

MANUAL

Premium Current Vector Control

EVO 8000 Series



目錄

CHAPTER 1 SAFETY	6
1.1 GENERAL SAFETY	6
1.1.1 Usage	6
1.1.2 Receiving	6
1.1.3 Installation	6
1.1.4 Wiring	7
1.1.5 Operation	7
1.1.6 Maintenance	8
1.2 WARNING LABEL	9
1.3 AC DRIVE APPLICATION PRECAUTIONS	9
1.3.1 AC Drive Selection	9
1.3.2 Settings	10
1.3.3 General Handling	10
1.4 WARRANTY	11
1.4.1 Warranty Period	11
1.4.2 Warranty Restrictions	11
CHAPTER 2 PRODUCT	12
2.1 COMPONENT NAMES	12
2.1.1 Installation in an IP20 Enclosure	12
2.1.2 Installation in an NEMA Type 1 Enclosure	13
2.2 RECEIVING CHECKLIST	14
2.3 NAMEPLATE	14
2.4 MODEL NUMBER DEFINITION	15
2.5 POWER RATINGS	15
2.6 COMMON SPECIFICATIONS	16
CHAPTER 3 DRIVE INSTALLATION	20
3.1 INSTALLATION ENVIRONMENT	20
3.2 INSTALLATION DIRECTION AND SPACING	21
3.2.1 Installation Direction	21
3.2.2 Installation Spacing	21
3.3 KEYPAD AND TERMINAL COVER INSTALLATION	23
3.4 WIRING PROTECTION	24
3.4.1 Drive and Input Cable Protection for Short-Circuit Situations	24
3.4.2 Motors and Output Cable Protection for Short-Circuit Situations	24

3.4.3 Keypad Mounted on Panel Door.....	24
CHAPTER 4 WIRING	25
4.1 WIRING SAFETY	25
4.2 MAIN CIRCUIT	26
4.2.1 Main Circuit Terminal.....	27
4.2.2 Main Circuit Wiring.....	27
4.2.3 Main Circuit Cable Size and Tightening Torque.....	29
4.3 CONTROL CIRCUIT.....	30
4.3.1 Control Circuit Terminals.....	31
4.3.2 Control Circuit Wiring	33
4.3.3 Control Circuit Cable Size and Tightening Torque.....	36
4.3.4 Ferrule-Type Terminals.....	36
4.4 I/O CONNECTIONS	37
4.4.1 NPN and PNP Mode Selection.....	37
4.4.2 Terminal A2 Voltage/Current Input Selection.....	38
4.4.3 Terminal AM Voltage/Current Output Selection.....	39
4.4.4 RS-485 Communication Termination ON / OFF Switch	40
4.5 CONNECTION TO PC	40
4.6 WIRING CHECKLIST.....	41
CHAPTER 5 KEYPAD	42
5.1 CHECK BEFORE OPERATION	42
5.2 POWERING UP THE DRIVE AND OPERATION STATUS DISPLAY.....	42
5.3 KEYPAD.....	43
5.3.1 Keys and Displays.....	43
5.3.2 Keypad Display.....	46
5.3.3 Keypad Programming.....	48
CHAPTER 6 PARAMETERS	50
6.1 GROUP A, INITIALIZATION	50
6.2 GROUP B, APPLICATION.....	56
6.3 GROUP C, TUNING.....	80
6.4 GROUP L, FREQUENCY COMMAND	98
6.5 GROUP D, MOTOR PARAMETERS.....	111
6.6 GROUP E, MULTI-FUNCTION TERMINALS.....	124
6.7 GROUP P, PROTECTIONS.....	163
6.8 GROUP N, SPECIAL ADJUSTMENTS	193
6.9 GROUP O, KEYPAD FUNCTION SETTINGS	196

6.10 GROUP T, AUTO-TUNING	199
6.11 GROUP F, OPTION SETTINGS.....	205
6.12 GROUP U, MONITOR SETTINGS	209
CHAPTER 7 OPTIONS.....	214
7.1 BRAKING RESISTOR OPTION	214
7.1.1 <i>Installing a Braking Resistor</i>	215
7.1.2 <i>Selecting a Braking Resistor</i>	215
7.2 AC REACTOR OPTION	216
7.2.1 <i>Installing an AC Reactor</i>	216
7.2.2 <i>AC Reactor Wiring Example</i>	217
7.3 INSTALLING INPUT FUSES.....	218
7.4 NOISE FILTER OPTION	219
7.4.1 <i>Noise Filter on the Primary Side</i>	219
7.4.2 <i>Zero Phase Noise Filter</i>	219
CHAPTER 8 TROUBLESHOOTING	220
8.1 ALARM AND FAULT DISPLAYS	220
8.2 FAULT DETECTION.....	224
8.3 OPERATION ERRORS.....	235
8.4 AUTO-TUNING FAULT DETECTION	237
CHAPTER 9 INSPECTION & MAINTENANCE.....	238
9.1 SAFETY	238
9.2 PERIODIC INSPECTION	239
9.2.1 <i>Environment</i>	239
9.2.2 <i>Voltage</i>	239
9.2.3 <i>Keypad Monitor</i>	239
9.2.4 <i>Enclosure</i>	239
9.2.5 <i>Main Circuit</i>	240
9.2.6 <i>Main Circuit- Terminals & Cables</i>	240
9.2.7 <i>Main Circuit- Capacitors</i>	240
9.2.8 <i>Main Circuit- Resistors</i>	240
9.2.9 <i>Main Circuit- Magnetic Contactors & Relays</i>	241
9.2.10 <i>Control Circuit- Control Boards & Connectors</i>	241
9.2.11 <i>Cooling- Fans</i>	241
9.2.12 <i>Cooling- Air Duct</i>	242
9.3 DRIVE COOLING FANS.....	242
9.3.1 <i>Cooling Fan Replacement</i>	242

9.3.2 Removing Cooling Fan.....	243
CHAPTER 10 DRIVE DERATING.....	244
10.1 TEMPERATURE DERATING	244
10.2 ALTITUDE DERATING.....	245
CHAPTER 11 COMMUNICATIONS	246
11.1 MODBUS COMMUNICATION SPECIFICATIONS	246
11.2 CONNECTING TO CONTROLLER/PLC/HMI.....	246
11.2.1 Communication Cable Connection.....	246
11.2.3 Termination Resistor Setting for Multiple Connections.....	248
11.2.4 Termination Resistor Function.....	248
11.2.5 When to Install Termination Resistor.....	248
11.3 MODBUS SETUP PARAMETERS	249
11.4 DRIVE OPERATIONS BY MODBUS	250
11.4.1 Actions by Modbus	250
11.4.2 Drive Control by Modbus.....	250
11.5 MESSAGE FORMAT	251
11.5.1 Message Content	251
11.5.2 Message Configuration.....	251
11.5.3 Slave Station Address	252
11.5.4 Function Code.....	252
11.5.5 Data.....	252
11.5.6 Error Check.....	252
11.5.7 Command Data.....	252
11.5.8 Response Message.....	253
11.6 EXAMPLE OF READING / RESPONDING DATA	253
11.7 MODBUS DATA	258
11.8 COMMUNICATION ERRORS	262
11.8.1 Modbus Errors.....	262
11.8.2 Slave Response.....	262

Chapter 1 | Safety

1.1 General Safety

Safety Information:

Warning: Indicates highly dangerous consequences such as fire, serious injury and death when failing to comply with the instructions.

Caution: Indicates dangerous consequences such as moderate injury and equipment damage when failing to comply with the instructions.

1.1.1 Usage

Danger
<ol style="list-style-type: none">1. The drive is used to control the speed of 3 phase synchronous and asynchronous motors, which must not be used for single phase or other purposes. Failure to comply could cause drive damage or serious injury by fire.2. The drive must not be used in any medical equipment in which human life may involve.3. The drive is manufactured according to strict quality control standard. However, bypass the safety protection in case the drive failure causes death or serious injury.

1.1.2 Receiving

Warning
<ol style="list-style-type: none">1. Do not install damaged drive or any drive without complete components inside. Failure to comply could result in accident.

1.1.3 Installation

Warning
<ol style="list-style-type: none">1. Carry the drive by the bottom as carrying by the front cover may cause injury and damage from the main body of the drive falling.2. Attach the drive to metal or other nonflammable materials. Keep away from heat and flammable items.3. A control panel must have cooling fans, air vents and room for ventilation when the drive is installed inside.

1.1.4 Wiring

Danger
<ol style="list-style-type: none">1. Allow only qualified electrical engineers to install the drive. Failure to comply could cause electrical shocks to personnel or damage to the drive.2. Ensure the power supply is off when connecting. Failure to comply could cause electrical shocks.3. Ensure the ground terminal PE is properly wired. Failure to comply could cause electrical shocks from the drive cover. Therefore ground the drive and motor for personnel safety.4. Do not touch the main circuit terminal. Keep the main circuit off drive cover to avoid electrical shocks.5. The terminal for braking resistor is B1 and B2. Do not connect it to any other terminals. Failure to comply could cause a fire.
Warning
<ol style="list-style-type: none">1. Do not connect three-phase power supply to terminals U, V and W. Failure to comply could damage the drive.2. An output reactor is recommended when the cable connecting between the drive and motor is over 100 meters. Failure to comply could result in drive damage with overcurrent caused by over-distributed capacitance.3. Never connect the output terminals to capacitors or unapproved LC/RC filters. Failure to comply could damage the drive components.4. Separate the drive main circuit cables and control circuit cables. Failure to comply could cause interference to the control signals5. Ensure the phase of power supply and rated voltage match the label on the drive. Failure to comply could drive damage.

1.1.5 Operation

Danger
<ol style="list-style-type: none">1. Connect the power after completion of wiring and closing the front cover. Opening the front cover when the power is on could cause electrical shocks.2. Keep other personnel off the equipment when setting the drive fault restart and momentary power loss restart functions. Failure to comply could cause damage to the personnel and equipment.3. Once the drive is powered, the terminals are live even when drive is not in operation. Touching the terminals could cause electrical shocks.

4. Cancel run command before resetting the alarm and fault. Failure to comply could cause physical injury.

Warning

1. Do not start or stop the drive by connecting or disconnecting the power supply. Failure to comply could cause drive damage.
2. Ensure the motor and equipment are in proper use before operation. Failure to; comply could damage the equipment.
3. The temperature of the braking resistor and heatsink could be very high during operation. Do not touch it or it could result in scald.
4. For lift applications, please install mechanical brakes.
5. Adjust a few parameters only if necessary as the defaults are optimum settings for most of applications. Editing parameters indiscriminately could cause equipment abnormal operation.
6. Interlock the electricity supply with AC drive supply when both are available to a motor.

1.1.6 Maintenance

Danger

1. Do not touch the main circuit of the drive when power is on. Failure to comply could cause electrical shocks.
2. Disconnect the power supply before opening the front cover of the drive.
3. Maintain the drive only when the CHARGE indicator light is off or 5 minutes after turning off power supply, so as to avoid charged capacitors causing physical injury.
4. Allow only qualified electric engineers and electrician to maintain, repair and replace the AC drive modules.

Warning

1. The release of breaker on the AC drive primary side could be caused by incorrect wiring, short circuit and damaged drive components. Investigate and remove the problem before reconnecting the breaker.
2. Do not use a megger (insulation resistor) to test the drive control circuit. Failure to comply could cause drive damage.

Notice:

All the instruction photographs and diagrams of opened drive in this manual are only for illustration. Do not attempt to operate any AC drives with the cover opened.

1.2 Warning Label

The warning label is on the front of the drive. Please read it carefully and follow the instructions.

- Read the user manual before operation.
- Risk of electrical shock. Shut off main power and wait for 5 minutes before servicing.
- Hot surface. Risk of burn.



1.3 AC Drive Application Precautions

1.3.1 AC Drive Selection

1.3.1.1 Drive Capacity

Before driving motors, ensure the motor rated current is lower than the drive rated output. In addition, when a single AC drive is driving more than 1 motor in parallel, make sure the drive capacity is higher than 110% of total motor rated current.

1.3.1.2 Starting Torque

The motor characteristics at start and during acceleration are limited by the drive overcurrent. If higher starting torque is needed, use a higher rating drive or increase capacity of both motor and drive.

1.3.1.3 Emergency Stop

When a drive fault occurs, protection function will be automatically triggered to shut off the output but the motor may not stop immediately. Therefore please install mechanical brake if immediate stop is necessary.

1.3.2 Settings

1.3.2.1 Upper Limits

The maximum output frequency of the drive is 400Hz. If the upper limit is set incorrectly, the motor will run at higher than its rated speed and cause danger. Please set the limit of output frequency in Frequency Upper Limit parameter. The default setting of the rated output frequency is 60Hz.

1.3.2.2 DC Braking

Excessive DC braking current and duration could cause motor overheat.

1.3.2.3 Acceleration /Deceleration Time (Acc./Dec. Time)

Acceleration and deceleration time is determined by the motor torque, load torque and load inertia. Set a longer Acc./Dec. time after Stall Prevention function is triggered. In addition, the acceleration and deceleration time will be extended depending on the Stall Prevention duration. If faster acceleration and deceleration are required, install proper braking options or use a higher rating motor and AC drive.

1.3.3 General Handling

1.3.3.1 Wiring

Connecting power supply to output terminals U/T1, V/T2 and W/T3 will damage the drive. Check all the connections and wiring sequence before turning on the power. Failure to comply could cause drive damage.

1.3.3.2 Maintenance

Capacitors in the drive may still be charged for a short time after shutting off the power. Wait for the amount of time specified on the drive before any maintenance. Failure to comply could cause electrical shocks to personnel. Besides, do not touch the heatsink which can be very hot during operation. Replace the cooling fan only when the heatsink has cooled down after shutting off the power. In addition, when a synchronous motor is coasting to stop, it regenerates voltage to keep the drive terminals live even when the drive power is off. Wait until the motor is fully stopped before drive maintenance. Failure to comply could cause electrical shocks to personnel.

1.3.3.3 Wiring Tools

Use only the tools suggested by the terminal supplier during drive maintenance.

1.3.3.4 Transportation and installation

Do not expose the drive to the environment containing the halogens or DOP gas during transportation or installation.

1.4 Warranty

1.4.1 Warranty Period

Contact local distributor for details.

1.4.2 Warranty Restrictions

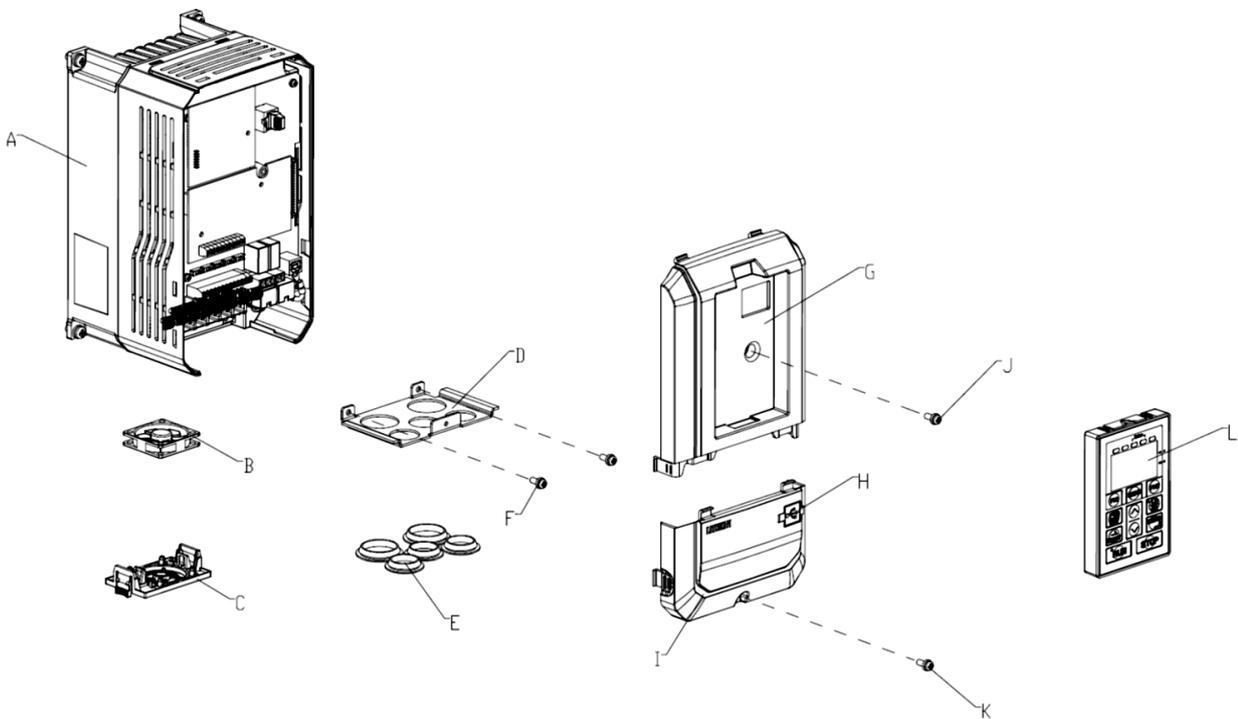
Warranty is not applicable when the drive is not properly used according to the manual regardless of warranty period.

Chapter 2 | Product

2.1 Component Names

This section illustrates each components of the drive.

2.1.1 Installation in an IP20 Enclosure

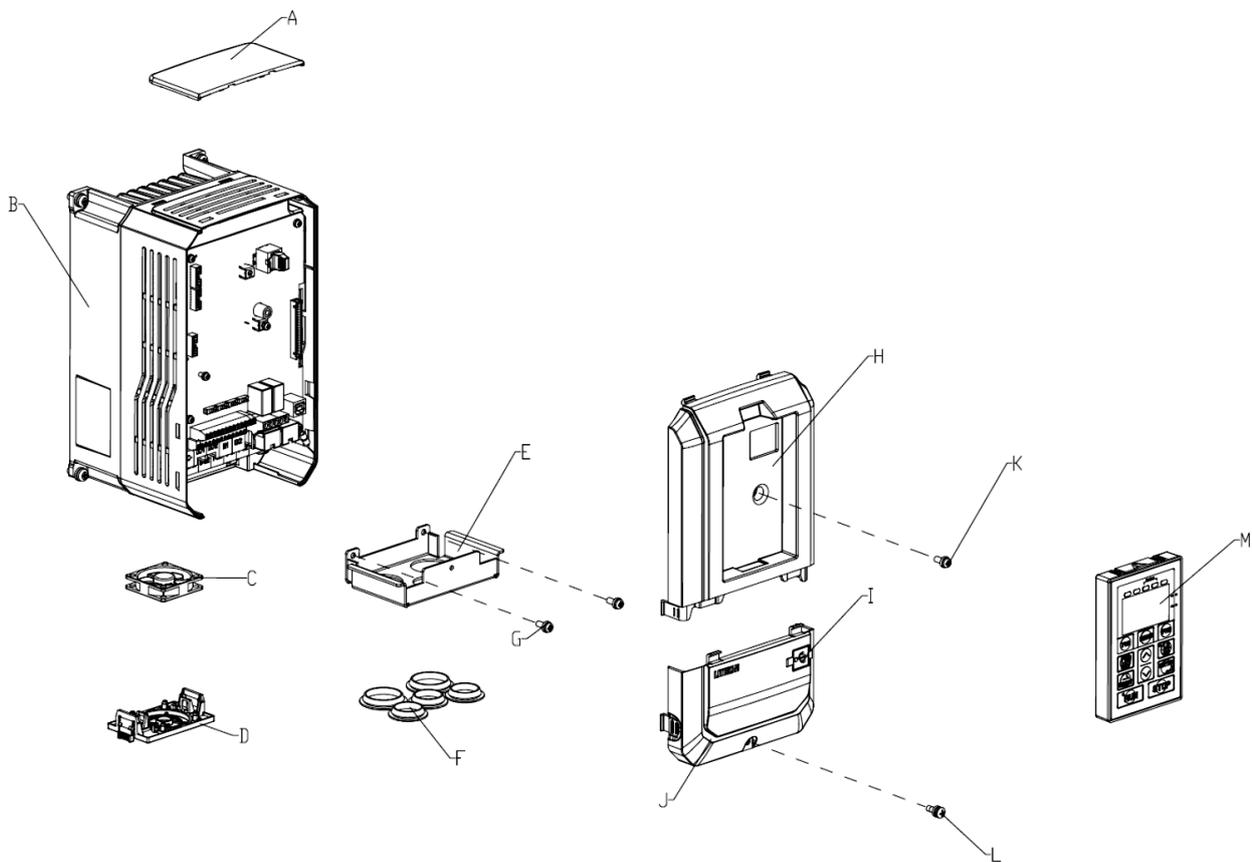


- A – Heatsink
- B – Cooling fan
- C – Cooling fan guard
- D – Conduit bracket
- E – Rubber bushing

- F – Terminal cover screw
- G – Front cover
- H – USB port
- I – Terminal cover
- J – Front cover screw

- K – Terminal cover screw
- L – Keypad

2.1.2 NEMA Type 1 Enclosure



A – Top cover
B – Heatsink
C – Cooling fan
D – Cooling fan guard
E – Conduit bracket

F – Rubber bushing
G – Terminal cover screw
H – Front cover
I – USB port
J – Terminal cover

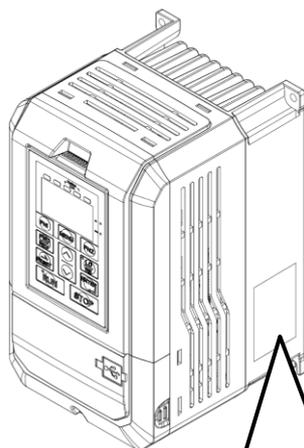
K – Front cover screw
L – Terminal cover screw
M – Keypad

2.2 Receiving Checklist

Check the following when receiving the drive:

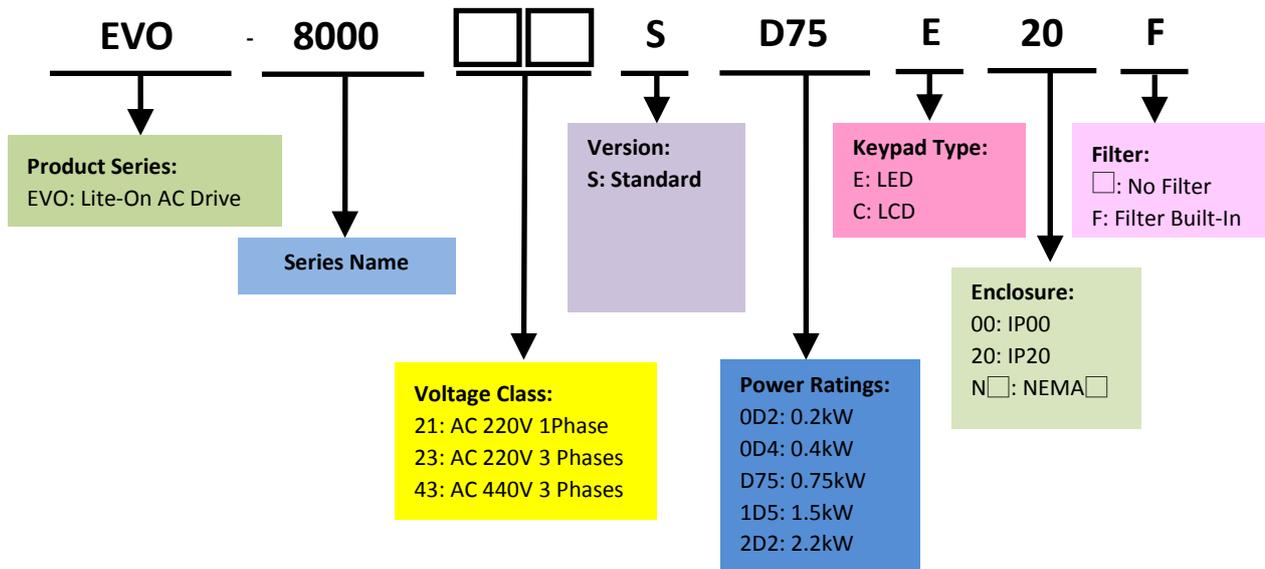
- | | |
|----|--|
| 1. | Is the packaging box in good condition? Any damage or damp ?
If so, contact the distributor or local Lite-On representative. |
| 2. | Is the model label on the box same as what you purchased?
If not, contact the distributor or local Lite-On representative. |
| 3. | After opening the box, is there any damp mark inside the box? Any damage or crack on the drive enclosure?
If so, contact the distributor or local Lite-On representative. |
| 4. | Does the drive nameplate show the same model number as the carton label?
If not, contact the distributor or local Lite-On representative. |
| 5. | Are the manual and keypad in the carton?
If not, contact the distributor or local Lite-On representative. |

2.3 Nameplate



Model number	→	MODEL:EVO800043SD75
Applicable motor rating	→	MOTOR RATING: 0.75kW/1.5kW
Input power supply	→	INPUT: AC3PH 380-480V 50/60Hz
Output power supply	→	OUTPUT: AC3PH 0-480V 0-400Hz 3.4A/4.1A
		11D7543XXXXXXXXXXXXXXXXXXXXX
		IP20
		
		LITEON LiteON ELECTRONICS, INC.
		MADE IN XXXXXX

2.4 Model Number Definition



2.5 Power Ratings

400V Class													
Model No.	EVO800043S		D75	1D5	2D2	3D7	5D5	7D5	011	015	018	022	030
Max. Motor Capacity	HP	HD	1	2	3	5	7.5	10	15	20	25	30	40
		ND	2	3	5	7.5	10	15	20	25	30	40	50
	kW	HD	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30
		ND	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
Input Voltage (V) / Frequency (Hz)			Three Phases, 380 to 480 V, -15% to +10%, 50/60Hz										
Rated Output	Current (ND)		4.1	5.4	6.9	10.8	13	23	31	38	44	58	72
	Current (HD)		3.4	4.8	5.5	9	12	18	24	31	39	45	60
	Output Frequency(Hz)		0 to 400 Hz										
	Carrier Frequency (kHz)		1 to 16kHz										
Cooling Method			Fan										
Frame Size			1		2		3		4				

2.6 Common Specifications

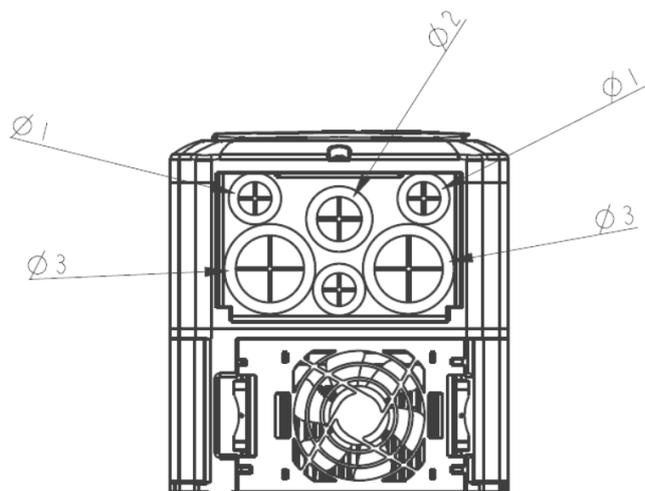
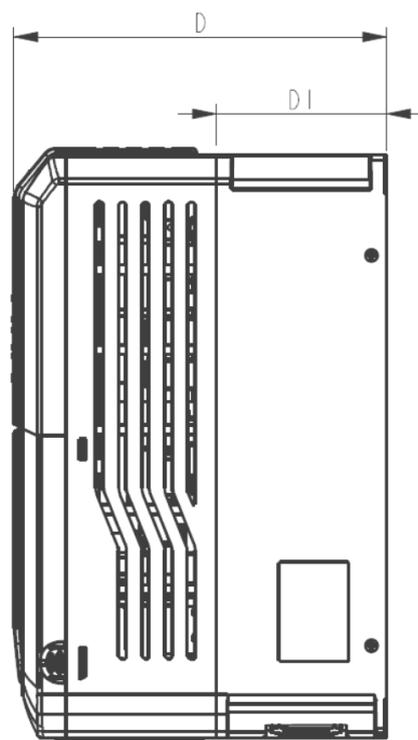
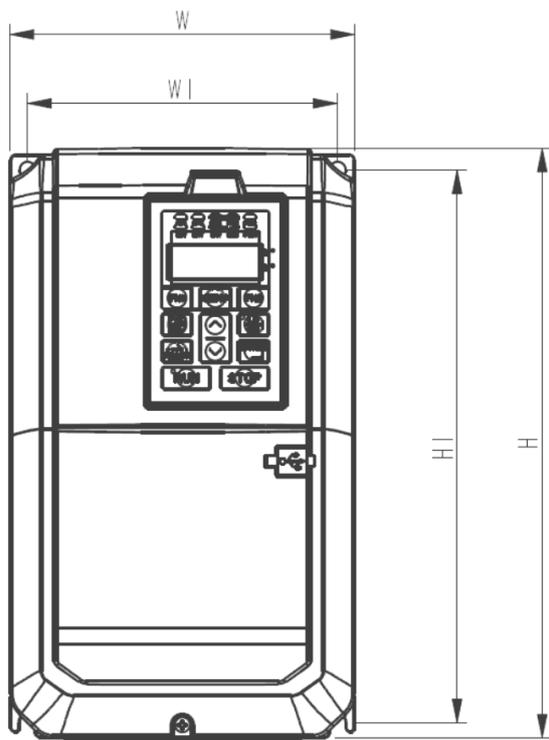
Item		Specification
Control Characteristic	Control Method	V/F, Closed-Loop V/F Control, IM/PM Motor Closed-Loop Vector Control, IM/PM Motor Open-Loop Vector Control
	Output Frequency	1 to 400 Hz
	Frequency Accuracy	Digital Input: Within $\pm 0.01\%$ of the max. output frequency
		Analog Input: Within $\pm 0.1\%$ of max. output frequency (-10°C to +50°C)
	Frequency Setting Resolution	Digital Input : 0.01Hz
		Analog Output: 1/1000 of max. frequency
	Starting Torque ^{*1}	150% / 3Hz (V/F and Closed-Loop V/F Control) 200% / 0.3Hz (IM Open-Loop Vector Control) 200% / 0r/min (IM/PM Motor Closed-Loop Vector Control) 100% / 5% speed (PM Motor Open-Loop Vector Control)
	Speed Control Range ^{*1}	1: 40 (V/F and Closed-Loop V/F Control) 1:200 (IM Open-Loop Vector Control) 1:20 (PM Motor Open-Loop Vector Control) 1:1500 (IM/PM Motor Closed-Loop Vector Control)
	Speed Control Accuracy ^{*1}	$\pm 0.2\%$ (Open-Loop Vector Control)
		$\pm 0.02\%$ (Closed-Loop Vector Control)
	Speed Response	Over 10 Hz (Open-Loop Vector Control)
		Over 50 Hz (Current Vector Control)
	Acc/Dec Time	0.0 to 6000.0
Braking Torque	Approx. 20%	
V/F Pattern	15 fixed patterns and 1 programmable pattern	
Overload Capacity	120% for 1 min. in every 10 min. (Normal Duty) 150% for 1 min. in every 10 min. (Heavy Duty)	
Parameter Function	Torque Control, Speed/Torque Control Switching, Feed Forward Control, Zero Speed Holding, Momentary Power Restart, Speed Search, Overtorque/Undertorque Detection, Torque Limit, Multi-Step Speed Operation, Acc./Dec. Switch, S-Curve Acc./Dec., 3-Wire Sequence Control, Auto-Tuning, Cooling Fan ON/OFF Switch, Slip Compensation, Torque Compensation, Frequency Jump, Upper/lower Limits for Frequency Command, DC Braking at Run/Stop, PID Control including Pause Function, Energy Saving Mode, Fault Restart, Kinetic Energy Braking, Auto Voltage Adjustment, Overvoltage Suppression, Traverse, etc.	

Operating Environment	Area of Use	Indoor without corrosive gas/liquid or flammable gas/liquid/oil mist/dust
	Ambient Temperature	-10°C to +50°C, -10°C to +40°C (NEMA1), below 90% RH without froze or condensation
	Storage Temperature	-20°C to +60°C
	Altitude	Up to 1000 meters
	Shock	10 to 20 Hz (9.8 m/s ²) , 20 to 55 Hz (5.9 m/s ²)
	Enclosure	IP20, NEMA1 (with optional NEMA kit)
Number of I/O	Analog Input (AI)	2 points (AI1: 0 to 10V, -10V to 10V (12 bits); AI2: 0/4 to 20mA, 0V to 10V, 0 to 5V)
	Digital Input (DI)	8 points
	Analog Output (AO)	2 points FM: 0 to 10V, -10V to 10V (10 bits), AM: 0 or 4 to 20mA (10 bits), 0 to 10V(11 bits)
	Digital Output (DO)	2 points
	Relay Output (RO)	2 points
	Pulse Input (PI)	1 point
	Pulse Output (PO)	1 point
Communications	Modbus (RS-485 port), USB port	
Communication Option Card	Profibus-DP, CANopen, DeviceNet EtherCAT, Ethernet, Profinet, LONWORKS, Powerlink	

*1. Results tested in labs

Frame Size 3

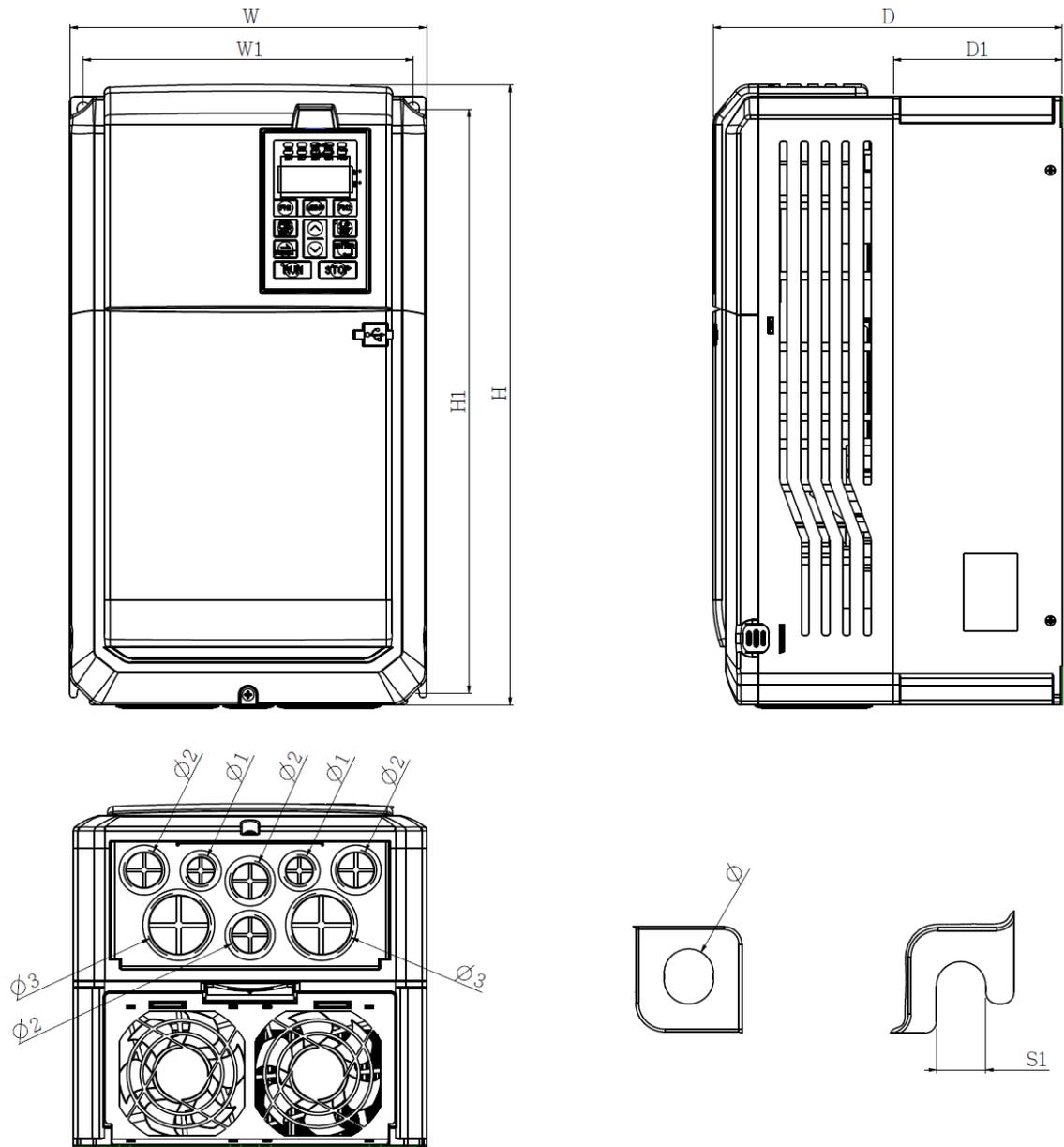
EVO800043S7D5E20, EVO800043S011E20, EVO800043S015E20



Series	Frame Size	W	W1	H	H1	D	D1
EVO8000	3	180[7.09]	162[6.38]	310[2.2]	290.6[11.44]	195[7.68]	89[3.5]
		S1	Ø	Ø1	Ø2	Ø3	
		8.4[0.33]	8.4[0.33]	22[0.86]	28[1.1]	44[1.73]	

Frame Size 4

EVO800043S018E20, EVO800043S022E20, EVO800043S030E20



Series	Frame Size	W	W1	H	H1	D	D1
EVO8000	4	240[9.45]	222[8.74]	420[16.53]	395.5[15.57]	235[9.25]	113.7[4.47]
		S1	Φ	Φ1	Φ2	Φ3	
		8.4[0.33]	8.4[0.33]	22[0.86]	28[1.1]	44[1.73]	

Chapter 3 | Drive Installation

3.1 Installation Environment

To ensure the optimum drive performance, install the AC drive in a proper environment specified below.

Environment	Conditions
Area of Use	Indoors
Ambient Temperature	<ul style="list-style-type: none"> ● -10°C to +40°C (IP20/NEMA 1 enclosure) ● -10°C to +50°C (IP00 enclosure) ● Do not install the drive in environments with wide temperature fluctuations so as to ensure the drive reliability. ● When the drive is installed in an enclosure cabinet, make sure the cooling works properly to keep the temperature within the specified levels. ● Do not allow the drive to freeze. ● When drives are installed side-by-side in a cabinet, follow the instruction illustrated in Figure 3.2 to ensure the air flow.
Humidity	<ul style="list-style-type: none"> ● Under 90% RH ● Free of condensation
Storage Temperature	-20°C to +60°C
Surrounding Area	<ul style="list-style-type: none"> ● Free from water, oil, metal shavings or other foreign materials. ● Free from flammable materials (e.g., wood) ● Free from harmful gases and liquids ● Free from direct sunlight ● Free from oil mist, corrosive gas, flammable gas or dust. ● Free from radioactive material ● Green Class 2 or above
Altitude	Up to 1000 m without derating. Up to 2000 meters with 1% rated current derated for every 100 m counted from 1000 m.
Vibration	<ul style="list-style-type: none"> ● 10 to 20 Hz at 9.8 m/s² ● 20 to 55 Hz at 5.9 m/s² (2A0004 to 2A0211, 4A0002 to 4A0165) , or 2.0 m/s² (2A0250 to 2A0415, 4A0208 to 4A1200)
Enclosure	IP20/NEMA 1.

3.2 Installation Direction and Spacing

3.2.1 Installation Direction

Install the AC drive upright for better cooling.

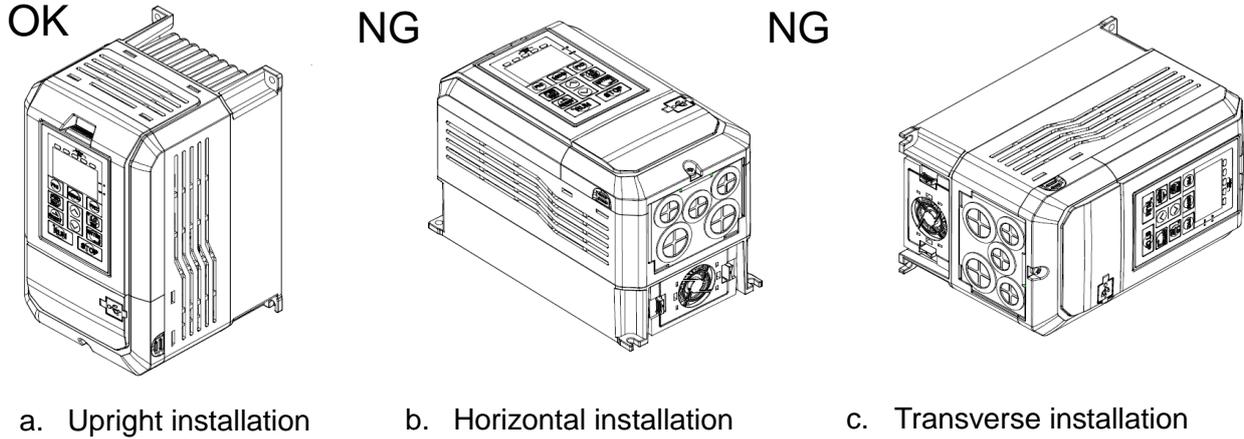


Figure 3.1 Installation Direction

3.2.2 Installation Spacing

3.2.2.1 Single Drive Installation

Install the AC drive as illustrated below to ensure the required space for airflow and wiring.

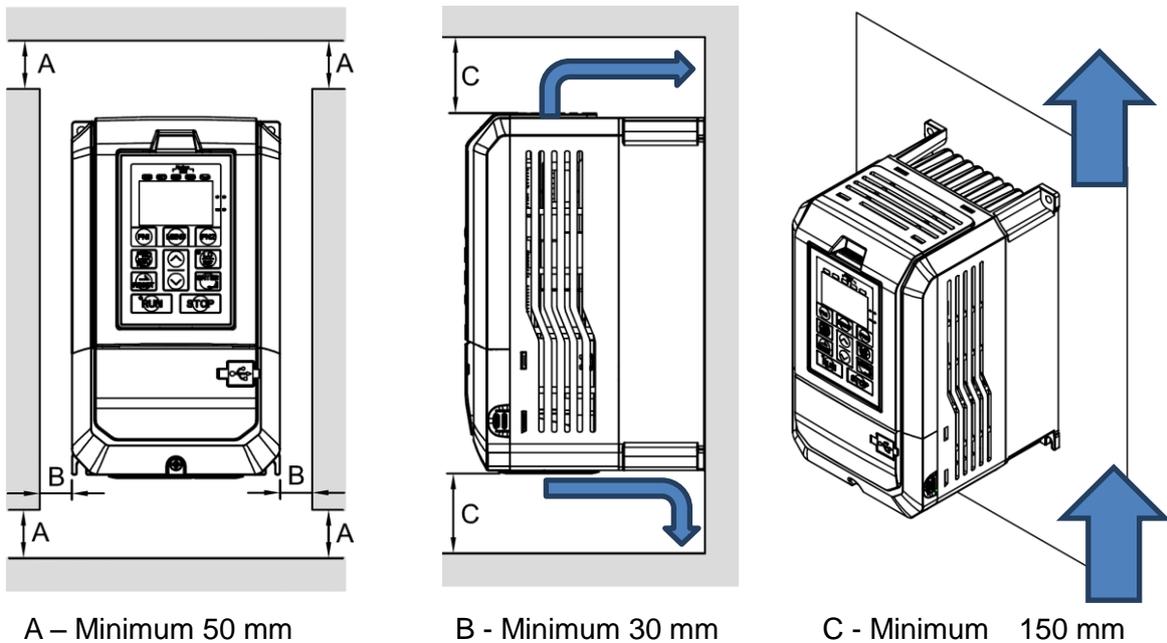


Figure 3.2 Installation Spacing for Single Drive

Note: Same amount of space is required for IP00 and NEMA 1 enclosure.

3.2.2.2 Side-by-Side Installation

Install the AC drives as illustrated below to ensure the required space for airflow and wiring.

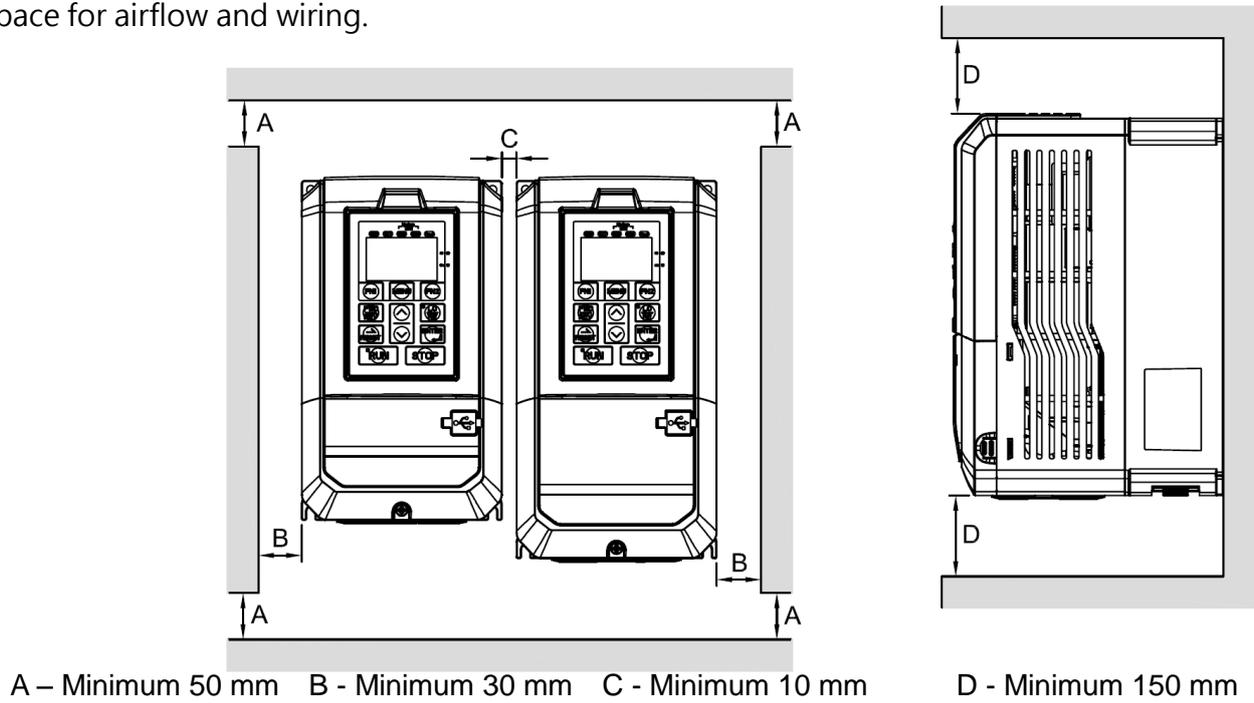


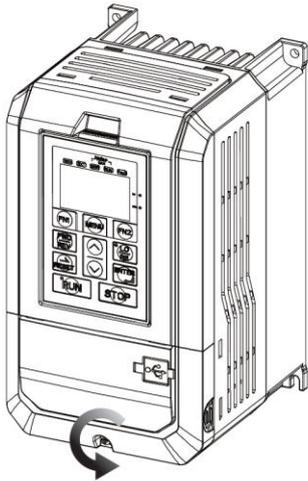
Figure 3.3 Installation Space for Side-by-Side Installation

Note: When installing drives of different sizes, align the tops of the drives for easier cooling fan replacement.

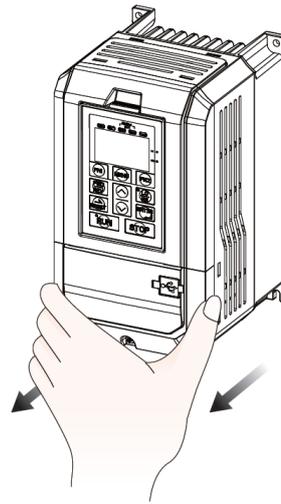
3.3 Keypad and Terminal Cover Installation

It is not necessary to remove the keypad before wiring. You just need to loosen the terminal cover screw and remove the terminal cover.

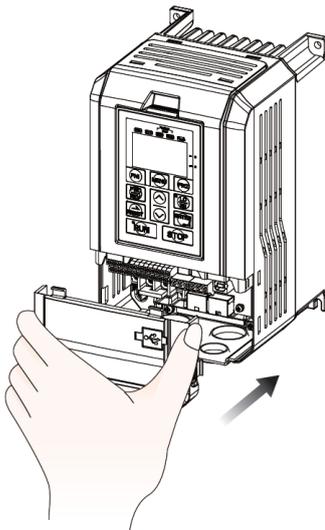
440V 1 to 40HP model enclosure are non-metal. Loosen terminal cover screw and remove terminal cover for wiring. After wiring, affix the terminal cover back in position and tighten the screw. For wiring instructions and screw tightening torque please refer to Chapter 4.



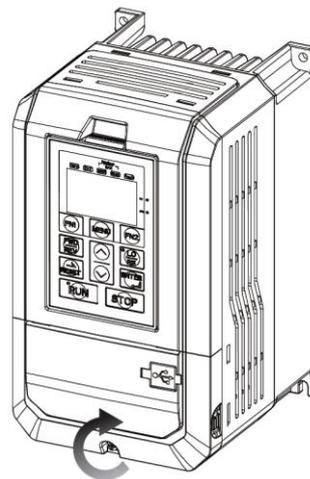
Step 1: Loosen the Screw



Step 2: Remove the Terminal Cover



Step 3: Affix the Terminal Cover After Wiring



Step 4: Tighten the Screw

3.4 Wiring Protection

3.4.1 Drive and Input Cable Protection for Short-Circuit Situations

Protect the drive and input power cable by using fuse in case potential short-circuit situations cause overheat. Please refer to the following figure for proper wiring.

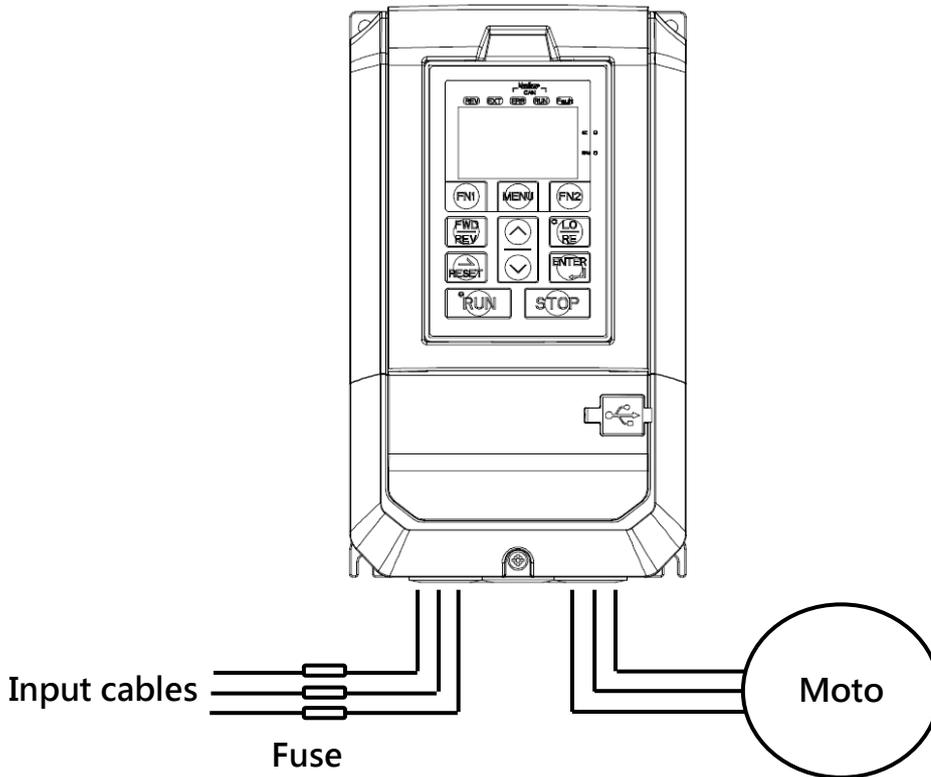


Figure 3.4 Fuse Installation

3.4.2 Motors and Output Cable Protection for Short-Circuit Situations

If the output cables are properly selected according to the drive rated current, the drive itself is fully capable of protecting the motor and output cables in case of short-circuit situations.

Note: If a single drive runs more than 1 motor, a separate thermal overload switch or a circuit breaker is required.

3.4.3 Keypad Mounted on Panel Door

The keypad of EVO 8000 series can be removed and connected to the drive using an extension cable. The remote keypad can be mounted on control panels with screws thread M4 X P0.7 and the screw length longer than the thickness of panel door.

Chapter 4 | Wiring

4.1 Wiring Safety

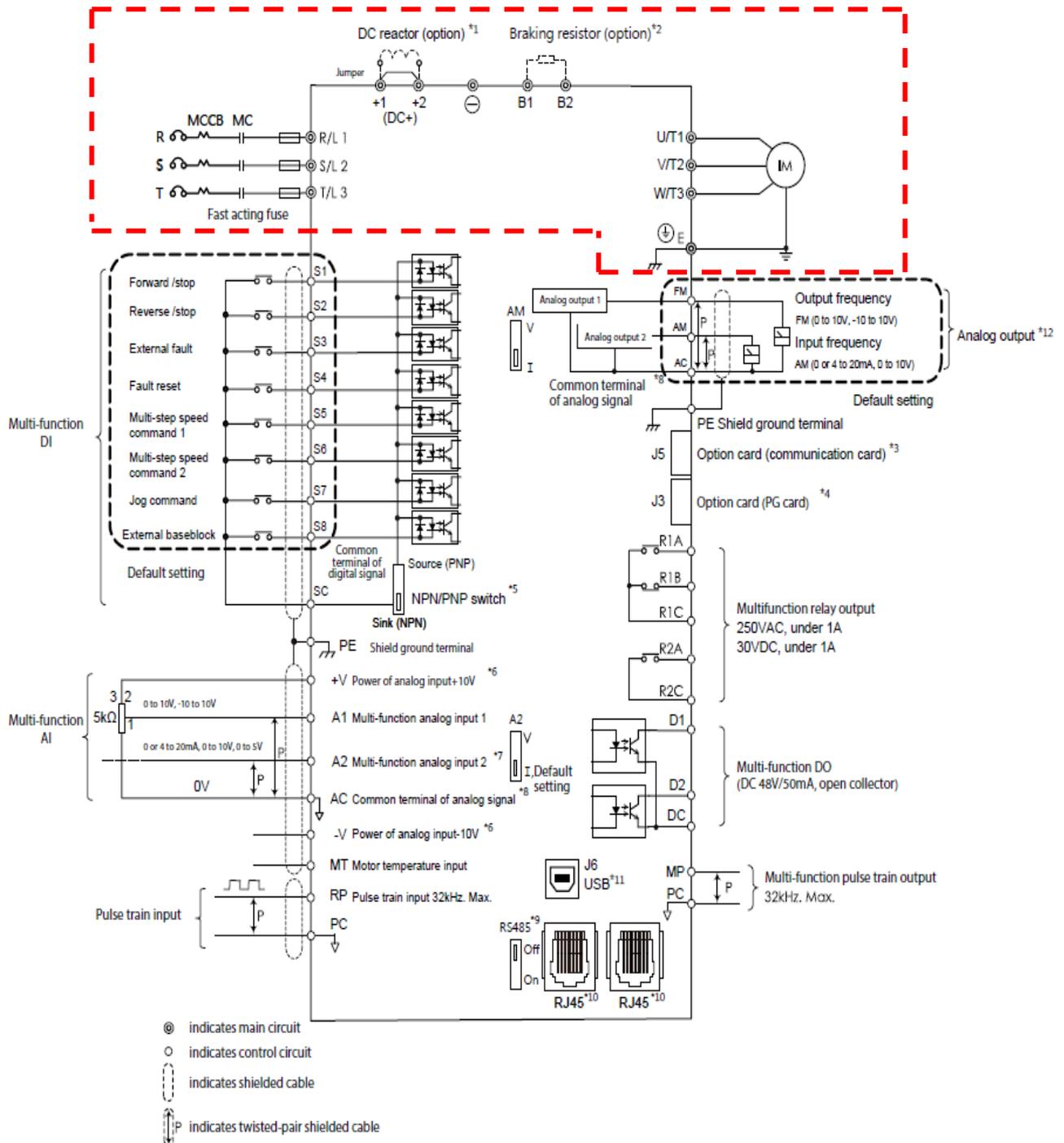
Danger

- Turn off all the power to the equipment before wiring. Wiring during power on could cause electrical shocks to personnel.
- Allow only qualified personnel for installation, wiring, repairing and parts replacement.
- Capacitors in the drive may still be charged for a short time after shutting off the power. Wait for the amount of time specified on the drive before any maintenance.
- Never touch input or output power cables. Do not connect any circuit to drive enclosure.

Warning

- Properly connect the motor ground terminal. Contacts between the motor ground terminal and motor enclosure could result in electrical shocks or a fire.
- Ensure terminal screws are all tightened. Loose connection to the main circuit could cause overheat or a fire.
- Verify if the rated voltage of the drive matches the voltage of the incoming power supply before applying power.
- Perform all wiring as specified in the wiring diagrams provided when installing braking options. Failure to comply could result in drive, braking components damage or a fire.
- Do not disconnect the motor from the drive while the drive is outputting voltage.
- Do not use unshielded cable for control circuit wiring. Failure to comply could cause abnormal operation of drive.
- Use shielded twisted-pair cables and connect the shield to ground terminal of the drive.
- Do not modify the drive circuits. Failure to comply could cause drive damage.
- Ensure all connections are correct after connecting the drive with other devices.
- Rubber grommets located on conduit box shall be removed and replaced with conduit hubs in the end use installation.
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes” , or the equivalent

4.2 Main Circuit



- Remove DC+(+1/+2) jumper before installing DC reactor.
- Ensure the Stall Prevention function is off when using a braking resistor.

4.2.1 Main Circuit Terminal

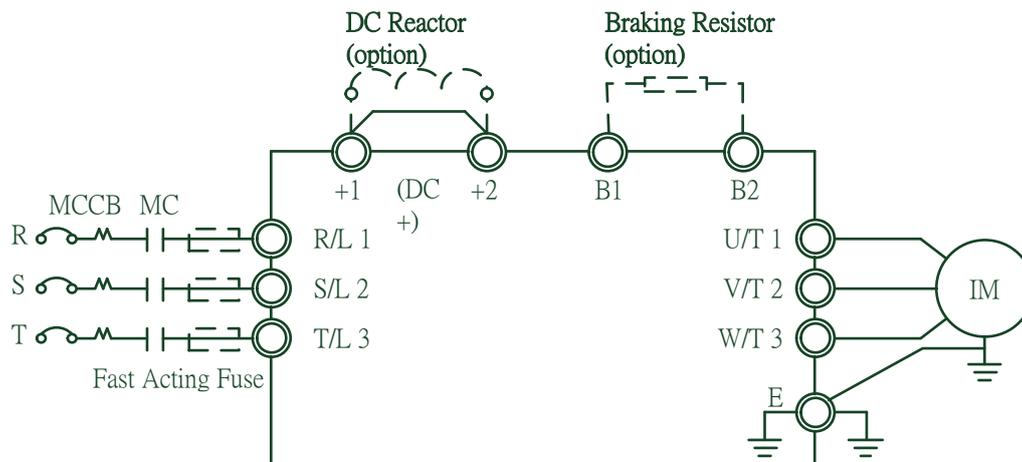


Table 4.2.1 Main Circuit Terminals

Terminal Name	Terminal Description
R/L1, S/L2, T/L3	Power input terminal
U/T1, V/T2, W/T3	Power output terminal
+1, +2 (DC+)	DC reactor terminal. Please remove the jumper before installation
B1, B2	Braking resistor terminal. Select option as per the specifications. (Please refer to Chapter 7.1)
E	Ground terminal

4.2.2 Main Circuit Wiring

4.2.2.1 Power Input Terminal

- Install a molded case circuit breaker (MCCB) between three phase AC input power and main circuit terminals R/L1, S/L2 and T/L3. A magnetic contactor (MC) in series connection is also suggested so as to shut off the power by drive protection functions. Install a R-C varistor on both ends of the MC.
- Ensure main circuit terminal screws are tightened to avoid vibration loosening the screws which could cause electric sparks.

4.2.2.2 Power Output Terminal

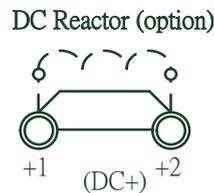
- When connecting a noise filter at AC drive output terminals U/T1, V/T2 and W/T3, always

use an inductive L-filter. Do not install any power capacitor, L-C or R-C filter.

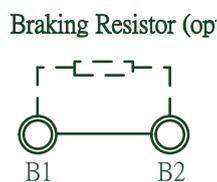
- Connect AC drive output terminals U/T1, V/T2 and W/T3 to motor input terminals U, V and W respectively. Ensure the motor and drive terminals are in same phase sequence or the motor will rotate reversely.
- Do not connect power cable to output terminals of the drive. Failure to comply could cause drive damage and a fire.

4.2.2.3 DC Reactor and Braking Resistor Terminal:

- The terminal is to connect a DC reactor so as to improve power factor. The drive is shipped from the factory with a short-circuit jumper. Remove the jumper before connecting a DC reactor.



- If the drive is used in a high-frequency or heavy duty application which requires frequent braking or shorter deceleration time, install an optional braking resistor to increase the braking torque.



- Please refer to the wiring diagram when installing braking options.

4.2.2.4 Ground Terminal

- Use grounding cables of dimensions regulated by electrical equipment standard. Shrink wiring distance to prevent leakage current resulting unstable electrical potential at the terminal distant from grounding terminal.
- Do not use share the same grounding cable with welding machines or any device requiring large current. Failure to comply could cause drive or equipment malfunction.
- Do not wind the grounding cable when multiple drives are installed. Failure to comply could cause drive or equipment malfunction.
- Ensure the neutral of the input side and drive terminal "  " are grounded

according to the local electrician regulations. TN and TT system are suggested for the drive primary side.

4.2.3 Main Circuit Cable Size and Tightening Torque

Select the cables and crimp terminals according to Table 4.2.2.

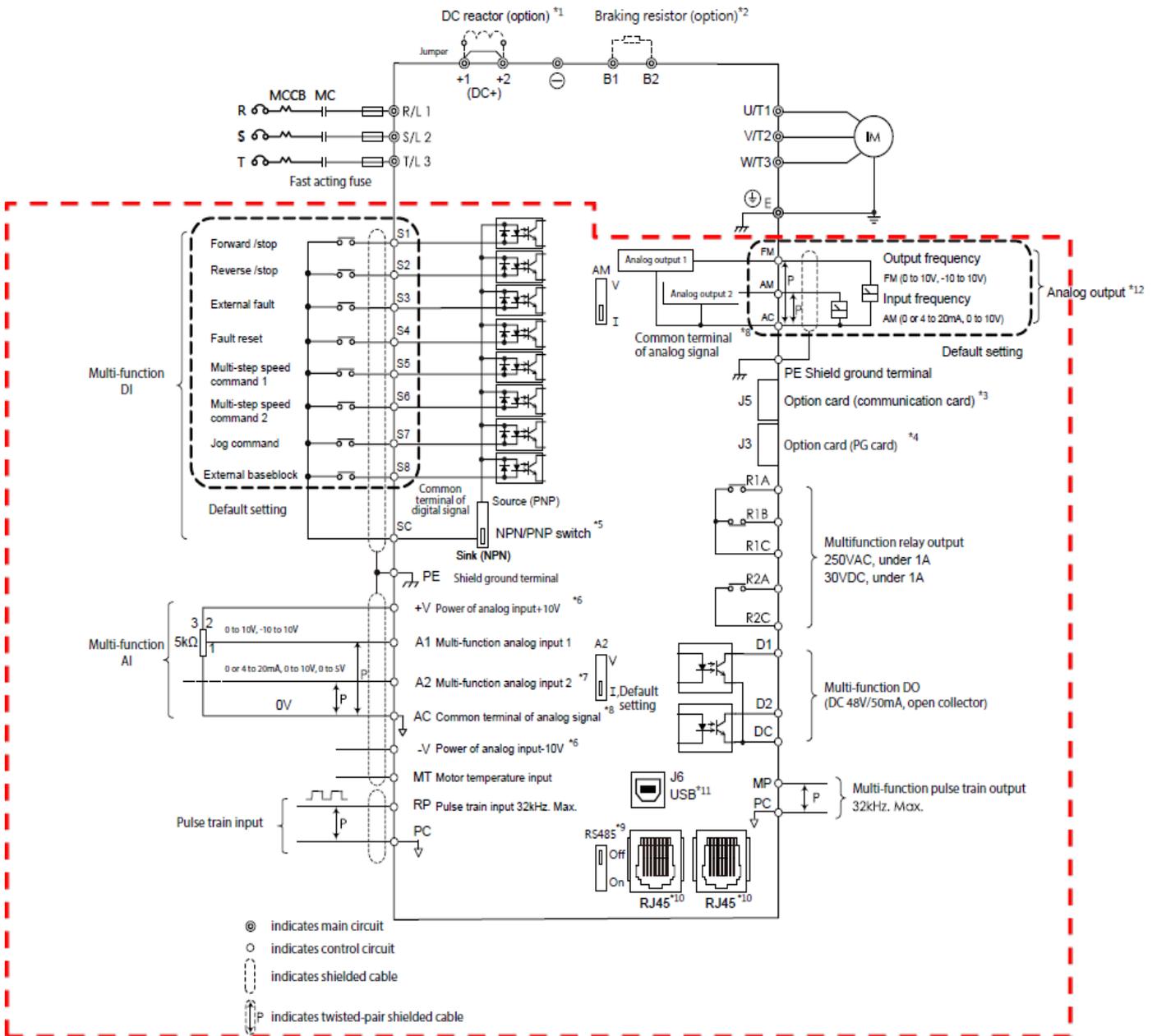
1. The recommended cables are 600 V vinyl-sheathed cables which have continuous temperature tolerance up to 75°C with ambient temperature tolerance up to 40 °C, wiring distance up to 100 meters and conditions suitable for on Normal Duty mode.
2. Terminal +1, +2, B1 and B2 are only for connecting DC reactor and braking resistor options. Do not connect it to other devices.
3. Consider the amount of voltage drop when selecting cable sizes. Increase the cable size when the voltage drop exceeds 2% of the motor rated voltage. The amount of voltage drop can be calculated using the following formula:

$$\text{Line drop voltage (V)} = 3 \times \text{cable resistance } (\Omega/\text{km}) \times \text{cable length (m)} \times \text{current (A)} \times 10^{-3}$$

Table 4.2.2 Cable Size and Tightening Torque (Three-phase 400 V)

Drive Rating	Terminal	Asia		USA		Europe & China		Terminal Screw Thread	Tightening Torque Nm (lb.in.)
		Suggested Cable Size mm ²	Applicable Cable Size mm ²	Suggested Cable Size AWG, kcmil	Applicable Cable Size AWG, kcmil	Suggested Cable Size mm ²	Applicable Cable Size mm ²		
0.75kW to 2.2kW	R,S,T,U,V ,W,PE	2.1	2.1 to 8.4	14	14 to 8	2.1	2.1 to 8.4	M4	1.57 (13.9)
3.7kW to 5.5kW	R,S,T,U,V ,W,PE	5.3	5.3 to 8.4	10	10 to 8	5.3	5.3 to 8.4	M4	1.57 (13.9)
7.5kW to 15kW	R,S,T,U,V, W,PE	13.3	5.3 to 13.3	6	10 to 6	13.3	5.3 to 13.3	M5	3.39 (30)
18.5kW to 30kW	R,S,T,U,V, W,PE	21.2	8.4 to 26.7	4	8 to 3	21.2	8.4 to 26.7	M8	5.65 (50)

4.3 Control Circuit



- J5 is the port for communication option card. Please refer to the instructions during installation.
- J3 is the port for PG feedback option card. Such option card may be needed depending on the control method. Please refer to the instructions during installation.
- Multi-function analog input S1 to S8 can be switched between Sink (NPN) mode and Source (PNP) mode. The default setting is NPN mode.

- +V and -V are for analog auxiliary power. Do not connect +V with -V.
- DIP switch A2 is used to set the analog input type as voltage or current.
- DIP switch AM is used to set the analog output type as voltage or current.
- AC (Analog Common) is the common terminal of analog signal.
- DIP switch RS-485 is used to set RS-485 termination resistor. Switch it ON in the last drive when using a single drive to run more than one motor.
- RJ45 is the communication port for RS-485.
- USB port is used to connect to a PC through a USB cable.
- Analog output is used to connect a frequency meter, current meter, voltage meter and power meter.

4.3.1 Control Circuit Terminals

4.3.1.1 Input Terminals

Table 4.3.1.1 Control Circuit Input Terminal

Terminal Type	Terminal Code	Terminal Name	Terminal Description
Multi-Function Digital Inputs	S1	Digital input terminal 1 (forward/stop)	Photocoupler, 24 V, 8 mA. Use NPN/PNP switch to select multi-function digital input type. The default is NPN mode.
	S2	Digital input terminal 2 (reverse/stop)	
	S3	Digital input terminal 3 (external fault signal 1)	
	S4	Digital input terminal 4 (fault reset)	
	S5	Digital input terminal 5 (multi-step speed 1)	
	S6	Digital input terminal 6 (multi-step speed 2)	
	S7	Digital input terminal 7 (Jog command)	
	S8	Digital input terminal 8 (baseblock command (normal open))	
	SC	Digital input common terminal for NPN/PNP mode switch. Select the mode correctly when connecting.	
Multi-Function Analog Inputs	+V	Auxiliary power terminal +10V	Analog input power+10V
	-V	Auxiliary power terminal -10V	Analog input power-10V
	A1	Analog input terminal 1 (main frequency command)	Voltage input 0 to 10V / -10V to +10V
	A2	Analog input terminal 2	Voltage or current input

		(auxiliary frequency command)	(Selectable). 0 or 4 to 20mA, 0 to 10V, 0 to 5V
	PE	Ground terminal	The ground terminal for control signals to avoid interference. Use shielded cables only.
	AC	Common terminal for analog signals	
	MT	Motor temperature signal terminal	Connects the temperature sensor of AC motor for the drive to know the motor temperature and trigger necessary protections.
Pulse Train Inputs	RP	Pulse train input (frequency command)	Input frequency up to 32KHz
	PC	Common terminal for pulse train signals	

4.3.1.2 Output Terminals

Table 4.3.1.2 Control Circuit Output Terminals

Terminal Type	Terminal Code	Terminal Name	Terminal Description
Multi-Function Relay Output	R1A	Relay 1 normal open	Relay output DC 30 V, 3 A AC 250 V, 5 A
	R1B	Relay 1 normal closed	
	R1C	Relay 1 common	
	R2A	Relay 2 normal open	
	R2C	Relay 2 normal closed	
Multi-Function Photocoupler Output	D1	Photocoupler Output terminal 1 (zero speed)	Photocoupler Output 48 V, 2 to 50 mA
	D2	Photocoupler Output terminal 2 (speed agree)	
	DC	Photocoupler Output terminal	
Multi-Function Analog Output	FM	Programmable analog output terminal (output frequency)	Voltage Output 0 to 10V, -10 to +10V
	AM	Multi-function analog output terminal (output current)	Voltage or current output (Selectable) 0 or 4 to 20mA, 0 to 10V
	AC	Analog common terminal	
Multi-Function Pulse Train Output	MP	Multi-function pulse train output (output frequency)	32KHz Max
	PC	Pulse train common terminal	

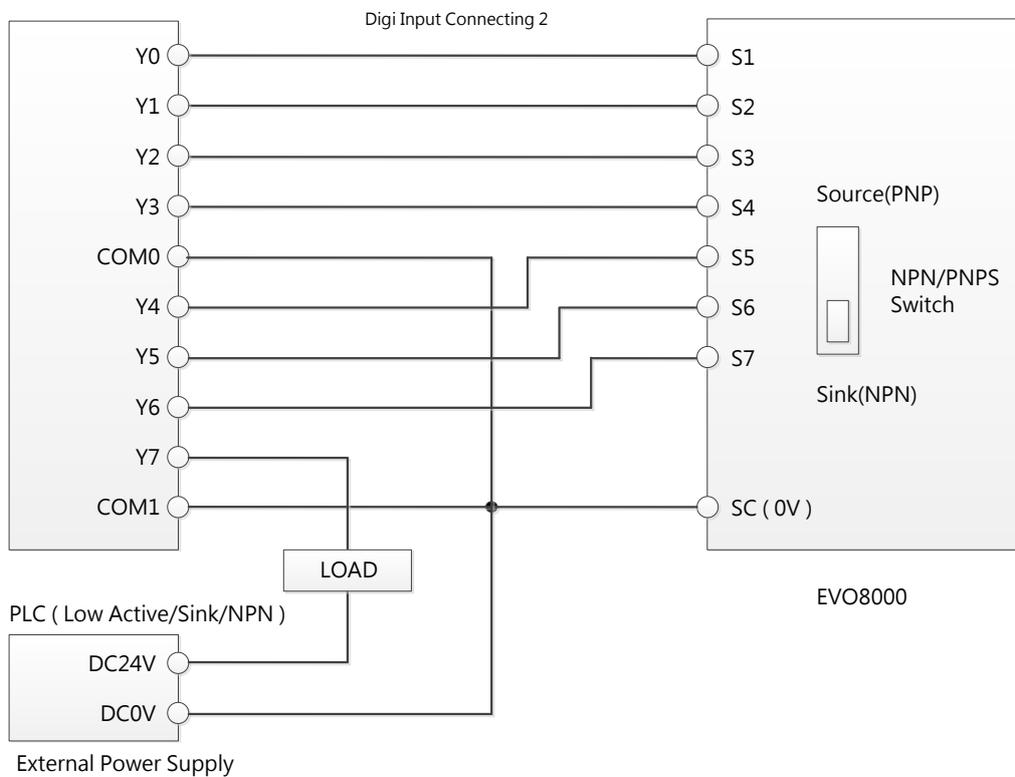
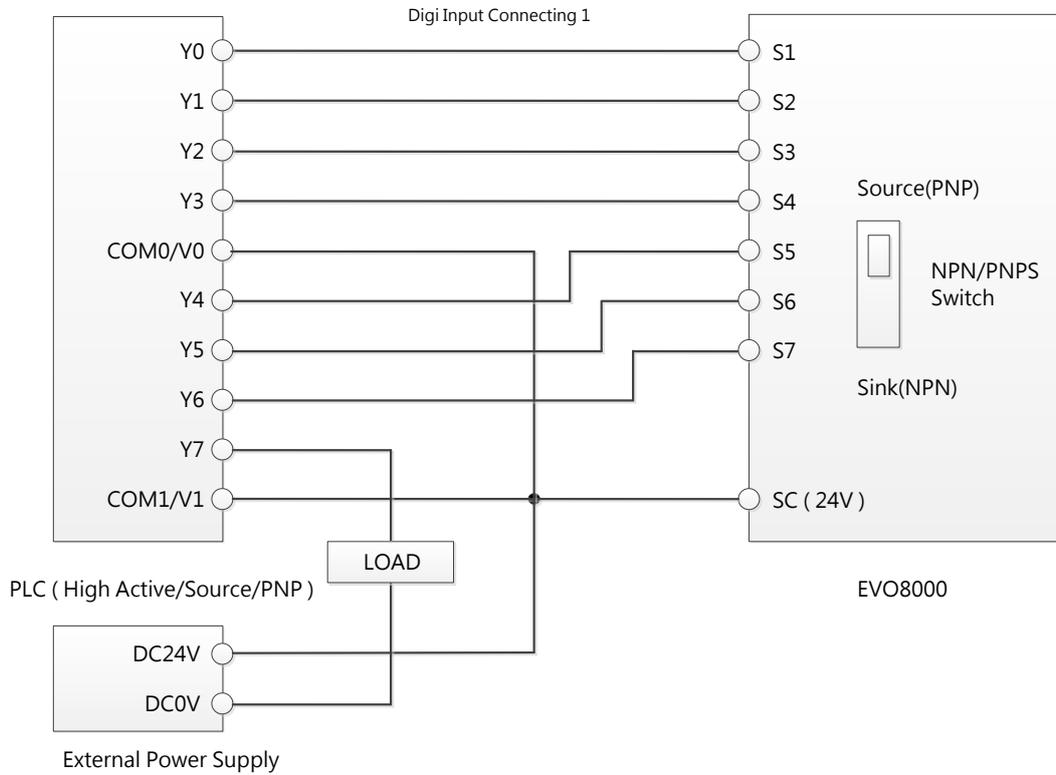
<1> Do not assign frequent switching functions such as ON/OFF to terminals R1 and R2, which may shorten the relay terminal life.

4.3.2 Control Circuit Wiring

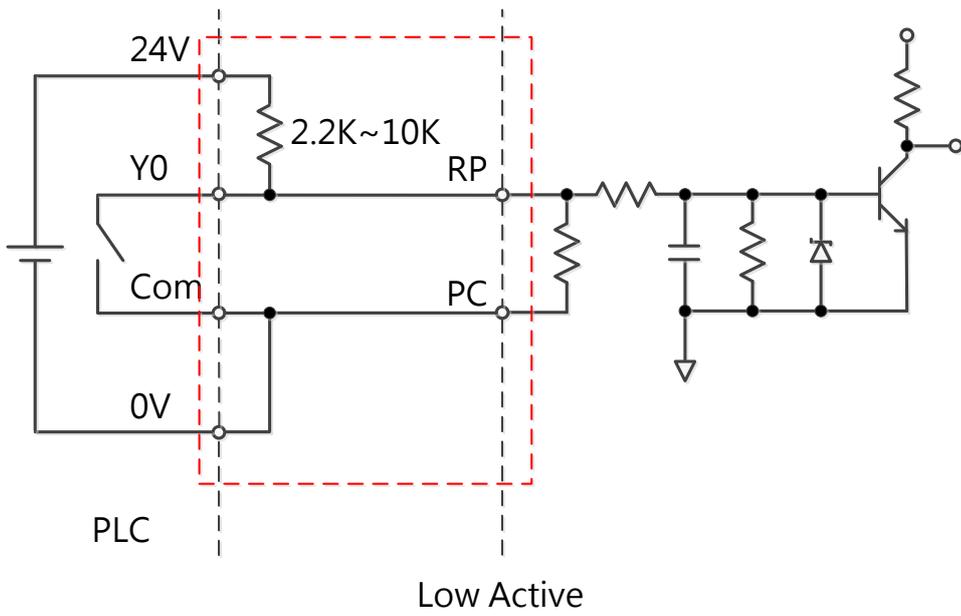
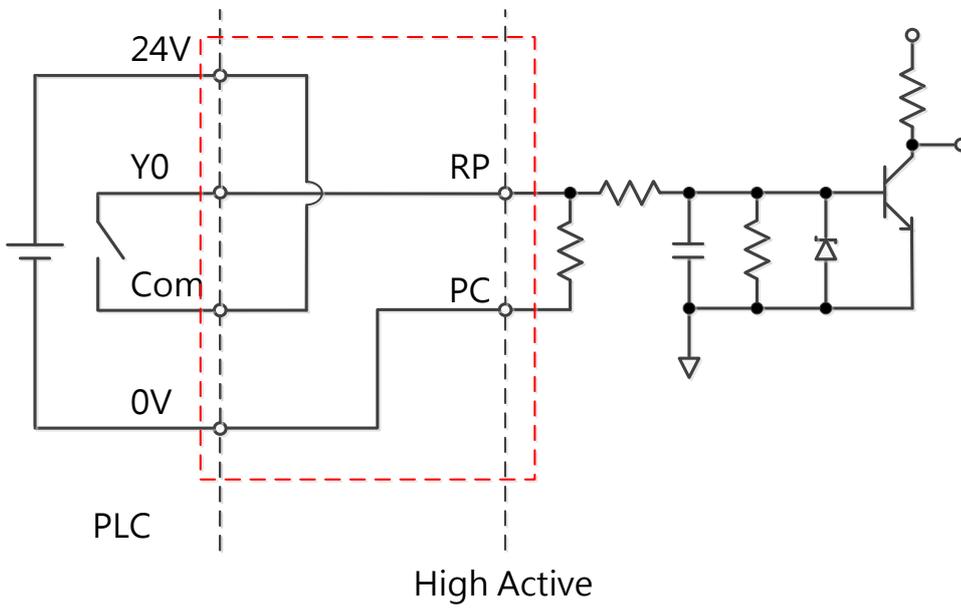
The applicable functions in parameter Group E can be assigned to multi-function digital inputs (S1 to S8), multi-function relay outputs (R1, R2), multi-function digital outputs (D1, D2), multi-function analog input (A1, A2) and multi-function analog output (FM, AM). The default settings are listed in Figure 4.3.1.1 and Figure 4.3.1.2.

- For safety, always check the emergency stop operation after wiring. Emergency stop circuit is necessary to stop the drive immediately in a safe manner to prevent any injuries.
- Do not remove the drive covers or touch the circuit boards when the power is on. Failure to comply could cause electrical shocks to personnel.
- Separate control circuit wiring from main circuit wiring and other power lines. Failure to comply could cause drive malfunction.
- Insulate shielded cable with tape to avoid contact with equipment and other signal lines. Improper insulation could cause drive or equipment malfunction.
- Always use shielded twisted-pair cables to prevent drive and equipment malfunction cause by electrical interference.
- Ground the shield to the ground terminal of drive. Failure to comply could cause erroneous operation or damage to the drive and equipment. Wire ground terminal and main circuit terminals before wiring control circuit terminals.

4.3.2.1 Digi Input Connecting



4.3.2.2 Pulse Input Connecting



4.3.3 Control Circuit Cable Size and Tightening Torque

Select the cable according to Table 4.3.3.1. Use crimp ferrules on the cable ends for simpler and more reliable wiring.

Table 4.3.3.1 Cable Size and Tightening Torque

Terminal	Screw Size	Tightening Torque Nm (lb.in.)	Bare Cable		Ferrule-Type Terminal		Cable Type
			Applicable Size mm2 (AWG)	Suggested Size mm2 (AWG)	Applicable Size mm2 (AWG)	Suggested Size mm2 (AWG)	
S1, S2, S3, S4, S5, S6, S7, S8, SC, -V, +V, A1, A2, AC, FM, AM, AC, MT, RP, PE, DC, D1, D2	M2	0.23 (2.0)	0.13 to 1.31 (26 to 16)	0.13 (26)	0.13 to 0.33 (26 to 22)	0.13 (26)	Shielded cable, etc.
R1A, R1B, R1C, R2A, R2C	M2.6	0.59 (5.2)	0.13 to 2.08 (26 to 14)	0.13 (26)	0.13 to 0.33 (26 to 22)	0.13 (26)	Shielded cable, etc.

4.3.4 Ferrule-Type Terminals

Always use ferrule-type terminals with insulated sleeves. Refer to Table 4.3.3.2. for dimensions. In addition, crimping tool CRIMPFOX ZA-3 manufactured by Phoenix Contact is recommended.

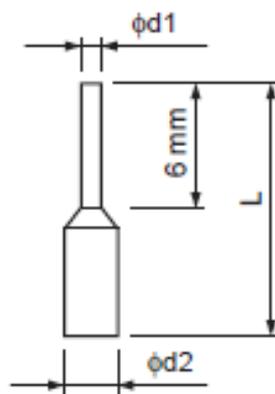


Table 4.3.3.2 Ferrule-Type Terminal Models and Sizes

Cable Size mm2 (AWG)	Type	L (mm)	d1 (mm)	d2 (mm)	Manufacturer
0.25 (24)	AI 0.25-6YE	10.5	0.8	2	Phoenix Contact
0.34 (22)	AI 0.34-6TQ	10.5	0.8	2	Phoenix Contact
0.5 (20)	AI 0.56-WH	14	1.1	2.5	Phoenix Contact

4.4 I/O Connections

4.4.1 NPN and PNP Mode Selection

Use Sink/Source DIP switch on the control board to set NPN/PNP mode for multi-function digital inputs S1 to S8. (Default: NPN mode)

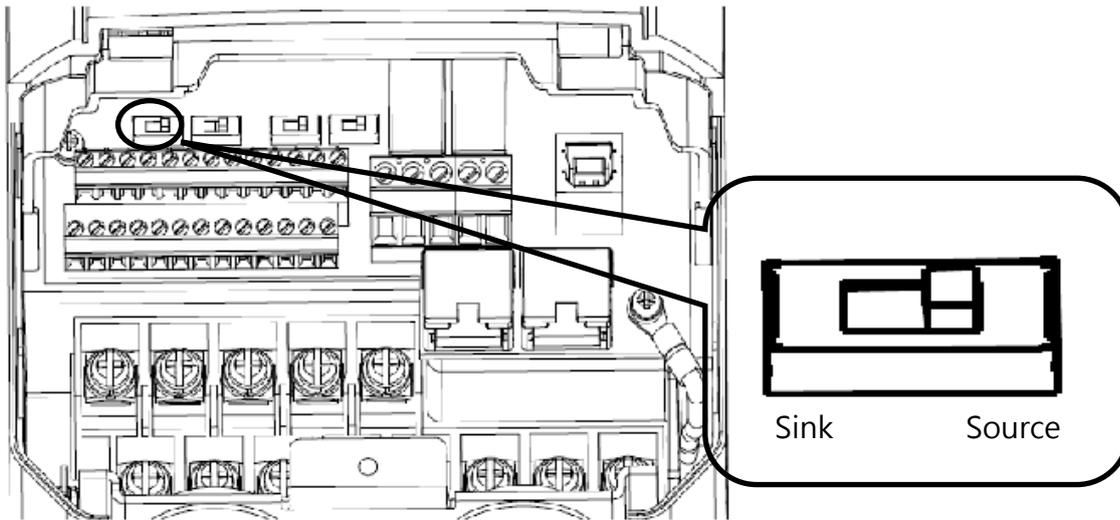


Figure 4.4.1 Sink/Source DIP Switch

4.4.2 Terminal A2 Voltage/Current Input Selection

Select voltage or current input at terminal A2

- To select current as the input type, set DIP switch A2 to I and set parameter E3-06 to 0 (0 to 20 mA) or 1 (4 to 20 mA).
- To select voltage as the input type, set DIP switch A2 to V and set parameter E3-06 to 2 (0 to 10 V) or 3 (0 to 5 V).

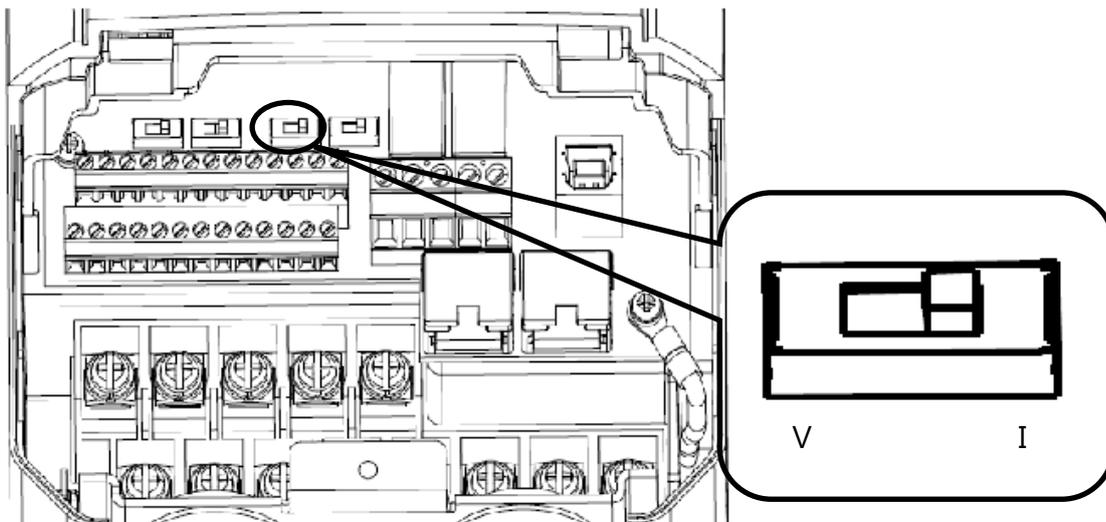


Figure 4.4.2 DIP Switch A2

Table 4.4.1 DIP Switch A2 Settings (Terminal A2)

Setting	Description
V	Voltage input (0 to 10 V or 0 to 5 V)
I	Current input (4 to 20 mA or 0 to 20 mA) (default)

Table 4.4.2 Parameter E3-06

No.	Parameter Name	Description	Setting Range	Default
E3-06	Terminal A2 Signal Level Selection	Selects the signal level for terminal A2. 0: 0 ~ 20 mA 1: 4 ~ 20 mA 2: 0 ~ 10 V 3: 0 ~ 5 V	0, 1, 2, 3	1

4.4.3 Terminal AM Voltage/Current Output Selection

Select voltage or current output type for terminal AM

- To select voltage as the output type, set DIP switch AM to V and set parameter E4-04 to 0 (0 to 10 V).
- To select current as the output type, set DIP switch AM to I and set parameter E4-04 to 1 (0 to 20 mA) or 2 (4 to 20 mA).

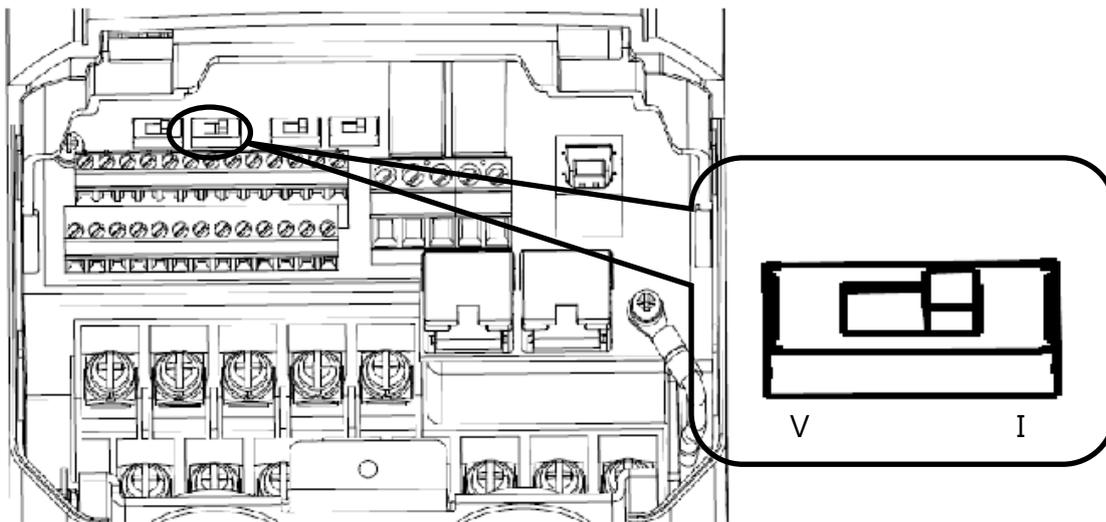


Figure 4.4.3 DIP Switch AM

Table 4.4.3 DIP Switch AM Setting (Terminal AM)

Setting	Description
V	Voltage output (0 to 10 V)
I	Current output (4 to 20 mA or 0 to 20 mA) (default)

Table 4.4.4 Parameter 4-04

No	Parameter Name	Description	Setting Range	Default
E4-04	Terminal AM Signal Level Selection	Selects the signal level for terminal AM 0 : 0 to 10 V 1 : 0 to 20 mA 2 : 4 to 20 mA	0, 1, 2	2

4.4.4 RS-485 Communication Termination ON / OFF Switch

The default of termination resistor for RS-485 communication is OFF. Switch it to ON when the drive is the last in a series of slave drives. Set this termination resistor on DIP switch RS485 illustrated in Figure 4.4.4.

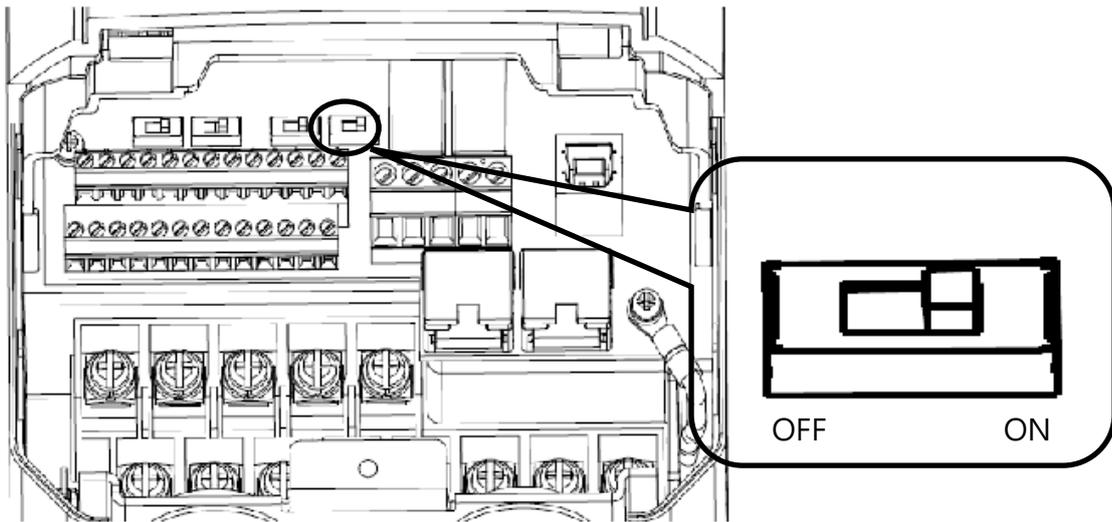


Figure 4.4.4 DIP Switch RS-485 Termination Resistor

4.5 Connection to PC

The drive is equipped with a USB port. The drive can connect to a PC through USB cable to manage parameter settings using LiteOn PC software.

Note: When USB connection is detected, the communication will be automatically switched from RS485 to USB, and return to RS-485 when USB is disconnected.

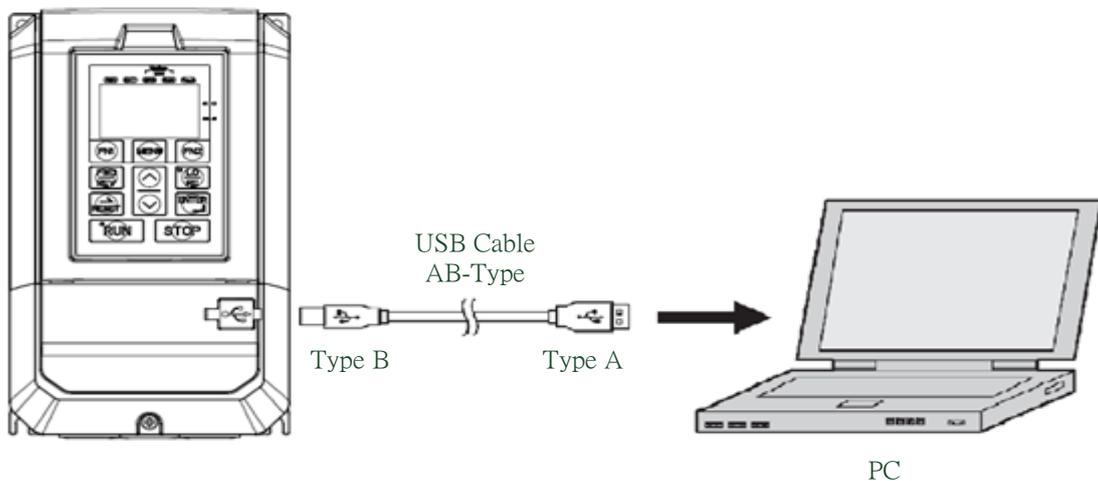
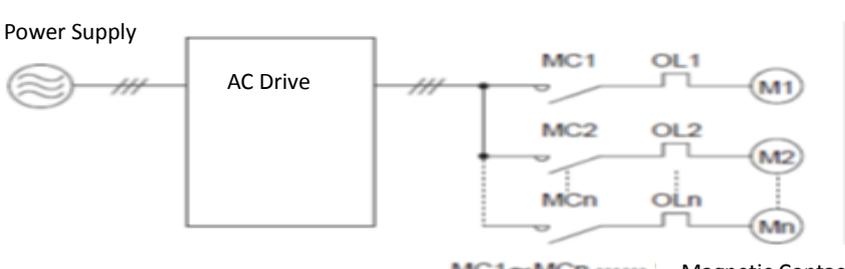


Figure 4.5 Connection to PC

4.6 Wiring Checklist

Table 4.6 Wiring Checklist

<input type="checkbox"/>	No.	Item	Page
Power Supply Voltage and Output Voltage			
<input type="checkbox"/>	1	Power supply voltage is within the voltage range of specified drive input.	
<input type="checkbox"/>	2	The motor voltage matches the drive output specifications.	
<input type="checkbox"/>	3	The drive rating matches the motor rating.	
Main Circuit Wiring			
<input type="checkbox"/>	4	An MCCB of proper specifications is connected between the drive and motor.	
<input type="checkbox"/>	5	Power cables are correctly connected to drive input terminals R/L1, S/L2 and T/L3.	
<input type="checkbox"/>	6	Motor terminals and drive terminals U/T1, V/T2 and W/T3 are in same phase sequence. (Otherwise the motor will rotate reversely)	
<input type="checkbox"/>	7	Power supply and motor power cable complies with electrician regulations.	
<input type="checkbox"/>	8	The drive is properly grounded.	
<input type="checkbox"/>	9	Drive terminal screws of the main circuit and ground are tightened.	
<input type="checkbox"/>	10	<p>An MC is installed for each motor if a single drive runs more than on motor.</p>  <p>Note: Set MC1 to MCn OFF before operating the drive. Do not switch MC1 to MCn ON or OFF during run.</p>	
<input type="checkbox"/>	11	When using a braking resistor or braking unit, an MC is installed on the drive input side and able to shut off the power to drive when overloaded.	
Control Circuit Wiring			
<input type="checkbox"/>	12	Twisted-pair cables are used for all drive control circuit wiring.	
<input type="checkbox"/>	13	Shielded cables are connected to the terminals.	
<input type="checkbox"/>	14	Options (if any) are properly installed.	
<input type="checkbox"/>	15	No wiring mistakes.	
<input type="checkbox"/>	16	Do not use a buzzer to check wiring.	
<input type="checkbox"/>	17	The control circuit terminal screws are tightened.	
<input type="checkbox"/>	18	No cable clippings or screws are left inside the drive enclosure.	
<input type="checkbox"/>	19	Control circuit wiring and main circuit wiring are separated.	

Chapter 5 | Keypad

5.1 Check before Operation

- Make sure the main circuit is properly wired. R/L1, S/L2 and T/L3 are power input terminals which cannot be mixed with U/T1, V/T2, W/T3. Failure to comply could cause damage to the AC drive.
- Make sure the ground terminal is properly wired.
- Make sure the drive capacity matches the related parameter settings.
- Do not use the drive with wet hands.
- Check the connected machinery status before Auto-Tuning to ensure personnel safety.
- Drives could increase the motor speed rapidly. Ensure appropriate speed tolerance for the motor and machinery.
- When using options such as a braking unit, always follow its instructions.
- Drives can only operate in environment with -10°C to +50°C, below 90% RH and free from condensation, metal shavings or liquid.

5.2 Powering Up the Drive and Operation Status Display

- Power Up

Check the following table before applying the power supply.

Table 5.2.1 Check List before Power Up

Item to Check	Description
Power supply voltage	400 V : Three-phase AC 380 V to 480 V, 50/60 Hz
	Properly wire the power input terminals R/L1, S/L2 and T/L3.
	Ensure proper grounding of AC drive and motor.
Status of drive output terminals and motor terminals	Ensure the drive output terminals (U/T1, V/T2 and W/T3) are wired properly with motor terminals (U, V and W).
Status of control circuit terminals	Ensure the drive control circuit terminals are wired properly with other control device.
Status of drive control terminals	Ensure all the drive control circuit terminals are open.
Status of the load and connected machinery	Check if the motor is connected to the machinery.

- Operation Status Display

When the power is switched on, the keypad monitor will display as the following.

Table 5.2.2 Operation Status Display

Status	Name	Description
Normal		The LED monitor displays the current frequency or speed.
Fault		The LED monitor displays the fault code. Refer to Chapter 8 for instructions. The Fault LED is lit.

5.3 Keypad

Use the keypad to enter RUN and STOP commands, display data, fault, alarm and set parameters.

5.3.1 Keys and Displays

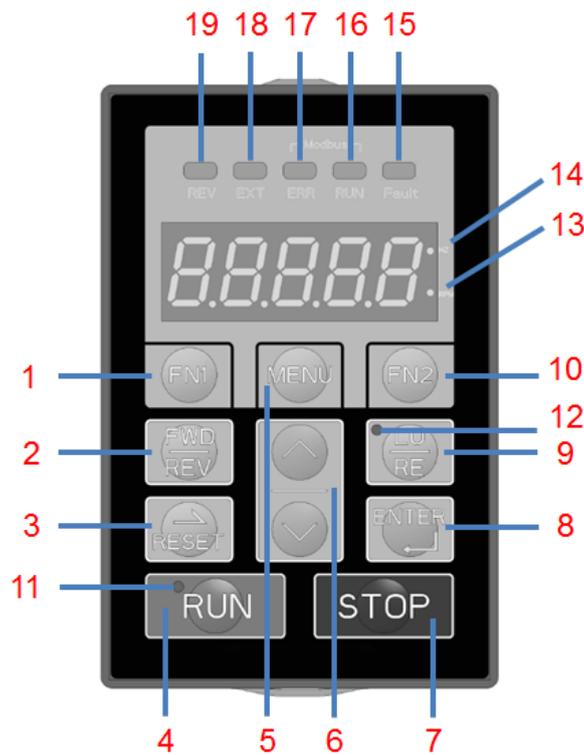
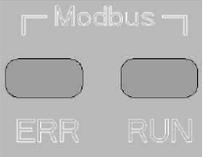
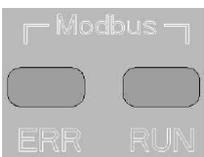
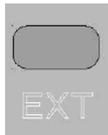


Figure 5.3.1 Keypad

Table 5.3.1 Keypad Keys and Displays

No	Display	Name	Function
1		FN1 Key	User-defined function key for Quick Setting Mode
2		FWD/REV Key	Forward/reverse selection
3		RESET Key	<ul style="list-style-type: none"> ■ Moves the cursor to the right ■ Resets the drive to clear a fault situation
4		RUN Key	Runs the drive
5		MENU Key	<ul style="list-style-type: none"> ■ Enters or exits the parameter group ■ Switches the displayed menu
6		UP/DOWN Key	Selects parameter numbers, increments and decrements setting value and frequency
7		STOP Key	Stops the drive
8		ENTER Key	<ul style="list-style-type: none"> ■ Enters parameter value, parameter and setting ■ Enters parameter setting menu.
9		LO/RE Selection Key	Switches drive control between the keypad (LOCAL) and an external source (REMOTE)
10		FN2 Key	Retain
11		RUN Light	Refer to Table 5.3.2.2
12		LO/RE Light	Refer to Table 5.3.2.2
13		RPM Light	Refer to Table 5.3.2.2
14		Hz Light	Refer to Table 5.3.2.2
15		Fault Light	Refer to Table 5.3.2.2

16	 <p>The image shows a rectangular panel with the word 'Modbus' at the top. Below it are two indicator lights. The left light is labeled 'ERR' and is unlit. The right light is labeled 'RUN' and is lit (glowing).</p>	Modbus Light RUN	Refer to Table 5.3.2.2
17	 <p>The image shows a rectangular panel with the word 'Modbus' at the top. Below it are two indicator lights. The left light is labeled 'ERR' and is lit (glowing). The right light is labeled 'RUN' and is unlit.</p>	Modbus Light ERR	Refer to Table 5.3.2.2
18	 <p>The image shows a rectangular panel with a single indicator light labeled 'EXT' which is lit (glowing).</p>	EXT Light	Refer to Table 5.3.2.2
19	 <p>The image shows a rectangular panel with a single indicator light labeled 'REV' which is lit (glowing).</p>	REV Light	Refer to Table 5.3.2.2

5.3.2 Keypad Display

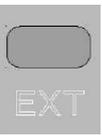
5.3.2.1 LED Display.

Table 5.3.2.1 LED Display

Number /Letter	LED Display	Number /Letter	LED Display	Number /Letter	LED Display	Number /Letter	LED Display
0		9		i		r	
1		A		J		S	
2		b		K	Nil	t	
3		c		L		U	
4		d		M	Nil	v	
5		E		n		W	Nil
6		F		o		X	Nil
7		G		P		y	Nil
8		H		q	Nil	Z	Nil

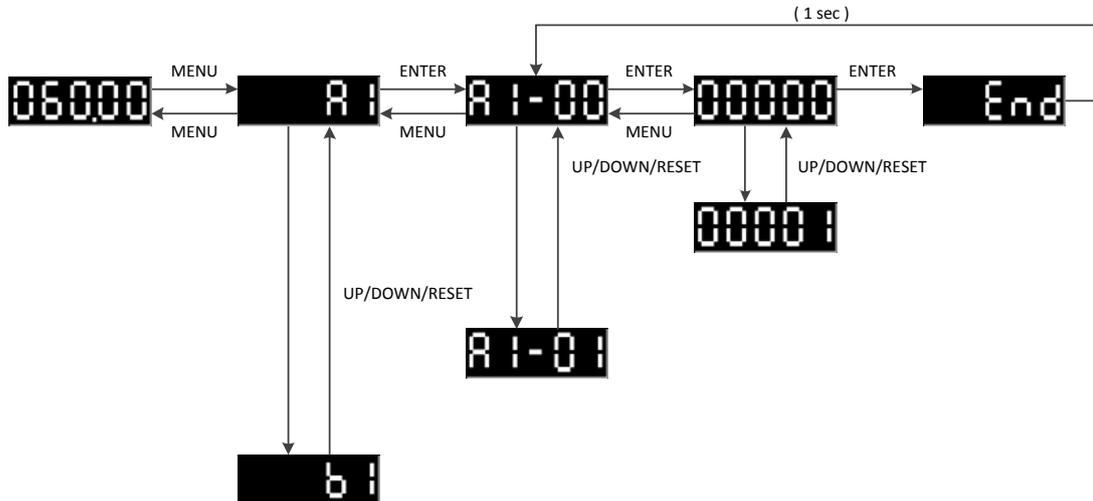
5.3.2.2 LED Indication

Table 5.3.2.2 LED Indication

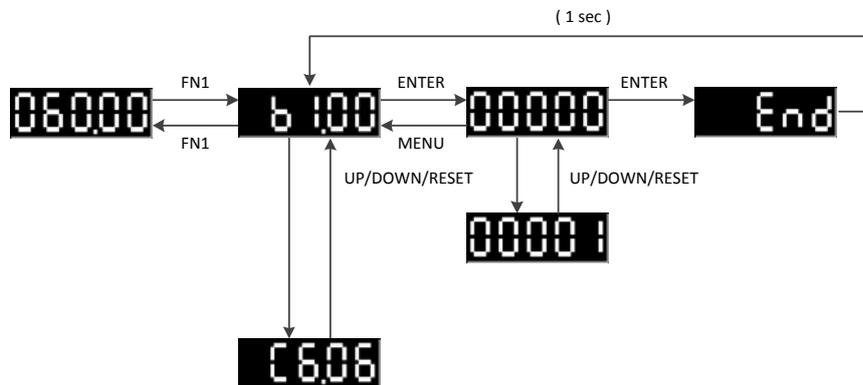
Indicator Light	Lit	Blinking	Off
	Drive in operation	<ul style="list-style-type: none"> ■ Drive in deceleration ■ Output frequency below the minimum frequency 	Drive not in operation
	Control from Local	Nil	Control from Remote
	Displaying output speed	Nil	Nil
	Displaying output frequency	Nil	Nil
	During fault	Nil	Normal operation
	Communication connected	Nil	Nil
	Communication error	Nil	Nil
	Frequency or run commands allowed only from a remote source	Nil	Frequency or run commands allowed only from keypad
	Rotating reversely	Nil	Nil

5.3.3 Keypad Programming

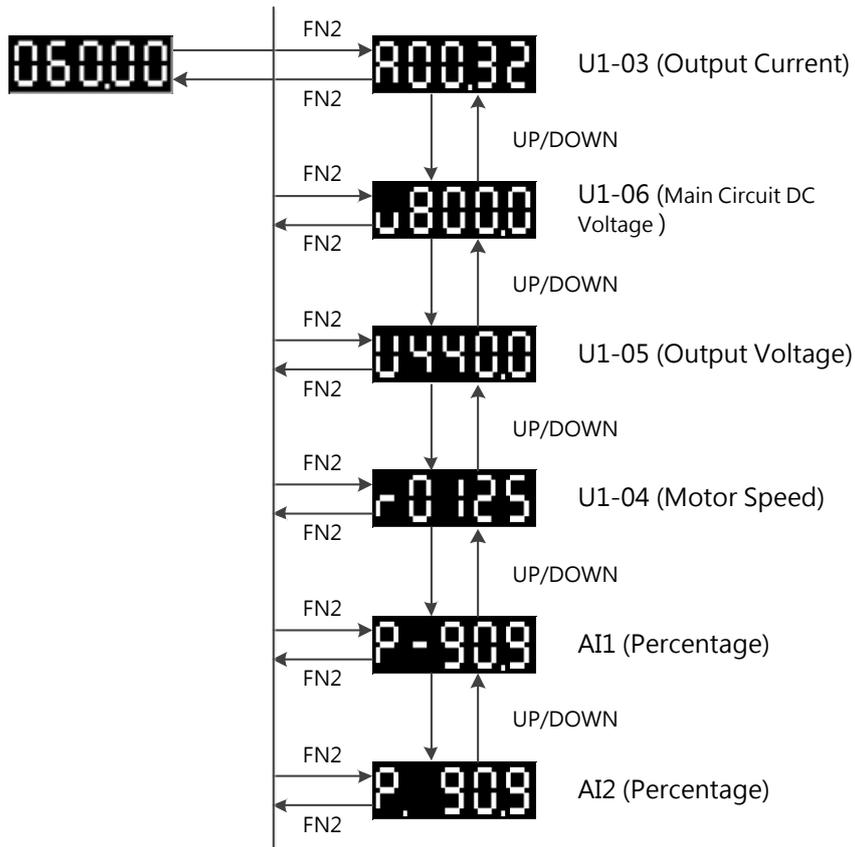
- Keypad Display Menu Structure
- Standard setting mode: Press MENU to enter or exit the parameter group. Press ENTER, MENU, UP, DOWN and RESET to monitor and edit settings.



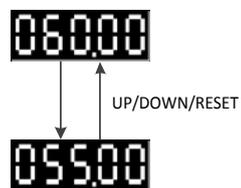
- Quick setting mode: User must assign the function to the FN1 key in advance so as to quickly set the parameter by pressing FN1 key.



- Quick monitor mode: Press FN2 key to quickly monitor part of the parameters and press UP and Down key to switch the parameter.



- During-operation setting mode: Drive frequency is adjustable during operation in Local mode



Chapter 6 | Parameters

6.1 Group A, Initialization

Sets the initial parameters (group A parameter) such as Access Level Selection, password and etc.

A1 Initialization

■ A1- 00 Retain

■ A1- 01 Access Level Selection

Selects access level (edit/ view)

No.	Name	Setting Range	Default
A1-01	Access Level Selection	0, 1, 2	2

0 : View Only

Access to only parameter A1-01

1 : User-Defined Parameter Access

Access to only parameter A1-01 and A2-00 to A2-31

2 : All Parameter Access

All parameters can be edited and viewed

Note:

- Once the password is set to A1-05, user cannot edit A1-01, A1-03, A1-06, A2-01 to A2-32 before entering the correct password in A1-04.
- Once E1-□□= 60 (Program Lockout) is set, user cannot edit any parameters before closing the assigned terminal, even when A1-01 = 1 or 2.
- When using Modbus communication to edit parameters, it is not possible to edit parameters via keypad until an ENTER command is given to the drive from the communication.

■ A1- 02 Control Method Selection

No.	Name	Setting Range	Default
A1-02	Control Method Selection	0 to 6	0

0 : Open-Loop V/F Control

This method is recommended for those applications without the need of fast response, accurate speed control. Select this method also when using a single drive to run more than one motors, the motor parameters are unknown or Auto-Tuning cannot be performed. The speed control range is 1 : 40.

1 : Closed-Loop V/F Control

This method is recommended for those applications which require high speed accuracy without the need of fast response during speed adjustment. Use this method when the motor parameters are unknown or Auto-Tuning cannot be performed. The speed control range is 1 : 40.

2 : Open-Loop Vector Control

This method is recommended for those applications which require accurate speed control, high torque at low speed and quick torque response without any speed feedback signal from the motor during speed adjustment. The speed control range is 1 : 200.

3 : Closed-Loop Vector Control

This method is recommended for those applications which require accurate speed control even at zero speed, accurate torque control and quick torque response with speed feedback signals from the motor during speed adjustment. The speed control range is 1 : 1500.

4 : PM Open-Loop Vector Control

This method is recommended for those applications of derated-torque purpose to achieve the energy saving characteristic of PM motors. Use this method to control an IPM and SPM motor with a speed control range of 1 : 20.

5 : PM Closed-Loop Vector Control

This method is recommended for those applications which require accurately constant torque, quick torque response and advanced torque control during speed adjustment. The option PG card is required to receive speed signals from the motor. The speed control range is 1 : 1500.

6 : Closed-Loop Torque Control

This method is recommended for those applications which require quick torque response and advanced torque control during speed adjustment using an asynchronous motor. The option PG card is required to receive speed signals from the motor.

■ A1-03 Reset

Resets parameter settings to default settings. After resetting parameters, the value will

automatically set to 0.

No.	Name	Setting Range	Default
A1-03	Reset	0 to 9999	0

0: N/A

2538: Resets 2-Wire Sequence/ 50Hz / 380V

2541: Resets 2-Wire Sequence / 50Hz / 415V

2544: Resets 2-Wire Sequence / 50Hz / 440V

2546: Resets 2-Wire Sequence / 50Hz / 460V

2638: Resets 2-Wire Sequence / 60Hz / 380V

2641: Resets 2-Wire Sequence / 60Hz / 415V

2644: Resets 2-Wire Sequence / 60Hz / 440V

2646: Resets 2-Wire Sequence / 60Hz / 460V

3538: Resets 3-Wire Sequence / 50Hz / 380V

3541: Resets 3-Wire Sequence / 50Hz / 415V

3544: Resets 3-Wire Sequence / 50Hz / 440V

3546: Resets 3-Wire Sequence / 50Hz / 460V

3638: Resets 3-Wire Sequence / 60Hz / 380V

3641: Resets 3-Wire Sequence / 60Hz / 415V

3644: Resets 3-Wire Sequence / 60Hz / 440V

3646: Resets 3-Wire Sequence / 60Hz / 460V

Note:

- The parameter listed in Table 6.1 will not be reset when setting 2220 or 3330 to A1-03.
- A1-02 (Control Method Selection) will not be reset when setting 2220 or 3330 to A1-03.

Table 6.1 Parameters Not Subject to Reset

NO.	Name
A1-00	Retain
A1-02	Control Method Selection

A1-06	ND/HD Selection
d1-01	V/F Pattern Selection
d3-00	Retain
E6-05	Retain
P7-12	Installation Method Selection
o2-03	Drive Capacity Selection

■ A1- 04/ A1- 05 Password

Set password to parameter A1-05 and enter the password to parameter A1-04 to unlock it.

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

■ Password and Password Setting

- Once the password other than 0000 is set to A1-05, user cannot edit A1-01 to A1-03, A1-06, A2-01 to A2-32. Enter the correct password in A1-04 to unlock parameter access.
- A1-04 will display " nULL" if password has never been set. The user can only set the password (A1-05). Once the password is set, A1-05 will display " LtH" . The user can only enter the set password (A1-04).

Follow the steps to set the password and enter password:

Table 6.2.1 Password Setting Steps

Step			
1	Turn on the power to the drive. The initial display appears.	➔	050.00
2	Press  and select A1-04.	➔	A 1-04
3	Press  to display A1-04 setting. "nULL" is displayed as the password has never been set.	➔	nULL
4	Press  to select A1-05.	➔	A 1-05
5	Press  to display A1-05 setting.	➔	00000
6	Press  or  to set the password. (1234 is an example)	➔	0 1234

7	Press  to display A1-05 setting.	→	
8	" LtH" is displayed when entering A1-05 setting.	→	

Table 6.2.2 Password Entering Steps

Step			
1	Press  and select A1-04.	→	
2	Press  to enter A1-04 setting. "nULL" is not displayed anymore as the password has been set.	→	
3	Press  or  to enter the correct password. (1234 is an example)	→	
4	The display leaves A1-04 setting automatically as the parameters are unlocked.	→	

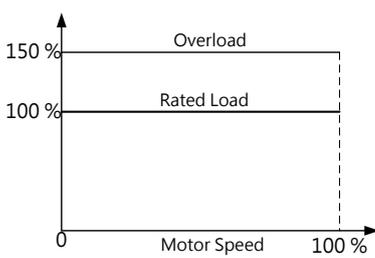
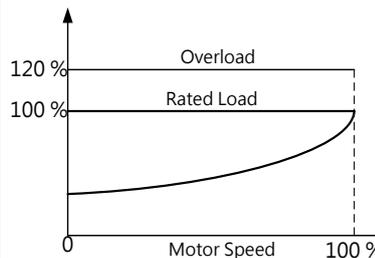
■ A1- 06 ND/HD Selection

The drive has two duty modes for the load characteristics, heavy duty (HD) mode and normal duty (ND) mode. The drive rated current and overload tolerance will change based on the duty mode selection. Choose the suitable mode in A1-06 according to the application.

The HD mode provides 150% overload for 1 minute whereas the ND mode provides 120% overload for 1 minute. Refer to the drive specifications for details.

No.	Name	Setting Range	Default
A1-06	ND/HD Selection	0, 1	0 (HD)

Table 6.3 Differences between Heavy Duty and Normal Duty

Characteristics	Heavy Duty Rating (HD)	Normal Duty Rating (ND)
A1-06	0	1
Performance		
Suitable Applications	Applications which require a high	Applications which do not require a

	overload tolerance at start, during acceleration or deceleration such as extruders and cranes.	high overload tolerance such as fans and pumps.
Overload Tolerance (oL2)	150% for 1 minute	120% for 1 minute
Stall Prevention during Acceleration (P3-01)	150%	120%
Stall Prevention during Run (P3-06)	150%	120%
Carrier Frequency	8 kHz	2 kHz Swing PWM

Note: Changing the duty mode automatically changes the maximum motor rating that the drive can run, defaults of d2-□□ and parameters related to the motor rating.

A2 User-Defined Parameters

■ A2- 00 to A2- 31 User-Defined Parameters 1 to 32

Selects up to 32 parameters and assigns them to parameter A2-00 to A2-31.

No.	Name	Setting Range	Default
A2-00 to A2-31	User-Defined Parameters 1 to 32	A1-00 to F1-18	

■ Recently Edited Parameter Save

Saved parameters can be viewed in User-Defined Parameter Access. To assign specific parameters to A2-00 to A2-31, set parameter A1-01 to 2. The saved parameters A2-00 to A2-31 can only be viewed if A1-01 is set to 1.

■ A2-32 User-Defined Parameter Automatic Save

Enables or disables the automatic save for A2-16 to A2-31.

No.	Name	Setting Range	Default
A2-32	User-Defined Parameter Automatic Save	0, 1	1

0 : Enabled

Sets A2-32 to 0 to save the parameter manually.

1 : Disabled

Automatically saves the most recently edited parameters started from A2-16 to A2-31 (maximum 16 parameters). When the edited parameters are more than 16, only the most recent 16 parameters will be saved while the old ones will be removed.

6.2 Group b, Application

b1: Operation Mode Selection

■ b1- 00 Frequency Command Selection 1

Selects the frequency command source for the REMOTE mode.

Note:

- When the run command is input with 0 Hz frequency command or below the minimum frequency, the RUN LED will blink.
- Press  to switch the frequency command source to LOCAL even if b1-00 is not set to 0 (Keypad).

No.	Name	Setting Range	Default
b1-00	Frequency Command Selection 1	0 to 4	1

0 : Keypad

Allows two ways to input the frequency command.

- Switching between the multi-step speed command in parameters L1-□□.
- Entering the frequency command on the keypad.

1 : Control Circuit Terminal (Analog Input)

Allows a voltage or current input as analog frequency command from terminal A1 and A2.

□ Voltage Input

Allows a voltage signal input via terminals A1 and A2. Refer to Table 6.4 for parameter settings.

Table 6.4 Frequency Command Using Voltage Signals

Terminal	Signal Level	Parameter Settings				Notes
		Signal Level Selection	Function Selection	Gain	Bias	
A1	0 to 10 V	E3-00 = 0	E3-01 = 0 (Main Frequency Command)	E3-02	E3-03	
	-10 to 10 V	E3-00 = 1				
A2	0 to 10 V	E3-06 = 2	E3-07 = 0 (Main Frequency Command)	E3-08	E3-09	Ensure DIP switch A2 is placed to V (voltage)
	0 to 5 V	E3-06 = 3				

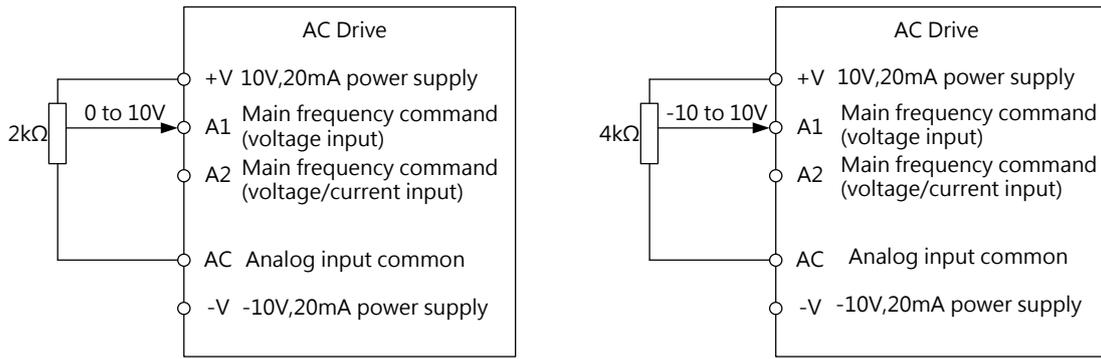


Figure 6.1 Setting Frequency Command as a Voltage Signal at Terminal A1

Wire all the analog input terminals according to Figure 6.1. Ensure DIP switch A2 is placed to V (voltage).

□ Current Input

Allows a voltage input via terminal A2. Refer to Table 6.5 for parameter settings.

Table 6.5 Frequency Command Using Current Signals

Terminal	Signal Level	Parameter Settings				Notes
		Signal Level Selection	Function Selection	Gain	Bias	
A2	0 to 20 mA	E3-06 = 0	E3-07 = 0	E3-08	E3-09	Ensure DIP switch A2 is placed to I (current)
	4 to 20 mA	E3-06 = 1				

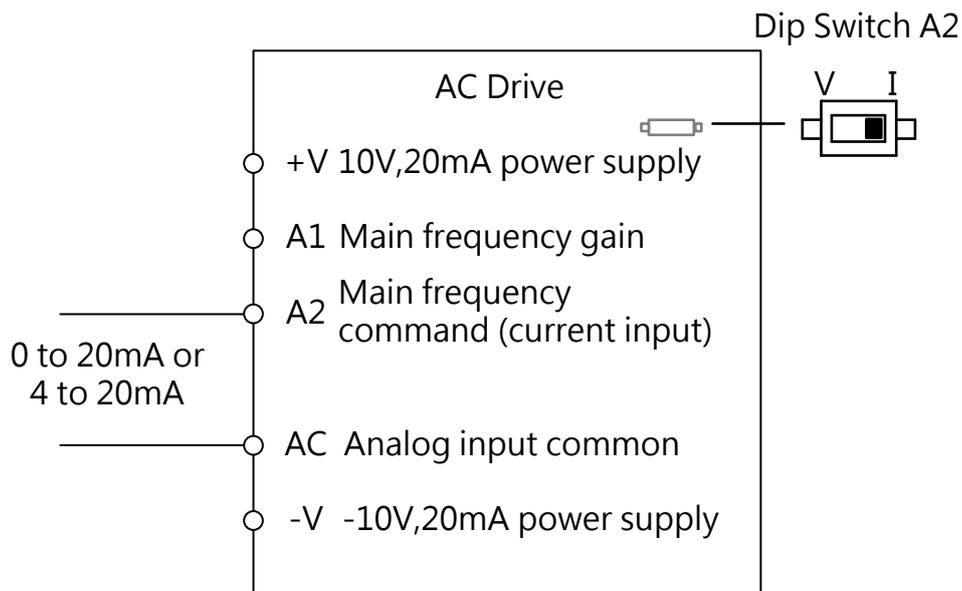


Figure 6.2 Setting Frequency Command as a Current Signal at Terminal A2

Ensure DIP switch A2 is placed to I (current).

- Switching between Main /Auxiliary Frequency Command

If either of analog input terminal A1 or A2 is set to 3 (Auxiliary Frequency Command),

2 : Terminal UP/DOWN

Use digital input terminals S1 to S8 to increase or decrease the frequency.

3 : Modbus Communication

Allows frequency command via the Modbus communication. Make sure RS-485/422 serial communications port is connected to control circuit terminals J1 and J4.

4 : Pulse Train Input (Including PWM Signal Input)

Allows frequency command from pulse train input terminal RP

Pulse Train Input Confirmation

- Set b1-00 = 4, E5-00 = 0 (Frequency Command)
- Set the E5-01 (Pulse Train Input Scaling) equal to 100% frequency.
- Enter a pulse train signal to terminal RP to check if the correct frequency command is displayed.

■ b1- 01 Run Command Selection 1

Selects the run command source for the REMOTE mode.

No.	Name	Setting Range	Default
b1-01	Run Command Selection 1	0 to 2	1

0 : Keypad

Allows the run command via the RUN key on the keypad.

1 : Control Circuit Terminal

Allows the run command via the digital input terminals using the following sequences.

- 2-Wire Sequence

Two inputs (forward/stop, reverse/stop). Set E1-00 (Terminal S1 Function Selection) to 0 (Forward/Stop) and E1-01(Terminal S2 Function Selection) to 1(Reverse/Stop).

- 3-Wire Sequence

Three inputs (forward, stop, forward/reverse). Set A1-03 = 3330 to reset the drive and automatically assign the 3-wire sequence control function to terminals S1, S2 and S5.

2 : Modbus Communication

Allows Run commands via the Modbus communication. Make sure RS-485/422 serial communications port is connected to control circuit terminals J1 and J4.

■ b1-02 Stopping Method Selection

Selects the way the drive stops the motor when a Stop command is entered or the run command is removed.

No.	Name	Setting Range	Default
b1-02	Stopping Method Selection	0 to 3	0

0 : Ramp to Stop

The drive will decelerate the motor according to the active deceleration time. The default of deceleration time is set in C1-01. The actual deceleration time will be changed depending on the load characteristics such as inertia.

When decelerating a load with high inertia, the drive perform ramp-to-stop first and then start DC braking to fully stop the motor. Refer to "b2 Group, DC Braking" for details.

- For Open-Loop V/F Control, Closed-Loop V/F Control, Open-Loop Vector Control and PM Open-Loop Vector Control:

When the output frequency falls below b2-00, DC Braking is enabled for the time set in b2-03. Refer to Figure 6.3.

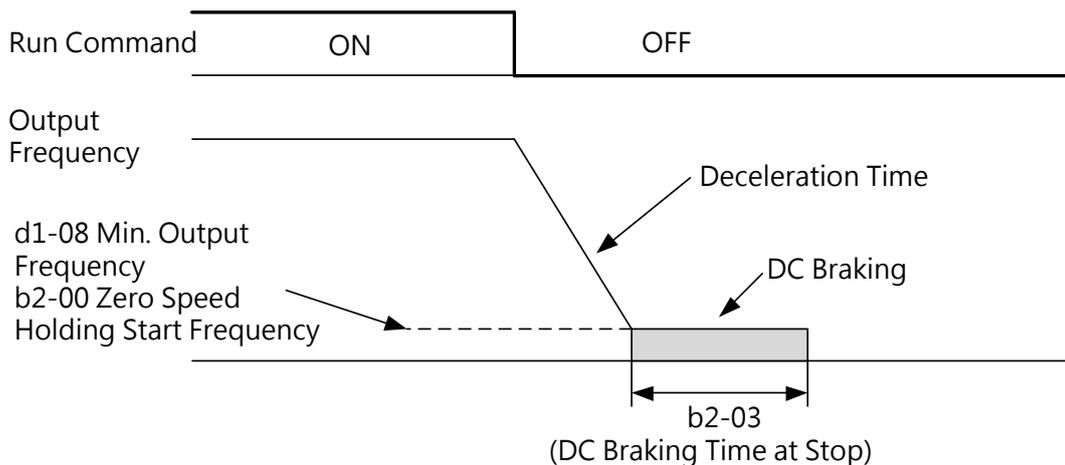


Figure 6.3 Ramp to Stop

Note: If the b2-00 value is smaller than the d1-08 value, DC Braking is enabled when the output frequency falls below the d1-08 value.

□ For Closed-Loop Vector Control, PM Closed-Loop Vector Control

When the output frequency falls below the b2-00 level, Zero Speed Holding is enabled for the time set to b2-03. Refer to Figure 6.3.

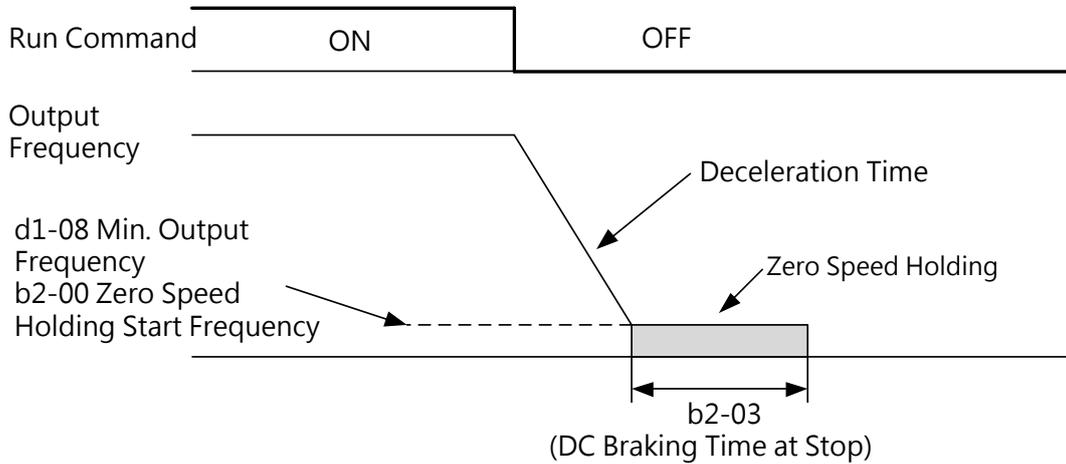


Figure 6.4 Ramp to Stop

Note: If the b2-00 value is smaller than the d1-08 value, Zero Speed Holding is enabled when the output frequency falls below the d1-08 value.

1 : Coast to Stop

When a Stop command is given, the drive will shut off its output. Then the motor will coast to stop for the time determined by the inertia and friction.

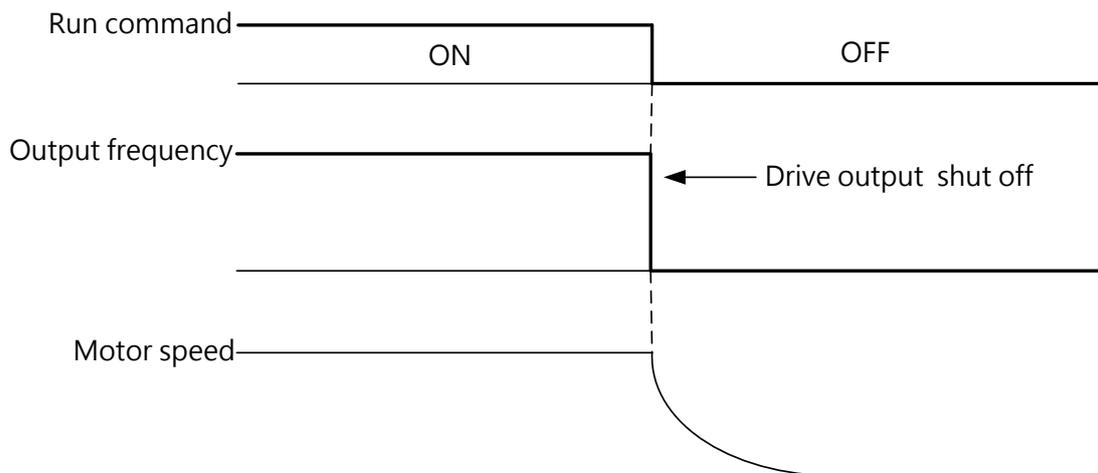


Figure 6.5 Coast to Stop

Note: After a Stop command is given, the drive will ignore any Run command entered until the minimum baseblock time set to P2-01. Do not enter Run command until the motor has completely stopped. To restart the motor before the complete stop, use DC braking at start (Refer to b2-02) or Speed Search (Refer to b3).

2 : DC Braking to Stop

When a Stop command is given, the drive will enter the current set to b2-01 to the motor after waiting the minimum baseblock time set to P2-01. DC Braking to Stop significantly shorter the stopping time compared to Coast to Stop.

Note: This function is not available in control methods for PM motors (A1-02 = 4, 5, 6, 8).

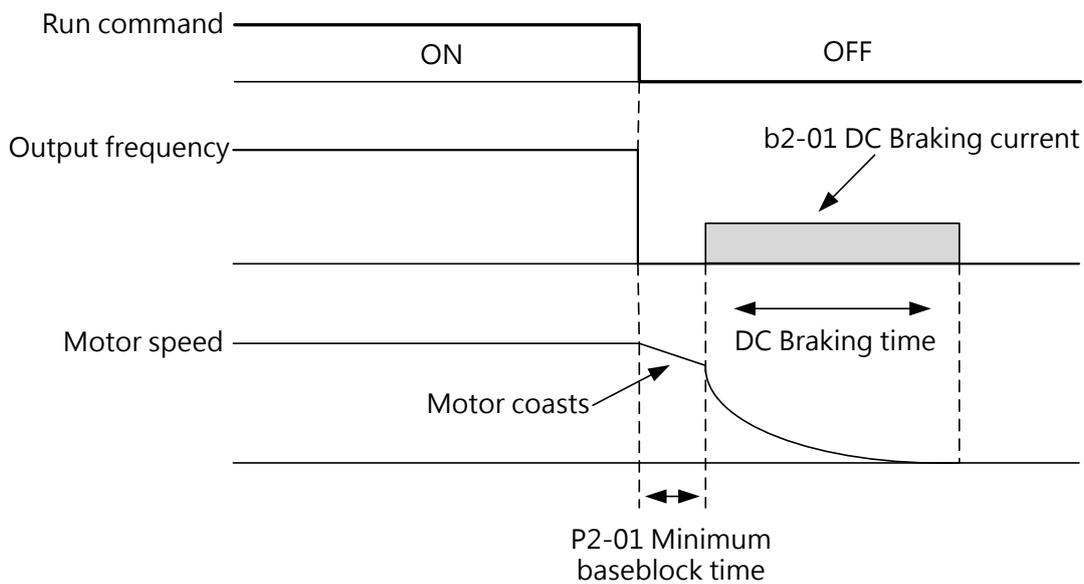


Figure 6.6 DC Braking to Stop

DC Braking time is determined by b2-03 (DC Braking Time at Stop) and the output frequency when a Stop command was entered.

$$\text{DC Braking time} = (b2-03) \times 10 \times \text{Output frequency} / d1-02(\text{Maximum output frequency})$$

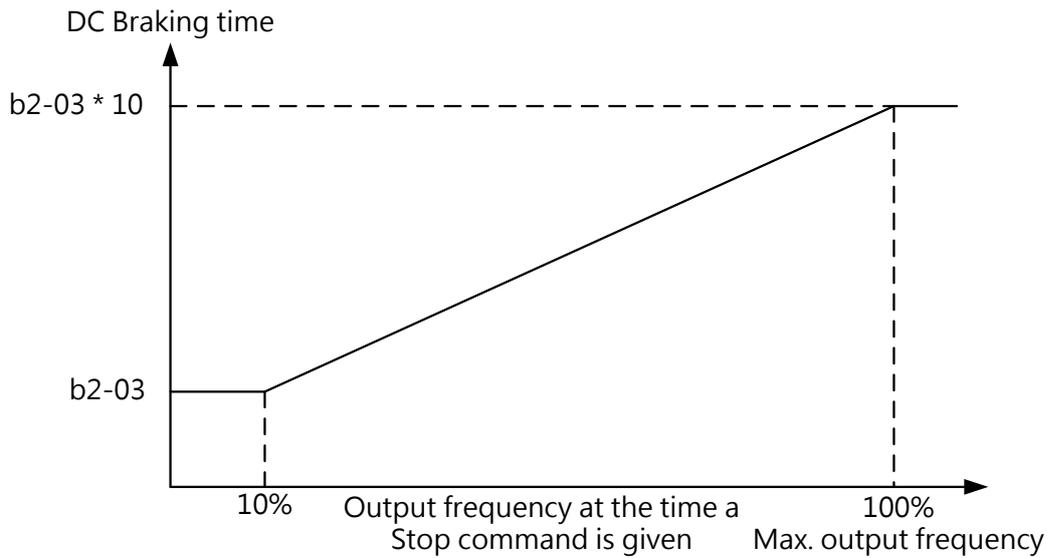


Figure 6.7 DC Braking Time Depending on Output Frequency

Note: If an OCD (Overcurrent) fault occurs, increase the minimum baseblock time to P2-01.

3 : Coast to Stop with Timer

When a Stop command is given, the drive shuts off its output and the motor will coast to stop. The drive will ignore any Run command until the wait time (t) ends.

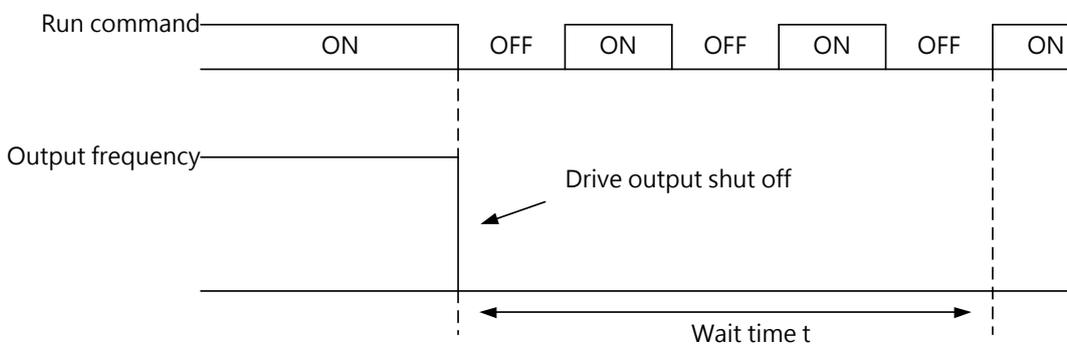


Figure 6.8 Coast to Stop with Timer

The wait time t is determined by the output frequency when the Stop command was given and by the active deceleration time.

For example, if the deceleration time is 10 seconds, the maximum frequency is 50Hz and the Stop command is entered when the speed is 25Hz, then the wait time is $(25\text{Hz}/50\text{Hz}) * 10\text{s} = 5\text{s}$.

■ b1-03 Reverse Rotation Selection

Determines whether reverse rotation is enabled. For some applications such as fans and pumps, reverse rotation could cause problems.

No.	Name	Setting Range	Default
b1-03	Reverse Rotation Selection	0, 1	0

0 : Reverse Rotation Enabled

Drive accepts a run command of both forward and reverse directions

1 : Reverse Rotation disabled

Drive can accept only run command of forward direction

■ **b1-05 Run Command Action after Switch**

The command source can be switched by pressing LO/RE key on the keypad, multi-function terminal input E1-□□= 3 (LOCAL/REMOTE Selection), E1-□□= 4 (Command Source 1/2 Selection) . Refer to parameter group E1 and LO/RE Key Function Selection (o2-00).

Enables or disables the protection to avoid an active Run command at the new source causing a sudden movement on the motor when the command source is switched from the old source to the new source.

No.	Name	Setting Range	Default
b1-05	Run Command Action after Switch	0, 1	0

0 : Ignore Active Run Command at the New Source

If a Run command at the new source is active, the drive will not start or the drive will stop operation if it was running, when switching from the old source to the new source. The drive can start only when the Run command is removed and given again.

1 : Accept Active Run Command at the New Source

WARNING! If a run command at the new source is active, the drive will accept it and run the motor immediately right after switching from the old source to the new source. Clear all personnel from the electrical connections and the running machinery prior to switching command sources. Failure to comply could cause serious injury.

■ **b1-06 Run Command Selection during Programming**

For safety reasons, the drive will ignore a Run command when the keypad is being used to edit parameters in Programming Mode. If allowing a Run command during programming is required in the application, set this parameter to 1.

No.	Name	Setting Range	Default
-----	------	---------------	---------

b1-06	Run Command Selection during Programming	0 to 2	0
-------	--	--------	---

0 : Run command disabled during Programming

A Run command is not accepted when the keypad is being used to edit parameters in Programming Mode.

1 : Run command enabled during Programming

A Run command is accepted when the keypad is being used to edit parameters in Programming Mode.

2 : Prohibit programming during run

The programming mode cannot be displayed during run except for monitoring parameter Group U.

■ **b1- 07 Frequency Command Selection 2**

Refer to the details of b1-00 (Frequency Command Selection 1). This parameter is only enabled while E1-00 to 07 is set to 4 and the DIP switch is set to OFF.

No.	Name	Setting Range	Default
b1-07	Frequency Command Selection 2	0 to 4	0

0 : Keypad

1 : Control Circuit Terminal (Analog Input)

2 : Terminal UP/DOWN

3 : Modbus Communication

4 : Pulse Train Input

■ **b1- 08 Run Command Selection 2**

Refer to the details of b1-01 (Run Command Selection 1). Enabled while E1-00 to 07 is set to 4 and the DIP switch is set to OFF

No.	Name	Setting Range	Default
b1-08	Run Command Selection 2	0 to 2	0

0 : Keypad

1 : Control Circuit Terminal (Sequence Control Input)

2 : Modbus Communication

■ **b1- 10 Run Command at Power up**

Determines to accept or ignore an active Run command from Remote during power up.

No.	Name	Setting Range	Default
b1-10	Run Command at Power up	0,1	0

0 : Ignore

Drive ignores an active run command during power up.

Note: The LED indicator blinks when there is an active Run command from Remote during power up. The drive can start only when the Run command is removed and entered again.

1 : Accept

Drive accepts an active Run command from Remote during power up and starts the motor immediately

WARNING! The drive will run the motor immediately at power up if there an active Run command from Remote. Ensure the protection measures are taken and clear all personnel from the electrical connections and the running machinery prior to switching command sources. Failure to comply could cause serious injury.

b2 DC Braking

■ b2-00 Zero Speed Holding (DC Braking) Start Frequency

Sets the start frequency for Zero Speed Holding (DC braking). Enabled when b1-02 (Stopping Method Selection) is set to 0 (Ramp to Stop)

No.	Name	Setting Range	Default
b2-00	Zero Speed Holding (DC Braking) Start Frequency	0.0 to 10.0 Hz	0.5 Hz

This function operates differently according to the selected control method.

- Open-Loop V/F Control, Closed-Loop V/F Control, Open-Loop Vector Control (A1- 02 = 0, 1, 2), PM Open-Loop Vector Control (A1- 02 = 4)

When the output frequency falls below the level set in this parameter, DC Braking is enabled for the time set to b2-03 (DC Braking Time at Stop).

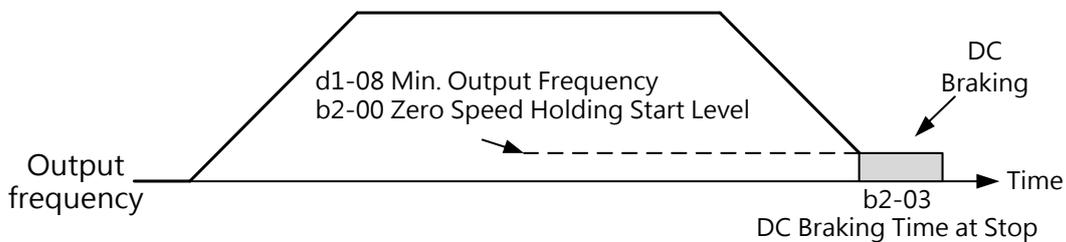


Figure 6.13 DC Braking Time at Stop

Note: When Zero Speed Holding Start Frequency (b2-00) is lower than Minimum Output Frequency (d1-08), Zero Speed Holding starts at Minimum Output Frequency (d1-08).

- IM/ PM Closed-Loop Vector Control (A1- 02 = 3, 5)

Use b2-00 to set the start frequency for Zero Speed Holding at stop. When the output frequency falls below the b2-00 level, the drive perform Zero Speed Holding for the duration set in b2-03 (DC Braking Time at Stop)

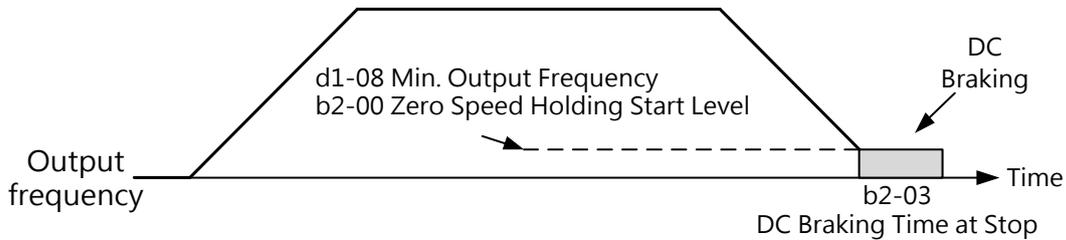


Figure 6.14 Zero Speed Holding at Stop

Note: When Zero Speed Holding Start Frequency (b2-00) is lower than Minimum Output Frequency (d1-08), Zero Speed Holding starts at Minimum Output Frequency (d1-08).

■ b2-01 DC Braking Current

Sets the DC braking current as a percentage of the drive rated current. When the current is set to more than 30%, the carrier frequency is automatically decreased to 1kHz.

No.	Name	Setting Range	Default
b2-01	DC Braking Current	0 to 100%	30%

The DC Braking current level affects the magnetic field strength to hold the motor shaft. The higher the current level is set, the higher amount of heat will be generated by the motor. Therefore do not set this value higher than the level necessary to hold the motor shaft.

■ b2- 02 DC Braking Time at Start

Sets the DC braking time at start to stop a coasting motor before restarting it or to apply braking torque at start when a high starting torque is needed. Disabled when set to 0.00.

No.	Name	Setting Range	Default
b2-02	DC Braking Time at Start	0.00 to 99.99 s	0.00 s

Note: Attempting to run a coasting motor without using DC Braking or Speed Search may trigger oV (Overvoltage) or oC (Overcurrent) fault. Use DC Braking to stop the motor or use Speed Search to detect the motor speed before restarting it

■ b2- 03 DC Braking Time at Stop

Sets the DC braking time at stop to stop a motor rotating with high inertia. Disabled when set to 0.00.

No.	Name	Setting Range	Default
-----	------	---------------	---------

b2-03	DC Braking Time at Stop	0.00 to 99.99 s	Determined by A1-02
-------	-------------------------	-----------------	---------------------

b3 Speed Search

The Speed Search function is to detect the actual motor speed driven by the inertia and starting the motor operation from the current speed directly without a stop. When a momentary power loss shuts off the drive and causes motor to coast. Speed Search helps the drive to detect the speed of the coasting motor and restart directly.

The Speed Search method of the drive is current detection type. Follow the settings and instructions below.

■ b3- 00 Speed Search Setting

No.	Name	Setting Range	Default
b3-00	Speed Search Setting	0 to 2	0

0 : Disabled

1 : Enabled and searched from the highest frequency

2 : Enabled and searched from the frequency command

3 : Retain

4 : Retain

■ b3- 01 Speed Search Operating Current

Sets the current level as a percentage of the drive rated current below which Speed Search is deactivated. This parameter normally does not require any change. Lower this current level if the drive cannot restart the motor.

No.	Name	Setting Range	Default
b3-01	Speed Search Operating Current	0 to 100%	80%

■ b3- 02 Retain

b4 Timer Function

The drive has the independent timer function. To enable this function, assign Timer Input (E1-□ □ =52) to multi-function input terminals S1 to S8, and Timer Output (E2-□ □ =15) to multi-function output terminals R1, R2, D1-DC and D2-DC. Set on-delay and off-delay time separately to eliminate the oscillation from sensors.

Set

■ b4- 00, b4- 01 Timer Function On-Delay and Off-Delay Time

Sets the on-delay and off-delay time to switch on/off the timer output.

No.	Name	Setting Range	Default
b4-00	Timer Function On-Delay Time	0.0 to 3000.0 s	0.0 s
b4-01	Timer Function Off-Delay Time	0.0 to 3000.0 s	0.0 s

■ Timer Function Operation

When the timer input closes for longer than the time set to b4-00, the timer switches on. When the timer input opens for longer than the time set to b4-01, the timer switches off. The Timer Function operation is illustrated in Figure 6.15.

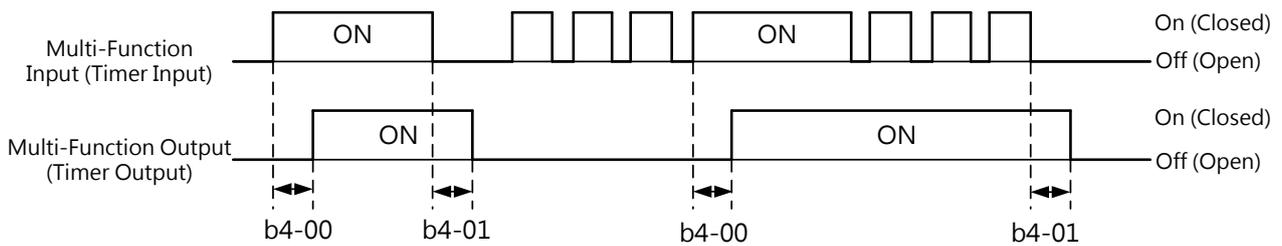


Figure 6.15 Timer Function Operation

b5 PID Control

PID control utilizes Proportional, Integral and Derivative Control to minimize the deviation between the PID target and feedback.

■ P Control

P control outputs the proportion of P gain and the deviation linearly. With only P control, the deviation will not fall to 0.

■ I Control

I control outputs the integral of the deviation. This minimizes the deviation between the PID target and feedback but not suitable for rapid load fluctuations.

■ D Control

D control multiplies a time constant with deviation derivative (deviation slope) to predict the deviation, and then adds this value to the PID input. This utilizes derivative to control the braking and vibration.

D control tends to cause instability as the interference to deviation signal is larger. Use P control only when necessary.

■ PID Control Operation

See the PID operation illustrated below how the P, I and D output frequency changes when the deviation between the PID target and feedback is constant.

■ PID Control Applications

PID control can be used in the following applications.

Application	Description	Sensors Used
Speed Control	Adjusts the machinery speed to the target speed. Synchronizes the machinery speed from other machinery as the target speed.	Tachometer
Pressure Control	Feeds back pressure data to maintain constant pressure.	Pressure sensor
Fluid Control	Feeds back flow data to keep a constant flow level	Flow rate sensor
Temperature Control	Feeds back temperature data to maintain a constant temperature by control the fan speed.	Thermistor, thermocoupler

■ PID Target Input Methods

The PID target can be input according to the methods showed in Table 6.6. If more than one PID targets are input, it will be selected as per the priority.

Ex. When E3-01=9 (PID Target) and E5-00=2 (PID Target), the signal from terminal A1 will be selected as the PID target.

Table 6.6 PID Target Input Sources

Priority	PID Target Input Sources	Settings
Highest *	Terminal A1	Set E3-01 to 9 (PID target)
	Terminal A2	Set E3-07 to 9 (PID target)
	Terminal RP	Set E5-00 to 2 (PID target)
	Parameter b5-18	Set b5-17 to 1, and input the PID target to b5-18.
Lowest	Modbus Register	Set bit 1 in Modbus register 000FH to 1 (PID target input) and input the target to 0006H.

Note: When both terminal A1 and A2 are set to 9 (PID Target), oPE07 fault will be triggered.

■ PID Feedback Input Methods

There are two input methods. The first is to input one feedback signal for normal PID control. The second is to input two signals to control the deviation in between.

Normal PID Feedback:

Selects the PID feedback signal in the source listed in Table 6.7.

Table 6.7 PID Feedback Sources

PID Feedback Source	Setting
Terminal A1	Set E3-01 to 8 (PID feedback)
Terminal A2	Set E3-07 to 8 (PID feedback)
Terminal RP	Set E5-00 to 1 (PID feedback)

Note: When more than one PID feedback input source is assigned, oPE09 fault will be triggered.

■ PID Differential Feedback

Selects the second PID feedback signal used for deviation calculation in Table 6.8. Assigning a differential feedback input will automatically activate the differential feedback function.

Table 6.8 PID Differential Feedback Sources

PID Differential Feedback Source	Settings
Terminal A1	Set E3-01 to 10 (differential feedback)
Terminal A2	Set E3-07 to 10 (differential feedback)

Note: When more than one PID feedback differential input source is assigned, oPE09 fault will be triggered.

■ b5- 00 PID Control Setting

Enables or disables the PID function and selects the PID mode.

No.	Name	Setting Range	Default
b5-00	PID Control Setting	0 to 4	0

0 : PID Control Disabled

1 : Output Frequency = PID Output 1

PID control is enabled. D (Derivative) control the deviation signal (U4-01) between the target and feedback as output frequency.

2 : Output Frequency = PID Output 2

PID control is enabled. D (Derivative) control the feedback signal (U4-05) as output frequency.

3 : Output Frequency = Frequency Command+ PID Output 1

PID control is enabled. D (Derivative) control the deviation signal (U4-01) between the target and feedback and add the frequency command as output frequency.

4 : Output Frequency = Frequency Command + PID Output 2

PID control is enabled. D (Derivative) control the feedback signal (U4-05) and add the frequency command as output frequency.

■ b5- 01 Proportional Gain Setting (P)

Sets the P gain for PID input.

The larger the P gain is set, the smaller the deviation will be, and vice versa. However vibration may occur if the value is set too high.

No.	Name	Setting Range	Default
b5-01	Proportional Gain Setting (P)	0.00 to 25.00	1.00

■ **b5- 02 Integral Time Setting (I)**

Deviation appears between PID target value and feedback value when using only proportional control. Set integral time (I) to reduce the deviation,

Sets the time to calculate the integral of the PID input. The shorter the integral time is set, the faster the deviation will be eliminated, and vice versa. However vibration or overshoot may occur if the value is set too high. I control is disabled when b5-02=0.00.

No.	Name	Setting Range	Default
b5-02	Integral Time Setting (I)	0.0 to 360.0 s	1.0 s

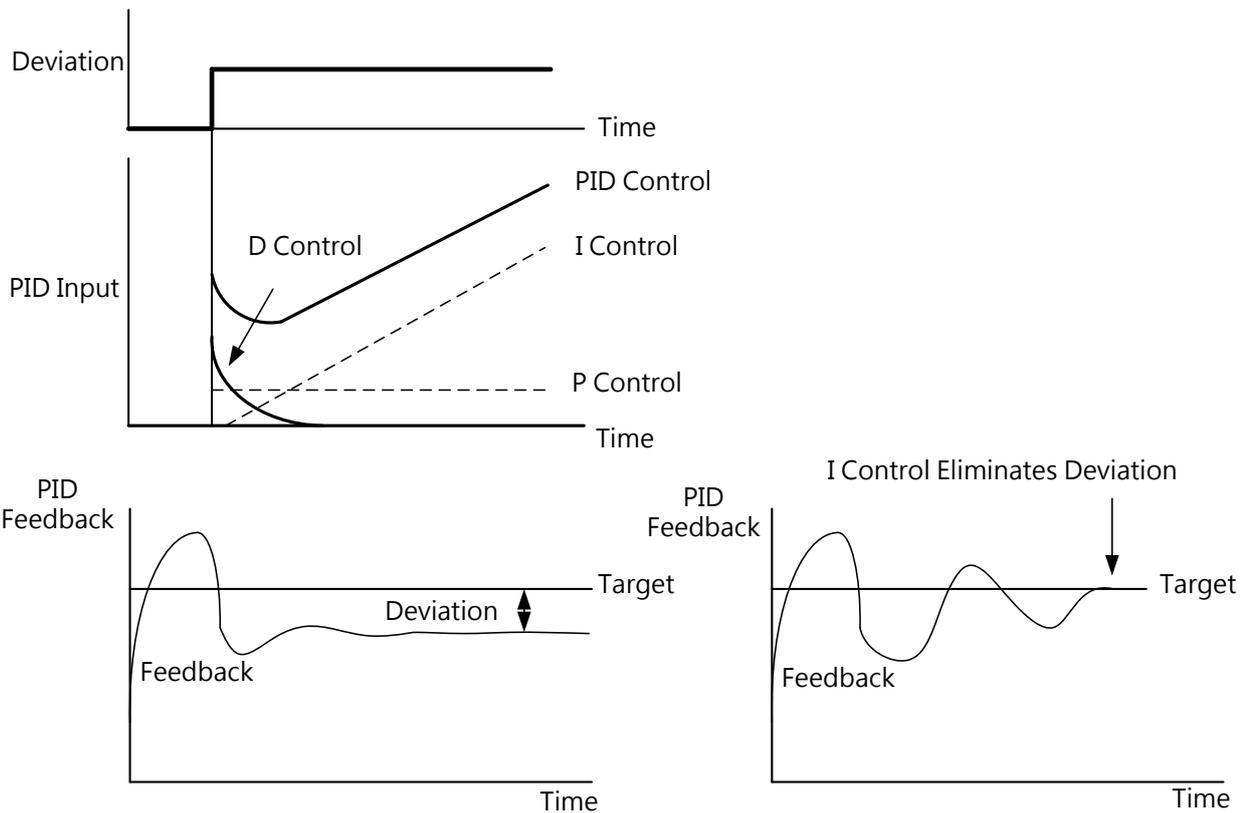


Figure 6.17 Relationship between Time and Deviation

■ **b5- 03 Integral Time (I) Limit Setting**

Sets the maximum output from the I (integral) control as a percentage of the maximum frequency (d1-02)

No.	Name	Setting Range	Default
-----	------	---------------	---------

b5-03	Integral Time (I) Limit Setting	0.0 to 100.0%	100.0%
-------	---------------------------------	---------------	--------

Note: During rapid load fluctuations, PID output may show vibration. Set a limit to suppress the vibration so as to prevent the equipment damage or motor stall.

■ b5- 04 Derivative Time (D)

Set this parameter when response improvement is needed.

Sets the time to predict the deviation based on the derivative of the PID input and PID feedback.. The longer derivative time improves the response but may cause vibration as the shorter derivative time suppress the overshoot but decrease the response. D control is disabled when b5-04=0.00.

No.	Name	Setting Range	Default
b5-04	Derivative Time (D)	0.00 to 10.00 s	0.00 s

■ b5- 05 PID Output Limit

Sets the upper limit of output from PID control as a percentage of the maximum frequency.

No.	Name	Setting Range	Default
b5-05	PID Output Limit	0.0 to 100.0%	100.0%

■ b5- 06 PID Bias Voltage Adjustment

Sets the PID bias voltage adjustment as a percentage of the maximum frequency to add to the PID control output.

No.	Name	Setting Range	Default
b5-06	PID Bias Voltage Adjustment	-100.0 to 100.0%	0.0%

■ b5- 07 PID Primary Delay Time

Sets the delay time for the PID output filter. Change is normally not required.

No.	Name	Setting Range	Default
b5-07	PID Primary Delay Time	0.00 to 10.00 s	0.00 s

Note: This parameter is effective to avoid the vibration when abrasion is high and rigidity is low. Increasing this delay time could reduce the response of the drive.

■ b5- 08 PID Output Reverse

Reverses the +/- sign of the PID output. This is suitable for reverse acting applications as a positive PID target decrease the output frequency of the drive.

No.	Name	Setting Range	Default
b5-08	PID Output Reverse	0, 1	0

0 : Normal PID Output

A positive PID input causes an increase in the PID output.

1 : Reverse PID Output

A positive PID input causes an decrease in the PID output.

■ b5- 09 PID Output Gain

Sets a gain to multiply by the PID output. The compensation will be more effective when b5-00=3 or 4.

No.	Name	Setting Range	Default
b5-09	PID Output Gain	0.00 to 25.00	1.00

■ b5- 10 PID Output Reverse Selection

Determines whether or not a negative PID output reverses the drive rotating direction. This parameter is disabled when b5-00 =3 or 4, but the PID output will not be limited (same as b5-27=1)

No.	Name	Setting Range	Default
b5-10	PID Output Reverse Selection	0, 1	0

0 : Reverse Disabled

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

1 : Reverse Enabled

The drive will run reversely if PID output is negative.

■ PID Feedback Low /High Detection

This detects whether the sensor or the sensor wiring is broken. Always use this function during PID control so as to avoid machinery accelerating to the maximum frequency cause by PID feedback low / high.

· PID Feedback Low

This will be detected when the value is lower than the set level for longer than the set time.

· PID Feedback High

This will be detected when the value is higher than the set level for longer than the set time.

The PID Feedback Low Detection operation is illustrated below. Same way applies to PID Feedback High Detection.

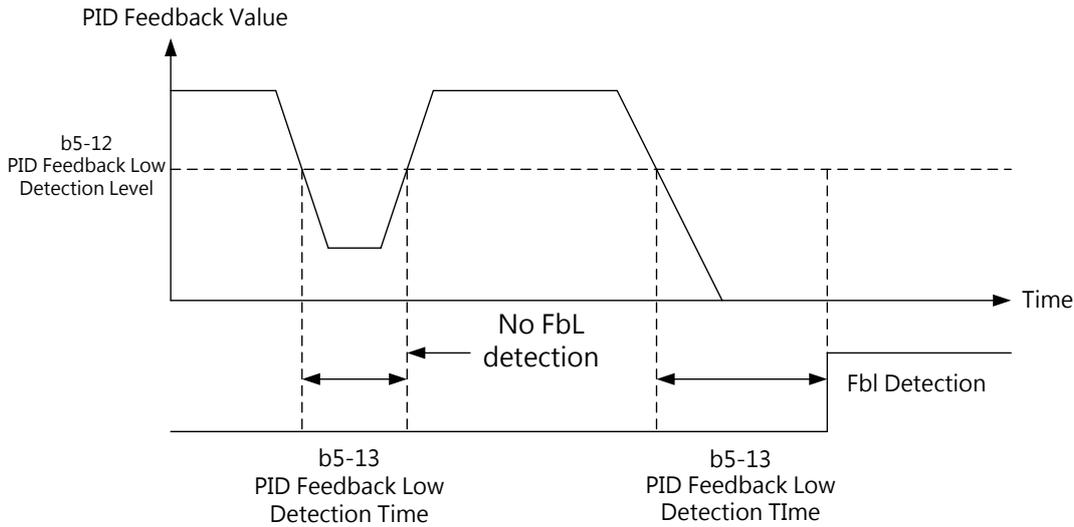


Figure 6.18 PID Feedback Low Detection

Set b5-11 to b5-13 for PID Feedback Low Detection, and b5-11, b5-22, b5-23 for PID Feedback High Detection.

■ **b5- 11 PID Feedback Low /High Detection Selection**

Sets the feedback low /high detection and the operation when it is detected.

No.	Name	Setting Range	Default
b5-11	PID Feedback Low /High Detection Selection	0 to 5	0

0 : Multi-Function Output Only

A multi-function output set for E2-□□= 40 (PID feedback low) will be triggered if the PID feedback value is lower than the detection level set to b5-12 for longer than the detection time set to b5-13

A multi-function output set for E2-□□= 41 (PID feedback high) will be triggered if the PID feedback value is higher than the detection level set to b5-22 for longer than the detection time set to b5-23

No alarm or fault will be triggered. The drive will continue operation. The output resets when the PID feedback value returns to the normal range.

1 : Feedback Low /High Alarm

A FbL (PID feedback low) alarm and a multi-function output set for E2-□□= 40 (PID feedback low) will be triggered if the PID feedback value is lower than the detection level set to b5-12 for longer than the detection time set to b5-13, the keypad

A FbH (PID feedback high) alarm and a multi-function output set for E2-□□= 41 (PID feedback high) will be triggered if the PID feedback value is higher than the detection level set to b5-22 for longer than the detection time set to b5-23

A multi-function output set for E2-□□=13 (alarm) will be triggered in either event. The drive will continue operation. The alarm resets when the PID feedback value returns to the normal range.

2 : Feedback Low /High Fault

A FbL (PID feedback low) fault will be triggered if the PID feedback value is lower than the detection level set to b5-12 for longer than the detection time set to b5-13, the keypad

A FbH (PID feedback high) fault will be triggered if the PID feedback value is higher than the detection level set to b5-22 for longer than the detection time set to b5-23

A multi-function output set for E2-□□=11 (fault) will be triggered in either event to cause the drive to stop the motor.

3 : Multi-Function Output only, even if PID is Disabled

4 : Feedback Failure Alarm, ever if PID is Disabled

5 : Feedback Failure Fault even if PID is Disabled

■ b5- 12 PID Feedback Low Detection Level

Sets the PID feedback level used for detection. When the PID feedback falls below this level for longer than the time set to b5-13, PID feedback loss will be detected.

No.	Name	Setting Range	Default
b5-12	PID Feedback Low Detection Level	0 to 100%	0%

■ b5- 13 PID Feedback Low Detection Time

Sets the PID feedback time used for detection. When the PID feedback falls below the level set to b5-12 for longer than this time, PID feedback loss will be detected.

No.	Name	Setting Range	Default
b5-13	PID Feedback Low Detection Time	0.0 to 25.5 s	1.0 s

■ PID Sleep

PID Sleep will be triggered when the PID output or frequency command falls below the set level for longer than the set time. The drive will resume operation when the PID output or frequency command exceeds the set level for longer than the set time.

PID Sleep operation is illustrated below.

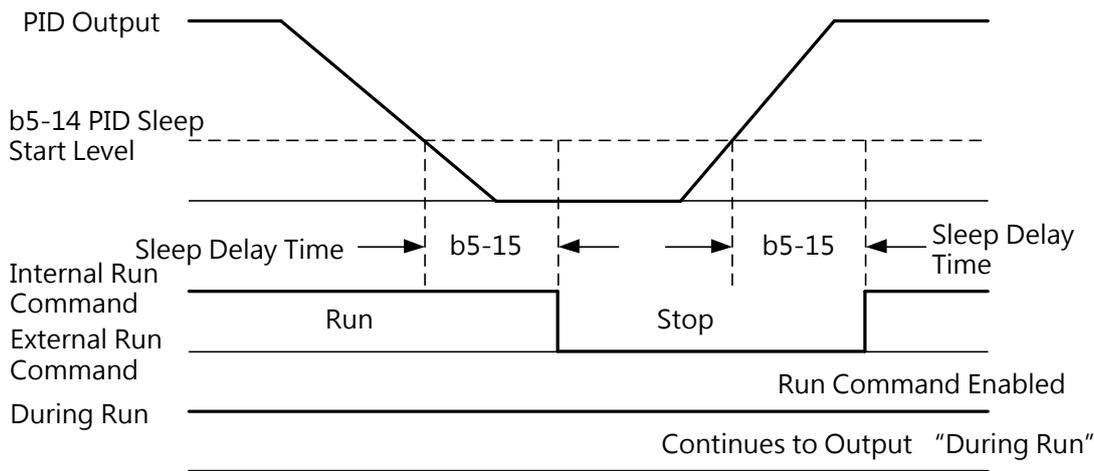


Figure 6.19 PID Sleep Operation

Notes for PID Sleep function

- The Stopping Method for PID Sleep function is determined by b1-02
- Set the PID Sleep function in b5-14 and b5-15.

■ b5- 14 PID Sleep Start Level

Sets the frequency level used to trigger PID Sleep.

PID Sleep will be triggered when the PID output or frequency command falls below the level set to b5-14 for the time longer than the time set to b5-15. The drive will resume operation when the PID output or frequency command exceeds the level set to b5-14 for longer than the time set in b5-15.

No.	Name	Setting Range	Default
b5-14	PID Sleep Start Level	0.0 Hz to <1>	0.0 Hz

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit).

■ b5- 15 PID Sleep Delay Time

Sets the delay time used to activate/deactivate the PID Sleep function.

No.	Name	Setting Range	Default
b5-15	PID Sleep Delay Time	0.0 to 25.5 s	0.0 s

■ b5- 16 PID Acc./Dec. Time

The PID Acc. /Dec. time is used for the PID target.

When the PID target changes quickly, the normal C1-□□ Acc. time decreases the response since it is applied after the PID output. This PID Acc./Dec. time prevents the overshoot, undershoot and hunting caused by the decreased response. In addition, set a lower value to

parameter group C1 to avoid hunting. This parameter will be disabled if a multi-function input is assigned to E1-□□= 49 (PID Soft-Start On/Off).

No.	Name	Setting Range	Default
b5-16	PID Acc./Dec. Time	0.0 to 6000.0 s	0.0 s

■ **b5- 17 PID Target Selection**

Enables or disables b5-18 for PID target.

No.	Name	Setting Range	Default
b5-17	PID Target Selection	0, 1	0

0 : PID Target Disabled

The value set to b5-18 is disabled.

1 : PID Target Enabled

The value set to b5-18 is enabled.

■ **b5- 18 PID Target Value**

Sets the PID target value as a percentage of the maximum output frequency when b5-17 is set to 0

No.	Name	Setting Range	Default
b5-18	PID Target Value	0.00 to 100.00%	0.00%

■ **b5- 19 PID Target Value Units**

Sets the display units for b5-18, U4-00 (PID Feedback) and U4-03 (PID Target).

No.	Name	Setting Range	Default
b5-19	PID Target Value Units	0 to 3	1

0 : Hz

Displays the PID target in 0.01 Hz units.

1 : 0.01%

Displays the PID target as a percentage of maximum frequency.

2 : r/min

Displays the PID target in r/min. Number of Motor Poles must be set

3 : User Defined

Displays the PID target in the units defined by b5-24 and b5-25

■ b5- 22 PID Feedback High Detection Level

Sets the level for PID feedback high detection as a percentage of the maximum output frequency.

PID feedback high will be detected when the feedback exceeds the level set in b5-22 for longer than the time set in b5-23.

No.	Name	Setting Range	Default
b5-22	PID Feedback High Detection Level	0 to 100%	100%

■ b5- 23 PID Feedback High Detection Time

Sets the time for PID feedback high detection. PID feedback high will be detected when the feedback exceeds the level set in b5-22 for longer than the time set in b5-23.

No.	Name	Setting Range	Default
b5-23	PID Feedback High Detection Time	0 to 25.5 s	1.0 s

■ b5- 24/b5- 25 PID Target Display Value/ PID Target Display Digits

When b5-19=3, b5-24 and b5-25 set a user-defined display for the PID feedback and target in U4-00 and U4-03. When b5-19≠3, parameters b5-24 and b5-25 cannot be edited.

b5-24 Sets the display value when run at the maximum frequency.

b5-25 Sets the number of decimal places to display..

No.	Name	Setting Range	Default
b5-24	PID Target Display Value	1 to 60000	Determined by b5-19
b5-25	PID Target Display Digits	0 to 3	Determined by b5-19

0 : No Decimal Places

1 : 1 Decimal Place

2 : 2 Decimal Places

3 : 3 Decimal Places

■ PID Fine-Tuning

Follow the following instructions when the PID control parameters are set.

Overshoot Suppression

When an overshoot occurs, reduce the derivative time set to b5-04 and increase the integral time set to b5-02.

Stability after Overshoot.

To immediately achieve stability after an overshoot, increase the derivative time set to b5-04 and reduce the integral time set to b5-02.

Long Cycle Oscillation Suppression

If the oscillation cycle is longer than the integral time set to b5-02, increase the time as the integral operation is too strong.

Short Cycle Oscillation Suppression

If the oscillation cycle is almost the same as the derivative time set to b5-04, reduce the time as the derivative operation is too strong.

If even 0.00 derivative time (D control disabled) cannot suppress the oscillation, reduce the P Gain set to b5-01 or increase the PID Primary Delay Time set to b5-07.

■ b5- 28 PID Disconnection Output Frequency

When a PID feedback disconnection alarm occurs, the drive will run at the frequency set to b5-28, and return to PID control when disconnection alarm is reset.

No.	Name	Setting Range	Default
b5-28	PID Disconnection Output Frequency	0.0 Hz to <1>	30.0 Hz

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit).

b6 DWELL

The Dwell function temporarily holds the frequency command to prevent speed loss when starting and stopping a heavy load. When driving a PM motor, the pause reduces the oscillations during acceleration. The Dwell function is illustrated below.

Note: When using Dwell at stop, set b1-02 (Stopping Method Selection) to 0 (Ramp to Stop).

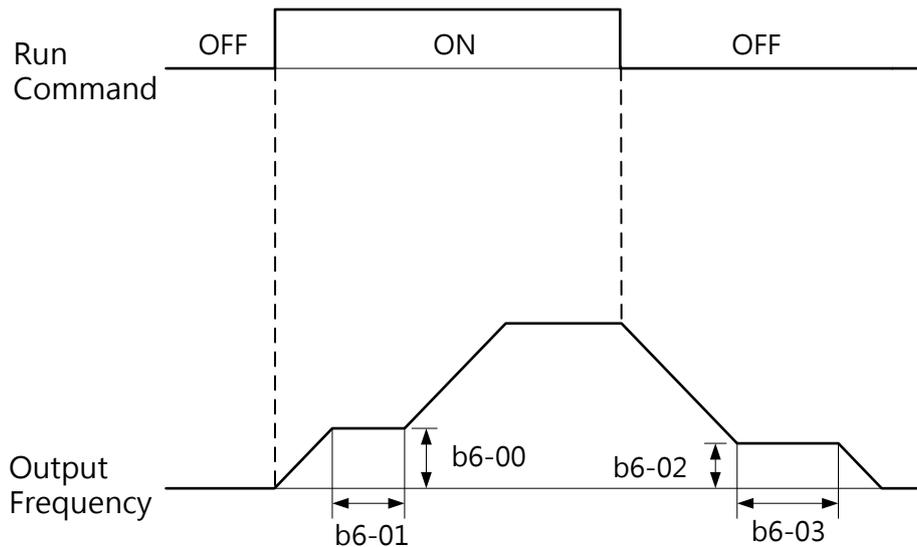


Figure 6.20 Dwell Function at Start and Stop

■ **b6- 00 / b6- 01 Dwell Frequency and time at Start**

Sets the frequency to b6-00 used to be held for the time set in b6-01 during acceleration.

No.	Name	Setting Range	Default
b6-00	Dwell Frequency at Start	0.0 Hz to <1>	0.0 Hz
b6-01	Dwell time at Start	0.0 to 10.0 s	0.0 s

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit)

■ **b6- 02 / b6- 03 Dwell Frequency and time at Stop**

Sets the frequency to b6-02 used to be held for the time set in b6-03 during deceleration.

No.	Name	Setting Range	Default
b6-02	Dwell Frequency at Stop	0.0 to <1>	0.0 Hz
b6-03	Dwell time at Stop	0.0 to 10.0 s	0.0 s

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit)

b7 to b9 Retain

6.3 Group C, Tuning

C1 Acceleration and Deceleration Time

■ C1- 00 to C1- 07 Acceleration and Deceleration Times 1 to 4

Four different acceleration and deceleration times can be set in the drive by multi-function input terminals, motor selection or switched during run.

Set the acceleration time to determine the time needed to accelerate from 0Hz to the maximum frequency (d1-02). Set the deceleration time to determine the time needed to decelerate from the maximum frequency (d1-02) to 0Hz.

C1-00 and C1-01 are the active acceleration and deceleration times by default.

No.	Name	Setting Range	Default
C1-00	Acceleration Time 1	0.0 to 6000.0 s <1>	10.0 s
C1-01	Deceleration Time 1		
C1-02	Acceleration Time 2		
C1-03	Deceleration Time 2		
C1-04	Acceleration Time 3 (Acceleration Time 1 for Motor 2)		
C1-05	Deceleration Time 3 (Deceleration Time 1 for Motor 2)		
C1-06	Acceleration Time 4 (Acceleration Time 2 for Motor 2)		
C1-07	Deceleration Time 4 (Deceleration Time 2 for Motor 2)		
C1-08	Fast Stop Time		

<1> The setting range of Acc./Dec is changed according to the setting of C1-09 (Acc./Dec. Time Unit Selection). When C1-09 = 0 (0.01 second), then the setting range is 0.00 to 600.00 (s).

□ Switching Acceleration Times by Multi-Function Input

C1-00 and C1-01 are the active acceleration and deceleration times by default. Enable C1-02 to C1-07 by E1-□□ (Multi-Function Digital Inputs)= 16 (Acc./Dec. Time Selection 1) and 17(Acc./Dec. Time Selection 2). Refer to Table 6.9.

Table 6.9 Acc./Dec. Times Selection by Multi-Function Input

Acc./Dec. Time Selection 1 E1-□□= 16	Acc./Dec Time Selection 2 E1-□□= 17	Active Times	
		Acceleration	Deceleration
0 (Open)	0 (Open)	C1-00	C1-01
1 (Closed)	0 (Open)	C1-02	C1-03
0 (Open)	1 (Closed)	C1-04	C1-05

1 (Closed)	1 (Closed)	C1-06	C1-07
------------	------------	-------	-------

Figure 6.21 illustrates an operation example for changing acceleration and deceleration times. b1-02 (Stopping Method Selection) = 0 (Ramp to Stop).

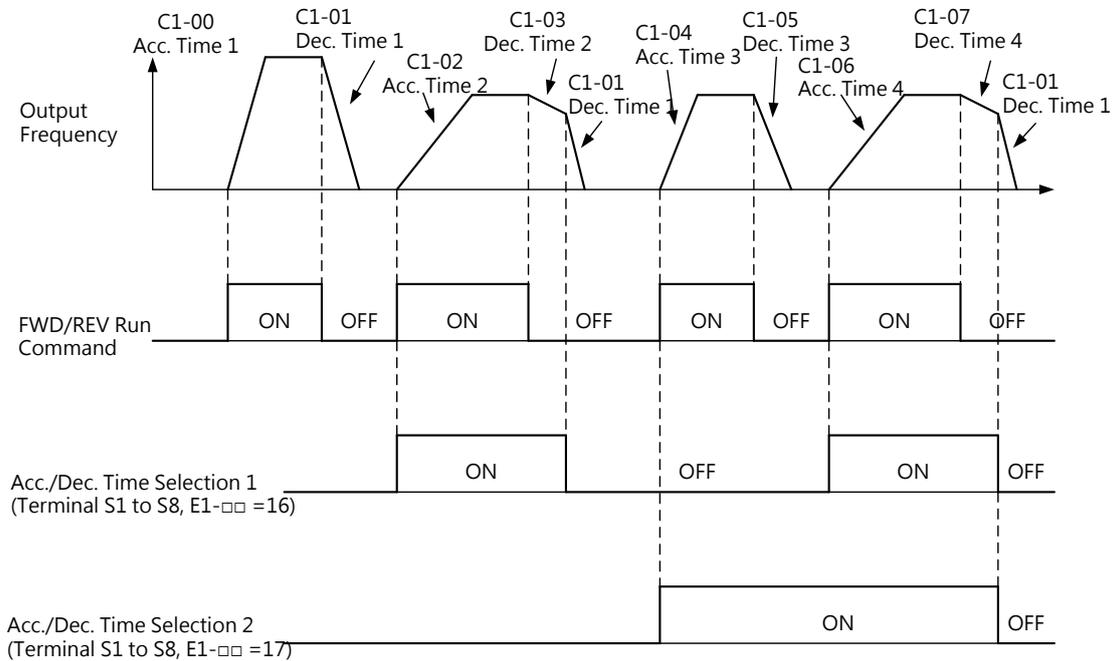


Figure 6.21 Operation of Acc./Dec. Time Change by Multi-Function Input

□ Switching Acceleration and Deceleration Times by Motor Selection

When setting E1-□□= 51 via a multi-function input, the motor can be switched between 1 and 2 by setting the input terminal On and Off. This function cannot be used for a PM motor.

When motor 1 is selected and E1-□□= 16 (Acc./Dec. Time Selection 1), the acceleration and deceleration times can be switched between C1-00, C1-01 (Acc./Dec. Time 1) and C1-02, C1-03 (Acc./Dec. Time 2) for motor 1

When motor 2 is selected and E1-□□= 16 (Acc./Dec. Time Selection 1), the acceleration and deceleration times can be switched between C1-04, C1-05 (Acc./Dec. Time 1 for Motor 2) and C1-06, C1-07 (Acc./Dec. Time 2 for Motor 2). Refer to Table 6.10.

Table 6.10 Acc./Dec. Times Selection by Motor Selection

Acc./Dec. Time Selection 1 E1-□□= 16	Motor 1 Selected		Motor 2 Selected	
	Acceleration	Deceleration	Acceleration	Deceleration
Open	C1-00	C1-01	C1-04	C1-05
Closed	C1-02	C1-03	C1-06	C1-07

Note: Motor cannot be switched in a PM control method.

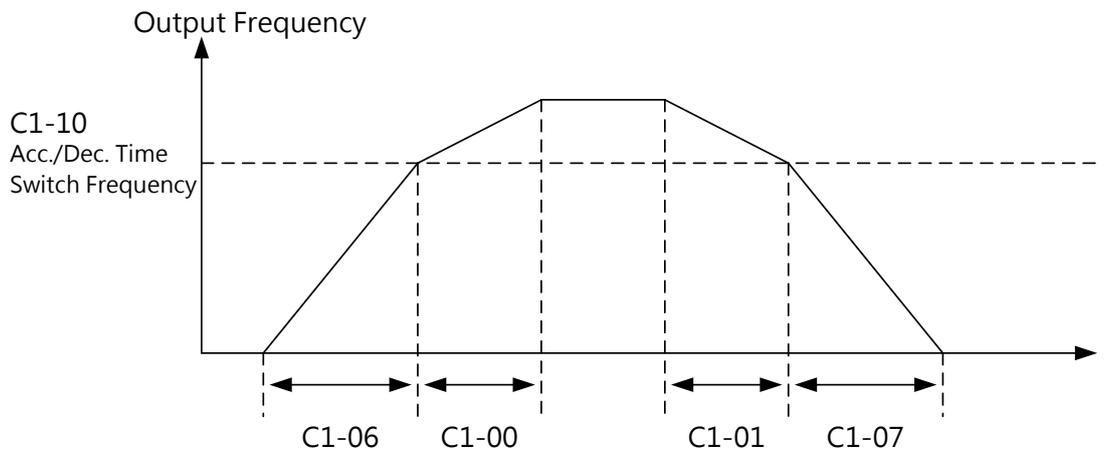
□ Switching Acceleration and Deceleration Times by a Frequency Level

The acceleration and deceleration times can be automatically switched by output frequency.

- When Acc./Dec. Time Switch Frequency C1-10 \neq 0.0 and the frequency is below the C1-10 level, the drive accelerates and decelerates according to C1-06 and C1-07 (Acc./Dec. Time 4).
- When Acc./Dec. Time Switch Frequency C1-10 \neq 0.0 and the frequency is above the C1-10 level, the drive accelerates and decelerates according to C1-00 and C1-01 (Acc./Dec. Time 1).
- When motor 2 is selected via a multi-function input and the frequency is below the C1-10 level, the drive accelerates and decelerates according to C1-06 and C1-07 (Acc./Dec. Time 2 for Motor 2).
- When motor 2 is selected via a multi-function input and the frequency is above the C1-10 level, the drive accelerates and decelerates according to C1-04 and C1-05 (Acc./Dec. Time 1 for Motor 2).

Refer to Figure 6.22.

Note: When set E1-□□ = 16 (Acc./Dec. Time 1) and 17 (Acc./Dec. Time 2) via multi-function input, the acceleration and deceleration times override the setting in C1-10. For example, when Acc./Dec. Time 2 is selected, even if the output frequency exceeds the C1-10 level, the acceleration and deceleration times will not be changed.



When the output frequency \geq C1-10, drive follows C1-00, C1-01(Acc./Dec. Time 1)
 When the output frequency $<$ C1-10, drive follows C1-06, C1-07(Acc./Dec. Time 4)

Figure 6.22 Operation of Acc./Dec. Time Change by a Frequency Level

■ C1- 08 Fast Stop Time

Sets the deceleration time when E1-□□ = 21 (Fast Stop: Normal Open) or 22 (Fast Stop: Normal Closed). The input terminal does not have to be closed continuously to trigger Fast Stop. It will trigger Fast Stop even if the closure is momentary. Different from the normal deceleration, the drive cannot be restarted after entering Fast Stop until completing deceleration, remove the

Fast Stop input and cycling the Run command.

If E2-□□ is set to 44 (During Fast Stop), this terminal will close during Fast Stop.

If Fast Stop is the action selected for a fault detection, the Fast Stop time set in this parameter will be the deceleration time.

No.	Name	Setting Range	Default
C1-08	Fast Stop Time	0.0 to 6000.0 s <1>	10.0 s

<1> The setting range is determined by the C1-09 (Acc./Dec. Time Unit Selection) setting. When C1-09 = 0, the setting range is 0.00 to 600.00 (second).

Note: A rapid deceleration will trigger an OVD fault and shut off the drive output causing the motor to coast. To avoid the motor coasting and to ensure the motor stops safely, always set an appropriate time to this parameter.

■ C1-09 Acc./Dec. Time Unit Selection

Set the time scaling for C1-00 to C1-08.

No.	Name	Setting Range	Default
C1-09	Acc./Dec. Time Unit Selection	0, 1	1

0: 0.01s

Sets the acceleration and deceleration times in 0.01 second units. The setting range will be 0.00 to 600.00 seconds. If 600.1 seconds or more is set to any parameter among C1-00 to C1-08, C1-09 cannot be set to 0.

1: 0.1s

Sets the acceleration and deceleration times in 0.1 second units. The setting range will be 0.00 to 6000.0 seconds.

■ C1-10 Acc./Dec. Time Switch Frequency

Sets the frequency level. The drive will switch the acceleration and deceleration time at this level.

No.	Name	Setting Range	Default
C1-10	Acc./Dec. Time Switch Frequency	0.0 to <1><2>	0.0 Hz

<1> In control method of PM Closed-Loop Vector Control, the setting range is 0.0 to 100.0%. The default setting is 0.0%.

<2> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13(Motor2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit)

Note: This parameter will be disabled when 0.0 Hz (0.0%) is set to this parameter. <1> The setting range is determined by the C1-09 (Acc./Dec. Time Unit Selection) setting. When C1-09 = 0, the setting range is 0.00 to 600.00 (second).

■ **C1-11/ C1-12 Jog Frequency Acc. / Dec. Time**

C1-11 sets the acceleration time from 0Hz to the Jog frequency command (L1-16). And C1-12 sets the deceleration time from the Jog frequency command (L1-16) to 0Hz.

No.	Name	Setting Range	Default
C1-11	Jog Frequency Acc. Time	0.0 to 6000.0 s <1>	10.0 s
C1-12	Jog Frequency Dec. Time		

<1> The setting range changes depending on the C1-09 setting. When C1-09 = 0 (Units of 0.01s), the range will be 0.00s to 600.00s.

C2 S-Curve Characteristics

Sets the S-curve characteristics to reduce the shock to the machinery at start and stop. Sets the S-curve characteristic time at the start and stop of acceleration and deceleration.

■ **C2- 00 to C2- 03 S-Curve Characteristic at Start/Stop of Acc./Dec.**

Sets the S-curve characteristic time in C2-00 to C2-03.

No.	Name	Setting Range	Default
C2-00	S-Curve Characteristic at Acc. Start	0.00 to 10.00 s	0.20 s
C2-01	S-Curve Characteristic at Acc. End		
C2-02	S-Curve Characteristic at Dec. Start		
C2-03	S-Curve Characteristic at Dec. End		

S-curve characteristics are illustrated below.

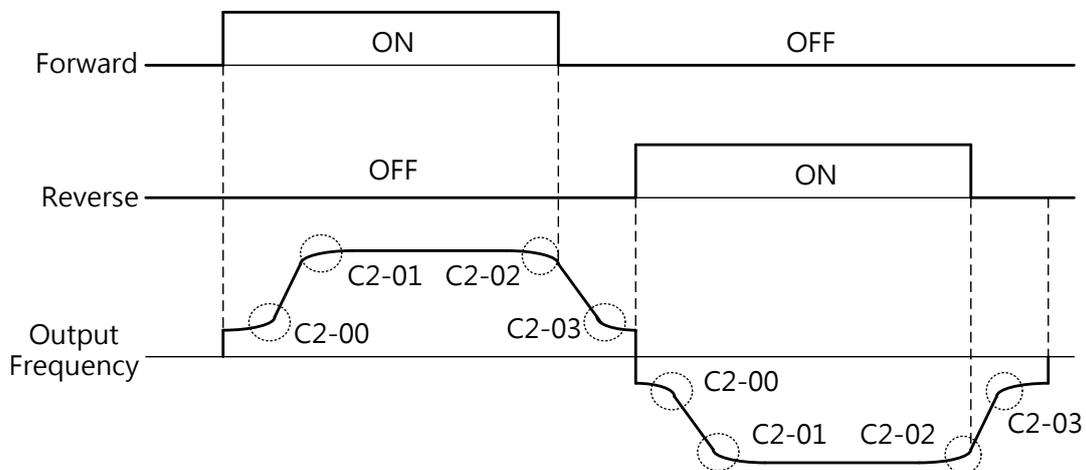


Figure 6.23 S-Curve Characteristics during Forward and Reverse

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

Actual acceleration time= acceleration time setting+(C2-00+C2-01) / 2

Actual deceleration time=deceleration time setting +(C2-02+C2-03) / 2

C3 Torque Compensation

The torque compensation is to enlarge the torque by increasing the output voltage when larger load is applied. The drive detects the increased amount of the load by the output current and adjusts the control with higher output voltage.

Note: Check if the motor parameters and the V/F pattern are set correctly before setting the torque compensation.

■ C3-00 Torque Compensation Gain

Sets the gain for the motor 1 Torque compensation.

No.	Name	Setting Range	Default
C3-00	Torque Compensation Gain	0.00 to 2.50	Determined by A1-02

□ Torque Compensation in Closed-Loop and Open-Loop V/F Control

The drive calculates the voltage loss on the output side using the output voltage and the d2-04 (Motor Line-to-Line Resistance) value, and improves the torque when it is insufficient during start or running at low speed.

Compensation voltage=Motor primary voltage loss x C3-00.

□ Torque Compensation in Open-Loop Vector Control, PM Open-Loop Vector Control

The motor excitation currents d-axis and q-axis are controlled separately. Torque compensation affects q-axis current only.

Compensation voltage= q-axis voltage compensation (calculated by q-axis current) x C3-00

Adjustment:

Normally there is no need to change this parameter setting. However, adjust this setting by scaling of 0.05 in the following situations.

- Increase the setting when using a long motor cable
- Decrease the setting when the motor oscillates
- During running at low speed, adjust C3-00 to keep the output current below the drive rated current

Note:

- Do not change the setting in Open-Loop Vector Control as it will reduce the torque accuracy.
- Do not change the setting in PM Open-Loop Vector Control as an excessive setting value could cause overcompensation and motor oscillation.

■ C3- 01 Motor 2 Torque Compensation Gain

Same function as parameter C3-00. Sets the gain for the motor 2 Torque compensation

No.	Name	Setting Range	Default
C3-01	Motor 2 Torque Compensation Gain	0.00 to 2.50	Determined by A1-02

■ C3-02 Torque Compensation Primary Delay Time

Sets the Torque compensation primary delay time.

No.	Name	Setting Range	Default
C3-02	Torque Compensation Primary Delay Time	0 to 10000 ms	Determined by A1-02

Adjustment:

Normally there is no need to change this parameter setting. However, adjust this setting by in the following situations.

- Increase the setting when the motor oscillates
- Decrease the setting when the response is slow

■ C3-03 Torque Compensation Primary Delay Time 2 (Only for Open-Loop Vector Control)

Sets the delay time used during motor regeneration or Speed Search. Increase this value if an ov (Overvoltage) fault is triggered at the end of deceleration with high inertia, or during a sudden change in the load.

No.	Name	Setting Range	Default
C3-03	Torque Compensation Primary Delay Time 2	0 to 10000 ms	150 ms

■ C3-04 Torque Compensation at Start (Forward) (Only for Open-Loop Vector Control)

Sets the torque compensation at start with forward rotation as a percentage of the motor rated torque. This function improves the speed response at start with a heavy load. Torque compensation time set in C3-06 is applied at start in forward direction. This feature is disabled when 0.0 is set to this parameter.

Set this parameter for applications with a dynamic load such as a lift.

No.	Name	Setting Range	Default
C3-04	Torque Compensation at Start (Forward)	0.0 to 200.0%	0.0%

■ C3-05 Torque Compensation at Start (Reverse) (Only for Open-Loop Vector Control)

Sets the torque compensation at start with reverse rotation as a percentage of the motor rated torque. This function improves the speed response at start with a heavy load. Torque compensation time set in C3-06 is applied at start in reverse direction. This feature is disabled when 0.0 is set to this parameter.

No.	Name	Setting Range	Default

C3-05	Torque Compensation at Start (Reverse)	-200.0 to 0.0%	0.0%
-------	--	----------------	------

■ **C3-06 Torque Compensation Time at Start (Only for Open-Loop Vector Control)**

Sets the time to apply the torque compensation at start determined by C3-04, C3-05.

No.	Name	Setting Range	Default
C3-06	Torque Compensation Time at Start	0 to 200 ms	10 ms

C4 ASR (Automatic Speed Regulator)

The ASR function controls the output frequency in Closed-Loop V/F Control, or torque command in IM/PM Closed-Loop Vector Control) to minimize the deviation between speed command and actual motor speed.

ASR operation is illustrated in the following figure.

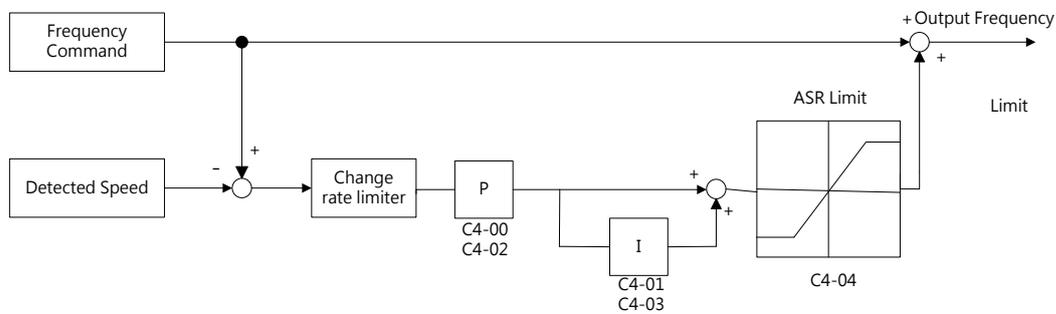


Figure 6.24 ASR Operation in Closed-Loop V/F Control

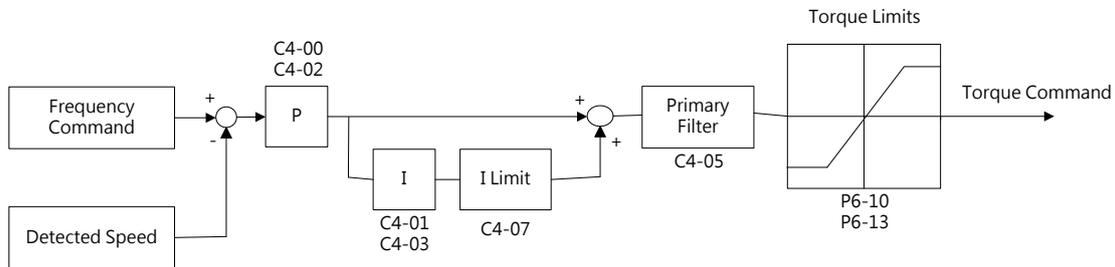


Figure 6.25 ASR Operation in IM/PM Closed-Loop Vector Control

■ **C4-00/C4-01 ASR Proportional Gain 1 (P)/ ASR Integral Time 1 (I)**

□ C4- 00 (ASR Proportional Gain 1 (P)) Adjustment

Increase this setting to improve the response. Normally the heavier the load is, the higher this setting should be. However, an excessive value will cause motor oscillation.

The ASR proportional gain operation is illustrated in the following figure.

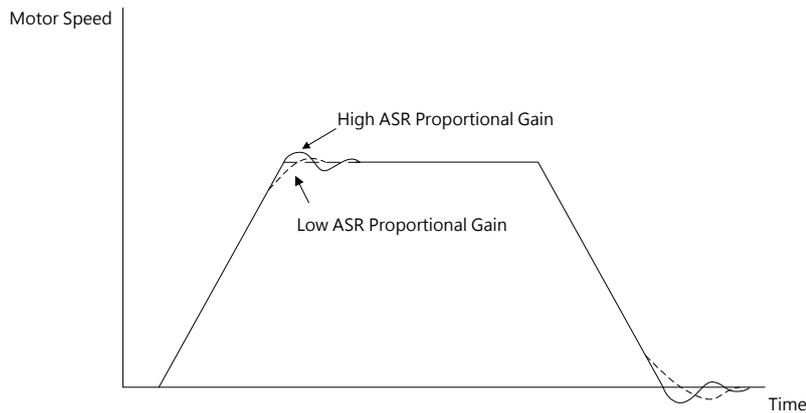


Figure 6.26 Responses in ASR Proportional Gain

□ C4- 01(ASR Integral Time 1 (I)) Adjustment

A long integral time causes slow response. On the other hand, if the integral time is too short, the motor will oscillate.

The ASR integral operation is illustrated in the following figure.

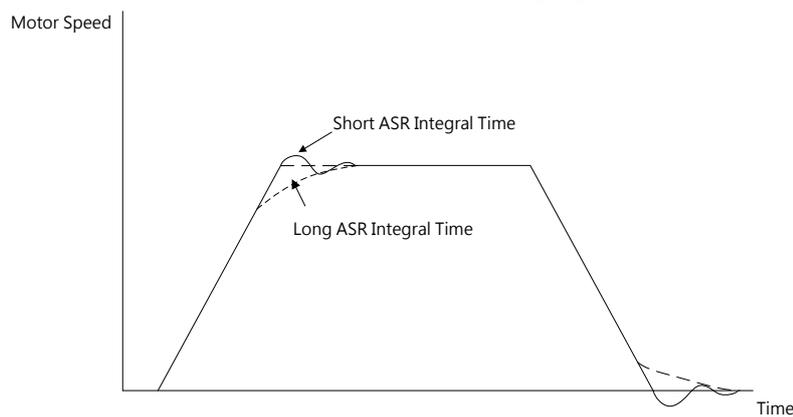


Figure 6.27 Responses in ASR Integral Time

- If the response is slow at the maximum output frequency, increase ASR proportional gain or decrease ASR integral time.
- If the motor oscillates at the maximum output frequency, decrease ASR proportional gain or increase ASR integral time.
- When setting C4-00 and C4-01, adjust ASR proportional gain first before adjusting ASR integral time.

□ ASR Proportional Gain Adjustment in Closed-Loop V/F Control

· Adjustment at Minimum Output Frequency

Run the motor at the minimum output frequency. Increase the C4-02 setting as much as possible without oscillation. Then decrease the C4-03 setting as much as possible without oscillation. Monitor the drive output current to ensure it is below 50% of the drive rated

current. If the output current is over 50%, decrease the C4-02 setting and increase the C4-03 setting.

- Adjustment at Maximum Output Frequency

Run the motor at the maximum output frequency. Increase the C4-00 setting as much as possible without oscillation. Then decrease the C4-01 setting as much as possible without oscillation.

- Precise Adjustment

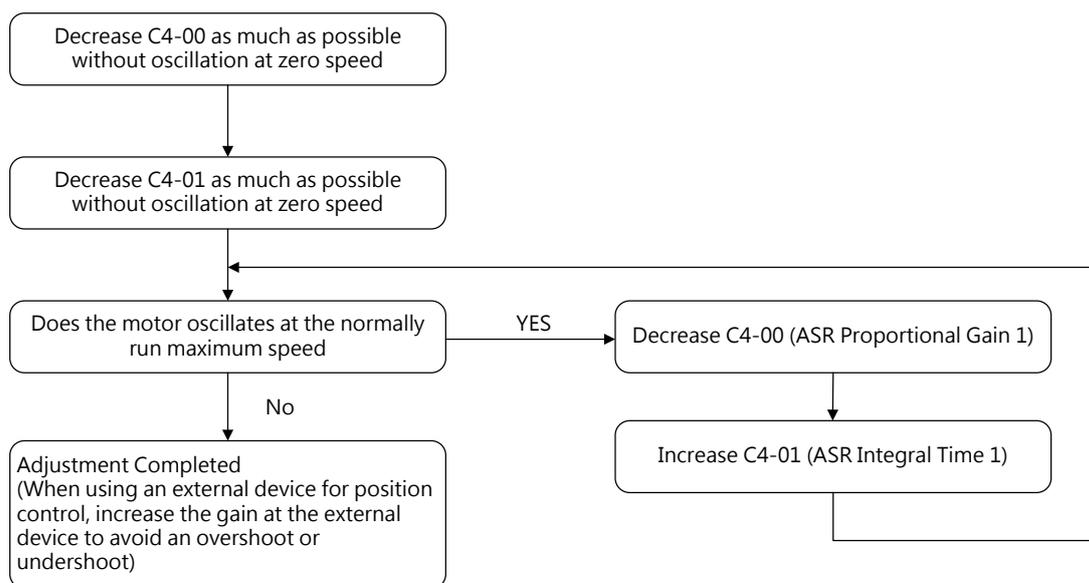
To adjust the proportional gain with higher precision, monitor the speed pattern while adjusting the parameters. Follow the same instructions for adjustment in Vector Control. To minimize the deviation between the output frequency and the frequency command during acceleration and deceleration.

If motor oscillates at the end of acceleration, decrease the C4-00 setting and increase the C4-01 setting. If motor oscillates at stop, decrease the C4-02 setting and increase the C4-03 setting.

If the proportional gain cannot eliminate overshoot or undershoot, decrease the C4-04 setting first and then decrease the frequency command compensation limit.

□ ASR Proportional Gain Adjustment in IM/PM Closed-Loop Vector Control

Adjust C4-01 and C4-02 when the drive is connected to the machinery. Adjust the parameters by the following steps.



No.	Name	Setting Range	Default
-----	------	---------------	---------

C4-00	ASR Proportional Gain 1 (P)	0.00 to 300.00	Determined by A1-02
C4-01	ASR Integral Time 1 (I)	0.000 to 10.000 s	Determined by A1-02

Note: C4-00 is locked up in the Auto-Tuning mode (t1-01 = 9 or t2-00 = 9).

■ C4- 02 / C4- 03 ASR Proportional Gain 2 (P) / ASR Integral Time 2 (I)

Adjusts the speed response. Follow the same instructions in C4-00 and C4-01. These parameters are not available in Closed-Loop Vector Control. In Closed-Loop V/F Control, set C4-00 and C4-01 for maximum frequency and set C4-02 and C4-03 for minimum frequency.

No.	Name	Setting Range	Default
C4-02	ASR Proportional Gain 2 (P)	0.00 to 300.00	Determined by A1-02
C4-03	ASR Integral Time 2 (I)	0.000 to 10.000 s	Determined by A1-02

■ C4-04 Retain

■ C4- 05 ASR Primary Delay Time

Sets the primary delay time when the torque command is given by ASR. Gradually increase this value in increments of 0.01 for loads with low rigidity or oscillation. Normally there is no need to change this setting.

No.	Name	Setting Range	Default
C4-05	ASR Primary Delay Time	0.000 to 0.500 s	Determined by A1-02

■ C4-06 ASR Gain Switching Frequency

Sets the frequency to switch between C4-00 and C4-02 (ASR proportional gain), and between C4-01 and C4-03 (ASR integral time 1, 2). ASR proportional gain and integral time switch at high or low speed prevents resonance. Set this value at about 80% of the frequency where motor oscillates or at the target speed.

No.	Name	Setting Range	Default
C4-06	ASR Gain Switching Frequency	0.0 to <1> <2>	0.0Hz

<1> In PM Closed-Loop Vector Control, the setting range is 0.0 to 100.0% and the default is 0.0% .

<2> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit)

□ Switching Gain of High/ Low Speed

Switch the gain of high speed and low speed if resonance occurs during high or low speed operation. Figure 6.29 illustrates how the motor speed switches the proportional gain (P) and integral time (I).

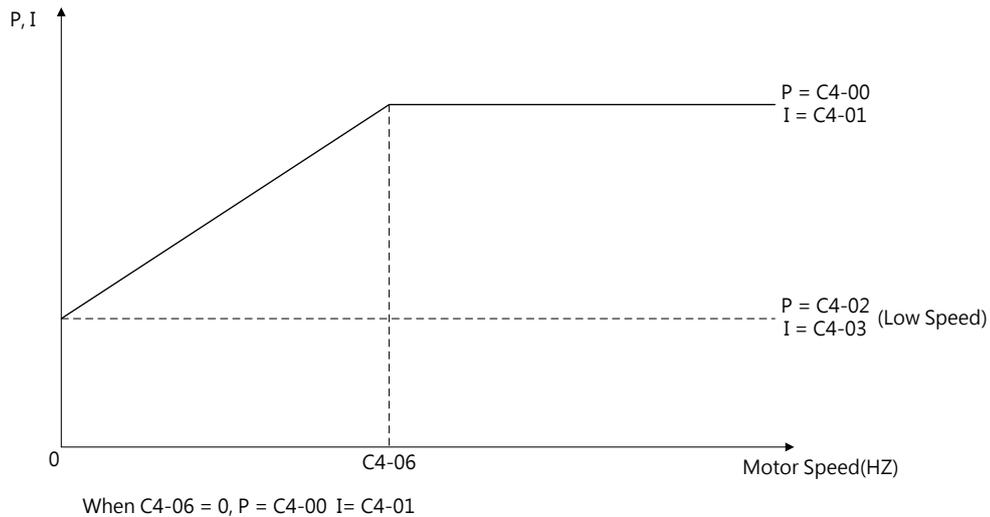


Figure 6.29 Switching Gain of High/ Low Speed

■ **C4- 07 Retain**

■ **C4- 11/C4- 12 Motor 2 ASR Proportional Gain 1 (P) / Motor 2 ASR Integral Time 1**

Determines the ASR responsiveness at the maximum output frequency for motor 2. Same function as C4-00 and C4-01. Refer to C4-00 and C4-01 for details.

No.	Name	Setting Range	Default
C4-11	Motor 2 ASR Proportional Gain 1 (P)	0.00 to 300.00	Determined by d1-12
C4-12	Motor 2 ASR Integral Time 1	0.000 to 10.000 s	Determined by d1-12

■ **C4- 13/C4- 14 Motor 2 ASR Proportional Gain 2 (P) / Motor 2 ASR Integral Time 2**

Determines the ASR responsiveness at the minimum output frequency for motor 2. Same function as C4-02 and C4-03. Refer to C4-02 and C4-03 for details.

No.	Name	Setting Range	Default
C4-13	Motor 2 ASR Proportional Gain 2 (P)	0.00 to 300.00	Determined by d1-12
C4-14	Motor 2 ASR Integral Time 2	0.000 to 10.000 s	Determined by d1-12

■ **C4- 16 Motor 2 ASR Primary Delay Time**

Sets the motor 2 primary delay time when the torque command is given by ASR. Same function as C4-05. Refer to C4-05 for details.

Note: Normal there is no need to change this setting.

No.	Name	Setting Range	Default
C4-16	Motor 2 ASR Primary Delay Time	0.000 to 0.500 s	Determined by d1-12

■ **C4- 17 Motor 2 ASR Gain Switching Frequency**

Sets the frequency to switch between C4-00 and C4-02 (ASR proportional gain), and between C4-01 and C4-03 (ASR integral time 1, 2). Same function as C4-06. Refer to C4-06 for details.

No.	Name	Setting Range	Default
C4-17	Motor 2 ASR Gain Switching Frequency	0.0 to <1>	0.0 Hz

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit)

■ C4- 18 Retain

C5 Slip Compensation

The heavier the load is at IM motors, the slower the motor speed is. The Slip Compensation function can improve the speed accuracy in such situations.

Note: Check if the settings of d2-00 (Motor Rated Current), d2-01 (Motor Rated Slip) and d2-02 (Motor No-Load Current) are correct before adjusting this parameter. It is automatically set by Auto-Tuning in Open-Loop Vector Control.

■ C5- 00 Slip Compensation Gain

Sets the slip compensation gain to improve the speed accuracy for heavy loads. Normally there is no need to change this parameter. However, adjust the setting in the following situations.

- Increase the setting if the motor speed is lower than the frequency command.
- Decrease the setting if the motor speed is higher than the frequency command.

No.	Name	Setting Range	Default
C5-00	Slip Compensation Gain	0.0 to 2.5	Determined by A1-02

Note: When A1-02 = 0 (Open-Loop V/F Control), the default setting is 0.0. When A1-02 = 0 (Open-Loop Vector Control), the default setting is 1.0.

■ C5- 01 Slip Compensation Primary Delay Time

Sets the slip compensation primary delay time to stabilize the motor speed or to improve the speed response. Normally there is no need to change this parameter. However, adjust the setting in the following situations.

- Decrease the setting if the slip compensation response is too slow.
- Increase the setting if the motor speed is unstable.

No.	Name	Setting Range	Default
C5-01	Slip Compensation Primary Delay Time	0 to 10000 ms	Determined by A1-02

Note: When A1-02 = 0 (Open-Loop V/F Control), the default setting is 2.000 s. When A1-02 = 0 (Open-Loop Vector Control), the default setting is 0.200 s.

■ C5- 02 Slip Compensation Limit

Sets the maximum slip compensation as percentage of the rated slip for motor 1.

No.	Name	Setting Range	Default
C5-02	Slip Compensation Limit	0 to 250%	200%

The slip compensation limit is constant within the constant torque range (frequency command \leq d1-04). In the output range (frequency command \geq d1-04), it is increased based on the setting in this parameter and the output frequency as shown in the following figure.

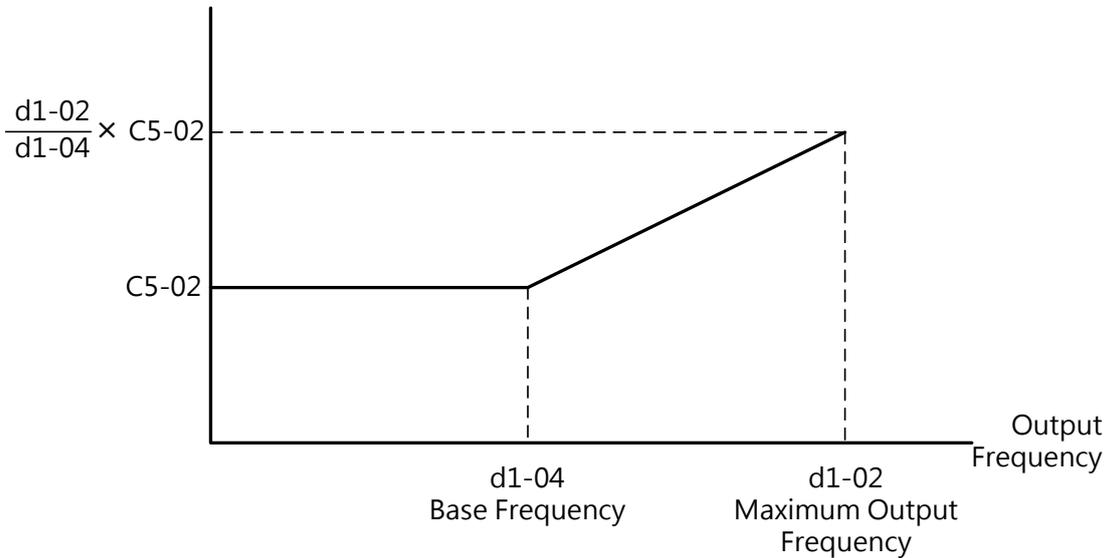


Figure 6.31 Slip Compensation Limit

■ C5- 08 Motor 2 Slip Compensation Gain

Same function as C5-00 (Slip Compensation Gain). Sets the slip compensation gain to improve the speed accuracy for heavy loads at motor 2. Check if the settings of d2-11 (Motor 2 Rated Current), d2-12 (Motor 2 Rated Slip) and d2-13 (Motor 2 No-Load Current) are correct before adjusting this parameter.

Normally there is no need to change this parameter. However, adjust the setting in the following situations.

- Increase the setting if the motor speed is lower than the frequency command.
- Decrease the setting if the motor speed is higher than the frequency command.

No.	Name	Setting Range	Default
C5-08	Motor 2 Slip Compensation Gain	0.0 to 2.5	Determined by d1-12

Note: When d1-12 = 0 (Open-Loop V/F Control), the default setting is 0.0. When d1-12 = 3 (Open-Loop Vector Control), the default setting is 1.0.

■ C5- 09 Motor 2 Slip Compensation Primary Delay Time

Same function as C5-01 (Slip Compensation Primary Delay Time). Sets the slip compensation primary delay time to stabilize the motor 2 speed or to improve the speed response. Normally

there is no need to change this parameter. However, adjust the setting in the following situations.

- Decrease the setting if the slip compensation response is too slow.
- Increase the setting if the motor speed is unstable.

No.	Name	Setting Range	Default
C5-09	Motor 2 Slip Compensation Primary Delay Time	0 to 10000 ms	Determined by d1-12

Note: When A1-02 = 0 (Open-Loop V/F Control), the default setting is 2.000 s. When A1-02 = 0 (Open-Loop Vector Control), the default setting is 0.200 s.

■ C5-10 Motor 2 Slip Compensation Limit

Sets the motor 2 maximum slip compensation as percentage of the rated slip for motor 1. Same function as C5-02 (Slip Compensation Limit). Refer to C5-02 for details.

No.	Name	Setting Range	Default
C5-10	Motor 2 Slip Compensation Limit	0 to 250%	200%

The slip compensation limit is constant within the constant torque range (frequency command \leq d1-15). In the output range (frequency command \geq d1-15), it is increased based on the setting in this parameter and the output frequency as shown in the following figure.

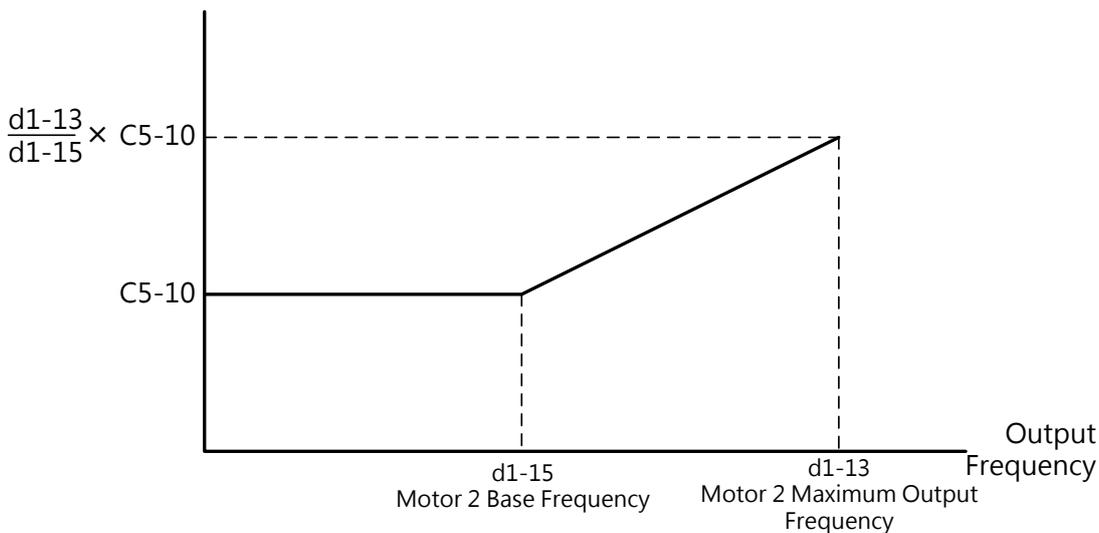


Figure 6.32 Motor 2 Slip Compensation Limit

C6 Carrier Frequency

■ C6-00 Carrier Frequency Selection

Sets the switching frequency of the drive output transistors. Adjust this setting to reduce audible noise and leakage current.

Note:

1. If this level is set higher than the default setting, the drive rated current will be decreased.

2. The default setting is 2 in PM motor control, 8 (8kHz) in IM motor HD mode and 2 (2kHz) in IM motor ND mode.

No.	Name	Setting Range	Default
C6-00	Carrier Frequency Selection	0 to 16	Determined by A1-02 and o2-03. Once A1-06 is redefined, the default will be changed accordingly

C6-00	Carrier Frequency	C6-00	Carrier Frequency	C6-00	Carrier Frequency
0	Determined by C6-01 to C6-03	6	6 kHz	12	12kHz
1	Retain	7	7 kHz	13	13 kHz
2	2 kHz	8	8 kHz	14	14kHz
3	3 kHz	9	9 kHz	15	15kHz
4	4 kHz	10	10 kHz	16	16kHz
5	5 kHz	11	11 kHz		

Setting Carrier Frequency

Situation	Solution
Speed and torque fluctuate at low speeds	Lower the carrier frequency
The drive noise affects peripheral devices	
Excessive leakage current from the drive	
Cable connecting the drive and motor is too long <1>	
Loud noise from the motor	Increase the carrier frequency <2>

<1> If the cable is too long, lower the carrier frequency according to the follow instructions.

<2> If ND mode is selected in A1-06, the default carrier frequency is 8kHz which is very close to the setting of 2kHz. The carrier frequency can be increased in ND mode. However the higher the setting is, the smaller the current will be.

Cable Length	Less than 50 m	Less than 100 m	More than 100 m
C6-00	2 to 16 (excluding 16 kHz)	2 to 5	2

Note: In PM Open-Loop Vector ControlP (A1-02=5), make sure the cable connecting the drive and motor is less than 100 meters.

■ C6-01/ C6-02/ C6-03 Maximum / Minimum Carrier Frequency / Carrier Frequency Proportional Gain

Set 0 to parameter C6-00 to enable this setting. Sets the maximum and minimum carrier frequency in V/F Control that the drive will adjust carrier frequency according to the output frequency.

No.	Name	Setting Range	Default
C6-01	Maximum Carrier Frequency	2.0 kHz to 16.0 kHz	Determined by C6-00

C6-02	Minimum Carrier Frequency	2.0 kHz to 16.0 kHz	
C6-03	Carrier Frequency Proportional Gain	0 to 99 <1>	

<1> This setting is only enabled when C6-00=0.

□ Setting a Fixed Carrier Frequency

C6-01 can be adjusted within the setting range when C6-00 is set to 0.
Set the same value in C6-01 and C6-02 in control methods other than V/F Control.

□ Setting a Variable Carrier Frequency (Only for V/F Control)

In V/F Control, the carrier frequency can be set up to change linearly with the output frequency by setting C6-01, C6-02 and C6-03 as shown in Figure 6.33.

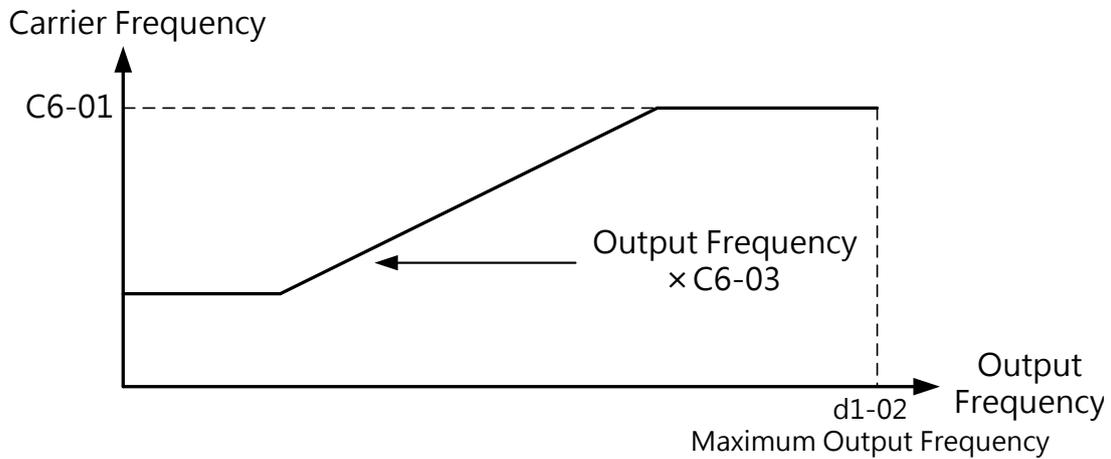


Figure 6.33 Carrier Frequency Changes Based on Output Frequency

Note:

1. When C6-03 > 27 and C6-01 < C6-02, the carrier frequency will be fixed to the value set to C6-01.
2. When C6-03 < 7, C6-02 is disabled and the carrier frequency will be fixed to the value set to C6-01.

■ C6-04 Retain

□ Carrier Frequency Changes Based on Rated Current

According to carrier frequency settings, the drive rated output current changes as shown in Table 6.11. The carrier frequency changes linearly with output current. Refer to Table 6.11 to calculate the value if it is not specified.

Table 6.11 Carrier Frequency Changes Based on Rated Current

Three Phase 400V Class						
Model	Rated Current (A)					
	HD (Heavy Duty)			ND (Normal Duty)		
	2kHz	8kHz	16kHz	2kHz	8kHz	16kHz

440V 1HP	3.4	3.4	2.0	4.1	3.4	2.0
440V 2HP	4.8	4.8	2.9	5.4	4.8	2.9
440V 3HP	5.5	5.5	3.3	6.9	5.5	3.3

6.4 Group L, Frequency Command

L1 Frequency Command

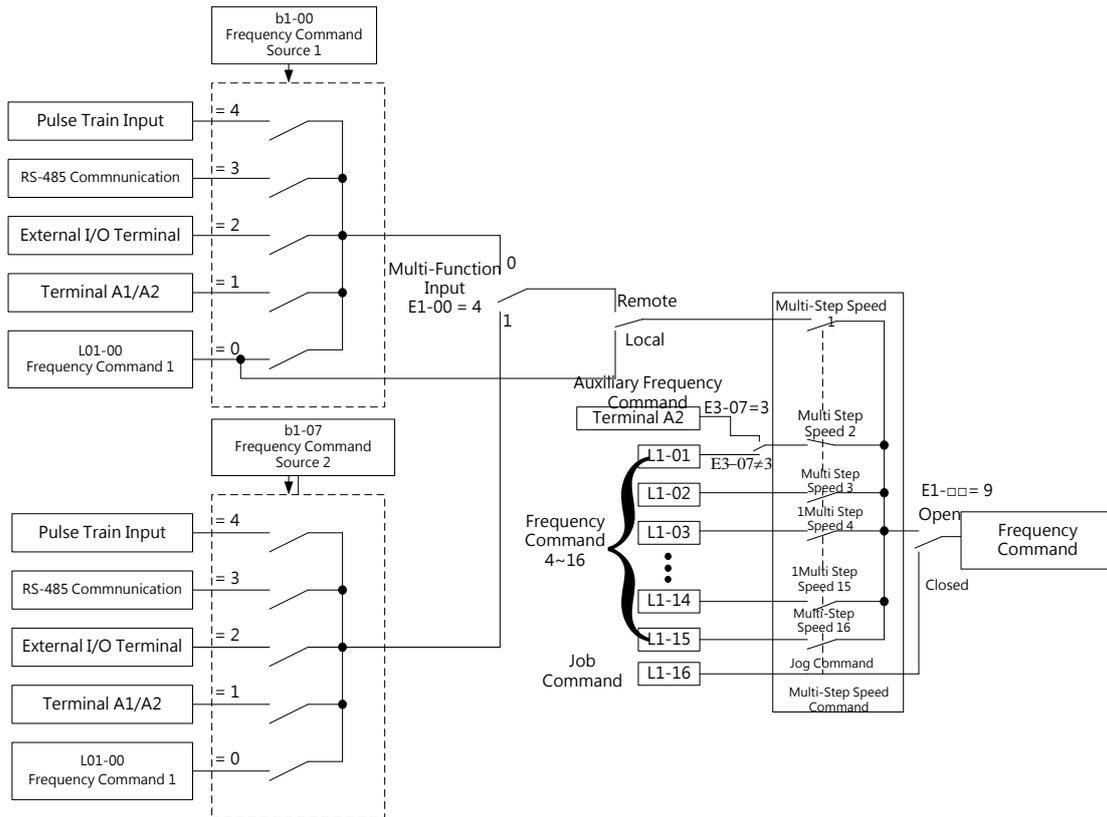


Figure 6.34 Frequency Command Diagram

■ L1-00 to L1-16 Frequency Command 1 to 16 and Jog Frequency Command

The drive allows the user to switch between up to 16 frequency commands and 1 Jog frequency command. The drive uses the selected acceleration and deceleration times when switching between each frequency command.

The Job frequency command overrides frequency command 1 to 16.

No.	Name	Setting Range	Default
L1-00 to L1-15	Frequency Command 1 to 16	0.00Hz to <1> <2> <3>	L1-00 5.00Hz L1-01 8.00Hz L1-02 10.00Hz L1-03 12.00Hz

			L1-04 15.00Hz L1-05 20.00Hz L1-06 25.00Hz L1-07 30.00Hz L1-08 35.00Hz L1-09 40.00Hz L1-10 42.00Hz L1-11 45.00Hz L1-12 50.00Hz L1-13 50.00Hz L1-14 50.00Hz L1-15 50.00Hz
L1-16	Jog Frequency Command	0.00Hz to <1> <2> <3>	6.00 Hz <2>

<1> The upper limit is determined by d1-02 (Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit).

<2> If L2-00 (Frequency Upper Limit) is adjusted, the excessive frequency in L1-00 to L1-15 will be automatically set to the upper limit determined in L2-00.

□ Setting Multi-Step Speed

To assign a multi-step speed command to a multi-function input, set E1-□□ = 5, 6, 7, 8 (Multi-Step Speed 1, 2, 3, 4). To assign the Jog frequency command to a multi-function input, set E1-□□ = 9.

Table 6.12 Multi-Step Speed Command and Multi-Function Terminal Combinations

Frequency Command	Multi-Step Speed Command 1 E1-□□=5	Multi-Step Speed Command 2 E1-□□=6	Multi-Step Speed Command 3 E1-□□=7	Multi-Step Speed Command 4 E1-□□=8	Multi-Step Speed Command 5 E1-□□=9
Frequency Command 1 (L1-00: set in b1-00)	OFF	OFF	OFF	OFF	OFF
Frequency Command 2 L1-01	ON	OFF	OFF	OFF	OFF
Frequency Command 3 L1-02	OFF	ON	OFF	OFF	OFF
Frequency Command 4 L1-03	ON	ON	OFF	OFF	OFF
Frequency Command 5 L1-04	OFF	OFF	ON	OFF	OFF
Frequency Command 6	ON	OFF	ON	OFF	OFF

L1-05					
Frequency Command 7 L1-06	OFF	ON	ON	OFF	OFF
Frequency Command 8 L1-07	ON	ON	ON	OFF	OFF
Frequency Command 9 L1-08	OFF	OFF	OFF	ON	OFF
Frequency Command 10 L1-09	ON	OFF	OFF	ON	OFF
Frequency Command 11 L1-10	OFF	ON	OFF	ON	OFF
Frequency Command 12 L1-11	ON	ON	OFF	ON	OFF
Frequency Command 13 L1-12	OFF	OFF	ON	ON	OFF
Frequency Command 14 L1-13	ON	OFF	ON	ON	OFF
Frequency Command 15 L1-14	OFF	ON	ON	ON	OFF
Frequency Command 16 L1-15	ON	ON	ON	ON	OFF
Jog Frequency Command L1-16 <1>	-	-	-	-	ON

<1> The Job frequency command overrides frequency command 1 to 16.

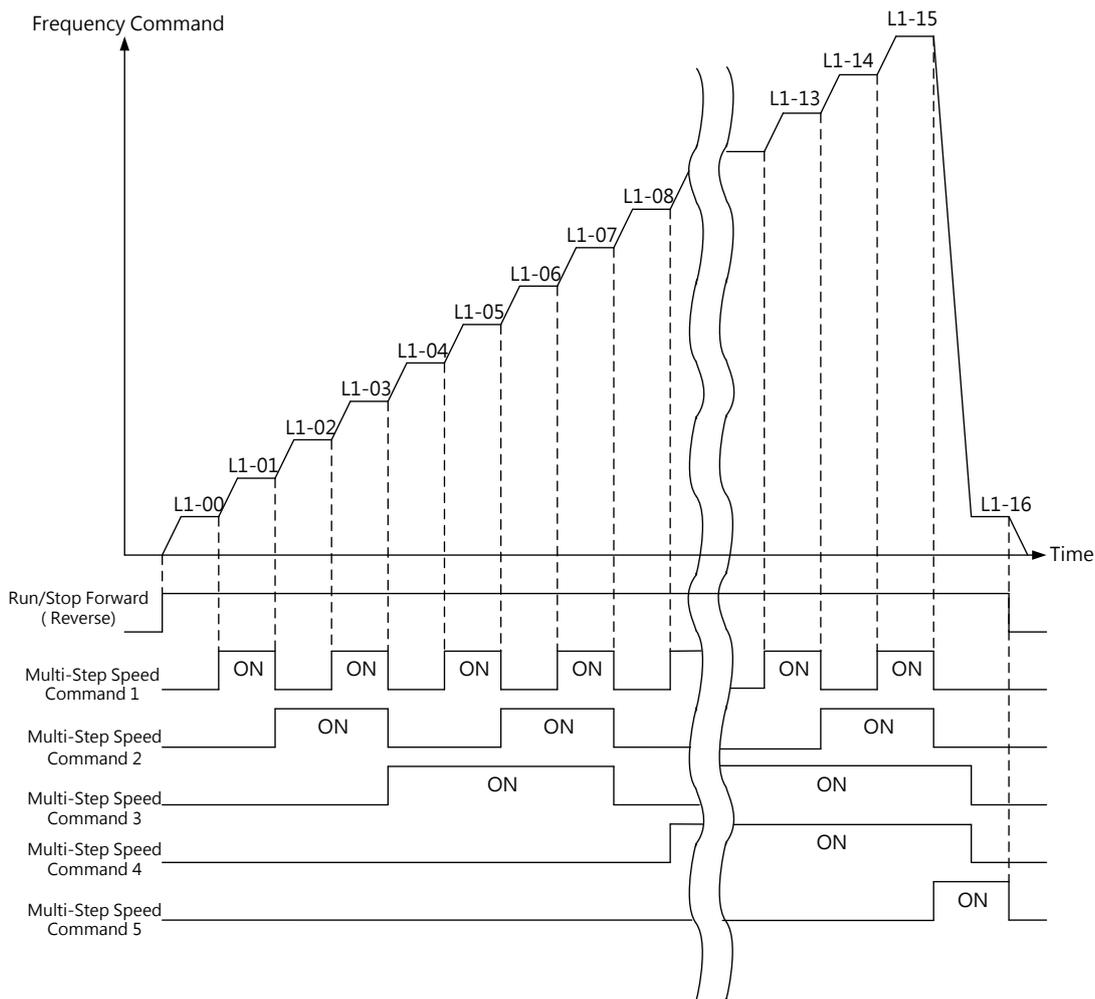


Figure 6.35 Jog Frequency Command Operation

L2 Frequency Upper/Lower Limit

Sets the upper and lower limits to make sure the motor runs in the range set to prevent resonance or machinery damage.

■ L2-00 Frequency Command Upper Limit

Sets the upper limit as a percentage of the maximum output frequency. Even if a frequency command higher than this level is entered, the drive will run at the limit set to this parameter.

No.	Name	Setting Range	Default
L2-00	Frequency Command Upper Limit	0.0 to 110.0 %	100.0 %

■ L2-01 Frequency Command Lower Limit

Sets the lower limit as a percentage of the maximum output frequency. Even if a frequency command lower than this level is entered, the drive will run at the limit set to this parameter.

No.	Name	Setting Range	Default
L2-01	Frequency Command Lower Limit	0.0 to 110.0%	0.0%

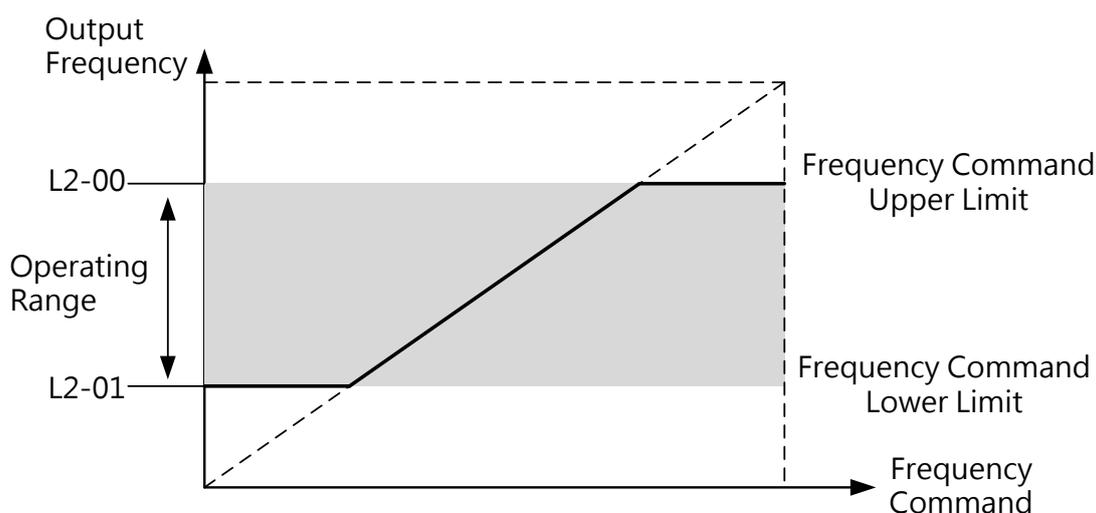


Figure 6.36 Frequency Command Upper and Lower Limits

L3 Jump Frequency

■ L3-00 to L3-03 Jump Frequency 1 to 3 / Jump Frequency Range

Sets the Jump frequency range to avoid operation at the speed causing resonance in the machinery. If the frequency command falls within a Jump frequency range, the drive will hold the frequency command at the upper limit of the range until accelerating past this range when the frequency command rises above that upper limit.

Sets L3-00 to L3-02 to 0.0 Hz to disable Jump frequency.

No.	Name	Setting Range	Default
L3-00	Jump Frequency 1	0.0 Hz to <1>	0.0 Hz <2>
L3-01	Jump Frequency 2		
L3-02	Jump Frequency 3		
L3-03	Jump Frequency Range	0.0 to d1-02 <3>	1.0 Hz <3>

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit).

<2> In PM Closed-Loop Vector Control, the setting range is 0.0 to 100.0% and the default setting is 0.0% .

<3> In PM Closed-Loop Vector Control, the setting range is 0.0 to 40.0% and the default setting is 1.0% .

The relationship between the output frequency and the Jump frequency is illustrated in the following figure.

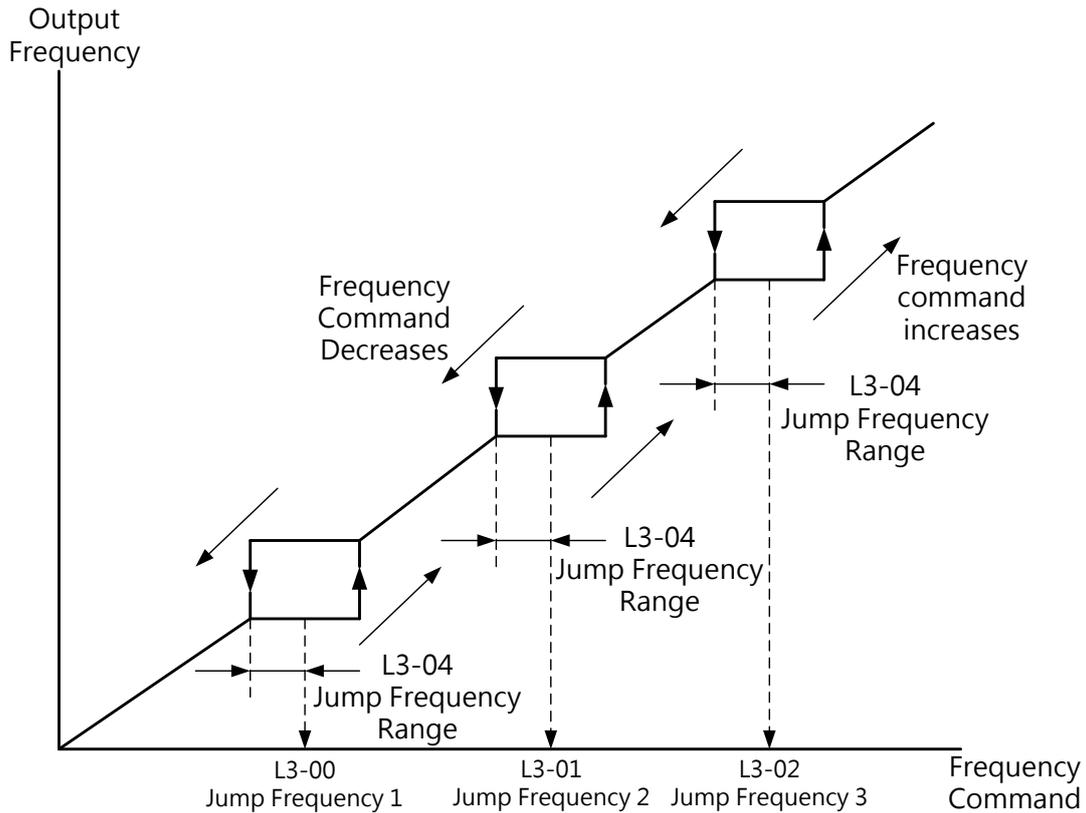


Figure 6.37 Jump Frequency Operation

Note:

1. The drive will not run at the frequency command or automatically change the frequency command within the Jump frequency range. The drive will smoothly run according to the acceleration and deceleration times C1-00 and C1-01.
2. When setting more than one Jump frequency, make sure $L3-00 \leq L3-01 \leq L3-02$.

L4 Up/Down 1, Up/Down 2 and Frequency Command Hold

■ L4-00 Up/Down Frequency Command Hold

This parameter is enabled in either of the following conditions.

- E1-□□ = 10/11 (Up/Down Command)
- E1-□□ = 12/13 (Up/Down 2 Command)

Determines whether or not to save the frequency command or the frequency bias (Up/Down 2) value when the Stop command is entered or the power supply is shut off.

No.	Name	Setting Range	Default
L4-00	Up/Down Frequency Command Hold	0, 1, 2	0

0 : Clear Up/Down Frequency Command at Stop

UP/DOWN commands via multi-function input terminals are enabled to adjust the speed only

when the drive is running. The frequency command will be reset to 0 Hz when the Stop command is entered or the drive power supply is shut off.

1 : Save Up/ Down Frequency Command at Stop

UP/DOWN commands via multi-function input terminals are enabled to adjust the speed only when the drive is running. The frequency command will be saved to L4-03 when the Stop command is entered. The drive will follow the saved frequency command when restart. To reset the saved frequency command to 0, enter UP or Down before giving any Run command.

2 : Accept Up/ Down Frequency Command at Stop

UP/DOWN commands via multi-function input terminals are enabled to adjust the speed even when the drive is not running. The frequency command will be saved to L4-03 when the Stop command is entered. The drive will follow the saved frequency command when restart.

■ **L4-01 Frequency Command Bias (Up 2 / Down 2)**

Sets the bias used to add to or subtract from the frequency command by Up/Down 2.

No.	Name	Setting Range	Default
L4-01	Frequency Command Bias (Up 2 / Down 2)	0.00 to 99.99 Hz	0.00 Hz

The operation is determined by the set value.

Setting L4-01=0.00 Hz

When the Up 2 or Down 2 command is enabled, the bias value is increased or decreased using the acceleration and deceleration times defined by L4-02 (Frequency Command Acc./Dec Setting) and the acceleration and deceleration times set in C1-00 to C1-07 will be overridden.

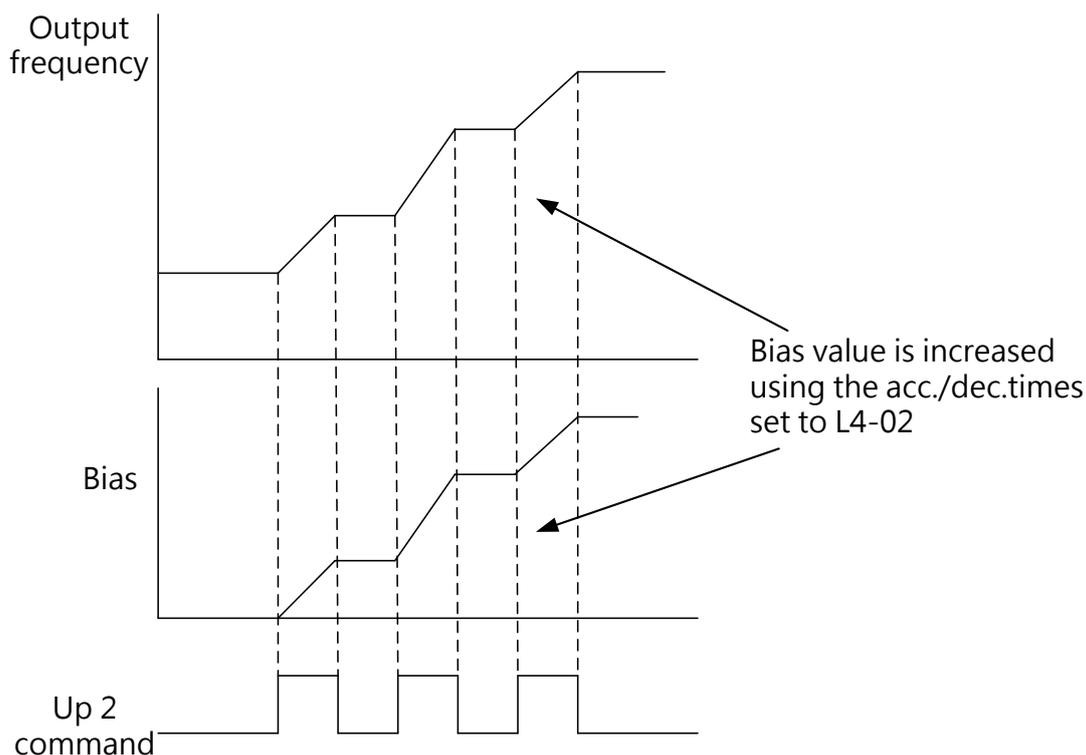


Figure 6.38 Up 2/Down 2 Bias when L4-01=0.0 Hz

Setting L4-01 \neq 0.00 Hz

If the Up 2 or Down 2 command is closed for less than 2 seconds, the bias is increased or decreased using the acceleration and deceleration times defined by L4-01 (Frequency Command Bias). If the Up 2 or Down 2 command is closed for more than 2 seconds, the bias is increased or decreased using the acceleration and deceleration times as Up 1/ Down 1. The frequency command changes with the acceleration and deceleration times defined by L4-02 (Frequency Command Acc./Dec Setting).

■ L4-02 Frequency Command Acc./Dec Setting (Up / Down 2)

Sets the acceleration/deceleration times to increase or decrease the frequency command bias for Up/Down 2.

No.	Name	Setting Range	Default
L4-02	Frequency Command Acc./Dec Setting (Up2 / Down 2)	0, 1	0

0 : Current Acc./Dec. Time

The drive uses the currently active acceleration or deceleration time.

1 : Acc./Dec. Time 4

The drive uses the C1-06 (Acceleration Time 4) and C1-07 (Deceleration Time 4).

■ L4-03 Up/Down Frequency Command Save

No.	Name	Setting Range	Default
L4-03	Up/Down Frequency Command Save	0.00 to <1>	0.00 Hz

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit).

Saves the frequency command from Up/Down 1 or Up/Down 2. Up/Down 1 and Up/Down 2 cannot be used at the same time. If a multi-function input terminal is assigned to Up/Down 1 and Up/Down 2, an alarm will be triggered.

This parameter is enabled in the following situations.

1. b1-00 (Frequency Command Selection 1) or b1-07 (Frequency Command Selection 2)=2 (Terminal Up/ Down)
2. E1-□□= 10/11 (Up/Down Command) or E1-□□= 12/13 (Up/Down 2 Command)
3. L4-00 (Frequency Command Hold)= 1 or 2 (Enabled)

The Up/Down Frequency Command Save can also be given when a Stop command is entered.

■ L4-04 Frequency Command Hold

This parameter is enabled when any multi-function terminal is assigned to E1-□□= 18 (Acc./Dec. Ramp Hold)

Determines whether or not to save the frequency command when the Stop command is entered or the power supply is shut off.

No.	Name	Setting Range	Default
L4-04	Frequency Command Hold	0, 1	0

0 : Disabled

The frequency command will be reset to 0 Hz when the Stop command is entered or the drive power supply is shut off. The active frequency command will be the drive uses when the drive restarts.

1 : Enabled

The frequency command will be saved when the Run command is removed, and remain active when the drive restarts. However if the input terminal assigned to E1-□□= 18 is open when applying the power supply, the saved frequency command will be reset to 0 Hz.

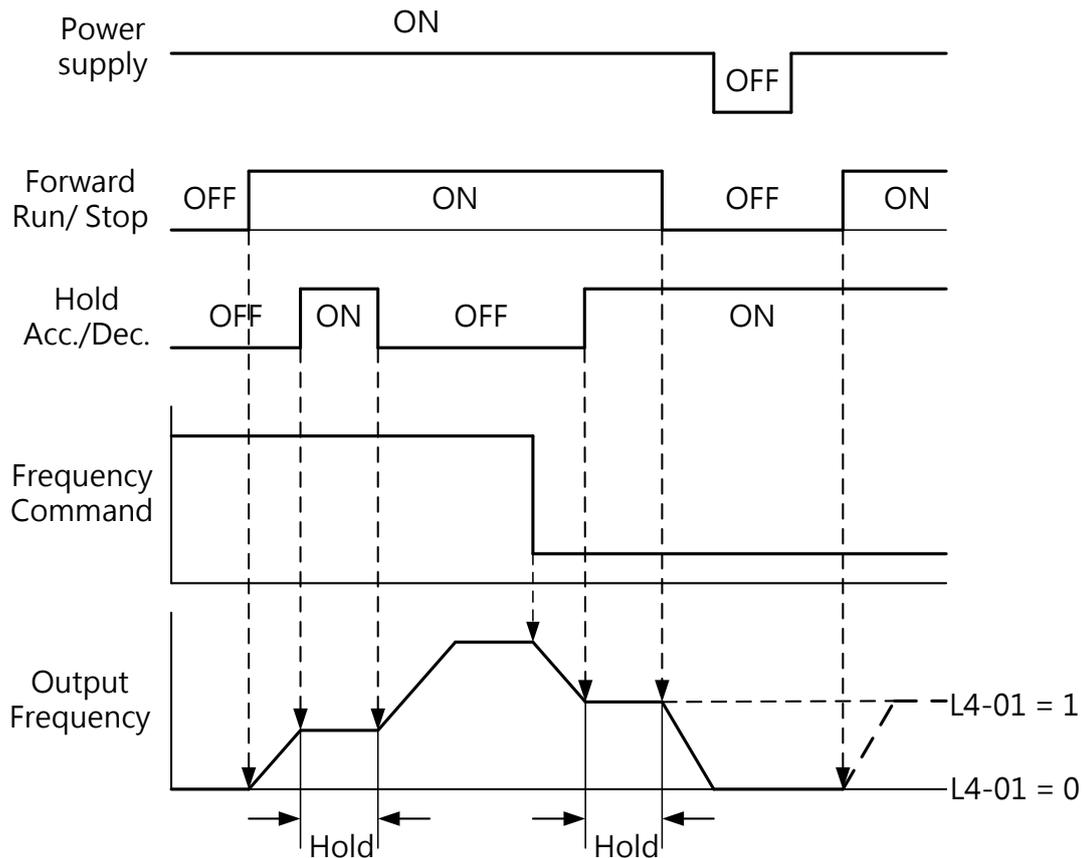


Figure 6.40 Frequency Command Hold with Acc./Dec. Hold

Up/Down and Up/Down 2

The frequency command will be saved when the Run command is removed, and remain active when the drive restarts. To reset the saved frequency command to 0 Hz, enter UP or DOWN before entering a Run command.

L5 Retain

L5 Torque Control

Torque Control gives a torque command as a target for the motor torque and is available when A1-02 = 3, 5 and 6 (Closed-Loop Vector Control, PM Closed-Loop Vector Control, Closed-Loop Torque Control).

■ Torque Control Operation

To enable the torque command, set A1-02 to 6, or assign E1-□□=70, when A1-02 = 3 or 5. The following is the torque control block diagram.

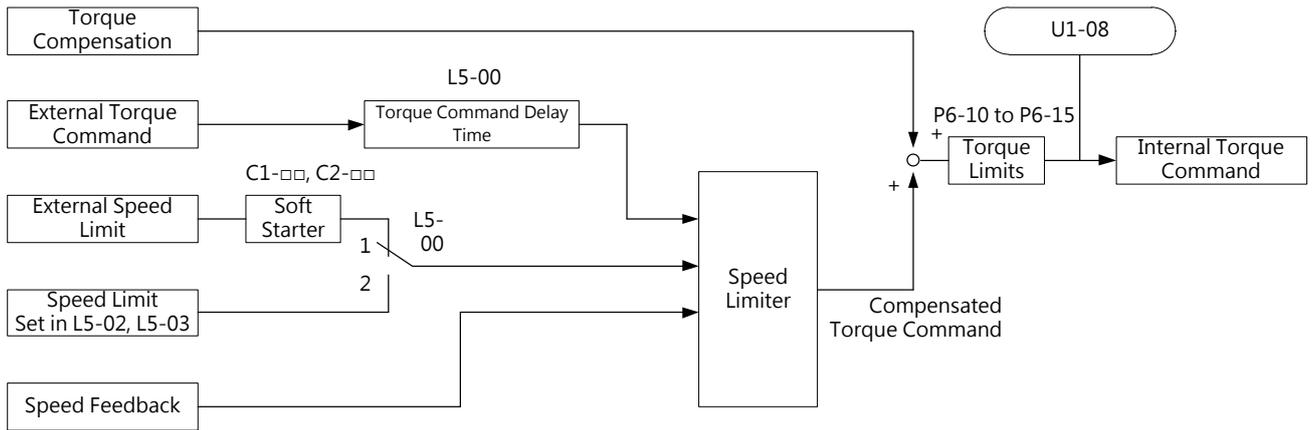


Figure 6.40.1 Torque Control Block Diagram

The externally input torque command is the target for the motor output torque. In Torque Control, if the motor torque command and the load torque are not in balance, the motor accelerates or decelerates accordingly. To prevent motor speed beyond the limit, compensate the external torque command if the speed reaches the limit. The compensation value is calculated using the speed limit, speed feedback, and the speed limit bias.

If an external torque compensation value is input, it is added to the speed limit compensated torque command value. The calculated value is limited by the P6-10 to P6-15 settings, and is then used as the internal torque command, which can be monitored in U1-08. The limits set in P6-10 to P6-15 have highest priority and the motor cannot be operated with a higher torque than these limits even if the external torque command value is higher.

■ Setting the Torque Command, Speed Limit and Torque compensation

□ Torque Control Command Sources

Set input values for Torque Control as per the following table.

Input Value	Signal Source	Settings	Remarks
Torque Command	Terminal A1 and A2	E3-01/ E3-07 = 15 <1>	Ensure the input terminal signal level settings and the signal being used are matched. Please refer to parameters E3.
Speed Limit	Signal selected as frequency command source (Selected by b1-00)	L5-01 = 1 The speed limit is taken from the input selected as frequency command source is b1-00 or b1-07	The C1-□□ settings for Acc./Dec. times and C 2-□□ settings for S-curve are applied to the speed limit value.
	L5-02, L5-03	L5-01 = 2	-

Torque Compensation	Terminal A1 and A2	E3-01/ E3-07 = 16 <1>	Ensure the input terminal signal level settings and the signal being used are matched. Please refer to parameters E3.
---------------------	--------------------	-----------------------	---

<1> Set terminals A1 and A2 to supply any of the speed limit, torque command, or torque compensation. Setting two inputs for the same function will trigger an oPE07 error.

□ Input value Polarity

The direction of the input values change depending on the polarity of the Run command and the input value.

*When the input value is "+", the Run command direction is forward.

*When the input value is "-", the Run command direction is reverse.

■ Switching Between Torque and Speed Control

The speed control and torque control can be switched when A1-02 = 3 or 5 (Closed-Loop Vector Control, PM Closed-Loop Vector Control) and E1-□□ = 70. If required by the application, set up a speed/torque control switch delay time using L5-04.

When switching from Speed Control to Torque Control, the torque limit becomes the torque command and the speed command becomes the speed limit. These changes are reversed when switching back to Speed Control.

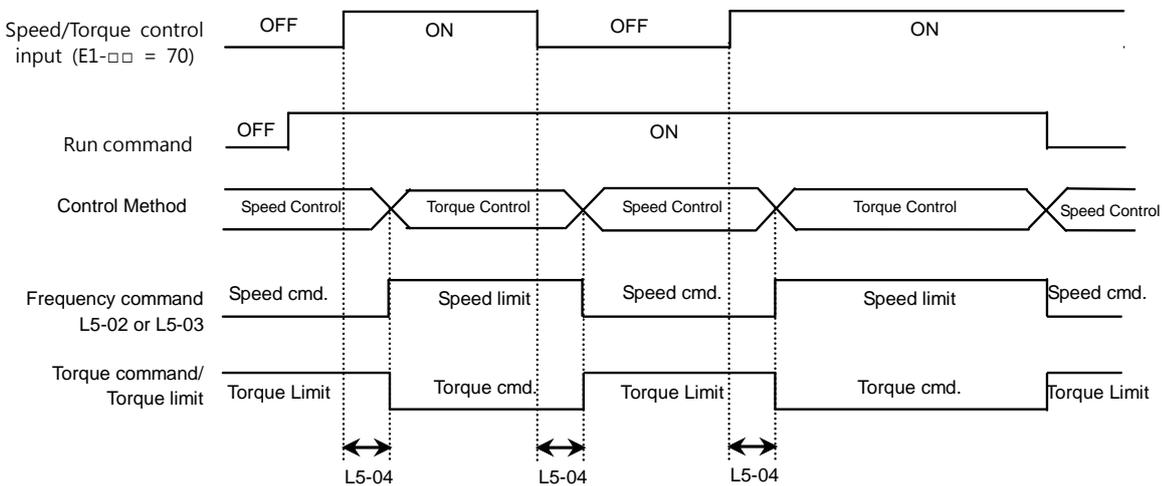


Figure 6.40.2 Speed/Torque Control Switching Time Operation

■ L5-00 Torque Command Delay Time

Apply a filter with the time constant set to parameter d5-02 to the torque reference signal to eliminate oscillation resulting from an unstable torque reference signal. Increase the setting when oscillation occurs during torque control.

No.	Name	Setting Range	Default
L5-00	Torque Command Delay Time	0 to 1000ms	0ms

■ L5-01 Speed Limit Selection

Selects the speed limit for Torque Control.

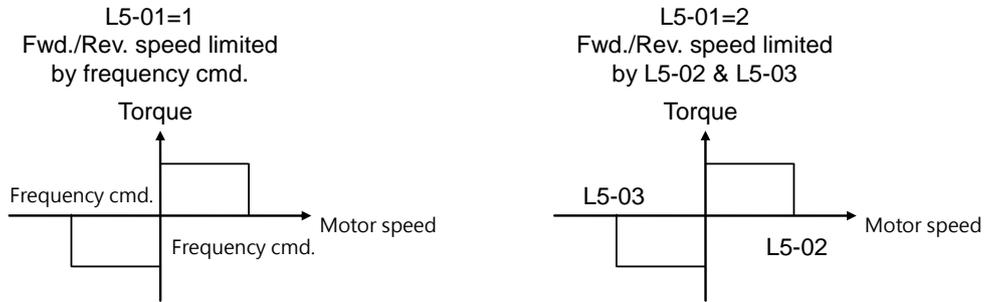
No.	Name	Setting Range	Default
L5-01	Speed Limit Selection	1, 2	1

1 : Frequency Command

The frequency command value set to b1-00 or b1-07 at the active command source will be used as speed limit. The C1-01 to C1-08 settings for acceleration and deceleration times and the C2-00 to C2-03 settings for S-curves will apply for the speed limit

2 : L5-02 and L5-03

Use the L5-02 and L5-03 settings as speed limit as a percentage of the maximum output frequency.



■ L5-02 Speed Limit Selection

Sets the forward speed limit during Torque Control as a percentage of highest speed when L5-01 = 2.

No.	Name	Setting Range	Default
L5-02	Forward Speed Limit	0 to 120 %	10 %

■ L5-03 Reverse Speed Limit Selection

Sets the reverse speed limit during Torque Control as a percentage of highest speed when L5-01 = 2.

No.	Name	Setting Range	Default
L5-03	Reverse Speed Limit	0 to 120 %	10 %

■ **L5-04 Speed/Torque Control Switch Delay Time**

Sets the delay time for switching between Speed Control and Torque Control.

No.	Name	Setting Range	Default
L5-04	Speed/Torque Control Switch Delay Time	0 to 1000 ms	0 ms

L6 Offset Frequency

■ **L6- 00 to L6- 02 Offset Frequency 1 to 3**

Sets the offset value as a percentage of the maximum output frequency to add to or subtract from the frequency command. Select the offset frequency in E1-□□ = 53, 54 and 55 (Offset Frequency 1 to 3). The offset frequency will not add up being minus value and run in a reverse direction as it is limited by the upper and lower limit.

No.	Name	Setting Range	Default
L6-00	Offset Frequency 1	-100.0 to 100.0%	0.0%
L6-01	Offset Frequency 2	-100.0 to 100.0%	0.0%
L6-02	Offset Frequency 3	-100.0 to 100.0%	0.0%

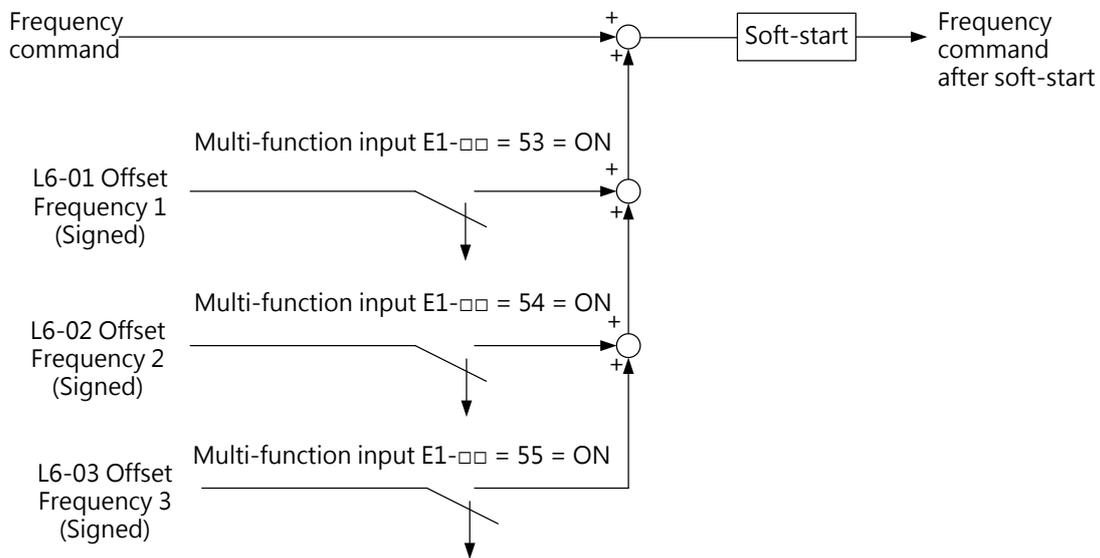


Figure 6.41 Offset Frequency Operation

6.5 Group d, Motor Parameters

d parameters set the V/F characteristics and motor parameters.

d1 V/F Characteristics

■ d1- 00 Input Voltage Setting

Sets this parameter to match the input voltage of the drive as the base for detections such as ov (Overvoltage) and Uv (Undervoltage).

Notice: To ensure the drive protection functions work properly, always set the input voltage of the drive (not motor) to this parameter. Failure to comply could cause damage to the machinery or injury to personnel.

No.	Name	Setting Range	Default
d1-00<1>	Input Voltage Setting	155 to 255 V <1>	230 V <1>

<1> This is for a 200 V AC drive. The value is doubled for a 400 V AC drive.

□ Values Related to Drive Input Voltage

The following detection levels are determined by the drive input voltage.

Voltage	d1-00 setting	Approximate Values				
		ov Detection Level	P7-13 (DC Braking Level) <1>	P2-03 (Detection Level)	P2-08 (Voltage Target During KEB)	P3-04 (Stall Prevention Level during Deceleration)
200 V	All settings	410 V	395 V	190 V	260 V	395
400 V	Setting ≥ 400 V	820 V	790 V	380 V	500 V	790
	Setting < 400 V	820 V	790 V	350 V	460 V	790

<1> The braking transistor operation level.

■ V/F Pattern Setting(d1-01)

The set V/F pattern determines the output voltage according to the frequency command. There are 15 different preset V/F patterns (setting 0 to E: only the maximum voltage and base voltage can be changed) and user-defined V/F patterns d1-02 to d1-11 (setting F).

■ d1- 01 V/F Pattern Selection

Selects 1 V/F pattern from the preset 15 ones or sets the user-defined V/F pattern.

No.	Name	Setting Range	Default
d1-01	V/F Pattern Selection	0 to 9, A to F <1>	F <2>

<1> This will not be reset by A1-03 (Reset).

<2> In Vector Control, d1-01 =F.

□ Preset V/F Pattern Selection (Setting Value 0 to E)

The preset V/F patterns are listed in Table 6.13. Select the appropriate V/F pattern and set to

this parameter. d1-02 to d1-11 cannot be edited.

Note:

1. An improper V/F could cause motor undertorque or increased current because of overexcitation.
2. d1-01 will not be reset by A1-03 (Reset).

Table 6.13 V/F Pattern Selection

Setting Value	Selections	Characteristic	Applications
0	50 Hz	Constant Torque	For general purpose applications such as conveyors. The torque remains constant regardless of the speed.
1	60 Hz		
2	60 Hz (with 50 Hz base)		
3	72 Hz (with 60 Hz base)		
4	50 Hz, cube of derate	Derated Torque	For applications such as fans, pumps and other derated loads.
5	50 Hz, square of derate		
6	60 Hz, cube of derate		
7	60 Hz, square of derate		
8	50 Hz, mid starting torque	High Starting Torque	<ul style="list-style-type: none"> · Long wiring between the drive and motor (more than 150 m) · Large starting torque is required such as elevators. · AC reactor is installed on the drive output side
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)	Fixed Output	Constant output voltage when running at 60 Hz and above.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		

The characteristics of the V/F patterns are illustrated in the following table. The table shows the V/F patterns for 200V. The voltage will be doubled for 400V.

Table 6.14 Constant Torque Characteristics (Setting 0 to 3)

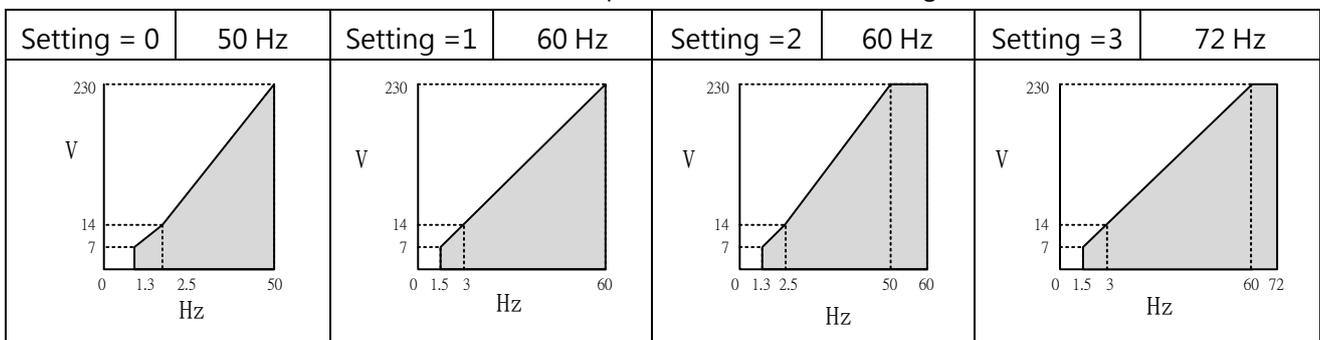


Table 6.15 Derated Torque Characteristics (Setting 4 to 7)

Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
-------------	-------	-------------	-------	-------------	-------	-------------	-------

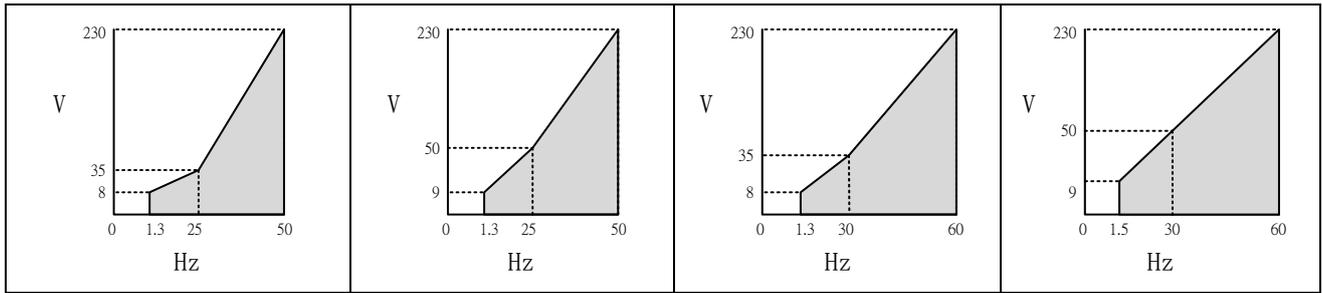


Table 6.16 High Starting Torque Characteristics (Setting 8 to B)

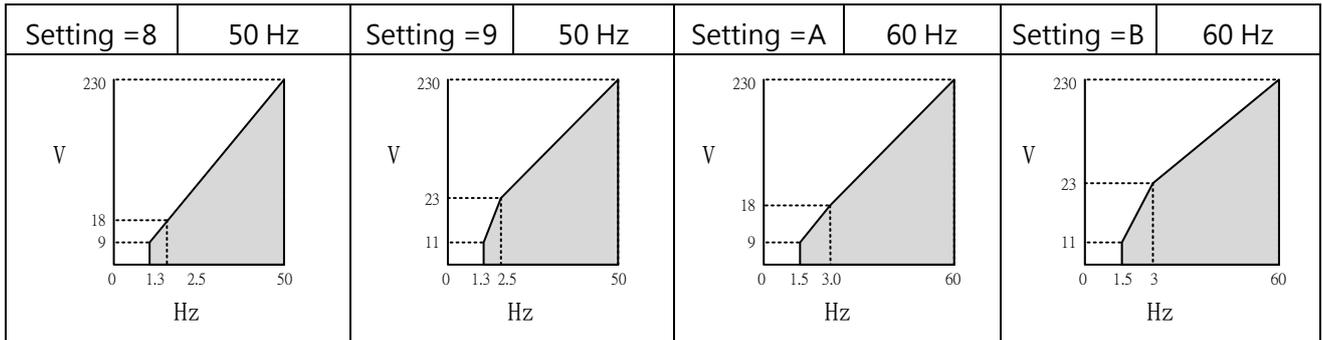
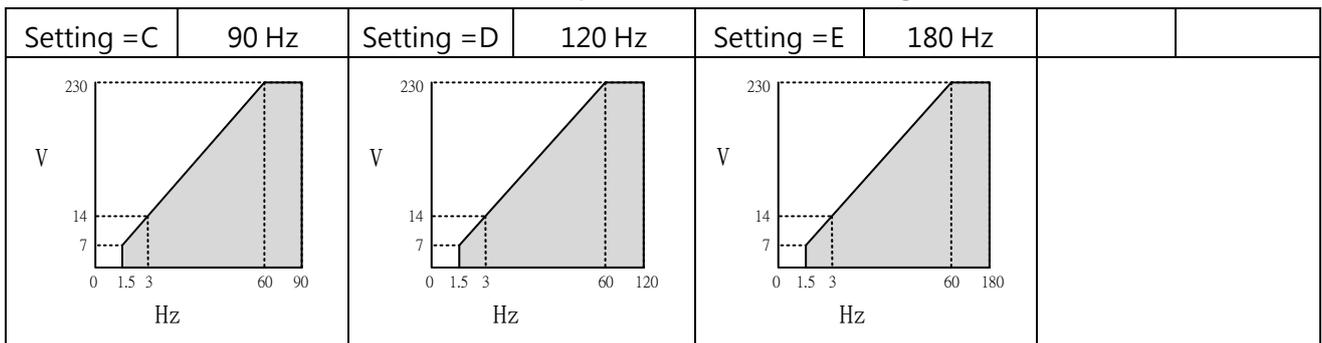


Table 6.17 Fixed Output Characteristics (Setting C to F)



User-Defined V/F Patterns (Default : F)

When d1-01 = F, d1-02 to d1-11 can be set to create a new pattern. d1-02 to d1-11 will be same as V/F pattern setting 1 after reset.

■ V/F Pattern Settings d1- 02 to d1- 11

When d1-01 ≤ E, the user can use d1-02 to d1-11 to monitor the V/F pattern settings. When d1-01 = F, d1-02 to d1-11 can be set to create a new pattern as shown in Figure 6.42.

No.	Name	Setting Range	Default
d1-02	Maximum Output Frequency	25.0 to 400.0 Hz	<1>
d1-03	Maximum Voltage	0.0 to 255.0 V <3>	<1> <2>
d1-04	Base Frequency	0.0 to d1-02	<1>
d1-05	Base Voltage	0.0 to 255.0 V <3>	0.0 V <2> <3>
d1-06	Middle Output Frequency	0.0 to d1-02	<1>

d1-07	Middle Output Frequency Voltage	0.0 to 255.0 V <3>	<1> <2>
d1-08	Minimum Output Frequency	0.0 to d1-02	<1>
d1-09	Minimum Output Frequency Voltage	0.0 to 255.0 V <3>	<1> <2>
d1-10	Middle Output Frequency 2	0.0 to d1-02	0.0 Hz <4>
d1-11	Middle Output Frequency Voltage 2	0.0 to 255.0 V <3>	0.0 V <2> <3> <4>

<1> The default setting is determined by A1-02 (Control Method Selection). The settings in this table are the default in Open-Loop V/F Control.

<2> This is the value for a 200 V AC drive. The value for a 400 V AC drive is doubled.

<3> This will be automatically changed in Auto-Tuning (rotational, stationary 1 or 2).

<4> d1-10 and d1-11 will be disabled when setting 0.0.

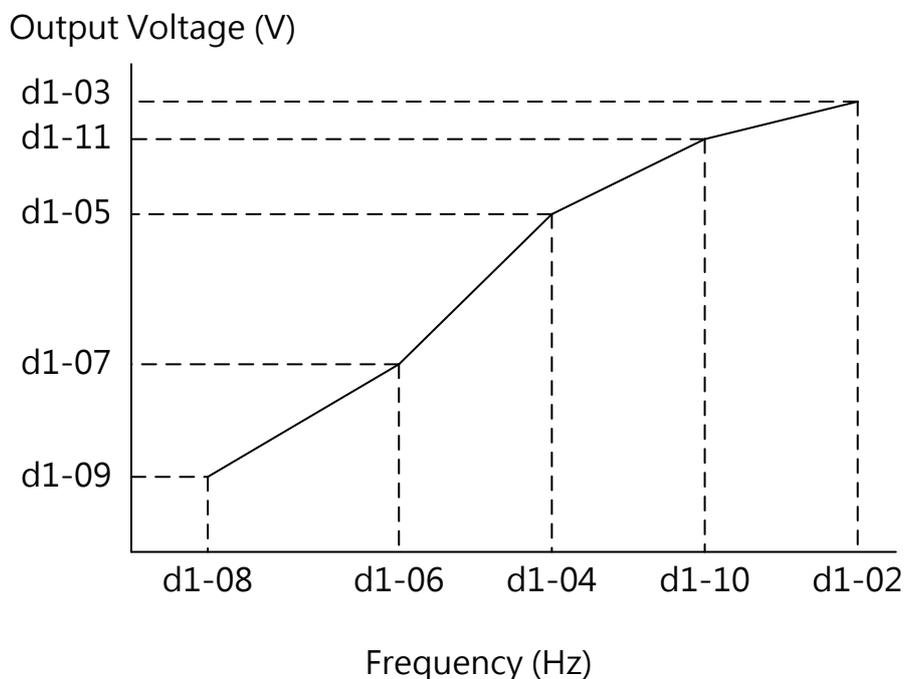


Figure 6.42 V/F Pattern

Note: When setting an user-defined V/F pattern, make sure $d1-08 \leq d1-06 < d1-04 \leq d1-10 \leq d1-02$.

V/F Characteristics for Motor 2

Use d1-13 to d1-22 to set the V/F pattern for motor 2.

If an multi-function input terminal assigned to E1-□□ = 51 switches to motor 2, and A1-02 is set to 5, 6 or 7, the oPE06 fault will be triggered.

■ d1- 12 Motor 2 Control Method Selection

Selects the control method for motor 2. A PM motor cannot be selected for motor 2.

Note:

1. When this setting is changed, all the parameters determined by d1-12 will be reset to the defaults.

2. The protection for oL1 (Motor Overload) fault is the same for both motor 1 and 2, which is determined by P1-00.

No.	Name	Setting Range	Default
d1-12	Motor 2 Control Method Selection	0 to 3	0

0 : Open-Loop V/F Control

1 : Err

2 : Open-Loop Vector Control

3 : Err

■ **d1- 13 to d1- 22**

Sets the V/F pattern for motor 2.

No.	Name	Setting Range	Default
d1-13	Motor 2 Max. Output Frequency	25.0 to 400.0 Hz	<2>
d1-14	Motor 2 Max. Voltage	0.0 to 255.0 V <1>	<1> <2>
d1-15	Motor 2 Base Frequency	0.0 to d1-13	<2>
d1-16	Motor 2 Base Voltage	0.0 to 255.0 V <1>	0.0 V <1> <3>
d1-17	Motor 2 Middle Output Frequency	0.0 to d1-13	<2>
d1-18	Motor 2 Middle Output Frequency Voltage	0.0 to 255.0 V <1>	<1> <2>
d1-19	Motor 2 Min. Output Frequency	0.0 to d1-13	<2>
d1-20	Motor 2 Min. Output Frequency Voltage	0.0 to 255.0 V <1>	<1> <2>
d1-21	Motor 2 Middle Output Frequency 2	0.0 to d1-13	0.0 Hz <4>
d1-22	Motor 2 Middle Output Frequency Voltage 2	0.0 to 255.0 V <1>	0.0 V <1> <3> <4>

<1> This is the value for a 200 V AC drive. The value for a 400 V AC drive is doubled.

<2> The default setting is determined by d1-12 (Motor 2 Control Method Selection).

<3> This will be automatically changed in Auto-Tuning (rotational, stationary 1 or 2).

<4> d1-21 and d1-22 will be disabled when setting 0.0.

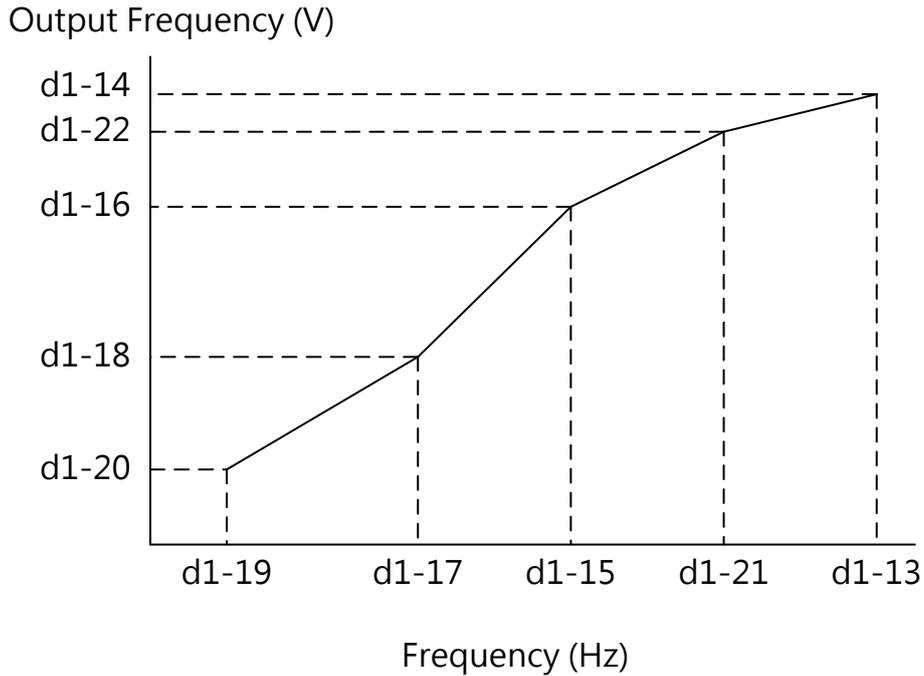


Figure 6.43 Motor 2 V/F Pattern

Note: When setting a V/F pattern, make sure $d1-19 \leq d1-17 < d1-15 \leq d1-21 \leq d1-13$

d2 Motor Parameters

d2 parameters set the important motor information required to perform optimum motor control. In open-loop control methods, the motor parameters will be set automatically during Auto-Tuning. If Auto-Tuning cannot be performed properly, set the parameters manually.

■ Motor 1 Parameters

■ d2- 00 Motor Rated Current

Sets the motor rated current according to the motor nameplate. This value determines the motor protection for torque and will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-00	Motor Rated Current	10 to 200% of drive rated current	Determined by o2-03, A1-06

Note:

1. If the maximum motor capacity the drive can run is less than 11kW, it will be displayed in units of 0.1A. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).
2. If the d2-00 (Motor Rated Current) setting is lower than the d2-02 (Motor No-Load Current) setting, an oPE02 (Parameter Range Setting Error) error will be triggered . Therefore properly set d2-02.

■ d2- 01 Motor Rated Slip

Sets the motor rated slip. This value determines the slip compensation and will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-01	Motor Rated Slip	0.00 to 20.00 Hz	Determined by o2-03, A1-06

If Auto-Tuning cannot be performed, use the information shown on the motor nameplate to calculate the motor rated slip by the following formula.

$$d2-01 = \frac{f - (n \cdot p)}{120}$$

f : rated frequency (Hz), n : motor rated speed (min^{-1}), p : number of motor poles

■ d2- 02 Motor No-Load Current

Sets the motor no-load current when running at no-load voltage and rated frequency. This will be set automatically during Auto-Tuning. This can also be set according to the no-load current listed on the motor test report. Contact the motor manufacturer for a test report.

No.	Name	Setting Range	Default
d2-02	Motor No-Load Current	0.0 A to [d2-00] A (exclude d2-00)	Determined by o2-03, A1-06

Note: If the maximum motor capacity the drive can run is less than 11kW, it will be displayed in units of 0.1A. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).

■ d2- 03 Number of Motor Poles

Sets the number of motor poles. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-03	Number of Motor Poles	2 to 48	4

■ d2- 04 Motor Line-to-Line Resistance

Sets the line-to-line resistance. This will be set automatically during Auto-Tuning. Do not mix motor line-to-line resistance with resistance for PM motors.

If Auto-Tuning cannot be performed, contact the motor manufacturer for the test report. Use the line-to-line resistance listed in the test report to calculate the line-to-line resistance by the following formula.

- E-type insulation: the resistance value (Ω) listed on the test report at $75^{\circ}\text{C} \times 0.92$
- B-type insulation: the resistance value (Ω) listed on the test report at $75^{\circ}\text{C} \times 0.92$
- F-type insulation: the resistance value (Ω) listed on the test report at $115^{\circ}\text{C} \times 0.87$

No.	Name	Setting Range	Default
-----	------	---------------	---------

d2-04	Motor Line-to-Line Resistance	0.000 to 65.000 Ω <1>	Determined by o2-03, A1-06
-------	-------------------------------	---------------------------------	-------------------------------

■ **d2- 05 Motor Leakage Inductance**

Sets the voltage drop caused by the motor leakage inductance relative to the motor rated frequency and current. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-05	Motor Leakage Inductance	0.00 to 650.00 mH	Determined by o2-03, A1-06

■ **d2- 06 Motor Rotor Resistance**

Sets the motor rotor resistance. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-06	Motor Rotor Resistance	0.000 to 65.000 Ω <1>	Determined by o2-03, A1-06

■ **d2- 07 Motor Mutual Inductance**

Sets the motor mutual inductance. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-07	Motor Mutual Inductance	0.0 to 6500.0 mH	Determined by o2-03, A1-06

■ **d2- 08 Retain**

■ **d2- 09 Retain**

■ **d2- 10 Motor Rated Capacity**

Sets the motor rated capacity in units of 0.01kW. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-10	Motor Rated Capacity	0.00 to 650.00 kW	Determined by o2-03

Note: If the maximum motor capacity the drive can run is less than 300kW, it will be displayed in units of 0.01kW. If the maximum motor capacity the drive can run is more than 300kW, it will be displayed in units of 0.1kW. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).

■ **Motor Parameters Manual Setting**

Use the information listed on the motor test report and follow the instructions below.

□ Motor Rated Current Setting

Enter the rated current written on the motor nameplate to d2-00.

□ Motor Rated Slip Setting

Use the rated speed written on the motor nameplate to calculate the motor rated slip and set to d2-01.

Motor rated slip = motor rated frequency [Hz]- rated speed (min⁻¹)×number of motor poles / 120

□ Motor No-Load Current Setting

Sets the motor no-load current when running at no-load voltage and rated frequency. This information is not written on the motor nameplate. Contact the motor manufacturer for the information.

□ Number of Motor Poles Setting

d2-03 is only enabled in Closed-Loop V/F Control and Closed-Loop Vector Control. Enter the number of motor poles written on the motor nameplate.

□ Motor Line-To-Line Resistance Setting

d2-04 will be set automatically during Auto-Tuning. However if Auto-Tuning cannot be performed, contact the motor manufacturer for the test report. Use the line-to-line resistance listed in the rest report to calculate the line-to-line resistance by the following formula.

- E-type insulation: the resistance value (Ω) listed on the test report at 75°C × 0.92
- B-type insulation: the resistance value (Ω) listed on the test report at 75°C × 0.92
- F-type insulation: the resistance value (Ω) listed on the test report at 115°C × 0.87

□ Motor Leakage Inductance Setting

d2-05 will be set automatically during Auto-Tuning.

□ Motor Rotor Resistance and Mutual Inductance Setting

d2-06 and d2-07 will be set automatically during rotational Auto-Tuning.

■ Motor 2 Parameters

The following parameters set the motor 2 information required to perform optimum motor control. In Vector Control, the motor parameters will be set automatically during Auto-Tuning. If Auto-Tuning cannot be performed properly, set the parameters manually.

■ d2- 11 Motor 2 Rated Current

Sets the motor rated current for motor 2 according to the motor nameplate. This value determines the motor protection for torque and will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-11	Motor 2 Rated Current	10% to 200% of the drive rated current	Determined by o2-03, A1-06

Note:

1. If the maximum motor capacity the drive can run is less than 11kW, it will be displayed in units of 0.1A. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).
2. If the d2-11 (Motor 2 Rated Current) setting is lower than the d2-13 (Motor 2 No-Load Current) setting, an oPE02 (Parameter Range Setting Error) error will be triggered. Therefore properly set d2-13.

■ d2- 12 Motor 2 Rated Slip

Sets the motor rated slip for motor 2. This value determines the slip compensation and will be set automatically during Auto-Tuning. Refer to d2-01 for the formula when setting manually.

No.	Name	Setting Range	Default
d2-12	Motor 2 Rated Slip	0.00 to 20.00 Hz	Determined by o2-03, A1-06

■ d2- 13 Motor 2 No-Load Current

Sets the motor 2 no-load current when running at no-load voltage and rated frequency. This will be set automatically during Auto-Tuning. This can also be set according to the no-load current listed on the motor test report. Contact the motor manufacturer for a test report.

No.	Name	Setting Range	Default
d2-13	Motor 2 No-Load Current	0 to d2-11	Determined by o2-03, A1-06

Note: If the maximum motor capacity the drive can run is less than 11kW, it will be displayed in units of 0.1A. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).

d2- 14 Number of Motor 2 Poles

Sets the number of motor poles for motor 2. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-14	Number of Motor 2 Poles	2 to 48	4

■ d2- 15 Motor 2 Line-to-Line Resistance

Sets the line-to-line resistance. This will be set automatically during Auto-Tuning. Do not mix motor line-to-line resistance with resistance for PM motors.

Refer to d2-04 for the formula when setting manually.

No.	Name	Setting Range	Default
-----	------	---------------	---------

d2-15	Motor 2 Line-to-Line Resistance	0.000 to 65.000 <1>	Determined by o2-03, A1-06
-------	---------------------------------	---------------------	-------------------------------

■ **d2- 16 Motor 2 Leakage Inductance**

Sets the motor leakage inductance for motor 2. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-16	Motor 2 Leakage Inductance	0.00 to 650.00 mH	Determined by o2-03, A1-06

■ **d2- 17 Motor 2 Rotor Resistance**

Sets the rotor resistance for motor 2. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-17	Motor 2 Rotor Resistance	0.000 to 65.000 Ω <1>	Determined by o2-03, A1-06

■ **d2- 18 Motor 2 Mutual Inductance**

Sets the motor mutual inductance for motor 2. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-18	Motor 2 Mutual Inductance	0.0 to 6500.0 mH	Determined by o2-03, A1-06

■ **d2- 19 Retain**

■ **d2- 20 Retain**

■ **d2- 21 Motor 2 Rated Capacity**

Sets the motor 2 rated capacity in units of 0.01kW. This will be set automatically during Auto-Tuning.

No.	Name	Setting Range	Default
d2-21	Motor 2 Rated Capacity	0.00 to 650.00 kW	Determined by o2-03

Note: If the maximum motor capacity the drive can run is less than 300kW, it will be displayed in units of 0.01kW. If the maximum motor capacity the drive can run is more than 300kW, it will be displayed in units of 0.1kW. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).

d3 PM Motor Parameters

Set d3 parameters to run a permanent motor. d3 parameters can be set manually and by

Auto-Tuning.

■ **d3- 00 Retain**

■ **d3- 01 PM Motor Rated Capacity**

Sets the motor rated capacity. This will be automatically set during Auto-Tuning. This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-01	PM Motor Rated Capacity	0.00 to 650.00 kW	Determined by o2-03

■ **d3- 02 PM Motor Rated Current**

Sets the motor rated current. This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-02	PM Motor Rated Current	10 to 200% of the drive rated current	Determined by o2-03

Note: If the maximum motor capacity the drive can run is less than 11kW, it will be displayed in units of 0.1A. The maximum motor capacity the drive can run is determined by A1-06 (ND/HD Mode).

■ **d3- 03 Number of PM Motor Poles**

Sets the number of motor poles. This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-03	Number of PM Motor Poles	2 to 48	6

■ **d3- 04 PM Motor Rotor Resistance (r 1)**

Sets the resistance per motor phase in units of 0.001 Ω . (Do not mix this with line-to-line resistance). If the resistance is calculated manually, set the value to this parameter. Refrain from change once this parameter is set. This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-04	PM Motor Rotor Resistance (r 1)	0.000 to 65.000 Ω	Determined by o2-03

■ **d3- 05 Motor d-Axis Inductance (Ld)**

Sets the motor d-axis inductance in units of 0.01 mH. This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-05	Motor d-Axis Inductance (Ld)	0.00 to 600.00 mH	Determined by o2-03

■ **d3- 06 Motor q-Axis Inductance (Lq)**

Sets the motor q-axis inductance in units of 0.01mH. This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-06	Motor q-Axis Inductance (Lq)	0.00 to 600.00 mH	Determined by o2-03

■ d3- 07 Motor Induction Voltage Constant 1 (Ke)

Sets the induced peak voltage per motor phase in units of 0.1 mV/(rad/s) (electrical angle). This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-07	Motor Induction Voltage Constant 1 (Ke)	0.0 to 2000.0 mV / (rad/s)	Determined by o2-03

Note: Set d3-09 to 0 before setting this parameter. If d3-07 and d3-09 are both set to 0 or value other than 0, an oPE08 alarm will be triggered.

■ d3- 08 Retain

■ d3- 09 Motor Induction Voltage Constant 2 (Ke)

Sets the induced line-to-line voltage in units of 0.1 mV/ (r/min) (mechanical angle). This is automatically set during Auto-Tuning.

No.	Name	Setting Range	Default
d3-09	Motor Induction Voltage Constant 2 (Ke)	0.0 to 2000.0 mV/rpm	Determined by o2-03

6.6 Group E, Multi-Function Terminals

E1 Multi-Function Digital Inputs

■ E1- 00 to E1- 07 Terminal S1 to S8 Function Selection

Assigns functions to multi-function terminals S1 to S8. Set this parameter according to Table 6.18.

No.	Name	Setting Range	Default
E1-00	Terminal S1 Function Selection	0 to 73	0 : 2-Wire Sequence Control (Forward/Stop)
E1-01	Terminal S2 Function Selection	0 to 73	1: 2-Wire Sequence Control (Forward/Stop)
E1-02	Terminal S3 Function Selection	0 to 73	23 : External Fault
E1-03	Terminal S4 Function Selection	0 to 73	39: Fault Reset
E1-04	Terminal S5 Function Selection	0 to 73	5: Multi-Step Speed Command 1
E1-05	Terminal S6 Function Selection	0 to 73	6: Multi-Step Speed Command 2

E1-06	Terminal S7 Function Selection	0 to 73	9: Jog Frequency
E1-07	Terminal S8 Function Selection	0 to 73	19: Baseblock Command (Normal Open.)

Table 6.18

Setting	Functions	Setting	Functions
0	2-Wire Sequence Control (Forward/Stop)	41	Multi-Function Analog Input Selection (Terminal A1 and A2)
1	2-Wire Sequence Control (Reverse/Stop)	42	Retain
2	3-Wire Sequence	43	Retain
3	Local/Remote Selection	44	Retain
4	Command Source 1/2 Selection	45	Communication Mode
5	Multi-Step Speed Command 1	46	PID Disable
6	Multi-Step Speed Command 2	47	PID Integral Reset
7	Multi-Step Speed Command 3	48	PID Integral Hold
8	Multi-Step Speed Command 4	49	PID Soft-Start On/Off
9	Jog Frequency	50	PID Input Characteristics Switch
10	Up Command	51	Motor 1/2 Switch
11	Down Command	52	Timer Input
12	Up2 Command	53	Offset Frequency 1
13	Down2 Command	54	Offset Frequency 2
14	FJOG Command	55	Offset Frequency 3
15	RJOG Command	56	KEB Command 1 (Normal Closed)
16	Acc./Dec. Time Selection 1	57	KEB Command 1 (Normal Open)
17	Acc./Dec. Time Selection 2	58	Retain
18	Acc./Dec. Ramp Hold	59	Retain
19	Baseblock Command (Normal Open)	60	Program Lockout
20	Baseblock Command (Normal Closed)	61	Analog Frequency Command Hold
21	Fast Stop (Normal Open)	62	Retain
22	Fast Stop (Normal Closed)	63	External Speed Search Command
23	External Fault 1	64	Retain
24	External Fault 2	65	DC Braking
25	External Fault 3	66	Retain
26	External Fault 4	67	Retain
27	External Fault 5	68	Retain
28	External Fault 6	69	Drive Enabled
29	External Fault 7	70	Retain
30	External Fault 8	71	Retain

31	External Fault 9	72	Retain
32	External Fault 10	73	Retain
33	External Fault 11		
34	External Fault 12		
35	External Fault 13		
36	External Fault 14		
37	External Fault 15		
38	External Fault 16		
39	Fault Reset		
40	oH2 (AC drive Overheat Alarm)		

0 : Forward/ Stop

1 : Reverse/ Stop

2 : 3-Wire Sequence Control

The multi-function input terminal S3 to S8 can be assigned to 3-Wire Sequence Control to be the input terminal for Forward/ Reverse Command. And terminals S1 and S2 will be automatically assigned to Run and Stop command separately.

When terminal S1 (Run command) closes for longer than 2ms, the drive runs the motor. When terminal S2 (Stop command) opens for even an instant, the drive stops the motor. When the input terminal assigned to 3-wire sequence control opens, the drive runs in forward direction, and when it is closed, the drive runs in reverse direction.

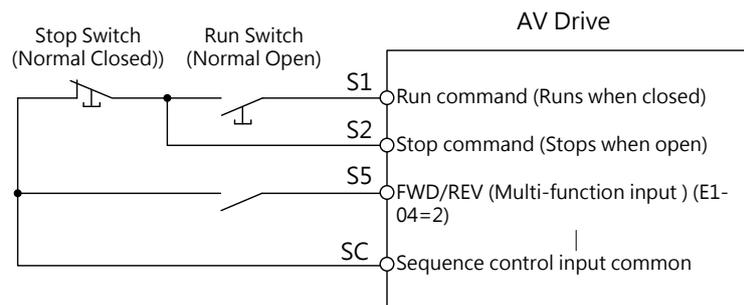


Table 6.44 3-Wire Sequence Wiring Diagram

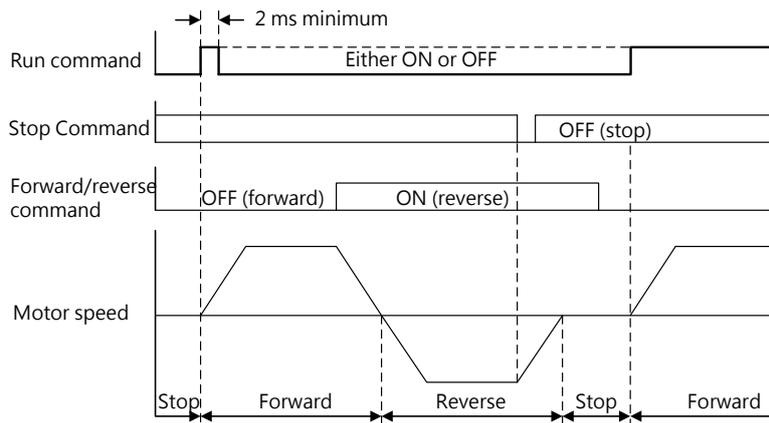


Table 6.45 3-Wire Sequence Operation

Note:

1. When entering a Run command, close the terminal for minimum 2 ms.
2. If the Run command is active at power up and b1-10 (Run Command at Power up)= 0 (Ignore), the protection will be triggered and LED indicator will flash. Set b1-10 (Run Command at Power up)=1 (Accept) to accept an active Run command at power up.

WARNING! Safety during Machinery Restart

- Make sure wiring for Run/ Stop and safety circuits are correct and check if the machinery is normal after applying power to the drive. Improper wiring could cause inquiry due to machinery sudden movement. When setting 3-wire sequence control, the drive could suddenly start running due to the control circuit momentarily close.
- If the Run command is active at power up with 3-wire sequence wiring and 2-wire sequence setting (default), the motor will run in reverse direction at power up. To avoid this, set b1-10 (Run Command at Power up)=0 (Ignore) to ignore an active Run command at power up.

3 : Local / Remote Selection

Switch the command source (Local/ Remote) by opening/ closing the terminal.

Terminal	Description
Open	Remote (If no terminal is assigned to E1-□□=4, b1-00 and b1-01 are enabled. If a multi-function input terminal is assigned to E1-□□=4, this terminal determines the source for frequency command and Run command.)
Closed	Local (Frequency command and Run command are entered from the keypad.)

Note:

1. When a multi-function input terminal is assigned to Local/ Remote, the LO/RE key on the keypad is disabled.
2.  LED indicator is lit in Local mode.
3. Local/ Remote cannot be switched during run. Refer to b1-05 for the run command action after switch.

4 : Command Source 1/2 Selection

Switches the command source by opening/ closing the terminal as per the following table.

Terminal	Description
Open	b1-00 (Frequency Command Selection 1) , b1-01 (Run Command Selection 1)
Closed	b1-07 (Frequency Command Selection 2) , b1-08 (Run Command Selection 2)

Note: This cannot be switched during run.

5 to 8 : Multi-Step Speed Command 1 to 4

Switches multi-step speed frequency commands L1-00 to L1-15. Refer to L1-00 to L1-15 (Frequency Command 1 to 16) for details.

9 : Jog Frequency

The Job frequency set by L1-16 is enabled when the terminal is closed. And the acceleration and deceleration time will be the values set to C1-11 and C1-12.

10/ 11 : Up/Down Command

Allows the frequency command to be set to two external terminals. Always set E1-□□= 10 (Up Command) and E1-□□= 11 (Down Command) in pair. To set the frequency by Up/ Down command, set b1-00 or b1-07 (Frequency Command Selection) to 2 (Terminal Up/Down) according to the following table.

Terminal		Drive Operation
Up Command (10)	Down Command (11)	
Open	Open	Hold the current frequency command
Closed	Open	Increase frequency command
Open	Closed	Decrease frequency command
Closed	Closed	Hold the current frequency command

Note: When only either of Up or Down command is assigned, an oPE03 (Multi-Function Input Selection Error) alarm will be triggered.

Using Up/ Down Function with Frequency Command Hold (L4-00)

- When the Run command is removed and L4-00 =0 (Frequency Command Hold Disabled), the Up/ Down command will be reset to 0.
- When L4-00=1 (Frequency Command Hold Enabled), the drive will save the frequency command set by Up/ Down command. When the drive stops, the frequency command will be saved. To reset the saved command to 0, remove the Run command and close the Up or Down input. Refer to L4-00 for details.

Using Up/ Down Function with Frequency Command Limits (L2)

- The frequency command upper limit is set in L2-00.

- The frequency command lower limit can be set by analog input or L2-01. If the analog input is set to 2, whichever smaller from the analog input or the L2-01 setting is the lower limit.

Up/ Down command operation is illustrated in the following figure. In this example, the frequency command lower limit is determined by L2-01.

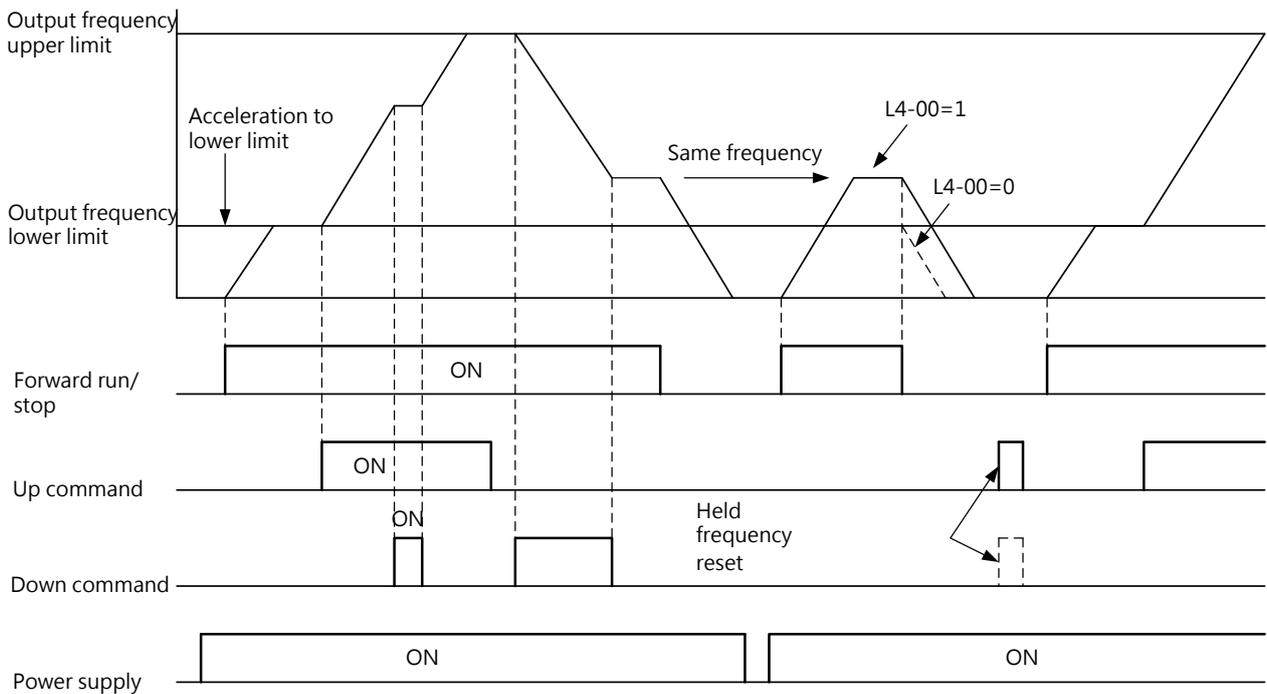


Figure 6.46 Up/ Down Command Operation

12/ 13: Up2/ Down 2 Command

Increases or decreases the frequency command bias. Refer to parameter L2 for details.

14/ 15: FJOG/RJOG Command

FJOG/RJOG commands are Jog frequency which do not require a Run command. And the acceleration and deceleration time will be the values set to C1-11 and C1-12. If the input terminal assigned to FJOG command is closed, the drive runs in forward direction at the frequency set to L1-16. The RJOG command also causes the same action in reverse direction. The FJOG and RJOG command can be set independently.

Note:

- The FJOG/ RJOG command overrides all other frequency commands. However, RJOG command is disabled when b1-03= 1 (Reverse Rotation Disabled).
- Entering both the FJOG and RJOG commands simultaneously for 500 ms or longer will trigger an alarm and the drive will ramp to stop.

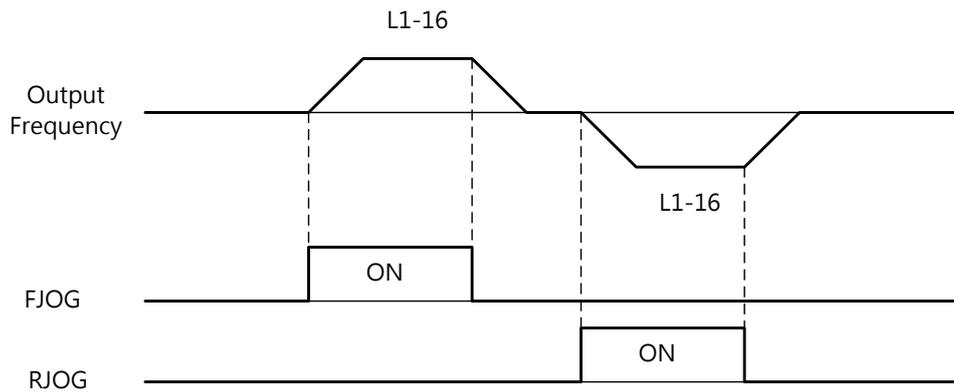


Figure 6.47 FJOG/ RJOG Command Operation

16 : Acc./Dec. Time Selection 1

Switches between C1-00, C1-01 (Acc./Dec. Time 1) and C1-02, C1-03 (Acc./Dec. Time 2) by opening or closing the terminal. Refer to C1-00 to C1-07 (Acc./Dec. Time 1 to 4) for details.

17 : Acc./Dec. Time Selection 2

Selects acceleration and deceleration times 1 to 4 in combination with E1-□□= 16 (Acc./Dec. Time Selection 1). Refer to C1-00 to C1-07 (Acc./Dec. 1 to 4) for details.

18 : Acc./Dec. Ramp Hold

When the terminal is closed, the drive holds the output frequency. When the terminal is reopened, the drive resumes the acceleration or deceleration. Refer to L4-00 (Frequency Command Hold) for details.

19: Baseblock Command (Normal Open)

20: Baseblock Command (Normal Closed)

A baseblock command shuts off the drive output immediately causing the motor to coast and the *bb* (baseblock) alarm to flash. When baseblock ends while a Run command is active, Speed Search will be performed to restart the motor.

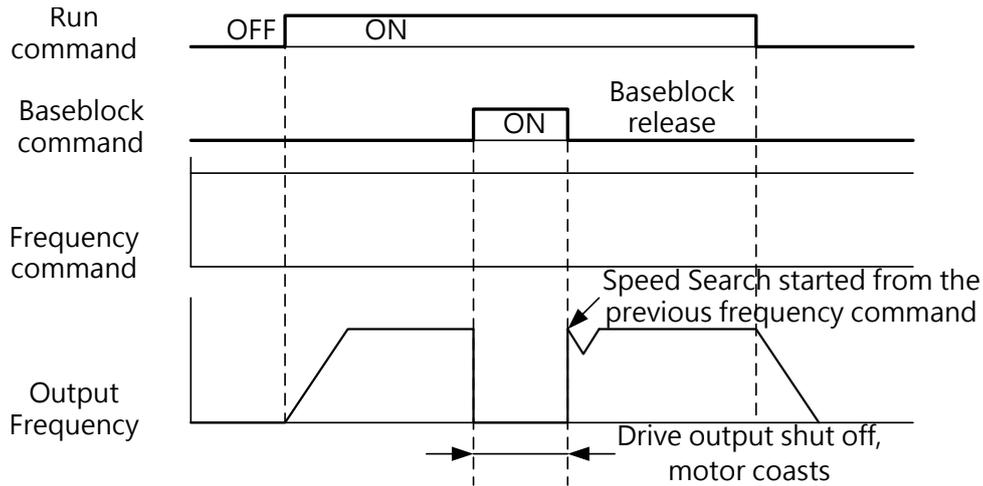


Figure 6.48 Baseblock Operation

Drive Operation	Input	
	Setting 19 (Normal Open)	Setting 20 (Normal Closed)
Normal operation	Open	Closed
Baseblock (drive output shut off)	Closed	Open

WARNING! In a lifting application, a baseblock command will shut off the drive output and cause the motor to coast. Therefore always make sure the brake is closed. Failure to comply could result in injury caused by a slipping load.

21/ 22: Fast Stop (Normal Open/ Normal Closed)

If a fast stop command is entered during run, the drives use the deceleration time set in C1-08 to stop the motor. Refer to C1-08 (Fast Stop Time). Once the fast stop command is entered, The drive can be restarted until a fully stop, removing the Fast Stop input and the Run command.

- To trigger Fast Stop with an normal open terminal, set E1-□□= 21.
- To trigger Fast Stop with an normal closed terminal, set E1-□□= 22.

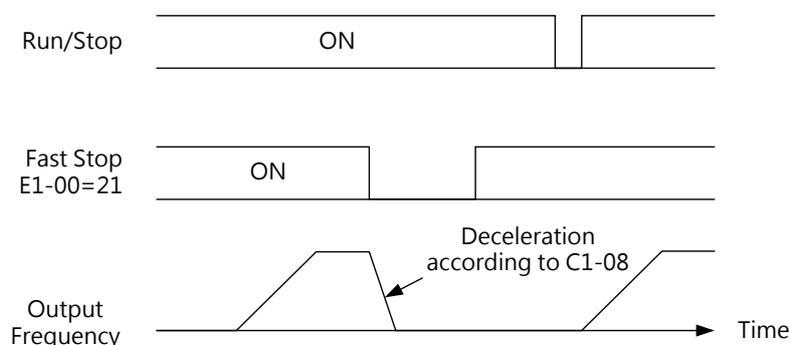


Figure 6.49 Fast Stop Operation

WARNING! Rapid deceleration could trigger an overvoltage fault. When the fault is triggered, the drive output

will be shut off the motor will coast resulting uncontrolled motor state. To avoid this, set an appropriate deceleration time to C1-08.

23 to 38 : External Fault

Stops the drive when problems occur with external devices.

To use the external fault function, set E1-00 to E1-07=23 to 38. While an external fault is triggered, EF□ will be displayed on the keypad where □ is the number of the terminal assigned to the external fault signal. For example, if an external fault signal is input to terminal S3, then EF3 will be displayed.

Selects the value to set to E1-□□ from a combination of the following three conditions:

- Input signal from peripheral devices
- Detection method of external fault
- Stopping method (for external fault detection)

The following table shows the combination of the conditions.

Setting	Input Signal <1>		Detection Method <2>		Stopping method			
	Normal Open	Normal Close	Always Detected	Detected during Run only	Ramp to Stop (fault)	Coast to Stop (fault)	Fast Stop (fault)	Alarm Only (continue operation)
23	○		○		○			
24		○	○		○			
25	○			○	○			
26		○		○	○			
27	○		○			○		
28		○	○			○		
29	○			○		○		
30		○		○		○		
31	○		○				○	
32		○	○				○	
33	○			○			○	
34		○		○			○	
35	○		○					○
36		○	○					○
37	○			○				○
38		○		○				○

<1> Determine the terminal status to detect the fault. (Normal Open: detection when terminal closed, normal closed: detection when terminal open)

<2> Determine the detection should be enabled only during run or always detected.

39: Fault Reset

When a fault is detected, close the assigned terminal output, shut off the drive output and stop the motor. Most of the faults cause the motor to coast, but stopping method can be set for some faults (e.g. P1-03 Motor Overheat Fault Operation Selection). To restart the drive, either remove the Run command, press the RESET key () on the keypad, or set 39 (Fault Reset) to any terminal input in E1-00 to E1-07 and close the terminal input.

Note: A fault reset signal will be ignored during run. Remove the Run command to perform fault reset.

40 : oH2 (AC drive Overheat Alarm)

When the input terminal is closed, oH2 alarm is triggered (the drive continue operation).

41 : Multi-Function Analog Input Selection(Terminal A1 and A2)

Enabled or disabled the multi-function analog input. When the assigned multi-function terminal input is open, the drive will ignore the analog input set to E3-12. To enable the analog input set to E3-12, close the input terminal.

45 : Communication Mode

Set this when using communications. The assigned terminal input can receive signals from Modbus or optional communication card.

46 : PID Disable

Even if PID control is enabled by b5-00 (PID Control Setting), closing the assigned input terminal will disable it. PID control remains active when the terminal is open.

47 : PID Integral Reset

Resets the PID control integral value to 0 when closing the input terminal.

48 : PID Integral Hold

Holds the PID integral value when the input terminal is closed, and restarts PID integral when the terminal is open.

49 : PID Soft-Start On/Off

Disables b5-16 (PID Command Acc./Dec. Time) when the input terminal is closed and enables it when the terminal is open.

50 : PID Input Characteristics Switch

Switches the PID input characteristics.

51 : Motor 1/2 Switch

Switches between IM motor 1 and IM motor 2 as illustrated in the following figure.

Note: When running a PM motor, motor 2 is disabled.

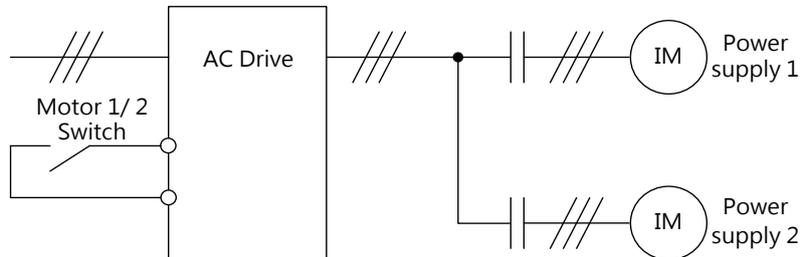


Figure 6.50 Motor 1/ 2 Switch Operation

Once the motor is switched, all the related parameters will be switched according to Table 6.19.

Table 6.19 Parameters Switched between motor 1 and motor 2

Parameters	Terminal Open: Motor 1	→	Terminal Closed: Motor 2
C1-□□ (Acc./Dec. Time)	C1-00 to C1-03	→	C1-04 to C1-07
C5-□□(Slip Compensation)	C5-00 to C5-03	→	C5-08 to C5-10
C3-□□(Torque Compensation)	C3-00	→	C3-01
C4-□□(ASR)	C4-00 to C4-08, C4-09, C4-10	→	C4-11 to C4-19, C5-35, C4-20, C4-21
D1-□□(V/F Characteristics) D2-□□ (Motor Parameters)	D1-02 to D1-11, D2-00 to D2-10	→	D1-13 to D1-22, D2-11 to D2-21
F1-□□(PG Card Settings)	F1-00 to F1-04	→	F1-02 to F1-04, F1-08 to F1-11, F1-14, F1-31 to F1-37

Note:

1. When using 2 motors, the motor protection (oL1) set to P1-00 applies to both motors.
2. Motor 1 and motor 2 cannot be switched in between during run. Attempting to switch it will trigger the rUn alarm.
3. There is 500ms delay time when switching between motor that equipped with a PG encoder.

52 : Timer Input

Use this setting combination with E2-□□=15 (Timer Output). Refer to b4 (Timer Function) for details.

53/54/55 : Offset Frequency 1/ 2/ 3

Adds offset frequencies L6-00 to L6-02 to the frequency command when the terminal is closed. Refer to L6-00 to L6-02 (Offset Frequency 1/ 2/ 3).

56 / 57: KEB Command 1 (Normal Closed)/ (Normal Open)

Enables or disables KEB Command 1. When KEB Command 1 is enabled, selects KEB method from P2-09 = 0 to 2.

Drive Operation	Multi-Function Terminal Input	
	Setting (Normal Closed)	Setting (Normal Open)
KEB Function	Open	Closed
Normal Operation	Closed	Open

58 : Retain

59 : Retain

60 : Program Lockout

When the input terminal is closed parameter settings can be changed. When the input terminal is open, all the parameter settings other than U1-01 (Frequency Command Monitor) cannot be changed. However parameter settings can always be viewed.

61 : Analog Frequency Command Hold

Sample the frequency command being input to terminal A1, A2 at which the drive will run. When the input terminal is closed for 100ms, the drive same the frequency command and hold the level as illustrated in the following figure. When the power is cut off, the held frequency command will be cleared and the frequency command will be reset to 0.

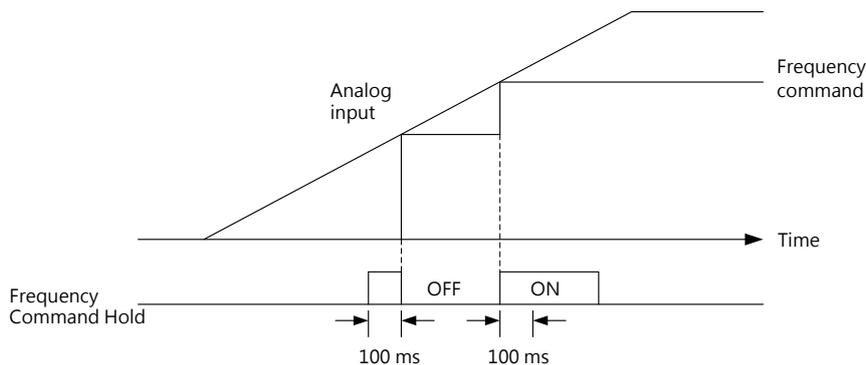


Figure 6.51 Analog Frequency Command Hold Operation

When this function is used with any of the following function at the same time, an oPE12 error will be triggered.

- Setting 18 (Acc./Dec. Ramp Hold)
- Setting 10 and 11 (Up/Down Command)

- Setting 53 to 55 (Offset Frequency 1/ 2/ 3)
- Setting 12 and 13 (Up 2/ Down 2 Command)

62: Retain

63: External Speed Search Command

If any multi-function input terminal (E1-00 to E1-07) is set to 63 and closed one second before run, Speed Search will start from the frequency command regardless the b3-00 setting.

64: Retain

65 : DC Braking

Stops the motor during deceleration. When a Run command or Jog command is entered, the DC braking will be removed as illustrated in the following figure. Refer to b2 (DC Braking) for details.

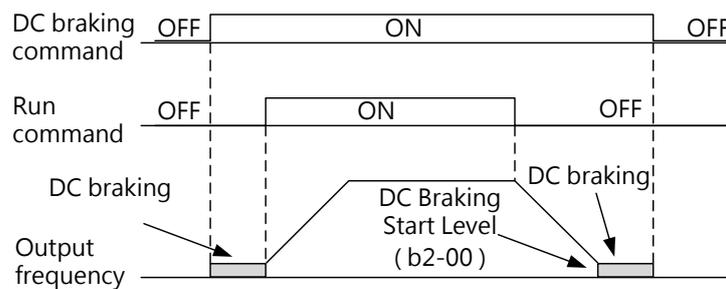


Figure 6.52 DC Braking Operation

66 to 68: Retain

69 : Drive Enabled

The drive does not accept any Run command until the input terminal closes. When the input terminal is open, the keypad will display "DNE" .

If a Run command is entered before the assigned terminal closes, then drive will not run until the Run command is cycled. If the terminal is open during run, the drive will stop according to b1-02 (Stopping Method Selection). Refer to b1-02 for details.

70 to 73: Retain

E2 Multi-Function Digital Output

■ **E2- 00 to E2- 03 Relay 1/ Relay 2, D1/ DC and D2/ DC Function Selection**

The drive has four multi-function output terminals. Assign the functions to E2-00 to E2-03

according to Table 6.20.

No.	Parameter Name	Setting Range	Default
E2-00	Relay 1 Function Selection	0 to 48/ 100 to 148	0: During run
E2-01	Relay 2 Function Selection	0 to 48/ 100 to 148	11: Fault
E2-02	D1/DC Function Selection (Open Collector)	0 to 48/ 100 to 148	1: Zero Speed
E2-03	D2/DC Function Selection(Open Collector)	0 to 48/ 100 to 148	2: Speed agree

Table 6.20 Multi-Function Output Terminal Settings

Setting	Function	Setting	Function
0	During Run	29	Mechanical Weakening Detection (Normal Open)
1	Zero Speed Holding	30	Retain
2	Frequency (Speed) Agree	31	Retain
3	User-Defined Frequency (Speed) Agree	32	Retain
4	Drive Ready	33	Retain
5	Uv (Undervoltage) Detection	34	Retain
6	During Baseblock	35	During Frequency Output
7	Retain	36	Drive Enabled
8	Frequency Command Source	37	Watt Hour Pulse Output
9	Frequency Command Loss	38	Local/Remote Mode
10	Run Command Source	39	During Speed Search
11	Fault	40	PID Feedback Low
12	Communication Mode	41	PID Feedback High
13	Alarm	42	During KEB Operation
14	Fault Restart	43	Retain
15	Timer Output	44	During Fast Stop
16	Frequency (FOUT) Detection 1	45	Internal Cooling Fan Alarm
17	Frequency (FOUT) Detection 2	46	Retain
18	Overvoltage/Undervoltage Detection 1	47	Retain
19	Retain	48	Retain
20	Overvoltage/Undervoltage Detection 2	49	Brake control (Desired frequency attained)
21	Retain	100 to 149	0 to 49 with Inverse Output
22	During Reverse		
23	Motor 1/ 2 Selection		
24	During Regeneration		
25	Restart Enabled		

26	Motor Overload Pre-Alarm (oL1) (Including oH3)		
27	Drive Overheat Pre-Alarm (oH)		
28	Retain		

0 : During Run

When the drive is outputting voltage, the output terminal closes.

Terminal	Description
Open	The drive is stopped.
Closed	A Run command is input or the drive is during DC braking or deceleration

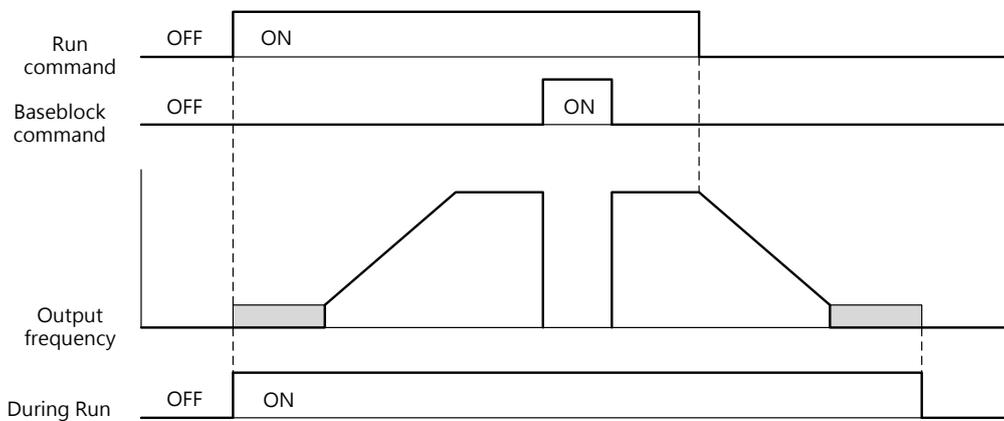


Figure 6.53 During Run Operation

1 : Zero Speed Holding

When the output frequency falls below the d1-08 (Minimum Output Frequency) or b2-00 (Zero Speed Holding Start Level) setting, the output terminal closes.

Terminal	Description
Open	Output frequency is higher than the d1-08 or b2-00 setting
Closed	Output frequency is lower than the d1-08 or b2-00 setting

Note: In IM/ PM Closed-Loop Vector Control, the terminal closes when the output frequency falls below the b2-00 setting. In all other control method, the terminal closes when the output frequency falls below the d1-08 setting.

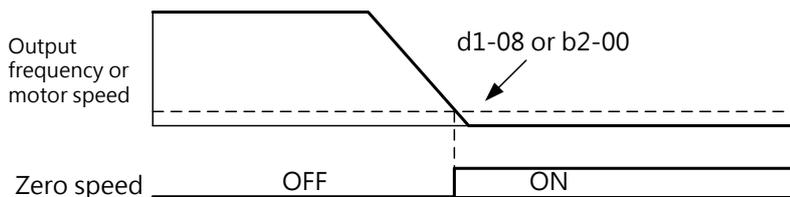


Figure 6.54 Zero Speed Holding Operation

2 : Frequency (Speed) Agree

When the output frequency is within the value set to P4-01 (Frequency Detection Width), the output terminal closes regardless the rotation direction.

Terminal	Description
Open	The output frequency does not match the frequency demand during run
Closed	Output frequency is within the value set to P4-01

Note:

1. The detection works in both forward and reverse directions.
2. In Closed-Loop Vector Control, the terminal closes when the motor speed is within the value set to P4-01.

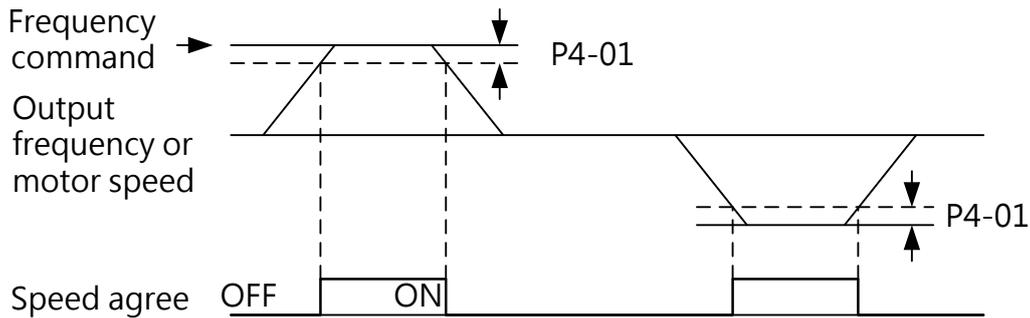


Figure 6.55 Speed Agree Operation

3 : User-Defined Frequency (Speed) Agree

When the output frequency and frequency command are both within the P4-00 (Frequency Detection Level) level plus or minus the P4-01 (Frequency Detection Width) value, the output terminal closes.

Terminal	Description
Open	Output frequency or frequency command is outside of the range of $(P4-00 \pm P4-01)$
Closed	Output frequency and frequency command are both within the range of $(P4-00 \pm P4-01)$

Note:

1. The detection and the P4-00 level work in both forward and reverse directions.

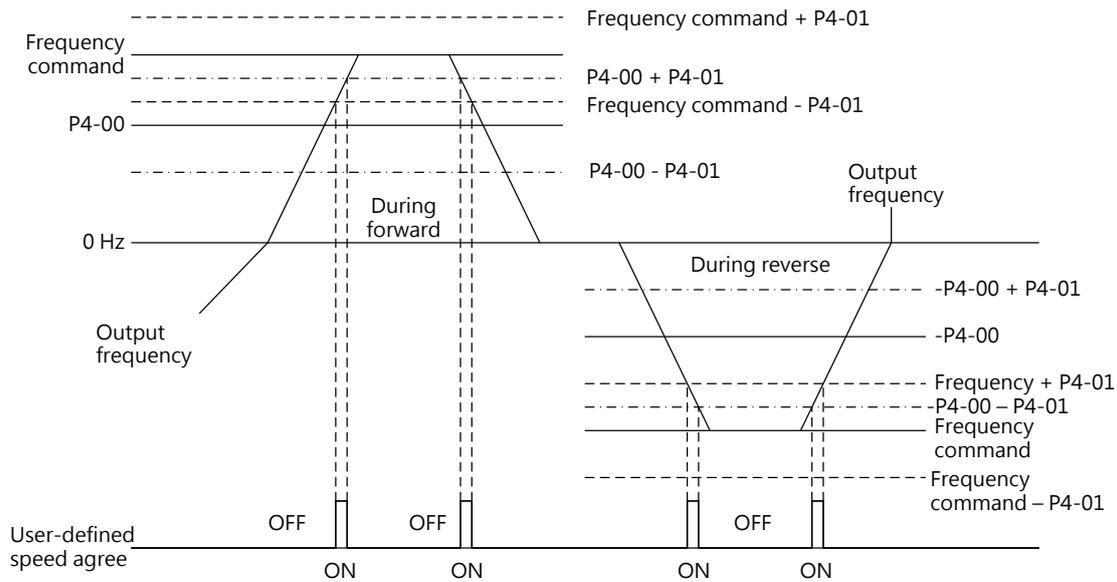


Figure 6.56 User-Defined Frequency (Speed) Agree Operation

4 : Drive Ready

When the drive is ready to run or during run, the output terminal closes. According to the conditions listed below, when a fault occurs or the drive cannot run even if a Run command is entered, the output terminal closes.

- When the power is cut off
- During a fault
- When the internal power supply of the drive malfunctions
- When an improper parameter setting makes the drive unable to run
- An overvoltage or undervoltage fault is triggered during stop
- When setting a parameter in the programming mode

5 : Uv (Undervoltage) Detection

When the main circuit DC voltage falls below the Uv detection level, the output terminal closes. The Uv detection level is set in P2-03.

Terminal	Description
Open	The main circuit voltage is higher than the P2-03 level
Closed	The main circuit voltage is lower than the P2-03 level

6 : During Baseblock

During baseblock, the output terminal closes and the output transistors do not switch.

Terminal	Description
Open	The drive is not performing baseblock
Closed	The drive is performing baseblock

7: Retain

8 : Frequency Command Source

Displays the currently selected frequency command source.

Terminal	Description
Open	Frequency command is provided from external command 1 (b1-00) or 2 (b1-07)
Closed	Frequency command is provided from the drive keypad

9 : Frequency Command Loss

When a frequency command loss is detected, the assigned output terminal closes. Refer to P4-02 (Frequency Command Loss Detection Selection) for details.

10: Run Command Source

Displays the currently selected Run command source.

Terminal	Description
Open	Run command is provided from external command 1 (b1-01) or 2 (b1-08)
Closed	Run command is provided from the drive keypad.

11 : Fault

When a fault is triggered, the assigned output terminal closes.

12 : Communication Mode

If the terminal is assigned to 12, it can be the output terminal for the upper controller using Modbus communication. If the signal is not set by the upper controller, the signal will not perform any action.

13 : Alarm

When an alarm such as PID Feedback High (FBH), PID Feedback Low (FBL) or Overcurrent (HCA) is triggered, the assigned output terminal closes.

14 : Fault Restart

When attempting to reset a fault from the control circuit terminals, via serial communications, the assigned output terminal closes.

15 : Timer Output

Sets a output terminal as the output for the timer function. Refer to b4 (Timer Function).

16 : Frequency (FOUT) Detection 1

When the output frequency exceeds the P4-00 (Frequency Detection Level) level plus the P4-01 (Frequency Detection Width) level, the assigned output terminal closes until the output frequency reaches the P4-00 level.

Terminal	Description
Open	The output frequency exceeds the P4-00 level plus the P4-01 level
Closed	The output frequency does not exceed the P4-00 level plus the P4-01 level

Note:

1. The detection and the P4-00 level work in both forward and reverse directions.
2. It will be the motor speed when using Closed-Loop Vector Control.

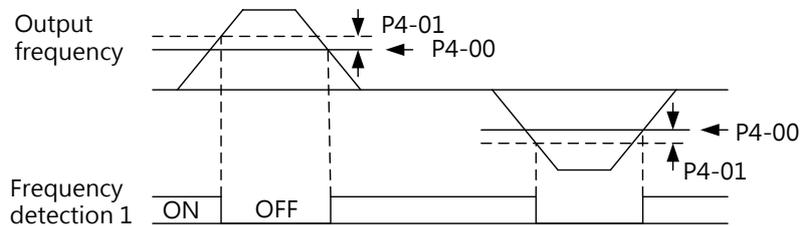


Figure 6.57 Frequency (FOUT) Detection 1 Operation

17 : Frequency (FOUT) Detection 2

When the output frequency exceeds the P4-00 (Frequency Detection Level) level, the assigned output terminal closes until the output frequency reaches the P4-00 level minus the P4-01 value.

Terminal	Description
Open	The output frequency does not exceed the P4-00 level, or below the P4-00 level minus the P4-01 value.
Closed	The output frequency exceeds the P4-00 level

Note:

1. The detection and the P4-00 level work in both forward and reverse directions.
2. It will be the motor speed when using Closed-Loop Vector Control.

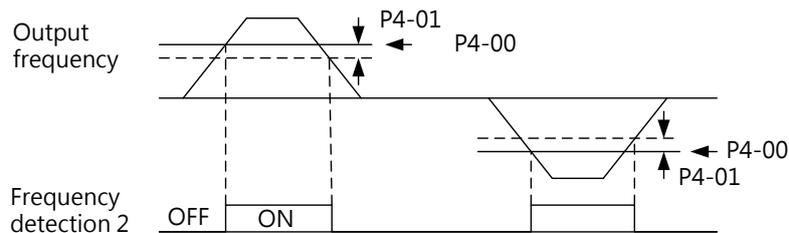


Figure 6.58 Frequency (FOUT) Detection 2 Operation

18/20: Overvoltage/ Undervoltage Detection 1/2

Outputs the overvoltage or undervoltage situations to the external devices. Set the torque detection and the output setting listed below. Refer to P6 (Overtorque/ Undertorque Detection) for details.

Setting	Terminal	Description
18	Open	Overvoltage/ Undervoltage Detection 1 (Normal Open) The output current or torque exceeds the P6-01 (Overtorque/ Undertorque Detection Level 1) level for the P6-02 (Overtorque/ Undertorque Detection Time 1) time
20	Closed	Overvoltage/ Undervoltage Detection 2 (Normal Open) The output current or torque exceeds the P6-04 (Overtorque/ Undertorque Detection Level 2) level for the P6-05 (Overtorque/ Undertorque Detection Time 2) time

22 : During Reverse

When the motor run in the reverse direction, the assigned output terminal closes.

Terminal	Description
Open	The motor runs in the forward direction
Closed	The motor runs in the reverse direction

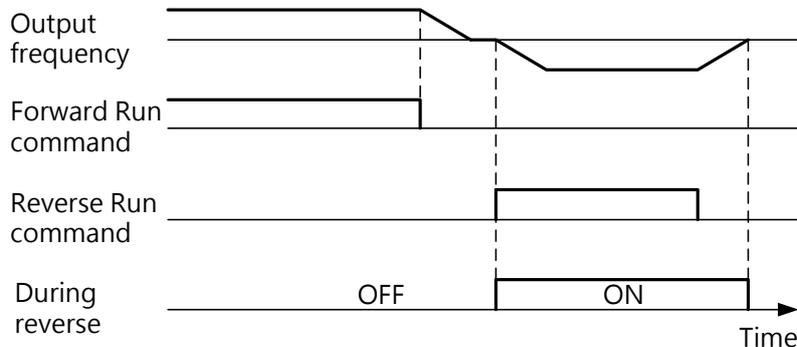


Figure 6.59 During Reverse Operation

23: Motor 1/ 2 Selection

Displays the motor 1/ 2 selection. Refer to setting 51 (Motor 1/ 2 Switch) of multi-function digital inputs for details.

Terminal	Description
Open	Motor 1 is selected
Closed	Motor 2 is selected

24: During Regeneration

When the motor outputs during regeneration, the assigned output terminal closes.

25 : During Restart

When the drive attempts to clear a fault during restart, the assigned output terminal closes. If the fault is cleared after restart, the output terminal opens. If the number of restart attempt reaches the number set to P5-00 (Number of Auto Restart Attempts) without clearing a fault successfully, the output terminal opens after the fault is triggered.

26 : Motor Overload Pre-Alarm (oL1)

When the motor overload level exceeds 90% of the detection level, the assigned output terminal closes. Refer to P1-00 (Motor Protection Function Selection) for details.

27 : Drive Overheat Pre-Alarm (oH)

When the drive heatsink temperature exceeds the oH (overheat) detection level, the assigned output terminal closes.

28 : Retain

29 : Mechanical Weakening Detection (Normal Open)

When the mechanical weakening situation is detected, the assigned output terminal closes.

30 to 34: Retain

35: During Frequency Output

When the drive is outputting frequency, the assigned output terminal closes.

Terminal	Description
Open	The drive is during stop, baseblock or DC braking.
Closed	The drive is outputting frequency

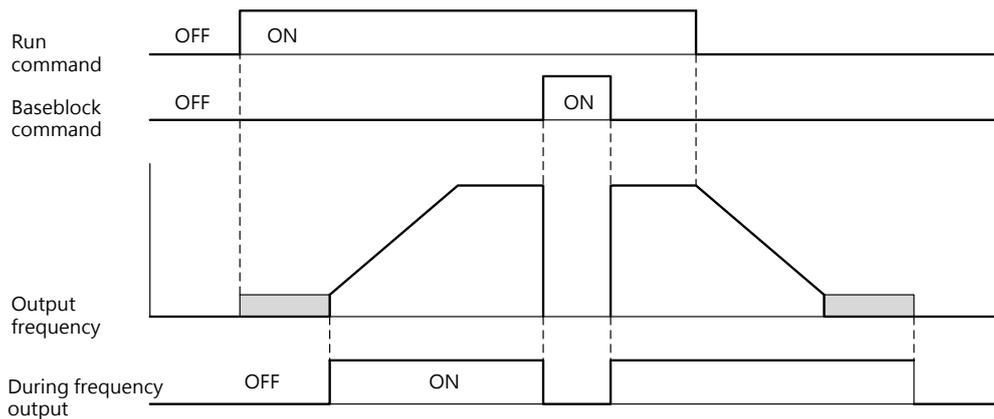


Figure 6.60 During Frequency Output Operation

36: Drive Enabled

Shows the status of multi-function terminal input E1-□□= 69 (Drive Enabled). When the input terminal E1-□□= 69 is closed, the output terminal closes as well.

37: Watt Hour Pulse Output

Outputs a pulse to indicate the watt hours. Refer to E2-05 (Output Power Detection Scaling) for details.

38 : Local/Remote Mode

The output terminal closes in Local mode and opens in Remote mode.

Terminal	Description
Open	Remote: The frequency and Run command can be provided by the external device selected by b1-00/b1-01 or b1-07/b1-08.
Closed	Local: The frequency and Run command can be provided by the drive keypad.

39 : During Speed Search

The assigned output terminal closes during Speed Search. Refer to b3 (Speed Search) for details.

40 :PID Feedback Low

When a PID Feedback Low is detected, the assigned output terminal closes. When the PID feedback value falls below the b5-12 level for longer than the time set to b5-13, the fault will be detected.

41 :PID Feedback High

When a PID Feedback High is detected, the assigned output terminal closes. When the PID feedback value exceeds the b5-22 level for longer than the time set to b5-23, the fault will be

detected.

42 : During KEB Operation

The assigned output terminal closes during KEB operation.

43 : Retain

44 : During Fast Stop

The assigned output terminal closes during a fast stop. Refer to setting 21 and 22 (Fast Stop) of multi-function Digital Inputs.

45 : Internal Cooling Fan Alarm.

When the internal cooling fan alarm is triggered, the assigned output terminal closes.

46 : Rotor Position Detection Complete

After the Run command is given and the rotor position detection is complete, the assigned terminal closes.

47 : Retain

48 : Retain

100 to 149: 0 to 49 with Inverse Output

E.g.: Setting 106 = Setting 6 (During Baseblock)

■ **E2- 04 Retain**

■ **E2- 05 Watt Hour Output Unit**

Selects the output unit for the terminal assigned to E2-00 or E2-03=37 for one pulse signal. This output function provides a watt hour meter or a PLC input by a 200ms pulse signal.

No.	Name	Setting Range	Default
E2-05	Watt Hour Output Unit	0 : 0.1 kWh units 1 : 1 kWh units 2 : 10 kWh units 3 : 100 kWh units 4 : 1000 kWh units	0

Note:

1. When a power output is negative(i.e. regeneration), it does not subtract from the total watt hours.

2. The drive keeps track of the watt hours only when the control circuit is powered. The value is reset once the power supply is cut off.

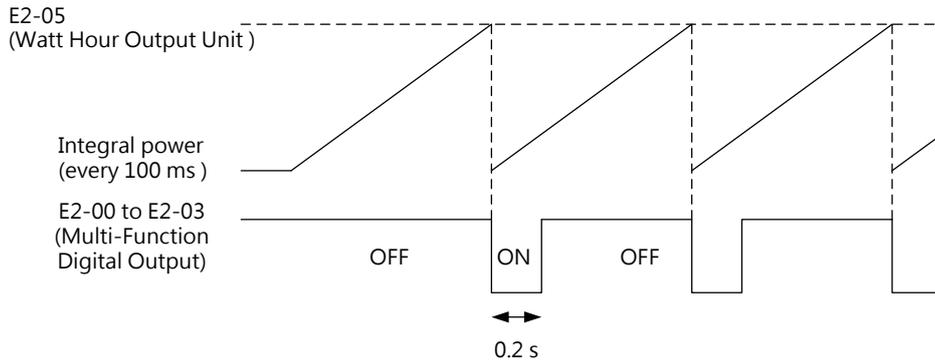


Figure 6.61 Watt Hour Output Operation

E3 Multi-Function Analog Input

The drive has two multi-function analog inputs (A1 and A2). Set the terminal A1 and A2 according to Table 6.21.

■ E3-00 Terminal A1 Signal Level Selection

Sets the signal level for terminal A1.

No.	Name	Setting Range	Default
E3-00	Terminal A1 Signal Level Selection	0, 1	0

0: 0 to 10 V

Inputs a 0 to 10 V signal. A negative signal by the gain and voltage bias is limited to 0%.

1: -10 to 10 V

Inputs a -10V to 10 V signal. A forward Run command can be compensated by the gain and voltage bias to become a negative signal and run the motor in the reverse direction.

■ E3-01 Terminal A1 Function Selection

Select the function to terminal A1.

No.	Name	Setting Range	Default
E3-01	Terminal A1 Function Selection	0 to 19	0

■ E3-02/ E3-03 Terminal A1 Input Gain/ Voltage Bias

E3-02 sets the terminal A1 input gain as a percentage when inputting 10V. E3-03 sets the terminal A1 input voltage bias as a percentage when inputting 0V. Terminal A1 input characteristics are determined by E3-02 and E3-03.

No.	Name	Setting Range	Default
-----	------	---------------	---------

E3-02	Terminal A1 Input Gain	-999.9 to 999.9%	100.0%
E3-03	Terminal A1 Voltage Bias	-999.9 to 999.9%	0.0%

Examples

- Gain = 200%, voltage bias = 0%, terminal A1 is used as frequency command input (E3-01 = 0)

When inputting a 10 V signal, the frequency command will be 200%. When inputting a 5V signal, the frequency command is 100%.

As the drive output is limited by d1-02 (Maximum Output Frequency), the frequency command will be 100% when the signal is 5 V and above.

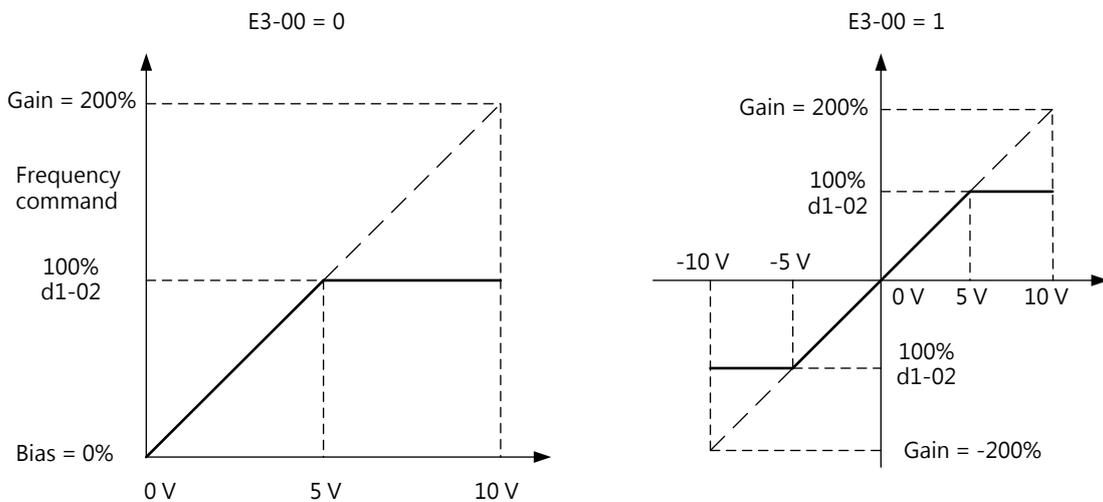


Figure 6.62 Frequency Command Adjusted by Input Gain and Bias

- Bias = -25%, terminal A1 is used as frequency command input

When inputting a 0 V signal, the frequency command will be -25%.

When E3-00=0 and inputting a signal between 0 to 2 V, the frequency command will be 0%.

When E3-00=0 and inputting a signal between 2 to 10 V, the frequency command will be between 0 to 100%.

When E3-00=1 and inputting 0 to 2 V, the motor will run in the reverse direction.

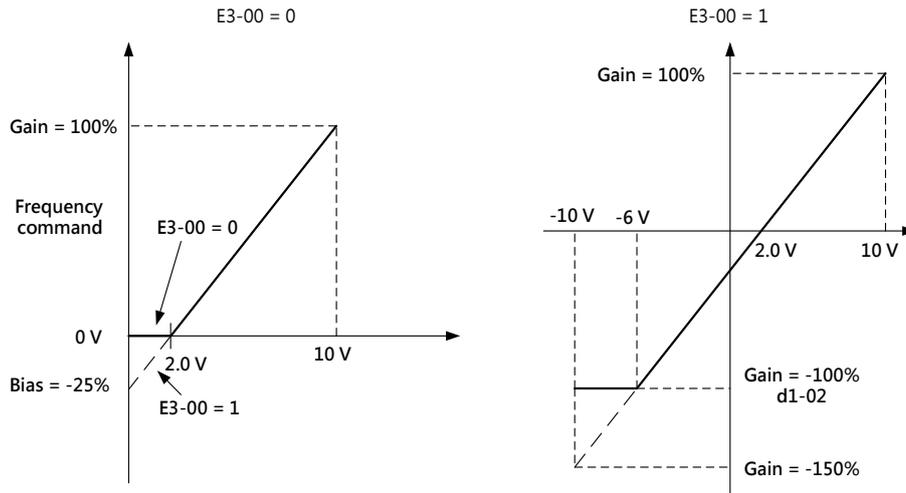


Figure 6.63 Frequency Command Adjusted by Input Gain and Negative Bias

■ **E3-04 Retain**

■ **E3-05 Terminal A1 Input Filter Time**

Sets the terminal A1 primary delay filter time, which can stabilize the drive operation by eliminating the interference. Long filter time stabilizes the drive but causes slow response to the analog input signal changes.

No.	Name	Setting Range	Default
E3-05	Terminal A1 Input Filter Time	0.00 to 2.00 s	0.5 s

■ **E3-06 Terminal A2 Signal Level Selection**

Selects the signal level for terminal A2.

No.	Name	Setting Range	Default
E3-06	Terminal A2 Signal Level Selection	0 to 3	1

0: 0 to 20 mA

1: 4 to 20 mA

2: 0 to 10 V

A negative signal by the gain and voltage bias is limited to 0%.

3: 0 to 5 V

A negative signal by the gain and voltage bias is limited to 0%.

■ **E3-07 Terminal A2 Function Selection**

Sets the function for terminal A2.

No.	Name	Setting Range	Default
E3-07	Terminal A2 Function Selection	0 to 19	8

■ **E3-08/E3-09 Terminal A2 Input Gain / Voltage Bias**

E3-08 sets the terminal A2 input gain as a percentage when inputting 10V. E3-09 sets the terminal A2 input voltage bias as a percentage when inputting 0V.

No.	Name	Setting Range	Default
E3-08	Terminal A2 Input Gain	-999.9 to 999.9%	100.0%
E3-09	Terminal A2 Voltage Bias	-999.9 to 999.9%	0.0%

■ **E3-10 Retain**

■ **E3-11 Terminal A2 Input Filter Time**

No.	Name	Setting Range	Default
E3-11	Terminal A2 Input Filter Time	0.00 to 2.00	0.5 s

Sets the terminal A2 primary delay filter time, which can stabilize the drive operation by eliminating the interference. Long filter time stabilizes the drive but causes slow response to the analog input signal changes.

■ **E3-12 Analog Input Terminal Enable/ Disable Selection**

No.	Name	Setting Range	Default
E3-12	Analog Input Terminal Enable/ Disable Selection	0 to 3	3

Enables the analog inputs when Multi-Function Terminal Input E1-□□ = 41 (Multi-Function Analog Input Selection).

0: Both Terminal A1 and A2 Disabled

1: Only Analog Input Terminal A1 Enabled

2: Only Analog Input Terminal A2 Enabled

3: Both Terminal A1 and A2 Enabled

■ **Multi-Function Analog Input Terminal Settings**

Assign the function listed in E3-01 and E3-07 to terminal A1 and A2 according to Table 6.21.

Note: The scaling of the functions listed below can be adjusted by the gain and bias. When assigning the function to the terminal, set an appropriate gain and bias.

Table 6.21 Multi-Function Analog Input Terminal Settings

Setting	Function	Setting	Function
---------	----------	---------	----------

0	Main Frequency Command	14	Regeneration Range Torque Limit
1	Frequency Gain	15	Retain
2	Output Frequency Lower Limit	16	Retain
3	Auxiliary Frequency Command	17	Forward and Reverse Torque Limit
4	Output Voltage Bias	18	Communication Mode 1
5	Acc./Dec. Time Gain (Decrease Only)	19	Communication Mode 2
6	DC Braking (DB) Current		
7	Stall Prevention Level During Run		
8	PID Feedback		
9	PID Target		
10	Differential PID Feedback		
11	Overtorque/ Undertorque Detection		
12	Forward Torque Limit		
13	Reverse Torque Limit		

0 : Main Frequency Command

Enters the frequency command via an analog input terminal when b1-00 or b1-07=1

1 : Frequency Gain

The input value of the assigned terminal will be multiplied with the analog frequency command value.

Example: When the frequency command from terminal A1 is 80%, and the frequency gain set to terminal A2 is 50%, the resulting frequency command will be 40% of the maximum output frequency.

2 : Output Frequency Lower Limit

The output frequency lower limit can be adjusted by the analog input value.

3 : Auxiliary Frequency Command

Sets the auxiliary frequency command 1 when multi-step speed operation is selected.

4 : Output Voltage Bias

Voltage bias increases the output voltage of the V/F characteristics as a percentage of 200V or 400V depending on the power supply. This function is only available in the V/F Control method.

5 : Acc./Dec. Time Gain (Decrease Only)

Adjusts the gain for acc./ dec. time assigned to C1-00 to C1-07.

When the acceleration time is assigned to C1-00, the drive acceleration time is calculated below.

$$\text{Acc. Time} = \text{C1-00 Acc. time} \times \text{Acc./dec. time gain}$$

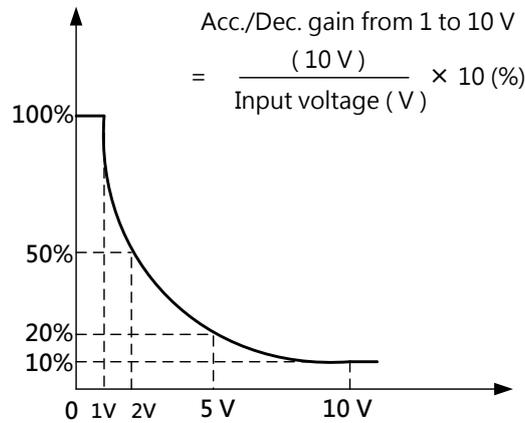


Figure 6.64 Acc./Dec. Time Gain Using Analog Input

6 : DC Braking (DB) Current

Adjusts the DC braking current by the analog input value.

When 10 V voltage or 20 mA current is input, the braking current will be 100% of the drive rated output current. The actual DC braking current is determined by the analog input value or the b2-01 value whichever is smaller.

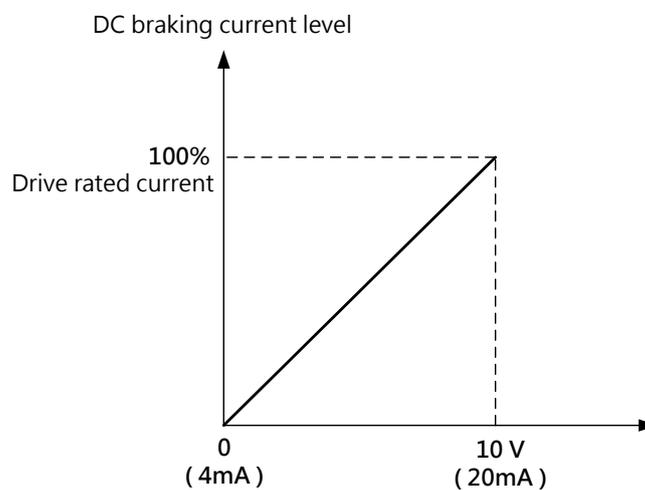


Figure 6.65 DC Braking Current Using Analog Input

7 : Stall Prevention Level During Run

Adjusts the stall prevention level by the analog input signal. The stall prevention level is determined by the analog input value or the P3-06 value whichever is smaller.

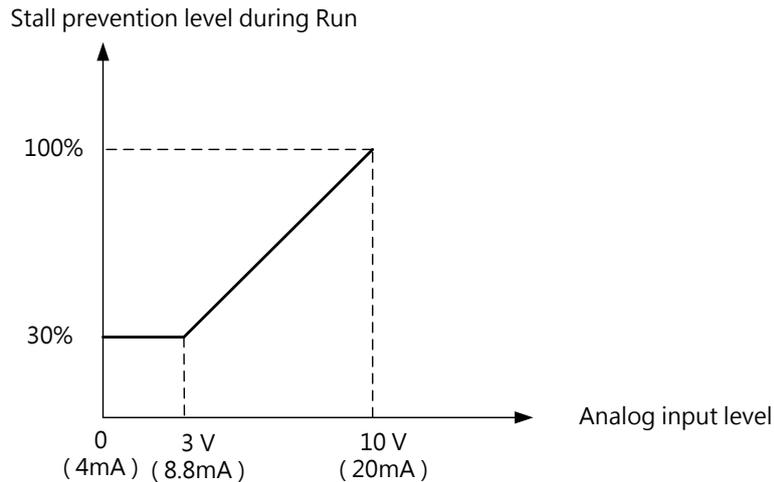


Figure 6.66 Stall Prevention Level Using Analog Input

8 : PID Feedback

Sets the PID feedback by the analog input value. To use this function, enable the PID control in b5-00.

9 : PID Target

Sets the PID target value by the analog input value. The frequency command entered by the command source selected in b1-00 (Frequency Command Selection 1) is disabled. To use this function, enable the PID control in b5-00.

10: Differential PID Feedback

Sets the differential PID feedback by the analog input value. The difference of the PID feedback input value and the differential feedback input value is used to calculate the PID input.

11 : Overtorque/ Undertorque Detection

Sets the detection level for overtorque and undertorque by the analog input value. Use the combination of this function and P6-00 (Overtorque/ Undertorque Detection Selection 1). This is the secondary source for P6-01 (Overtorque/ Undertorque Detection Level 1). When the input is 100% (10 V, 20 mA), the motor rated torque will be 100%. Refer to P6 (Overtorque/ Undertorque Detection) for details.

12/13/14/17 : Forward/Reverse/Regeneration Range/Forward and Reverse Torque Limit

Sets the torque limit by the analog input value. The torque limit applies to all four quadrants illustrated in Figure 6.67. Set this value as a percentage of the motor rated torque.

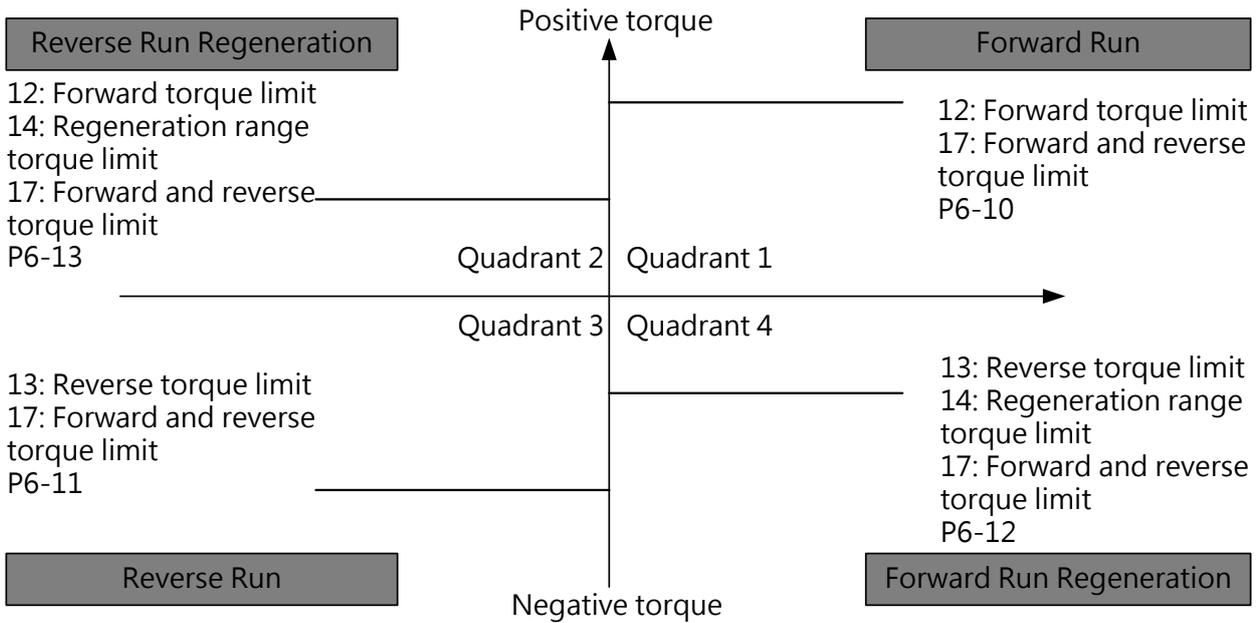


Figure 6.67 Torque Limit Using Analog Input

Setting torque limit using parameter and analog input

The relationship between setting the torque limit using parameter and analog input is illustrated in the following figure.

Whichever smaller between the torque limit set by the parameter and the analog input

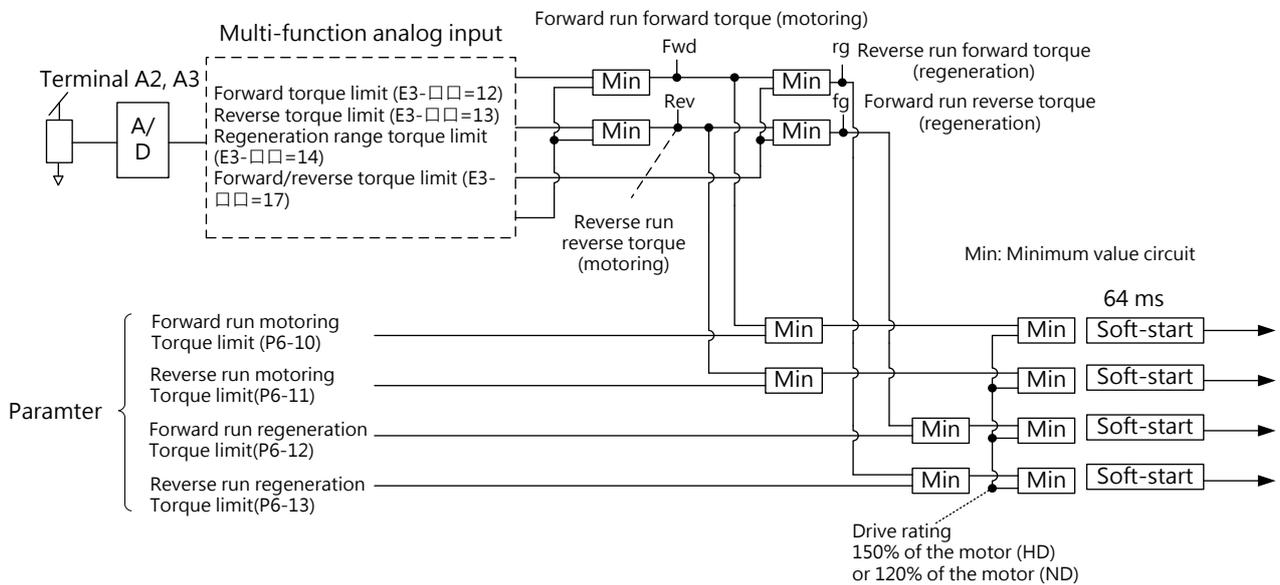


Figure 6.68 Torque Limit Using Parameter and Analog Input

15, 16: Retain

18/19 : Communication Mode

If the terminal is assigned to 18 or 19, the input signal can be used as an analog input from the upper controller via Modbus.

20 : Motor Temperature Input (PTC Input)

Sets the detection for oL1 (Motor Overload) as a secondary source using PTC resistance to protect the motor.

E4 Multi-Function Analog Output

These parameters assign functions to terminal FM and AM to monitor the status of the drive.

■ E4-00 Terminal FM Signal Level Selection

Sets the signal level to terminal FM using E4-01.

No.	Name	Setting Range	Default
E4-00	Terminal FM Signal Level Selection	0, 1	0

0: 0 to 10 V

1: - 10 V to 10 V

■ E4-04 Terminal AM Signal Level Selection

Selects the signal level to terminal AM.

No.	Name	Setting Range	Default
E4-04	Terminal AM Signal Level Selection	0, 1, 2	0

0: 0 to 10 V

1: 0 to 20 mA

2: 4 to 20 mA

■ E4-01 / E4-05 Terminal FM and AM Monitor Selection

Selects the monitor for terminal FM and AM.

No.	Name	Setting Range	Default
E4-01	Terminal FM Monitor Selection	0 to 11	1
E4-05	Terminal AM Monitor Selection	0 to 11	2

Setting	Function
0	Frequency Command
1	Output Frequency
2	Output Current

3	Motor Speed
4	Output Voltage
5	DC Voltage
6	Output Power
7	Torque Command
8	AI1 Input
9	AI2 Input
10	Soft Starter Output Frequency
11	Pulse Train Input

■ E4- 02/ E4- 03 Terminal FM Monitor Gain / Voltage Bias

■ E4- 06/ E4- 07 Terminal AM Monitor Gain / Voltage Bias

E4-02/ E4-06 Sets the gain for terminal FM and AM as a percentage.

E4-03/ E4-07 Sets the voltage bias for terminal FM and AM as a percentage.

10 V equals 100% when setting E4-02, E4-03, E4-06 and E4-07. Figure 6.69 illustrates the gain and bias operation.

No.	Name	Setting Range	Default
E4-02	Terminal FM Monitor Gain	-999.9 to 999.9%	100.0%
E4-03	Terminal FM Voltage Bias	-999.9 to 999.9%	0.0%
E4-06	Terminal AM Monitor Gain	-999.9 to 999.9%	100.0%
E4-07	Terminal AM Voltage Bias	-999.9 to 999.9%	0.0%

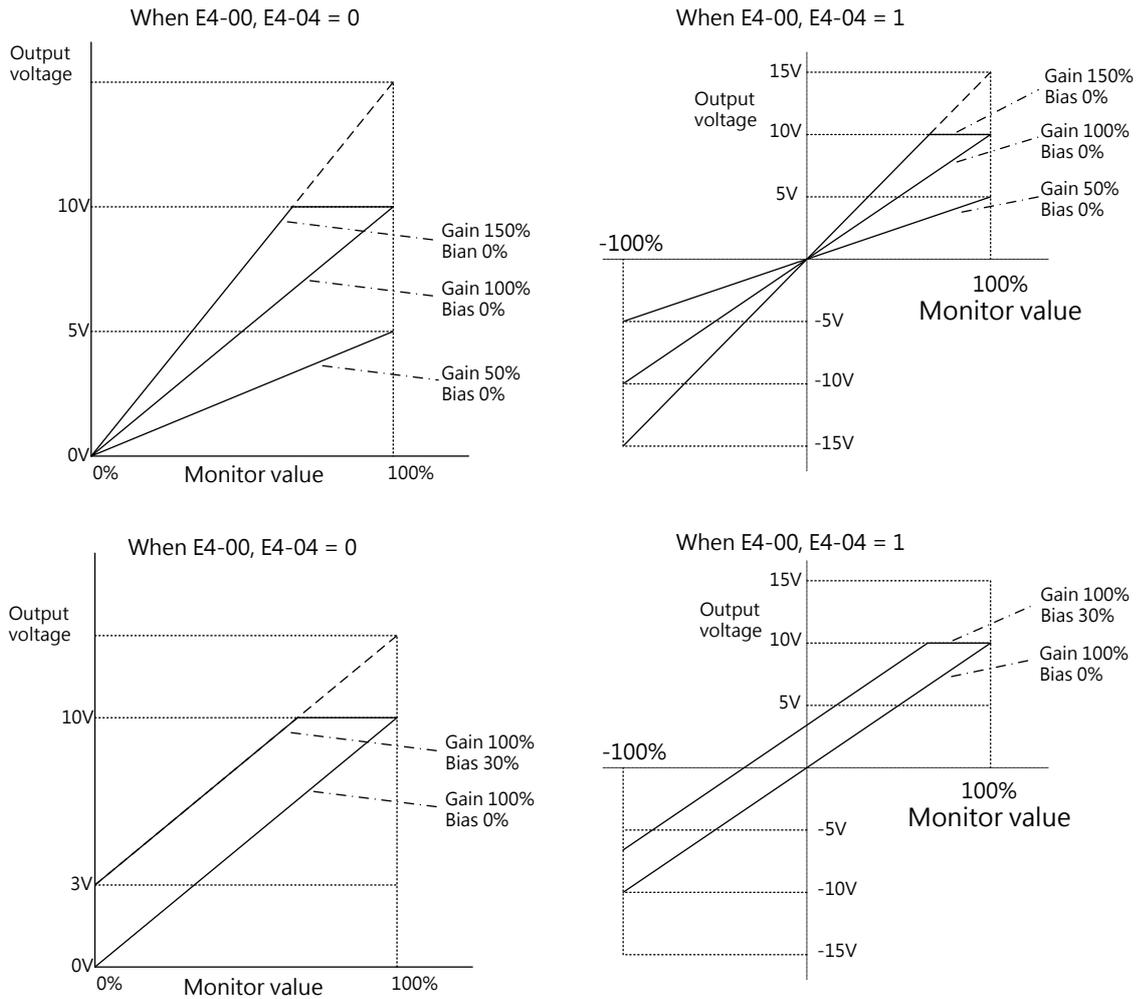


Figure 6.69 Analog Output Gain and Bias Operation

Example 1: When E4-02 = 80% , the voltage output to terminal FM equals to 100% resulting 8 V.

Example 2: When E4-03 = 5% , the voltage output to terminal FM equals to 0% resulting 0.5 V.

E5 Pulse Train Input/Output

A pulse train signal of maximum 32kHz frequency can input to terminal RP as frequency command, PID control, PID target, or as the speed feedback in V/F Control method.

The pulse output monitor terminal MP can output drive monitor values as a pulse train signal of maximum 32kHz frequency.

Set the scale and functions of the pulse input terminal RP and pulse output terminal MP by E5-□□ as illustrated in Figure 6.70.

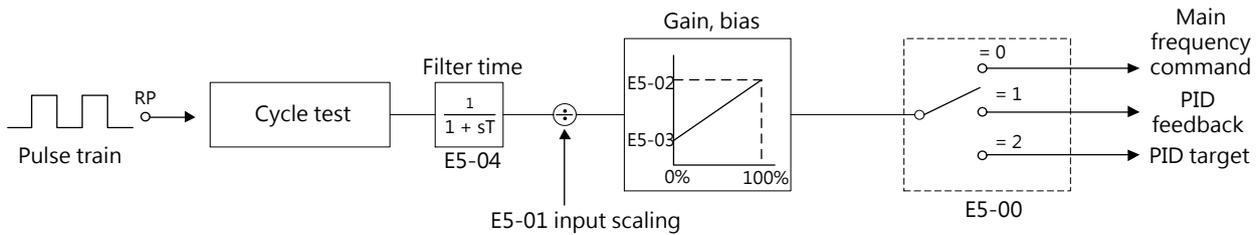


Figure 6.70 Pulse Train Input Opeartion

■ E5-00 Pulse Train Input Function Selection

Sets the function for pulse train input terminal RP.

No.	Name	Setting Range	Default
E5-00	Pulse Train Input Function Selection	0 to 3	0

0 : Frequency Command

If the frequency command is set to pulse train input (b1-00=4 or b1-07=4), the drive will use the frequency command from terminal RP.

1 : PID Feedback

The PID feedback value is entered to terminal RP as a pulse signal.

2 : PID Target

The PID target value is entered to terminal RP as a pulse signal.

3: Speed Detection (Closed-Loop V/F Control) (Only enabled when Motor 1 is selected in V/F control mode)

■ E5-01 Pulse Train Input Scaling

Sets the frequency equal to 100% frequency in Hz.

No.	Name	Setting Range	Default
E5-01	Pulse Train Input Scaling	100 to 32000 Hz	1440 Hz

■ E5-02 Pulse Train Input Gain

Sets the level of the input gain to terminal RP.

No.	Name	Setting Range	Default
E5-02	Pulse Train Input Gain	0.0 to 1000.0%	100.0%

■ E5-03 Pulse Train Input Voltage Bias

Sets the level of the input voltage bias when no signal (0Hz) is input to terminal RP.

No.	Name	Setting Range	Default

E5-03	Pulse Train Input Voltage Bias	-100.0 to 100.0%	0.0%
-------	--------------------------------	------------------	------

■ **E5-04 Pulse Train Input Filter Time**

Sets the pulse train input primary filter time in seconds.

No.	Name	Setting Range	Default
E5-04	Pulse Train Input Filter Time	0.00 to 2.00 s	0.10 s

■ **E5-05 Pulse Train Input Minimum Frequency**

Sets the minimum frequency detected by the pulse train input in units of 0.1 Hz.

- When the pulse input frequency drops below this level, the pulse input value becomes 0.0Hz.
- Enabled when E5-00 = 0, 1 or 2.
- When E5-00 = 3 (Simple Closed-Loop V/F Control), the minimum frequency becomes the setting for F1-04.

No.	Name	Setting Range	Default
E5-05	Pulse Train Input Minimum Frequency	0.1 to 1000.0 Hz	0.5 Hz

■ **E5-06 Pulse Train Monitor Selection**

Selects the pulse train monitor.

No.	Name	Setting Range	Default
E5-06	Pulse Train Monitor Selection	0 to 4	0

Sets the function of pulse train output terminal MP.

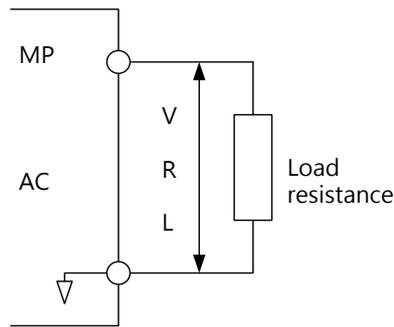
Setting	Function
0	Frequency Command
1	Output Frequency
2	Soft Starter Output Frequency
3	PID Feedback Value
4	PID Target Value

Notice: When using pulse train monitor, set the peripheral devices according to the load conditions below. Failure to comply could cause low performance or machinery damage.

□ When used as a common collector output

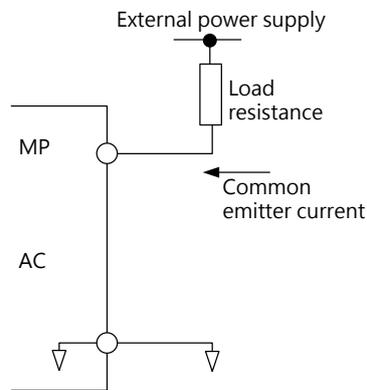
Output voltage (insulation type) VRL (V)	Load resistance (kΩ)
5 V or above	1.5 kΩ or above
8 V or above	4.0 kΩ or above
10 V or above	10 kΩ or above

Used as common collector output



External power supply (V)	DC12 V \pm 10%, DC15 V \pm 10%
Common emitter current (mA)	16 mA Max

Used as common emitter input



■ E5-07 Pulse Train Monitor Scaling

Sets the pulse train output frequency when the specified monitor item is at 100%. Sets E5-06 to 1 (Output Frequency) and E5-07 to 0 to make the pulse train monitor output synchronous to the output frequency.

No.	Name	Setting Range	Default
E5-07	Pulse Train Monitor Scaling	100 to 32000 Hz	1440 Hz

■ E5-08 Terminal RP Function Selection

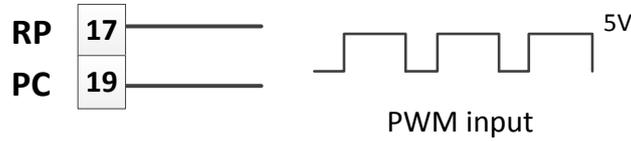
If b1-00 or b1-07 is set to 4 (Pulse Train Input) and E5-00 is set to 0 (Frequency Command), this parameter can be used for pulse train input or PWM signal input for terminal RP.

No.	Name	Setting Range	Default
E5-08	Terminal RP Function Selection	0, 1	0

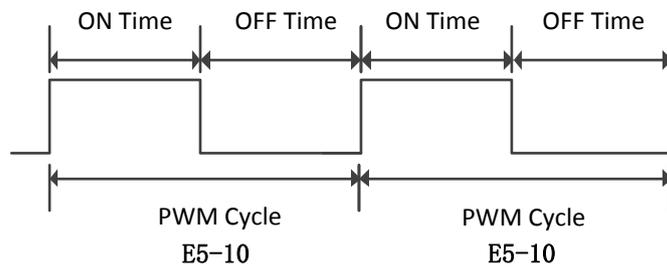
0 : Pulse train input

1 : PWM signal input

Wiring :

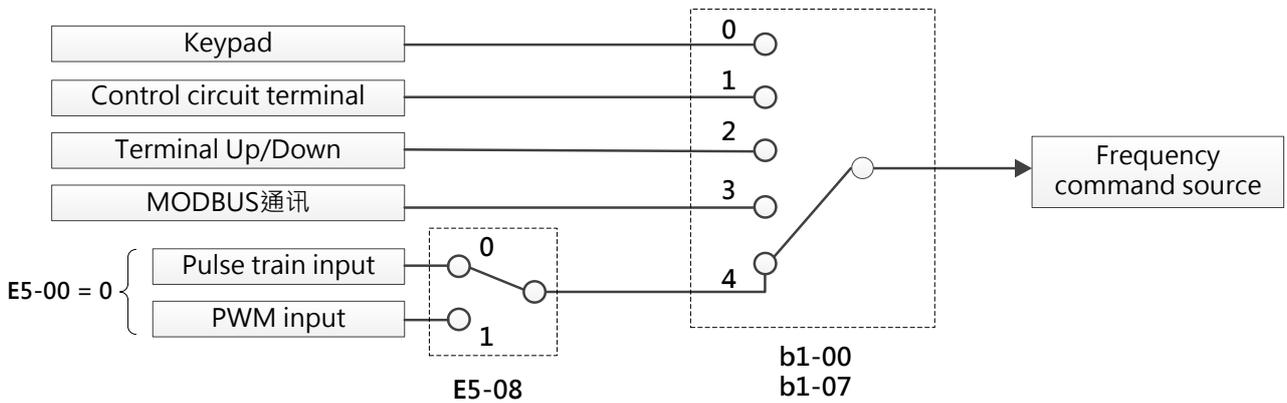


The PWM signals are input to drive as signal level 5V via terminal RP.



$$\text{Frequency command (Hz)} = \frac{\text{On Time}}{\text{PWM Cycle}} \times \text{Maximum output frequency}$$

To use PWM signal as the frequency command source, set b1-00 or b1-07 to 4 (Pulse Train Input), E5-00 to 0 (Frequency Command) and E5-08 to 1 (PWM Signal Input). When E5-08 is set to 0 (Pulse Train Input), the drive will use pulse train input as the frequency command source.



■ E5-09 Average PWM Signal Times

The drive averages the PWM signal for the set times to be an more stable frequency command. If it is set to 5 times, the drive then averages the continuous 5 PWM signals as the frequency command. The more times it is set, the more stable the frequency command will be. But the response of the frequency command will be slower at the same time.

No.	Name	Setting Range	Default
-----	------	---------------	---------

E5-09	Average PWM Signal Times	1 to 100	1
-------	--------------------------	----------	---

■ **E5-10 PWM Signal Cycle**

Sets the PWM signal cycle. The tolerance is about $\pm 12.5\%$.

No.	Name	Setting Range	Default
E5-10	PWM Signal Cycle	1 to 999 ms	100 ms

E6 Optional Communication Card Settings

■ **E6-00 to E6-05 Retain**

■ **E6-06 Drive Station Address**

No.	Name	Setting Range	Default
E6-06	Drive Station Address	1 to 31	1

■ **E6-07 RS-485 Communication Speed Selection**

No.	Name	Setting Range	Default
E6-07	RS-485 Communication Speed Selection	0 to 8	3

0: 1200 bps (bit/sec)

1: 2400 bps

2: 4800 bps

3: 9600 bps

4: 19200 bps

5: 38400 bps

6 : 57600 bps

7 : 76800 bps

8 : 115200 bps

■ **E6-08 RS-485 Communication Parity Selection**

No.	Name	Setting Range	Default
E6-08	RS-485 Communication Parity Selection	0 to 11	1

0: 8, N, 2 (MODBUS RTU)

1: 8, N, 1 (MODBUS RTU)

2: 8, E, 1 (MODBUS RTU)

3: 8, O, 1 (MODBUS RTU)

4: 8, N, 2 (MODBUS ASCII)

5: 8, N, 1 (MODBUS ASCII)

- 6: 8, E, 1 (MODBUS ASCII)
- 7: 8, O, 1 (MODBUS ASCII)
- 8: 7, N, 2 (MODBUS ASCII)
- 9: 7, N, 1 (MODBUS ASCII)
- 10: 7, E, 1 (MODBUS ASCII)
- 11: 7, O, 1 (MODBUS ASCII)

■ **E6-09 Communication Error Detection Time**

Determines the detection time to trigger the communication error. (This function is disabled when set to 0)

No.	Name	Setting Range	Default
E6-09	Communication Fault Detection time	0.0 to 10.0 s	0.0 s

■ **E6-10 Transmit Wait Time**

Sets the wait time between the drive receiving data and responding data.

No.	Name	Setting Range	Default
E6-10	Transmit Wait Time	5 to 65 ms	5 ms

■ **E6-11 Drive Operation During Communication Error**

No.	Name	Setting Range	Default
E6-11	Drive Operation During Communication Error	0, 1	0

0 : Display CE Alarm Only

The drive continues operation.

1 : Display CE Fault

The drive coasts to stop.

6.7 Group P, Protections

P1 Motor Protection Function

■ **P1-00 Motor Protection Function Selection**

The drive has an overload protection using an electrothermal relay. The overload tolerance is

calculated by the output current, output frequency and thermal motor characteristics. When the motor overload is detected, an oL1 (Motor Overload) fault shuts off the drive output.

Set this parameter according to the motor being used.

No.	Name	Setting Range	Default
P1-00	Motor Protection Function Selection	0 to 5	Determined by A1-02

Note:

1. When the motor protection is enabled (P1-00≠0), an oL1 alarm can be output via the multi-function output terminal assigned (E2-00 = 26). When the motor overload level exceeds 90% of the oL1 detection level, the output terminal closes.
2. When the drive is running a single motor, set a value other than 0 to enable this function. An external thermal relay is not required.

0 : Disabled (Motor Overload Protection Disabled)

Sets 0 (disabled) when using one drive to run more than one motor. Install an overload relay between the drive and each motor as illustrated in Figure 6.71.

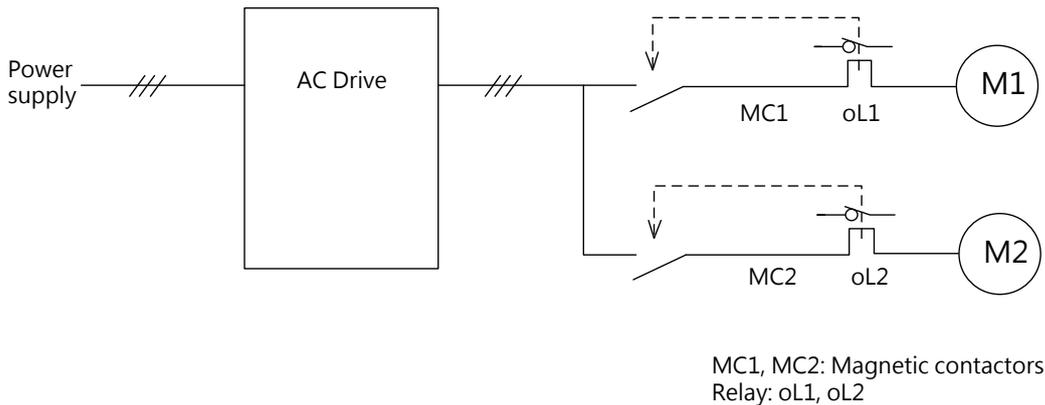


Figure 6.71 Protection Circuit for Multiple Motors

NOTICE: When a drive is running more than one motor or a motor with a rated current higher than other standard motors (such as a submersible motor), the thermal protection cannot be provided. Set 0 to P1-00 to disable this function and install an individual motor thermal relay for each motor. MC1 and MC1 cannot be switch on or off during run.

1 : General-Purpose Motor (Standard Motor)

The motor is self-cooled so the overload tolerance falls when the motor speed is decreased. The Electrothermal relay trigger level changes according to the motor overload characteristics to protect the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics (when motor load is 100%)

	<p>Motor to operate from line power. Motor cooling is most effective when running at 50/60 Hz</p>	<p>Running continuously at below 50/60 Hz triggers an oL1 fault. A fault is output and the motor will coast to stop.</p>
--	---	--

2 : Drive Dedicated Motor (Constant Torque Range 1 : 10)

The motor is allowed to run with 100% load from 10% to 100% speed. When the motor runs slower with 100% load, an overload fault will be triggered.

Overload Tolerance	Cooling Ability	Overload Characteristics (when motor load is 100%)
	<p>Motor cools itself effectively even at low speeds (about 6 Hz)</p>	<p>Continuous run from 6 Hz to 60 Hz</p>

3 : Vector Motor (Constant Torque Range 1 : 100)

The motor is allowed to run with 100% load from 1% to 100% speed. When the motor runs slower with 100% load, an overload fault will be triggered.

Overload Tolerance	Cooling Ability	Overload Characteristics (when motor load is 100%)

	<p>Motor cools itself effectively even at low speeds (about 6 Hz)</p>	<p>Continuous run from 6 Hz to 60 Hz</p>
--	---	--

4 : Derated Torque PM Motor

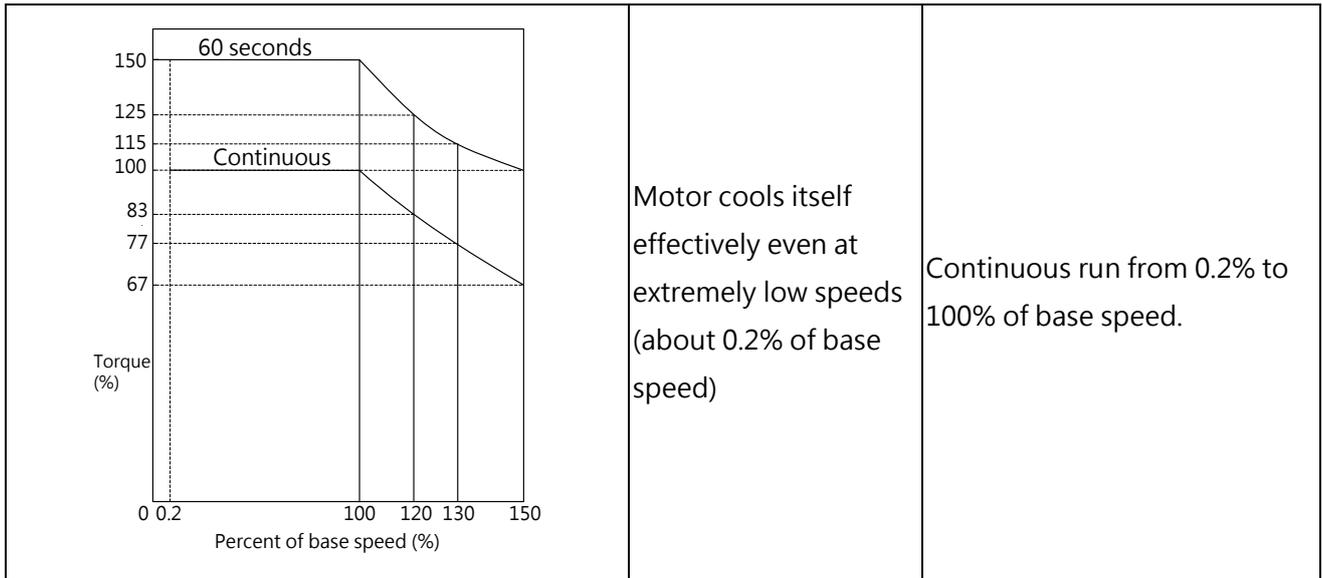
A PM motor for derated torque is designed to cool itself. Therefore the overload tolerance falls as the motor slows. The Electrothermal relay trigger level changes according to the motor overload characteristics to protect the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics (when motor load is 100%)
	<p>When running at base speed, the motor is capable of cooling itself if the torque is 100%.</p>	<p>Continuous running below the base frequency with torque exceeding 100% cause a motor overload fault (oL1). A fault is output and the motor will coast to stop.</p>

5 : Constant Torque PM Motor (Constant Torque Range 1 : 500)

The motor is allowed to run with 100% load from 0.2 % to 100% speed. When the motor runs slower with 100% load, an overload fault will be triggered.

Overload Tolerance	Cooling Ability	Overload Characteristics (when motor load is 100%)



■ P1-01 Motor Overload Protection Time

Sets the time for the drive to shut down on motor overload. (Normal this parameter does not require adjustment. However, enter the time the motor can withstand operation in a hot motor overload condition if the motor overload tolerance data is confirmed by the motor manufacturer.)

No.	Name	Setting Range	Default
P1-01	Motor Overload Protection Time	0.1 to 5.0 min	1.0 min

The default is operation with 150% overload tolerance for one minute in a hot start.

The electrothermal protection operation time is illustrated in the following figure. Motor overload protection operates in the range between a cold start and a hot start.

(P1-01 = 1 minute, 60 Hz speed, general-purpose motor)

- Cold start: The motor protection operation time responds to an overload situation which is suddenly reached when starting a stationary motor.
- Hot start: The motor protection operation time responds to an overload situation which occurs when the motor was running continuously at its rated current.

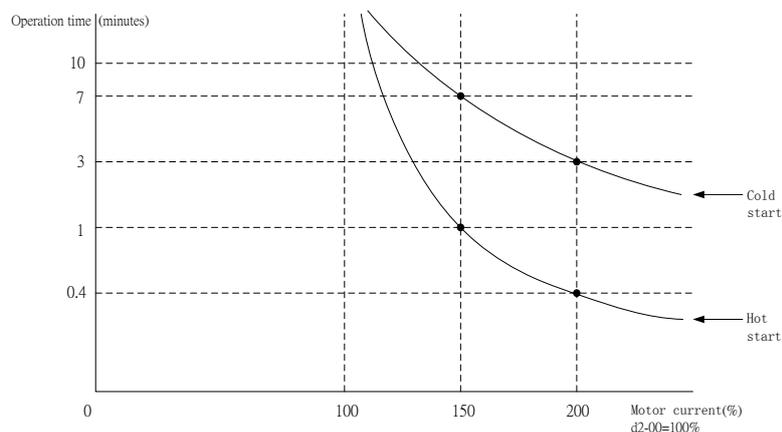


Figure 6.72 Motor Protection Opeartion Time

■ Motor Protection Using PTC Input

A motor PTC can be connected to the drive analog input terminal MT for motor overheat protection.

When the motor PTC signal exceeds the overheat alarm level, the keypad will display OH1 (Motor Overheat) and the motor will continue to run. When the motor PTC signal exceeds the overheat fault level, the keypad will display OH1 (Motor Overheat) and the drive will shut off the output and stop the motor using the stop method selected in P1-03.

Connect the PTC according to the following figure.

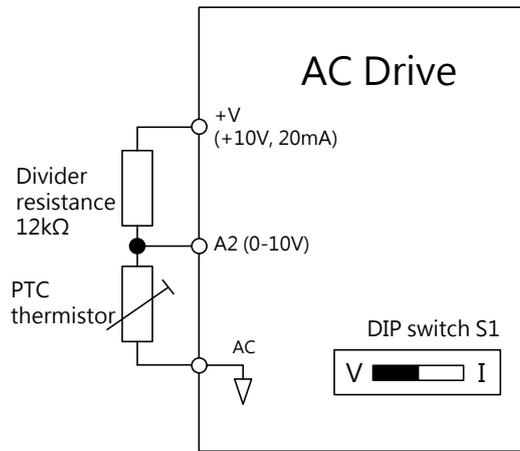


Figure 6.73 PTC Input Wiring

The PTC must have the characteristics illustrated in the following figure in each motor phase. The motor overload protection normally requires 3 PTC inputs connecting in a series.

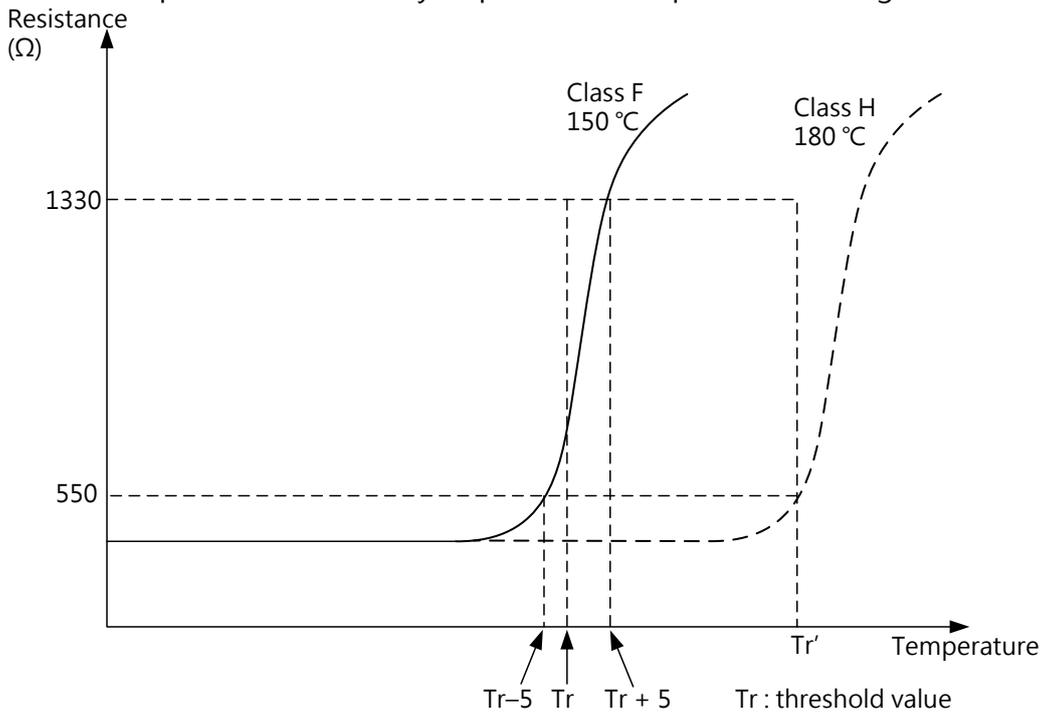


Figure 6.74 PTC Characteristics

Set the overheat detection using a PTC in P1-03 to P1-04 as explained in the section below.

■ **P1-03 Motor Overheat Fault Operation Selection (MT Input)**

Selects the drive operation when the MT input signal reaches the level of motor overheat fault.

No.	Name	Setting Range	Default
P1-03	Motor Overheat Fault Operation Selection (MT Input)	0 to 2	1

0 : Ramp to Stop

Stop the motor using the deceleration time set to C1-01 (Deceleration Time 1).

1 : Coast to Stop

The drive output is shut off, the motor coasts to stop.

2 : Fast Stop

Follows the fast stop time set in C1-08

P2 Momentary Power Loss

■ **P2-00 Momentary Power Loss Operation Selection**

Selects the drive operation when a momentary power loss occurs (the main circuit DC voltage falls below the P2-03 level). The drive can automatically return to the operation it was performing before the power loss.

No.	Name	Setting Range	Default
P2-00	Momentary Power Loss Operation Selection	0 to 3	0

0 : Disabled (Default)

When the power supply falls below the P2-03 (Uv Detection Level) value for 10ms, a Uv (Undervoltage) fault will be triggered to shut off the drive output and the motor coasts to stop.

1 : Recover if CPU Has Power

When the CPU of the drive is powered after a momentary power loss, the drive will resume the operation. The KEB function will not perform even if KEB is enabled.

2 : KEB function if CPU Has Power

When a momentary power loss occurs, the drive decelerates using regenerative power from the motor. If the power returns, the drive accelerates to the frequency it was running before

the power loss. If the power does not return and the output frequency falls below the minimum output frequency, the drive output will be shut off.

3 : Ramp to Stop with KEB Deceleration

When a momentary power loss occurs, the drive decelerates using regenerative power from the motor even if the power recovers within this duration. If KEB is assigned to a multi-function input terminal, the drive accelerates back up when the power returns only if the input terminal is opened.

■ KEB Function

When a power loss is detected, KEB (Kinetic Energy Backup) starts decelerating the motor and using regenerative power to control the motor. Therefore the drive can continue to run during a momentary power loss. When the power returns, the drive accelerates back up to the frequency it was run in before the power loss.

When using a single drive, set P2-09 = 0 (KEB Operation Method 1) or P2-09 = 1 (KEB Operation Method 2).

When multiple drives have to perform KEB and decelerate at a certain speed ratio in applications such as textile machinery, set P2-09 = 1 (KEB Operation Method 2) or 2 (KEB Operation Method 3).

■ P2-01 Minimum Baseblock (bb) Time

Sets the minimum baseblock time when power is restored right after a momentary power loss. This determines the time the drive waits for the residual voltage in the motor to dissipate.

Increase this value if overcurrent or overvoltage occurs at the beginning of Speed Search and DC Braking.

No.	Name	Setting Range	Default
P2-01	P2-01 Minimum Baseblock (bb) Time	0.1 to 5.0 s	Determined by o2-03, A1-06

■ P2-03 Uv (Undervoltage) Detection Level

Sets the voltage level of undervoltage detection or KEB function activation. Normally this parameter does not require any change.

No.	Name	Setting Range	Default
P2-03	Uv (Undervoltage) Detection Level	150 to 210 V <1>	Determined by d1-00 and o2-03<2>

<1> This is the value for 200V. Double this value for 400V.

<2> The default setting for 400 V drives depends on whether the drive input voltage is higher or lower than 400V.

Note:

1. When setting a value lower than the default, install an AC reactor option on the drive input side to prevent damage to the drive parts.
2. When using KEB function and P2-04 is set too low, the Uv1 (Undervoltage Detection 1) fault will be triggered before the KEB can be performed. Therefore do not set this value too low.

■ P2-04 KEB Deceleration Time

Sets the time to decelerate during KEB function. Set a longer time if Uv1 (Undervoltage Detection 1) fault is triggered during KEB function. On the other hand, set a shorter time if ov (Overvoltage) is triggered during KEB function.

- When performing KEB operation method 1, the drive deceleration time is based on the setting of P2-04 and changes according to the main circuit voltage.
- When performing KEB operation method 2 or 3, the drive deceleration time is determined by p2-04.

No.	Name	Setting Range	Default
P2-04	KEB Deceleration Time	0.0 to 6000.0 s <1>	0.0 s

<1> The setting range is determined by the units set in C1-09 (Acc./Dec. Time Unit Selection). When C1-09 = 0 (0.01 s), then the setting range is 0.00 to 600.00 (s).

■ P2-05 Acceleration Time after KEB

Sets the time to reaccelerate from the speed when KEB function was deactivated to the set frequency command (operation frequency before power loss).

When set to 0.0 s, the drive will accelerate to the previously active frequency according to the active acceleration time set by any of C1-00, C1-02, C1-04 or C1-06.

No.	Name	Setting Range	Default
P2-05	Acceleration Time after KEB	0.0 to 6000.0 s <1>	0.3 s

<1> The setting range is determined by the units set in C1-09 (Acc./Dec. Time Unit Selection). When C1-09 = 0 (0.01 s), then the setting range is 0.00 to 600.00 (s).

■ P2-06 Retain

■ P2-07 KEB Detection Time

Sets the minimum duration of KEB operation once KEB is enabled (P2-00 = 2 or 3). KEB will be performed throughout this detection time even if power recovers within this duration. When KEB is enabled or the multi-function input terminal assigned to KEB closes, and the main circuit voltage falls below the P2-03 level, the drive continues to perform KEB within the detection time set to this parameter. When P2-00 = 0 or 1, set a longer possible time to P2-07.

When the multi-function input terminal assigned to KEB is closed, the KEB operation will continue after the detection time (P2-07). If the terminal is released, the drive will reaccelerate. When KEB is not assigned to a multi-function input terminal and the main circuit voltage

exceeds the P2-08 setting after the detection time (P2-07), the drive reaccelerates. If the main circuit voltage falls below the P2-08 setting after the detection time (P2-07), the KEB operation continues.

No.	Name	Setting Range	Default
P2-07	KEB Detection Time	0 to 2000 ms	50 ms

■ **P2-08 Voltage Target During KEB**

Sets the target value for the main circuit DC voltage or to deactivate KEB.

No.	Name	Setting Range	Default
P2-08	Voltage Target During KEB	150 to 400 V <1>	<2>

<1> This value is for a 200 V drive. Double this value for a 400 V drive.

<2> This default is determined by d1-00.

■ **P2-09 KEB Method Selection**

To enable KEB, set P2-00=2 to 3 or close the assigned multi-function input terminal.

No.	Name	Setting Range	Default
P2-09	KEB Method Selection	0 1, 2	0

0 : KEB Operation Method 1

Based on P2-04 (KEB Deceleration Time), the drive adjusts the deceleration time during the KEB operation to match P2-08 (Voltage Target During KEB).

Note: When a Uv (Undervoltage) is triggered during KEB, set a shorter time to P2-04 (KEB Deceleration Time). When an ov (Overvoltage) is triggered during KEB, set a longer time to P2-04 (KEB Deceleration Time).

1 : KEB Operation Method 2

The drive uses the time set to P2-04 (KEB Deceleration Time) to perform the KEB operation regardless the main circuit voltage. Install a braking option as an ov (Overvoltage) might be triggered.

2 : KEB Operation Method 3

The drive uses the time set to P2-04 (KEB Deceleration Time) to perform the KEB operation and monitors the main circuit voltage at the same time. If the main circuit voltage increases, the drive holds the frequency to avoid ov (Overvoltage). Select this operation method when no braking option is installed.

Refer to setting 56 KEB Command 1 (Normal Closed) and 57 KEB Command 1 (Normal Open) of multi-function terminal inputs for details.

- KEB Operation Start

The KEB function is triggered by the following conditions.

- The multi-function input terminal assigned to KEB closes.
- The main circuit voltage falls below the P2-03 level.

□ KEB Operation End

The KEB function is disabled by the following conditions.

- The multi-function input terminal assigned to KEB releases after the time set in P2-07 (KEB Detection Time).
- When no multi-function input terminal is assigned to KEB and the voltage returns to the P2-08 level (Voltage Target During KEB) after the time set in P2-07 (KEB Detection Time).

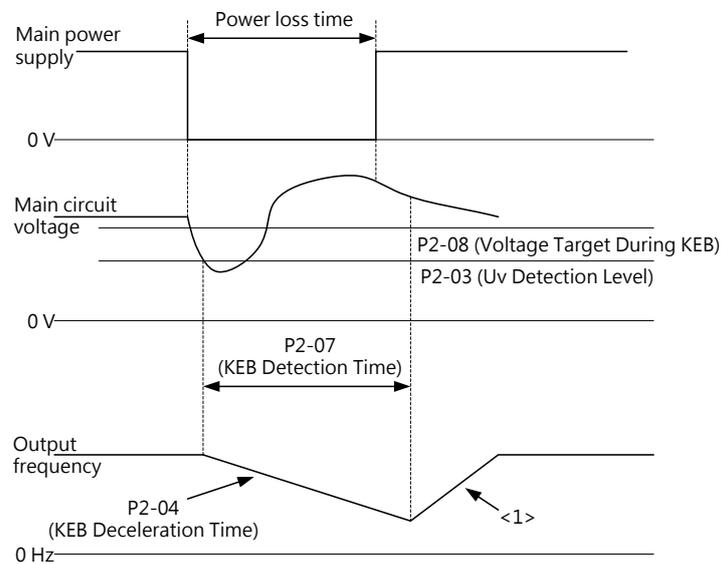


Figure 6.75 KEB Opeartion Method 2 (P2-00=3 and P2-09=1 without Using Multi-Function Input for KEB)

Note: After the time set to P2-07 (KEB Detection Time), KEB continues if the voltage is still below the P2-08 (Voltage Target During KEB) level and KEB ends if the voltage exceeds the P2-08 level.

<1> When P2-05 = 0, the drive will accelerate to the previously active frequency according to the active acceleration time set by any of C1-00, C1-02, C1-04 or C1-06.

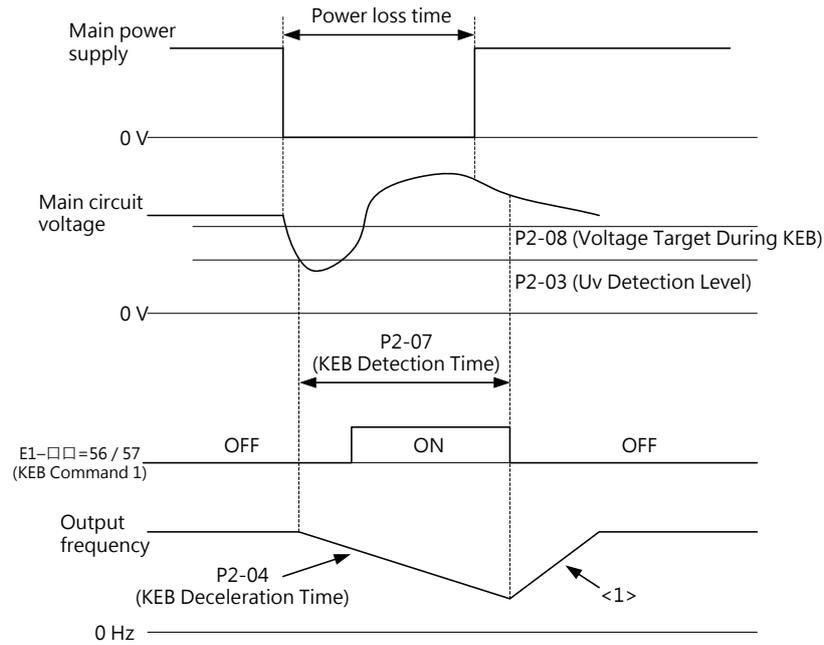


Figure 6.76 KEB Opeartion Method 2 Using KEB Command 1 (P2-00 = 3, P2-09 = 1 and E1-□□=56,57)

Note: Whichever between voltage falling below the P2-03 level and entering KEB Command 1 occurs earlier activates the KEB function.

<1> When P2-05=0, the drive accelerates to the previously active frequency according to the active acceleration time set by any of C1-00, C1-02, C1-04 or C1-06. When P2-05≠0, the drive accelerates using the acceleration time set to P2-05.

Figure 6.77 illustrates a wiring example to trigger KEB at the momentary power loss using terminal S6.

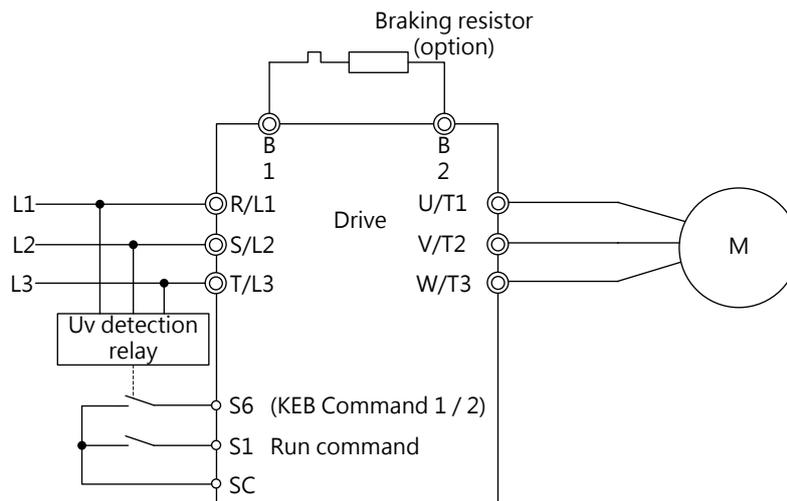


Figure 6.77 KEB Function Wiring

Note:

1. Check if a Run command during power loss is enabled. When the Run command is removed, the drive cannot

accelerate to the frequency command even if the power is restored.

2. Install a braking resistor option when P2-09 = 1 (KEB Operation Method 2).

■ P2-10 AVR Selection

No.	Name	Setting Range	Default
P2-10	AVR Selection	0, 1	1

0 : Disabled

1 : Enabled

P3 Stall Prevention

When the load is too heavy or the deceleration time is too short, the motor may not be able to keep up with the frequency command and slips. The regenerative power from the power will then exceed the tolerance of main circuit capacitor and trigger an ov (Overvoltage) fault to stop the drive. This process is called "stall" . When a motor stalls, it cannot be accelerated or decelerated. The Stall Prevention Function prevents the motor from stalling and while allowing the motor to keep up with the desired speed without changing the acceleration or deceleration times. This function can be set separately for acceleration, operating at constant speeds, and deceleration.

■ P3- 00 Stall Prevention during Acceleration

Sets the method to prevent the motor being stopped by oC(Overcurrent), oL1 (Motor Overload) or oL2 (Drive Overload) fault.

No.	Name	Setting Range	Default
P3-00	Stall Prevention during Acceleration	0 to 1	1

0 : Disabled

The Stall Prevention function is not provided during acceleration. If the acceleration time is too short, the motor might not be able to be accelerated causing an overload fault and stop.

1 : Enabled

The Stall Prevention is enabled during acceleration. The operation is determined by the selected control method.

- V/F Control / Open-Loop Vector Control

Acceleration stops when the output current exceeds the value set in P3-01. Acceleration continues when the output current drops 15% below the value set in P3-01. The Stall Prevention level is automatically decreased in the constant power range. Refer to P3-02 (Stall Prevention Limit during Acceleration) for details..

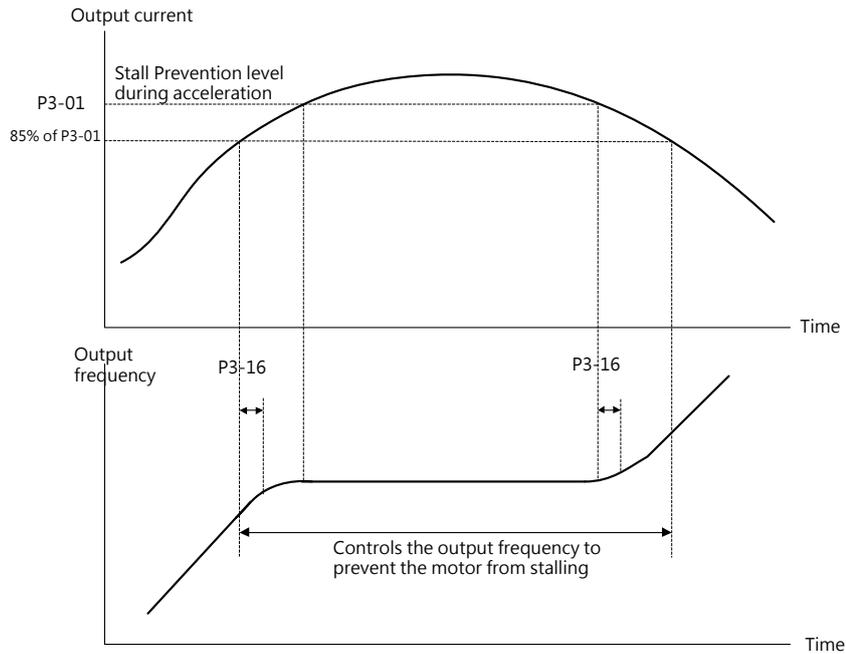


Figure 6.78 Stall Prevention during Acceleration for IM motors

· PM Open-Loop Vector Control

When the output current is higher than the P3-01 (Stall Prevention Level during Acceleration) level for longer than the time set to P3-16, the drive decelerates using P3-11 (Stall Deceleration Time during Acceleration). Refer to P3-11 for details.

The drive reaccelerates when the output current drops 15% below the value set in P3-01.

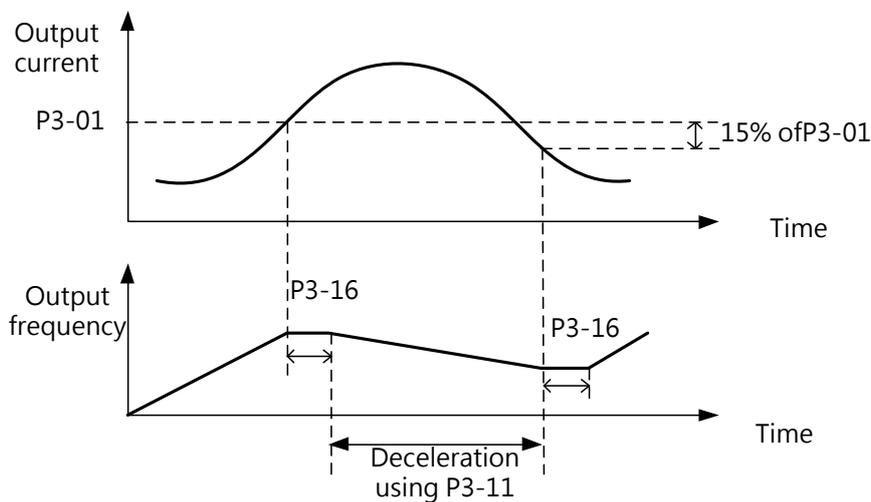


Figure 6.79 Stall Prevention during Acceleration for PM motors

■ P3-01 Stall Prevention Level during Acceleration

Sets the output current level to activate the Stall Prevention function during acceleration.

No.	Name	Setting Range	Default
P3-01	Stall Prevention Level during Acceleration	0 to 150% <1>	<1>

<1> The value is determined by A1-06 (ND/ HD Selection).

- When the motor rating is smaller than the drive rating, using the default to run the motor could cause motor to stall. If the stall occurs, set a smaller to this parameter.
- Set P3-02 as well when running the motor in the constant power range.

■ P3-02 Stall Prevention Limit during Acceleration

when running the motor in the constant power range, the P3-01 value will be automatically reduced.

Sets the lower limit of Stall Prevention in the constant power range as a percentage of the drive rated output current.

No.	Name	Setting Range	Default
P3-02	Stall Prevention Limit during Acceleration	0 to 100%	50%

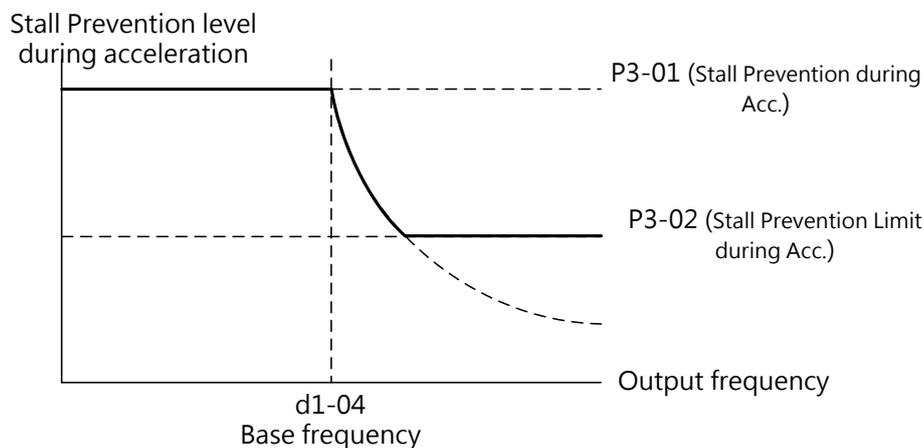


Figure 6.80 Stall Prevention Level during Acceleration

■ P3-03 Stall Prevention during Deceleration

The Stall Prevention function during deceleration controls the deceleration base on the main circuit DC voltage, and use high inertia or rapid deceleration to prevent an ov (Overvoltage) fault.

No.	Name	Setting Range	Default
P3-03	Stall Prevention during Deceleration	0 to 1	1

0 : Disabled

The drive decelerates according to the set deceleration time. With high inertia loads or rapid deceleration, an ov (Overvoltage) fault could be triggered. Therefore use braking options or set this parameter to 1.

1 : Enabled

When the main circuit voltage exceeds the stall Prevention level during acceleration, the deceleration pauses and hold the frequency. When the main circuit voltage falls below the Stall Prevention level, the drive continues to decelerate using the set deceleration time. Stall Prevention might be triggered repeatedly to prevent an overvoltage fault.

Stall Prevention might lengthen the total deceleration time until a completely stop. Therefore install a braking option for applications such as conveyors.

The Stall Prevention function is illustrated below.

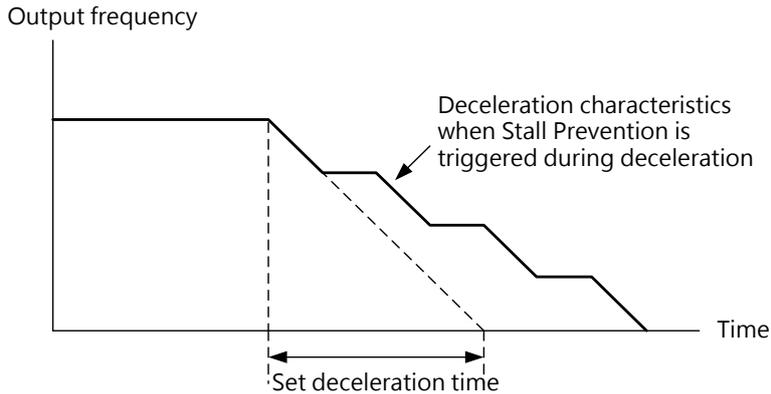


Figure 6.81 Stall Prevention during Deceleration Operation

■ **P3-04 Stall Prevention Level during Deceleration**

Sets the voltage level to activate the Stall Prevention function during deceleration.

No.	Name	Setting Range	Default
P3-04	Stall Prevention Level during Deceleration	330V to 410V <1>	395V <1>

When the regenerative power boosts the main circuit DC voltage higher than the value set to this parameter during deceleration, the drive performs Stall Prevention during deceleration to prevent an oV (Overvoltage) fault. Lower this value if the load is too heavy which causes a rapid regenerative power increase.

<1> This value is for a 200 V AC drive. Double this value for a 400 V AC drive.

■ **P3-05 Stall Prevention during Run**

Stall Prevention during run prevents an oL1 (Motor Overload) fault when the motor is running at constant speed.

No.	Name	Setting Range	Default
P3-05	Stall Prevention during Run	0 to 2	1

Note:

1. Available in Open-Loop V/F Control, Closed-Loop V/F Control and PM Open-Loop Vector Control control methods.

2. Disable when the output frequency is below 6 Hz regardless the P3-05 and P3-06 settings.

0 : Disabled

The drive runs at the set frequency command. A heavy load might cause the motor too stall and triggered an oC (Overcurrent) or oL1 (Motor Overload) to stop the motor.

1 : Enabled (Deceleration Time 1)

When the drive output current exceeds the P3-06 (Stall Prevention Level during Run) level, the deceleration time C1-01, C1-03, C1-05 or C1-07 will be used to decelerate. When the drive output current falls below the value of P3-06 minus 2% for 100 ms, the drive accelerates back to the frequency command at the active acceleration time.

2 : Enabled (Deceleration Time 2)

Same as P3-05 = 1 except the drive decelerates using the C1-03 deceleration time.

■ P3-06 Stall Prevention Level during Run

Sets the current level to activate the Stall Prevention function during run.

No.	Name	Setting Range	Default
P3-06	Stall Prevention Level during Run	30 to 150	<1>

<1> The default setting is determined by A1-06 (ND/HD Selection).

□ Using Analog Input to Change Stall Prevention Level during Run

If E3-□□= 7 (Stall Prevention Level during Run) is set, this value can be changed via input terminal A1 or A2.

The Stall Prevention level during run is determined by the smaller value of the P3-06 setting or the input via terminal A1 or A2.

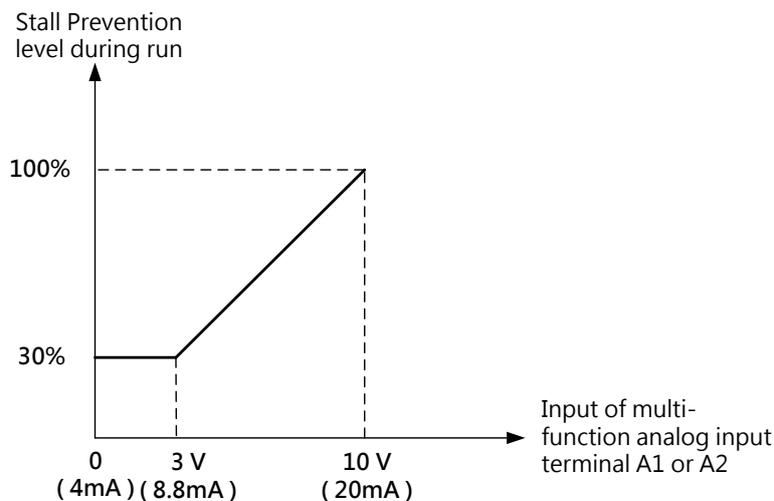


Figure 6.82 Using Analog Input to Change Stall Prevention Level during Run

■ P3-07 to P3-10 Retain

■ **P3-11 Stall Deceleration Time during Acceleration**

Sets the deceleration time for a stall during acceleration when running a PM motor. Setting 0 to this parameter will disable this function. When the motor stalls, the drive use the currently active deceleration time to decelerate.

This function is enabled when P3-00=2 in PM Open-Loop Vector Control.

No.	Name	Setting Range	Default
P3-11	Stall Deceleration Time during Acceleration	0.0 to 6000.0 s	0.0 s

■ **P3-12 to P3-16 Retain**

P4 Frequency Detection

P4 parameters set the frequency agree and frequency detection to the assigned multi-function output terminal.

■ **P4-00 / P4-01 Frequency Detection Level / Width**

P4-00 sets the detection level for the multi-function output terminal assigned to E2-□□ = 2 (Frequency Agree), E2-□□=3 (User-Defined Frequency Agree), E2-□□=16 (Frequency Detection 1) or E2-□□=17 (Frequency Detection 2).

P4-01 Sets the detection width for the multi-function output terminal.

No.	Name	Setting Range	Default
P4-00	Frequency Detection Level	0.0 to <1>	30.0 Hz
P4-01	Frequency Detection Width	0.1 to 25.5 Hz	2.0 Hz

<1> The upper limit is determined by the values set to d1-02 (Maximum Output Frequency), d1-13 (Motor 2 Maximum Output Frequency) and L2-00 (Frequency Command Upper Limit).

■ **P4-02 Frequency Command Loss Detection Selection**

The drive can detection a frequency command loss from terminal A1 or A2. When the frequency command falls below 90% of the command within the time set in P4-04, the frequency command loss will be detected.

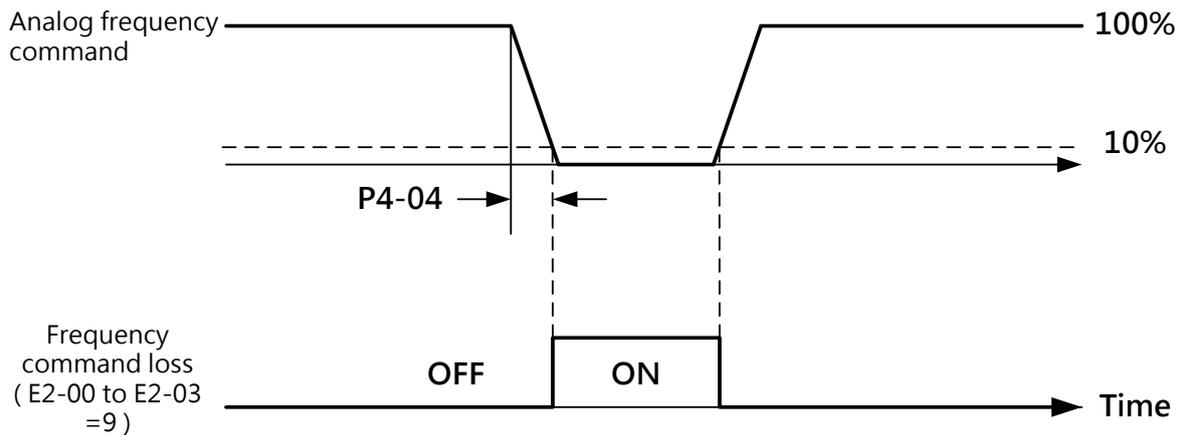


Figure 6.83 Frequency Command Loss Detection Operation

This parameter sets the drive operation when a frequency command loss is detected. Set E2-00 to E2-03 to 9 (Frequency Command Loss) for the output terminal to trigger when frequency command loss occurs.

No.	Name	Setting Range	Default
P4-02	Frequency Command Loss Detection Selection	0,1	0

0 : Drive stop

The drive runs according to the frequency command.

1 : Continue operation according to the setting in P4-03.

The drive continues to run at the frequency set to P4-03 during frequency command loss. When the frequency command is restored, the operation will be continued with the frequency command.

■ P4-03 Frequency Command at Frequency Command Loss

Sets the frequency command level at which the drive runs when detecting a frequency command loss and when L4-02 is set to 1. Sets the value as a percentage of the maximum output frequency set in d1-02. (Sets the value as a percentage of the motor 2 maximum output frequency set in d1-13.)

No.	Name	Setting Range	Default
P4-03	Frequency Command at Frequency Command Loss	0.0 to 100.0%	80.0 %

■ P4-04 Frequency Command Loss Detection Time

When the frequency command falls below 90% of the command within this detection time, the frequency command loss will be detected.

No.	Name	Setting Range	Default
P4-04	Frequency Command Loss Detection Time	20 to 400ms	20ms

P5 Fault Restart

Fault Restart tries to automatically restart the motor and continue operation to prevent the motor from stopping when a fault is detected.

The drive diagnoses itself and continues operation when a fault is detected during run. If the self-diagnosis is successful to clear the fault, the drive restarts automatically with Speed Search. Refer to b3 (Speed Search) for details.

Note:

1. The Run command (forward/ reverse) will automatically be removed when the sequency control circuit makes the fault shut off the drive output.
2. When the Run command is removed, the drive diagnoses itself, attempts to clear the fault and restart.

WARNING! Do not perform Fault Restart in applications such as lifting, which could cause the machine to drop the load.

Fault Restart can be performed when the following faults occur.

Fault	Fault Name	Fault	Fault Name
GF	Ground Fault	OL2	Drive Overload
OVA	Overvoltage (Acceleration)	Ot1	Overload Detection 1
OVD	Overvoltage (Deceleration)	Ot2	Overload Detection 2
OVC	Overvoltage (Constant Speed)	PF	Input Phase Loss
oCA	Overcurrent (Acceleration)	LF1	Output Phase Loss
oCD	Overcurrent (Deceleration)		
oCC	Overcurrent (Constant Speed)		
OH	Heatsink Overheat		
OL1	Motor Overload		

Set Fault Restart in P5-00 to P5-03.

Set E2-00 to E2-03 to 14 (Fault Start) to output the signal to an external devices.

■ P5-00 Number of Auto Restart Attempts

Sets the number of times to automatically attempt to restart the drive when detecting the fault listed above. The drive will stop operation when the restart attempts reach the number set in this parameter. Clear the cause of the fault manually and restart the drive.

The number of auto restart attempts is reset to 0 in the following situations.

- The drive runs normally for 10 minutes after a fault restart.
- A fault is reset manually after the protection function is triggered.
- The power supply is cycled.

No.	Name	Setting Range	Default
P5-00	Number of Auto Restart Attempts	0 to 10	0

■ **P5- 01 Auto Restart Fault Output Operation**

Enables or disables the fault output via E2-□□= 11 (Fault) during Fault Restart.

No.	Name	Setting Range	Default
P5-01	Auto Restart Fault Output Operation	0, 1	0

0 : Fault Output Disabled

1 : Fault Output Enabled

■ **P5-02 Fault Restart Interval Time**

Sets the amount of time between restart attempts.

No.	Name	Setting Range	Default
P5-02	Fault Restart Interval Time	0.5 to 600.0 s	10.0 s

P6 Overtorque/Undertorque Detection

When the load is too heavy (overload) or suddenly drops (undertorque), the drive will output a torque detection signal to the multi-function output terminal (Relay 1, Relay 2, D1-DC or D2-DC). The torque detection function is set by P6 parameters.

CAUTION! When overtorque occurs, the drive may trigger the fault to stop the motor. To prevent the drive from stopping, use torque detection to indicate an overload situation before the fault is triggered. Similar situations also apply to undertorque. Use undertorque detection to find out application problems such as torn belts, a pump shutting off and etc.

E2-00 to E2-03 Setting	Name
18	Overvoltage/ Undervoltage Detection 1 (normal open)
20	Overvoltage/ Undervoltage Detection 2 (normal open)

Overtorque and undertorque operations are illustrated in Figure 6.84 and Figure 6.85.

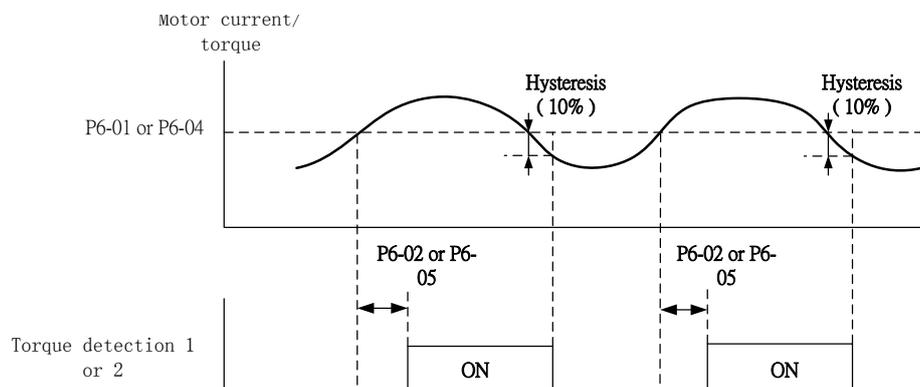


Figure 6.84 Overtorque Detection Operation

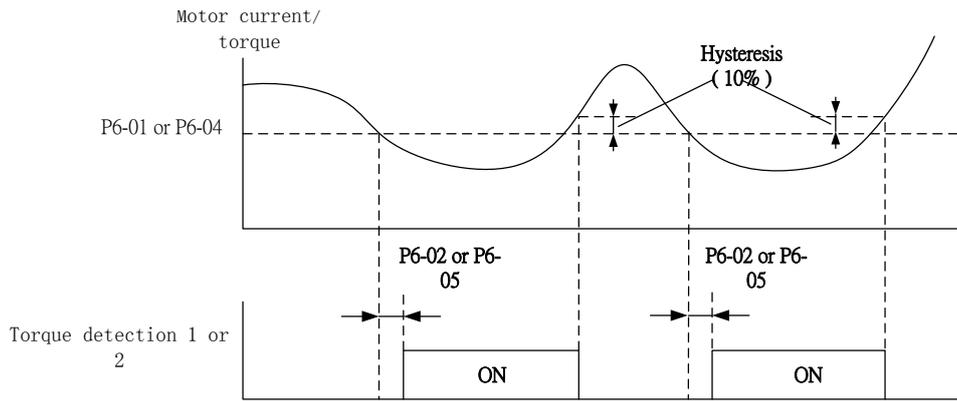


Figure 6.85 Undertorque Detection Operation

Note:

1. A 10% of the drive rated current and motor rated torque are used for the torque detection function.
2. Overtorque/ undertorque detection is set as a percentage of the drive rated output current in Open-Loop V/F Control, Closed-Loop V/F Control, and PM Open-Loop Vector Control control methods. Overtorque/ undertorque detection is set as a percentage of the motor rated torque in Open-Loop Vector Control, Closed-Loop Vector Control, and PM Closed-Loop Vector Control control methods.

■ P6-00 Overtorque/ Undertorque Detection Selection 1

Sets the operation when the motor current or torque exceeds the P6-01 level for longer than the time set to P6-02.

No.	Name	Setting Range	Default
P6-00	Overtorque/ Undertorque Detection Selection 1	0 to 8	0

0 : Disabled

1 : Overtorque Alarm at Speed Agree

Overtorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive continues to run after an ot1 (Overtorque Detection 1) alarm is triggered.

2 : Overtorque Alarm at Run

Overtorque detection is active when the Run command is active. The drive continues to run after an ot1 (Overtorque Detection 1) alarm is triggered.

3 : Overtorque Fault at Speed Agree

Overtorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive stops operation after

an ot1 (Overtorque Detection 1) fault is triggered.

4 : Overtorque Fault at Run

Overtorque detection is active when the Run command is active. The drive stops operation after an ot1 (Overtorque Detection 1) fault is triggered.

5 : Undertorque Alarm at Speed Agree

Undertorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive continues to run after an Ut1 (Undertorque Detection 1) alarm is triggered.

6 : Undertorque Alarm at Run

Undertorque detection is active when the Run command is active. The drive continues to run after an Ut1 (Undertorque Detection 1) alarm is triggered.

7 : Undertorque Fault at Speed Agree

Undertorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive stops operation after an Ut1 (Undertorque Detection 1) fault is triggered.

8 : Undertorque Fault at Run

Undertorque detection is active when the Run command is active. The drive stops operation after an Ut1 (Overtorque Detection 1) fault is triggered.

■ P6-01 Overtorque/ Undertorque Detection Level 1

Sets the level for overtorque/undertorque detection

Overtorque/ undertorque detection is set as a percentage of the drive rated output current in Open-Loop V/F Control, Closed-Loop V/F Control, and PM Open-Loop Vector Control control methods. Overtorque/ undertorque detection is set as a percentage of the motor rated torque in Open-Loop Vector Control, Closed-Loop Vector Control, and PM Closed-Loop Vector Control control methods.

No.	Name	Setting Range	Default
P6-01	Overtorque/ Undertorque Detection Level 1	0 to 300%	150%

Note: This level can be set by the analog input terminal assigned to E3-□□=11. The analog input overrides the setting in this parameter. However P6-04 (Overtorque/ Undertorque Detection Level 2) cannot be set by the analog input terminal.

■ P6-02 Overtorque/ Undertorque Detection Time 1

Sets the time for overtorque/undertorque detection 1.

No.	Name	Setting Range	Default
P6-02	Overtorque/ Undertorque Detection Time 1	0.0 to 10.0 s	0.1 s

■ P6-03 Overtorque/ Undertorque Detection Selection 2

Sets the operation when the motor current or torque exceeds the P6-04 level for longer than the time set to P6-05.

No.	Name	Setting Range	Default
P6-03	Overtorque/ Undertorque Detection Selection 2	0 to 8	0

0 : Disabled

1 : Overtorque Alarm at Speed Agree

Overtorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive continues to run after an ot2 (Overtorque Detection 2) alarm is triggered.

2 : Overtorque Alarm at Run

Overtorque detection is active when the Run command is active. The drive continues to run after an ot2 (Overtorque Detection 2) alarm is triggered.

3 : Overtorque Fault at Speed Agree

Overtorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive stops operation after an ot2 (Overtorque Detection 2) fault is triggered.

4 : Overtorque Fault at Run

Overtorque detection is active when the Run command is active. The drive stops operation after an ot2 (Overtorque Detection 2) fault is triggered.

5 : Undertorque Alarm at Speed Agree

Undertorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive continues to run after an Ut2 (Undertorque Detection 2) alarm is triggered.

6 : Undertorque Alarm at Run

Undertorque detection is active when the Run command is active. The drive continues to run after an Ut2 (Undertorque Detection 2) alarm is triggered.

7 : Undertorque Fault at Speed Agree

Undertorque detection is active only when the output frequency is the same as the frequency command. No detection during acceleration or deceleration. The drive stops operation after an Ut2 (Undertorque Detection 2) fault is triggered.

8 : Undertorque Fault at Run

Undertorque detection is active when the Run command is active. The drive stops operation after an Ut2 (Overtorque Detection 2) fault is triggered.

■ P6-04 Overtorque/ Undertorque Detection Level 2

Sets the level for overtorque/undertorque detection 2.

Overtorque/ undertorque detection is set as a percentage of the drive rated output current in Open-Loop V/F Control, Closed-Loop V/F Control, and PM Open-Loop Vector Control control methods. Overtorque/ undertorque detection is set as a percentage of the motor rated torque in Open-Loop Vector Control, Closed-Loop Vector Control, and PM Closed-Loop Vector Control control methods.

No.	Name	Setting Range	Default
P6-04	Overtorque/ Undertorque Detection Level 2	0 to 300%	150%

Note: The P6-01 level can be set by the analog input terminal assigned to E3-□□=11. The analog input overrides the setting in this parameter. However P6-04 (Overtorque/ Undertorque Detection Level 2) cannot be set by the analog input terminal.

■ P6- 05 Overtorque/ Undertorque Detection Time 2

Sets the time for overtorque/undertorque detection 2.

No.	Name	Setting Range	Default
P6-05	Overtorque/ Undertorque Detection Time 2	0.0 to 10.0 s	0.1 s

■ Mechanical Weakening Detection

This function uses the set time to detect the mechanical weakening of a machine that could cause overtorque or undertorque. When the cumulative drive operation time displayed in U3-00 exceeds the time set in P6-09, this function will be activated. When overtorque or undertorque occurs in the speed range determined by P6-06 and P6-07, Mechanical Weakening Detection uses the torque detection 1 set in P6-00 to P6-02 and triggers an oL (Mechanical Weakening Overtorque Detection) or UL (Mechanical Weakening Undertorque Detection) fault.

To output a signal for Mechanical Weakening Detection, set E2-□□= 29.

■ P6-06 Mechanical Weakening Detection Operation

Sets the speed range to detect mechanical weakening and the operation when detected.

No.	Name	Setting Range	Default
P6-06	Mechanical Weakening Detection Operation	0 to 8	0

0 : Disabled

1 : Continue Operation if the Speed (Signed) is above P6-07

When the speed (signed) exceeds the P6-07 level, an oL (Mechanical Weakening Overtorque Detection) alarm will be triggered and the drive will continue operation.

2 : Continue Operation if the Speed (Unsigned) is above P6-07

When the speed (unsigned) exceeds the P6-07 level, an oL (Mechanical Weakening Overtorque Detection) alarm will be triggered and the drive will continue operation.

3 : Stop Operation if the Speed (Signed) is above P6-07

When the speed (signed) exceeds the P6-07 level, an oL (Mechanical Weakening Overtorque Detection) fault will be triggered and the drive will stop operation.

4 : Stop Operation if the Speed (Unsigned) is above P6-07

When the speed (unsigned) exceeds the P6-07 level, an oL (Mechanical Weakening Overtorque Detection) fault will be triggered and the drive will stop operation.

5 : Continue Operation if the Speed (Signed) is below P6-07

When the speed (signed) is below the P6-07 level, an UL (Mechanical Weakening Undertorque Detection) alarm will be triggered and the drive will continue operation.

6 : Continue Operation if the Speed (Unsigned) is below P6-07

When the speed (unsigned) is below the P6-07 level, an UL (Mechanical Weakening Undertorque Detection) alarm will be triggered and the drive will continue operation.

7 : Stop Operation if the Speed (Signed) is below P6-07

When the speed (signed) is below the P6-07 level, an UL (Mechanical Weakening Undertorque Detection) fault will be triggered and the drive will stop operation.

8 : Stop Operation if the Speed (Unsigned) is below P6-07

When the speed (unsigned) is below the P6-07 level, an UL (Mechanical Weakening Undertorque Detection) fault will be triggered and the drive will stop operation.

■ **P6-07 Mechanical Weakening Detection Speed Level**

Sets the speed level for Mechanical Weakening Detection as a percentage of d1-02 (Maximum Output Frequency).

No.	Name	Setting Range	Default
P6-07	Mechanical Weakening Detection Speed Level	-110.0 to 110.0%	110.0%

The drive detects Mechanical Weakening by the settings of P6-00 to P6-02. When P6-06 is set for unsigned speed detection, the negative values are treated as positive values.

■ P6-08 Mechanical Weakening Detection Time

If the condition set in P6-06 lasts the time set in this parameter, Mechanical Weakening is detected.

No.	Name	Setting Range	Default
P6-08	Mechanical Weakening Detection Time	0.0 to 10.0 s	0.1 s

■ P6-09 Mechanical Weakening Detection Start Time

Sets the cumulative drive operation time to activate Mechanical Weakening Detection. If U3-00 reaches the value set in this parameter, Mechanical Weakening is detected.

No.	Name	Setting Range	Default
P6-09	Mechanical Weakening Detection Start Time	0 to 65535	0

■ P6-10 to P6-13 Torque Limit

Sets the torque limits as a percentage of the motor rated torque.

No.	Name	Setting Range	Default
P6-10	Forward Torque Limit	0 to 300%	200%
P6-11	Reverse Torque Limit	0 to 300%	200%
P6-12	Forward Regenerative Torque Limit	0 to 300%	200%
P6-13	Reverse Regenerative Torque Limit	0 to 300%	200%

Note: When E3-□□= 12 (Forward Torque Limit), 13 (Reverse Torque Limit), 14 (Refeneration Range Torque Limit), 17 (Forward and Reverse Torque Limit), the drive follows whichever smaller between the setting of P6-10 to P6-13 and the assigned analog input. Refer to setting 12, 13, 14 and 17 of multi-function analog input for details.

■ P6-14 Torque Limit Integral Time Constant

Sets the integral time constant for the torque limit. Set shorter time for faster torque limit.

No.	Name	Setting Range	Default
P6-14	Torque Limit Integral Time Constant	5 to 10000 ms	200 ms

■ P6-15 Torque Limit Control Selection during Acc./Dec

Selects the control method during acceleration and deceleration.

No.	Name	Setting Range	Default
-----	------	---------------	---------

P6-15	Torque Limit Control Selection during Acc./Dec	0,1	0
-------	--	-----	---

0 : Proportional Control (Integral Control at constant speed)

The torque limit function uses proportional control during acceleration and deceleration, and uses integral control at constant speed. Use this setting to accelerate or decelerate to the desired speed within a shorter time if the torque limit function is not prioritized.

1 : Integral Control

The torque limit function always uses intergral control during acceleration and deceleration. Use this setting when a highly accurate torque limit is prioritized even during speed changes. This function may increase the acceleration time and the torque limit may prevent the motor speed from reaching the frequency command.

P7 Drive Protection

■ **P7-00 Input Phase Loss Protection**

Enables or disables the input phase loss detection.

No.	Name	Setting Range	Default
P7-00	Input Phase Loss Protection	0, 1	0

0 : Disabled

1 : Enabled

When a power supply voltage is imbalance or main circuit capacitor is weakening, the input phase loss will be detected and a PF (Phase Loss) fault will be triggered.

The detection is disabled in the following situations.

- The drive is decelerating
- No Run command is entered
- Output current is below or equal to 30% of the drive rated current

■ **P7-01 Output Phase Loss Protection**

Sets the output phase loss detection. The output phase loss will be detected when the output current is less than 5% of the drive rated output current.

Note:

1. If the motor rated current is too small compared with the drive rating, output phase loss detection may be mistakenly triggered. Set P7-01 to 0 (disabled) in this situation .
2. Output phase loss detection is not provided when the drive is running a PM motor with light load.

No.	Name	Setting Range	Default
P7-01	Output Phase Loss Protection	0 to 2	0

0 : Disabled

1 : Enabled when One Phase is Lost

A LF1 (Output Phase Loss) fault is triggered when one output phase is lost. The drive output is cut off and the motor coasts to stop.

2 : Enabled when Two Phases are Lost

A LF1 (Output Phase Loss) fault is triggered when more than one output phases are lost. The drive output is cut off and the motor coasts to stop.

■ P7-02 Output Ground Fault Detection

Enables or disables the output ground fault detection.

No.	Name	Setting Range	Default <1>
P7-02	Output Ground Fault Detection	0, 1	0

0 : Disabled

No ground fault detection.

1 : Enabled

A GF (Ground Fault) fault is triggered when a ground short circuit or high leakage current occurs in one or two output phases.

■ P7-03 Heatsink Cooling Fan Operation

Sets the heatsink cooling fan operation.

No.	Name	Setting Range	Default
P7-03	Heatsink Cooling Fan Operation	0 to 2	0

0 : Enabled when drive is running

The fan is switched on when a Run command is entered and switched off with the wait time set to P7-04 after removing the Run command. This setting can be used to extend the fan lifetime.

1 : Enabled when power supply is On

The fan operates as long as the power is supplied to the AC drive.

2 : Enabled when the heatsink temperature reaches the limit.

■ P7-04 Heatsink Cooling Fan Off-Delay Time

Sets the cooling fan off-delay time when P7-03=0 that the drive waits to disabled the cooling fan after run command is released.

No.	Name	Setting Range	Default
P7-04	Heatsink Cooling Fan Off-Delay Time	0 to 300 s	60 s

■ P7-05 Ambient Temperature Setting

Sets the ambient temperature. This automatically decreases the drive rated current when the ambient temperature is higher than the temperature specified in drive specifications. The installation method is required to be set in P7-12.

No.	Name	Setting Range	Default
P7-05	Ambient Temperature Setting	-10 to 50°	40°

■ P7-06 oL2 Detection Time Reduction at Low Speed

Determines whether to reduce the oL2 (Drive Overload) fault detection time at low speed (below 6 Hz) to prevent premature output transistor failures.

Note: Contact Lite-On for consultation before disabling the protection by setting 0 to this parameter.

No.	Name	Setting Range	Default
P7-06	oL2 Detection Time Reduction at Low Speed	0, 1	0

0 : Detection time is not reduced

The oL2 (Drive Overload) fault detection time is not reduced at low speed (below 6 Hz). Running the drive with high output current at low speed could damage the output transistor.

1 : Detection time is reduced

The oL2 (Drive Overload) fault detection time is reduced at low speed (below 6 Hz).

■ P7-11 High Current Alarm Setting

Enables or disables the High Current Alarm (HCA) when the output current is too high.

No.	Name	Setting Range	Default
P7-11	High Current Alarm Setting	0, 1	0

0 : Disabled (No Alarm)

No alarm will be triggered.

1 : Enabled (Alarm)

When the output current is higher than 150% of the drive rated current, the alarm will be triggered and the assigned multi-function input terminal (E2-□□= 13) will close.

■ P7-12 Installation Method Selection

Selects the installation type. The drive overload detection limit will be changed according to the selection.

Note:

1. This value cannot be reset by A1-03 (Reset).
2. The default value is preset to the appropriate value. Do not change this value unless using side-by-side installation or mounting the drive with the heatsink outside the cabinet.

No.	Name	Setting Range	Default <1><2><3>
P7-12	Installation Method Selection	0 to 2	0

0 : IP20 Enclosure in a Cabinet

Select this when the IP20 enclosure drive is installed in a cabinet with at least 30 mm room to the next drive or a cabinet wall.

1 : Side-by-Side Mounting

Select this when the drive is mounted side-by-side with 2 mm to 29 mm room to the next drive.

2 : NEMA 1 Enclosure

Select this when the NEMA 1 enclosure drive is installed.

■ P7- 13 DC Braking Level Setting

Sets the DC braking transistor level.

No.	Name	Setting Range	Default
P7-13	DC Braking Level Setting	360V to 400 V <1>	395 V <1>

<1> The value is for a 200V AC drive. Double this value for a 400V AC drive.

6.8 Group n, Special Adjustments

n1 Hunting Prevention

Hunting Prevention prevents the drive from hunting when running with low inertia and light load. Hunting often occurs with a high carrier frequency and a low output frequency (below 30 Hz).

■ n1- 00 Hunting Prevention Setting

Enables or disables the hunting prevention function.

Note: This function is only provided in V/F Control. When drive response is prioritized over suppressing motor oscillation, disable Hunting Prevention. This function can be disabled without problems in applications with high inertia loads or heavy loads.

No.	Name	Setting Range	Default
n1-00	Hunting Prevention Setting	0, 1	0

0 : Disabled

1 : Enabled

■ **n1- 01 Hunting Prevention Gain**

Sets the gain for Hunting Prevention.

No.	Name	Setting Range	Default
n1-01	Hunting Prevention Gain	0.00 to 2.50	1.00

Normally there is no need to change this setting. However, change the setting in the following situations.

- If the motor oscillates during light load, gradually increase this value by units of 0.1
- If the motor stalls, gradually decrease this value by units of 0.1

■ **n1- 02 Retain**

■ **n1- 03 Retain**

n2 to n5 Retain

n6 PM Motor Control

n6 parameters set the control performance in PM Vector Control methods.

■ **n6-00 Retain**

■ **n6-01 Retain**

■ **n6-02 Initial Rotor Position Detection (only in PM Closed-Loop Vector Control)**

Selects the method used to detect the rotor position at start.

Note:

1. In PM Closed-Loop Vector Control, the drive performs a magnetic pole search the first time it applies the power supply. After that, rotor position will be calculated from the PG pulse train signal and saved until the drive power is shut off.
2. n6-02 = 1 and 2 can only be set for IPM motors. Set n6-02 = 0 for SPM motors .

No.	Name	Setting Range	Default
n6-02	Initial Rotor Position Detection (only in PM Closed-Loop Vector Control)	0 to 2	1

0 : Pull In

Use pull-in current to start the rotor.

1 : High Frequency Injection

Inject high frequency to detect the rotor position. This may generate some noise from the motor at start.

2 : Pulse Injection

Inject a pulse train signal to detect the rotor position.

■ n6-03 Speed Feedback Detection Control Gain (only in PM Open-Loop Vector Control)

Sets the gain for internal speed feedback detection control.

Normally there is no need to change this setting. However, change the setting in the following situations.

- Increase the gain if motor oscillates.
- Decrease the gain if drive response is too slow. Decrease this setting gradually by 0.05 units.

No.	Name	Setting Range	Default
n6-03	Speed Feedback Detection Control Gain (only in PM Open-Loop Vector Control)	0.00 to 10.00	0.80

■ n6-11 Output Voltage Limit (for PM Motors)

Sets the limit for output voltage to avoid voltage saturation. Set this value lower than the actual input voltage.

No.	Name	Setting Range	Default
n6-11	Output Voltage Limit (for PM Motors)	0.0 to 230.0 V <1>	200.0 V <1>

<1> The value is for a 200 V AC drive. Double this value for a 400 V drive.

■ n6-12 to n6-14 Retain

6.9 Group o, Keypad Function Settings

o1 Retain

o2 Multi-Function Selection

o2 parameters determine the functions assigned to the keys on the keypad.

■ o2-00 LO/RE (LOCAL/REMOTE) Key Function Selection

Enables or disables LO/RE key on the keypad

No.	Name	Setting Range	Default
o2-00	LO/RE (LOCAL/REMOTE) Key Function Selection	0, 1	1

0 : Disabled

Switches between Local and Remote are disabled.

1 : Enabled

Switches between Local and Remote Operation but only during drive stop. Switching is not possible when entering a Run command. When Local mode is selected, the LED indicator on the LO/RE will light up.

WARNING! Pay attention to the following situations when b1-05 (Run Command Action after Switch) is set to 1 (Accept Active Run Command at the New Source).

If a run command at the new source is active, the drive will accept it and run the motor immediately right after switching from the old source to the new source. Clear all personnel from the electrical connections and the running machinery prior to switching command sources. Failure to comply could cause serious injury.

Refer to Table 6.22 for the relationship between o2- 00 and b1- 05.

Table 6.22 Relationship between LO/RE and b1-05

o2-00	b1-05	Switch from Local to Remote	Switch from Remote to Local
0	0	Not possible to switch	Not possible to switch
	1	Not possible to switch	Not possible to switch
1	0	The drive will not run until a new Run command is entered.	Not possible to run
	1	If a Run command is entered, the drive will start running as soon as the LO/RE key is pressed.	Not possible to run

■ **o2-01 STOP Key Function Selection**

Determines if the STOP key on the keypad will stop the drive when Remote is selected as the command source.

No.	Name	Setting Range	Default
o2-01	STOP Key Function Selection	0, 1	1

0 : Disabled

1 : Enabled

The STOP key always stops drive operation even if the command source is not set to the keypad. To restart the drive, cycle the Run command if the drive has been stopped by pressing the STOP key.

■ **o2-02 Retain**

■ **o2-03 Drive Capacity Selection**

Set this parameter after replacing the terminal block or drive modules..

CAUTION! An incorrect o2- 03 setting may cause the drive performance to suffer and drive damage.

No.	Name	Setting Range	Default
o2-03	Drive Capacity Selection	-	Determined by drive capacity

Rating (kW) (200V series)	0.25	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11
o2-03 Setting	0	1	2	3	4	5	6	7	8
Rating (kW) (200V series)	15	18.5	22	30	37	45			
o2-03 Setting	9	10	11	12	13	14			

Rating (kW) (400V Series)	0.25	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11
o2-03 Setting	32	33	34	35	36	37	38	39	40
Rating (kW) (400V Series)	15	18.5	22	30	37	45	55	75	
o2-03 Setting	41	42	43	44	45	46	47	48	

■ **o2-04 ENTER Key Function During Frequency Command Setting**

Determines whether the ENTER key is required to be pressed after changing the frequency

command using the keypad in Local mode.

No.	Name	Setting Range	Default
o2-04	ENTER Key Function During Frequency Command Setting	0,1	0

0 : ENTER Key Required

The ENTER key is required to be pressed to trigger the frequency command.

1 : ENTER Key Not Required

When entering a frequency command, the output frequency changes immediately by UP or DOWN key without pressing ENTER. The frequency command will be saved 5 seconds after it is changed by pressing the UP or DOWN key.

■ o2-05 Retain

■ o2-06 Operation Direction at Power Up when Using Keypad

Determines the motor rotating direction after the drive power up and the Run command is entered from the digital operator.

Note: This parameter is provided only in Local mode when b1-01=0 or b1-08 = 0 (Keypad).

No.	Name	Setting Range	Default
o2-06	Operation Direction at Power Up when Using Keypad	0, 1	0

0 : Forward

1 : Reverse

o3 Retain

o4 Maintenance Settings

■ o4-00 Cumulative Operation Time Setting

Sets the initial value by 10 hours to start keeping track of cumulative operation time. The cumulative operation time can be viewed in U3-00.

Note: A setting of 20 will set the cumulative operation time to 200h and the monitor will display 200h in U3-00.

No.	Name	Setting Range	Default
o4-00	Cumulative Operation Time Setting	0 to 6000 h	0h

■ o4-01 Cumulative Operation Time Selection

Selects the conditions in which the drive keeps track of the cumulative operation time.

No.	Name	Setting Range	Default
-----	------	---------------	---------

o4-01	Cumulative Operation Time Selection	0, 1	0
-------	-------------------------------------	------	---

0 : Time of Power On

Keeps track of time from the power up to power cutoff.

1 : Time of Run

Keeps track of time when the output voltage is active.

■ **o4-02 Cooling Fan Operation Time Setting**

Sets the initial value to start keeping track of cumulative fan operation time. View the cumulative fan operation time in U3-01. Reset this value to 0 after the fan replacement.

Note:

1. Set this value in units of 10 h. A setting of 20 will set the cumulative operation time to 200h and the monitor will display 300h in U3-00.

No.	Name	Setting Range	Default
o4-02	Cooling Fan Operation Time Setting	0 to 6000 h	0h

■ **o4-03 to o4-05 Retain**

■ **o4-06 U2 Reset Setting**

Resets the data for U2-□□ (Fault Information) as this data will not be reset by A1-03 (Reset).

No.	Name	Setting Range	Default
o4-06	U2 Reset Setting	0,1	0

0 : No Action

The data for the U2-□□ (Fault Information) monitor will not be reset.

1 : Enabled

Resets the data for the U2-□□ (Fault Information) monitor. Set this value to 1 and press ENTER will clear all the fault information to 0.

6.10 Group t, Auto-Tuning

t1 IM Motor Auto-Tuning

t1 parameters set the data for IM motor Auto-Tuning

Note: When running variable speed motors or vector motors, the voltage or frequency may be lower than

general-purpose motors. Therefore set the motor data according to the motor nameplate and perform Auto-Tuning. After that, change the maximum output frequency in d1-02.

■ **t1-00 Motor 1/2 Selection**

Selects the motor to be auto-tuned when E1-□□ is set to 51. This parameter will not be displayed if motor 1/2 switch is disabled.

No.	Name	Setting Range	Default
t1-00	Motor 1/2 Selection	1, 2	1

1 : Motor 1

Set details in d1-01 to d1-11, d2-00 to d2-10.

2 : Motor 2

Set details in d1-12 to d1-22, d2-11 to d2-22. Connect motor 2 to the drive for Auto-Tuning.

■ **t1-01 Auto-Tuning Method Selection**

Selects the method of Auto-Tuning.

No.	Name	Setting Range	Default
t1-01	Auto-Tuning Method Selection	0,1,2	0

0 : Rotational Auto-Tuning

1 : Stationary Auto-Tuning 1

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

■ **t1-02 Motor Output Power**

Sets the motor rated output power in kW units.

No.	Name	Setting Range	Default
t1-02	Motor Output Power	0.00 to 650.00 kW	Determined by o2-03, A1-06

Note:

1. The maximum motor rating the drive can run changes depending on the A1-06 (ND/HD Selection) setting. 1HP (Horse Power) = 0.746kW

■ **t1-03 Motor Rated Voltage**

Sets the motor rated voltage according to the motor nameplate. If the motor is operating above base speed, enter the voltage base speed here.

Variable speed motors and vector motors may have lower voltage or frequency than the general-purpose ones. Therefore make sure the data entered matches the motor test report.

Enter the no-load voltage in this parameter for better control precision. If the motor test report or the nameplate data is not available, set approximately 90% of the motor rated voltage.

If the drive input voltage is low, set approximately 90% of the drive input voltage. 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> This value is for a 200 V drive. Double this value for a 400 V drive.

■ t1-04 Motor Rated Current

Sets the motor rated current according to the motor nameplate. Set the motor rated current between 50% and 100% of the drive rated current for optimal performance. 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	d2-10 (d2-21)

Note: The setting range changes depending on the settings of o2-03 (Drive Capacity Selection)and A1-06(ND/HD Selection).

■ t1-05 Motor Base Frequency

Sets the motor base frequency according to the motor nameplate. Enter the maximum frequency to d1-02 (d1-13 for motor 2) after Auto-Tuning if a motor with an extended speed range is used or the motor is used in the field weakening area.

No.	Name	Setting Range	Default
t1-05	Motor Base Frequency	0.0 to 400.0 Hz	50.0

■ t1-06 Number of Motor Poles

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

No.	Name	Setting Range	Default
t1-06	Number of Motor Poles	2 to 48	4

■ t1-07 Motor Base Speed

Sets the motor base speed according to the motor nameplate.

No.	Name	Setting Range	Default
t1-07	Motor Base Speed	0 to 24000 rpm	1450 rpm

■ t1-08 PG Number of Pulses Per Revolution

Sets the number of pulses per revolution for the PG (pulse generator or encoder). This

parameter will only be displayed in Closed-Loop Vector Control.

No.	Name	Setting Range	Default
t1-08	PG Number of Pulses Per Revolution	1 to 60000 ppr	1024 ppr

■ **t1-09 Motor No-Load Current (Stationary Auto-Tuning)**

Sets the no-load current for the motor. After the motor output power and rated current are set in t1-02 and t1-04, this parameter will automatically display the no-load current of a standard motor. The no-load current must be entered according to the motor test report.

No.	Name	Setting Range	Default
t1-09	Motor No-Load Current (Stationary Auto-Tuning)	0.0 A to (t1-04) (Max : 0 to 2999.9)	-

Note: The maximum motor rating the drive can run changes depending on the A1-06 (ND/HD Selection) setting.

■ **t1-10 Retain**

■ **t1-11 Retain**

■ **t1-12 Motor Auto-Tuning Setting**

Enables or disables Auto-Tuning when A1-02=0 to 3.

No.	Name	Setting Range	Default
t1-12	Motor Auto-Tuning Setting	0,1	0

0: Disabled

1: Enabled

Enables the motor Auto-Tuning. Set t1-12 to 1 and press the ENTER key to switch the display to the motor Auto-Tuning preparation (tUnxx). The last two letters changes depending on the selected motor (motor 1 or 2) and t1-01 setting.

Press the MENU key to cancel Auto-Tuning and leave this display or press the RUN key to start the motor Auto-Tuning function.

The display flashes in process and shows "End" after Auto-Tuning is completed. If Auto-Tuning fails, the process stops immediately and shows "tnFxx" on the screen which "xx" indicates the problems. Refer to Chapter 8.4 Auto-Tuning for more details.

When the Auto-Tuning function is required to be controlled by the keypad, set b1-01(Run Command Selection 1) to 0 (Keypad). Otherwise Auto-Tuning cannot be started by pressing the RUN key.

t2 PM Motor Auto-Tuning

■ t2-00 PM Motor Auto-Tuning Method Selection

Selects the method used for PM motor Auto-Tuning.

No.	Name	Setting Range	Default
t2-00	PM Motor Auto-Tuning Method Selection	0 to 3	0

0 : PM Initial Position Stationary Auto-Tuning

1 : PM Rotor Resistance Stationary Auto-Tuning

2 : PM Synchronous Inductor Stationary Auto-Tuning

3 : PM Back EMF Rotational Auto-Tuning

Note: To ensure the torque accuracy, perform one of the following before selecting.

- Perform Auto-Tuning.
- Set the correct value according to the test report or motor nameplate.

■ t2-02 PM Motor Type Selection

Selects the type of PM motor.

No.	Name	Setting Range	Default
t2-02	PM Motor Type Selection	0, 1	1

0 : IPM Motor

1 : SPM Motor

■ t2-03 PM Motor Output Power

Sets the PM motor rated output power in kW units.

No.	Name	Setting Range	Default
t2-03	PM Motor Output Power	0.00 to 650.00 kW	Determined by o2-03

Note:

1. The maximum motor that the drive can run changes depending on the A1-06 (ND/HD Selection) setting.
2. 1HP (Horse Power) = 0.746kW

■ t2- 04 PM Motor Rated Voltage

Sets the PM motor rated voltage according to the motor nameplate.

No.	Name	Setting Range	Default
t2-04	PM Motor Rated Voltage	0.0 to 255.0 V <1>	200.0 V <1>

<1>This value is for a 200 V drive. Double this value for a 400 V drive.

■ t2- 05 PM Motor Rated Current

Sets the PM motor rated current according to the motor nameplate.

No.	Name	Setting Range	Default
t2-05	PM Motor Rated Current	10 to 200% of drive rated current	50% of drive rated current

■ t2- 06 PM Motor Base Frequency

Sets the PM motor base frequency according to the motor nameplate.

No.	Name	Setting Range	Default
t2-06	PM Motor Base Frequency	0.0 to 400.0 Hz	87.5 Hz

Note: This parameter will only be displayed in PM Open-Loop Vector Control.

■ t2- 07 Number of PM Motor Poles

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

No.	Name	Setting Range	Default
t2-07	Number of PM Motor Poles	2 to 48	6

■ t2- 08 PM Motor Base Speed

Sets the PM motor base speed according to the motor nameplate.

No.	Name	Setting Range	Default
t2-08	PM Motor Base Speed	0 to 24000 rpm	1750 rpm

Note: This parameter will be displayed in PM Closed-Loop Vector Control.

■ t2- 09 PM Motor Rotor Resistance

Sets the PM motor d-axis inductance per phase according to the motor nameplate.

No.	Name	Setting Range	Default
t2-09	PM Motor Rotor Resistance	0.000 to 65.000 Ω	0.000 Ω

■ t2- 10 PM Motor d-Axis Inductance

Sets the PM motor d-axis inductance according to the motor nameplate.

No.	Name	Setting Range	Default
t2-10	PM Motor d-Axis Inductance	0.00 to 600.00 mH	0.00 mH

■ t2- 11 PM Motor q-Axis Inductance

Sets the PM motor q-axis inductance according to the motor nameplate.

No.	Name	Setting Range	Default
t2-11	PM Motor q-Axis Inductance	0.00 to 600.00 mH	0.00 mH

■ t2- 12 PM Motor Induced Voltage Constant Unit Selection

Sets the units used for setting the induced voltage coefficient.

No.	Name	Setting Range	Default
t2-12	PM Motor Induced Voltage Constant Unit Selection	0, 1	1

0 : mV/ (r/min)

d3-09 will be used, and d3-07 will automatically be set to 0.

1 : mV/ (rad/s)

d3-07 will be used, and d3-09 will automatically be set to 0.

■ t2- 13 PM Motor Induced Voltage Constant (Ke)

Sets the PM motor induced voltage constant according to the motor nameplate.

No.	Name	Setting Range	Default
t2-13	PM Motor Induced Voltage Constant (Ke)	0.1 to 2000.0	0.1

■ t2- 14 PM Motor Auto-Tuning Current

Sets the amount of current for Auto-Tuning as a percentage of the motor rated current. Normally there is no need to change this setting. However, increase this value when inertia is high.

No.	Name	Setting Range	Default
t2-14	PM Motor Auto-Tuning Current	0 to 120%	30%

■ t2- 15 Retain

■ t2- 16 Retain

■ t2- 17 PM Motor Auto-Tuning Setting

No.	Name	Setting Range	Default
t2-17	PM Motor Auto-Tuning Setting	0,1	0

0: Disabled

1: Enabled

t3 Retain

6.11 Group F, Option Settings

F1 PG Card Settings

Set the PG option card (PG-O, PG-L and PG-PM) when it is connected to terminal J3.

■ **F1-00 PG Pulse Number**

Sets the number of pulses (pulse generator and encoder) per resolution for PG. The PG output pulses can be calculated below.

PG pulses at the maximum frequency=Motor speed at the maximum output frequency (min^{-1})/60 X (p/rev).

No.	Name	Setting Range	Default
F1-00	PG Pulse Number	1 to 60000 ppr <1>	1024 ppr

<1> The setting range for PM motors is 1 to 15000ppr.

■ **F1- 01 PG Rotation Setting**

Selects the direction indicated by the PG pulses.

No.	Name	Setting Range	Default
F1-01	PG Rotation Setting	0, 1	Determined by A1-02

0 : A pulse leads with Forward fun command.

1 : B pulse leads with Forward fun command.

■ **F1-02 PG Output Division Ratio**

Sets the division ratio of pulse output for a PG card. Set X for a ratio of 1/X. When only A pulse is set, monitor pulse output will be 1:1 regardless of the setting in F1-02.

No.	Name	Setting Range	Default
F1-02	PG Output Division Ratio	1 to 255 (1 to $\frac{1}{255}$)	1

■ **F1- 03 PG Signal Selection**

Sets the channels of signal to the PG card in Closed-Loop V/F Control. Set this value to 1 in Closed-Loop Vector Control and PM Closed-Loop Vector Control.

No.	Name	Setting Range	Default
F1-03	PG Signal Selection	0, 1	1

0 : Channel A Only

1 : Channels A and B

■ **F1- 04 PG Disconnection Detection**

Enables or disables the detection if PG-L or PG-PM is disconnected.

No.	Name	Setting Range	Default
F1-04	PG Disconnection Detection	0, 1	1

0 : Disabled

1 : Enabled

■ F1-06/F1-07 PG Open (PGO) Operation Setting / Detection Time

No.	Name	Setting Range	Default
F1-06	PG Open (PGo) Operation Setting	0: Ramp to Stop 1: Coast to Stop 2: Alarm Only	1
F1-07	PG Open (PGo) Detection Time	0.0 to 10.0 s	2.0 s

When a PGO (PG Open) fault is detected for longer than the time set in F1-07(PG Open Detection Time), the drive stops according to F1-06.

Figure 6.86 illustrates the operation of PG feedback fault detection.

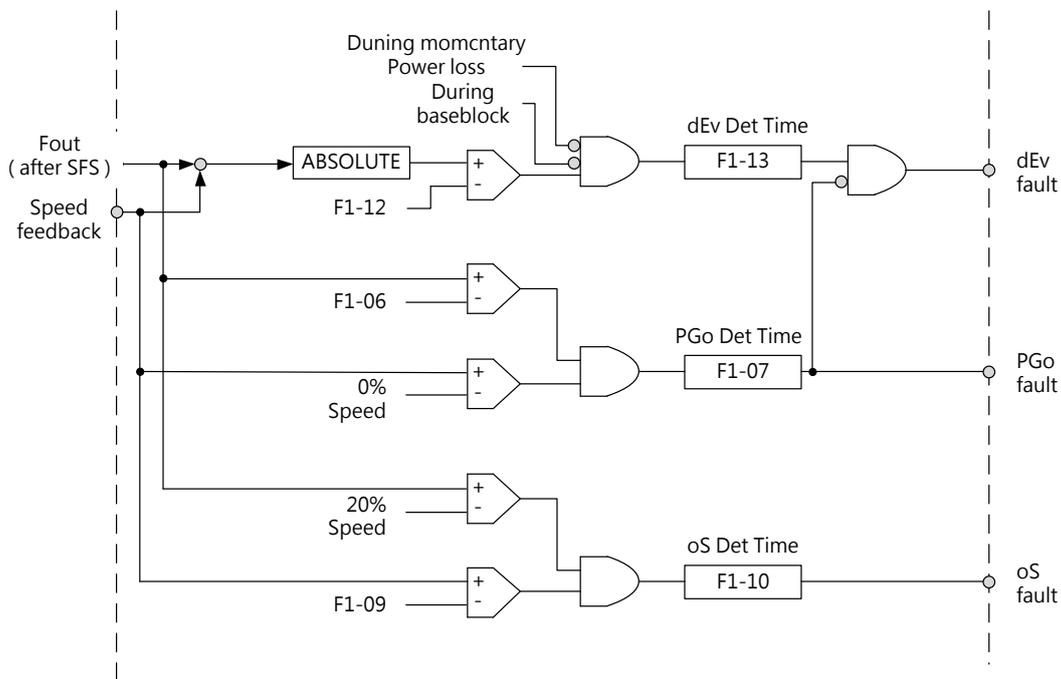


Figure 6.86 PG Feedback Fault Detection Operation

■ F1-08 /F1-09/F1-10 Overspeed (oS) 原先為大寫 Operation Setting/ Detection Level/ Detection Delay Time

No.	Name	Setting Range	Default
F1-08	Overspeed (oS) Operation Setting	0: Ramp to Stop 1: Coast to Stop 2: Alarm Only	1
F1-09	Overspeed (oS) Detection Level	0 to 120 %	115 %
F1-10	Overspeed (oS) Detection Delay Time	0.0 to 2.0 s	0.5 s

Sets the Overspeed (oS) detection level as a percentage of the maximum output frequency (d1-02). An oS fault will be triggered and stops the drive according to F1-08 if the motor speed feedback is greater than the level set in F1-09 for longer than the delay time set in F1-10.

■ **F1-11 /F1-12 /F1-13 Speed Deviation (dEv) Operation Setting/ Detection Level/ Detection Delay Time**

No.	Name	Setting Range	Default
F1-11	Speed Deviation (dEv) Operation Setting	0: Ramp to Stop 1: Coast to Stop 2: Alarm Only	2
F1-12	Speed Deviation (dEv) Detection Level	0 to 50 %	10 %
F1-13	Speed Deviation (dEv) Detection Delay Time	0.0 to 10.0 s	0.5 s

Sets the speed deviation (dEv) detection level as a percentage of the maximum output frequency (d1-02). A dEv fault will be triggered and stops the drive according to F1-11 if the difference between the motor speed feedback and frequency command is greater than the level set in F1-12 for longer than the delay time set in F1-13.

Refer to Figure 6.86 (PG Feedback Fault Detection Operation).

■ **F1- 14/ F1- 15 PG Number of Gear Teeth 1/2 (Only in Closed-Loop Control)**

Sets the number of the gear teeth (ratio) on the machinery side between the motor shaft and PG encoder. Set the gear teeth on the motor side in F1-14 and on the machinery in F1-15. The drive uses the following formula to calculate the motor speed.

$$\text{Motor speed } [\text{min}^{-1}] = \frac{\text{Input pulse frequency from PG} \times 60}{\text{F1-00}} \times \frac{\text{F1-15 PG gear teeth on load side}}{\text{F1-14 PG gear teeth on motor side}}$$

No.	Name	Setting Range	Default
F1-14	PG Number of Gear Teeth 1	0 to 1000	0
F1-15	PG Number of Gear Teeth 2	0 to 1000	0

Note: When 0 is set to either F1-14 or F1-15, the ratio will be 1.

■ **F1- 16 PG dv3 Detection Setting (Only in PM Closed-Loop Vector Control)**

Sets the number of detection times to trigger a dv3 (Inverion Detection) fault. A dv3 condition will be detected when the torque command and speed command are in opposite directions while the difference between the actual motor speed and the speed command is more than 30%.

No.	Name	Setting Range	Default
F1-16	PG dv3 Detection Setting	0 to 10	10

0 : Disabled

n : Sets the number of detection times to trigger dv3.

■ **F1- 17 PG dv4 Detection Setting (Only in PM Closed-Loop Vector Control)**

Sets the number of pulses to trigger a dv4 (Inversion Prevention Detection) fault when there is a motor speed deviation opposite to the speed command.

No.	Name	Setting Range	Default
F1-17	PG dv4 Detection Setting	0 to 5000	128

0 : Disabled

n : Sets the number of pulses to trigger dv4

Note: For applications where the load direction is opposite of the speed command, set this parameter to 0.

■ **F1- 18 Retain**

6.12 Group U, Monitor Settings

U parameters views the data concerning drive operation.

Parameter	Name	Description	Unit
Group U, Monitor Settings			
U1: Status Monitors			
U1-00	Control Method	0: Open-Loop V/F Control 1: Closed-Loop V/F Control 2: Open-Loop Vector Control 3: Closed-Loop Vector Control 4: PM Open-Loop Vector Control 5: PM Closed-Loop Vector Control 6: Closed-Loop Torque Control	-
U1-01	Frequency Command	Displays the frequency command. (Display units are defined by o1-00)	-
U1-02	Output Frequency	Displays the output frequency. (Display units are defined by o1-00)	-
U1-03	Output Current	Displays output current.	0.01A
U1-04	Motor Speed	Displays the motor speed.	-
U1-05	Output Voltage Command	Displays the drive output voltage command.	0.1V
U1-06	Main Circuit DC Voltage	Displays the main circuit DC voltage.	0.1V
U1-07	Output Power	Displays the internal output power calculated by the drive.	0.001kW
U1-09	Input Terminal Status	Displays the status of the input terminal.	-

Parameter	Name	Description	Unit
		U1-09=C11111111: The following indicate each digit from right to left. 1:Digital Input 1 (S1 enabled) 1:Digital Input 2 (S2 enabled) 1:Digital Input 3 (S3 enabled) 1:Digital Input 4 (S4 enabled) 1:Digital Input 5 (S5 enabled) 1:Digital Input 6 (S6 enabled) 1:Digital Input 7 (S7 enabled) 1:Digital Input 8 (S8 enabled)	
U1-10	Output Terminal Status	Displays the status of the output terminal. U1-10=01111: The following indicate each digit from right to left. Multi-Function Terminal Output (terminal R1A/R1B-R1C) Multi-Function Terminal Output (terminal R2A –R2C) Multi-Function Photocoupler Output 1 (terminal D1) Multi-Function Photocoupler Output 2 (terminal D2)	-
U1-11	Drive Operation Status	Displays the status of the drive operation. U1-11=11111111 The following indicate each digit from right to left. 1:During Run 1:During Zero Speed Holding 1:During Reverse 1:During Fault Reset Signal Input 1:During Speed Agree 1:Drive Ready 1:During Alarm Detection 1:During Fault Detection	-
U1-12	Terminal A1 Input Voltage	Displays the terminal A1 input voltage.	0.1%
U1-13	Terminal A2 Input Voltage	Displays the terminal A2 input voltage.	0.1%
U1-15	Input Pulse Monitor	Displays the frequency to pulse input.	1Hz
U1-16	Software Version	Displays the software version.	-
U1-18	PG Card Software Version	Displays the PG card software version.	-
U2: Fault Information			
U2-00	Current Fault	Displays the current fault.	-
U2-01	1 st Most Recent Fault	Displays the first most recent fault.	-
U2-02	2 nd Most Recent Fault	Displays the second most recent fault.	-
U2-03	3 rd Most Recent Fault	Displays the third most recent fault.	-
U2-04	4 th Most Recent Fault	Displays the fourth most recent fault.	-

Parameter	Name	Description	Unit
U2-05	Frequency Command at 1 st Most Recent Fault	Displays the frequency command at the first most recent fault.	-
U2-06	Output Frequency at 1 st Most Recent Fault	Displays the output frequency at the first most recent fault.	-
U2-07	Output Current at 1 st Most Recent Fault	Displays the output current at the first most recent fault.	0.01A
U2-08	Motor Speed at 1 st Most Recent Fault	Displays the motor speed at the first most recent fault.	-
U2-09	Output Voltage command at 1 st Most Recent Fault	Displays the output voltage command at the first most recent fault.	0.1V
U2-10	Main Circuit DC Voltage at 1 st Most Recent Fault	Displays the main circuit DC voltage at the first most recent fault.	0.1V
U2-13	Input Terminal Status at 1 st Most Recent Fault	Displays the input terminal status at the first most recent fault. (Same status display as U1-09)	-
U2-14	Output Terminal Status at 1 st Most Recent Fault	Displays the output terminal status at the first most recent fault. (Same status display as U1-10)	-
U2-15	Operation Status at 1 st Most Recent Fault	Displays the operation status at the first most recent fault. (Same status display as U1-11)	-
U2-20	Output Frequency at 2 nd Most Recent Fault	Displays the output frequency at the second most recent fault.	-
U2-21	Output Current at 2 nd Most Recent Fault 2 nd	Displays the output current at the second most recent fault.	0.01A
U2-22	Motor Speed at 2 nd Most Recent Fault	Displays the motor speed at the second most recent fault.	-
U2-23	Output Voltage command at 2 nd Most Recent Fault	Displays the output voltage command at the second most recent fault.	0.1V
U2-24	Main Circuit DC Voltage at 2 nd Most Recent Fault	Displays the main circuit DC voltage at the second most recent fault.	0.1V
U2-27	Input Terminal Status at 2 nd Most Recent Fault	Displays the input terminal status at the second most recent fault. (Same status display as U1-09)	-
U2-28	Output Terminal	Displays the output terminal status at the second most recent	-

Parameter	Name	Description	Unit
	Status at 2 nd Most Recent Fault	fault. (Same status display as U1-10)	
U2-29	Operation Status at 2 nd Most Recent Fault	Displays the operation status at the second most recent fault. (Same status display as U1-11)	-
U2-33	Current Alarm	Displays the current alarm.	-
U2-34	1 st Most Recent Alarm	Displays the first most recent alarm.	-
U2-35	2 nd Most Recent Alarm	Displays the second most recent alarm.	-
U2-36	3 rd Most Recent Alarm	Displays the third most recent alarm.	-
U2-37	4 th Most Recent Alarm	Displays the fourth most recent alarm.	-
U3: Maintenance Monitors			
U3-00	Cumulative Drive Operation Time	Displays the cumulative operation time for the drive. The initial value is determined by o4-00. Keeping track of time from run or power up is determined by o4-01. The maximum number displayed is 60000, after which the value will be counted from 0.	1h
U3-01	Cumulative Cooling Fan Operation Time	Displays the cumulative operation time for the cooling fan. The initial value is determined by o4-02. The maximum number displayed is 60000, after which the value will be counted from 0.	1h
U3-06	Heatsink Temperature	Displays the heatsink temperature.	1°C
U3-10	Peak Hold Current	Displays the peak current value during operation	0.01A
U3-11	Peak Hold Output Frequency	Displays the output frequency when the peak current displayed in U3-10 occurred.	-
U3-12	Motor Overload Estimate (oL1)	Displays the value of the motor overload detection accumulator. An oL1 will be triggered when reaching 100%.	1%
U3-13	Frequency Command Source Selection	Displays the source for the frequency command as XY-nn. X: Command Used 1: Command 1 2: Command 2 Y-nn: Frequency Command Source 0-01: Keypad 1-01: Analog input (Terminal AI 1) 1-02: Analog input (Terminal AI 2) 2-02 to 2-16: Multi-step speed command	-

Parameter	Name	Description	Unit
		2-17: Jog frequency command 3-01: PID frequency command 4-01: Terminal UP/ DOWN 5-01: Modbus communication 6-01: Pulse train command	
U3-14	Run Command Source Selection	Displays the source for the frequency command as XY-nn. XY-nn: 00-00: Local X: Command Used 1: Command 1 2: Command 2 Y-nn: Command Source 0-00: Keypad 1-00: Control circuit terminal (sequence control input) Analog input (Terminal AI 0: Keypad 1: Control Circuit Terminal (Sequence Control Input) 3: Modbus communication 4: Communication option card 7: LiteOn Studio PC software nn: Command Limit Status 00: No limit status 01: Run command was left on when stopped in programming mode 02: Run command was left on when switching from Local to Remote mode 03: Waiting for the charge to bypass MC after power up (Uv1 or Uv blinks after 10 s) 04: Waiting for the time of "Run command disabled" to end 05: Fast Stop (multi-function terminal input or keypad) 06: b1-10 (Run command at power up) 07: During baseblock when coast to stop with timer 08: Frequency command is less than d1-08 (Minimum Output Frequency) during baseblock. 09: Waiting for ENTER command.	-
U3-17	Drive Overload Estimate (oL2)	Displays the value of the drive overload detection accumulator. An oL2 will be triggered when reaching 100%.	1%
U4: PID Monitors			
U4-00	PID Feedback	Displays the PID feedback value as a percentage of the maximum output frequency.	0.01%
U4-01	PID Input	Displays the PID input value as a percentage of the maximum output frequency.	0.01%

Parameter	Name	Description	Unit
U4-02	PID Output	Displays the PID output value as a percentage of the maximum output frequency.	0.01%
U4-03	PID Target	Displays the PID target value as a percentage of the maximum output frequency.	0.01%
U4-04	PID Differential Feedback	Displays the difference of both feedback values when 10 is set to both E3-01 and E3-07.	0.01%
U4-05	PID Feedback 2	Displays the adjusted feedback value if differential feedback is used (U4-00 to U4-04) The value in U4-00 and U4-05 will be the same if differential feedback is not used.	0.01%
U4-06	PG Rotating Direction	0: Correct PG wiring 1: The speed command is opposite to the PG feedback direction. Please check the wiring.	-
U5: Control Monitors			
U5-00	Motor Speed Feedback	Displays the motor speed feedback with a positive or negative sign that PG receives.	1rpm
U5-01	Number of PG Pulse Train	Displays the PG pulse train feedback without positive or negative sign.	1pulse
U5-02	d-Axis Current	Displays the d-Axis current.	0.01A
U5-03	q-Axis Current	Displays the q-Axis current.	0.01A
U5-14	ASR Input	Displays the ASR input.	0.01%

Chapter 7 | Options

The following peripheral device options can be installed to improve the drive performance. Contact the local distributor to purchase the options if needed.

7.1 Braking Resistor Option

Applicable Motor		125% Braking Torque 10%ED			* 2 Max. Braking Torque Limit		
HP	kW	Braking Torque (kg-m)	Suitable Braking Resistance	Total Braking Current (A)	Min. Resistance Limit (Ω)	Max. Total Braking Current Limit (A)	Max. Peak Rating (kW)
1	0.7	0.5	150W/750 Ω	1	120	6.25	4.7
2	1.5	1.0	150W/400 Ω	1.9	120	6.25	4.7
3	2.2	1.5	260W/250 Ω	3	100	7.5	5.6
5	3.7	2.5	400W/150 Ω	5	60	12.5	9.4
7.5	5.5	2.7	600W/130 Ω	5.8	43	17.44	13.1

When the motor is during fast deceleration or driven by a high-inertia load, the actual speed is faster than the speed command. The motor then regenerates the power back to the drive as a generator. This regenerative power will charge the main circuit capacitors and increase the voltage. The drive voltage will continue to rise until an ov (Overvoltage) fault is triggered to cut off the drive output. Such situations can be prevented by installing proper braking resistors

- **WARNING!** Allow only electricians to perform wiring. Failure to comply could cause damage to the drive or braking option circuit. Read the instructions of the braking unit or braking resistor carefully before wiring.
- **WARNING!** Do not connect the braking resistor to terminals other than B1 and B2. Failure to comply could cause drive damage or fire.
- **CAUTION!** Follow the instructions illustrated in the following diagrams. Incurring wiring could cause damage to drive or other devices.

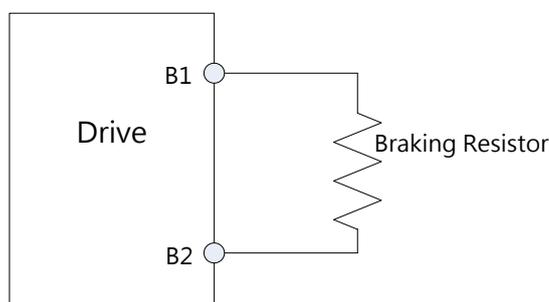
Note: To decelerate within the set time, ensure the appropriate braking resistors are installed according to the drive rating. Check if the installed braking resistor operates properly within the set deceleration time before running the drive.

Prevent the braking resistor from overload. The heat generated at the resistor could cause fire. Install a thermal relay between the drive and braking resistor to cut off the drive output when overload.

7.1.1 Installing a Braking Resistor

For the drive models with braking transistor built-in, connect the terminal B1 and B2 to each end of the braking resistor regardless of polarity.

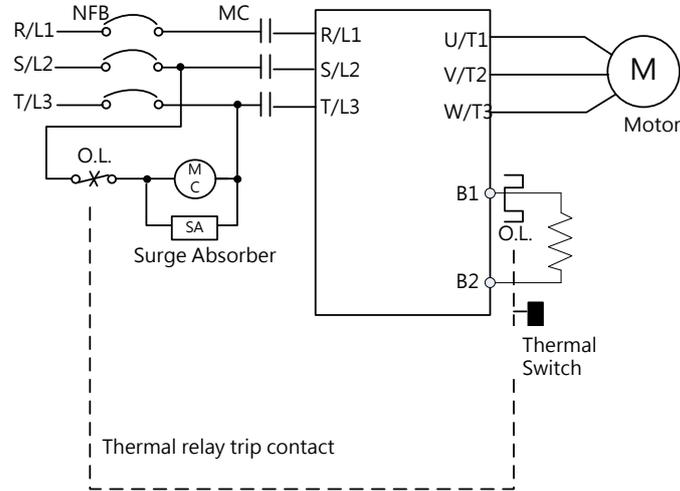
- Do not connect the braking resistor to terminals other than B1 and B2. Failure to comply could cause drive damage or fire.



7.1.2 Selecting a Braking Resistor

For safety in applications with braking resistor installed, set the sequence control circuit to shut off the drive power when the braking resistor overheat is detected. Install a magnetic

contactor (MC) on the drive input side for double protection as well. This circuit is to protect the braking resistor not to be burnt by frequent overheat, or frequent conduction caused by excessive input power voltage. The only way to avoid the braking resistor damage in this situation is to cut off the drive power supply.



1. For any drive or machinery damage using braking resistors not provided by Lite-On, Lite-On is not responsible of warranty.
2. Consider the safety and combustibility of the ambient environment when installing braking resistors. Contact the local distributor for the watt hour calculation if the minimum resistance is required.
3. When using more than two braking units, make sure the resistance in parallel is greater than the minimum resistance requirement of the drive. Follow the wiring instructions of the braking units during installation.

7.2 AC Reactor Option

7.2.1 Installing an AC Reactor

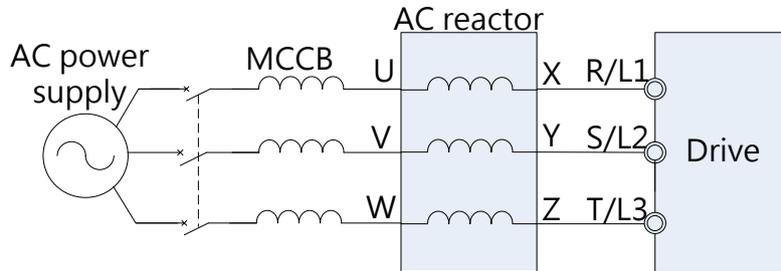
The non-linear components such as rectifiers and SCRs on the drive input side will cause high harmonic input current which interrupts the power supply and affects the power factor. To suppress the surges in current and improve the power factor, install an AC reactor on the drive input side in the following situations.

- To suppress harmonic current or improve the power factor of the power supply
- To suppress voltage surges on the input power when using a phase advancing capacitor switch so as to protect the connected devices.
- A large capacity power transformer (600kVA and above) is connected to the drive.

Note: Always install an AC reactor when connecting a SCR such as a DC drive to the same power supply regardless of the power supply conditions.

7.2.2 AC Reactor Wiring Example

Note: Do not connect the AC reactor to the drive output side (secondary side).



460V, 50/60Hz, Three phase

kW	HP	Reactor Rated Current	Max. Continuous Current	Inductance (mh) 3 to 5% Impedance	
				3% Impedance	5% Impedance
0.75	1	4	6	9	12
1.5	2	4	6	6.5	9
2.2	3	8	12	5	7.5
3.7	5	12	18	2.5	4.2
5.5	7.5	18	27	1.5	2.5

7.3 Installing Input Fuses

Installing fuses on the drive input side is recommended to prevent internal short circuit. Select the suitable fuses below or the branch circuit protection in compliance with local electrician regulations.

460V Model	Input Current I (A)	Line Fuse	
	Heavy Duty	I (A)	Bussmann P/N
0.75KW (1 HP)	4.3	10	FRS-R-10
1.5KW (2 HP)	5.9	10	FRS-R-10
2.2KW (3 HP)	8.7	15	FRS-R-15
3.7KW (5 HP)	14	20	FRS-R-20
5.5KW (7.5 HP)	17	40	FRS-R-40
460V Model	Input Current I (A)	Line Fuse	
	Normal Duty	I (A)	Bussmann P/N
0.75KW (1 HP)	2.3 (4.1)	10	FRS-R-10
1.5KW (2 HP)	4.3 (5.4)	15	FRS-R-15
2.2KW (3 HP)	6.1 (6.9)	20	FRS-R-20
3.7KW (5 HP)	9.7 (10.8)	35	FRS-R-35
5.5KW (7.5 HP)	14 (14.1)	50	FRS-R-50

7.4 Noise Filter Option

EVO8000 series has its own noise filter on the input side and zero phase noise filter on the output side complying with EN61800-3 and EN55011 Group 1 Class A standard.

7.4.1 Noise Filter on the Primary Side

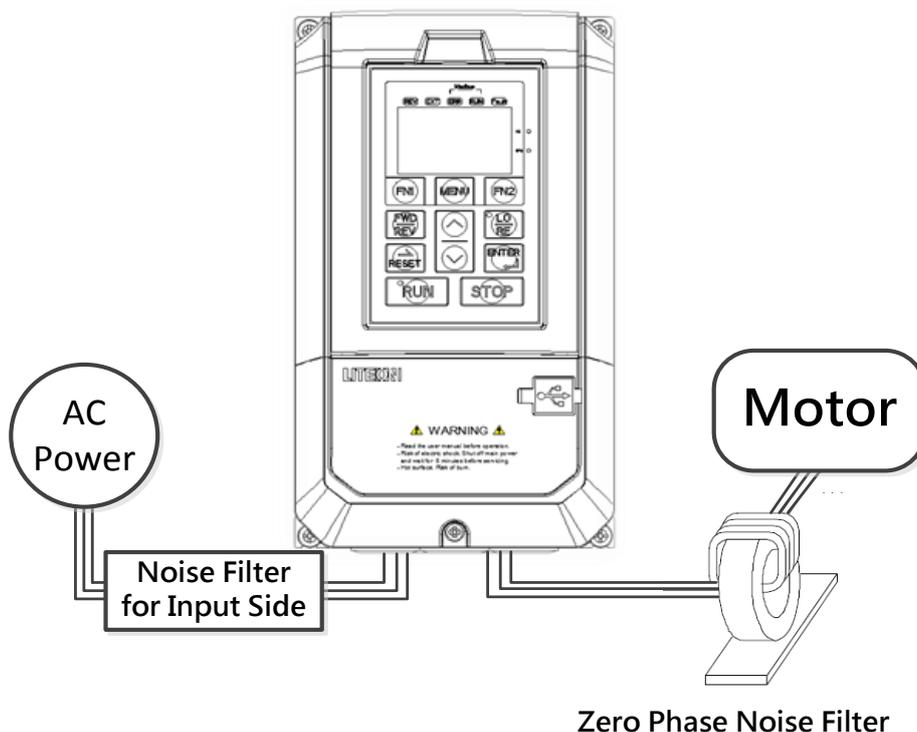
Select the noise filter option according to the table below.

AC Drive Model		Noise Filter (Manufacturer : Schaffner)		
Input Voltage	Drive Power Rating	Filter Model	Rated Current (A)	Dimensions (mm)
3Φ 400V	0.75kW, 1.5kW	FN3258-7-45	7	190*40*70
	2.2kW, 3.7kW, 5.5kW	FN3258-16-45	16	250*45*70

7.4.2 Zero Phase Noise Filter

Select the zero phase noise filter option according to the table below.

AC Drive Model		Noise Filter (Manufacturer : Schaffner)		
Input Voltage	Drive Power Rating	Filter Model	Rated Current (A)	Dimensions (mm)
3Φ 400V	0.75kW, 1.5kW, 2.2kW	VAC W422	2	40*32*15
	3.7kW, 5.5kW	VAC W514	2	30*20*15



Chapter 8 | Troubleshooting

8.1 Alarm and Fault Displays

Table 8.1 Alarm and Fault Displays, Causes, and Possible Solutions

Keypad Display	Fault Name	Cause	Possible Solution
EFO	Retain		
EF1 to EF8	External Fault (Input Terminal S1 to S8)	<ol style="list-style-type: none"> 1. An external device tripped an alarm 2. Incorrect wiring 3. Multi-function input wiring is not correct 	<ol style="list-style-type: none"> 1. Remove the cause of the external fault then reset the multi-function input. 2. Confirm if the signal lines is properly connected to the terminals assigned for external fault detection (E1-□□ = 23 to 38) 3. Confirm if E1-□□ = 23 to 38 is set to the unused terminals.
dEv	<p>Speed Deviation (for Closed-Loop Control Methods)</p> <p>The deviation between the pulse input speed feedback and speed command is greater than then level set to F1-12 for longer than the time set to F1-13.</p>	<ol style="list-style-type: none"> 1. Over loaded 2. The load is locked up 3. Motor is being braked 	<ol style="list-style-type: none"> 1. Increase the deceleration and acceleration times (C1-00 to C1-07) 2. Check if F1-12 and F1-13 are set correctly. 3. Check the motor brake and make sure it is released
FbH	<p>PID Feedback High</p> <p>PID feedback input is greater than the detection level set to b5-22 for longer than the detection time set to b5-23</p>	<ol style="list-style-type: none"> 1. b5-22 and b5-23 inappropriate setting 2. PID feedback wiring incorrect 3. Feedback sensor malfunction 4. Feedback input circuit malfunction 	<ol style="list-style-type: none"> 1. Confirm b5-22 and b5-23 settings 2. Correct the wiring 3. Replace the sensor if it is damaged 4. Replace the PCB or drive. Contact the local distributor.
FbL	PID Feedback Low	1. Inappropriate setting in	1. Correct b5-12 and b5-13

Keypad Display	Fault Name	Cause	Possible Solution
	When the PID feedback detection is enabled in b5-11, a FbL will be triggered while the PID feedback falls below the level set to b5-12 for longer than the time set to b5-13.	b5-12 and b5-13 2. Incorrect PID feedback wiring 3. Feedback sensor malfunction 4. Incorrect feedback input circuit	settings 2. Correct the wiring 3. Replace the sensor if it is damaged 4. Contact the local distributor to replace the board or the drive.
oH	Heatsink Overheat Heatsink temperature over 90 to 100°C (Overheat level is determined by rating of the drive)	1. Ambient temperature is too high 2. Internal cooling fan stopped operating 3. Bad air flow due to insufficient room.	1. Check the temperature surrounding the drive a. Improve the air flow inside the enclosure panel b. Install an air conditioner or fan to cool the environment c. Remove any possible source of heat 2. Measure the output current a. Reduce the load b. Lower setting in C6-00 (Carrier Frequency Option) 3. Replace the cooling fan
oH1	Motor Overheat The temperature signal from motor temperature sensor via the terminal MT exceeded the overheat detection level of the drive.	1. Incorrect motor temperature input (terminal MT) wiring 2. Fault on the machinery (e.g., machinery is locked up) 3. Motor overheat	1. Correct the wiring for terminal MT. 2. Check the machinery status 3. Check the load, acceleration / deceleration time and cycle time a. Reduce the load. b. Increase the C1-00 to C1-07 (Acc./Dec. Time) settings c. Adjust d1-02 to d1-11 (V/F Characteristics)
ot1	Overtorque Detection 1 The current has exceeded the torque level set to P6-01 for longer than the time set to P6-02	1. Incorrect parameter settings 2. Malfunction on machinery	1. Reset P6-01 and P6-02 2. Check machinery and load status
ot2	Overtorque Detection 2	1. Incorrect parameter settings	1. Reset P6-04 and P6-05 2. Check machinery and load

Keypad Display	Fault Name	Cause	Possible Solution
	The current has exceeded the torque level set to P6-04 for longer than the time set to P6-05	2. Malfunction on machinery	status
ov	<p>Overvoltage</p> <p>Voltage in the DC bus exceeded the overvoltage detection level</p> <p>1.200 V class: 410 V</p> <p>2.400 V class: 820 V</p>	<p>1. Drive input power has surge voltage entering</p> <p>2. Machinery output short circuit</p> <p>3. Ground fault in the output circuit causes the DC bus capacitor to overcharge</p> <p>4. Electrical signal interference causes drive malfunction</p> <p>5. PG cable is disconnected</p> <p>6. Incorrect PG cable wiring</p> <p>7. PG encoder wiring is interference by electrical signal</p>	<p>1. Install a DC link choke</p> <p>Voltage surge can result from a thyristor convertor and phase advancing capacitor using the same input power supply</p> <p>2. Check the motor power cable, relay terminals and motor terminal box</p> <p>3. Correct grounding shorts and reapply power</p> <p>4. Check the solutions for interference suppression</p> <p>»Check the control circuit lines, main circuit lines and grounding wiring.</p> <p>»If the MC is the source of interference, connect a suppressor to it.</p> <p>5. Reconnect the cable</p> <p>6. Correct the wiring</p> <p>7. Separate the wiring from the source of the electrical signal interference. It is usually the output lines from the drive</p>
Uv	<p>Undervoltage</p> <p>1.Voltage in the DC bus fell below the undervoltage detection level (P2-03)</p> <p>2.200 V class: 190 V</p> <p>3.400 V class: 380 V</p>	<p>1. Input power phase loss</p> <p>2. Loose wiring terminals of drive input power</p> <p>3. Problem with the voltage from the drive input power</p> <p>4. The drive main circuit capacitors are weakened.</p> <p>5. The contactor or relay on the soft-charge bypass circuit is damaged</p>	<p>1. Correct the drive input power wiring</p> <p>2. Tighten the terminals</p> <p>3. Check the voltage</p> <p>a. Adjust the voltage according to the drive input power specifications</p> <p>b. Check the main circuit magnetic contactor if there is no problem with the power supply</p> <p>4&5. Turn on and turn off the power to see if any problem</p>

Keypad Display	Fault Name	Cause	Possible Solution
			occurs Replace either the entire drive or the control board if the problem continues to occur. Contact the local distributor for more information.
Ut1	Undertorque Detection 1 The current has dropped below the torque detection level set to P6-01 for longer than the time set to P6-02	1. Incorrect parameter settings 2. Malfunction on machinery side	1. Reset P6-01 and P6-02 2. Ensure there is no problem on the machinery side.
Ut2	Undertorque Detection 2 The current has dropped below the torque detection level set to P6-04 for longer than the time set to P6-05	1. Incorrect parameter settings 2. Malfunction on machinery side	1. Reset P6-04 and P6-05 2. Ensure there is no problem on the machinery side.
UL	Mechanical Weakening Detection for Undertorque Undertorque in the conditions set to P6-06	Undertorque in the conditions set to P6-06	Check the condition of mechanical weakening
oL	Mechanical Weakening Detection for Overtorque Overtorque in the conditions set to P6-06	Overtorque in the conditions set to P6-06	Check the condition of mechanical weakening
oS	Overspeed The motor speed feedback exceeded the	1. Overshoot occurs 2. Incorrect PG pulse train settings	1. Increase setting of C4-00 (ASR Proportional Gain 1) and C4-01 (ASR Integral Time 1) 2. Reset F1-09 (Overspeed

Keypad Display	Fault Name	Cause	Possible Solution
	level set to F1-09		Detection Level) and F1-10 (Overspeed Detection Delay Time)
Bb	Baseblock Drive output interrupted by an external baseblock signal	An external baseblock signal was input via one of the multi-function input terminals (S1 to S8)	Check baseblock signal input timing and external sequence
oH2	Drive Overheat Warning Drive Overheat Warning input via a multi-function input terminal (S1to S8) when E1-□□= 40	An overheat warning in the drive was triggered by an external device	1. Search the device which caused the overheat warning. Remove the cause of the problem. 2. Reset Drive Overheat Warning input at the assigned multi-function input terminal (S1to S8)
HCA	Current Alarm Drive current exceeded the level of over current warning (150% of the rated current)	1. The load is too heavy 2. Deceleration and acceleration times are too short 3.The drive is attempting to run a motor greater than the maximum allowable capacity, or a special-purpose motor is being used 4.The current level went up because of Speed Search while attempting to perform a fault restart or after a momentary power loss	1. Reduce the load or use a drive of higher rating 2. Calculate the torque required during acceleration and the inertia »Take the following steps if the torque level is not right for the load · Increase the settings for acceleration and deceleration time (C1-00 to C1-07) · Use a drive of higher rating 3. Check the motor capacity · Make sure the motor capacity is right for the drive rating. 4. During a momentary power loss or an attempt to reset a fault, the alarm is displayed. However, there is no need to take any action because the fault display will disappear shortly

8.2 Fault Detection

Table 8.2 Fault Displays, Causes, and Possible Solution

Keypad Display	Fault Name	Cause	Possible Solution
GF	Ground Fault	Output power cable is damaged	Check and replace output power cable
oVA, oVd, oVC	Overvoltage (Acceleration, Deceleration and Constant Speed) The main circuit DC voltage exceeded the overvoltage detection level 200V class: 410V 400 V class: 820 V	<p>1. Regenerative energy is flowing from the motor into the drive because the deceleration time is too short</p> <p>2. The motor overshoot the speed reference because the acceleration time is too short</p> <p>3. Excessive braking load</p> <p>4. Surge voltage entering from the drive input power</p> <p>5. Motor short-circuited Ground fault current charges the drive main circuit capacitor.</p> <p>6. Improper parameter settings for Speed Search (including Speed Search after a fault restart and after a momentary power loss)</p> <p>7. Drive input voltage is too high</p> <p>8. The braking transistor or braking resistor are wired incorrectly</p> <p>9. PG cable is disconnected</p> <p>10. PG cable wiring is incorrect</p> <p>11. PG encoder wiring has interference of electrical signal</p> <p>12. Electrical signal interference causes the drive malfunction</p> <p>13. Incorrect inertia setting of the load</p> <p>14. Motor hunting occurs</p>	<p>1. Increase the deceleration time settings (C1-01, C1-03, C1-05, C1-07) »Install a braking unit or a dynamic braking resistor »Set P3-03 (Stall Prevention during Deceleration) to 1 (Enabled)(default is 1)</p> <p>2. Confirm if overvoltage alarm oVA or oVC was triggered during sudden drive acceleration. »Increase the acceleration time »Use S-curve deceleration and acceleration times and increase the value set to C2-01 (S-curve at acceleration end)</p> <p>3. Install a braking unit or a braking resistor</p> <p>4. Install a DC reactor »Thyristor convertor and phase advancing capacitor using the same input power supply might cause a voltage surge</p> <p>5. Check the motor power cable, relay terminals and motor terminal box » Correct grounding shorts and reapply power</p> <p>6. Adjust parameter settings for Speed Search (group b3) »Proceed Auto-Tuning for line-to-line resistance</p> <p>7. Check the voltage »Lower drive input power voltage within the range listed in the drive specifications</p> <p>8. Check the wiring of the braking resistor and braking unit »Correct the wiring</p>

Keypad Display	Fault Name	Cause	Possible Solution
			<p>9. Tighten the terminal or replace the damaged cable</p> <p>10. Correct the wiring</p> <p>11. Separate the PG wiring from the source of the electrical signal interference (drive output cable)</p> <p>12. Check the solutions for interference suppression »Check the wiring of control circuit I, main circuit and grounding.</p> <p>13. Check the load inertia settings when using KEB, or Stall Prevention during deceleration</p> <p>14. Adjust the parameters to suppress hunting »Adjust n1-01 (Hunting Prevention Gain)</p>
oCA, oCd, oCC	Overcurrent (Acceleration, Deceleration and Constant Speed)	<p>1. The motor insulation is damaged or the motor is overheated</p> <p>2. Grounding problem caused by damaged motor cable</p> <p>3. The drive is damaged</p> <p>4. The load is too heavy</p> <p>5. Settings for acceleration or deceleration time is too short</p> <p>6. The drive is running a special purpose motor or a motor larger than the drive rated capacity</p> <p>7. A magnetic contactor (MC) on the output side of the drive has turned on or off</p> <p>8. V/F set incorrectly</p> <p>9. Excessive torque compensation</p> <p>10. Electrical signal</p>	<p>1. Check the insulation resistance</p> <p>2. Check the motor power cable</p> <p>3. Check the resistance between the cable and the terminal.</p> <p>4. Short circuit on drive output side or grounding causes register damage.</p> <p>5. Measure the current flowing into the motor</p> <p>5. Check the motor capacity</p> <p>6. Calculate the torque required during acceleration according to the load inertia and acceleration time. If the required torque is insufficient, check the motor capacity.</p> <p>7. Install a sequence controller to ensure the MC does not open or close when the drive is outputting voltage.</p> <p>8. Check the ratios between the frequency and voltage set by V/F.</p>

Keypad Display	Fault Name	Cause	Possible Solution
		<p>interference causes drive malfunction</p> <p>11. Overexcitation gain is set too high</p> <p>12. Run command was applied while motor was coasting</p> <p>13. Incorrect motor code</p> <p>14. The motor does not match the drive control method</p> <p>15. The motor cable is too long</p>	<p>9. Adjust d1-02 to d1-11 (or d1-13 to d1-22 for motor 2)</p> <p>10. Check the amount of torque compensation</p> <p>11. Find out possible solutions to suppress the electrical signal interference</p> <p>11. Check if the fault occurs frequently with overexcitation function operation</p> <p>12. Enable Speed Search via multi-function input terminal</p> <p>14. Check the control method (A1-02)</p> <p>15. Use a larger drive</p>
SC	IGBT Fault or Output Short Circuit	<p>1. Motor has been damaged due to the motor insulation weakened or overheat</p> <p>2. The cable is damaged</p> <p>3. Hardware fault</p> <p>4. The drive is damaged</p>	<p>1. Replace the motor or check the motor insulation resistance</p> <p>2. Repair any short circuits and check the motor power cable</p>
EFO	Retain		
EF1to EF8	External Fault (Input Terminal S1 to S8)	<p>1. An external device tripped an alarm</p> <p>2. Incorrect wiring</p> <p>3. Multi-function input wiring is not correct</p>	<p>1. Remove the cause of the external fault then reset the multi-function input.</p> <p>2. Confirm if the signal lines is properly connected to the terminals assigned for external fault detection (E1-□□ = 23 to 38)</p> <p>3. Confirm if E1-□□ = 23 to 38 is set to the unused terminals.</p>
oH	Heatsink Overheat Heatsink temperature over 90 to 100°C (Overheat level is determined by rating of the drive)	<p>1. Ambient temperature is too high</p> <p>2. Internal cooling fan stopped operating</p> <p>3. Bad air flow due to insufficient room.</p>	<p>1. Check the temperature surrounding the drive</p> <p>a. Improve the air flow inside the enclosure panel</p> <p>b. Install an air conditioner or fan to cool the environment</p> <p>c. Remove any possible source of heat</p> <p>2. Measure the output current</p> <p>a. Reduce the load</p>

Keypad Display	Fault Name	Cause	Possible Solution
			b. Lower setting in C6-00 (Carrier Frequency Option) 3. Replace the cooling fan
oH1	Motor Overheat The temperature signal from motor temperature sensor via the terminal MT exceeded the overheat detection level of the drive.	1. Incorrect motor temperature input (terminal MT) wiring 2. Fault on the machinery (e.g., machinery is locked up) 3. Motor overheat	1. Correct the wiring for terminal MT. 2. Check the machinery status 3. Check the load, acceleration / deceleration time and cycle time a. Reduce the load. b. Increase C1-00 to C1-07 (Acc./Dec. Time) settings c. Adjust d1-02 to d1-11 (V/F Characteristics)
oL	Mechanical Weakening Detection for Overtorque Overtorque in the conditions set to P6-06	Overtorque in the conditions set to P6-06	Check the condition of mechanical weakening
oL1	Motor Overload	1. The load is too heavy 2. The acceleration and deceleration times are too short 3. The motor is driven below the rated speed with a high load 4. Incorrect setting in P1-00 (Motor Protection Function Selection) when running a special motor 5. The voltage determined by the V/F is too high 6. d2-00 (Motor Rated Current) setting incorrect 7. The base frequency is set too low 8. Use one drive to run multiple motors 9. The electrical thermal protection characteristics do	1. Check loading capacity » Reduce the load 2. Confirm acceleration and deceleration times » Increase C1-00 to C1-07 parameter settings 3. » Reduce the load » Increase the speed » Either increase the motor capacity or use a special-purpose motor if the motor needs to operate at low speeds 4. Set P1-00 to 2. 5. Adjust d1-02 to d1-11 settings (V/F Characteristics) Note: If d1-02 to d1-11 settings are too low, load tolerance at low speeds will be reduced 6. Confirm the motor rated current » Set d2-00 (Motor Rated

Keypad Display	Fault Name	Cause	Possible Solution
		<p>not match the motor overload characteristics.</p> <p>10. The electrical thermal relay operates at the wrong level</p> <p>11. Motor overheated by overexcitation operations</p> <p>12. Speed Search related parameters are set incorrectly</p> <p>13. Power supply phase loss causes output current oscillation.</p>	<p>Current) according to the motor nameplate</p> <p>7. Confirm the rated frequency showed on the motor nameplate »Set d1-04 (Base Frequency) according to the motor nameplate</p> <p>8. Set P1-00 (Motor Protection Function Selection) to 0 (Disabled) and install a thermal relay to each motor</p> <p>9. Confirm characteristics of the motor »Set P1-00 (Motor Protection Function Selection) correctly »Install an external thermal relay</p> <p>10. Overexcitation increases the motor loss</p> <p>11. Adjust parameters related to Speed Search »Adjust the b3-01 (Speed Search Operation Current) setting</p> <p>12. Check the power supply for phase loss</p>
oL2	Drive Overload	<p>1. The load is too heavy</p> <p>2. The acceleration and deceleration times are too short</p> <p>3. The voltage determined by the V/F is too high</p> <p>4. The drive capacity is too small</p> <p>5. The motor is driven below the rated speed with a high load</p> <p>6. Torque compensation is too high</p> <p>7. Speed Search related parameters are set incorrectly</p> <p>8. Power supply phase loss</p>	<p>1. Check loading capacity » Reduce the load</p> <p>2. Confirm acceleration and deceleration times »Increase C1-00 to C1-07 parameter settings</p> <p>3. Adjust d1-02 to d1-11 settings (V/F Characteristics) Note: If d1-02 to d1-11 settings are too low, load tolerance at low speeds will be reduced</p> <p>4. Use a larger drive</p> <p>5. »Reduce the load at low speed » Use a larger drive » Set a lower value to C6-00 (Carrier Frequency)</p> <p>6. Check the torque</p>

Keypad Display	Fault Name	Cause	Possible Solution
		causes output current oscillation	compensation » Set a lower value to C3-00 (Torque Compensation Gain) until the current is decreased and the motor does not stall. 7. Adjust parameters related to Speed Search » Adjust b3-01 (Speed Search Operation Current) 8. Check the power supply for phase loss
ot1	Overtorque Detection 1 The current has exceeded the torque level set to P6-01 for longer than the time set to P6-02	1. Incorrect parameter settings 2. Malfunction on the machinery side	1. Reset P6-01 and P6-02 2. Check machinery and load status
ot2	Overtorque Detection 2 The current has exceeded the torque level set to P6-04 for longer than the time set to P6-05	1. Incorrect parameter settings 2. Malfunction on the machinery side	1. Reset P6-04 and P6-05 2. Check machinery and load status
Ut1	Undertorque Detection 1 The current has dropped below the torque detection level set to P6-01 for longer than the time set to P6-02	1. Incorrect parameter settings 2. Malfunction on the machinery side	1. Reset P6-01 and P6-02 2. Ensure there is no problem on the machinery side.
Ut2	Undertorque Detection 2 The current has dropped below the	1. Incorrect parameter settings 2. Malfunction on the machinery side	1. Reset P6-04 and P6-05 2. Ensure there is no problem on the machinery side.

Keypad Display	Fault Name	Cause	Possible Solution
	torque detection level set to P6-04 for longer than the time set to P6-05		
UL	Mechanical Weakening Detection for Undertorque Undertorque in the conditions set to P6-06	Undertorque in the conditions set to P6-06	Check the condition of mechanical weakening
Uv1	Undervoltage Detection 1 Voltage in the DC bus fell below the undervoltage detection level (P2-03) during run. · 200 V class: 190 V · 400 V class: 380 V	1. Input power phase loss 2. Loose wiring terminals of drive input power 3. Problem with the voltage from the drive input power 4. The drive main circuit capacitors are weakened. 5. The contactor or relay on the soft-charge bypass circuit is damaged	1. Correct the drive input power wiring 2. Tighten the terminals 3. Check the voltage a. Adjust the voltage according to the drive input power specifications b. Check the main circuit magnetic contactor if there is no problem with the power supply 4. Turn on and turn off the power to see if any problem occurs a. Replace either the entire drive or the control board if the problem continues to occur. Contact the local distributor for more information.
Uv2	Retain		
PF	Input Phase Loss Drive input power has a large imbalance of voltage between phases or has an open phase (Detected when P7-00=1)	1. Phase loss in the drive input power 2. Drive input power terminals has a loose wiring 3. Drive input power voltage has an excessive fluctuation 4. The main circuit capacitors are impaired	1. Check wiring for errors in the main circuit drive input power »Correct wiring 2. Make sure the terminals are tightened correctly »Apply the tightening torque as showed in the manual 3. Confirm the voltage from the drive input power

Keypad Display	Fault Name	Cause	Possible Solution
			»Apply possible solutions for drive input power stabilization 4. Check drive input power. If drive input power seems normal but the alarm continues to occur, replace either the entire drive or the control board. Contact the local distributor for more information.
LF1	Output Phase Loss Phase loss on the drive output side	1. The output cable is not connected 2. The motor winding is impaired 3. The output terminal is loose 4. The rated current of the motor being used is 5% less than the drive rated current 5. An output transistor is impaired 6. A single phase motor is activating	1. Check the errors for wiring then properly connect the output cable »Correct the wiring 2. Check the resistance which located between motor lines »If the winding is impaired, replace the motor 3. Use tightening torque which showed in the manual in order to fasten the terminal 4. Check motor capacities and the drive 5. The drive cannot run a single phase motor
LF2	Retain		
dEv	Speed Deviation (for closed-loop control method) The deviation between the speed feedback and speed reference is longer than the time set to F1-13 and greater than the setting in F1-12	1. The load is too heavy 2. The deceleration and acceleration times are too short 3. The load is locked up 4. Inappropriate parameter settings 5. Motor is being braked by a mechanical brake	1. Reduce the load 2. Increase the deceleration and acceleration times C1-00 to C1-07 3. Check the machinery 4. Check the F1-12 (Speed Deviation Detection Level) and F1-13 (Speed Deviation Detection Delay Time) settings 5. Check the motor brake and make sure it is released
dv1	Retain		
dv2	Retain		

Keypad Display	Fault Name	Cause	Possible Solution
dv3	Retain		
dv4	Retain		
FbH	PID Feedback High	<ol style="list-style-type: none"> 1. Incorrect parameter settings 2. Incorrect PID feedback wiring 3. Feedback sensor malfunction 	<ol style="list-style-type: none"> 1. Reset b5-22 and b5-23 2. Correct the wiring 3. Check the sensor
FbL	PID Feedback Low	<ol style="list-style-type: none"> 1. Incorrect parameter settings 2. Incorrect PID feedback wiring 3. Feedback sensor malfunction 	<ol style="list-style-type: none"> 1. Reset b5-12 and b5-13 2. Correct the wiring 3. Check the sensor
bUS	Retain		
CE	Modbus Communication Error	<ol style="list-style-type: none"> 1. Incorrect wiring 2. Communication data error caused by noise 	<ol style="list-style-type: none"> 1. Correct the wiring »Check short circuits and disconnected cables, repair if necessary 2. Check possible solution to suppress the noise
CF	Retain		
Err	Retain		
oS	<p>Overspeed</p> <p>The motor speed exceeded F1-09 setting</p>	<ol style="list-style-type: none"> 1. Overshoot 2. Incorrect speed feedback scaling if terminal RP is used as speed feedback input in V/F control 3. Incorrect PG pulse number settings 4. Incorrect parameter settings 	<ol style="list-style-type: none"> 1. Increase the C4-00 (ASR Proportional Gain 1) and C4-01(ASR Integral Time 1) 2. Reset F1-09 (Overspeed Detection Level) and F1-10 (Overspeed Detection Delay Time)
PGo	<p>PG Open (for closed-loop control method)</p> <p>No PG pulses are received within the</p>	<ol style="list-style-type: none"> 1. The PG cable is opened 2. The PG cable wiring is wrong 3. The PG has no power supply 4. PG is being braked 	<ol style="list-style-type: none"> 1. Connect the cable 2. Correct the wiring 3. Check the power cable wiring 4. Ensure the mechanical brake is released when the motor is operating

Keypad Display	Fault Name	Cause	Possible Solution
	time set to F1-07		
Sto	Retain		
FAnEr	Internal Fan Fault Fan or magnetic contactor failure	1. Cooling fan malfunction 2. Fault detected in the magnetic contactor or the internal cooling fan	1. Cycle power to the drive » Check the fan operation » Verify the cumulative operation time of the fan with monitor U3-01 »If the cooling fan is damaged in any other way or has exceed its expected performance life, follow the instruction for replacement 2. Cycle power to the drive » If the problem continues, replace either the entire drive or the power board. For more information, please contact the local distributor
JoGEr	FJOG/ RJOG Input Error	A FJOG and RJOG Run commands are received at the same time	Check the Run command from the external source for Fjog/Rjog

8.3 Operation Errors

Table 8.3 Error Displays, Causes, and Possible Solutions

Keypad Display	Error Name	Cause	Possible Solution
oPE02	Parameter Range Setting Error	Parameters are set outside of the possible setting range	<ol style="list-style-type: none"> 1. Set the parameters to the proper values 2. Reset the drive
oPE03	Multi-Function Input Selection Error	<ol style="list-style-type: none"> 1. Either of Up command and Down command is not set (E1-□□= 10 or 11) 2. Either of Up command 2 and Down command 2 is not set (E1-□□=12 or 13) 	Properly assign both of the UP and Down commands to the multi-function input terminal.
oPE04	3-Wire Sequence Control Error	Multi-Function input terminals S1 and S2 are assigned to E1-□□= 2 (3-Wire Sequence)	Do not assign multi-function input terminals S1 and S2 to E1-□□= 2 (3-Wire Sequence)
oPE05	Communication Error		
oPE06	Control Method Selection Error	A control method that requires a PG option card (A1-02 = 1, 3, or 5) is selected, but no PG card is installed	Install a PG option card or correct the value set to A1-02
oPE07	Multi-Function Analog Input Selection Error	E3-01 and E3-07 are set to the same value	Set different values to E3-01 and E3-07
oPE09	PID Control Selection Fault (When b5-00 (PID Control Setting)= 1 to 4)	<ol style="list-style-type: none"> 1. Contradictory settings <ul style="list-style-type: none"> · b5-14 (PID Sleep Start Level) is not set to 0.0 · b1-02 (Stopping Method Selection) is set to 2 (DC Braking to Stop) or 3 (Coast to Stop with Timer) 2. L2-01 (Frequency Command Lower Limit)≠0 when b5-00 = 1 or 2 (PID Control Enabled) 3. b5-10 (PID Output Reverse Selection) = 1 (Reverse 	<ol style="list-style-type: none"> 1. Correct the parameter setting. 2. Correct the parameter setting. 3. Correct the parameter setting. 4. Correct the parameter setting.

Keypad Display	Error Name	Cause	Possible Solution
		Enabled) when b5-00 = 1 or 2 4. L2-01 ≠ 0 when b5-00 = 3 or 4	
oPE10	V/F Data Setting Error Incorrect d1-02, d1-04, d1-06, d1-08, d1-10 (or d1-13, d1-15, d1-17, d1-19, d1-21) settings	V/F parameters setting incorrect	Correct the setting in d1-02, d1-04, d1-06, d1-08 and d1-10 (or d1-13, d1-15, d1-17, d1-19 and d1-21).
oPE11	Carrier Frequency Setting Error	1. Contradictory settings · C6-03 (Carrier Frequency Proportional Gain) > 6 · C6-02 (Minimum Carrier Frequency) > C6-01 (Maximum Carrier Frequency) Note: If C6-03 ≤ 6, the drive operates at C6-01 2. The limit set in C6-00 to C6-03 are contradictory	Correct the parameter setting.
oPE12	Analog Frequency Command Hold Error	When E1-□□=61, there is another E1-□□ is set to 10 to 13, 18 or 53 to 55.	Correct the setting.
oPE14	Incorrect Jump Frequency Setting	The setting does not follow L3-00 ≤ L3-01 ≤ L3-02	Correct the setting.
oPE15	Torque Control Setting Error	The following are set when A1-02 = 3 or 5 (Closed-Loop Vector Control) · L5-00 = 1 and E1-□□ = 70 · L5-00 = 1 or E1-□□ = 70, and E1-□□= 58 or 59 · L5-00 = 1 or E1-□□ = 70	Correct the parameter setting.

8.4 Auto-Tuning Fault Detection

Table 8.4 Auto-Tuning Codes, Causes, and Possible Solution

Keypad Display	Fault Name	Cause	Possible Solution
TnF00	Auto-Tuning Stop	User presses STOP key during Auto-Tuning	Do not press STOP key during Auto-Tuning
TnF01	Line-to Line Resistance Error	The line-to-line resistance in Auto-Tuning is negative or limited by the upper the lower limit	Check and correct motor wiring
TnF02	Stationary Auto-Tuning Error	The voltage or current is too large during stationary Auto-Tuning	Make sure the data entered in t1-03 to t1-05 is the same as the information showed on the motor nameplate Check and correct motor wiring
TnF03	Rotational Auto-Tuning Error	The voltage or current is too large during rotational Auto-Tuning	Make sure the data entered in t1-03 to t1-05 is the same as the information showed on the motor nameplate Check and correct motor wiring Perform Auto-Tuning after disconnect the motor from the machinery
TnF07	Motor Data Error	t5-05 and t1-07 setting incorrect	Make sure the data entered to t1-05 and t1-07 is the same as the information showed on the motor nameplate. Reset the parameters.
TnF09	PM Motor Inductance Error	The voltage or current is too large or the inductance value is error during inductance Auto-Tuning	Make sure the parameter is properly set according to the motor nameplate. Reset T2 parameters
TnF10	PM Motor Back EMF Error	The voltage or current is too large or the value is error during back EMF Auto-Tuning	Make sure the parameter is properly set according to the motor nameplate. Reset T2 parameters

Chapter 9 | Inspection & Maintenance

9.1 Safety



Electrical Shock

- Allow only qualified electrical engineers to install the drive. Failure to comply could cause electrical shocks to personnel or damage to the drive.
- Ensure the power supply is off when connecting. Failure to comply could cause electrical shocks.
- Shut off the power supply of all the equipment before inspection. Maintain the drive only when the CHARGE indicator light is off or 5 minutes after turning off power supply, so as to avoid charged capacitors causing physical injury.
- Do not perform wiring, remove option card or replace cooling fan during drive operation to prevent an electrical shock.
- Shut off the drive power supply and ensure no voltage is left before maintenance.
- Do not operate the drive with the drive enclosure removed. Failure to comply could cause electrical shocks.
- Properly wire the ground terminal of the motor side. Failure to comply could cause electrical shocks when touching the motor enclosure.
- Do not touch any live components to avoid electrical shocks.
- Do not touch the terminals. Avoid output cables contacting the drive enclosure.
- Do not inspect or maintain the drive when wearing loose clothing, jewelry or without eye protection. Failure to comply could cause electrical shocks or injury.

AC drives consist of electronics such as IC, resistors, capacitors, transistors fans and relays. As electronics components have limited life, characteristic changes or malfunction will occur after years of use under normal conditions. Regular inspections, components replacement are therefore necessary. Perform the regular inspection according to the check list in this chapter.

- More frequent inspection is needed in the following situations.
 - Poor storage conditions.
 - High ambient temperature
 - Frequent starts and stops
 - Excessive vibration or shock load
 - Fluctuations in the AC power supply or load
 - Dust, metal shavings, salt, sulfuric acid and chlorine atmospheres

Perform the first inspection one to two years after installation.

9.2 Periodic Inspection

Perform regular inspections according to the following check lists to ensure the optimum product performance and status.

9.2.1 Environment

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Ambient temperature, humidity, vibration, dust, harmful gases, oil mist, water.	Eliminate the source of contaminants or correct poor environment.	○		
Any foreign material or tool left around ?	Eliminate foreign material or tool.	○		

9.2.2 Voltage

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Is the DC bus and control circuit voltage normal ?	<ul style="list-style-type: none"> · Correct the voltage or power supply to within nameplate specifications. · Verify all main circuit phases. 	○		

9.2.3 Keypad Monitor

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Is the display clear to see ?	Clean the keypad monitor.	○		
Any character missing?	Contact the local Lite-On distributor.	○		

9.2.4 Enclosure

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Are the screws all tightened ?	Replace the damaged screws or terminals if tightening is not possible.		○	
Is the shape changed ?	<ul style="list-style-type: none"> · Replace the damaged components · Replace the entire drive if necessary. 		○	

Is the color changed by the heat ?	<ul style="list-style-type: none"> · Replace the damaged components · Replace the entire drive if necessary. 		<input type="radio"/>	
Any dust collection or stain?	<ul style="list-style-type: none"> · Affix the terminal block cover · Remove the dust with a vacuum cleaner · Replace components if cleaning is not possible. 		<input type="radio"/>	

9.2.5 Main Circuit

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Are the screws all tightened ?	Replace the damaged screws or terminals if tightening is not possible.	<input type="radio"/>		
Any shape change, crack, damage or color change at the components or insulators because of heat ?	Replace the entire drive if the board is impossible to be repaired or replaced.		<input type="radio"/>	
Any dust collection or stain?	Remove the foreign material and dust.		<input type="radio"/>	

9.2.6 Main Circuit- Terminals & Cables

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Any damage or color change at the cables ?	Repair or replace the damaged cables.		<input type="radio"/>	

9.2.7 Main Circuit- Capacitors

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Any liquid leakage, color change, crack or swell?	Replace the entire drive if the component is impossible to be replaced.	<input type="radio"/>		
Has the cap come off or swollen?		<input type="radio"/>		

9.2.8 Main Circuit- Resistors

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months

Any odor or crack because of heat?	<ul style="list-style-type: none"> It is normal if the color changes slightly. Check the connection if the color changes. 	<input type="radio"/>		
Any disconnection?		<input type="radio"/>		
Any damage at the connection?		<input type="radio"/>		

9.2.9 Main Circuit- Magnetic Contactors & Relays

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Any noise during operation?	<ul style="list-style-type: none"> Check the circuit voltage respectively when the voltage exceeds or is within the tolerance. Replace the damaged MC, relay or board. 	<input type="radio"/>		
Any damage at the connection?		<input type="radio"/>		

9.2.10 Control Circuit- Control Boards & Connectors

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Are the screws and connectors all tightened ?	<ul style="list-style-type: none"> Fix the loose connections. Replace the board if an antistatic cloth or vacuum plunger cannot be used. Do not use any solvents to clean the board. Remove the dust with a vacuum cleaner. Replace the entire drive if the component is impossible to be cleaned or replaced. 		<input type="radio"/>	
Any odor or color change because of heat?			<input type="radio"/>	
Any crack, damage, shape change or rust?			<input type="radio"/>	
Any liquid leakage or swell at the capacitor?			<input type="radio"/>	

9.2.11 Cooling- Fans

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Any abnormal noise or vibration?	Clean or replace the cooling fan.		<input type="radio"/>	
Are the screws all tightened ?			<input type="radio"/>	
Any color change because of heat?			<input type="radio"/>	

9.2.12 Cooling- Air Duct

Inspection Points	Corrective Action	Inspection Cycle		
		Daily	6 months	12 months
Any obstruction at the heatsink , air intake and exhaust openings?	Clean the obstruction and dust.		○	

9.3 Drive Cooling Fans

NOTICE: The cooling fan cannot operate properly when installed incorrectly and could damage the drive. Contact the local Lite-On distributor to order replacement colling fans when required. For drives with multiple cooling fans, replace all the cooling fans when performing maintenance to ensure maximum product performance life.

9.3.1 Cooling Fan Replacement



CAUTION

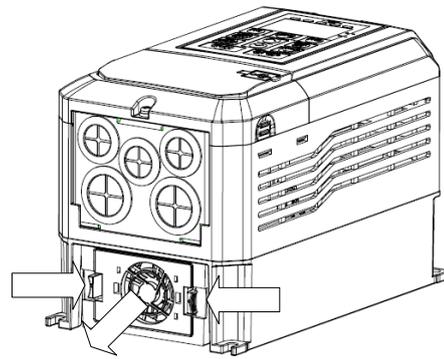
- Allow only qualified electrical engineers to install the drive. Failure to comply could cause electrical shocks to personnel or damage to the drive.
- Ensure the power supply is off when connecting. Failure to comply could cause electrical shocks.
- Shut off the power supply of all the equipment before inspection. Maintain the drive only when the CHARGE indicator light is off or 5 minutes after turning off power supply, so as to avoid charged capacitors causing physical injury.
- Do not perform wiring, remove option card or replace cooling fan during drive operation to prevent an electrical shock.
- Shut off the drive power supply and ensure no voltage is left before maintenance.
- Do not operate the drive with the drive enclosure removed. Failure to comply could cause electrical shocks.
- Properly wire the ground terminal of the motor side. Failure to comply could cause electrical shocks when touching the motor enclosure.
- Do not touch any live components to avoid electrical shocks.
- Do not touch the terminals. Avoid output cables contacting the drive enclosure.
- Do not inspect or maintain the drive when wearing loose clothing, jewelry or without eye protection. Failure to comply could cause electrical shocks or injury.
- Do not touch the drive heatsink which could be very hot during operation.
- Do not replace the cooling fan until 15 minutes after shutting off the drive power and making sure the heatsink is cooled down.

- The cooling fan cannot operate properly when installed incorrectly and could damage the drive. Follow the instructions when replacing cooling fans. For drives with multiple cooling fans, replace all the cooling fans when performing maintenance to ensure maximum product performance life.

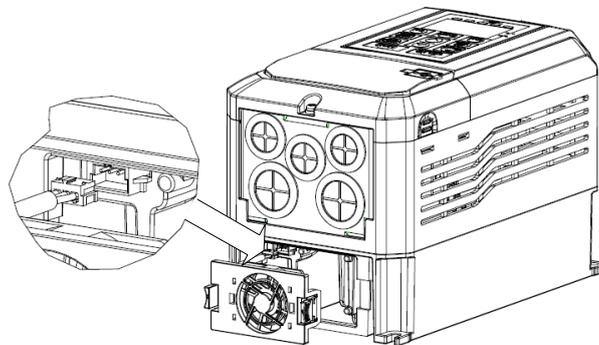
9.3.2 Removing Cooling Fan

1 to 3HP

1. Depress the right and left sides of the cooling fan cover tabs and pull outward.



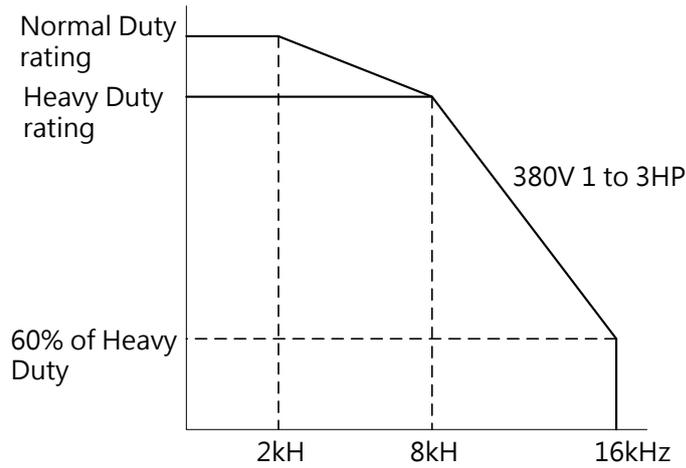
2. When the fan is pulled outward, disconnect the power cable.



Chapter 10 | Drive Derating

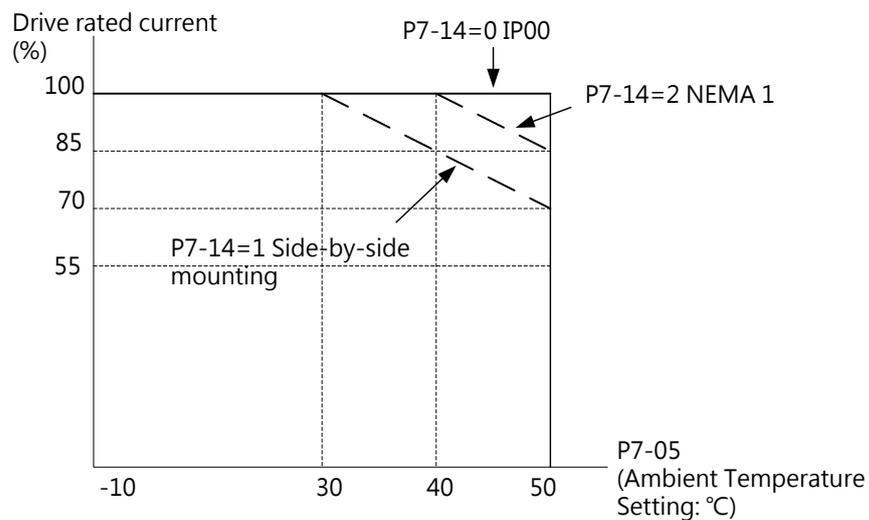
By derating the drive capacity, the drive can run at above the rated temperature, altitude and default carrier frequency. For example, a drive with 20 A rated current can be derated to 16A current so as to run with higher temperature tolerance.

Change the carrier frequency to derate the drive.



10.1 Temperature Derating

When the ambient temperature exceeds the tolerance specified in the product specifications, the drive output current must be derated to ensure the performance life. Meanwhile, set P7-12 (Installation Method Selection) according to the installation conditions so as to ensure reliable drive overload protection.



10.2 Altitude Derating

- The most appropriate altitude to install the drive is below 1000m.
- The drive rated voltage and the rated output current must be derated for 1% per 100 m for drive installations from 1000 m to 3000 m altitude.
- The drive cannot be installed above 3000 m altitude.

Chapter 11 | Communications

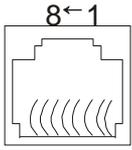
11.1 Modbus Communication Specifications

Item	Specifications
Interface	RS-485
Communications Cycle	Asynchronous
Communication Parameters	Communication speeds
	Data length
	Select even, odd or none
	Stop bit
Protocol	Modbus
Max number of Slaves	31 AC drives

11.2 Connecting to Controller/PLC/HMI

11.2.1 Communication Cable Connection

1. Connect the communications cable to the drive and the controller/PLC/HMI when the power is cut off. Use the drive terminal RJ45 for Modbus communication.



Modbus RS-485
Pin 1, 2, 7, 8: Retain
Pin 3, 6:SGND
Pin 4:SG-
Pin 5:SG+

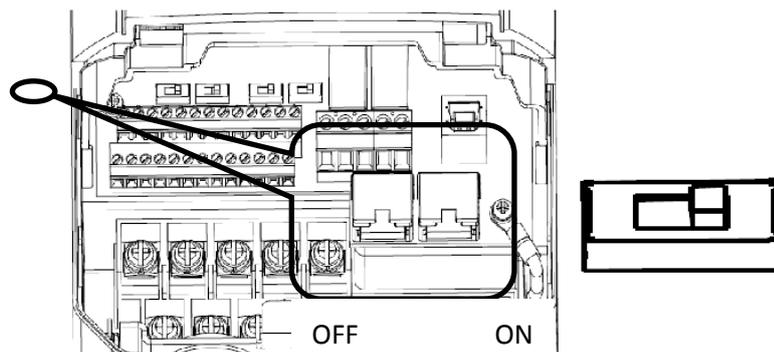
RS-48

Note: To prevent the interference, separate the communications cables from the main circuit cables, power cable and other wiring. Always use shielded cables for the communications cables, and shielded clamps.

2. Ensure the termination resistor is installed in the last drive of the slave series.
3. Turn the power on.
4. Set the parameters needed for the communication(E6 - 00 to E6 - 12) using the keypad.
5. Shut the power off and wait until the display goes out.
6. Turn the power on.
7. The communication between the drive and the controller/PLC/HMI is now ready.

11.2.3 Termination Resistor Setting for Multiple Connections

The default of termination resistor for RS-485 communication is OFF. Switch this DIP switch to ON when the drive is the last in a series of slave drives. In addition, make sure this DIP switch RS-485 in all other slaves is placed to OFF.



11.2.4 Termination Resistor Function

- Interference signal suppression
- Wiring impedance balance

11.2.5 When to Install Termination Resistor

Install the termination resistor in the drive on the end of the network and the master device to suppress the interference signal in the following situations. (Note: The installation must be on the both ends)

1. Multiple devices are connected by the network.
2. The communication cable is too long.
3. Multiple devices are connected via long communication cables.

11.3 Modbus Setup Parameters

This section explains the parameters needed for Modbus communication.

E6- 07 Communication Speed Selection

Selects the speed for the Modbus communication.

Note: Cycle the drive power to activate the setting..

E6-07	RS-485 Communication Baud Rate Setting	Sets the baud rate for terminals SG(+) and SG(-) of RS-485 communication. 0: 1200 bps (bit/sec) 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps 6 : 57600 bps 7 : 76800 bps 8 : 115200 bps	Default: 3 Range: 0 to 8
-------	--	---	-----------------------------

E6- 08 RS-485 Communication Parity Selection

Sets the Modbus communication type.

E6-08	RS-485 Communication Parity Selection	Selects the communication parity for terminals SG(+) and SG(-) of RS-485 communication. 0: 8, N, 2 (Modbus RTU) 1: 8, N, 1 (Modbus RTU) 2: 8, E, 1 (Modbus RTU) 3: 8, O, 1 (Modbus RTU) 4: 8, N, 2 (Modbus ASCII) 5: 8, N, 1 (Modbus ASCII) 6: 8, E, 1 (Modbus ASCII) 7: 8, O, 1 (Modbus ASCII) 8: 7, N, 2 (Modbus ASCII) 9: 7, N, 1 (Modbus ASCII) 10: 7, E, 1 (Modbus ASCII) 11: 7, O, 1 (Modbus ASCII)	Default: 1 Range: 0 to 11
-------	---------------------------------------	---	------------------------------

E6- 09 Communication Error Detection Time

Determines the detection time to trigger the communication error.

E6-09	Communication Error Detection Time	Determines the detection time to trigger the communication error. (This function is disabled when set to 0)	Default: 0.0 s Range: 0.0 to 10.0 s
-------	------------------------------------	---	--

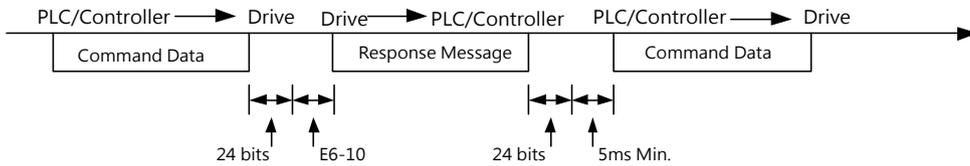
If the drive does not receive any response via pulse train communication within the time set in

E6-09, the fault will be triggered to perform the action set in E6-00.

E6- 10 Transmit Wait Time

Sets the wait time between sending and receiving data.

E6-10	Transmit Wait Time	Sets the wait time between sending and receiving data.	Default: 5ms Range: 5 to 65 ms
-------	--------------------	--	-----------------------------------



11.4 Drive Operations by Modbus

The drive operations by Modbus communication are determined by the drive parameter settings. This section explains the provided functions and the related parameters.

11.4.1 Actions by Modbus

The following actions can be performed by a PLC regardless of the parameter settings except for E6 parameters.

- Monitor drive operation from a PLC.
- View and change parameter settings.
- Reset faults.
- Assign multi-function inputs.

11.4.2 Drive Control by Modbus

Select Modbus communication according to the following table to run/stop the motor and give frequency commands.

b1-00	Frequency Command Selection 1	0: Keypad 1: Control Circuit Terminal (Analog Input) 2: Terminal Up/Down 3: Modbus Communication 4: Pulse Train Input (Including PWM signal input)	Default: 1 Min.: 0 Max.: 4
b1-01	Run Command Selection 1	0: Keypad 1: Control Circuit Terminal (Sequence Control Input) 2: Modbus Communication	Default: 1 Range: 0, 1, 2
b1-07	Frequency Command Selection 2	Enabled while E1-00 to E1-07 is set to 4 and the DIP switch is set to OFF 0: Keypad	Default: 0 Min.: 0 Max.: 4

		1: Control Circuit Terminal (Analog Input) 2: Terminal Up/Down 3: Modbus Communication 4: Pulse Train Input (Including PWM signal input)	
b1-08	Run Command Selection 2	Enabled while E1-00 to E1-07 is set to 4 and the DIP switch is set to OFF 0: Keypad 1: Control Circuit Terminal (Sequence Control Input) 2: Modbus Communication	Default: 0 Range: 0, 1, 2

11.5 Message Format

11.5.1 Message Content

In Modbus communications, the master gives commands to the slave, and the slave responds. The following table shows the configured message for both sending and receiving, and the length of data packets is determined by the command (function) content.

11.5.2 Message Configuration

ASCII scheme:

STX	Start = ' ' (3AH)
Address Hi	Station address:
Address Lo	8-bit, consists of two ASCII codes
Function Hi	Function code:
Function Lo	8-bit, consists of two ASCII codes
DATA (n-1)	Data Characters:
.....	n×8-bit, consists of two ASCII codes
DATA 0	n≤16, max. 32 ASCII codes (20 pieces of data)
LRC CHK Hi	LRC check code:
LRC CHK Lo	8-bit, consists of two ASCII codes
END Hi	End:
END Lo	END Hi = CR (0DH), END Lo = LF(0AH)

RTU scheme:

Address	Station address: 8-bit binary
Function	Function code: 8-bit binary
DATA (n-1)	Data Characters:
.....	n×8-bit data, n≤16
DATA 0	
CRC CHK Low	CRC checksum:

CRC CHK High	16-bit, consists of 2 sets of 8-bit binary
--------------	--

11.5.3 Slave Station Address

Use code between 0 and FF (hex) to set the slave station address. If a message with slave station address 0 is sent (broadcast), the command from the master will be sent to all slaves. The slave do not responds to a broadcast message.

00H: To all drive (broadcast)

01H: To drive address 01

0FH: To drive address 15

10H: To drive address 16, so on and so forth up to 31(1FH).

11.5.4 Function Code

There are four types of function codes:

03H : Read Modbus registers

06H : Write a word to registers(Write to registers)

08H : Loopback test

10H : Write to multiple registers

11.5.5 Data

By combining the Modbus register address (test code in case of a loopback test) and the register data, the drive configures consecutive data. The length of the data depends on the command details.

The Modbus register always consists of a data length of two bytes. Data written into the register must also consist of a length of two bytes. Register data read out from the drive will always have two bytes.

11.5.6 Error Check

The drive check data validity using CRC scheme.

11.5.7 Command Data

When the drive receives data, it checks for errors. To do so, the drive calculates the CRC and compares it to the CRC-16 value received in the message. The command will not be processed if these two values do not match.

Use the default value of FFFFH (i.e., all 16 bits equal 1) to caculate CRC-16 in Modbus. Calculate the CRC-16 checksum using the following steps:

- (1). The starting value of a 16-bit register value is FFFFH (all 16 bits equal 1).
- (2). Perform an exclusive OR of this value and the slave address. Then save the result in

the register.

- (3). Right shift the result, put 0 to the left of the high-order byte and check the CRC register value.
- (4). If the value is 0, save the result from step (3) above in the CRC register.
If the value is not 0, perform an exclusive OR of the result from step (3) and the value A001h(1010 0000 0000 0001). Then save the result in the CRC register.
- (5). Repeat step (3) and (4) until 8-bit operations are all performed.
- (6). Repeat step (2) to (5). 8-bit command data until all the command data are calculated.
The result of the last shift is the CRC checksum. Send the low-order byte before the high-order byte when sending the CRC checksum. For an example of CRC checksum 1241hex, the high-order byte of CRC-16 must be set to 41hex, and the low-order byte must be set to 12hex.

□ CRC Calculation:

```
UWORD ch_sum ( UBYTE long , UBYTE *rxdbuf ) {
    BYTE i = 0;
    UWORD wkg = 0xFFFF;
    while ( long-- ) {
        wkg ^= rxdbuf++;
        for ( i = 0 ; i < 8; i++ ) {
            if ( wkg & 0x0001 ) {
                wkg = ( wkg >> 1 ) ^ 0xa001;
            }
            else {
                wkg = wkg >> 1;
            }
        }
    }
    return( wkg );
}
```

11.5.8 Response Message

Perform a CRC calculation on the response message according to the above description. The result of the calculation should match the CRC checksum of the response message.

11.6 Example of Reading / Responding Data

The following are examples of command and response data.

Example: For the drive address 01H, To read 2 consecutive register data for the drive address 01H, the message is "starting address 2422H.

ASCII Scheme:

Command Message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting address	'2'
	'4'
	'2'
	'2'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'B'
	'4'
END	CR
	LF

Respond Message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of data (count by byte)	'0'
	'4'
Content of address 2422H	'1'
	'7'
	'7'
	'0'
Content of address 2423H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU Scheme:

Command Message:

Address	01H
Function	03H
Starting data address	24H
	22H
Number of data (count by world)	00H
	02H
CRC CHK Low	6EH
CRC CHK High	F1H

Respond Message:

Address	01H
Function	03H
Number of data (count by byte)	04H
Content of data address 2422H	17H
	70H
Content of data address 2423H	00H
	00H
CRC CHK Low	FEH
CRC CHK High	5CH

Function code 06H: Write one piece of data to register

Example: For the drive address 01H, 1(01H) will be written to the drive internal parameter 0100H (b1-00).

ASCII Scheme:

Command Message:		Respond Message:	
STX	':'	STX	':'
Address	'0'	Address	'0'
	'1'		'1'
Function	'0'	Function	'0'
	'6'		'6'
Data address	'0'	Data address	'0'
	'1'		'1'
	'0'		'0'
	'0'		'0'
Data content	'0'	Data content	'0'
	'0'		'0'
	'0'		'0'
	'1'		'1'
LRC Check	'F'	LRC Check	'F'
	'7'		'6'
END	CR	END	CR
	LF		LF

RTU Scheme:

Command Message:		Respond Message:	
Address	01H	Address	01H
Function	06H	Function	06H
Data address	01H	Data address	01H
	00H		00H
Data content	00H	Data content	00H

	01H		01H
CRC CHK High	49H	CRC CHK High	49H
CRC CHK Low	F6H	CRC CHK Low	F6H

Command code: 10H, write consecutive data to register (Max. 20 pieces of consecutive data).
 For example, changing the drive (address 01H) multi-step speed setting L1-00=60.00 (0880H),
 L1-01=50.00 (8801H).

ASCII Scheme

Command Message:		Respond Message:	
STX	':'	STX	':'
ADR 1	'0'	ADR 1	'0'
ADR 0	'1'	ADR 0	'1'
CMD 1	'1'	CMD 1	'1'
CMD 0	'0'	CMD 0	'0'
Data Starting Address	'0'	Data Address	'0'
	'8'		'8'
	'8'		'8'
	'0'		'0'
Data Quantity (Word)	'0'	Data Quantity (Word)	'0'
	'0'		'0'
	'0'		'0'
	'2'		'2'
Data Quantity (Byte)	'0'	LRC Check	'6'
	'4'		'5'
First Storage Register	'0'	END	CR
	'2'		LF
	'5'		
	'8'		
Next Storage Register	'0'		
	'1'		
	'F'		
	'4'		
LRC Check	'1'		
	'2'		
END	CR		
	LF		

RTU Scheme:

Command Message:		Respond Message:	
ADR	01H	ADR	01H
CMD	10H	CMD	10H
Starting Address	08H	Starting Address	08H
(Word)	80H	(Word)	80H
Data Quantity	00H	Register Written Quantity	00H
(Word)	02H	(Word)	02H
Data Quantity (Byte)	04H		
First Storage Register	00H	CRC Check High	42H
	3CH	CRC Check Low	40H
Second Storage Register	00H		
	32H		
CRC Check High	DDH		
CRC Check Low	D6H		

during a communication error

When a error occurs during communication with the drive, the drive responds to the error code, set the highest-order byte (bit7) of command data to 1 (Function code AND 80H) and respond to the control system to inform control system about the error. And the drive keypad displays CE-XX (XX is the error code) as the warning message.

Example:

ASCII Scheme:		RTU Scheme:	
STX	“:”	Address	01H
Address	‘0’	Function	86H
	‘1’	Exception code	02H
Function	‘8’	CRC CHK Low	C3H
	‘6’	CRC CHK High	A1H
Exception code	‘0’		
	‘2’		
LRC CHK	‘7’		

	'7'
END	CR
	LF

11.7 Modbus Data

The following tables shows all data including command, monitor and broadcast.

■ Command Data (Read and write)

Register No.	Definitions	
2400H	Retain	
2401H	Operation Commands	
	Bit 0	Stop/Run (0:Stop, 1:Run)
	Bit 1	Forward/Reverse (0:Forward, 1:Reverse)
	Bit 2	External Fault EF0
	Bit 3	Fault reset
	Bit 4	Retain
	Bit 5	Retain
	Bit 6	Retain
	Bit 7	Retain
	Bit 8	Multi-Function Terminal 1 (1: ON)
	Bit 9	Multi-Function Terminal 2 (1: ON)
	Bit 10	Multi-Function Terminal 3 (1: ON)
	Bit 11	Multi-Function Terminal 4 (1: ON)
	Bit 12	Multi-Function Terminal 5 (1: ON)
	Bit 13	Multi-Function Terminal 6 (1: ON)
	Bit 14	Multi-Function Terminal 7 (1: ON)
Bit 15	Multi-Function Terminal 8 (1: ON)	
2402H	Frequency Command (0.01Hz Units)	
2403H	Torque Command (-16384 to 16384 equal -200% to 200% of motor rated torque)	

■ Monitor Data (Read Only)

Register No.	Definitions	
2420H	Retain	
2421H	Operation Status	
	Bit 0	1: During Run

	Bit 1	1: During reverse
	Bit 2	1: During Zero Speed Holding
	Bit 3	1: During fault
	Bit 4	1: During alarm detecton
	Bit 5	1: During speed agree
	Bit 6	1: During ready
	Bit 7	1: Frequency command provided from Remote
	Bit 8	1: Run command provided from Remote
	Bit 9	1: Torque mode
	Bit 10	1: Zero Speed Holding
	Bit 11 to 15	Retain
2422H	Frequency command (0.01Hz units)	
2423H	Output frequency (0.01Hz units)	
2424H	Output current (0.1A units)	
2425H	Output voltage (0.1V units)	
2426H	DC voltage (0.1V units)	
2427H	Alarm description	
2428H	Fault description	
2429H	Multi-Function Inputs and Outputs Status	
	Bit 0	1: Multi-Function Terminal 1 ON
	Bit 1	1: Multi-Function Terminal 2 ON
	Bit 2	1: Multi-Function Terminal 3 ON
	Bit 3	1: Multi-Function Terminal 4 ON
	Bit 4	1: Multi-Function Terminal 5 ON
	Bit 5	1: Multi-Function Terminal 6 ON
	Bit 6	1: Multi-Function Terminal 7 ON
	Bit 7	1: Multi-Function Terminal 8 ON
	Bit 8 to 10	Retain
	Bit 12	1: Relay 1 ON
	Bit 13	1: Relay 2 ON
	Bit 14	1: PH1 ON
	Bit 15	Retain
242AH	AI1 input (0 equals 0V or 0mA, 1000 equals 10V or 20mA)	
242BH	AI2 input (0 equals 0V or 4mA, 1000 equals 10V or 20mA)	
242CH	Retain	

242DH	AO1 input (-1000 equals -10V, 0 equals 0V or 4mA, 1000 equals 10V or 20mA)
242EH	AO2 input (-1000 equals -10V, 0 equals 0V or 4mA, 1000 equals 10V or 20mA)

■ Alarm Data (2427H)

No.	Contents	No.	Contents	No.	Contents
0	No alarm	8	EF6 (External Fault 6)	16	ot2 (Overtorque Detection 2)
1	dEv (Speed Deviation)	9	EF7 External Fault 7)	17	Ov (Overvoltage)
2	EF0 (Option Card External Fault)	10	EF8 (External Fault 8)	18	Uv(Undervoltage)
3	EF1 (External Fault 1)	11	FbH (PID Feedback High)	19	Ut1 (Undertorque Detection 1)
4	EF2 (External Fault 2)	12	FbL (PID Feedback Low)	20	Ut2 (Undertorque Detection 2)
5	EF3 (External Fault 3)	13	oH (Heatsink Overheat)	21	UL (Mechanical Weakening Undertorque Detection)
6	EF4 (External Fault 4)	14	oH1 (Motor Overheat)		
7	EF5 (External Fault 5)	15	ot1 (Overtorque Detection 1)		

■ Fault Data (2428H)

No.	Contents	No.	Contents	No.	Contents
0	No fault	26	Retain	52	dv3 (Inversion Detection)
1	GF (Ground Fault)	27	Retain	53	dv4 (Inversion Prevention Detection)
2	oVA (Acceleration Overvoltage)	28	Retain	54	FbH (PID Feedback High)
3	oVd (Deceleration Overvoltage)	29	Retain	55	FbL (PID Feedback Low)
4	oVC (Constant Speed Overvoltage)	30	Retain	56	bUS (Option Communication Error)

5	oCA (Acceleration Overcurrent)	31	Retain	57	CE (Modbus Communication Error)
6	oCd (Deceleration Overcurrent)	32	Retain	58	CF (Control Fault)
7	oCC (Constant Speed Overcurrent)	33	oH (Heatsink Overheat)	59	Err (EEPROM Write Error)
8	EF	34	oH1 (Motor Overheat)	60	oS (Overspeed)
9	SC (IGBT Fault or Output Short Circuit)	35	oL (Mechanical Weakening Overtorque Detection)	61	PGo (PG Open)
10	Retain	36	oL1 (Motor Overload)	62	Retain
11	Retain	37	oL2 (Drive Overload)	63	SEr
12	Retain	38		64	STo (Oscillation Detection)
13	Retain	39	ot1 (Overtorque Detection 1)	65	
14	Retain	40	ot2 (Overtorque Detection 2)	66	
15	Retain	41	Ut1 (Undertorque Detection 1)	67	
16	Retain	42	Ut2 (Undertorque Detection 2)	68	
17	EF0 (Option Card External Fault)	43	UL (Mechanical Weakening Undertorque Detection)	69	
18	EF1 (External Fault 1)	44	Uv1(Undervoltage Detection 1)	70	
19	EF2 (External Fault 2)	45	Uv2 (Control Power Supply Voltage Fault)	71	
20	EF3 (External Fault 3)	46	PF (Input Phase Loss)	72	Retain
21	EF4 (External Fault 4)	47	LF1(Output Phase Loss)	73	Retain
22	EF5 (External Fault 5)	48	Retain	74	Retain

23	EF6 (External Fault 6)	49	dEv (Speed Deviation)	75	Retain
24	EF7 (External Fault 7)	50	dv1 (Z Pulse Fault)	76	Retain
25	EF8 (External Fault 8)	51	dv2 (Z Pulse Noise Fault)	77	Retain

11.8 Communication Errors

11.8.1 Modbus Errors

The Modbus error codes are listed in the following table.

When an error occurs, remove the cause of the fault and restart communications. Each error code may have different definitions depending on the function code.

Error Code	Function Code	Description
1	3,6,8,10	Function code error
2	3	Read data is outside the setting range
	6	Write data is outside the setting range
	10	Write data is outside the setting range
3	3	Read data exceeds 125 pieces
	6	Write data is outside the setting range
	8	Read request value error including CRC check error
	10	Write data exceeds 123 pieces or byte count does not match the amount of write data.
4	3	Read register error
	6	Write register error
	8	Response pocket error
	10	Write register error

11.8.2 Slave Response

In the following situations, the slave will ignore the command message sent from the master and not respond to it.

- When a communications error (overrun, framing, parity, or CRC) is detected in the command message.
- The slave address in the command message do not match the slave address in the drive (Set the slave address for the drive using E5-06 in advance).
- The gap between two blocks of a message is greater than 24 bits.

- The command message length is incorrect.

Note: When the slave address in the command message is 00H, all slaves perform the write function, but do not send any response message to the master.

EVOLution Series

LITEON Industrial Automation

Copyright 2014 LITEON Industrial Automation. All Rights Reserved

Lite-On Group Headquarters

22F, 392, Ruey Kuang Road, Neihu, Taipei City 114, Taiwan

Lite-On IA Headquarters

11F, 866-1, Chung-Zheng Rd., Chung Ho District, New Taipei City 235, Taiwan

Factory

7, Lane 3, San-Ho Rd., San-Shi Village, Dayuan Town, Taoyuan County 337, Taiwan

Email: IA.Hotline.overseas@liteon.com



www.liteon-ia.com