	*223*
H6-03 (42E) RUN	Pulse Train Input Gain	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	*223*
H6-04 (42F) RUN	Pulse Train Input Bias	Sets the level of the value selected in H6-01 when 0 Hz is input.	Default: 0.0% Min.: -100.0 Max.: 100.0	*224*
H6-05 (430) RUN	Pulse Train Input Filter Time	Sets the pulse train input filter time constant.	Default: 0.10 s Min.: 0.00 Max.: 2.00	*224*
H6-08 (43F)	Pulse Train Input Minimum Frequency	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 Max.: 1000.0	*224*

B.8 L: Protection Function

L parameters provide protection to the drive and motor, including control during momentary power loss, Stall Prevention, frequency detection, fault restarts, overtorque detection, and other types of hardware protection.

◆ L1: Motor Protection

No. (Addr. Hex)	Name	Description	Values	Page
L1-01 (480)	Motor Overload Protection Selection	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 6: General purpose motor (50 Hz) The drive may not be able to provide protection when using multiple motors, even if overload is enabled in L1-01. Set L1-01 to 0 and install separate thermal relays to each motor.	Default: 1 Range: 0 to 6	*225*
L1-02 (481)	Motor Overload Protection Time	Sets the motor thermal overload protection (oL1) time.	Default: 1.0 min Min.: 0.1 Max.: 5.0	*227*
L1-03 (482)	Motor Overheat Alarm Operation Selection (PTC input)	Sets operation when the motor temperature analog input (H3-02, H3-10, or H3-06 = 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 Range: 0 to 3	*228*
L1-04 (483)	Motor Overheat Fault Operation Selection (PTC input)	Sets stopping method when the motor temperature analog input (H3-02, H3-10, or H3-06 = 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 Range: 0 to 2	*228*
L1-05 (484)	Motor Temperature Input Filter Time (PTC input)	Adjusts the filter for the motor temperature analog input (H3-02, H3-10, or H3-06 = E).	Default: 0.20 s Min.: 0.00 Max.: 10.00	*228*
L1-13 (46D)	Continuous Electrothermal Operation Selection	0: Disabled 1: Enabled 2: Enabled (RTC)	Default: 1 Range: 0 to 2	*228*

◆ L2: Momentary Power Loss Ride-Thru

No. (Addr. Hex)	Name	Description	Values	Page
L2-01 (485)	Momentary Power Loss Operation Selection	0: Disabled. Drive trips on Uv1 fault when power is lost. 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. 3: KEB deceleration for the time set to L2-02. 4: KEB deceleration as long as CPU has power. 5: KEB deceleration to stop.	Default: 2 Range: 0 to 5	*229*
L2-02 (486)	Momentary Power Loss Ride-Thru Time	Sets the Power Loss Ride-Thru time. Enabled only when L2-01 = 1 or 3.	Default: <1> Min.: 0.0 s Max.: 25.5 s	*234*
L2-03 (487)	Momentary Power Loss Minimum Baseblock Time	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: <1> Min.: 0.1 s Max.: 5.0 s	*234*
L2-04 (488)	Momentary Power Loss Voltage Recovery Ramp Time	Sets the time for the output voltage to return to the preset V/f pattern during Speed Search.	Default: <1> Min.: 0.0 s Max.: 5.0 s	*234*

No. (Addr. Hex)	Name	Description	Values	Page
L2-05 (489)	Undervoltage Detection Level (Uv1)	Sets the DC bus undervoltage trip level.	Default: 190 Vdc <2> <3> Min.: 150 Vdc Max.: 210 Vdc <3>	234
L2-06 (48A)	KEB Deceleration Time	Sets the time required to decelerate from the speed when KEB was activated to zero speed.	Default: 0.00 s Min.: 0.00 Max.: 6000.0 <4>	234
L2-07 (48B)	KEB Acceleration Time	Sets the time to accelerate to the frequency reference when momentary power loss is over. If set to 0.0, the active acceleration time is used.	Default: 0.00 s Min.: 0.00 Max.: 6000.0 <4>	235
L2-08 (48C)	Frequency Gain at KEB Start	Sets the percentage of output frequency reduction at the beginning of deceleration when the KEB Ride-Thru function is started. Reduction = (slip frequency before KEB) × L2-08 × 2	Default: 100% Min.: 0 Max.: 300	235
L2-10 (48E)	KEB Detection Time (Minimum KEB Time)	Sets the time to perform KEB Ride-Thru.	Default: 50 ms Min.: 0 Max.: 2000	235
L2-11 (461)	DC Bus Voltage Setpoint during KEB	Sets the desired value of the DC bus voltage during KEB Ride-Thru.	Default: <2> [E1-01] × 1.22 Min.: 150 Vdc Max.: 400 Vdc <5>	235
L2-29 (475)	KEB Method Selection	0: Single Drive KEB Ride-Thru 1 1: Single Drive KEB Ride-Thru 2 2: System KEB Ride-Thru 1 3: System KEB Ride-Thru 2	Default: 0 Range: 0 to 3	235

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Default setting is dependent on parameter E1-01, Input voltage Setting.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

<4> 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.

<5> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives, but set the value below 1040 Vdc (overvoltage protection level).

◆ L3: Stall Prevention

No. (Addr. Hex)	Name	Description	Values	Page
L3-01 (48F)	Stall Prevention Selection during Acceleration	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.	Default: 1 Range: 0 to 2	236
L3-02 (490)	Stall Prevention Level during Acceleration	Used when L3-01 = 1 or 2. 100% is equal to the drive rated current.	Default: <1> Min.: 0% Max.: 150% <1>	236
L3-03 (491)	Stall Prevention Limit during Acceleration	Sets Stall Prevention lower limit during acceleration when operating in the constant power range. Set as a percentage of drive rated current.	Default: 50% Min.: 0 Max.: 100	236
L3-04 (492)	Stall Prevention Selection during Deceleration	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. Decelerates while increasing the motor flux. 5: Overexcitation Deceleration 2. Adjust the deceleration rate according to the DC bus voltage.	Default: 1 Range: 0 to 5	237

No. (Addr. Hex)	Name	Description	Values	Page
L3-05 (493)	Stall Prevention Selection during Run	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.	Default: 1 Range: 0 to 2	*238*
L3-06 (494)	Stall Prevention Level during Run	Enabled when L3-05 is set to 1 or 2. 100% is equal to the drive rated current.	Default: <1> Min.: 30% Max.: 150% <1>	*238*
L3-11 (4C7)	Overvoltage Suppression Function Selection	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	Default: 0 Range: 0, 1	*239*
L3-17 (462)	Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention	Sets the desired value for the DC bus voltage during overvoltage suppression and Stall Prevention during deceleration.	Default: 375 Vdc <2> <3> Min.: 150 Max.: 400 <3>	*239*
L3-20 (465)	DC Bus Voltage Adjustment Gain	Sets the proportional gain for KEB Ride-Thru, Stall Prevention, and overvoltage suppression.	Default: 1.00 Min.: 0.00 Max.: 5.00	*239*
L3-21 (466)	Accel/Decel Rate Calculation Gain	Sets the proportional gain used to calculate the deceleration rate during KEB Ride-Thru, ov suppression function, and Stall Prevention during deceleration (L3-04 = 2).	Default: 1.00 Min.: 0.10 Max.: 10.00	*239*
L3-23 (4FD)	Automatic Reduction Selection for Stall Prevention during Run	0: Sets the Stall Prevention level set in L3-04 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.	Default: 0 Range: 0, 1	*240*
L3-24 (46E)	Motor Acceleration Time for Inertia Calculations	Sets the time needed to accelerate the uncoupled motor at rated torque from stop to the maximum frequency.	Default: <4> <5> Min: 0.001 s Max: 10.000 s	*240*
L3-25 (46F)	Load Inertia Ratio	Sets the ratio between the motor and machine inertia.	Default: 1.0 Min.: 1.0 Max.: 1000.0	*240*
L3-26 (455)	Additional DC Bus Capacitors	When DC bus capacitors have been added externally, be sure to add those values to the internal capacitor table for proper DC bus calculations.	Default: 0 µF Min: 0 Max: 65000	*241*
L3-27 (456)	Stall Prevention Detection Time	Sets the time the current must exceed the Stall Prevention level to activate Stall Prevention.	Default: 50 ms Min.: 0 Max.: 5000	*241*

<1> Upper limit is dependent on parameter L8-38, Frequency Reduction Selection.

<2> Default setting is dependent on parameter E1-01, Input voltage Setting.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives, but set the value below 1040 Vdc (overvoltage protection level).

<4> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

<5> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ L4: Speed Detection

No. (Addr. Hex)	Name	Description	Values	Page
L4-01 (499)	Speed Agreement Detection Level	L4-01 sets the frequency detection level for digital output functions H2-□□ = 2, 3, 4, 5.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*241*
L4-02 (49A)	Speed Agreement Detection Width	L4-02 sets the hysteresis or allowable margin for speed detection.	Default: 2.0 Min.: 0.0 Max.: 20.0	*241*
L4-03 (49B)	Speed Agreement Detection Level (+/-)	L4-03 sets the frequency detection level for digital output functions H2-□□ = 13, 14, 15, 16.	Default: 0.0 Hz Min.: -400.0 Max.: 400.0	*241*

No. (Addr. Hex)	Name	Description	Values	Page
L4-04 (49C)	Speed Agreement Detection Width (+/-)	L4-04 sets the hysteresis or allowable margin for speed detection.	Default: 2.0 Min.: 0.0 Max.: 20.0	*241*
L4-05 (49D)	Frequency Reference Loss Detection Selection	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 Range: 0, 1	*241*
L4-06 (4C2)	Frequency Reference at Reference Loss	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	*242*
L4-07 (470)	Speed Agreement Detection Selection	0: No detection during baseblock. 1: Detection always enabled.	Default: 0 Range: 0, 1	*242*

◆ L5: Fault Restart

No. (Addr. Hex)	Name	Description	Values	Page
L5-01 (49E)	Number of Auto Restart Attempts	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 Min.: 0 Max.: 10	*243*
L5-02 (49F)	Auto Restart Fault Output Operation Selection	0: Fault output not active. 1: Fault output active during restart attempt.	Default: 0 Range: 0, 1	*243*
L5-04 (46C)	Fault Reset Interval Time	Sets the amount of time to wait between performing fault restarts.	Default: 10.0 s Min.: 0.5 Max.: 600.0	*243*
L5-05 (467)	Fault Reset Operation Selection	0: Continuously attempt to restart while incrementing restart counter only at a successful restart (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 as V7).	Default: 0 Range: 0, 1	*243*

◆ L6: Torque Detection

No. (Addr. Hex)	Name	Description	Values	Page
L6-01 (4A1)	Torque Detection Selection 1	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 9: UL6 Alarm at Speed Agree 10: UL6 Alarm during Run 11: UL6 Fault at Speed Agree 12: UL6 Fault during Run	Default: 0 Range: 0 to 12	*244*
L6-02 (4A2)	Torque Detection Level 1	Sets the overtorque and undertorque detection level.	Default: 15% Min.: 0 Max.: 300	*245*
L6-03 (4A3)	Torque Detection Time 1	Sets the time an overtorque or undertorque condition must exist to trigger torque detection 1.	Default: 10.0 s Min.: 0.0 Max.: 10.0	*245*

No. (Addr. Hex)	Name	Description	Values	Page
L6-04 (4A4)	Torque Detection Selection 2	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 Range: 0 to 8	*244*
L6-05 (4A5)	Torque Detection Level 2	Sets the overtorque and undertorque detection level.	Default: 150% Min.: 0 Max.: 300	*245*
L6-06 (4A6)	Torque Detection Time 2	Sets the time an overtorque or undertorque condition must exist to trigger torque detection 2.	Default: 0.1 s Min.: 0.0 Max.: 10.0	*245*
L6-13 (62E)	Motor Underload Protection Selection Underload Select	Sets the motor underload protection (UL6) based on motor load. 0: Base frequency enable 0: Base Freq Enable 1: Max frequency enable 1: Max Freq Enable	Default: 0 Range: 0, 1	*244*
L6-14 (62F)	Motor Underload Protection Level at Minimum Frequency Underload Level	Sets the UL6 detection level at minimum frequency by percentage of drive rated current.	Default: 15% Min.: 0 Max.: 300	*244*

◆ L8: Drive Protection

No. (Addr. Hex)	Name	Description	Values	Page
L8-01 (4AD)	Internal Dynamic Braking Resistor Protection Selection (ERF type)	0: Resistor overheat protection disabled 1: Resistor overheat protection enabled	Default: 0 Range: 0, 1	*245*
L8-02 (4AE)	Overheat Alarm Level	An overheat alarm occurs when heatsink temperature exceeds the L8-02 level.	Default: <1> Min.: 50 °C Max.: 150 °C	*245*
L8-03 (4AF)	Overheat Pre-Alarm Operation Selection	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. 4: Continue operation at reduced speed as set in L8-19.	Default: 3 Range: 0 to 4	*246*
L8-05 (4B1)	Input Phase Loss Protection Selection	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	*247*
L8-07 (4B3)	Output Phase Loss Protection Selection	0: Disabled 1: Enabled (triggered by a single phase loss) 2: Enabled (triggered when two phases are lost)	Default: 1 Range: 0 to 2	*247*
L8-09 (4B5)	Output Ground Fault Detection Selection	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	*247*
L8-10 (4B6)	Heatsink Cooling Fan Operation Selection	0: During run only. Fan operates only during run for L8-11 seconds after stop. 1: Fan always on. Cooling fan operates whenever the drive is powered up.	Default: 0 Range: 0, 1	*247*
L8-11 (4B7)	Heatsink Cooling Fan Off Delay Time	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 Max.: 300	*248*
L8-12 (4B8)	Ambient Temperature Setting	Enter the ambient temperature. This value adjusts the oL2 detection level.	Default: 40 °C Min.: -10 Max.: 50	*248*
L8-15 (4BB)	oL2 Characteristics Selection at Low Speeds	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 Range: 0, 1	*248*
L8-18 (4BE)	Software Current Limit Selection	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*248*
L8-19 (4BF)	Frequency Reduction Rate during Overheat Pre-Alarm	Specifies the frequency reference reduction gain at overheat pre-alarm when L8-03 = 4.	Default: 0.8 Min.: 0.1 Max.: 0.9	*247*
L8-32 (4E2)	Main Contactor and Cooling Fan Power Supply Failure Selection	Determines drive response 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 set to C1-09) 3: Alarm only ("FAn" will flash) 4: Continue operation at reduced speed as set to L8-19.	Default: 1 Range: 0 to 4	*248*
L8-35 (4EC)	Installation Method Selection	0: IP00/Open-Chassis enclosure 1: Side-by-Side mounting 2: IP20/NEMA Type 1 enclosure 3: Finless model drive or external heatsink installation	Default: <2> <3> Range: 0 to 3	*249*
L8-38 (4EF)	Carrier Frequency Reduction	0: Disabled 1: Enabled below 6 Hz 2: Enabled for the entire speed range	Default: 2 Range: 0 to 2	*249*
L8-40 (4F1)	Carrier Frequency Reduction Off Delay Time	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: 0.5 s Min.: 0.00 Max.: 2.00	*249*
L8-41 (4F2)	High Current Alarm Selection	0: Disabled 1: Enabled. An alarm is triggered at output currents above 150% of drive rated current.	Default: 0 Range: 0, 1	*250*
L8-55 (45F)	Internal Braking Transistor Protection	0: Disabled. Disable when using a regen converter or optional braking unit. 1: Protection enabled.	Default: 1 Range: 0, 1	*250*
L8-93 (73C)	LSo Detection Time at Low Speed	Sets the amount of time until baseblock is executed after detecting pull-out at low speed.	Default: 1.0 s Min.: 0.0 Max.: 10.0	*250*

No. (Addr. Hex)	Name	Description	Values	Page
L8-94 (73D)	LSo Detection Level at Low Speed	Determines the detection level of pull-out at low speed.	Default: 3% Min.: 0 Max.: 10	*250*
L8-95 (73D)	Average LSo Frequency at Low Speed	Sets the average number of times pull-out can occur at low speed.	Default: 10 times Min.: 1 Max.: 50	*250*

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Parameter setting value is not reset to the default value when the drive is initialized.

<3> Default setting is determined by the drive model:
Setting 2: Model code CIMR-P□2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242
Setting 0: Model code CIMR-P□2A0250 to 2A0415 and 4A0208 to 4A0675

B.9 n: Special Adjustment

The n parameters adjust more advanced performance characteristics such as Hunting Prevention, High Slip Braking, and Overexcitation Braking.

◆ n1: Hunting Prevention

No. (Addr. Hex)	Name	Description	Values	Page
n1-01 (580)	Hunting Prevention Selection	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	*251*
n1-02 (581)	Hunting Prevention Gain Setting	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	*251*
n1-03 (582)	Hunting Prevention Time Constant	Sets the time constant used for Hunting Prevention.	Default: <1> Min.: 0 ms Max.: 500 ms	*251*
n1-05 (530)	Hunting Prevention Gain while in Reverse	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	*251*

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ n3: High Slip Braking (HSB) and Overexcitation Braking

No. (Addr. Hex)	Name	Description	Values	Page
n3-01 (588)	High-Slip Braking Deceleration Frequency Width	Sets the output frequency reduction step width for when the drive stops the motor using HSB. Set as a percentage of the maximum output frequency. Increase this setting if overvoltage occurs during HSB.	Default: 5% Min.: 1 Max.: 20	*252*
n3-02 (589)	High-Slip Braking Current Limit	Sets the current limit during HSB as a percentage of the motor rated current.	Default: <1> Min.: 100% Max.: 200%	*252*
n3-03 (58A)	High-Slip Braking Dwell Time at Stop	Sets the time the drive will run with minimum frequency (E1-09) at the end of deceleration. If this time is set too low, the machine inertia can cause the motor to rotate slightly after HSB.	Default: 1.0 s Min.: 0.0 Max.: 10.0	*252*
n3-04 (58B)	High-Slip Braking Overload Time	Sets the time required for an HSB overload fault (oL7) to occur when the drive output frequency does not change during an HSB stop. This parameter does not typically require adjustment.	Default: 40 s Min.: 30 Max.: 1200	*252*
n3-13 (531)	Overexcitation Deceleration Gain	Sets the gain applied to the V/f pattern during Overexcitation Deceleration (L3-04 = 4).	Default: 1.10 Min.: 1.00 Max.: 1.40	*253*
n3-14 (532)	High Frequency Injection during Overexcitation Deceleration	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*253*
n3-21 (579)	High-Slip Suppression Current Level	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.	Default: 100% Min.: 0 Max.: 150	*253*
n3-23 (57B)	Overexcitation Operation Selection	0: Enabled in both directions 1: Enabled only when rotating forward 2: Enabled only when in reverse	Default: 0 Range: 0 to 2	*253*

<1> Default setting is dependent on parameter L8-38, Frequency Reduction Selection.

B.10 o: Operator-Related Settings

The o parameters set up the digital operator displays.

◆ o1: Digital Operator Display Selection

No. (Addr. Hex)	Name	Description	Values	Page
o1-01 (500) RUN	Drive Mode Unit Monitor Selection	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) Range: 104 to 809	254
o1-02 (501) RUN	User Monitor Selection after Power Up	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 Range: 1 to 5	254
o1-03 (502)	Digital Operator Display Selection	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) 3: User-selected units (set by o1-09, o1-10 and o1-11)	Default: 0 Range: 0 to 3	254
o1-06 (517)	User Monitor Selection Mode Monitor Mode Sel	Selects the monitors displayed on the second and third lines of the digital operator display. 0: 3 Monitor Sequential (displays the next two sequential monitors) 0: 3 Mon Sequential 1: 3 Monitor Selectable 1: 3 Mon Selectable (set by o1-07 and o1-08)	Default: 0 Range: 0, 1	254
o1-07 (518)	Second Line Monitor Selection 2nd Monitor Sel	Selects the monitor that is shown in the second line. Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set "403" to display monitor parameter U4-03. **Note:** Parameter is effective only when o1-06 is set to 1.	Default: 102 Range: 101 to 799	254
o1-08 (519)	Third Line Monitor Selection 3rd Monitor Sel	Selects the monitor that is shown in the third line. Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set "403" to display monitor parameter U4-03. **Note:** Parameter is effective only when o1-06 is set to 1.	Default: 103 Range: 101 to 799	254
o1-09 (51C)	Frequency Reference Display Units Fref Disp Unit	Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3. 0: WC 0: WC (Inch of water) 1: PSI 1: PSI (Pounds per square inch) 2: GPM 2: GPM (Gallons per minute) 3: F 3: °F (Degrees Fahrenheit) 4: CFM 4: CFM (Cubic feet per minute) 5: CMH 5: CMH (Cubic meters per hour) 6: LPH 6: LPH (Liters per hour) 7: LPS 7: LPS (Liters per second) 8: Bar 8: Bar (Bar) 9: Pa 9: Pa (Pascal) 10: C 10: °C (Degrees Celsius) 11: Mtr 11: Mtr (Meters) 12: Ft 12: Ft (Feet) 13: LPM 13: LPM (Liters per minute) 14: CMM 14: CMM (Cubic meters per minute) 15: “Hg 15: Hg (inches of mercury) 24: Custom units (determined by o1-13 to o1-15) 25: None 25: No Unit	Default: 25 Range: 0 to 15; 24, 25	254
o1-10 (520)	User-Set Display Units Maximum Value	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. o1-11 sets the position of the decimal position.	Default: <1> Range: 1 to 60000	255
o1-11 (521)	User-Set Display Units Decimal Display		Default: <1> Range: 0 to 3	256
o1-13 (3105)	Frequency Reference and Frequency Related Monitor Custom Units 1 Fref Cust Unit 1	Sets the first character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.	Default: 41 Range: 30 to 7A	256

No. (Addr. Hex)	Name	Description	Values	Page
o1-14 (3106)	Frequency Reference and Frequency Related Monitor Custom Units 2 Fref Cust Unit 2	Sets the second character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.	Default: 41 Range: 30 to 7A	*256*
o1-15 (3107)	Frequency Reference and Frequency Related Monitor Custom Units 3 Fref Cust Unit 3	Sets the third character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.	Default: 41 Range: 30 to 7A	*256*

<1> Default setting is dependent on parameter o1-03, Digital Operator Display Selection.

◆ o2: Digital Operator Keypad Functions

No. (Addr. Hex)	Name	Description	Values	Page
o2-01 (505)	LO/RE Key Function Selection	0: Disabled 1: Enabled. LO/RE key switches between LOCAL and REMOTE operation.	Default: 1 Range: 0, 1	*256*
o2-02 (506)	STOP Key Function Selection	0: Disabled. STOP key is disabled in REMOTE operation. 1: Enabled. STOP key is always enabled.	Default: 1 Range: 0, 1	*257*
o2-03 (507)	User Parameter Default Value	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 Range: 0 to 2	*257*
o2-04 (508)	Drive Model Selection	Enter the drive model. Setting required only if installing a new control board.	Default: Determined by drive capacity	*257*
o2-05 (509)	Frequency Reference Setting Method Selection	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 Range: 0, 1	*257*
o2-06 (50A)	Operation Selection when Digital Operator is Disconnected	0: The drive continues operating if the digital operator is disconnected. 1: An oPr fault is triggered and the motor coasts to stop.	Default: 1 Range: 0, 1	*258*
o2-07 (527)	Motor Direction at Power Up when Using Operator	This parameter requires assigning drive operation to the digital operator. 0: Forward 1: Reverse	Default: 0 Range: 0, 1	*258*
o2-20 (81E) RUN	Operator RUN Save at Power Loss	When running during a power loss, the Run command is issued via the digital operator and the Run state is saved to the EEPROM. When power is restored, the Run command is automatically applied if the LOCAL/REMOTE or FREF conditions have not changed in the drive. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*258*

◆ o3: Copy Function

No. (Addr. Hex)	Name	Description	Values	Page
o3-01 (515)	Copy Function Selection	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 Range: 0 to 3	*259*
o3-02 (516)	Copy Allowed Selection	0: Read operation prohibited 1: Read operation allowed	Default: 0 Range: 0, 1	*259*

◆ o4: Maintenance Monitor Settings

No. (Addr. Hex)	Name	Description	Values	Page
o4-01 (50B)	Cumulative Operation Time Setting	Sets the value for the cumulative operation time of the drive in units of 10 h.	Default: 0 Min.: 0 Max.: 9999	*259*
o4-02 (50C)	Cumulative Operation Time Selection	0: Logs power-on time 1: Logs operation time when the drive output is active (output operation time).	Default: 0 Range: 0, 1	*259*
o4-03 (50E)	Cooling Fan Operation Time Setting	Sets the value of the fan operation time monitor U4-03 in units of 10 h.	Default: 0 Min.: 0 Max.: 9999	*260*
o4-05 (51D)	Capacitor Maintenance Setting	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	*260*
o4-07 (523)	DC Bus Pre-Charge Relay Maintenance Setting	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	*260*
o4-09 (525)	IGBT Maintenance Setting	Sets the value of the Maintenance Monitor for the IGBTs. See U4-07 for IGBT replacement times.	Default: 0% Min.: 0 Max.: 150	*260*
o4-11 (510)	U2, U3 Initialization	0: U2-□□ and U3-□□ monitor data is not reset when the drive is initialized (A1-03). 1: U2-□□ and U3-□□ monitor data is reset when the drive is initialized (A1-03).	Default: 0 Range: 0, 1	*260*
o4-12 (512)	kWh Monitor Initialization	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 when the drive is initialized (A1-03).	Default: 0 Range: 0, 1	*260*
o4-13 (528)	Number of Run Commands Counter Initialization	0: Number of Run commands counter is not reset when the drive is initialized (A1-03). 1: Number of Run commands counter is reset when the drive is initialized (A1-03).	Default: 0 Range: 0, 1	*261*
o4-17 (3100)	Set/Reset Real-Time Clock	Sets the current date and time for the Real-Time Clock. 0: - - 1: Set 2: Reset	Default: 0 Range: 0 to 2	*108*
o4-20 (81F)	Time Display Format	Sets the time display format. 0: 12-hour 1: 24-hour	Default: 0 Range: 0, 1	*261*

B.11 S: Special Application

◆ S1: Dynamic Noise Control Function

No. (Addr. Hex)	Name	Description	Values	Page
S1-01 (3200)	Dynamic Audible Noise Control Function Selection Dyn Noise Ctrl	0: Disabled 0: Disabled 1: Enabled 1: Enabled	Default: 1 Range: 0, 1	*262*
S1-02 (3201)	Voltage Reduction Rate Volt Reduce Amt	Sets the rate at which the output voltage will be reduced as a percentage of the V/f pattern when operating with no load.	Default: 50.0% Min.: 50.0 Max.: 100.0	*262*
S1-03 (3202)	Voltage Restoration Level V Reduce On Lvl	Sets the level when the drive should start restoring the voltage as a percentage of the drive rated torque.	Default: 20.0% Min.: 0.0 Max.: 90.0	*262*
S1-04 (3203)	Voltage Restoration Complete Level V Reduce Off Lvl	Sets the level at which voltage restoration for the V/f pattern is complete as a percentage of the drive rated torque. If the output torque rises above the value of S1-04, then the voltage will be controlled in a manner specified by the V/f pattern setting.	Default: 50.0% Min.: S1-03 + 10.0 Max.: 100.0	*263*
S1-05 (3204)	Voltage Restoration Sensitivity Time Constant Sensitivity Time	Sets the level of sensitivity of the output torque and LPF time constants for the voltage reduction rate. The level of sensitivity can be adjusted in accordance with the load response.	Default: 1.000 s Min.: 0.000 Max.: 3.000	*263*
S1-06 (3205)	Voltage Restoration Time Constant at Impact Impact Load Time	Sets the voltage restoration time constant if an impact load is added.	Default: 0.050 s Min.: 0.000 Max.: 1.000	*263*
S1-07 (323C)	Output Phase Loss Level for Dynamic Noise Control DNC Outp Ph Loss	Reduces the output phase loss level when Dynamic Noise Control is active.	Default: 100.0% Min.: 10.0 Max.: 100.0	*263*

◆ S2: Programmable Run Timers

No. (Addr. Hex)	Name	Description	Values	Page
S2-01 (3206)	Sequence Timer 1 Start Time Tmr 1 Start Time	Sets the start time for timer 1. The value must be set less than or equal to S2-02.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	*266*
S2-02 (3207)	Sequence Timer 1 Stop Time Tmr 1 Stop Time	Sets the stop time for timer 1. The value must be set greater than or equal to S2-01.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	*267*
S2-03 (3208)	Sequence Timer 1 Day Selection Tmr 1 Day Sel	Sets the days for which sequence timer 1 is active. 0: Timer disabled 0: Timer disabled 1: Daily 1: Daily 2: Mon - Fri 2: Mon - Fri 3: Sat - Sun 3: Sat - Sun 4: Monday 4: Monday 5: Tuesday 5: Tuesday 6: Wednesday 6: Wednesday 7: Thursday 7: Thursday 8: Friday 8: Friday 9: Saturday 9: Saturday 10: Sunday 10: Sunday	Default: 0 Range: 0 to 10	*267*
S2-04 (3209)	Sequence Timer 1 Selection Tmr 1 Seq Sel	Sets the action that occurs when sequence timers 1 is active. 0: Digital output only 0: Digital out only 1: Run 1: Run 2: Run - PI disable 2: Run - PI Disable	Default: 0 Range: 0 to 2	*267*

No. (Addr. Hex)	Name	Description	Values	Page
S2-05 (320A)	Sequence Timer 1 Reference Source Tmr 1 Ref Source	Selects the frequency reference source used for running the drive when sequence timer 1 is active (only applicable when S2-04 is set to 1 or 2). 0: Operator (d1-01) 0: Operator (d1-01) 1: Operator (d1-02) 1: Operator (d1-02) 2: Operator (d1-03) 2: Operator (d1-03) 3: Operator (d1-04) 3: Operator (d1-04) 4: Terminals 4: Terminals 5: Serial communication 5: Serial com 6: Option card 6: Option PCB 7: Pulse input	Default: 0 Range: 0 to 7	*267*
S2-06 (320B)	Sequence Timer 2 Start Time Tmr 2 Start Time	Sets the start time for timer 2. The value must be set less than or equal to S2-07.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	*266*
S2-07 (320C)	Sequence Timer 2 Stop Time Tmr 2 Stop Time	Sets the stop time for timer 2. The value must be set greater than or equal to S2-06.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	*267*
S2-08 (320D)	Sequence Timer 2 Day Selection Tmr 2 Day Sel	Sets the days for which sequence timer 2 is active. 0: Timer disabled 0: Timer disabled 1: Daily 1: Daily 2: Mon - Fri 2: Mon - Fri 3: Sat - Sun 3: Sat - Sun 4: Monday 4: Monday 5: Tuesday 5: Tuesday 6: Wednesday 6: Wednesday 7: Thursday 7: Thursday 8: Friday 8: Friday 9: Saturday 9: Saturday 10: Sunday 10: Sunday	Default: 0 Range: 0 to 10	*267*
S2-09 (320E)	Sequence Timer 2 Selection Tmr 2 Seq Sel	Sets the action that occurs when sequence timer 2 is active. 0: Digital output only 0: Digital out only 1: Run 1: Run 2: Run - PI disable 2: Run - PI Disable	Default: 0 Range: 0 to 2	*267*
S2-10 (320F)	Sequence Timer 2 Reference Source Tmr 2 Ref Source	Selects the frequency reference source used for running the drive when sequence timer 2 is active (only applicable when S2-09 is set to 1 or 2). 0: Operator (d1-01) 0: Operator (d1-01) 1: Operator (d1-02) 1: Operator (d1-02) 2: Operator (d1-03) 2: Operator (d1-03) 3: Operator (d1-04) 3: Operator (d1-04) 4: Terminals 4: Terminals 5: Serial communication 5: Serial com 6: Option card 6: Option PCB 7: Pulse input	Default: 0 Range: 0 to 7	*267*
S2-11 (3210)	Sequence Timer 3 Start Time Tmr 3 Start Time	Sets the start time for timer 3. The value must be set less than or equal to S2-12.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	*266*
S2-12 (3211)	Sequence Timer 3 Stop Time Tmr 3 Stop Time	Sets the stop time for timer 3. The value must be set greater than or equal to S2-11.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	*267*
S2-13 (3212)	Sequence Timer 3 Day Selection Tmr 3 Day Sel	Sets the days for which sequence timer 3 is active. 0: Timer disabled 0: Timer disabled 1: Daily 1: Daily 2: Mon - Fri 2: Mon - Fri 3: Sat - Sun 3: Sat - Sun 4: Monday 4: Monday 5: Tuesday 5: Tuesday 6: Wednesday 6: Wednesday 7: Thursday 7: Thursday 8: Friday 8: Friday 9: Saturday 9: Saturday 10: Sunday 10: Sunday	Default: 0 Range: 0 to 10	*267*

No. (Addr. Hex)	Name	Description	Values	Page
S2-14 (3213)	Sequence Timer 3 Selection Tmr 3 Seq Sel	Sets the action that occurs when sequence timer 3 is active. 0: Digital output only 0: Digital out only 1: Run 1: Run 2: Run - PI disable 2: Run - PI Disable	Default: 0 Range: 0 to 2	267
S2-15 (3214)	Sequence Timer 3 Reference Source Tmr 3 Ref Source	Selects the frequency reference source used for running the drive when sequence timer 3 is active (only applicable when S2-14 is set to 1 or 2). 0: Operator (d1-01) 0: Operator (d1-01) 1: Operator (d1-02) 1: Operator (d1-02) 2: Operator (d1-03) 2: Operator (d1-03) 3: Operator (d1-04) 3: Operator (d1-04) 4: Terminals 4: Terminals 5: Serial communication 5: Serial com 6: Option card 6: Option PCB 7: Pulse input	Default: 0 Range: 0 to 7	267
S2-16 (3215)	Sequence Timer 4 Start Time Tmr 4 Start Time	Sets the start time for timer 4. The value must be set less than or equal to S2-17.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	266
S2-17 (3216)	Sequence Timer 4 Stop Time Tmr 4 Stop Time	Sets the stop time for timer 4. The value must be set greater than or equal to S2-16.	Default: 00:00 Min.: 00:00 Max.: 24:00 <1>	267
S2-18 (3217)	Sequence Timer 4 Day Selection Tmr 4 Day Sel	Sets the days for which sequence timer 4 is active. 0: Timer disabled 0: Timer disabled 1: Daily 1: Daily 2: Mon - Fri 2: Mon - Fri 3: Sat - Sun 3: Sat - Sun 4: Monday 4: Monday 5: Tuesday 5: Tuesday 6: Wednesday 6: Wednesday 7: Thursday 7: Thursday 8: Friday 8: Friday 9: Saturday 9: Saturday 10: Sunday 10: Sunday	Default: 0 Range: 0 to 10	267
S2-19 (3218)	Sequence Timer 4 Selection Tmr 4 Seq Sel	Sets the action that occurs when sequence timer 4 is active. 0: Digital output only 0: Digital out only 1: Run 1: Run 2: Run - PI disable 2: Run - PI Disable	Default: 0 Range: 0 to 2	267
S2-20 (3219)	Sequence Timer 4 Reference Source Tmr 4 Ref Source	Selects the frequency reference source used for running the drive when sequence timer 4 is active (only applicable when S2-19 is set to 1 or 2). 0: Operator (d1-01) 0: Operator (d1-01) 1: Operator (d1-02) 1: Operator (d1-02) 2: Operator (d1-03) 2: Operator (d1-03) 3: Operator (d1-04) 3: Operator (d1-04) 4: Terminals 4: Terminals 5: Serial communication 5: Serial com 6: Option card 6: Option PCB 7: Pulse input	Default: 0 Range: 0 to 7	267

<1> Setting the sequence timer start time to a higher value than the sequence timer stop time disables that sequence timer.

◆ S3: Secondary PI (PI2) Control

No. (Addr. Hex)	Name	Description	Values	Page
S3-01 (321A) RUN	Secondary PI Enable Selection PI2 Enable Sel	Determines when the secondary PI controller is enabled. 0: Disabled 0: Disabled 1: Always 1: Always 2: Drive running 2: Drive running 3: Motor running 3: Motor running **Note:** Setting 3 does not run the motor at zero speed, baseblock, or in DC injection.	Default: 0 Range: 0 to 3	*268*
S3-02 (321B) RUN	Secondary PI User Display PI2 UsrDspMaxVal	Sets the scale value of 100% PI input.	Default: 10000 Min.: 0 Max.: 60000	*268*
S3-03 (321C) RUN	Secondary PI Display Digits PI2 UsrDspDigits	Sets the decimal place display for secondary PI units. 0: No decimal places 0: No Dec (XXXXX) 1: One decimal place 1: 1 Dec (XXXX.X) 2: Two decimal places 2. 2 Dec (XXX.XX) 3: Three decimal places 3: 3 Dec (XX.XXX)	Default: 2 Range: 0 to 3	*269*
S3-04 (321D) RUN	Secondary PI Unit Selection PI2 Unit Sel	Sets the units for the secondary PI control function. 0: Inch of water (WC) 0: WC 1: Pounds per square inch (PSI) 1: PSI 2: Gallons per minute (GPM) 2: GPM 3: Degrees Fahrenheit (F) 3: °F 4: Cubic feet per minute (CFM) 4: CFM 5: Cubic meters per hour (CMH) 5: CMH 6: Liters per hour (LPH) 6: LPH 7: Liters per second (LPS) 7: LPS 8: Bar (Bar) 8: Bar 9: Pascals (Pa) 9: Pa 10: Degrees Celsius (C) 10: °C 11: Meters (Mtr) (Ft: Feet) 11: Mtr 12: Liters per minute (LPM) 12: LPM 13: Cubic meters per minute (CMM) 13: CMM 14: No unit 14: No unit 15: Percentage (%) 15: %	Default: 15 Range: 0 to 15	*269*
S3-05 (321E) RUN	Secondary PI Setpoint Value PI2 Setpoint	Sets the secondary PI controller target value.	Default: 0.00 *<1>* Min.: 0.00 Max.: 600.00 *<2>*	*269*
S3-06 (321F) RUN	Secondary PI Proportional Gain Setting PI2 Gain	Sets the proportional gain of the secondary PI controller. A setting of 0.00 disables P control.	Default: 1.00 Min.: 0.00 Max.: 25.00	*269*
S3-07 (3220) RUN	Secondary PI Integral Time Setting PI2 I Time	Sets the integral time for the secondary PI controller. A setting of 0.0 s disables integral control.	Default: 1.0 s Min.: 0.0 Max.: 360.0	*269*
S3-08 (3221) RUN	Secondary PI Integral Limit Setting PI2 I Limit	Sets the maximum output possible from the integrator.	Default: 100.0% Min.: 0.0 Max.: 100.0	*270*
S3-09 (3222) RUN	Secondary PI Output Upper Limit PI2 Upper Limit	Sets the maximum output possible from the secondary PI controller.	Default: 100.0% Min.: 0.0 Max.: 100.0	*270*
S3-10 (3223) RUN	Secondary PI Output Lower Limit PI2 Lower Lim	Sets the minimum output possible from the secondary PI controller.	Default: 0.00% Min.: -100.00 Max.: 100.00	*270*
S3-11 (3224) RUN	Secondary PI Output Level Selection PI2 Out Lvl Sel	Sets the secondary PI controller output direction. 0: Normal Output 0: Normal Character (direct acting) 1: Reverse Output 1: Rev Character (reverse acting)	Default: 0 Range: 0, 1	*270*

No. (Addr. Hex)	Name	Description	Values	Page
S3-12 (3225) RUN	Secondary PI Disable Mode PI2 Disable Mode	Selects the secondary PI controller output when disabled. 0: No output (0%) 0: No output 1: Lower Limit (S3-10) 1: Lower Limit (S3-10) 2: Setpoint 2: Setpoint	Default: 0 Range: 0 to 2	*270*
S3-13 (3226) RUN	Secondary PI Low Feedback Detection Level PI2 Low FB Lvl	Sets the secondary PI low feedback detection level.	Default: 0.00 <1> Min.: 0.00 Max.: 600.00 <2>	*270*
S3-14 (3227) RUN	Secondary PI Low Feedback Detection Time PI2 Low FB Time	Sets the secondary PI low feedback detection delay time in seconds.	Default: 1.0 s Min.: 0.0 Max.: 25.5	*271*
S3-15 (3228) RUN	Secondary PI High Feedback Level PI2 High FB Lvl	Sets the secondary PI high feedback detection level.	Default: 100.00 <1> Min.: 0.00 Max.: 600.00 <2>	*271*
S3-16 (3229) RUN	Secondary PI High Feedback Detection Time PI2 High FB Tim	Sets the secondary PI high feedback detection delay time in seconds.	Default: 1.0 s Min.: 0.0 Max.: 25.5	*271*
S3-17 (322A) RUN	Secondary PI Feedback Detection Selection PI2 FB Det Sel	Selects when secondary PI controller low and high feedback detection are active. 0: Secondary PI enabled 0: PI2 Enabled 1: Always 1: Always	Default: 0 Range: 0, 1	*271*

<1> Unit is determined by S3-04.

<2> Upper limit is S3-02, decimal placeholder is determined by S3-03.

◆ S6: P1000 Protection

No. (Addr. Hex)	Name	Description	Values	Page
S6-01 (3236)	Emergency Override Speed E Override Speed	Sets the speed command used in emergency override mode when S6-02 = 0.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00	*271*
S6-02 (3237)	Emergency Override Reference Selection E OverrideRefSel	Selects the emergency override speed source. 0: Use S6-01 Reference 0: Use S6-01 Ref 1: Use Frequency Reference 1: Use Freq Ref	Default: 0 Range: 0, 1	*271*
S6-07 (323C)	Output Phase Loss Level for Dynamic Noise Control DNC Outp Ph Loss	Reduces the output phase loss level when Dynamic Noise Control is active.	Default: 100.0% Min.: 10.0 Max.: 100.0	*272*

B.12 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. Hex)	Name	Description	Values	Page
T1-01 (701)	Auto-Tuning Mode Selection	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)	Default: 2 Range: 2, 3	*124*
T1-02 (702)	Motor Rated Power	Sets the motor rated power as specified on the motor nameplate. **Note:** Use the following formula to convert horsepower into kilowatts: 1HP = 0.746 kW.	Default: <1> Min.: 0.00 kW Max.: 650.00 kW	*124*
T1-03 (703)	Motor Rated Voltage	Sets the motor rated voltage as specified on the motor nameplate.	Default: 200.0 V <2> Min: 0.0 Max: 255.0 <2>	*124*
T1-04 (704)	Motor Rated Current	Sets the motor rated current as specified on the motor nameplate.	Default: <1> Min.: 10% of drive rated current Max.: 200% of drive rated current	*125*
T1-05 (705)	Motor Base Frequency	Sets the rated frequency of the motor as specified on the motor nameplate.	Default: 60.0 Hz Min.: 0.0 Max.: 400.0	*125*
T1-06 (706)	Number of Motor Poles	Sets the number of motor poles as specified on the motor nameplate.	Default: 4 Min.: 2 Max.: 48	*125*
T1-07 (707)	Motor Base Speed	Sets the rated speed of the motor as specified on the motor nameplate.	Default: 1750 r/min Min.: 0 Max.: 24000	*125*
T1-11 (70B)	Motor Iron Loss	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.	Default: 14 W <3> Min.: 0 Max.: 65535	*125*

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

<3> Default setting value differs depending on the motor code value and motor parameter settings.

B.13 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. Hex)	Name	Description	Analog Output Level	Unit
U1-01 (40)	Frequency Reference	Monitors the frequency reference. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-02 (41)	Output Frequency	Displays the output frequency. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-03 (42)	Output Current	Displays the output current.	10 V: Drive rated current	<1> <2>
U1-04 (43)	Control Method	0: V/f Control	No signal output available	–
U1-06 (45)	Output Voltage Reference	Displays the output voltage.	10 V: 200 Vrms <3>	0.1 Vac
U1-07 (46)	DC Bus Voltage	Displays the DC bus voltage.	10 V: 400 V <3>	1 Vdc
U1-08 (47)	Output Power	Displays the output power (this value is calculated internally).	10 V: Drive capacity (motor capacity) kW	<4>
U1-10 (49)	Input Terminal Status	Displays the input terminal status. U1 - 10 = 00000000 1 Digital input 1 (terminal S1 enabled) 1 Digital input 2 (terminal S2 enabled) 1 Digital input 3 (terminal S3 enabled) 1 Digital input 4 (terminal S4 enabled) 1 Digital input 5 (terminal S5 enabled) 1 Digital input 6 (terminal S6 enabled) 1 Digital input 7 (terminal S7 enabled) 1 Digital input 8 (terminal S8 enabled)	No signal output available	–
U1-11 (4A)	Output Terminal Status	Displays the output terminal status. U1 - 11 = 00000000 1 Multi-Function Digital Output (terminal M1-M2) 1 Multi-Function Digital Output (terminal M3-M4) 1 Multi-Function Digital Output (terminal MD-ME-MF) 0 Not Used 1 Fault Relay (terminal MA-MC closed MA-MC open)	No signal output available	–

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U1-12 (4B)	Drive Status	Verifies the drive operation status. U1-12=00000000 1 During run 1 During zero-speed 1 During REV 1 During fault reset signal input 1 During speed agree 1 Drive ready 1 During alarm detection 1 During fault detection	No signal output available	–
U1-13 (4E)	Terminal A1 Input Level	Displays the signal level to analog input terminal A1.	10 V: 100%	0.1%
U1-14 (4F)	Terminal A2 Input Level	Displays the signal level to analog input terminal A2.	10 V: 100%	0.1%
U1-15 (50)	Terminal A3 Input Level	Displays the signal level to analog input terminal A3.	10 V: 100%	0.1%
U1-16 (53)	Output Frequency after Soft Starter	Displays output frequency with ramp time and S-curves. Units determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-18 (61)	oPE Fault Parameter	Displays the parameter number that caused the oPE02 or oPE08 operation error.	No signal output available	–
U1-19 (66)	MEMOBUS/Modbus Error Code	Displays the contents of a MEMOBUS/Modbus error. U1-19=00000000 1 CRC Error 1 Data Length Error 0 Not Used 1 Parity Error 1 Overrun Error 1 Framing Error 1 Timed Out 0 Not Used	No signal output available	–
U1-24 (7D)	Input Pulse Monitor	Displays the frequency to pulse train input terminal RP.	Determined by H6-02	1 Hz
U1-25 (4D)	Software Number (Flash)	FLASH ID	No signal output available	–
U1-26 (5B)	Software No. (ROM)	ROM ID	No signal output available	–
U1-29 (7AA)	Software No. (PWM)	PWM ID	No signal output available	–
U1-75 (851)	Time-Hour/Minute	Displays the current time (Hours and Minutes).	No signal output available	–
U1-76 (852)	Date – Year	Displays the current year.	No signal output available	–
U1-77 (853)	Date – Month/Day	Displays the current date (Month and Date).	No signal output available	–
U1-78 (854)	Date – Week Day	Displays the current date of the week. 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	No signal output available	–

<1> The number of decimal places in the parameter value depends on the drive model and the ND selection. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

<2> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

<4> The display resolution depends on the ND selection. This value has two decimal places (0.01 kW) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 kW) if the maximum applicable motor capacity is higher than 11 kW.

◆ U2: Fault Trace

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U2-01 (80)	Current Fault	Displays the current fault.	No signal output available	–
U2-02 (81)	Previous Fault	Displays the previous fault.	No signal output available	–
U2-03 (82)	Frequency Reference at Previous Fault	Displays the frequency reference at the previous fault.	No signal output available	0.01 Hz
U2-04 (83)	Output Frequency at Previous Fault	Displays the output frequency at the previous fault.	No signal output available	0.01 Hz
U2-05 (84)	Output Current at Previous Fault	Displays the output current at the previous fault.	No signal output available	<1> <2>
U2-07 (86)	Output Voltage at Previous Fault	Displays the output voltage at the previous fault.	No signal output available	0.1 Vac
U2-08 (87)	DC Bus Voltage at Previous Fault	Displays the DC bus voltage at the previous fault.	No signal output available	1 Vdc
U2-09 (88)	Output Power at Previous Fault	Displays the output power at the previous fault.	No signal output available	0.1 kW
U2-11 (8A)	Input Terminal Status at Previous Fault	Displays the input terminal status at the previous fault. Displayed as in U1-10.	No signal output available	–
U2-12 (8B)	Output Terminal Status at Previous Fault	Displays the output status at the previous fault. Displays the same status displayed in U1-11.	No signal output available	–
U2-13 (8C)	Drive Operation Status at Previous Fault	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 (8D)	Cumulative Operation Time at Previous Fault	Displays the cumulative operation time at the previous fault.	No signal output available	1 h
U2-15 (7E0)	Soft Starter Speed Reference at Previous Fault	Displays the speed reference for the soft starter at the previous fault.	No signal output available	0.01 Hz
U2-20 (8E)	Heatsink Temperature at Previous Fault	Displays the temperature of the heatsink when the most recent fault occurred.	No signal output available	1 °C
U2-27 (7FA)	Motor Temperature at Previous Fault (NTC)	Displays the temperature of the motor when the most recent fault occurred.	No signal output available	1 °C
U2-28 (7FC)	Malfunctioned Module	Display the module where the previous fault occurred at a decimal number.	No signal output available	–
U2-30 (3008)	Date Year at Previous Fault Date Year YYYY	Displays the year when the most recent fault occurred.	No signal output available	–
U2-31 (3009)	Date Month and Day at Previous Fault Date Mo Day MMDD	Displays the date and day when the most recent fault occurred.	No signal output available	–
U2-32 (300A)	Time Hours and Minutes at Previous Fault Time Hr Min HHMM	Displays the time when the most recent fault occurred.	No signal output available	–

<1> The number of decimal places in the parameter value depends on the drive model and the ND selection. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

<2> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

◆ U3: Fault History

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U3-01 to U3-04 (90 to 93 (800 to 803))	First to 4th Most Recent Fault	Displays the first to the fourth most recent faults.	No signal output available	–
U3-05 to U3-10 (804 to 809)	5th to 10th Most Recent Fault	Displays the fifth to the tenth most recent faults. After ten faults, 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 each time a fault occurs.	No signal output available	–
U3-11 to U3-14 (94 to 97 (80A to 80D))	Cumulative Operation Time at 1st to 4th Most Recent Fault	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 (80E to 813)	Cumulative Operation Time at 5th to 10th Most Recent Fault	Displays the cumulative operation time when the fifth to the tenth most recent faults occurred.	No signal output available	1 h
U3-21 (300B)	Date Year at Most Recent Fault Fault 1 YYYY	Displays the year when the most recent fault occurred.	No signal output available	–
U3-22 (300C)	Date Month and Day at Most Recent Fault Fault 1 MMDD	Displays the date and day when the most recent faults occurred.	No signal output available	–
U3-23 (300D)	Time Hours and Minutes at Most Recent Fault Fault 1 HHMM	Displays the time when the most recent fault occurred.	No signal output available	–
U3-24 (300E)	Date Year at 2nd Most Recent Fault Fault 2 YYYY	Displays the year when the second most recent fault occurred.	No signal output available	–
U3-25 (300F)	Date Month and Day at 2nd Most Recent Fault Fault 2 MMDD	Displays the date and day when the second most recent fault occurred.	No signal output available	–
U3-26 (3010)	Time Hours and Minutes at 2nd Most Recent Fault Fault 2 HHMM	Displays the time when the second most recent fault occurred.	No signal output available	–
U3-27 (3011)	Date Year at 3rd Most Recent Fault Fault 3 YYYY	Displays the year when the most third recent fault occurred.	No signal output available	–
U3-28 (3012)	Date Month and Day at 3rd Most Recent Fault Fault 3 MMDD	Displays the date and day when the third most recent fault occurred.	No signal output available	–
U3-29 (3013)	Time Hours and Minutes at 3rd Most Recent Fault Fault 3 HHMM	Displays the time when the third most recent fault occurred.	No signal output available	–
U3-30 (3014)	Date Year at 4th Most Recent Fault Fault 4 YYYY	Displays the year when the fourth most recent fault occurred.	No signal output available	–
U3-31 (3015)	Date Month and Day at 4th Most Recent Fault Fault 4 MMDD	Displays the date and day when the fourth most recent fault occurred.	No signal output available	–
U3-32 (3016	Time Hours and Minutes at 4th Most Recent Fault Fault 4 HHMM	Displays the time when the fourth most recent fault occurred.	No signal output available	–
U3-33 (3017)	Date Year at 5th Most Recent Fault Fault 5 YYYY	Displays the year when the fifth most recent fault occurred.	No signal output available	–
U3-34 (3018)	Date Month and Day at 5th Most Recent Fault Fault 5 MMDD	Displays the date and day when the fifth most recent fault occurred.	No signal output available	–

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U3-35 (3019)	Time Hours and Minutes at 5th Most Recent Fault Fault 5 HHMM	Displays the time when the fifth most recent fault occurred.	No signal output available	–
U3-36 (301A)	Date Year at 6th Most Recent Fault Fault 6 YYYY	Displays the year when the sixth most recent fault occurred.	No signal output available	–
U3-37 (301B)	Date Month and Day a 6th Most Recent Fault Fault 6 MMDD	Displays the date and day when the sixth most recent fault occurred.	No signal output available	–
U3-38 (301C)	Time Hours and Minutes at 6th Most Recent Fault Fault 6 HHMM	Displays the time when the most sixth recent fault occurred.	No signal output available	–
U3-39 (301D)	Date Year at 7th Most Recent Fault Fault 7 YYYY	Displays the year when the most seventh recent fault occurred.	No signal output available	–
U3-40 (301E)	Date Month and Day at 7th Most Recent Fault Fault 7 MMDD	Displays the date and day when the seventh most recent fault occurred.	No signal output available	–
U3-41 (301F)	Time Hours and Minutes at 7th Most Recent Fault Fault 7 HHMM	Displays the time when the seventh most recent fault occurred.	No signal output available	–
U3-42 (3020)	Date Year at 8th Most Recent Fault Fault 8 YYYY	Displays the year when the eighth most recent fault occurred.	No signal output available	–
U3-43 (3021)	Date Month and Day 8th at Most Recent Fault Fault 8 MMDD	Displays the date and day when the eighth most recent fault occurred.	No signal output available	–
U3-44 (3022)	Time Hours and Minutes at 8th Most Recent Fault Fault 8 HHMM	Displays the time when the eighth most recent fault occurred.	No signal output available	–
U3-45 (3023)	Date Year at 9th Most Recent Fault Fault 9 YYYY	Displays the year when the ninth most recent fault occurred.	No signal output available	–
U3-46 (3024)	Date Month and Day at 9th Most Recent Fault Fault 9 MMDD	Displays the date and day when the ninth most recent fault occurred.	No signal output available	–
U3-47 (3025)	Time Hours and Minutes at 9th Most Recent Fault Fault 9 HHMM	Displays the time when the ninth most recent fault occurred.	No signal output available	–
U3-48 (3026)	Date Year at 10th Most Recent Fault Fault 10 YYYY	Displays the year when the tenth most recent fault occurred.	No signal output available	–
U3-49 (3027)	Date Month and Day at 10th Most Recent Fault Fault 10 MMDD	Displays the date and day when the tenth most recent fault occurred.	No signal output available	–
U3-50 (3028)	Time Hours and Minutes at 10th Most Recent Fault 10 HHMM	Displays the time when the tenth most recent fault occurred.	No signal output available	–

◆ U4: Maintenance Monitors

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U4-01 (4C)	Cumulative Operation Time	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 (75)	Number of Run Commands	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

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U4-03 (67)	Cooling Fan Operation Time	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 (7E)	Cooling Fan Maintenance	Displays main cooling fan usage time as a percentage of its expected performance life. Parameter o4-03 can be used to reset this monitor. Replace the fan when this monitor reaches 90%.	No signal output available	1%
U4-05 (7C)	Capacitor Maintenance	Displays main circuit capacitor usage time as a percentage of their expected performance life. Parameter o4-05 can be used to reset this monitor. Replace the capacitor when this monitor reaches 90%.	No signal output available	1%
U4-06 (7D6)	Soft Charge Bypass Relay Maintenance	Displays the soft charge bypass relay maintenance time as a percentage of its estimated performance life. Parameter o4-07 can be used to reset this monitor. Replace the soft charge bypass relay when this monitor reaches 90%.	No signal output available	1%
U4-07 (7D7)	IGBT Maintenance	Displays IGBT usage time as a percentage of the expected performance life. Parameter o4-09 can be used to reset this monitor. Replace the IGBT when this monitor reaches 90%.	No signal output available	1%
U4-08 (68)	Heatsink Temperature	Displays the heatsink temperature.	10 V: 100 °C	1 °C
U4-09 (5E)	LED Check	Lights all segments of the LED to verify that the display is working properly.	No signal output available	–
U4-10 (5C)	kWh, Lower 4 Digits	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 (5D)	kWh, Upper 5 Digits		No signal output available	1 MWh
U4-13 (7CF)	Peak Hold Current	Displays the highest current value that occurred during run.	No signal output available	0.01 A <1>
U4-14 (7D0)	Peak Hold Output Frequency	Displays the output frequency when the current value shown in U4-13 occurred.	No signal output available	0.01 Hz
U4-16 (7D8)	Motor Overload Estimate (oL1)	Shows the value of the motor overload detection accumulator. 100% is equal to the oL1 detection level.	10 V: 100%	0.1%
U4-18 (7DA)	Frequency Reference Source Selection	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 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 1-03 = Analog (terminal A3) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus communications 4-01 = Communication option card 5-01 = Pulse input	No signal output available	–
U4-19 (7DB)	Frequency Reference from MEMOBUS/Modbus Comm.	Displays the frequency reference provided by MEMOBUS/Modbus (decimal).	No signal output available	0.01%
U4-20 (7DC)	Option Frequency Reference	Displays the frequency reference input by an option card (decimal).	No signal output available	–

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U4-21 (7DD)	Run Command Source Selection	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 (7DE)	MEMOBUS/Modbus Communications Reference	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 (7DF)	Communication Option Card Reference	Displays drive control data set by an option card as a four-digit hexadecimal number.	No signal output available	–
U4-32 (7FB)	Motor Temperature (NTC)	Displays the motor temperature (NTC). U4-32 will display "20 °C" when a multi-function analog input is not set for motor thermistor input (H1-□□ = 17H).	200 °C	1 °C
U4-37 (1044)	oH Alarm Location Monitor	Displays the module where the oH alarm occurred as a binary number.	No signal output available	–
U4-38 (1045)	FAn Alarm Location Monitor	Displays the module where the FAn alarm occurred as a binary number.	No signal output available	–
U4-39 (1046)	voF Alarm Location Monitor	Displays the module where the voF alarm occurred as a binary number.	No signal output available	–

<1> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

◆ U5: PID Monitors

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U5-01 (57)	PID Feedback 1	Displays the PID feedback value.	10 V: 100%	0.01% <1>
U5-02 (63)	PID Input	Displays the amount of PID input (deviation between PID setpoint and feedback).	10 V: 100%	0.01%
U5-03 (64)	PID Output	Displays PID control output.	10 V: 100%	0.01%
U5-04 (65)	PID Setpoint	Displays the PID setpoint.	10 V: 100%	0.01% <1>
U5-05 (7D2)	PID Differential Feedback	Displays the 2nd PID feedback value if differential feedback is used (H3-□□ = 16).	10 V: 100%	0.01%
U5-06 (7D3)	PID Adjusted Feedback	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%
U5-14 (86B)	PI Output 2 Upper 4 Digits PI Output2 U4	Displays the custom PI output. U5-14 shows the upper 4 digits while U5-15 shows the lower 4 digits. Monitors are scaled by b5-43 and b5-44	No signal output available	1 <2>
U5-15 (86C)	PI Output 2 Lower 4 Digits PI Output2 L4	Displays the custom PI output. U5-14 shows the upper 4 digits while U5-15 shows the lower 4 digits. Monitors are scaled by b5-43 and b5-44.	No signal output available	0.01 <2>

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U5-17 (86E)	PI2 Setpoint PI2 Setpoint	Displays the secondary PI setpoint.	Dependent upon S3-02	<3>
U5-18 (86F)	PI2 Feedback PI2 Feedback	Displays the secondary PI feedback value.	Dependent upon S3-02	<3>
U5-19 (870)	PI2 Input PI2 Input	Displays the secondary PI input (deviation between PI target and feedback).	Dependent upon S3-02	<3>
U5-20 (871)	PI2 Output PI2 Output	Displays the secondary PI control output.	Dependent upon S3-02	<3>
U5-30 (3000)	Time Hr Min HHMM Time Hr Min HHMM	Displays the current time (Hours and Minutes).	No signal output available	1
U5-31 (3001)	Date Year Date Year	Displays the current year.	No signal output available	1
U5-32 (3002)	Date Mo Day MMDD Date Mo Day MMDD	Displays the current date (Month and Day).	No signal output available	1
U5-33 (3003)	Date Week 000W Date Week	Displays the current date of the week. 0: Sunday 0: Sunday 1: Monday 1: Monday 2: Tuesday 2: Tuesday 3: Wednesday 3: Wednesday 4: Thursday 4: Thursday 5: Friday 5: Friday 6: Saturday 6: Saturday	No signal output available	1
U5-99 (1599)	PID Setpoint Command PID Setpoint Cmd	Displays the PID Setpoint commanded by the source.	No signal output available	0.01% <1>

<1> Unit, range and resolution is determined by b5-20, b5-38, b5-39, and b5-46

<2> Unit is determined by b5-41

<3> Unit is determined by S3-04.

◆ U6: Operation Status Monitors

No. (Addr. Hex)	Name	Description	Analog Output Level	Unit
U6-01 (51)	Motor Secondary Current (Iq)	Displays the value of the motor secondary current (Iq). Motor rated secondary current is 100%.	10 V: Motor secondary rated current	0.1%

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

B.14 V/f Pattern Default Values

The following tables show the V/f pattern setting default values depending on the V/f pattern selection (E1-03).

Table B.3 E1-03 V/f Pattern Settings for Drive Capacity: 2A0004 to 2A0021, 4A0002 to 4A0011, and 5A0003 to 5A0009

No.	Unit	V/f Control															
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0
E1-05 <2>	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	230.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 <2>	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	17.3
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5
E1-10 <2>	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	10.2

<2> Values shown here are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

Table B.4 E1-03 V/f Pattern Settings for Drive Capacity: 2A0030 to 2A0211, 4A0018 to 4A0103, and 5A0011 to 5A0077

No.	Unit	V/f Control														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F <1>
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0
E1-05 <2>	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	230.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 <2>	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0	16.1
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5
E1-10 <2>	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0	8.1

<1> This value determines the default values for E1-04 through E1-10.

<2> Values shown here are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

Table B.5 E1-03 V/f Pattern Settings for Drive Capacity: 2A0250 to 2A0415, 4A0139 to 4A1200, and 5A0099 to 5A0242

No.	Unit	V/f Control														
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F <1>
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0
E1-05 <2>	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	230.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 <2>	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	13.8
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5
E1-10 <2>	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.9

<1> This value determines the default values for E1-04 through E1-10 .

<2> Values shown here are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.

B.15 Defaults by Drive Model

The following tables show parameters and default settings that change with the drive model selection (o2-04).

Table B.6 200 V Class Drives Default Settings by Drive Model Selection and ND settings

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	2A0004	2A0006	2A0008	2A0010
o2-04	Drive Model Selection	Hex.	62	63	64	65
E2-11	Motor Rated Output	kW (HP)	0.75 (0.75)	1.1 (1)	1.5 (2)	2.2 (3)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	1	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	223.7	196.6	169.4	156.8
C5-17	Motor Inertia	kgm^2	0.0028	0.0068	0.0068	0.0088
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	3.3	4.9	6.2	8.5
E2-02	Motor Rated Slip	Hz	2.5	2.6	2.6	2.9
E2-03	Motor No-Load Current	A	1.8	2.3	2.8	3
E2-05	Motor Line-to-Line Resistance	Ω	5.156	3.577	1.997	1.601
E2-06	Motor Leakage Inductance	%	13.8	18.5	18.5	18.4
E2-10	Motor Iron Loss for Torque Compensation	W	26	38	53	77
L2-02	Momentary Power Loss Ride-Thru Time	s	0.1	0.2	0.3	0.3
L2-03	Momentary Power Loss Minimum Baseblock Time	s	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
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.142	0.142	0.166	0.145
L8-02	Overheat Alarm Level	°C	115	115	115	115
L8-35	Installation Method Selection	–	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	2A0012	2A0018	2A0021	2A0030
o2-04	Drive Model Selection	Hex.	66	67	68	6A
E2-11	Motor Rated Output	kW (HP)	3.0 (3)	3.7 (5)	5.5 (7.5)	7.5 (10)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	136.4	122.9	94.75	72.69
C5-17	Motor Inertia	kgm^2	0.0158	0.0158	0.0255	0.037
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	11.4	14	19.6	26.6
E2-02	Motor Rated Slip	Hz	2.7	2.73	1.5	1.3
E2-03	Motor No-Load Current	A	3.7	4.5	5.1	8
E2-05	Motor Line-to-Line Resistance	Ω	1.034	0.771	0.399	0.288
E2-06	Motor Leakage Inductance	%	19	19.6	18.2	15.5
E2-10	Motor Iron Loss for Torque Compensation	W	91	112	172	262
L2-02	Momentary Power Loss Ride-Thru Time	s	0.5	1	1	1
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.5	0.6	0.7	0.8
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.145	0.154	0.168	0.175
L8-02	Overheat Alarm Level	°C	125	110	110	120
L8-35	Installation Method Selection	–	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

B.15 Defaults by Drive Model

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	2A0040	2A0056	2A0069	2A0081
o2-04	Drive Model Selection	Hex.	6B	6D	6E	6F
E2-11	Motor Rated Power	kW (HP)	11 (15)	15 (20)	18.5 (25)	22 (30)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	70.44	63.13	57.87	51.79
C5-17	Motor Inertia	kgm^2	0.053	0.076	0.138	0.165
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	39.7	53	65.8	77.2
E2-02	Motor Rated Slip	Hz	1.7	1.6	1.67	1.7
E2-03	Motor No-Load Current	A	11.2	15.2	15.7	18.5
E2-05	Motor Line-to-Line Resistance	Ω	0.23	0.138	0.101	0.079
E2-06	Motor Leakage Inductance	%	19.5	17.2	15.7	19.5
E2-10	Motor Iron Loss for Torque Compensation	W	245	272	505	538
L2-02	Momentary Power Loss Ride-Thru Time	s	1	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.9	1	1	1
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.6	0.6	0.6
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.265	0.244	0.317	0.355
L8-02	Overheat Alarm Level	°C	125	120	120	125
L8-35	Installation Method Selection	–	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	2A0110	2A0138	2A0169	2A0211
o2-04	Drive Model Selection	Hex.	70	72	73	74
E2-11	Motor Rated Power	kW (HP)	30 (40)	37 (50)	45 (60)	55 (75)
b3-04	V/f Gain during Speed Search	%	80	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	2.00
b8-04	Energy Saving Coefficient Value	–	46.27	38.16	35.78	31.35
C5-17	Motor Inertia	kgm^2	0.220	0.273	0.333	0.490
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	105	131	160	190
E2-02	Motor Rated Slip	Hz	1.8	1.33	1.6	1.43
E2-03	Motor No-Load Current	A	21.9	38.2	44	45.6
E2-05	Motor Line-to-Line Resistance	Ω	0.064	0.039	0.03	0.022
E2-06	Motor Leakage Inductance	%	20.8	18.8	20.2	20.5
E2-10	Motor Iron Loss for Torque Compensation	W	699	823	852	960
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.1	1.1	1.2	1.3
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.6	0.6	1	1
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.323	0.32	0.387	0.317
L8-02	Overheat Alarm Level	°C	130	130	130	125
L8-35	Installation Method Selection	–	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

B.15 Defaults by Drive Model

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	2A0250	2A0312	2A0360	2A0415
o2-04	Drive Model Selection	Hex.	75	76	77	78
E2-11	Motor Rated Power	kW (HP)	30 (100)	37 (125)	45 (150)	55 (175)
b3-04	V/f Gain during Speed Search	%	80	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.7	0.7	0.7	0.7
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	23.1	20.65	18.12	18.12
C5-17	Motor Inertia	kgm^2	0.90	1.10	1.90	1.90
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	260	260	260	260
E2-02	Motor Rated Slip	Hz	1.39	1.39	1.39	1.39
E2-03	Motor No-Load Current	A	72	72	72	72
E2-05	Motor Line-to-Line Resistance	Ω	0.023	0.023	0.023	0.023
E2-06	Motor Leakage Inductance	%	20	20	20	20
E2-10	Motor Iron Loss for Torque Compensation	W	1200	1200	1200	1200
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.5	1.5	1.7	1.7
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	1	1	1	1
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.533	0.592	0.646	0.646
L8-02	Overheat Alarm Level	°C	115	120	120	120
L8-35	Installation Method Selection	–	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	100	100

Table B.7 400 V Class Drives Default Settings by Drive Model

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	4A0002	4A0004	4A0005	4A0007
o2-04	Drive Model Selection	Hex.	92	93	94	95
E2-11	Motor rated power	kW (HP)	0.75 (0.75)	1.5 (2)	2.2 (3)	3.0 (3)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	447.4	338.8	313.6	265.7
C5-17	Motor Inertia	kgm^2	0.0028	0.0068	0.0088	0.0158
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	1.6	3.1	4.2	5.7
E2-02	Motor Rated Slip	Hz	2.6	2.5	3	2.7
E2-03	Motor No-Load Current	A	0.8	1.4	1.5	1.9
E2-05	Motor Line-to-Line Resistance	Ω	22.459	10.1	6.495	4.360
E2-06	Motor Leakage Inductance	%	14.3	18.3	18.7	19
E2-10	Motor Iron Loss for Torque Compensation	W	26	53	77	105
L2-02	Momentary Power Loss Ride-Thru Time	s	0.1	0.2	0.3	0.5
L2-03	Momentary Power Loss Min. Baseblock Time	s	0.3	0.4	0.5	0.5
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.142	0.166	0.145	0.145
L8-02	Overheat Alarm Level	°C	110	110	110	110
L8-35	Installation Method Selection	–	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	4A0009	4A0011	4A0018	4A0023
o2-04	Drive Model Selection	Hex.	96	97		9A
E2-11	Motor Rated Power	kW (HP)	3.7 (5)	5.5 (7.5)	7.5 (10)	11 (15)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	245.8	189.5	145.38	140.88
C5-17	Motor Inertia	kgm^2	0.0158	0.0255	0.037	0.053
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	7	9.8	13.3	19.9
E2-02	Motor Rated Slip	Hz	2.7	1.5	1.3	1.7
E2-03	Motor No-Load Current	A	2.3	2.6	4	5.6
E2-05	Motor Line-to-Line Resistance	Ω	3.333	1.595	1.152	0.922
E2-06	Motor Leakage Inductance	%	19.3	18.2	15.5	19.6
E2-10	Motor Iron Loss for Torque Compensation	W	130	193	263	385
L2-02	Momentary Power Loss Ride-Thru Time	s	0.5	0.5	0.8	1
L2-03	Momentary Power Loss Min. Baseblock Time	s	0.6	0.7	0.8	0.9
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.3	0.3	0.3	0.3
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.154	0.168	0.175	0.265
L8-02	Overheat Alarm Level	°C	110	110	110	115
L8-35	Installation Method Selection	–	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	4A0031	4A0038	4A0044	4A0058
o2-04	Drive Model Selection	Hex.	9C	9D	9E	9F
E2-11	Motor Rated Power	kW (HP)	15 (20)	18.5 (25)	22 (30)	30 (40)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	126.26	115.74	103.58	92.54
C5-17	Motor Inertia	kgm^2	0.076	0.138	0.165	0.220
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	26.5	32.9	38.6	52.3
E2-02	Motor Rated Slip	Hz	1.6	1.67	1.7	1.8
E2-03	Motor No-Load Current	A	7.6	7.8	9.2	10.9
E2-05	Motor Line-to-Line Resistance	Ω	0.55	0.403	0.316	0.269
E2-06	Motor Leakage Inductance	%	17.2	20.1	23.5	20.7
E2-10	Motor Iron Loss for Torque Compensation	W	440	508	586	750
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1	1	1	1.1
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.6	0.6	0.6	0.6
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.244	0.317	0.355	0.323
L8-02	Overheat Alarm Level	°C	120	120	115	120
L8-35	Installation Method Selection	–	2	2	2	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

B.15 Defaults by Drive Model

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	4A0072	4A0088	4A0103	4A0139
o2-04	Drive Model Selection	Hex.	A1	A2	A3	A4
E2-11	Motor rated power	kW (HP)	37 (50)	45 (60)	55 (75)	75 (100)
b3-04	V/f Gain during Speed Search	%	100	100	80	60
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.7
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	76.32	71.56	67.2	46.2
C5-17	Motor Inertia	kgm^2	0.273	0.333	0.490	0.90
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	65.6	79.7	95	130
E2-02	Motor Rated Slip	Hz	1.33	1.6	1.46	1.39
E2-03	Motor No-Load Current	A	19.1	22	24	36
E2-05	Motor Line-to-Line Resistance	Ω	0.155	0.122	0.088	0.092
E2-06	Motor Leakage Inductance	%	18.8	19.9	20	20
E2-10	Motor Iron Loss for Torque Compensation	W	925	1125	1260	1600
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2
L2-03	Momentary Power Loss Min. Basebl. Time	s	1.1	1.2	1.2	1.3
L2-04	Momentary Power Loss Volt. Recov. Time	s	0.6	0.6	1	1
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.32	0.387	0.317	0.533
L8-02	Overheat Alarm Level	°C	120	110	120	130
L8-35	Installation Method Selection	–	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	30

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	4A0165	4A0208	4A0250	4A0296
o2-04	Drive Model Selection	Hex.	A5	A6	A7	A8
E2-11	Motor rated power	kW (HP)	90 (125)	110 (150)	132 (200)	160 (250)
b3-04	V/f Gain during Speed Search	%	60	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.7	0.7	0.7	0.7
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	38.91	36.23	32.79	30.13
C5-17	Motor Inertia	kgm^2	1.10	1.90	2.10	3.30
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	156	190	223	270
E2-02	Motor Rated Slip	Hz	1.4	1.4	1.38	1.35
E2-03	Motor No-Load Current	A	40	49	58	70
E2-05	Motor Line-to-Line Resistance	Ω	0.056	0.046	0.035	0.029
E2-06	Motor Leakage Inductance	%	20	20	20	20
E2-10	Motor Iron Loss for Torque Compensation	W	1760	2150	2350	2850
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2
L2-03	Momentary Power Loss Min. Basebl. Time	s	1.5	1.7	1.7	1.8
L2-04	Momentary Power Loss Volt. Recov. Time	s	1	1	1	1
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.592	0.646	0.673	0.777
L8-02	Overheat Alarm Level	°C	130	120	120	125
L8-35	Installation Method Selection	–	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	30	30	30

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	4A0362	4A0414	4A0515	4A0675
o2-04	Drive Model Selection	Hex.	A9	AA	AC	AE
E2-11	Motor rated power	kW (HP)	185 (300)	220 (350)	250 (400 -450)	355 (500 -550)
b3-04	V/f Gain during Speed Search	%	60	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.7	0.7	0.7	0.7
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	30.57	27.13	21.76	23.84
C5-17	Motor Inertia	kgm^2	3.60	4.10	6.50	12.00
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	310	370	500	650
E2-02	Motor Rated Slip	Hz	1.3	1.3	1.25	1
E2-03	Motor No-Load Current	A	81	96	130	130
E2-05	Motor Line-to-Line Resistance	Ω	0.025	0.02	0.014	0.012
E2-06	Motor Leakage Inductance	%	20	20	20	20
E2-10	Motor Iron Loss for Torque Compensation	W	3200	3700	4700	5560
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2	2
L2-03	Momentary Power Loss Min. Basebl. Time	s	1.9	2	2.1	2.3
L2-04	Momentary Power Loss Volt. Recov. Time	s	1	1	1	1
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.864	0.91	1.392	1.667
L8-02	Overheat Alarm Level	°C	130	140	140	140
L8-35	Installation Method Selection	–	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	100	100	100

Table B.8 600 V Class Drives Default Settings by Drive Model

No.	Name	Unit					
–	Model CIMR-P□	–	5A0003	5A0004	5A0006	5A0009	5A0011
o2-04	Drive Model Selection	Hex.	C3	C4	C5	C7	
E2-11	Motor Rated Power	kW (HP)	1.5 (2)	2.2 (3)	3.7 (5)	5.5 (7.5)	7.5 (10)
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.50	0.50	0.50	0.50	0.50
b8-04	Energy Saving Coefficient Value	–	494.4	415.3	320.2	239.95	199.86
C5-17	Motor Inertia	kgm^2	0.0068	0.0088	0.0158	0.0255	0.037
C6-02	Carrier Frequency Selection	–	7	7	7	7	7
E2-01	Motor Rated Current	A	2.7	3.9	6.1	9	11
E2-02	Motor Rated Slip	Hz	2.5	3.0	2.7	1.5	1.3
E2-03	Motor No-Load Current	A	0.8	1.2	1.8	2.7	3.3
E2-05	Motor Line-to-Line Resistance	Ω	13.72	8.825	4.936	2.601	1.446
E2-06	Motor Leakage Inductance	%	18.3	18.7	19.3	18.2	15.5
E2-10	Motor Iron Loss for Torque Compensation	W	53	77	130	193	263
L2-02	Momentary Power Loss Ride-Thru Time	s	0.2	0.3	0.5	0.5	0.8
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.5	0.5	0.8	0.8	1
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.5	0.5	0.6	0.7	0.8
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.166	0.145	0.154	0.168	0.175
L8-02	Overheat Alarm Level	°C	110	110	110	110	115
L8-35	Installation Method Selection	–	2	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10

B.15 Defaults by Drive Model

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	5A0017	5A0022	5A0027	5A0032
o2-04	Drive Model Selection	Hex.	CA	CC	CD	CE
E2-11	Motor Rated Power	kW (HP)	11 (15)	15 (20)	18.5 (25)	22 (30)
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.5	0.5	0.5	0.5
b8-04	Energy Saving Coefficient Value	–	172	154	140	129
C5-17	Motor Inertia	kgm^2	0.053	0.076	0.138	0.165
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	17	22	27	32
E2-02	Motor Rated Slip	Hz	1.7	1.6	1.67	1.7
E2-03	Motor No-Load Current	A	5.1	6.6	8.1	9.6
E2-05	Motor Line-to-Line Resistance	Ω	1.17	0.9	0.66	0.52
E2-06	Motor Leakage Inductance	%	19.6	17.2	20.1	23.5
E2-10	Motor Iron Loss for Torque Compensation	W	385	440	508	586
L2-02	Momentary Power Loss Ride-Thru Time	s	1	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1	1.2	1.2	1.2
L2-04	Momentary Power Loss Voltage Recovery Time	s	0.9	1	1	1
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.27	0.24	0.32	0.36
L8-02	Overheat Alarm Level	°C	120	120	115	115
L8-35	Installation Method Selection	–	2	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10

No.	Name	Unit	Default Settings		
–	Model CIMR-P□	–	5A0041	5A0052	5A0062
o2-04	Drive Model Selection	Hex.	CF	D1	D2
E2-11	Motor Rated Power	kW (HP)	30 (40)	37 (50)	45 (60)
b3-04	V/f Gain during Speed Search	%	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	0.5	0.5	0.5
b8-04	Energy Saving Coefficient Value	–	115.57	97.01	90.07
C5-17	Motor Inertia	kgm^2	0.220	0.273	0.333
C6-02	Carrier Frequency Selection	–	7	7	7
E2-01	Motor Rated Current	A	41	52	62
E2-02	Motor Rated Slip	Hz	1.8	1.33	1.6
E2-03	Motor No-Load Current	A	12.3	15.6	18.8
E2-05	Motor Line-to-Line Resistance	Ω	0.438	0.267	0.21
E2-06	Motor Leakage Inductance	%	20.7	18.8	19.9
E2-10	Motor Iron Loss for Torque Compensation	W	750	925	1125
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.2	1.2	1.5
L2-04	Momentary Power Loss Voltage Recovery Time	s	1.1	1.2	1.3
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.323	0.32	0.387
L8-02	Overheat Alarm Level	°C	110	110	110
L8-35	Installation Method Selection	–	2	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10

B.15 Defaults by Drive Model

No.	Name	Unit	Default Settings	
–	Model CIMR-P□	–	5A0077	5A0099
o2-04	Drive Model Selection	Hex.	D3	D4
E2-11	Motor Rated Power	kW (HP)	55 (75)	75 (100)
b3-04	V/f Gain during Speed Search	%	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–
b3-26	Start Speed Search Select	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	2	2
b8-04	Energy Saving Coefficient Value	–	80.87	70.07
C5-17	Motor Inertia	kgm^2	0.490	0.90
C6-02	Carrier Frequency Selection	–	7	7
E2-01	Motor Rated Current	A	77	99
E2-02	Motor Rated Slip	Hz	1.46	1.39
E2-03	Motor No-Load Current	A	23.1	29.7
E2-05	Motor Line-to-Line Resistance	Ω	0.15	0.099
E2-06	Motor Leakage Inductance	%	20	20
E2-10	Motor Iron Loss for Torque Compensation	W	1260	1600
L2-02	Momentary Power Loss Ride-Thru Time	s	2	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.8	1.8
L2-04	Momentary Power Loss Voltage Recovery Time	s	1.5	1.6
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.317	0.533
L8-02	Overheat Alarm Level	°C	110	110
L8-35	Installation Method Selection	–	2	2
L8-38	Carrier Frequency Reduction Selection	–	2	2
n1-03	Hunting Prevention Time Constant	ms	10	30

No.	Name	Unit	Default Settings			
–	Model CIMR-P□	–	5A0125	5A0145	5A0192	5A0242
o2-04	Drive Model Selection	Hex.	D5	D6	D7	D9
E2-11	Motor Rated Power	kW (HP)	90 (125)	110 (150)	160 (200)	185 (250)
b3-04	V/f Gain during Speed Search	%	80	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	–	–	–	–	–
b3-26	Start Speed Search Select	–	–	–	–	–
b8-03	Energy Saving Control Filter Time Constant	s	2.00	2.00	2.00	2.00
b8-04	Energy Saving Coefficient Value	–	61.50	58.67	49.90	42.90
C5-17	Motor Inertia	kgm^2	1.10	1.90	2.10	4.10
C6-02	Carrier Frequency Selection	–	7	7	7	7
E2-01	Motor Rated Current	A	125	145	192	242
E2-02	Motor Rated Slip	Hz	1.39	1.40	1.35	1.35
E2-03	Motor No-Load Current	A	37.5	43.2	57.6	57.6
E2-05	Motor Line-to-Line Resistance	Ω	0.079	0.060	0.037	0.037
E2-06	Motor Leakage Inductance	%	20.0	20.0	20.0	20.0
E2-10	Motor Iron Loss for Torque Compensation	W	2150	2150	2850	2850
L2-02	Momentary Power Loss Ride-Thru Time	s	2.0	2.0	2.0	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	2.0	2.0	2.0	2.0
L2-04	Momentary Power Loss Voltage Recovery Time	s	1.7	1.8	2.0	2.0
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.592	0.646	0.673	0.864
L8-02	Overheat Alarm Level	°C	110	110	110	110
L8-35	Installation Method Selection	–	0	0	0	0
L8-38	Carrier Frequency Reduction Selection	–	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	30	30	30

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Appendix: C

MEMOBUS/Modbus Communications

C.1 MEMOBUS/MODBUS CONFIGURATION....464
C.2 COMMUNICATION SPECIFICATIONS....465
C.3 CONNECTING TO A NETWORK....466
C.4 MEMOBUS/MODBUS SETUP PARAMETERS....468
C.5 DRIVE OPERATIONS BY MEMOBUS/MODBUS....471
C.6 COMMUNICATIONS TIMING....472
C.7 MESSAGE FORMAT....473
C.8 MESSAGE EXAMPLES....475
C.9 MEMOBUS/MODBUS DATA TABLE....477
C.10 ENTER COMMAND....493
C.11 COMMUNICATION ERRORS....494
C.12 SELF-DIAGNOSTICS....495

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 communications can be configured using one master (PLC) and up to 255 slaves. The drive has slave functionality only, and serial communication is normally initiated from the master and responded to by the slaves.

The master communicates with the specified slave drive. The address or node for each slave must be set prior so 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 send a response back to the master.

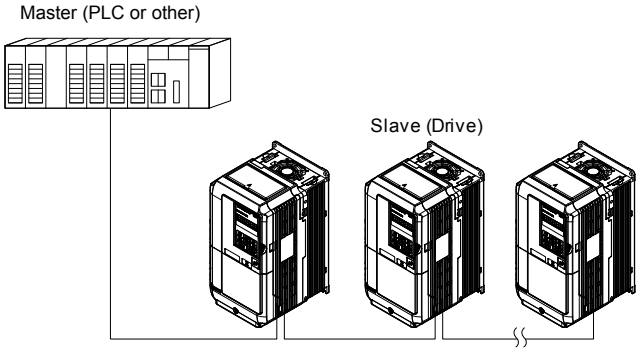

Figure C.1 Connecting Multiple Drives to a PLC

C.2 Communication Specifications

MEMOBUS/Modbus specifications appear in *Table C.1*:

Table C.1 MEMOBUS/Modbus Communications Specifications

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	31 drives (RS-485)	

C.3 Connecting to a Network

This section explains how to connect the drive to a MEMOBUS/Modbus network and the network termination required for a connection.

◆ 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.

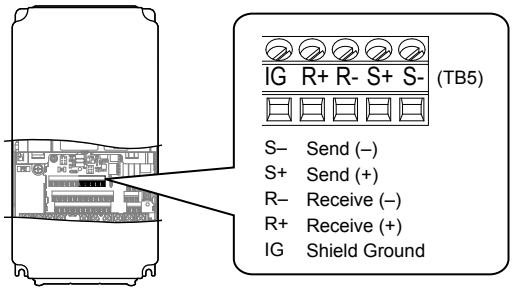

Figure C.2 Serial Communications Cable Connection Terminals (TB5)

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 ***467*** for slaves that are P1000 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 Connections

Figure C.3 and *Figure C.4* explain the wiring diagrams for multiple connections using MEMOBUS/Modbus communication.

■ RS-485 Interface

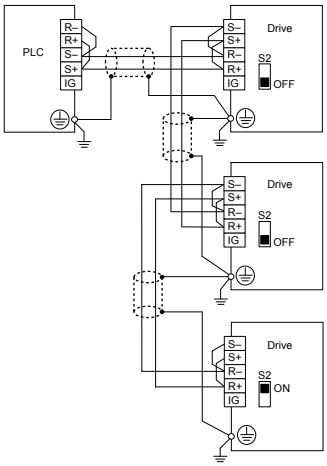

Figure C.3 RS-485 Interface

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

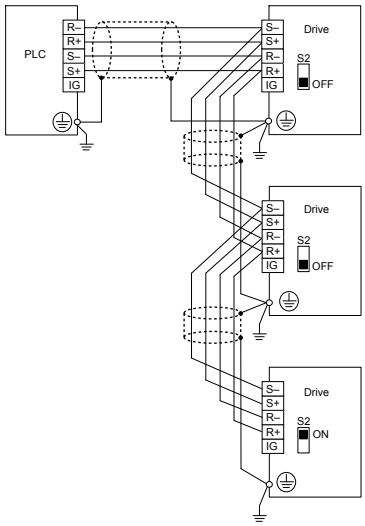

Figure C.4 RS-422 Interface

◆ 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.

C.4 MEMOBUS/Modbus Setup Parameters

◆ MEMOBUS/Modbus Serial Communication

This section describes parameters necessary to set up MEMOBUS/Modbus communications.

■ H5-01: Drive Node Address

Sets the drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S- . .

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address		1F (Hex)

■ H5-02: Communication Speed Selection

Sets the MEMOBUS/Modbus communications speed.

Note: Cycle the power after changing this parameter 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 communications.

Note: Cycle the power after changing this parameter 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 CE	0 to 3	3

Setting 0: Ramp to stop (uses the deceleration time currently enabled)
Setting 1: Cost to stop
Setting 2: Fast Stop
Setting 3: Alarm only (continue operation)

■ H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for 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

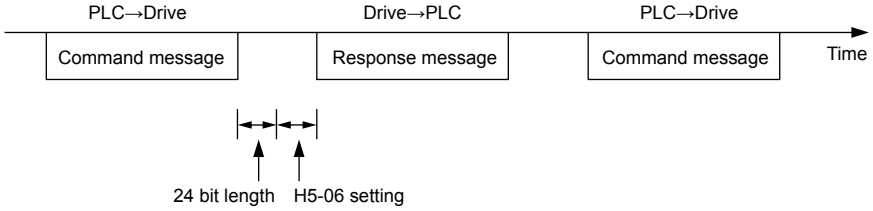

Figure C.5 Drive Transmit Wait Time Setting

■ 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 or multi-drop RS-422 communications.

Setting 1: Enabled. RTS switches while sending.

Use this setting when using RS-485 signals for communications or when using the RS-422 signals for point-to-point communications.

■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault 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 whether an Enter command is necessary to change parameter values via MEMOBUS/Modbus communications. *Refer to Enter Command on page 493*.

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	1

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 for H5-□□parameters):

- observe drive status and drive control terminal status from a PLC.
- read and write parameters.
- set and reset faults.
- set multi-function inputs.

Note: Input settings from the input terminals (S1 to S8) and from MEMOBUS/Modbus communications are both linked by a logical OR operation.

◆ Controlling the Drive

Select an external reference and adjust the parameters in ***Table C.2*** accordingly to start and stop the drive or set the frequency reference using MEMOBUS/Modbus communications.

Table C.2 Setting Parameters for Drive Control from MEMOBUS/Modbus

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Selection 1	2
	b1-02	Run Command Selection 1	2
External Reference 2	b1-15	Frequency Reference Selection 2	2
	b1-16	Run Command Selection 2	2

Refer to b1-01: Frequency Reference Selection 1 on page 139 and ***Refer to b1-02: Run Command Selection 1 on page 140*** for details on external reference parameter selections. ***Refer to Setting 2: External Reference 1/2 Selection on page 198*** for instructions on selecting external references 1 and 2.

C.6 Communications Timing

To prevent a communications 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

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in ***Table C.3***.

Table C.3 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	Write parameters	H5-11 = 0: 50 ms H5-11 = 1: 200 ms <1>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	Enter with storage to drive EEPROM after initialization	5 s

<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.

Set a timer 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.

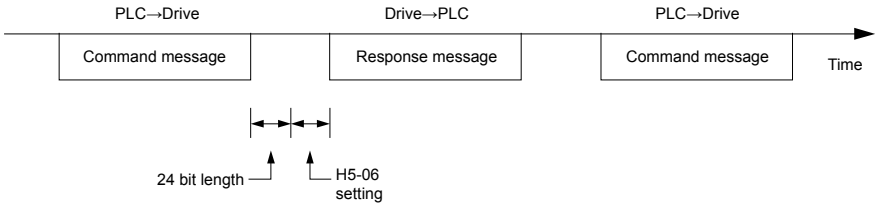

Figure C.6 Minimum Response Wait Time

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 note 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. 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.
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.4* 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.4 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 (upper) (lower)	
			Continue from here with next data.		

■ Response Data

Perform a CRC-16 calculation on the response message data as described above as a validation check. The result should match the CRC-16 checksum received within the response message.

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 that returns a response message with exactly the same content as the command message. The response message can be used to check communications between the master and slave. User-defined test code and data values can also 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, in that the address of the first register to be written and the data quantity are 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 60.0 Hz for the slave 1 drive.

If parameter values are changed using the Write command, an Enter command may be necessary to activate or save the data depending on the setting of H5-11. ***Refer to H5-11: Communications Enter Function Selection on page 470*** and ***Refer to Enter Command on page 493*** 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	02H						
	Lower	58H						
CRC-16	Upper	63H						
	Lower	39H						

Note: Double the number of the data quantity for the number of bytes in the command message.

C.9 MEMOBUS/Modbus Data Table

The 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 d: Reference Settings on page 173* for ComRef explanations.
	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.
0003H	Output voltage gain/ Unit: 0.1% Range: 20 (2.0%) to 2000 (200.0%), Default when power on: 1000 (100.0%)	
0004H to 0005H	Reserved	
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 (Terminal M1-M2)
	bit 1	Multi-Function Contact Output (Terminal M3-M4)
	bit 2	Multi-Function Contact Output (Terminal MD-MF)
	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 000CH	Reserved	
000DH	PI2 Setpoint	
000EH	Reserved	

Register No.	Contents	
000FH	Control Selection Setting	
	bit 0	Reserved
	bit 1	PID Setpoint Input
	bit 2, 3	Reserved
	bit 4	PI2 Target Input
	bit 5 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 to 001FH	Reserved	
3004H	Set Time – Hours/Minutes (HHmm)	
3005H	Set Date – Year/Day of Week (YYdd)	
3006H	Set Date – Month/Day (MMDD)	
3007H	RTC Set Command/Statud 0 = Complete 1 = Set RTC data using registers 3004H to 3006H 8 = failed	
302FH	RTC Enter 0 = Overwrite RTC data using registers 3004H to 3006H. Only effective when 3030H bit 1 (RTC Enter Enable) is set.	
3030H	bit 1	RTC Enter Enable
	bit 2	RTC TIE Fault Enable

◆ 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 (terminal M1-M2)
	bit 6	
	bit 7	
	bit 8 to bit D	Reserved
	bit E	ComRef status
	bit F	ComCtrl status

Register No.	Contents	
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 oFx)
	bit 9	Motor Overload (oL1), Overtorque Detection 1/2 (oL3/oL4), Undertorque Detection 1/2 (UL3/UL4)
	bit A	Reserved
	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)
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 <1>	
0024H	Output Frequency <1>	
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	Reserved	
0029H	Fault Contents 2	
	bit 0	IGBT Short Circuit (SC)
	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

Register No.	Contents	
002AH	Alarm Contents 1	
	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
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 (Terminal M1-M2)
	bit 1	Multi-Function Contact Output (Terminal M3-M4)
	bit 2	Multi-Function Contact Output (Terminal MD-MF)
	bit 3 to 6	Reserved
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved

Register No.	Contents	
002EH	Reserved	
002FH	Frequency Reference Bias (from Up/Down 2 Function), 0.1% units	
0030H	Reserved	
0031H	DC Bus Voltage, 1 Vdc units	
0032H to 0033H	Reserved	
0034H	Product Code 1 [ASCII], Product Type	
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	Overrun 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 U: Monitors on page 437* for parameter details.	
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 to 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 U2: Fault Trace on page 439* and *Refer to U3: Fault History on page 440* for parameter details.	
007FH	Alarm Code, *Refer to Alarm Register Contents on page 492* for alarm codes.	
0080H to 0097H	Used for monitors U2-☐☐, U3-☐☐. *Refer to U: Monitors on page 437* for parameter details and *Refer to Fault Trace Contents on page 490* for register value descriptions.	
0098H	High Word of Accumulated Operation Time Monitor, 10 h units (U4-01)	
0099H	Low Word of Accumulated Operation Time Monitor, 1 h units (U4-01)	
009AH	High Word of Cooling Fan Operation Time Monitor (U4-03)	
009BH	Low Word of Cooling Fan Operation Time Monitor (U4-03)	
009CH to 00AAH	Reserved	
00ABH	Drive Rated Current <2>	
00ACH to 00AFH	Reserved	

Register No.	Contents	
00B0H	Option Code Connected to CN5-A	Register contains ASCII code of the option card. AO-A3 = 0004H Communication Option: Register contains ASCII code of first and third digit of the option card type number. Example: Register value is 5343H for “SC” if an SI-C3 option card is installed.
00B1H	Reserved	
00B2H	Option Code Connected to CN5-B	
00B3H	Option Code Connected to CN5-C	
00B4H	Reserved	
00B5H	Frequency Reference After Soft-starter (U1-16)	r/min units <4>
00B6H		0.01% units
00B7H	Frequency Reference	r/min <4>
00B8H		0.01% units
00B9H to 00BEH	Reserved	
00BFH	Lists the last two digits of operation error code oPE□□.	
00C0H	Fault Contents 3	
	bit 1	Undervoltage (Uv1)
	bit 2	Control Power Supply Undervoltage (Uv2)
	bit 3	Soft Charge Circuit Fault (Uv3)
	bit 4	IGBT Short Circuit (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 to 9	Reserved
	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)

Register No.	Contents	
00C2H	Fault Contents 5	
	bit 0	MEMOBUS/Modbus Communication Error (CE)
	bit 1	Option Communication Error (bUS)
	bit 2 to 5	Reserved
	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	High Slip Braking Overload (oL7)
	bit B to E	Reserved
	bit F	Hardware Fault (includes oFx)
00C3H	Fault Contents 6	
	bit 0 to 4	Reserved
	bit 5	Current Imbalance (LF2)
	bit 6	Pullout Detection (STo)
	bit 7	Reserved
	bit 8	SI-T3 Watchdog Error (E5)
	bit 9	Reserved
	bit A	Too many speed search restarts (SEr)
	bit B to F	Reserved
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	Reserved
	bit 1	Node Setup Fault (nSE)
	bit 2	Thermistor Disconnect (THo)
	bit 3	Variable Torque Overload (VToL)
	bit 4 to 8	Reserved
	bit 9	Underload Detection 6 (UL6)
	bit A, B	Reserved
	bit C	HOA Time Not Set (TIM)
	bit D	HOA Battery Low (bAT)
	bit E	HOA Time Data Error (TdE)
	bit F	HOA Time Interval Error (TIE)
00C6H to 00C7H	Reserved	

Register No.	Contents	
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	Reserved
00C9H	Alarm Contents 3	
	bit 0, 1	Reserved
	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, 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)
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 to F	Reserved

Register No.	Contents	
00CBH	Alarm Contents 5	
	bit 0	SI-T3 Watchdog Error (E5)
	bit 1	SI-T3 Station Address Setting Error (AEr)
	bit 2	SI-T3 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 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 to 6	Reserved
	bit 7	Motor Overheat (NTC Input) (oH5)
	bit 8 to B	Reserved
	bit C	Thermistor Disconnect (THo)
	bit D	Underload Detection 6 (UL6)
	bit E	Waiting for Run (wRUn)
	bit F	Reserved
00CDH	Reserved	
00CEH	bit 0, 1	Reserved
	bit 2	Time Not Set (TIM)
	bit 3	Battery Low (bAT)
	bit 4	Time Deviation Error (TdE)
	bit 5	Reserved
	bit 6	Emergency Override FWD (EoF)
	bit 7	Emergency Override REV (Eor)
00CFH	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	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	Same type of option card already connected (oFA02)
	bit 3, 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 to 00DBH	Reserved	

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 to 00DFH	Reserved	

Register No.	Contents	
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
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, 00E4H	Reserved	

Register No.	Contents	
00E5H	oFC3x Contents (CN5-C)	
	bit 0	Comm. ID Error (oFC30)
	bit 1	Model Code Error (oFC31)
	bit 2	Sumcheck Error (oFC32)
	bit 3	Comm. option timeout waiting for response (oFC33)
	bit 4	MEMOBUS Timeout (oFC34)
	bit 5	Drive timeout waiting for response (oFC35)
	bit 6	CI Check Error (oFC36)
	bit 7	Drive timeout waiting for response (oFC37)
	bit 8	Control Command Selection Error (oFC38)
	bit 9	Drive timeout waiting for response (oFC39)
	bit A	Control Response Selection 1 Error (oFC40)
	bit B	Drive timeout waiting for response (oFC41)
	bit C	Control Response Selection 2 Error (oFC42)
	bit D	Control Response Selection Error (oFC43)
	bit E, F	Reserved
00E6H to 00FFH	Reserved	

<1> Parameter o1-03, Digital Operator Display Selection, determines the units.

<2> The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW. *Refer to Power Ratings on page 374*.

<3> Communication error contents are saved until the fault is reset.

<4> Set the number of motor poles to parameter E2-04.

◆ 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.5 Fault Trace / History Register Contents

Fault Code	Fault Name	Fault Code	Fault Name
0002H	Undervoltage (Uv1)	004EH	Braking Resistor Transistor Fault (rF)
0003H	Control Power Supply Undervoltage (Uv2)	004FH	Braking Transistor Overload Fault (boL)
0004H	Soft Charge Circuit Fault (Uv3)	0050H	Motor Overheat (NTC Input) (oH5)
0005H	IGBT Short Circuit (SC)	0052H	Node Setup Fault (nSE)
0006H	Ground Fault (GF)	0053H	Thermistor Disconnect (THo)
0007H	Overcurrent (oC)	005AH	Underload Detection 6 (UL6)
0008H	Overvoltage (ov)	005DH	HOA Time Not Set (TIM)
0009H	Heatsink Overheat (oH)	005EH	HOA Battery Low (bAT)
000AH	Heatsink Overheat (oH1)	005FH	HOA Time Deviation Error (TdE)
000BH	Motor Overload (oL1)	0060H	HOA Time Interval Error (TIE)
000CH	Drive Overload (oL2)	0083H	A/D Conversion Error (CPF02)
000DH	Overtorque Detection 1 (oL3)	0084H	PWM Data Fault (CPF03)
000EH	Overtorque Detection 2 (oL4)	0087H	EEPROM Memory Data Error (CPF06)
000FH	Dynamic Braking Transistor (rr)	0088H	Terminal Board Connection Error (CPF07)
0010H	Braking Resistor Overheat (rH)	0089H	EEPROM Serial Communication Fault (CPF08)
0011H	External Fault at Input Terminal S3 (EF3)	008CH	RAM Fault (CPF11)
0012H	External Fault at Input Terminal S4 (EF4)	008DH	Flash Memory Circuit Exception (CPF12)
0013H	External Fault at Input Terminal S5 (EF5)	008EH	Watchdog Circuit Exception (CPF13)
0014H	External Fault at Input Terminal S6 (EF6)	008FH	Control Circuit Fault (CPF14)
0015H	External Fault at Input Terminal S7 (EF7)	0091H	Clock Fault (CPF16)
0016H	External Fault at Input Terminal S8 (EF8)	0092H	Timing Fault (CPF17)
001BH	Input Phase Loss (PF)	0093H	Control Circuit Fault (CPF18)
001CH	Output Phase Loss (LF)	0094H	Control Circuit Fault (CPF19)
001DH	Motor Overheat (PTC input) (oH3)	0095H	Hardware Fault at Power Up (CPF20)
001EH	Digital Operator Connection (oPr)	0096H	Hardware Fault at Communication Start Up (CPF21)
001FH	EEPROM Write Error (Err)	0097H	A/D Conversion Fault (CPF22)
0020H	Motor Overheat (PTC input) (oH4)	0098H	PWM Feedback Fault (CPF23)
0021H	MEMOBUS/Modbus Communication Error (CE)	0099H	Drive Unit Signal Fault (CPF24)
0022H	Option Communication Error (bUS)	009AH	Terminal Board is Not Properly Connected. (CPF25)
0027H	Option External Fault (EF0)	009BH	ASIC BB Circuit Error (CPF26)
0028H	PID Feedback Loss (FbL)	009CH	ASIC PWM Setting Register Error (CPF27)
0029H	Undertorque Detection 1 (UL3)	009DH	ASIC PWM Pattern Error (CPF28)
002AH	Undertorque Detection 2 (UL4)	009EH	ASIC On-delay Error (CPF29)
002BH	High Slip Braking Overload (oL7)	009FH	ASIC BBON Error (CPF30)
0030H	Hardware Fault (including oFx)	00A0H	ASIC Code Error (CPF31)
0036H	Output Current Imbalance (LF2)	00A1H	ASIC Start-up Error (CPF32)
0037H	Pullout Detection (Sto)	00A2H	Watch-dog Error (CPF33)
003BH	Too Many Speed Search Restarts (SEr)	00A3H	ASIC Power/Clock Error (CPF34)
0041H	PID Feedback Loss (FbH)	00A4H	External A/D Converter Error (CPF35)
0042H	External Fault 1, Input Terminal S1 (EF1)	00A9H	Control Circuit Error (CPF40)
0043H	External Fault 2, Input Terminal S2 (EF2)	00AAH	Control Circuit Error (CPF41)
0046H	Current Offset Fault (CoF)	00ABH	Control Circuit Error (CPF42)
0047H	PLC Detection Error 1 (PE1)	00ACH	Control Circuit Error (CPF43)
0048H	PLC Detection Error 2 (PE2)	00ADH	Control Circuit Error (CPF44)
004DH	Output Voltage Detection Fault (voF)	00AEH	Control Circuit Error (CPF45)

Fault Code	Fault Name
0101H	Option Compatibility Error (oFA00)
0102H	Option Not Properly Connected (oFA01)
0103H	Same Type of Option Card Already Connected (oFA02)
0106H	A/D Conversion Error (oFA05)
0107H	Option Response Error (oFA06)
0111H	Option RAM Fault (oFA10)
0112H	Option Operation Mode Fault (SLMOD) (oFA11)
0113H	Drive Receive CRC Error (oFA12)
0114H	Drive Receive Frame Error (oFA13)
0115H	Drive Receive Abort Error (oFA14)
0116H	Option Receive CRC Error (oFA15)
0117H	Option Receive Frame Error (oFA16)
0118H	Option Receive Abort Error (oFA17)
0131H	Comm. ID Error (oFA30)
0132H	Model Code Error (oFA31)
0133H	Sumcheck Error (oFA32)
0134H	Comm. Option Timeout Waiting for Response (oFA33)
0135H	MEMOBUS Timeout (oFA34)
0136H	Drive Timeout Waiting for Response (oFA35)
0137H	CI Check Error (oFA36)
0138H	Drive Timeout Waiting for Response (oFA37)
0139H	Control Command Selection Error (oFA38)
013AH	Drive Timeout Waiting for Response (oFA39)
013BH	Control Response Selection 1 Error (oFA40)
013CH	Drive Timeout Waiting for Response (oFA41)
013DH	Control Response Selection 2 Error (oFA42)
013EH	Control Response Selection Error (oFA43)
0200H	Option Compatibility Error (oFb00)
0202H	Option Connection Error (oFb01)
0203H	Same Type of Option Card Already Connected (oFb02)
0206H	A/D Conversion Error (oFb05)
0207H	Option Response Error (oFb06)
0211H	Option RAM Fault (oFb10)
0212H	Option Operation Mode Fault (SLMOD) (oFb11)
0213H	Drive Receive CRC Error (oFb12)
0214H	Drive Receive Frame Error (oFb13)
0215H	Drive Receive Abort Error (oFb14)
0216H	Option Receive CRC Error (oFb15)
0217H	Option Receive Frame Error (oFb16)
0218H	Option Receive Abort Error (oFb17)
0231H	Comm. ID Error (oFb30)

Fault Code	Fault Name
0232H	Model Code Error (oFb31)
0233H	Sumcheck Error (oFb32)
0234H	Comm. option Timeout Waiting for Response (oFb33)
0235H	MEMOBUS Timeout (oFb34)
0236H	Drive Timeout Waiting for Response (oFb35)
0237H	CI Check Error (oFb36)
0238H	Drive Timeout Waiting for Response (oFb37)
0239H	Control Command Selection Error (oFb38)
023AH	Drive Timeout Waiting for Response (oFb39)
023BH	Control Response Selection 1 Error (oFb40)
023CH	Drive Timeout Waiting for Response (oFb41)
023DH	Control Response Selection 2 Error (oFb42)
023EH	Control Response Selection Error (oFb43)
0301H	Option Compatibility Error (oFC00)
0302H	Option Not Properly Connected (oFC01)
0303H	Same Type of Option Card Already Connected (oFC02)
0306H	A/D Conversion Error (oFC05)
0307H	Option Response Error (oFC06)
0311H	Option RAM Fault (oFC10)
0312H	Option Operation Mode Fault (SLMOD) (oFC11)
0313H	Drive Receive CRC Error (oFC12)
0314H	Drive Receive Frame Error (oFC13)
0315H	Drive Receive Abort Error (oFC14)
0316H	Option Receive CRC Error (oFC15)
0317H	Option Receive Frame Error (oFC16)
0318H	Option Receive Abort Error (oFC17)
0331H	Comm. ID Error (oFC30)
0332H	Model Code Error (oFC31)
0333H	Sumcheck Error (oFC32)
0334H	Comm. Option Timeout Waiting for Response (oFC33)
0335H	MEMOBUS Timeout (oFC34)
0336H	Drive Timeout Waiting for Response (oFC35)
0337H	CI Check Error (oFC36)
0338H	Drive Timeout Waiting for Response (oFC37)
0339H	Control Command Selection Error (oFC38)
033AH	Drive Timeout Waiting for Response (oFC39)
033BH	Control Response Selection 1 Error (oFC40)
033CH	Drive Timeout Waiting for Response (oFC41)
033DH	Control Response Selection 2 Error (oFC42)
033EH	Control Response Selection Error (oFC43)

◆ Alarm Register Contents

The table below shows the alarm codes that can be read out from MEMOBUS/Modbus register 007FH.

Table C.6 Alarm Register 007FH Contents

Fault Code	Fault Name	Fault Code	Fault Name
0001H	Undervoltage (Uv)	0027H	PID Feedback Loss (FbL)
0002H	Overvoltage (ov)	0028H	PID Feedback Loss (FbH)
0003H	Heatsink Overheat (oH)	002AH	Drive Disabled (dnE)
0004H	Drive Overheat (oH2)	0031H	SI-T3 Watchdog Error (E5)
0005H	Overtorque 1 (oL3)	0032H	SI-T3 Station Address Setting Error (AEr)
0006H	Overtorque 2 (oL4)	0033H	SI-T3 Comm. Cycle Setting Error (CyC)
0007H	Run commands input error (EF)	0034H	High Current Alarm (HCA)
0008H	Drive Baseblock (bb)	0035H	Cooling Fan Maintenance Time (LT-1)
0009H	External Fault 3, input terminal S3 (EF3)	0036H	Capacitor Maintenance Time (LT-2)
000AH	External Fault 4, input terminal S4 (EF4)	0038H	SI-S EEPROM Error (EEP)
000BH	External Fault 5, input terminal S5 (EF5)	0039H	External Fault (input terminal S1) (EF1)
000CH	External Fault 6, input terminal S6 (EF6)	003AH	External Fault (input terminal S2) (EF2)
000DH	External Fault 7, input terminal S7 (EF7)	003FH	PLC Alarm (PA1)
000EH	External Fault 8, input terminal S8 (EF8)	0040H	PLC Alarm (PA2)
000FH	Cooling Fan Error (FAn)	0041H	Output Voltage Detection Fault (voF)
0014H	MEMOBUS/Modbus Communication Error (CE)	0042H	IGBT Maintenance Time (90%) (TrPC)
0015H	Option Communication Error (bUS)	0043H	Soft Charge Bypass Relay Maintenance Time (LT-3)
0016H	Serial Communication Transmission Error (CALL)	0044H	IGBT Maintenance Time (50%) (LT-4)
0017H	Motor Overload (oL1)	0045H	Braking Transistor Overload (boL)
0018H	Drive Overload (oL2)	0048H	Motor Overheat (NTC Input) (oH5)
001AH	Option Card External Fault (EF0)	004EH	Underload Detection 6 (UL6)
001BH	Motor Switch command input during run (rUn)	004FH	Waiting for Run (wRUn)
001DH	Serial Communication Transmission Error (CALL)	0063H	HOA Time Not Set (TIM)
001EH	Undertorque Detection 1 (UL3)	0064H	HOA Battery Low (bAT)
001FH	Undertorque Detection 2 (UL4)	0065H	HOA Time Deviation Error (TdE)
0020H	MEMOBUS/Modbus Test Mode Fault (SE)	0067H	Emergency Override FWD (EoF)
0022H	Motor Overheat (oH3)	0068H	Emergency Override REV (Eor)

C.10 Enter Command

When writing parameters to the drive from the PLC using MEMOBUS/Modbus communication, parameter H5-11 determines whether an Enter command must be issued to enable these parameters. This section describes the types and functions of the Enter commands.

◆ Enter Command Types

The drive supports two types of Enter commands as shown in *Table C.7*. An Enter command is enabled by writing 0 to register numbers 0900H or 0910H. It is only possible to write to these registers; attempting to read from these registers will cause an error.

Table C.7 Enter Command Types

Register No.	Description
0900H	Simultaneously writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM. Parameter changes remain after cycling power.
0910H	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.

Note: The EEPROM can only be written to 100,000 times, so it is recommended to limit the number of times writing to the EEPROM. The Enter command registers are write-only and if these registers are read, the register address will be invalid (Error code: 02H). An Enter command is not required when reference or broadcast data are sent to the drive.

◆ Enter Command Settings when Upgrading the Drive

When replacing previous Yaskawa drive models with the P1000 and keeping the MEMOBUS/Modbus communications settings, set parameter H5-11 in accordance with the Enter command configuration in the older drive. H5-11 determines whether an Enter command is necessary to activate parameter changes in the drive.

- If upgrading from a G7, F7, or P7 series drive to a P1000, set parameter H5-11 to 0.
- If upgrading from a V7 series drive to a P1000, set parameter H5-11 to 1.

■ H5-11 and the Enter Command

An enter command is not required when writing registers 0000H to 001FH. Changes to those registers take effect immediately, independent of the setting in parameter H5-11.

H5-11 Settings	H5-11 = 0	H5-11 = 1
Drive being replaced	G7, F7, P7	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
	• Attempted to set a function code from a PLC other than 03H, 08H, and 10H.
02H	Register Number Error
	• A register number specified in the command message does not exist. • Attempted to send a broadcast message using other register numbers than 0001H or 0002H.
03H	Bit Count Error
	• Read data or write data is greater than 16 bits. Invalid command message quantity. • 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.).
21H	Data Setting Error
	• Control data or parameter write data is outside the allowable setting range. • Attempted to write a contradictory parameter setting.
22H	Write Mode Error
	• During run, the user attempted to write a parameter that cannot be written to during run. • During an EEPROM memory data error (CPF06), the master attempted to write to a parameter other than A1-00 to A1-05, E1-03, or o2-04. • Attempted to write to read-only data.
23H	DC Bus Undervoltage Write Error
	• During an undervoltage situation, the master attempted to write to parameters that cannot be written to during undervoltage.
24H	Write Error During Parameter Process
	• Master attempted writing to the drive while the drive was processing parameter data.

◆ 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 (overrun, 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.
4. With the power off, wire the drive as shown in ***Figure C.7***, connecting terminals R+ and S+, R- and S-, and S6 and SC.

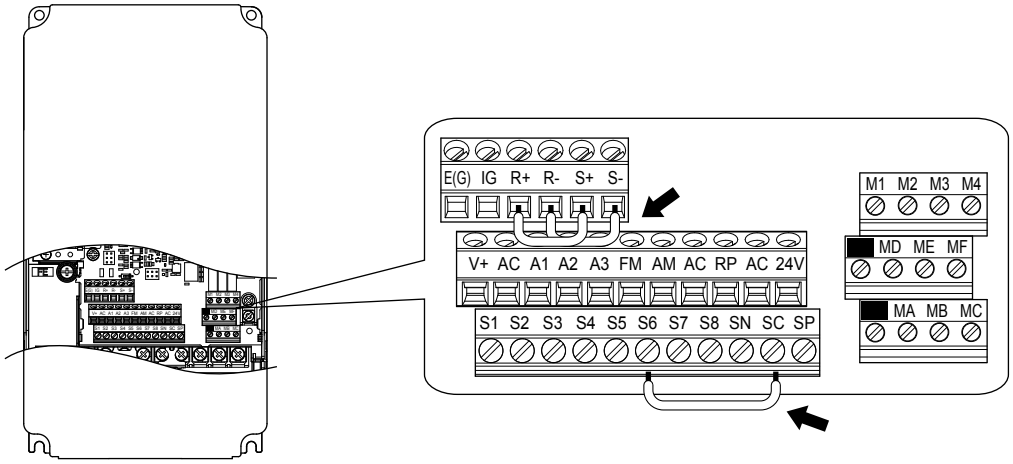

Figure C.7 Terminal Connections for Communication Self-Diagnostics

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 “Pass” to indicate that the communications test mode is operating normally.

   When a fault occurs, the drive will display “CE” on the keypad display.
8. Turn off the power supply.
9. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SC. Reset jumper S3 to its original position and set terminal S6 to its original function.
10. Return to normal operation.

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Appendix: D

Standards Compliance

This appendix explains the guidelines and criteria for maintaining CE and UL standards.

D.1 SECTION SAFETY....498
D.2 EUROPEAN STANDARDS....500
D.3 UL AND CSA STANDARDS....507

D.1 Section Safety

⚠ WARNING

Electrical Shock Hazard

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

Failure to comply could 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; After all indicators are OFF, measure the DC bus voltage level to confirm it has reached a safe level.

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.

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 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.

If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices.

Contact your supplier if the cause cannot be identified after checking the above.

Do not restart the drive immediately operate the peripheral devices if a fuse is blown or a GFCI is tripped.

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.

Note: 600 V class drives (models 5□□□□□□) are not compliant with European Standards.

◆ CE Low Voltage Directive Compliance

This drive has been tested according to European standard IEC61800-5-1, 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 IEC664.

■ Factory Recommended Branch Circuit Protection

Yaskawa recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in ***Table D.1***.

NOTICE: *If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of peripheral devices to identify the cause. Contact Yaskawa before restarting the drive or the peripheral devices if the cause cannot be identified.*

Table D.1 Factory Recommended Drive Branch Circuit Protection

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
Three-Phase 200 V Class		
2A0004	FWH-70B	70
2A0006	FWH-70B	70
2A0008	FWH-70B	70
2A0010	FWH-70B	70
2A0012	FWH-70B	70
2A0018	FWH-90B	90
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

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
2A0169	FWH-400A	400
2A0211	FWH-400A	400
2A0250	FWH-600A	600
2A0312	FWH-700A	700
2A0360	FWH-800A	800
2A0415	FWH-1000A	1000
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
4A0414	FWH-800A	800
4A0515	FWH-1000A	1000
4A0675	FWH-1200A	1200
Three-Phase 600 V Class		
5A0003 <I>	FWP-50B	50
5A0004 <I>	FWP-50B	50
5A0006 <I>	FWP-60B	60
5A0009 <I>	FWP-60B	60
5A0011 <I>	FWP-70B	70
5A0017 <I>	FWP-100B	100
5A0022 <I>	FWP-100B	100
5A0027 <I>	FWP-125A	125
5A0032 <I>	FWP-125A	125
5A0041 <I>	FWP-175A	175
5A0052 <I>	FWP-175A	175
5A0062 <I>	FWP-250A	250
5A0077 <I>	FWP-250A	250
5A0099 <I>	FWP-250A	250

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
5A0125 <1>	FWP-350A	350
5A0145 <1>	FWP-350A	350
5A0192 <1>	FWP-600A	600
5A0242 <1>	FWP-600A	600

<1> 600 V class drives are not compliant with European Standards.

■ Guarding Against Harmful Materials

When installing IP00/Open Type 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 EN61800-3: 2004.

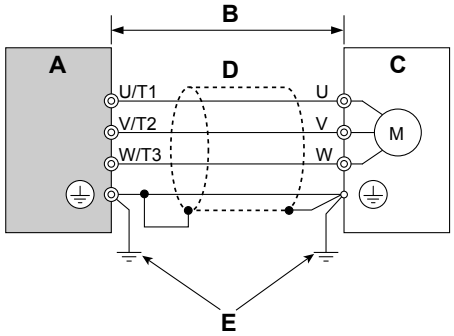
■ EMC Filter Installation

The following conditions must be met to ensure continued compliance with guidelines. *Refer to EMC Filters on page 505* 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.

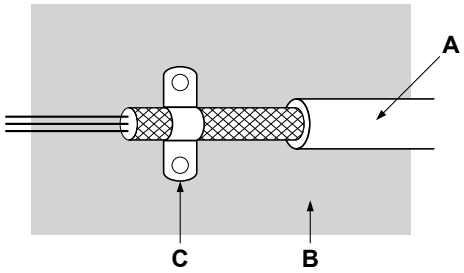


A – Drive
B – 10 m max cable length between drive and motor
C – Motor
D – Metal conduit
E – Ground wire should be as short as possible.

Figure D.2 Installation Method

5. Make sure the protective earthing conductor complies with technical standards and local safety regulations.

WARNING! *Electrical Shock Hazard. Because the leakage current exceeds 3.5 mA in models 4A0414 to 4A1200, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor, or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.*

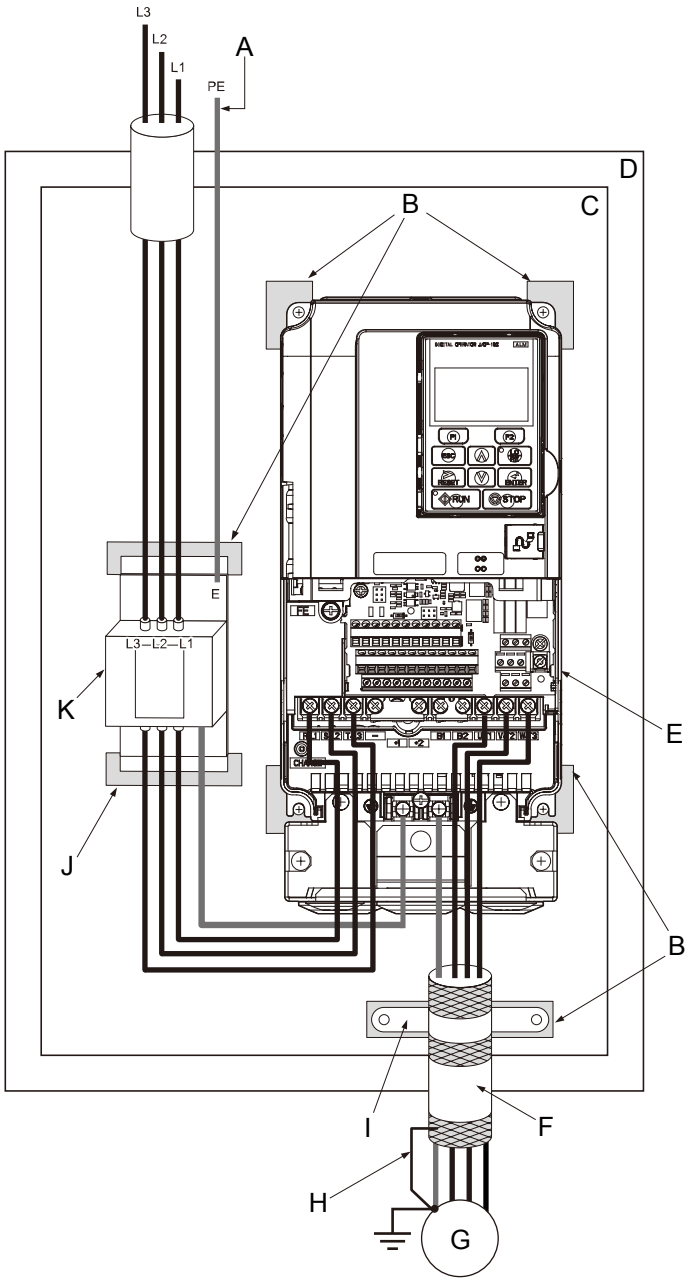


A – Braided shield cable
B – Metal panel
C – Cable clamp (conductive)

Figure D.3 Ground Area

6. Connect a DC link choke to minimize harmonic distortion. ***Refer to DC Link Chokes for EN 61000-3-2 Compliance on page 506***.

Three-Phase 200 V / 400 V Class



A – Make sure the ground wire is grounded
B – Grounding surface (remove any paint or sealant)
C – Metal plate
D – Enclosure panel
E – Drive
F – Motor cable (braided shield cable, max. 10 m)
G – Motor
H – Cable shield ground
I – Cable clamp
J – Ground plate (scrape off any visible paint)
K – EMC noise filter

Figure D.4 EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

■ EMC Filters

Install the drive with the EMC filters listed in *Table D.2* to comply with the EN61800-3 requirements.

Table D.2 EN61800-3 Filters

Drive Model	Filter Data (Manufacturer: Schaffner)					
	Type	Rated Current (A)	Weight (lb)	Dimensions [W x D x H] (in)	Y x X (in)	Figure
Three-Phase 200 V Class						
2A0004	FS5972-10-07	10	2.6	5.6 × 1.8 × 13.0	4.5 × 12.3	1
2A0006						
2A0008						
2A0010	FS5972-18-07	18	2.9	5.6 × 1.8 × 13.0	4.5 × 12.3	
2A0012						
2A0018	FS5972-35-07	35	4.6	8.1 × 2.0 × 14.0	6.9 × 13.2	
2A0021						
2A0030						
2A0040	FS5972-60-07	60	8.8	9.3 × 2.6 × 16.1	8.1 × 15.4	
2A0056						
2A0069	FS5972-100-35	100	7.5	3.5 × 5.9 × 13.0	2.6 × 10.0	2
2A0081						
2A0110	FS5972-170-40	170	13.2	4.7 × 6.7 × 17.8	4.0 × 14.4	
2A0138						
2A0169	FS5972-250-37	250	25.8	5.1 × 9.5 × 24.0	3.5 × 19.6	
2A0211						
2A0250	FS5972-410-99	410	23.1	10.2 × 4.5 × 15.2	9.3 × 4.7	3
2A0312						
2A0360	FS5972-600-99	600	24.3	10.2 × 5.3 × 15.2	9.3 × 4.7	
2A0415						
Three-Phase 400 V Class						
4A0002	FS5972-10-07	10	2.7	5.6 × 1.8 × 13.0	4.5 × 12.3	1
4A0004						
4A0005						
4A0007						
4A0009	FS5972-18-07	18	2.9	5.6 × 1.8 × 13.0	4.5 × 12.3	
4A0011						
4A0018	FS5972-35-07	35	4.6	8.1 × 2.0 × 14.0	6.9 × 13.2	
4A0023						
4A0031						
4A0038	FS5972-60-07	60	8.8	9.3 × 2.6 × 16.1	8.0 × 15.4	
4A0044						
4A0058						
4A0072	FS5972-100-35	100	16.5	3.5 × 5.9 × 13.0	2.6 × 10.0	2
4A0088						
4A0103	FS5972-170-35	170	10.4	4.7 × 6.7 × 17.8	4.0 × 14.4	
4A0139						
4A0165						
4A0208	FS5972-250-37	250	25.8	5.1 × 9.5 × 24.0	3.5 × 19.6	
4A0250	FS5972-410-99	410	23.1	10.2 × 4.5 × 15.2	9.3 × 4.7	3
4A0296						
4A0362						
4A0414	FS5972-600-99	600	24.3	10.2 × 5.3 × 15.2	9.3 × 4.7	
4A0515						
4A0675	FS5972-800-99	800	69.4	11.8 × 6.3 × 28.2	10.8 × 8.3	

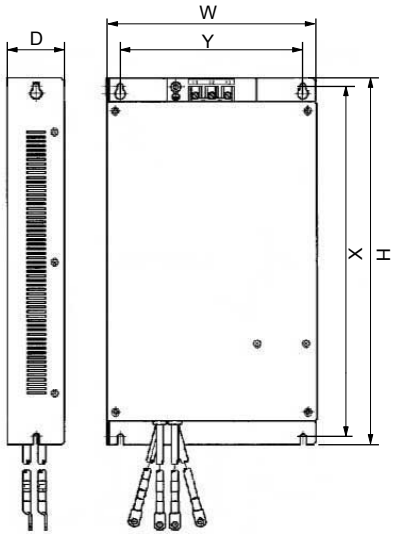


Figure 1

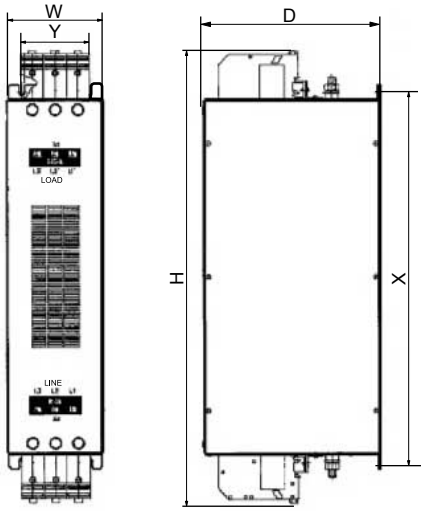


Figure 2

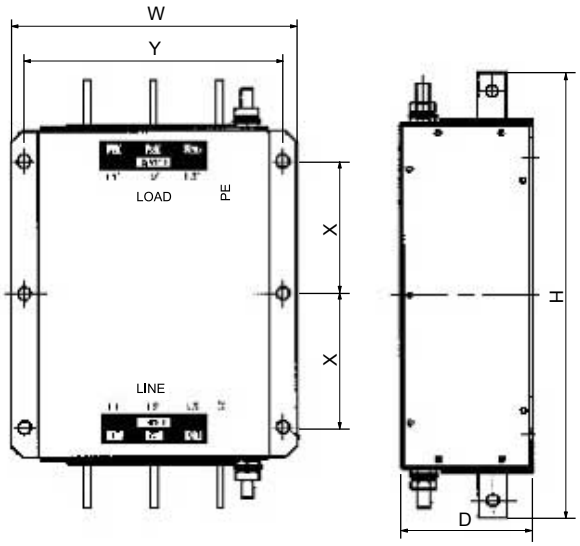


Figure 3

Figure D.5 EMC Filter Dimensions

■ DC Link Chokes for EN 61000-3-2 Compliance

Table D.3 DC Link Chokes for Harmonic Reduction

Drive Model	DC Link Chokes	
	Model	Rating
200 V Three-Phase Units		
2A0004	UZDA-B	5.4 A 8 mH
2A0006		
400 V Three-Phase Units		
4A0002	UZDA-B	3.2 A 28 mH
4A0004		

Note: DC link chokes are not required for other models to comply with EMC.

D.3 UL and CSA 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).

■ Main Circuit Terminal Wiring

Yaskawa recommends using closed-loop crimp terminals on all drive models. To maintain UL/cUL approval, UL-Listed closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2A0110 to 2A0415, 4A0058 to 4A0675, and 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping. *Refer to Closed-Loop Crimp Terminal Size on page 514* for closed-loop crimp terminal recommendations.

The wire gauges listed in the following tables are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

Note: The ⏚ mark indicates the terminals for protective ground connection as defined in IEC60417-5019.
Grounding impedance:
200 V: 100 Ω or less
400 V: 10 Ω or less
600 V: 10 Ω or less

Wire Gauges and Tightening Torques

Table D.4 Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0004 2A0006 2A0008 2A0010	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0012	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0018	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0021	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	12 to 10		
	–, +1, +2	–	12 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	12 to 10		
2A0030	R/L1, S/L2, T/L3	8	10 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	8	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	14 to 10		
	⏚	8 <1>	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0040	R/L1, S/L2, T/L3	6	8 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	8	8 to 6		
	–, +1, +2	–	6		
	B1, B2	–	12 to 10		
	⏚	8 <1>	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0056	R/L1, S/L2, T/L3	4	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	4	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	4 to 6 (35.4 to 53.1)
2A0069	R/L1, S/L2, T/L3	3	4 to 3	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	–, +1, +2	–	4 to 3		
	B1, B2	–	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
2A0081	R/L1, S/L2, T/L3	2	3 to 2	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 2		
	–, +1, +2	–	3 to 2		
	B1, B2	–	6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
2A0110 <2>	R/L1, S/L2, T/L3	1/0	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1/0	3 to 1/0		
	–, +1	–	2 to 1/0		
	B1, B2	–	6 to 1/0		
	⏚	6	6 to 4		
2A0138 <2>	R/L1, S/L2, T/L3	2/0	1 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 2/0		
	–, +1	–	1/0 to 3/0		
	B1, B2	–	4 to 2/0		
	⏚	4	4	M8	9 to 11 (79.7 to 97.4)
2A0169 <2>	R/L1, S/L2, T/L3	4/0	2/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	–, +1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 2		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0211 <2>	R/L1, S/L2, T/L3	1/0 × 2P	1/0 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1/0 × 2P	1/0 to 2/0		
	–, +1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 1/0		
2A0250 <2>	R/L1, S/L2, T/L3	3/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	–, +1	–	3/0 to 300		
	+3	–	2 to 300	M10	18 to 23 (159 to 204)
	⏚	3	3 to 300	M12	32 to 40 (283 to 354)
2A0312 <2>	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	–, +1	–	3/0 to 300		
	+3	–	3/0 to 300	M10	18 to 23 (159 to 204)
	⏚	2	2 to 300	M12	32 to 40 (283 to 354)
2A0360 <2>	R/L1, S/L2, T/L3	250 × 2P	4/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	4/0 to 600		
	–, +1	–	250 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
2A0415 <2>	R/L1, S/L2, T/L3	350 × 2P	250 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	300 to 600		
	–, +1	–	300 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

<1> When installing an EMC filter, additional measures must be taken to comply with IEC61800-5-1. *Refer to EMC Filter Installation on page 502* for details.

<2> Drive models 2A0110 to 2A0415 require the use of UL-Listed closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

Table D.5 Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0002 4A0004	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	12	14 to 12		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
4A0011	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
4A0018	R/L1, S/L2, T/L3	10	12 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	10	12 to 6		
	–, +1, +2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10	14 to 10	M5	2 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	10	10 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10	12 to 10	M5	2 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	8	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	U/T1, V/T2, W/T3	8	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8	M5	
	⏚	8	10 to 8	M6	4 to 6 (35.4 to 53.1)
4A0038	R/L1, S/L2, T/L3	6	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	U/T1, V/T2, W/T3	8	8 to 6		
	–, +1, +2	–	6		
	B1, B2	–	10 to 8	M5	
	⏚	6	10 to 6	M6	4 to 6 (35.4 to 53.1)
4A0044	R/L1, S/L2, T/L3	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	4 to 6 (35.4 to 53.1)
4A0058 <I>	R/L1, S/L2, T/L3	4	6 to 4	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	4	6 to 4		
	–, +1	–	6 to 1		
	B1, B2	–	8 to 4		
	⏚	6	8 to 6		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0072 <1>	R/L1, S/L2, T/L3	3	4 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	–, +1	–	4 to 1		
	B1, B2	–	6 to 3		
	⏚	6	6		
4A0088 <1>	R/L1, S/L2, T/L3	2	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 1/0		
	–, +1	–	3 to 1/0		
	+3	–	6 to 1/0		
	⏚	4	6 to 4		
4A0103 <1>	R/L1, S/L2, T/L3	1/0	2 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1	2 to 1/0		
	–, +1	–	3 to 1/0		
	+3	–	4 to 1/0		
	⏚	4	6 to 4		
4A0139 <1>	R/L1, S/L2, T/L3	3/0	1/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1/0 to 4/0		
	–, +1	–	1/0 to 4/0		
	+3	–	3 to 4/0		
	⏚	4	4		
4A0165 <1>	R/L1, S/L2, T/L3	4/0	3/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	–,+1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 2		
4A0208 <1>	R/L1, S/L2, T/L3	300	2 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	300	2 to 300		
	–,+1	–	1 to 250		
	+3	–	3 to 3/0		
	⏚	4	4 to 300		
4A0250 <1>	R/L1, S/L2, T/L3	400	1 to 600	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	400	1/0 to 600		
	–,+1	–	3/0 to 600		
	+3	–	1 to 325		
	⏚	2	2 to 350		
4A0296 <1>	R/L1, S/L2, T/L3	500	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	500	2/0 to 600		
	–,+1	–	3/0 to 600		
	+3	–	1 to 325	M10	18 to 23 (159 to 204)
	⏚	2	2 to 350	M12	32 to 40 (283 to 354)
4A0362 <1>	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	3/0 to 600		
	–,+1	–	4/0 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0414 <1> <2>	R/L1, S/L2, T/L3	300 × 2P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	4/0 to 300		
	–,+1	–	3/0 to 300		
	+3	–	3/0 to 300		
	⏚	1	1 to 3/0		
4A0515 <1> <2>	R/L1, S/L2, T/L3	3/0 × 4P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 4P	3/0 to 300		
	–,+1	–	1/0 to 300		
	+3	–	1/0 to 300		
	⏚	1/0	1/0 to 300		
4A0675 <1> <2>	R/L1, S/L2, T/L3	300 × 4P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 4P	4/0 to 300		
	–,+1	–	1/0 to 300		
	+3	–	1/0 to 300		
	⏚	2/0	2/0 to 300		

<1> Drive models 4A0058 to 4A0675 require the use of UL-Listed closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

<2> When installing an EMC filter, additional measures must be taken to comply with IEC61800-5-1. *Refer to EMC Filter Installation on page 502* for details.

Table D.6 Wire Gauge and Torque Specifications (Three-Phase 600 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0003 5A0004 5A0006	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
5A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	12 to 10		
5A0011	R/L1, S/L2, T/L3	10	14 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 6		
	–, +1, +2	–	14 to 6		
	B1, B2	–	14 to 10		
	⏚	8	12 to 8	M5	2 to 2.5 (17.7 to 22.1)
5A0017	R/L1, S/L2, T/L3	10	10 to 6	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8		
	⏚	8	12 to 8	M6	4 to 6 (35.4 to 53.1)
5A0022	R/L1, S/L2, T/L3	8	10 to 6	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8		
	⏚	8	10 to 6	M6	4 to 6 (35.4 to 53.1)
5A0027 5A0032	R/L1, S/L2, T/L3	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
	⏚	6	10 to 6	M6	4 to 6 (35.4 to 53.1)
5A0041	R/L1, S/L2, T/L3	6	10 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	–, +1	–	6 to 1		
	B1, B2	–	12 to 3		
	⏚	6	6		
5A0052	R/L1, S/L2, T/L3	4	10 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	–, +1	–	6 to 1		
	B1, B2	–	8 to 3		
	⏚	6	6		
5A0062	R/L1, S/L2, T/L3	4	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4	10 to 4/0		
	–, +1	–	4 to 4/0		
	+3	–	6 to 4/0		
	⏚	4	4		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0077	R/L1, S/L2, T/L3	3	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3	10 to 4/0		
	–, +1	–	3 to 4/0		
	+3	–	6 to 4/0		
	⏚	4	4		
5A0099	R/L1, S/L2, T/L3	1/0	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1	10 to 4/0		
	–, +1	–	2 to 4/0		
	+3	–	4 to 4/0		
	⏚	4	4		
5A0125	R/L1, S/L2, T/L3	2/0	1 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 300		
	–, +1	–	2/0 to 3/0		
	+3	–	1 to 1/0		
	⏚	3	4 to 300		
5A0145	R/L1, S/L2, T/L3	3/0	2/0 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3/0	2/0 to 300		
	–, +1	–	3/0 to 4/0		
	+3	–	1/0 to 2/0		
	⏚	3	4 to 300		
5A0192	R/L1, S/L2, T/L3	300	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	250	2/0 to 600		
	–, +1	–	2/0 to 400		
	+3	–	2/0 to 250	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
5A0242	R/L1, S/L2, T/L3	400	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	350	2/0 to 600		
	–, +1	–	2/0 to 500		
	+3	–	250 to 300	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

Closed-Loop Crimp Terminal Recommendations

Yaskawa recommends crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap. *Table D.7* 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 representative or the Yaskawa sales department.

The closed-loop crimp terminal sizes and values listed in *Table D.7* are Yaskawa recommendations.

Wire gauge values shown in ***bold italic*** are the recommended values. Refer to local codes for proper selections.

Table D.7 Closed-Loop Crimp Terminal Size

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
200 V Class								
2A0004	***14***		M4	R2-4	YA-4	AD-900	TP-003	100-054-028
2A0006	12			R5.5-4			TP-005	100-054-029
2A0008	10							
2A0010								

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
2A0012	14	***14***	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12	12		R5.5-4			TP-005	100-054-029
	10							
2A0018	–	14	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12			R5.5-4			TP-005	100-054-029
	10							
2A0021	12		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	10							
2A0030	10		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	8			8-4		AD-901	TP-008	100-054-031
	6			14-NK4		AD-902	TP-014	100-054-033
2A0040	8	***8***	M4	8-4	YA-4	AD-901	TP-008	100-054-031
	6	6		14-NK4		AD-902	TP-014	100-054-033
2A0056	6		M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4			R22-6		AD-953	TP-022	100-051-262
2A0069	4		M8	R22-8	YA-5	AD-953	TP-022	100-051-263
	3			R38-8		AD-954	TP-038	100-051-264
2A0081	3		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	2							
2A0110	3		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	2							
	1							
	1/0			R60-8	YA-5	AD-955	TP-060	100-051-265
2A0138	1		M10	R38-10	YF-1 YET-300-1	TD-321, TD-311	TP-060	100-061-114
	1/0			R60-10				100-051-266
	2/0			70-10		TD-323, TD-312	TP-080	100-054-036
2A0169	2/0	–	M10	70-10	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-054-036
	3/0			80-10				100-051-267
	4/0			R100-10		TD-324, TD-312	TP-100	100-051-269
2A0211	***1/0 × 2P***		M10	R60-10	YF-1 YET-300-1	TD-321, TD-311	TP-060	100-051-266
	2/0 × 2P			70-10		TD-323, TD-312	TP-080	100-054-036
2A0250	***3/0 × 2P***		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P			100-L12		TD-324, TD-312	TP-100	100-051-560
	–	250 × 2P		150-L12		TD-325, TD-313	TP-150	100-051-562
	250	–		R150-12			TP-150	100-051-273
	300							
2A0312	3/0 × 2P	***3/0 × 2P***	M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P	4/0 × 2P		100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
2A0360	4/0 × 2P	***4/0 × 2P***	M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 2P	250 × 2P		150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
	350 × 2P			180-L12		TD-327, TD-314	TP-200	100-066-688
	400 × 2P			200-L12				100-051-564
	500 × 2P			325-12		TD-328, TD-315	TP-325	100-051-277
	600	600 × 2P						
2A0415	250 × 2P	–	M12	150-L12	YF-1 YET-300-1	TD-325, TD-313	TP-150	100-051-562
	300 × 2P	***300 × 2P***						
	350 × 2P	350 × 2P		180-L12		TD-327, TD-314	TP-200	100-066-688
	400 × 2P			200-L12				100-051-564
	500 × 2P			325-12		TD-328, TD-315	TP-325	100-051-277
	600 × 2P							
400 V Class								
4A0002 4A0004 4A0005 4A0007 4A0009	***14***		M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12			R5.5-4			TP-005	100-054-029
	10							
4A0011	14	***14***	M4	R2-4	YA-4	AD-900	TP-003	100-054-028
	12	12		R5.5-4			TP-005	100-054-029
	10							
4A0018	12		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	10							
	8			8-4		AD-901	TP-008	100-054-031
	6			14-NK4		AD-902	TP-014	100-054-033
4A0023	**10**		M4	R5.5-4	YA-4	AD-900	TP-005	100-054-029
	8			8-4		AD-901	TP-008	100-054-031
	6			14-NK4		AD-902	TP-014	100-054-033
4A0031	–	10	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
	8			R8-5		AD-901	TP-008	100-054-032
	6			R14-5		AD-902	TP-014	100-054-034
4A0038	8	***8***	M5	R8-5	YA-4	AD-901	TP-008	100-054-032
	6	6		R14-5		AD-902	TP-014	100-054-034
4A0044	***6***		M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4			R22-6		AD-953	TP-022	100-051-262
4A0058	6		M8	R14-8	YA-5	AD-952	TP-014	100-054-035
	4			R22-8		AD-953	TP-022	100-051-263
4A0072	4		M8	R22-8	YA-5	AD-953	TP-022	100-051-263
	3			R38-8		AD-954	TP-038	100-051-264
4A0088	3		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	2							
	1							
	1/0			R60-8		AD-955	TP-060	100-051-265
4A0103	2		M8	R38-8	YA-5	AD-954	TP-038	100-051-264
	1	***1***						
	1/0	1/0		R60-8		AD-955	TP-060	100-051-265

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
4A0139	1/0		M10	R60-10	YF-1 YET-300-1	TD-321, TD-311	TP-060	100-051-266
	2/0	***2/0***		70-10		TD-323, TD-312	TP-080	100-054-036
	3/0	3/0		80-10				100-051-267
	4/0			R100-10		TD-324, TD-312	TP-100	100-051-269
4A0165	3/0		M10	80-10	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-267
	4/0			R100-10		TD-324, TD-312	TP-100	100-051-269
4A0208	2 × 2P		M10	38-L10	YF-1 YET-150-1	TD-224, TD-212	TP-038	100-051-556
	1 × 2P							
	3/0 × 2P			80-L10		TD-227, TD-214	TP-080	100-051-557
	4/0			R100-10		TD-228, TD-214	TP-100	100-051-269
	250			R150-10		TD-229, TD-215	TP-150	100-051-272
	300							
4A0250	1 × 2P	–	M10	38-L10	YF-1 YET-150-1	TD-224, TD-212	TP-038	100-051-556
	3/0 × 2P			80-L10		TD-227, TD-214	TP-080	100-051-557
	4/0 × 2P			100-L10		TD-228, TD-214	TP-100	100-051-559
	250 × 2P			150-L10		TD-229, TD-215	TP-150	100-051-561
	300			R150-10			TP-150	100-051-272
	350			180-10	YF-1 YET-300-1	TD-327, TD-314	TP-200	100-066-687
	400			200-10				100-051-563
	500			325-10		TD-328, TD-315	TP-325	100-051-565
	600							
4A0296	3/0 × 2P		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P			100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
	–	350 × 2P		180-L12		TD-327, TD-314	TP-200	100-066-688
	350	–		180-12				100-066-689
	400			R200-12				100-051-275
	500			325-12		TD-328, TD-315	TP-325	100-051-277
	600							
4A0362	3/0 × 2P		M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 2P			100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
	350 × 2P			180-L12		TD-327, TD-314	TP-200	100-066-688
	400 × 2P			200-L12				100-051-564
	500			325-12		TD-328, TD-315	TP-325	100-051-277
	600							
4A0414	4/0 × 2P		M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 2P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							

Drive Model	Wire Gauge (AWG, kcmil)		Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw		
4A0515	***3/0 × 4P***	3/0 × 4P	M12	80-L12	YF-1 YET-300-1	TD-323, TD-312	TP-080	100-051-558
	4/0 × 4P	***4/0 × 4P***		100-L12		TD-324, TD-312	TP-100	100-051-560
	250 × 4P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 2P							
4A0675	4/0 × 4P		M12	100-L12	YF-1 YET-300-1	TD-324, TD-312	TP-100	100-051-560
	250 × 4P			150-L12		TD-325, TD-313	TP-150	100-051-562
	300 × 4P							

<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].

Note: Use crimp insulated terminals or insulated shrink tubing for wiring connections. Wires should have a continuous maximum allowable temperature of 75 °C 600 Vac UL-approved vinyl-sheathed insulation.

Input Fuse Installation

Yaskawa recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in ***Table 8.3***.

Table D.8 Factory Recommended AC Drive Branch Circuit Protection (Normal Duty)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
200 V Class						
2A0004	0.75	3.9	15	6.25	10	FWH-70B (70)
2A0006	1 - 1.5	7.3	15	12	20	FWH-70B (70)
2A0008	2	8.8	15	15	25	FWH-70B (70)
2A0010	3	10.8	20	17.5	30	FWH-70B (70)
2A0012	3	13.9	25	20	40	FWH-70B (70)
2A0018	5	18.5	35	30	50	FWH-90B(90)
2A0021	7.5	24	45	40	70	FWH-90B(90)
2A0030	10	37	60	60	110	FWH-100B (100)
2A0040	15	52	100	90	150	FWH-200B (200)
2A0056	20	68	125	110	200	FWH-200B (200)
2A0069	25	80	150	125	225	FWH-200B (200)
2A0081	30	96	175	150	275	FWH-300A (300)
2A0110	40	111	200	175	300	FWH-300A (300)
2A0138	50	136	250	225	400	FWH-350A (350)
2A0169	60	164	300	250	450	FWH-400A (400)
2A0211	75	200	400	350	600	FWH-400A (400)
2A0250	100	271	500	450	800	FWH-600A (600)
2A0312	125	324	600	500	800	FWH-700A (700)
2A0360	150	394	700	600	1000 <5>	FWH-800A (800)
2A0415	175	471	900	800	1400 <5>	FWH-1000A (1000)
400 V Class						
4A0002	1	2.1	15	3.5	6	FWH-40B (40)
4A0004	2	4.3	15	7.5	12	FWH-50B (50)
4A0005	3	5.9	15	10	17.5	FWH-70B (70)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
4A0007	3	8.1	15	12	20	FWH-70B (70)
4A0009	5	9.4	15	15	25	FWH-90B (90)
4A0011	7.5	14	25	20	40	FWH-90B (90)
4A0018	10	20	40	35	60	FWH-80B (80)
4A0023	15	24	45	40	70	FWH-100B (100)
4A0031	20	38	75	60	110	FWH-125B (125)
4A0038	25	44	75	75	125	FWH-200B (200)
4A0044	30	52	100	90	150	FWH-250A (250)
4A0058	40	58	100	100	150	FWH-250A (250)
4A0072	50	71	125	110	200	FWH-250A (250)
4A0088	60	86	150	150	250	FWH-250A (250)
4A0103	75	105	200	175	300	FWH-250A (250)
4A0139	100	142	250	225	400	FWH-350A (350)
4A0165	125	170	300	250	500	FWH-400A (400)
4A0208	150	207	400	350	600	FWH-500A (500)
4A0250	200	248	450	400	700	FWH-600A (600)
4A0296	250	300	600	500	800	FWH-700A (700)
4A0362	300	346	600	600	1000 <5>	FWH-800A (800)
4A0414	350	410	800	700	1200 <5>	FWH-800A (800)
4A0515	400 - 450	465	900	800	1350 <5>	FWH-1000A (1000)
4A0675	500 - 600	657	1200	1100 <5>	1800 <5>	FWH-1200A (1200)
600 V Class						
5A0003	2	3.6	15	6.25	10	FWP-50B (50)
5A0004	3	5.1	15	8	15	FWP-50B (50)
5A0006	5	8.3	15	12	20	FWP-60B (60)
5A0009	7.5	12	20	20	35	FWP-60B (60)
5A0011	10	16	30	25	45	FWP-70B (70)
5A0017	15	23	40	40	60	FWP-100B (100)
5A0022	20	31	60	50	90	FWP-100B (100)
5A0027	25	38	75	60	110	FWP-125A (125)
5A0032	30	45	75	75	125	FWP-125A (125)
5A0041	40	44	75	75	125	FWP-175A (175)
5A0052	50	54	100	90	150	FWP-175A (175)
5A0062	60	66	125	110	175	FWP-250A (250)
5A0077	75	80	150	125	225	FWP-250A (250)
5A0099	100	108	175	175	300	FWP-250A (250)
5A0125	125	129	225	225	350	FWP-350A (350)
5A0145	150	158	300	275	450	FWP-350A (350)
5A0192	200	228	400	350	600	FWP-600A (600)
5A0242	250	263	500	450	700	FWP-600A (600)

<1> Maximum MCCB Rating is 15 A, or 200 % of drive input current rating, whichever is larger. MCCB voltage rating must be 600 VAC or greater.

<2> Maximum Time Delay fuse is 175% of drive input current rating. This covers any Class CC, J or T class fuse.

<3> Maximum Non-time Delay fuse is 300% of drive input current rating. This covers any CC, J or T class fuse.

<4> When using semiconductor fuses, Bussman FWH and FWP are required for UL compliance. Select FWH for 200 V Class and 400 V Class models and FWP fuses for 600 V models.

<5> Class L fuse is also approved for this rating.

■ 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. The external power supply shall be a UL listed Class 2 power supply source or equivalent only.

Table D.9 Control Circuit Terminal Power Supply

Input / Output	Terminal Signal	Power Supply Specifications
Open Collector Outputs	P1, P2, PC, DM+, DM-	Requires class 2 power supply
Digital inputs	S1 to S8, SC, 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

The drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class), and 600 Vac maximum (600 V Class) when protected by Bussmann Type FWH or FWP fuses as specified in *Factory Recommended Branch Circuit Protection* on page *500*.

◆ CSA Standards Compliance

Figure D.7 CSA Mark

■ CSA for Industrial Control Equipment

The drive is CSA-certified as Industrial Control Equipment Class 3211.

Specifically, the drive is certified to: CAN/CSA C22.2 No. 04-04 and CAN/CSA C22.2 No.14-05.

◆ 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 protects the motor when parameter L1-01 is not set to 0. The default for L1-01 is 1, which enables protection for standard induction motors.

If Auto-Tuning has been performed successfully, the motor data entered to T1-04 is automatically written to 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 that 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.10 Overload Protection Settings

Setting	Description	
0	Disabled	Disabled the internal motor overload protection of the drive.
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 reduced 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.
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 reduced 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 motor overload protection (L1-01 ≠ 0) 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 while 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 60 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.

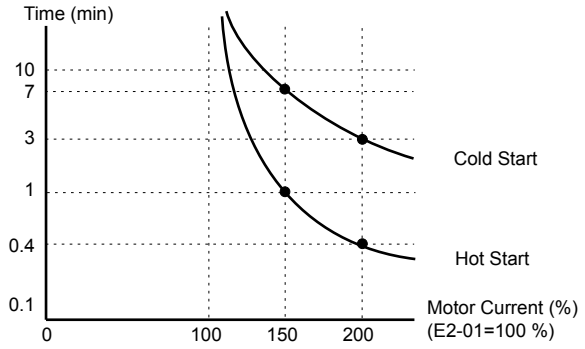


Figure D.8 Motor Overload Protection Time

◆ Precautionary Notes on External Heatsink (IP00/Open Type Enclosure)

When using an external heatsink, UL compliance requires covering exposed capacitors in the main circuit to prevent injury to surrounding personnel.

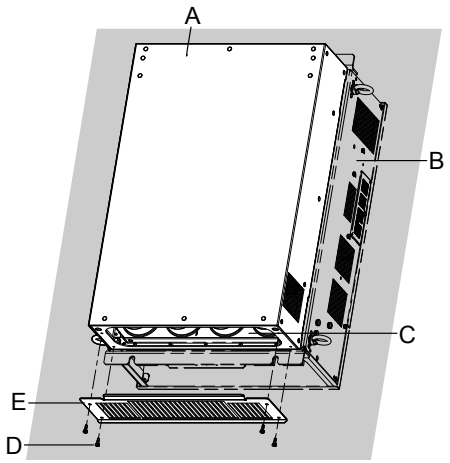
The portion of the external heatsink that projects out can be protected with the enclosure or with the appropriate capacitor cover after completing drive installation. Use ***Table D.11*** to match drive models with available capacitor covers. Order capacitor covers from a Yaskawa representative or directly from the Yaskawa sales department.

Refer to ***Figure D.9*** for a detailed description of the capacitor cover parts.

Table D.11 Capacitor Cover

Drive Model	Code Number	Model
2A0110	100-061-273	ECAT31875-11
2A0138	100-061-274	ECAT31876-11
2A0169	100-061-275	ECAT31877-11
2A0211		
2A0250	100-061-277	ECAT31726-11
2A0312		
2A0360	100-061-278	ECAT31698-11
2A0415		
4A0058	100-061-273	ECAT31875-11
4A0072	100-061-274	ECAT31876-11
4A0088	100-061-276	ECAT31878-11
4A0103		
4A0139	100-061-275	ECAT31877-11
4A0165		
4A0208	100-061-277	ECAT31726-11
4A0250	100-061-278	ECAT31698-11
4A0296		
4A0362		
4A0414	100-061-279	ECAT31740-11
4A0515	100-061-280	ECAT31746-11
4A0675		
5A0041	100-061-274	ECAT31876-11
5A0052		
5A0062	100-061-275	ECAT31877-11
5A0077		
5A0099		
5A0125	100-061-277	ECAT31726-11
5A0145		
5A0192	100-061-278	ECAT31698-11
5A0242		

<1> Requires two sets.



A – Drive (outside panel)
B – Drive (inside panel)
C – Opening to capacitors
D – Installation screws
E – Capacitor cover

Figure D.9 Capacitor Cover

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Appendix: E

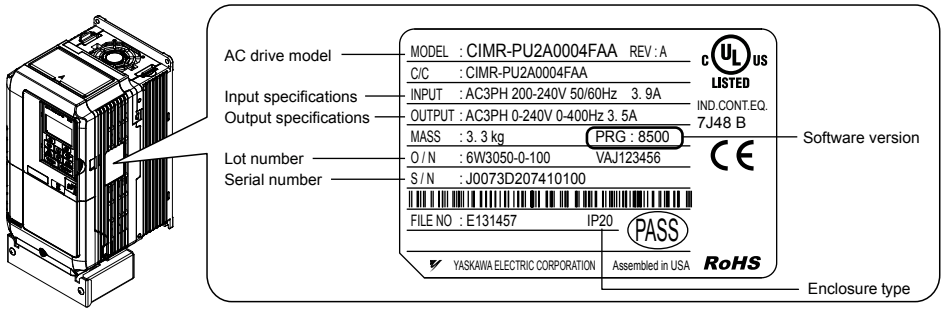
Quick Reference Sheet

This section provides tables to keep record of the drive specifications, motor specifications, and drive settings. Fill in the table data after commissioning the application and have them ready when contacting Yaskawa for technical assistance.

E.1 DRIVE AND MOTOR SPECIFICATIONS.....526
E.2 BASIC PARAMETER SETTINGS.....527
E.3 USER SETTING TABLE.....529

E.1 Drive and Motor Specifications

◆ Drive Specifications



Items	Description
Model	CIMR-P
Serial Number	
Software Version (PRG)	
Options used	
Date of Usage	

◆ Motor Specifications

■ Induction Motor

Items	Description		Items	Description	
Manufacturer			**Motor Rated Current (T1-04)**		A
Model			**Motor Base Frequency (T1-05)**		Hz
Motor Rated Power (T1-02)		HP	**Number of Motor Poles (T1-06)**		
Motor Rated Voltage (T1-03)		V	**Motor Base Speed (T1-07)**		r/min

Note: These values must be entered as part of the Auto-Tuning process.

■ Motor Speed Encoder (if used)

Items	Description	Items	Description
Manufacturer		**Resolution**	
Interface			

E.2 Basic Parameter Settings

Use the following tables to keep records of important parameters. Have this data available when contacting Yaskawa technical support.

◆ Basic Setup

Item	Setting Value	Memo
Frequency Reference Source	b1-01 =	
Run Command Source	b1-02 =	

◆ V/f Pattern Setup

Item	Setting Value	Memo
V/f Pattern Selection	E1-03 =	
Max. Output Frequency	E1-04 =	
Max. Voltage	E1-05 =	
Base Frequency	E1-06 =	
Mid. Output Frequency	E1-07 =	
Mid. Output Frequency Volt.	E1-08 =	
Min. Output Frequency	E1-09 =	
Min. Output Frequency Volt.	E1-10 =	

◆ Motor Setup

Motor Type	Item	Setting Value	Memo
Induction	**Motor Rated Current**	E2-01 =	
	Motor Rated Slip	E2-02 =	
	Motor No-Load Current	E2-03 =	
	No. of Motor Poles	E2-04 =	
	Line-to-Line Resistance	E2-05 =	
	Motor Leakage Inductance	E2-06 =	

◆ Multi-Function Digital Inputs

Terminal	Input Used	Setting Value and Function Name	Memo
S1		H1-01 =	
S2		H1-02 =	
S3		H1-03 =	
S4		H1-04 =	
S5		H1-05 =	
S6		H1-06 =	
S7		H1-07 =	
S8		H1-08 =	

◆ 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 =	
MD-ME-MF		H2-03 =	

◆ Monitor Outputs

Terminal	Output Used	Setting Value and Function Name	Memo
FM		H4-01 =	
AM		H4-04 =	

E.3 User Setting Table

Use the Verify Menu to determine which parameters have been changed from their original default settings

RUN below the parameter number indicates that the parameter setting can be changed during run.

No.	Name	User Setting
A1-00 RUN	Language Selection	
A1-01 RUN	Access Level Selection	
A1-03	Initialize Parameters	
A1-04	Password	
A1-05	Password Setting	
A1-06	Application Preset	
A2-01 to A2-32	User Parameters, 1 to 32	
A2-33	User Parameter Automatic Selection	
b1-01	Frequency Reference Selection 1	
b1-02	Run Command Selection 1	
b1-03	Stopping Method Selection	
b1-04	Reverse Operation Selection	
b1-07	LOCAL/REMOTE Run Selection	
b1-08	Run Command Selection while in Programming Mode	
b1-11	Run Delay Time Setting	
b1-14	Phase Order Selection	
b1-15	Frequency Reference Selection 2	
b1-16	Run Command Selection 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	
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	
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	
b3-10	Speed Search Detection Compensation Gain	
b3-12	Minimum Current Detection Level during Speed Search	
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	

No.	Name	User Setting
b3-26	Direction Determining Level	
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 RUN	Proportional Gain Setting (P)	
b5-03 RUN	Integral Time Setting (I)	
b5-04 RUN	Integral Limit Setting	
b5-05 RUN	Derivative Time (D)	
b5-06 RUN	PID Output Limit	
b5-07 RUN	PID Offset Adjustment	
b5-08 RUN	PID Primary Delay Time Constant	
b5-09	PID Output Level Selection	
b5-10 RUN	PID Output Gain Setting	
b5-11	PID Output Reverse Selection	
b5-12	PID Feedback Loss Detection Selection	
b5-13	PID Feedback Loss Detection Level	
b5-14	PID Feedback Loss 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 RUN	PID Setpoint Value	
b5-20	PID Setpoint Scaling	
b5-34 RUN	PID Output Lower Limit	
b5-35 RUN	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	
b5-41	PI Output 2 Unit Selection	
b5-42 RUN	PI Output 2 Calculation Mode	

E.3 User Setting Table

No.	Name	User Setting
b5-43 RUN	PI Output 2 Monitor Max Upper 4 Digits	
b5-44 RUN	PI Output 2 Monitor Max Lower 4 Digits	
b5-45 RUN	PI Output 2 Monitor Minimum	
b5-46	PID Units Selection	
b5-47	Reverse Operation Selection 2 by PID Output	
b5-89 RUN	Sleep Method Selection	
b5-90	EZ Sleep Unit	
b5-91 RUN	EZ Minimum Speed	
b5-92 RUN	EZ Sleep Level	
b5-93 RUN	EZ Sleep Time	
b5-94 RUN	EZ Wake-up Level	
b5-95	EZ Wake-up Mode	
b5-96 RUN	EZ Wake-up Time	
b6-01	Dwell Reference at Start	
b6-02	Dwell Time at Start	
b6-03	Dwell Reference at Stop	
b6-04	Dwell Time at Stop	
b8-01	Energy Saving Control Selection	
b8-04	Energy Saving Coefficient Value	
b8-05	Power Detection Filter Time	
b8-06	Search Operation Voltage Limit	
C1-01 RUN	Acceleration Time 1	
C1-02 RUN	Deceleration Time 1	
C1-03 RUN	Acceleration Time 2	
C1-04 RUN	Deceleration Time 2	
C1-09 RUN	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 RUN	Slip Compensation Gain	
C3-02 RUN	Slip Compensation Primary Delay Time	
C3-03	Slip Compensation Limit	
C3-04	Slip Compensation Selection during Regeneration	
C4-01 RUN	Torque Compensation Gain	
C4-02 RUN	Torque Compensation Primary Delay Time	
C6-02	Carrier Frequency Selection	
C6-03	Carrier Frequency Upper Limit	
C6-04	Carrier Frequency Lower Limit	
C6-05	Carrier Frequency Proportional Gain	
d1-01 RUN	Frequency Reference 1	
d1-02 RUN	Frequency Reference 2	
d1-03 RUN	Frequency Reference 3	
d1-04 RUN	Frequency Reference 4	
d1-05 RUN	Frequency Reference 5	
d1-06 RUN	Frequency Reference 6	
d1-07 RUN	Frequency Reference 7	
d1-08 RUN	Frequency Reference 8	
d1-09 RUN	Frequency Reference 9	
d1-10 RUN	Frequency Reference 10	
d1-11 RUN	Frequency Reference 11	
d1-12 RUN	Frequency Reference 12	
d1-13 RUN	Frequency Reference 13	
d1-14 RUN	Frequency Reference 14	
d1-15 RUN	Frequency Reference 15	
d1-16 RUN	Frequency Reference 16	
d1-17 RUN	Jog Frequency Reference	
d2-01	Frequency Reference Upper Limit	
d2-02	Frequency Reference Lower Limit	
d2-03	Master Speed Reference Lower Limit	
d3-01	Jump Frequency 1	
d3-02	Jump Frequency 2	
d3-03	Jump Frequency 3	

No.	Name	User Setting
d3-04	Jump Frequency Width	
d4-01	Frequency Reference Hold Function Selection	
d4-03 RUN	Frequency Reference Bias Step (Up/Down 2)	
d4-04 RUN	Frequency Reference Bias Accel/Decel (Up/Down 2)	
d4-05 RUN	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	
d4-06	Frequency Reference Bias (Up/Down 2)	
d4-07 RUN	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	
d4-08 RUN	Frequency Reference Bias Upper Limit (Up/Down 2)	
d4-09 RUN	Frequency Reference Bias Lower Limit (Up/Down 2)	
d4-10	Up/Down Frequency Reference Limit Selection	
d6-01	Field Weakening Level	
d6-02	Field Weakening Frequency Limit	
E1-01	Input Voltage Setting	
E1-03	V/f Pattern Selection	
E1-04	Maximum Output Frequency	
E1-05	Maximum Voltage	
E1-06	Base Frequency	
E1-07	Middle Output Frequency	
E1-08	Middle Output Frequency Voltage	
E1-09	Minimum Output Frequency	
E1-10	Minimum Output Frequency Voltage	
E1-11	Middle Output Frequency 2	
E1-12	Middle Output Frequency Voltage 2	
E1-13	Base Voltage	
E2-01	Motor Rated Current	
E2-02	Motor Rated Slip	
E2-03	Motor No-Load Current	
E2-04	Number of Motor Poles	
E2-05	Motor Line-to-Line Resistance	
E2-06	Motor Leakage Inductance	
E2-10	Motor Iron Loss for Torque Compensation	
E2-11	Motor Rated Power	
F4-01	Terminal V1 Monitor Selection	
F4-02 RUN	Terminal V1 Monitor Gain	
F4-03	Terminal V2 Monitor Selection	
F4-04 RUN	Terminal V2 Monitor Gain	
F4-05 RUN	Terminal V1 Monitor Bias	
F4-06 RUN	Terminal V2 Monitor Bias	
F4-07	Terminal V1 Signal Level	
F4-08	Terminal V2 Signal Level	

No.	Name	User Setting
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	
F6-07	Multi-Step Speed Enable/Disable Selection when NefRef/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 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	
F6-35	CANopen Node ID Selection	
F6-36	CANopen Communication Speed	
F6-50	DeviceNet MAC Address	
F6-51	DeviceNet Communication Speed	
F6-52	DeviceNet PCA Setting	
F6-53	DeviceNet PPA Setting	
F6-54	DeviceNet Idle Mode Fault Detection	
F6-55	DeviceNet Baud Rate Monitor	
F6-56	DeviceNet Speed Scaling	
F6-57	DeviceNet Current Scaling	
F6-58	DeviceNet Torque Scaling	
F6-59	DeviceNet Power Scaling	
F6-60	DeviceNet Voltage Scaling	
F6-61	DeviceNet Time Scaling	
F6-62	DeviceNet Heartbeat Interval	
F6-63	DeviceNet Network MAC ID	
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	

E.3 User Setting Table

No.	Name	User Setting
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	
H2-01	Multi-Function Contact Output (terminal M1-M2)	
H2-02	Multi-Function Contact Output 2 (terminal M3-M4)	
H2-03	Multi-Function Contact Output (terminal MD-ME-MF)	
H2-06	Watt Hour Output Unit Selection	
H3-01	Terminal A1 Signal Level Selection	
H3-02	Terminal A1 Function Selection	
H3-03 RUN	Terminal A1 Gain Setting	
H3-04 RUN	Terminal A1 Bias Setting	
H3-05	Terminal A3 Signal Level Selection	
H3-06	Terminal A3 Function Selection	
H3-07 RUN	Terminal A3 Gain Setting	
H3-08 RUN	Terminal A3 Bias Setting	
H3-09	Terminal A2 Signal Level Selection	
H3-10	Terminal A2 Function Selection	
H3-11 RUN	Terminal A2 Gain Setting	
H3-12 RUN	Terminal A2 Bias Setting	
H3-13	Analog Input Filter Time Constant	
H3-14	Analog Input Terminal Enable Selection	
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 RUN	Multi-Function Analog Output Terminal FM Gain	
H4-03 RUN	Multi-Function Analog Output Terminal FM Bias	
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	
H4-05 RUN	Multi-Function Analog Output Terminal AM Gain	
H4-06 RUN	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	

No.	Name	User Setting
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 RUN	Pulse Train Input Scaling	
H6-03 RUN	Pulse Train Input Gain	
H6-04 RUN	Pulse Train Input Bias	
H6-05 RUN	Pulse Train Input Filter Time	
H6-08	Pulse Train Input Minimum Frequency	
L1-01	Motor Overload Protection Selection	
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	
L1-15	Motor 1 Thermistor Selection (NTC)	
L1-16	Motor 1 Overheat Temperature	
L1-20	Operation at Motor Overheat (oH5)	
L2-01	Momentary Power Loss Operation Selection	
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 (Uv1)	
L2-06	KEB Deceleration Time	
L2-07	KEB Acceleration Time	
L2-08	Frequency Gain at KEB Start	
L2-10	KEB Detection Time (Minimum KEB Time)	
L2-11	DC Bus Voltage Setpoint during KEB	
L2-29	KEB Method Selection	
L3-01	Stall Prevention Selection during Acceleration	
L3-02	Stall Prevention Level during Acceleration	
L3-03	Stall Prevention Limit during Acceleration	
L3-04	Stall Prevention Selection during Deceleration	
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	
L3-20	DC Bus Voltage Adjustment Gain	
L3-21	Accel/Decel Rate Calculation Gain	

No.	Name	User Setting
L3-23	Automatic Reduction Selection for Stall Prevention during Run	
L3-24	Motor Acceleration Time for Inertia Calculations	
L3-25	Load Inertia Ratio	
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	
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	
L6-13	Motor Underload Protection Selection	
L6-14	Motor Underload Protection Level at Minimum Frequency	
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	
L8-19	Frequency Reduction Rate during Overheat Pre-Alarm	
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	
L8-55	Internal Braking Transistor Protection	
L8-78	Power Unit Output Phase Loss Protection	
L8-93	LSo Detection Time at Low Speed	
L8-94	LSo Detection Level at Low Speed	
L8-95	Average LSo Frequency at Low Speed	

No.	Name	User Setting
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	
n3-01	High-Slip Braking Deceleration Frequency Width	
n3-02	High-Slip Braking Current Limit	
n3-03	High-Slip Braking Dwell Time at Stop	
n3-04	High-Slip Braking Overload Time	
n3-13	Overexcitation Deceleration Gain	
n3-14	High Frequency Injection during Overexcitation Deceleration	
n3-21	High-Slip Suppression Current Level	
n3-23	Overexcitation Operation Selection	
o1-01 RUN	Drive Mode Unit Monitor Selection	
o1-02 RUN	User Monitor Selection After Power Up	
o1-03	Digital Operator Display Selection	
o1-06	User Monitor Selection Mode	
o1-07	Second Line Monitor Selection	
o1-08	Third Line Monitor Selection	
o1-09	Frequency Reference Display Units	
o1-10	User-Set Display Units Maximum Value	
o1-11	User-Set Display Units Decimal Display	
o1-13	Frequency Reference and Frequency Related Monitor Custom Units 1	
o1-14	Frequency Reference and Frequency Related Monitor Custom Units 2	
o1-15	Frequency Reference and Frequency Related Monitor Custom Units 3	
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	
o2-20 RUN	Operator RUN Save at Power Loss	
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	

E.3 User Setting Table

No.	Name	User Setting
o4-17	Set/Reset Real-Time Clock	
o4-20	Time Display Format	
S1-01	Stillness Control Selection	
S1-02	Voltage Reduction Rate	
S1-03	Voltage Restoration Level	
S1-04	Voltage Restoration Complete Level	
S1-05	Voltage Restoration Sensitivity Time Constant	
S1-06	Voltage Restoration Time Constant at Impact	
S1-07	Output Phase Loss Level for Dynamic Noise Control	
S2-01	Sequence Timer 1 Start Time	
S2-02	Sequence Timer 1 Stop Time	
S2-03	Sequence Timer 1 Day Selection	
S2-04	Sequence Timer 1 Selection	
S2-05	Sequence Timer 1 Reference Source	
S2-06	Sequence Timer 2 Start Time	
S2-07	Sequence Timer 2 Stop Time	
S2-08	Sequence Timer 2 Day Selection	
S2-09	Sequence Timer 2 Selection	
S2-10	Sequence Timer 2 Reference Source	
S2-11	Sequence Timer 3 Start Time	
S2-12	Sequence Timer 3 Stop Time	
S2-13	Sequence Timer 3 Day Selection	
S2-14	Sequence Timer 3 Selection	
S2-15	Sequence Timer 3 Reference Source	
S2-16	Sequence Timer 4 Start Time	
S2-17	Sequence Timer 4 Stop Time	
S2-18	Sequence Timer 4 Day Selection	
S2-19	Sequence Timer 4 Selection	
S2-20	Sequence Timer 4 Reference Source	
S3-01 RUN	Secondary PI Enable Selection	
S3-02 RUN	Secondary PI User Display	
S3-03 RUN	Secondary PI Display Digits	
S3-04 RUN	Secondary PI Unit Selection	
S3-05 RUN	Secondary PI Setpoint Value	
S3-06 RUN	Secondary PI Proportional Gain Setting	
S3-07 RUN	Secondary PI Integral Time Setting	
S3-08 RUN	Secondary PI Integral Limit Setting	
S3-09 RUN	Secondary PI Output Upper Limit	
S3-10 RUN	Secondary PI Output Lower Limit	
S3-11 RUN	Secondary PI Output Level Selection	
S3-12 RUN	Secondary PI Disable Mode	
S3-13 RUN	Secondary PI Low Feedback Detection Level	
S3-14 RUN	Secondary PI Low Feedback Detection Time	
S3-15 RUN	Secondary PI High Feedback Level	
S3-16 RUN	Secondary PI High Feedback Detection Time	
S3-17 RUN	Secondary PI Feedback Detection Selection	
S6-01	Emergency Override Speed	
S6-02	Emergency Override Reference Selection	
S6-07	Output Phase Loss Level for Dynamic Noise Control	
T1-01	Auto-Tuning Mode Selection	
T1-02	Motor Rated Power	
T1-03	Motor Rated Voltage	
T1-04	Motor Rated Current	
T1-05	Motor Base Frequency	
T1-06	Number of Motor Poles	
T1-07	Motor Base Speed	
T1-11	Motor Iron Loss	

Index

-

-....75

+

+1....75
+2....75
+3....75
+V....87

Numerics

24 V Power Supply....355
2-Wire Initialization....135
3-Wire Initialization....135
3-Wire Sequence....135
3-Wire Sequence Wiring Diagram....197
5th Most Recent Fault....440

A

A/D Conversion Error....284
A1....87
A1-01....129
A1-03....129
A1-04....315
A1-04, A1-05: Password and Password Setting....135
A1-05....315
A2....87
A2-01....129
A2-32....129
A2-33....129
A3....87
AC....87
Accel/Decel Rate Calculation Gain....239
Accel/Decel Time....278, 383
Accel/Decel Time Setting Units....169
Accel/Decel Time Switching Frequency....168
Acceleration Error....309
Acceleration Time....168
Access Level Selection....129, 134
AC Reactor....355
Additional DC Bus Capacitors....241
Adjusted Slip Calculation Error....307
AEr....297
Alarm Outputs for Maintenance Monitors....330
Alarm Register 007FH Contents....492
Alarms and Errors....3
Allowable Frequency Fluctuation....377, 378, 379, 380, 381, 382
Allowable Voltage Fluctuation....377, 378, 379, 380, 381, 382
ALM LED Light....101
Altitude....46
AM....87
Ambient Temperature....46
Ambient Temperature and Installation Method Derating....390
Ambient Temperature Setting....248, 389, 425
Analog Filter Time Constant....278
Analog Frequency Reference Fluctuation Limit....180
Analog Frequency Reference Sample/Hold....201
Analog Input Filter Time Constant....218
Analog Inputs / Pulse Train Input....87
Analog Input Terminal Enable Selection....218
Analog Monitor Card Settings....189
AO-A3....355
AO-A3 Settings....189
Application Selection....3
Attachment for External Heatsink....355, 371
Automatic Reduction Selection for Stall Prevention during Run....240, 422
Auto Restart Fault Output Operation Selection....243
Auto Restart Operation Selection....423
Auto-Tuning....3, 121, 124
Auto-Tuning Codes....307
Auto-Tuning Errors....282
Auto-Tuning Fault Codes....122
Auto-Tuning Fault Detection....186
Auto-Tuning Fault Solutions....307
Auto-Tuning for Induction Motors....121
Auto-Tuning Input Data....121, 122
Auto-Tuning Interruption and Fault Codes....122
Auto-Tuning Mode Selection....124, 436

B

B1....75
b1-01....315
b1-02....315
b1-04....316
B2....75
b2-02....320
b2-04....320
b5-09....320
b6-01 through b6-04....278
Backing Up Parameter Values....129
Baseblock....297
Base Frequency....185
Base Voltage....186
Basic Auto-Tuning Preparations....121
bAT....283

bb. 297
Bi-Directional Speed Search Selection 149
boL 283, 297
Braking circuit protective cover 84
Braking Resistor 355, 363
Braking Resistor Fault 293
Braking Resistor Overheat 293
Braking Resistor Overheat Protection 384
Braking Resistor Overload Protection 364
Braking Torque 383
Braking Transistor 383
Braking Transistor Overload Fault 283, 297
Broadcast Messages 489
bUS 283, 297
bUS Error Detection Time 191

C

C1-01 112
C2-01 through C2-04 278
C3-01 278
C4-01 278
C4-02 278
C6-02 97, 278, 319
C6-05 319
Cable Length Between Drive and Motor 83
CALL 297
Cannot Change Parameter Settings 314
Cannot Reset 298
CANopen Communication Speed 193
CANopen Node ID Selection 193
CANopen Parameters 190, 193
Capacitor Maintenance 442
Capacitor Maintenance Setting 260, 430
Capacitor Maintenance Time 300
Carrier Frequency 171, 374, 375, 376, 377, 378, 379, 380, 381, 382
Carrier Frequency and Current Derating 387, 388
Carrier Frequency Lower Limit 172
Carrier Frequency Proportional Gain 172
Carrier Frequency Reduction 425
Carrier Frequency Reduction Off-Delay Time 249
Carrier Frequency Reduction Selection 249
Carrier Frequency Selection 83, 278
Carrier Frequency Setting Error 306
Carrier Frequency Upper Limit 172
CC-Link bUS Error Auto Reset 191
CC-Link Communication Speed 191
CC-Link Node Address 191
CC-Link Parameters 190, 191
CE 283, 298
CE Detection Time 469
CE Low Voltage Directive Compliance 500
CE mark 500
Changing Parameter Settings or Values 110
Circulation Fan 40
Clock Adjustment Mode 106
Closed-Loop Crimp Terminal Size 77
Coast to stop 141
Coast to Stop with Timer 142
Comm. option card connection error (CN5-A) 289
Command Messages from Master to Drive 472
Communication Error 310
Communication Fault Detection Selection 468
Communication Option Card 190
Communication Option Card Reference 443
Communication Option Station Number Setting Error (CC-Link, CANopen, MECHATROLINK-II) 297
Communication Parity Selection 468
Communications Enter Function Selection 470
Communications Error Operation Selection 190
Communication Speed Selection 468
Communications Timing 472
Comparing Parameter Settings 311
Component Names 34
Conduit bracket 34, 36
Conduit Bracket Dimensions for IP20/NEMA Type 1 54
Conduit bracket front cover 34
Connected Machinery Vibrates When Motor Rotates 319
Connecting a DC Link Choke 367
Connecting an AC Reactor 367
Connecting a Noise Filter 368
Connecting a Suppression Diode 87
Connecting a Surge Absorber 367
Connecting Braking Units in Parallel 365
Connecting Peripheral Devices 356
Connecting to a PC (USB) 95
Connection of a Motor PTC 227
Continuous Electrothermal Operation Selection 228, 420
Control Board Connection Error 284, 285
Control Circuit Error 283, 284, 285
Control Circuit Input Terminals 86
Control Circuit Output Terminals 87
Control Circuit Terminal Block Functions 86
Control Mode 28, 437
Control Mode Features 28
Control Power Supply Voltage Fault 296
Cooling Fan 34, 35, 37, 38, 39, 40
Cooling fan 36
Cooling Fan Maintenance 442
Cooling Fan Maintenance Setting (Operation Time) 430
Cooling Fan Maintenance Time 300
Cooling Fan Operation Time 442
Cooling Fan Operation Time Setting 260
Cooling Fan Replacement 290
CoPy 310
Copy Allowed Selection 259
Copy Function 130
Copy Function Errors 279
Copy Function Selection 259
Copy Unit Error 310
CopyUnitManager 130
CPF02 284
CPF03 284
CPF06 284
CPF07 284
CPF08 284
CPF11 to CPF14 283
CPF16 to CPF19 283
CPF20 284
CPF21 284
CPF22 284

CPF23 285
CPF24 285
CPF25 285
CPF26 to CPF35 285
CPF40 to CPF43 285
CPyE 310
CRC-16 473
CRC-16 Checksum Calculation Example 474
CrST 298
CSEr 310
Cumulative Operation Time 441
Cumulative Operation Time at 5th Most Recent Fault 440
Cumulative Operation Time at Most Recent Fault 440
Cumulative Operation Time at Previous Fault 439
Cumulative Operation Time Selection 259, 430
Cumulative Operation Time Setting 259, 430
Current Alarm 300
Current Detection Error 309
Current Detection Speed Search 145
Current Fault 439
Custom PI Output Monitor Setting 1/2 164
Custom PI Output Monitor Setting 3 164
Cyclic Redundancy Check 473

D

d2-01 320
d3-01 319
d3-01 through d3-04 278
d3-04 319
Daily Inspection 326
DC bus circuit protective cover 84
DC Bus Overvoltage 302
DC Bus Pre-Charge Relay Maintenance Setting 260
DC Bus Undervoltage 295
DC Bus Voltage 437
DC Bus Voltage Adjustment Gain 239
DC Bus Voltage at Previous Fault 439
DC Bus Voltage Setpoint during KEB 235
DC Injection Braking at Stop 320
DC Injection Braking Current 145, 320
DC Injection Braking Input Timing Diagram 203
DC Injection Braking Start Frequency 141
DC Injection Braking Time at Start 141
DC Injection Braking Time at Stop 145
DC Injection Braking to Stop 141
DC link choke 355
DC Link Chokes for EN 61000-3-2 Compliance 503
D Control 151
Deceleration Rate Calculation Gain 422
Deceleration Time 168
Defaults by Drive Model Selection (o2-04) 257
Delay Timers 151
Derivative Time (D) 155
Desired DC Bus Voltage during KEB 421
DeviceNet Baud Rate Monitor 194
DeviceNet Communication Speed 193
DeviceNet Heartbeat Interval 195
DeviceNet Idle Mode Fault Detection 194
DeviceNet MAC Address 193
DeviceNet Network MAC ID 195
DeviceNet Parameters 190, 193
DeviceNet PCA Setting 194
DeviceNet PPA Setting 194
DeviceNet Scaling Factors 194
dFPS 310
Diagnosing and Resetting Faults 312
Digital Operator 34, 35, 36, 37, 38, 39, 40, 34
Digital Operator Battery Voltage Low 283
Digital Operator Dimensions 49
Digital Operator Display Selection 254, 428
Digital Operator Installation Methods and Required Tools 49
Digital Operator Keypad Functions 256
Digital Operator Menu and Screen Structure 105
Digital Operator Remote Installation 49
digital operator remote usage 48
Dimensions for IP00/Open Type Enclosure: 200 V Class 57
Dimensions for IP00/Open Type Enclosure: 400 V Class 57
Dimensions for IP00/Open Type Enclosure: 600V Class 57
Dimensions for IP20/NEMA Type 1 Enclosure: 200 V Class 52
Dimensions for IP20/NEMA Type 1 Enclosure: 400 V Class 53
Dimensions for IP20/NEMA Type 1 Enclosure: 600 V Class 53
DIP Switch S2 41
dnE 298
Down Arrow Key 101
Drive/kVA Selection 429
Drive Capacity Setting Fault 304
Drive Cooling Fans 328
Drive Cover 35, 36, 37, 38, 39, 40
Drive Delay Time Setting 144
Drive Derating Data 27
Drive Disabled 298
Drive Mode 106, 109
Drive Model Mismatch 310
Drive Models and Types 51
Drive Model Selection 257
Drive Mode Unit Monitor Selection 254, 428
Drive Operation Status at Previous Fault 439
Drive Overheat Warning 301
Drive Overload 291
Drive Ready 96
Drive Replacement 350
Drive Slave Address 468
Drive Specifications 383
Drive Status 438
Drive Transmit Wait Time 469
Drive Unit Signal Fault 285
Drive Watt Loss Data 385
DriveWizard Industrial 130, 355
During Frequency Output Time Chart 214
During Run Time Chart 207
Dwell Function 165, 278
Dwell Reference at Start 166
Dwell Reference at Stop 166
Dwell Time at Start 166
Dwell Time at Stop 166
Dynamic Audible Noise Control Function Selection 431
Dynamic Audible Noise Control Selection 262
Dynamic Braking Options 363
Dynamic Braking Transistor 294
Dynamic Noise Control Function 262

E

E (G) 87
E1-03 317
E1-04 317, 320
E1-08 278
E1-09 315
E1-10 278
E2-01 278, 520
E2-02 278
E2-03 278, 308
E5 285
EEPROM Memory Data Error 284
EEPROM Write Error 286
EF 298
EF0 285, 298
EF1 285, 299
EF2 285, 299
EF3 285, 299
EF4 285, 299
EF5 286, 299
EF6 286, 299
EF7 286, 299
EF8 286, 299
EMC Filter and Drive Installation for CE Compliance 504
EMC Filter Installation 79
EMC Filters 502
EMC Guidelines 500
EMC Guidelines Compliance 502
Emergency Override Reference Selection 271
Emergency Override Speed 271
EN61800-3 Filters 505
Enclosure Types 32
End 310
End1 307
End2 307
End3 307
End4 307
End5 307
End6 307
End7 308
Energy Saving 166
Energy Saving Coefficient Value 166
Energy Saving Control Selection 166
Enter Command 470
Enter command necessary 470
Enter command not necessary 470
Enter Command Settings when Upgrading the Drive 493
Enter Command Types 493
Enter Data from the Motor Nameplate 123
ENTER Key 101
EoF 299
Eor 299
Er-01 308
Er-02 308
Er-03 308
Er-04 308
Er-05 308
Er-08 309
Er-09 309
Er-11 309
Er-12 309
Er-13 309
Er-17 309
Err 286
Error Reading Data 311
Errors and Displays When Using the Copy Function 282
Error Writing Data 310
European Standards 3
Excessive Motor Oscillation and Erratic Rotation 318
Excessive PID Feedback 286, 299
Excessive V/f Setting 307
Exterior and Mounting Dimensions 51
External Digital Operator Connection Fault 292
External Fault 285, 286, 299
External Fault from Comm. Option Detection Selection 190
External Fault from Comm. Option Operation Selection 190
External Interlock 96
EZ Minimum Speed 162
EZ Sleep Level 162
EZ Sleep Unit 162
EZ Wake-up Level 162

F

FAn 286
FAn Alarm Location Monitor 443
Fan Bracket 37, 38, 39
Fan bracket 36
Fan Cover 34, 35
Fan Finger Guard 34, 35
Fan Guard 37, 38, 39, 40
Fast Stop Sequence 201
Fast Stop Time 169
Fault Causes and Solutions 283
Fault Detection 283
Fault Displays 283
Fault History 273, 312
Fault Relay Output 87
Fault Reset Interval Time 243, 423
Fault Reset Methods 279
Fault Reset Operation Selection 243, 423
Fault Restart 213
Faults 279, 280
Fault Trace 273, 312
FbH 286, 299
FbL 287, 300
Ferrule Dimensions 89
Ferrule Terminal Types and Sizes 89
Ferrule-Type Wire Terminals 89
Field Weakening 181
Field Weakening Frequency Limit 181
Field Weakening Level 181
Fine-Tuning V/f Control 278
FJOG/RJOG Operation 200
FM 87
Forward/Reverse Run Command Input Error 298
Frequency Accuracy (Temperature Fluctuation) 383
Frequency Control Range 383
Frequency Detection 1 Time Chart 209
Frequency Detection 2 Time Chart 209

Frequency Detection 3 Example with a Positive L3-04 Value 212
Frequency Detection 4 Example with Positive L3-04 Value 213
Frequency Gain at KEB Start 235
Frequency Reduction Rate during Overheat Pre-Alarm..... 247, 425
Frequency Reference 173, 437
Frequency Reference and Frequency Related Monitor Custom Units 1 ..... 256, 428
Frequency Reference and Frequency Related Monitor Custom Units 2 ..... 256, 429
Frequency Reference and Frequency Related Monitor Custom Units 3 ..... 256, 429
Frequency Reference at Previous Fault..... 439
Frequency Reference at Reference Loss..... 242, 423
Frequency Reference Bias..... 178
Frequency Reference Bias Accel/Decel 179
Frequency Reference Bias Lower Limit..... 178
Frequency Reference Bias Operation Mode Selection 179
Frequency Reference Bias Step..... 178
Frequency Reference Bias Upper Limit 178
Frequency Reference Display Units..... 255, 428
Frequency Reference from MEMOBUS/Modbus Comm. 442
Frequency Reference Hold 177
Frequency Reference Hold Function Selection..... 177
Frequency Reference Loss Detection Selection 210, 423
Frequency Reference Lower Limit..... 175
Frequency Reference Monitor Content During PID 163
Frequency Reference Selection..... 394
Frequency Reference Selection 1..... 139, 315
Frequency Reference Selection 2..... 144
Frequency Reference Setting / Decimal Display 428
Frequency Reference Setting and User-Set Display 428
Frequency Reference Setting Hierarchy..... 173
Frequency Reference Setting Method Selection..... 257, 429
Frequency Reference Source Selection..... 442
Frequency Reference Upper Limit 175
Frequency Setting Resolution..... 383
Frequency Setting Signal 383
Front Cover.....34, 35, 36, 37, 38, 39, 40
Front Cover Screw.....35, 37, 38, 39, 40
Function Code..... 473
Functions for Terminals S1 to S8..... 196
Fuse..... 369
Fuse Selection..... 369, 500, 518

G

General Safety Information.....17
GF..... 287
Ground Fault 287
Ground Terminal.....41
Ground Wiring 84

H

H1 Multi-Function Digital Input Selections..... 411
H3-01.....94
H3-02..... 317, 318, 320
H3-05.....94
H3-09.....94
H3-10..... 318, 320
H3-11..... 320
H3-13..... 278, 319
H3 Multi-Function Analog Input Settings..... 417
HCA 300
Heatsink.....34, 35, 36, 37, 38, 39, 40
Heatsink Cooling Fan Off-Delay Time 248
Heatsink Cooling Fan Operation Delay Time 425
Heatsink Cooling Fan Operation Selection..... 247, 425
Heatsink Overheat 290, 301
Heatsink Temperature..... 442
High Current Alarm Selection 250
High Frequency Injection during Overexcitation Deceleration 253
High Slip Braking 251
High Slip Braking Current Limit 252
High-Slip Braking Current Limit..... 427
High Slip Braking Deceleration Frequency Width..... 252
High-Slip Braking Deceleration Frequency Width..... 427
High Slip Braking Dwell Time at Stop 252
High-Slip Braking Dwell Time at Stop..... 427
High-slip Braking oL..... 292
High Slip Braking Overload Time..... 252
High-Slip Braking Overload Time 427
High Slip Suppression Current Level..... 253
High-Slip Suppression Current Level..... 427
HSB..... 204
Humidity.....46
Hunting Prevention..... 251
Hunting Prevention Gain 278
Hunting Prevention Gain Setting 251, 427
Hunting Prevention Gain while in Reverse 251, 427
Hunting Prevention Selection..... 251, 427
Hunting Prevention Time Constant 251, 427
Hybrid IC Failure..... 284

I

I/O Connections.....88
I Control..... 151
iFEr 310
IG 88
IGBT Maintenance 442
IGBT Maintenance Setting..... 260, 430
IGBT Maintenance Time (50%)..... 301
IGBT Maintenance Time (90%) 302
IGBT Short Circuit or Ground Fault 294
Induced Noise 368
Initialization 134
Initialization Required 305
Initialize Parameters..... 129, 134
Initial Operation..... 116
Input Current 374, 375, 376, 377, 378, 379, 380, 381, 382
Input Fuses..... 369, 500, 518
Input Phase Loss 293
Input Phase Loss Protection Selection..... 247, 425
Input Power..... 374, 375, 376, 377, 378, 379, 380, 381, 382
Input Pulse Monitor 438
Input Terminals 115
Input Terminal Status 437
Input Terminal Status at Previous Fault 439
Input Voltage Setting..... 182
Inrush Prevention Circuit Fault 296
Inrush Prevention Relay Maintenance Setting..... 430
Inspection..... 326, 327
Installation Area 46

Installation Environment....46
Installation Method Selection....47
Installation Orientation....46
Installation Orientation and Spacing....46
Installation Spacing....47
Installing a Braking Resistor\: ERF type....363
Installing a Braking Resistor Unit\: LKEB type....363
Installing a Braking Unit\: CDBR Type....364
Installing a GFCI....366
Installing a Magnetic Contactor....21
Installing a Molded Case Circuit Breaker (MCCB)....21
Installing a Motor Thermal Overload (oL) Relay on the Drive Output....371
Installing Other Types of Braking Resistors....364
Installing Peripheral Devices....363
Installing the Cooling Fan....335
Integral Limit Setting....155
Integral Time Setting (I)....155
Interlock Circuit Example....96
Internal Dynamic Braking Resistor Protection Selection (ERF type)....245, 425
IP00/Open Type Enclosure....32
IP20/NEMA Type 1 Enclosure....32
IP20/NEMA Type 1 Kit....355
IP20/NEMA Type 1 Kit Selection....58

J

Jog Frequency Reference....173
Jumper S1....41
Jumper S1 Settings....93
Jump Frequency....176, 278
Jump Frequency Width....176

K

KEB Acceleration Time....235, 421
KEB Deceleration Time....234, 421
KEB Detection Time....235
KEB Function Related Adjustments....233
KEB Method Selection....235
KEB Operation Using a KEB Input....230
KEB Operation Using L2-02, Without KEB Input....231
KEB Operation Using L2-02 and KEB Input....231
KEB Operation Using L2-10, Without KEB Input....232
KEB Operation Using L2-10 and KEB Input....232
KEB Operation Wiring Example....232
KEB Ride-Thru End Detection....230
KEB Ride-Thru Function....204
KEB Ride-Thru Start....230
KEB Start Output Frequency Reduction....421
Keys and Displays on the Digital Operator....101
kWh....442
kWh, Lower 4 Digits....442
kWh, Upper 5 Digits....442
kWh Monitor Initialization....260
kWh Monitor Initial Value Selection....430

L

L3-01 through L3-06....278
L3-02....317, 320
L3-04....318
L3-06....317
L3-11....278
L7-01 through L7-04....318
L8-12....389
L8-35....389
L8-38....320
Language Selection....134
LCD Display....102
Leakage Inductance Alarm....307
Leakage Inductance Error....309
LED Check....442
LF....287
Line-to-Line Resistance Error....308
LO/RE....103, 114, 126
LO/RE (LOCAL/REMOTE) Key Function Selection....143
LO/RE LED....103
LO/RE Light....101
LO/RE Selection Key....101
Load Inertia Ratio....240, 422
LOCAL....114
LOCAL/REMOTE Key Function Selection....429
LOCAL/REMOTE Run Selection....143
Loopback Test....475
Loss of Reference Function....241
Low Voltage Directive....500
Low Voltage Wiring for Control Circuit Terminals....520
LT-1....300
LT-2....300
LT-3....300
LT-4....301

M

M1....87
M2....87
M3....87
M4....87
MA....87
Main Circuit Connection Diagram....65, 85
Main Circuit Terminal....41
Main Circuit Terminal and Motor Wiring....83
Main Circuit Terminal Block Configuration....67
Main Circuit Terminal Functions....75
Main Circuit Terminal Wiring....41
Main Circuit Wiring....75
Main Power Circuit Voltage Adjustment Gain....422
Maintenance....214, 330
Maintenance Alarms....330
Maintenance Monitors....273
Maintenance Monitor Settings....259
Master Speed Reference Lower Limit....176
Maximum Applicable Motor Capacity....374, 375, 376, 377, 378, 379, 380, 381, 382
Maximum Output Frequency....185, 374, 375, 376, 377, 378, 379, 380, 381, 382
Maximum Output Voltage....374, 375, 376, 377, 378, 379, 380, 381, 382
Maximum Voltage....185
MB....87
MC....87
MD....87
ME....87
MECHATROLINK-II Parameters....190

MEMOBUS/Modbus Comm. Test Mode Complete 302
MEMOBUS/Modbus Communication Error 283, 298
MEMOBUS/Modbus Communications Reference 443
MEMOBUS/Modbus Communication Test Mode Error 302
MEMOBUS/Modbus Data Table 477
MEMOBUS/Modbus Error Code 438
MEMOBUS/Modbus Error Codes 494
MEMOBUS/Modbus Setup Parameters 468
MEMOBUS/Modbus Specifications 465
MEMOBUS/Modbus Switch Settings 94
MEMOBUS/Modbus Termination 41
Menu Structure for Digital Operator 105
Message Format 473
MF 87
Middle Output Frequency 185
Middle Output Frequency 2 186
Middle Output Frequency Voltage 185
Middle Output Frequency Voltage 2 186
Mid Output Voltage A 278
Minimum KEB Time 235
Minimum Output Frequency 185
Minimum Output Frequency Voltage 185
Minimum Output Voltage 278
Minimum Wait Time for Sending Messages 472
Minor Alarms 280
Minor Fault 308
Minor Fault and Alarm Displays 281
Minor Faults 280
Minor Faults and Alarms 279, 280
Model, Voltage Class, Capacity Mismatch 310
Model Number and Nameplate Check 29
Modes 106
Momentary Overcurrent Protection 383
Momentary Power Loss Minimum Baseblock Time 234, 420
Momentary Power Loss Operation Selection 148, 420
Momentary Power Loss Ride-Thru 229, 384
Momentary Power Loss Ride-Thru Time 234, 420
Momentary Power Loss Voltage Recovery Ramp Time 234, 420
Monitor Output 87
Monitor Parameters 221, 437
Most Recent Fault 440
Motor 1 Parameters 186
Motor Acceleration Time for Inertia Calculations 240, 422
Motor Base Frequency 123, 125, 436
Motor Base Speed 125, 436
Motor Data Error 308
Motor Direction at Power Up when Using Operator 258, 429
Motor Does Not Rotate 315
Motor Hunting and Oscillation Control Parameters 278
Motor Iron-Core Saturation Coefficient 307
Motor Iron Loss 125, 436
Motor Iron Loss for Torque Compensation 187
Motor is Too Hot 316
Motor Leakage Inductance 187
Motor Line-to-Line Resistance 187
Motor No-Load Current 187
Motor Overheat 301
Motor Overheat Alarm Operation Selection 228, 420
Motor Overheat Fault (PTC Input) 301
Motor Overheat Fault Operation Selection 228, 420
Motor Overload 291
Motor Overload Estimate (oL1) 442
Motor Overload Protection Selection 213, 420, 521
Motor Overload Protection Time 227, 420, 521
Motor Parameters 182
Motor Performance Fine-Tuning 278
Motor Poles 123
Motor Produces Insufficient Torque 320
Motor Protection 225
Motor Protection Using a Positive Temperature Coefficient Thermistor 221
Motor PTC Characteristics 228
Motor Rated Current 125, 186, 436, 520
Motor Rated Power 124, 187, 436
Motor Rated Slip 186
Motor Rated Voltage 124, 436
Motor Rotates After the Drive Output is Shut Off 320
Motor Rotates Faster Than the Frequency Reference 318
Motor Rotates in One Direction Only 316
Motor Secondary Current (Iq) 444
Motor Speed Fault 309
Motor Stalls During Acceleration or With Large Loads 317
Motor Switch during Run 302
Motor Temperature (NTC 443
Motor Temperature Input Filter Time 228, 420
Motor Underload 295
Motor Underload Protection Level at Minimum Frequency 245, 424
Motor Underload Protection Selection 245, 424
Motor Wiring 83
Mounting Hole 35, 37, 38, 39, 40
Mounting hole 34, 36
Multi-Function Analog Inputs 216
Multi-Function Analog Input Selection Error 305
Multi-Function Analog Input Terminal Settings 216
Multi-Function Analog Outputs 221
Multi-Function Analog Output Terminal AM Bias 222
Multi-Function Analog Output Terminal AM Gain 222
Multi-Function Analog Output Terminal AM Monitor Selection 221
Multi-Function Analog Output Terminal AM Signal Level Selection 223
Multi-Function Analog Output Terminal FM Bias 222
Multi-Function Analog Output Terminal FM Gain 222
Multi-Function Analog Output Terminal FM Monitor Selection 221
Multi-Function Analog Output Terminal FM Signal Level Selection 223
Multi-Function Digital Inputs 86, 115
Multi-Function Digital Input Terminal Settings 196
Multi-Function Digital Output 87
Multi-Function Digital Outputs 206
Multi-Function Digital Output Terminal Settings 206
Multi-Function Input Selection Error 304
Multiple Drive Installation 47
Multiple Drive Wiring 84
Multi-Step Speed Selection 140

L1-01 521

N

n1-02 278
Nameplate 29
ndAT 310

NetRef/ComRef Function Selection..... 190
Network Termination 466
Noise From the Drive or Motor Cables When the Drive is Powered On 319
No-Load Current Alarm 308
No-Load Current Error..... 308
No-Load Operation..... 126
No-Load Operation Test Run 126
Notes on Rotational Auto-Tuning 122
Notes on Stationary Auto-Tuning 122
nSE 287
Number of Auto Restart Attempts..... 243, 423
Number of Motor Poles..... 125, 187, 436
Number of Run Commands 441
Number of Run Commands Counter Initialization..... 261
Number of Speed Search Restarts 150

O

o2-01..... 315
o2-03..... 129
oC 287
oFA00 288
oFA01 288
oFA03 to oFA06 288
oFA10 288
oFA11 288
oFA12 to oFA17 289
oFA30 to oFA43 289
oFb00..... 289
oFb01..... 289
oFb02..... 289
oFb03 to oFb11 289
oFb12 to oFb17 289
oFC00 289
oFC01 289
oFC02 290
oFC03 to oFC11 290
oFC12 to oFC17 290
oFC50 to oFC55 290
oH..... 290, 301
oH1 290
oH2 301
oH3 301
oH4 301
oH Alarm Location Monitor 443
oL1..... 291
oL2..... 291, 320
oL2 Characteristics Selection at Low Speeds..... 248, 425
oL3..... 291
oL4..... 292
oL7..... 292
oPE 304
oPE01 304
oPE02 304
oPE03 304
oPE04 305
oPE05 305
oPE07 305
oPE09 306
oPE10 306
oPE11 306
oPE28 306
oPE Fault Parameter..... 438
Operating with the Load Connected..... 128
Operation Errors 279, 282
Operation Selection when Digital Operator is Disconnected 258, 429
Operation Status Monitors..... 273
Operator Programming Errors 304
Operator Related Settings..... 254
Operator RUN Save at Power Loss 258, 429
oPr 292
Optional 24 V DC power supply connector cover 34, 35, 36, 37, 38, 39
Option card connection error (CN5-A) 289
Option Card Connection Error at Option Port CN5-A..... 288
Option Card Connection Error at Option Port CN5-C..... 289
Option card connector (CN5-A) 41
Option card connector (CN5-B) 41
Option card connector (CN5-C) 41
Option card error occurred at option port CN5-A 288
Option card error occurred at option port CN5-B 289
Option card error occurred at option port CN5-C 290
Option Card External Fault..... 285, 298
Option Card Fault at Option Port CN5-A 288
Option Card Fault at Option Port CN5-B..... 289
Option Card Fault at Option Port CN5-C..... 289, 290
Option Communication Error 283, 297
Option Frequency Reference..... 442
Option Installation..... 357
Option Settings..... 189
Oscillation or Hunting..... 319
Output Current 437
Output Current 1 During Speed Search..... 149
Output Current at Previous Fault 439
Output Frequency..... 437
Output Frequency after Soft Start 438
Output Frequency at Previous Fault..... 439
Output Frequency is not as High as Frequency Reference..... 320
Output Frequency Reduction During Overheat Alarm 246
Output Frequency Resolution 383
Output Ground Fault Detection Selection 247, 425
Output Phase Loss 287
Output Phase Loss Detection Level for Dynamic Audible Noise Control 272
Output Phase Loss Level for Dynamic Noise Control..... 263
Output Phase Loss Protection..... 425
Output Phase Loss Protection Selection 247
Output Power..... 437
Output Power at Previous Fault..... 439
Output Terminal Status 437
Output Terminal Status at Previous Fault 439
Output Voltage at Previous Fault..... 439
Output Voltage Detection Fault..... 296
Output Voltage Reference 437
ov..... 292, 302
Overcurrent 287
Overexcitation Deceleration..... 238
Overexcitation Deceleration Gain 253, 427
Overexcitation Operation Selection 253, 427
Overheat 1 (Heatsink Overheat) 290
Overheat Alarm Level..... 213, 425

Overheat Pre-Alarm Operation Selection 215, 425
Overload Protection 383
Overload Tolerance..... 374, 375, 376, 377, 378, 379, 380, 381, 382
Overtorque Detection 1 291
Overtorque Detection 2 292
Overtorque Detection Operation..... 244
Overvoltage..... 292
Overvoltage Protection..... 383
Overvoltage Suppression Function..... 238
Overvoltage Suppression Function Selection..... 239
ov Suppression Function Selection..... 422

P

P1000 Models 27
Parameter Access Level..... 129
Parameter Range Setting Error..... 304
Parameter Settings..... 110
Parameters for KEB Ride-Thru..... 233
Parameters to Minimize Motor Hunting and Oscillation..... 278
PASS 302
Password 129, 135
Password Setting..... 135
Password Settings..... 129
P Control..... 151
Peak Hold Current..... 442
Peak Hold Output Frequency 442
Performance Life 329, 3
Performance Life Monitors Maintenance Monitors..... 3
Periodic Inspection 327
Periodic Maintenance 214
PF 293
PG-B3 Settings..... 189
PG-X3 Settings..... 189
Phase Order Selection..... 144
PID Accel/Decel Time 158
PID Block Diagram..... 154
PID Control..... 151
PID Feedback 1 443
PID Feedback High Detection Level..... 158
PID Feedback High Detection Time 158
PID Feedback Input Methods 152
PID Feedback Loss 287, 300
PID Feedback Loss Detection Selection..... 157
PID Feedback Low Detection Level 157
PID Feedback Low Detection Time..... 157
PID Fine Tuning 165
PID Function Setting 155
PID Input (feedback) 443
PID Input Limit 163
PID Monitors..... 273
PID Offset Adjustment..... 155
PID Output..... 443
PID Output Fault..... 320
PID Output Gain Setting..... 156
PID Output Level Selection 156
PID Output Limit 155
PID Output Lower Limit..... 163
PID Output Reverse Selection 156
PID Output Reverse Selection 2 164
PID Primary Delay Time Constant..... 155
PID Setpoint..... 443
PID Setpoint Display Digits..... 161
PID Setpoint Input Methods..... 152
PID Setpoint Scaling 160
PID Setpoint Selection 159
PID Setpoint User Display 161
PID Setpoint Value 159
PID Sleep 158
PID Sleep Delay Time 158
PID Sleep Function Start Level..... 158
PI Output Monitor Calculation Method..... 164
PI Setpoint Monitor Unit Selection..... 161
PI Unit Selection..... 163
Power Detection Filter Time 166
Powering Up the Drive..... 117
Power Ratings (Three-Phase 200 V Class)..... 374, 375, 376
Power Ratings (Three-Phase 400 V Class)..... 377, 378, 379
Power Ratings (Three-Phase 600 V Class)..... 380, 381, 382
Predefined V/f Patterns 183
Preface.....16
Preparing the Ends of Shielded Cables 90
Preset Reference Timing Diagram 175
Previous Fault..... 439
PROFIBUS-DP Clear Mode Selection 192
PROFIBUS-DP Data Format Selection..... 193
PROFIBUS-DP Node Address 192
PROFIBUS-DP Parameters 190, 192
Programmable Run Timers for Real Time Clock (RTC)..... 263
Programming Mode 106, 110
Proportional Gain Setting (P) 155
Protective Cover 47
Protective Covers, Reattaching 70
Protective Covers, Removing 69, 70
Protective cover to prevent miswiring 41
PTC..... 221
Pulse Output Connection Using External Voltage Supply 93
Pulse Output Connection Using Internal Voltage Supply.....93
Pulse Train Input/Output..... 223
Pulse Train Input Bias..... 224
Pulse Train Input Filter Time 224
Pulse Train Input Gain 223
Pulse Train Input Minimum Frequency..... 224
Pulse Train Input Scaling..... 223
Pulse Train Input Terminal RP Function Selection 223

R

R-.....88
R/L1 75
R+.....88
Radiated and Radio Frequency Noise..... 369
Ramp to stop 141
Rated Current Depending on Carrier Frequency 387
Rated Current Setting Alarm..... 307
Rated Output Capacity..... 374, 375, 376, 377, 378, 379, 380, 381, 382
Rated Output Current..... 374, 375, 376, 377, 378, 379, 380, 381, 382
Rated Slip Error..... 309
Rated Voltage, Rated Frequency .. 374, 375, 376, 377, 378, 379, 380, 381, 382
rdEr 311
READ 259

rEAd 311
Reading Drive MEMOBUS/Modbus Register Contents 475
Reading Parameter Settings 311
Real Time Clock 263
Reattaching the Digital Operator 71
Reattaching the Front Cover 73
Reattaching the Protective Cover 74
Reattaching the Terminal Cover on an IP00/Open Type Enclosure Drive 70
Reattaching the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive 69
REMOTE 114
Removing the Cooling Fan 334
Removing the Digital Operator 71
Removing the Front Cover 71
Removing the Protective Cover 74
Removing the Terminal Cover on an IP00/Open Type Enclosure Drive 70
Removing the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive 69
Replacement Parts 329
Replacing the Drive 351
Reset Communication Parameters 191
RESET Key 101
Resistance Tuning Error 307
Response Messages from Drive to Master 472
Reverse Direction Output Example Time Chart 213
Reverse Operation Selection 143
Reverse Prohibited Error 309
rF 293
rH 293
Rotational Auto-Tuning 122
Rotational Auto-Tuning for V/f Control 121
RP 87
rr 294
RS-422 Interface 467
RS-485 Interface 466
RTS Control Selection 469
Rubber Bushing 34
rUn 302
Run Command/Frequency Reference Source Selection Error 305
Run Command at Power Up 144
Run Command Method Selection 470
Run Command Selection 315
Run Command Selection 1 ..... 140, 394
Run Command Selection 2 144
Run command selection while in Programming Mode 143
Run Command Source Selection 443
RUN Key 101
RUN LED 103
RUN Light 101

S

S- 88
S: Special Application 262
S: Special Parameters 431
S/L2 75
S+ 88
S1 86
S1: Dynamic Noise Control Function 431
S2 86
S2: Programmable Run Timers 263, 431
S3 86
S4 86
S5 86
S6 86
S7 86
S8 86
Safety Hazard Definitions 17
Safety Information 17
Safety Standard 384
SC 86, 294
S-Curve Characteristics 169, 278
SE 302
Search Operation Voltage Limit 167
Secondary PI (PI2) Control 268
Secondary PI Disable Mode 270, 435
Secondary PI Display Digits 269, 434
Secondary PI Enable Selection 268, 434
Secondary PI Feedback Detection Selection 271, 435
Secondary PI High Feedback Detection Time 271, 435
Secondary PI High Feedback Level 271, 435
Secondary PI Integral Limit Setting 270, 434
Secondary PI Integral Time Setting 269, 434
Secondary PI Low Feedback Detection Level 270, 435
Secondary PI Low Feedback Detection Time 271, 435
Secondary PI Output Level Selection 270, 434
Secondary PI Output Lower Limit 270, 434
Secondary PI Output Upper Limit 270, 434
Secondary PI Proportional Gain Setting 269, 434
Secondary PI Setpoint Value 269, 434
Secondary PI Unit Selection 269, 434
Secondary PI User Display 268, 434
Second Line Monitor Selection 428
Self-diagnosing function of the serial communication interface circuits 495
Sequence Timer 1 263
Sequence Timer 1 Day Selection 431
Sequence Timer 1 Reference Source 432
Sequence Timer 1 Selection 431
Sequence Timer 1 Start Time 431
Sequence Timer 1 Stop Time 431
Sequence Timer 2 Day Selection 432
Sequence Timer 2 Reference Source 432
Sequence Timer 2 Selection 432
Sequence Timer 2 Start Time 432
Sequence Timer 2 Stop Time 432
Sequence Timer 3 Day Selection 432
Sequence Timer 3 Reference Source 433
Sequence Timer 3 Selection 433
Sequence Timer 3 Start Time 432
Sequence Timer 3 Stop Time 432
Sequence Timer 4 Day Selection 433
Sequence Timer 4 Reference Source 433
Sequence Timer 4 Selection 433
Sequence Timer 4 Start Time 433
Sequence Timer 4 Stop Time 433
Sequence Timer Error 306
Sequence Timers 1/2/3/4 Reference Source 267
Sequence Timers 1/2/3/4 Selection 267

Sequence Timers 1 to 4 Day Selection..... 267
Sequence Timers 1 to 4 Start Time..... 266
Sequence Timers 1 to 4 Stop Time..... 267
Sequence Timers 2 to 4 264
SEr 294
Serial Communications Cable Connection Terminals (TB5)..... 466
Serial Communication Terminals.....88
Serial Communication Transmission Error 297
Serviceable Parts..... 350
Set Time..... 108
Setup Group Parameters 114
Setup Groups 109
Setup Modes..... 110
Shielded Twisted-Pair Cables.....90
Side-by-Side Installation.....47
Side-by-Side Mounting 389
Side-by-Side Setup 47
Simplified Setup Using the Setup Groups..... 110
Single Drive KEB Ride-Thru 1 230
Single Drive KEB Ride-Thru 2 230
Sink/source jumper S3 41
Sinking/Sourcing Mode Switch for Digital Inputs 41
Slave Address 473
Slip Compensation..... 170
Slip Compensation Gain 170
Slip Compensation Limit 170
Slip Compensation Primary Delay Time 170
Slip Compensation Selection during Regeneration 170
SN.....86
Soft Charge Bypass Relay Maintenance..... 442
Soft Charge Bypass Relay Maintenance Time..... 300
Soft CLA Selection..... 425
Soft Starter Speed Reference at Previous Fault..... 439
Software Current Limit Selection 248
Software No. (Flash) 438
Software No. (PWM)..... 438
Software No. (ROM) 438
Software version 29
Sound from Motor 320
Space Between Drives (Side-by-Side Mounting) 47
Speed Agree 1 Time Chart 208
Speed Agree 2 Time Chart 211
Speed Agreement Detection Level 241, 422
Speed Agreement Detection Level (+/-)..... 241, 422
Speed Agreement Detection Selection..... 242
Speed Agreement Detection Width 241, 422
Speed Agreement Detection Width (+/-) 241, 423
Speed Control Range..... 383
Speed Estimation Type Speed Search..... 146
Speed Search 141
Speed Search Deactivation Current 148
Speed Search Deceleration Time 148
Speed Search Delay Time 149
Speed Search Detection Compensation Gain 149
Speed Search Method Selection 150
Speed Search Restart Current Level..... 150
Speed Search Restart Detection Time..... 150
Speed Search Selection at Start 148
Speed Search Wait Time..... 150
Stall Prevention 235, 278
Stall Prevention Detection Time..... 241
Stall Prevention Level during Acceleration 236, 421
Stall Prevention Level during Run 238, 422
Stall Prevention Limit during Acceleration 236, 421
Stall Prevention Selection during Acceleration..... 236, 421
Stall Prevention Selection during Deceleration..... 237, 421
Stall Prevention Selection during Run 238, 422
Standard Connection Diagram 62
Starting Torque..... 383
Start-Up Flowchart 116
Stationary Auto-Tuning for Line-to-Line Resistance..... 121
Status Display 117
STOP button Input..... 308
STOP Key 101
STOP Key Function Selection 257, 429
Stopping Method after Communication Error 468
Stopping Method Selection..... 141
Storage Temperature 46
Surrounding Area.....46
Swing PWM..... 171
Switching Between LOCAL and REMOTE 114
System KEB Ride-Thru 1 230
System KEB Ride-Thru 2 230

T

T/L3.....75
T1-03 123
T1-04 123
T1-05 123
T1-06 123
T1-07 123
Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention 239
Task Complete 310
TdE 294
Temperature Derating..... 248
Terminal A1 Bias Setting..... 216
Terminal A1 Function Selection..... 216
Terminal A1 Gain Setting 216
Terminal A1 Signal Level Selection 216
Terminal A2 Bias Setting..... 218
Terminal A2 Function Selection..... 218
Terminal A2 Gain Setting 218
Terminal A2 Signal Level Selection 218
Terminal A3 Bias Setting..... 218
Terminal A3 Function Selection..... 217
Terminal A3 Gain Setting 218
Terminal A3 Signal Level Selection 217
Terminal Block Configuration 67
Terminal Board 34, 35, 36, 37, 38, 39, 40, 41, 350
Terminal Board Connection Error..... 284
Terminal Board Connector 41
Terminal Board Not Connected..... 285
Terminal Connections for Communication Self-Diagnostics..... 495
Terminal Cover 34, 35, 36, 37, 38, 39, 40, 69
Terminal Cover Screw 34
Terminal M1-M2 Function Selection 206
Terminal M3-M4 Function Selection 206
Terminal MD-ME-MF Function Selection..... 206
Terminal V1 Monitor Bias 189

Terminal V1 Monitor Gain 189
Terminal V1 Monitor Selection 189
Terminal V1 Signal Level 189
Terminal V2 Monitor Bias 189
Terminal V2 Monitor Gain 189
Terminal V2 Monitor Selection 189
Terminal V2 Signal Level 189
Test Run 121, 122, 124, 126
Test Run Checklist 131
Test Run with Load Connected 128
Third Line Monitor Selection 428
TIE 294
Tightening Torque 77
TIM 294
Time Data Error 294
Time Interval Error 294
Time Not Set 294
Timer Function Off-Delay Time 151
Timer Function On-Delay Time 151
Too Many Speed Search Restarts 294
Top Protective Cover 34
Top protective Cover 36
Torque Compensation 171
Torque Compensation Gain 171, 278
Torque Compensation Primary Delay Time 171, 278
Torque Detection 210
Torque Detection Level 1 ..... 245, 423
Torque Detection Level 2 ..... 245, 424
Torque Detection Selection 1 ..... 244, 423
Torque Detection Selection 2 ..... 244, 424
Torque Detection Time 1 ..... 245, 423
Torque Detection Time 2 ..... 245, 424
Torque Specifications, Three Phase 200 V Class 77, 507
Torque Specifications, Three Phase 400 V Class 79, 510
Torque Specifications, Three Phase 600 V Class 82, 513
Troubleshooting without Fault Display 3
TrPC 302
Tuning Errors 279
Types of Alarms, Faults, and Errors 279
Types of Auto-Tuning for Induction Motors 121

U

U/T1 75
U1-01 ..... 315, 317
U1-07 315
U1-09 315
U2, U3 Initialization 260
U2, U3 Initial Value Selection 430
U2-02 312
U2-03 through U2-17 312
U4-05 303
UL3 295
UL4 295
UL6 295
UL and CSA Standards 3
UL Standards Compliance 77
Undertorque Detection 1 295
Undertorque Detection 2 295
Undertorque Detection Operation 244
Undervoltage 303
Undervoltage 3 296
Undervoltage 3 (Soft-Charge Bypass Circuit Fault) 296
Undervoltage Detection Level (Uv1) 234, 421
Undervoltage Protection 383
Unexpected Noise from Connected Machinery 319
Unit Code 257
Unit Selection for MEMOBUS/Modbus Register 0025H 469
Up/Down 2 Function 177
Up/Down 2 Operations 205
Up/Down Command Operation 200
Up/Down Frequency Reference Limit Selection 180
Up Arrow Key 101
USB Copy Unit 130, 355
USB port (type-B) 34, 35, 36, 37, 38, 39, 40, 95
User Defaults 129
User Monitor Selection after Power Up 254, 428
User Monitor Selection Mode 428
User Parameter Automatic Selection 129, 138, 393
User Parameter Default Value 257, 429
User Parameters 129
User Parameters 1 to 32 ..... 129, 138, 393
User-Set Display Units Decimal Display 256
User-Set Display Units Maximum Value 255
User Set Speed Agree 1 Time Chart 208
User Set Speed Agree 2 Example with a Positive L3-04 Value 212
Using Braking Units in Parallel 365
Using the Pulse Train Output 92
Uv 303
Uv1 295
Uv2 296
Uv3 296

V

V/f Characteristics 383
V/f Control 28
V/f Control Mode Tuning 278
V/f Control Mode Tuning Parameters 278
V/f Data Setting Error 306
V/f Gain During Speed Search 149
V/f Pattern Defaults 445
V/f Pattern for Motor 1 182
V/f Pattern Selection 182, 317
V/T2 75
vAEr 311
VERIFY 259
Verifying Parameter Changes 109
Verify Menu 109
vFyE 311
voF 296
voF Alarm Location Monitor 443
Voltage Class, Capacity Mismatch 311
Voltage drop calculation formula 77
Voltage Reduction Rate 262, 431
Voltage Restoration Complete Level 263, 431
Voltage Restoration Level 262, 431
Voltage Restoration Sensitivity Time Constant 263, 431
Voltage Restoration Time Constant at Impact 263, 431
vrFy 311
vToL 296
VT Overload 296

W

W/T3 75
Waiting for Run 303
Warranty Information 24
Watt Hour Output Example 216
Watt Hour Output Unit Selection 214
Watt Loss 200 V Class Three Phase Models 385
Watt Loss 400 V Class Three Phase Models 385
Watt Loss Three-Phase 600 V Class Models 386
Wire Gauge, Three Phase 200 V Class 77, 507
Wire Gauge, Three Phase 400 V Class 79, 510
Wire Gauge, Three Phase 600 V Class 82, 513
Wire Gauges 77
Wiring Checklist 97
Wiring Diagram for 2-Wire Sequence 203
Wiring Distance 171
Wiring the Control Circuit Terminal 69
WRITE 259
Writing Parameter Settings 310
Writing to Multiple Registers 476
WrUn 303

Z

Zero-Speed Time Chart 208

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Industrial Fan and Pump Drive

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