Digitized Automation for a Changing World

Delta Compact Elevator Drive
MH300-L User Manual

www.deltaww.com

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PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

☑ Disconnect AC input power before connecting any wiring to AC motor drive.

☑ Turn OFF the AC motor drive power before doing any wiring. A charge with hazardous voltages may remain in the DC bus capacitors even after the power has been turned off for a short time. Do not touch the internal circuits and components before the POWER LED (behind the digital keypad) is OFF. For your safety, measure the remaining voltage with a DC voltmeter on +1/DC+ and DC- and do not start wiring before the voltage drops to a safe level (less than 25 V_{DC}). Installing wiring with a residual voltage may cause personal injury, sparks and short circuit.

☑ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Take anti-static measure before touching these components or the circuit boards.

☑ Never modify the internal components or wiring.

☑ Ground the AC motor drive by using the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed.

☑ Do NOT install the AC motor drive in a location with high temperature, direct sunlight or inflammable materials or gases.

CAUTION

☑ Never connect the AC motor drive output terminals U/T1, V/T2 and W/T3 directly to the AC mains circuit power supply.

☑ After finishing the wiring of the AC motor drive, check if R/L1, S/L2 and T/L3 are short-circuited to ground with a multimeter. Do NOT power the drive if short circuits occur. Eliminate the short circuits before the drive is powered.

☑ The rated voltage of power system to install motor drives is listed below. Ensure that the installation voltage is in the correct range when installing a motor drive.

1. For 230V models, the range is between 170–264V.
2. For 460V models, the range is between 323–528V.

☑ Refer to the table below for short circuit rating:

Model (Power)	Short circuit rating
230V	5 kA
460V	5 kA

☑ Only qualified persons are allowed to install, wire and maintain the AC motor drives.

☑ Even if the three-phase AC motor is stopped, a charge with hazardous voltages may still remain in the main circuit terminals of the AC motor drive.

☑ The performance of electrolytic capacitor will degrade if it is not charged for a long time. It is recommended to charge the drive which is stored in no charge condition every 2 years for 3–4 hours to restore the performance of electrolytic capacitor in the motor drive. Note: When power up the motor drive, use adjustable AC power source (e.g. AC autotransformer) to charge the drive at 70%–80% of rated voltage for 30 minutes (do not run the motor drive). Then charge the drive at 100% of rated voltage for an hour (do not run the motor drive). By doing these, restore the performance of electrolytic capacitor before starting to run the motor drive. Do NOT run the motor drive at 100% rated voltage right away.

☑ Pay attention to the following precautions when transporting and installing this package (including wooden crate and wood stave)

1. If you need to deworm the wooden crate, do NOT use fumigation or you will damage the drive. Any damage to the drive caused by using fumigation voids the warranty.
2. Use other methods, such as heat treatment or any other non-fumigation treatment, to deworm the wood packaging material.

	3. If you use heat treatment to deworm, leave the packaging materials in an environment of over 56°C for a minimum of thirty minutes. ☑ Connect the drive to a three-phase three-wire or three-phase four-wire Wye system to comply with UL standards. ☑ If the motor drive generates leakage current over AC 3.5 mA or over DC 10 mA on a grounding conductor, compliance with local grounding regulations or IEC61800-5-1 standard is the minimum requirement for grounding.

NOTE:

1. In the pictures in this manual, the cover or safety shield is disassembled only when explaining the details of the product. During operation, install the top cover and wiring correctly according to the provisions. Refer to the operation descriptions in the manual to ensure safety.
2. The figures in this instruction are only for reference and may be slightly different depending on your model, but it will not affect your customer rights.
3. The content of this manual may be revised without prior notice. Consult our distributors or download the latest version at http://www.deltaww.com/iadownload_acmotordrive.

Table of Contents

Issued Edition: 01
Firmware Version: V1.03
(Refer to Parameter 00-06 on the product to get the firmware version.)
Issued Date: 2024/06

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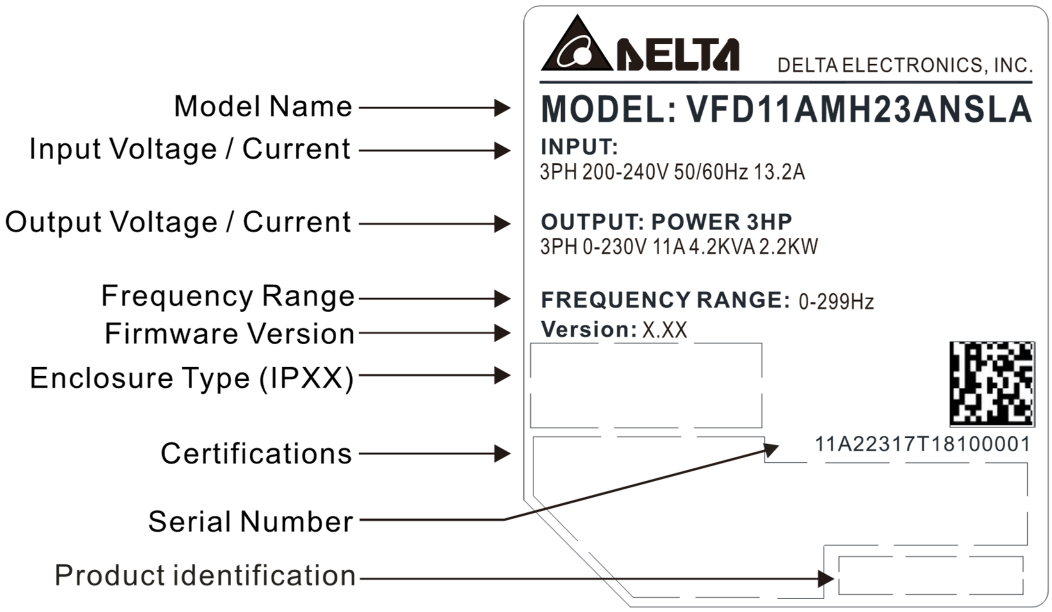
Chapter 1 Introduction

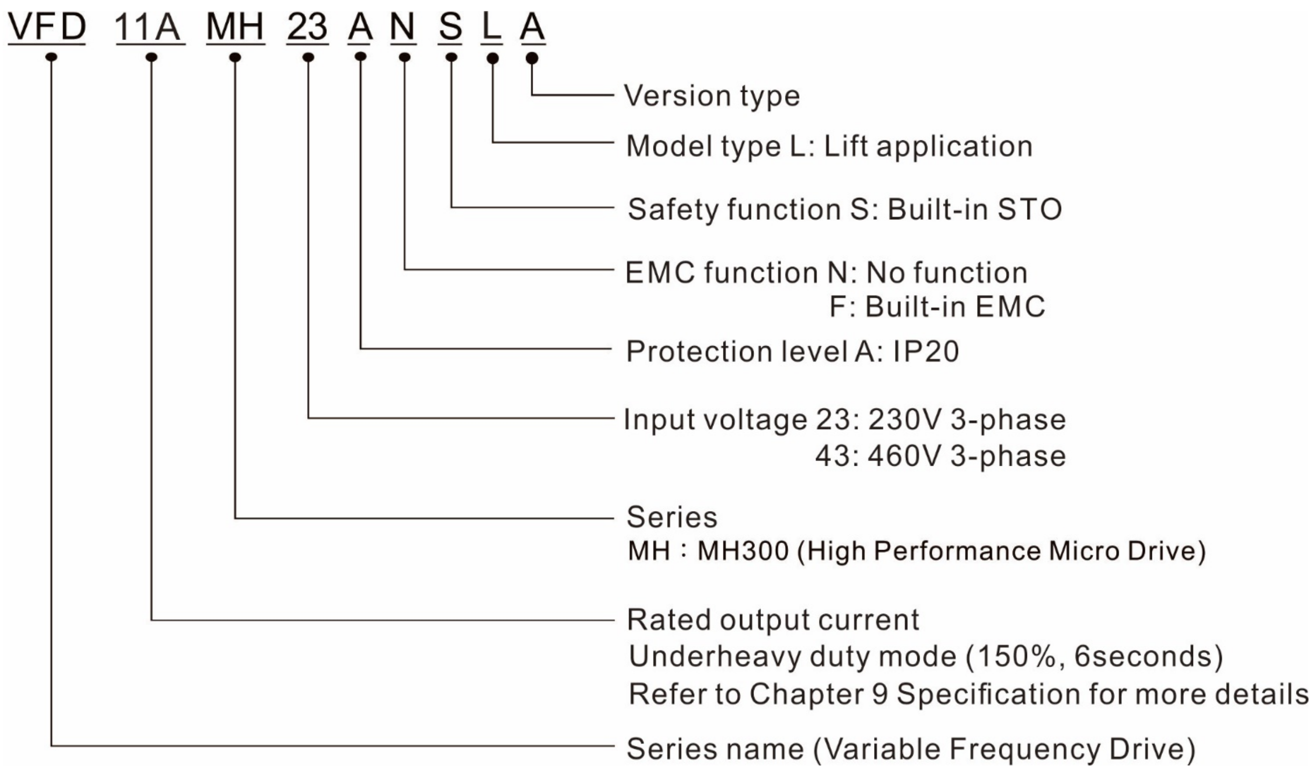
After receiving the AC motor drive, check for the following:

1. Inspect the unit after unpacking to ensure that it was not damaged during shipment. Make sure that the part number printed on the package matches the part number indicated on the nameplate.
2. Make sure that the mains voltage is within the range indicated on the nameplate. Install the AC motor drive according to the instructions in this manual.
3. Before applying power, make sure that all devices, including mains power, motor, control board, and digital keypad are connected correctly.
4. When wiring the AC motor drive, make sure that the wiring for the input terminals “R/L1, S/L2, T/L3”, and the output terminals "U/T1, V/T2, W/T3” are correct to prevent damage to the drive.
5. When power is applied, use the digital keypad (KPMH-LC01) to select the language and set parameters. When executing a trial run, begin with a low speed and then gradually increase the speed to the desired speed.

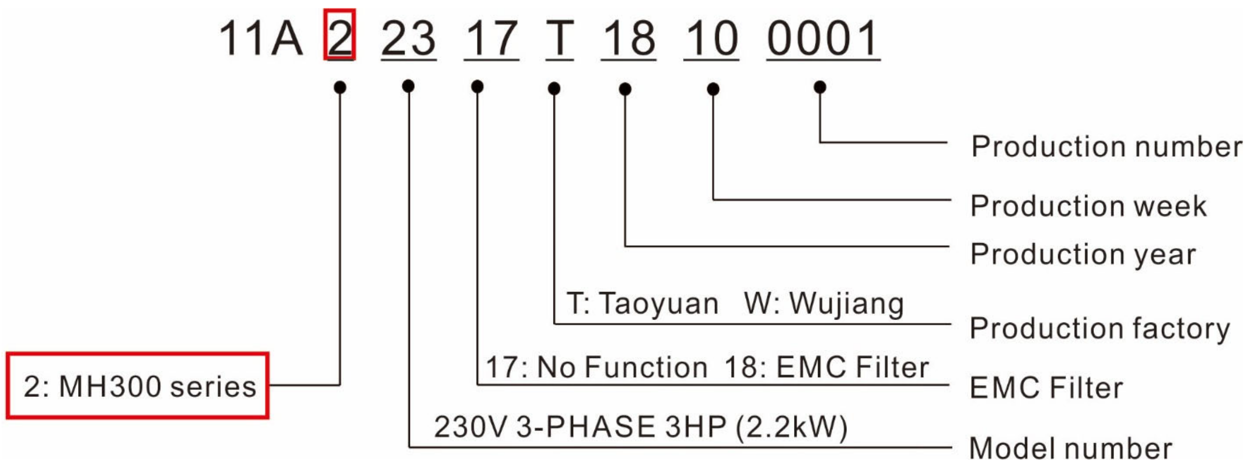
1-1 Nameplate Information



1-2 Model Name



1-3 Serial Number

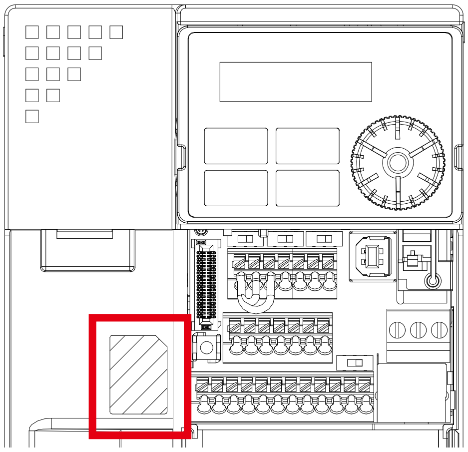


1-4 Apply After-sales Service by Mobile Device

1-4-1 Location of Service Link Label

Frame C–F

Service link label (Service Label) will be pasted on the area as below drawing shown.



1-4-2 Service Link Label

QR code

https://service.deltaww.com/ia/repair?sn=product-serial-number

Serial number

Web address of product service

https://service.deltaww.com

Scan QR Code to request service

1. Find out the QR code sticker (as shown above).
2. Use a smartphone to run a QR Code reader APP.
3. Point your camera at the QR Code. Hold your camera steady until the QR code comes into focus.
4. Access the Delta After-sales Service website.
5. Fill your information into the column marked with an orange star.
6. Enter the CAPTCHA and click "Submit" to complete the application.

Cannot find the QR Code

1. Open a web browser on your computer or smartphone.
2. Enter https://service.deltaww.com/tw/Repair/Request?type=IA in browser address bar and press the Enter key.
3. Fill your information into the column marked with an orange star.
4. Enter the CAPTCHA and click "Submit" to complete the application.

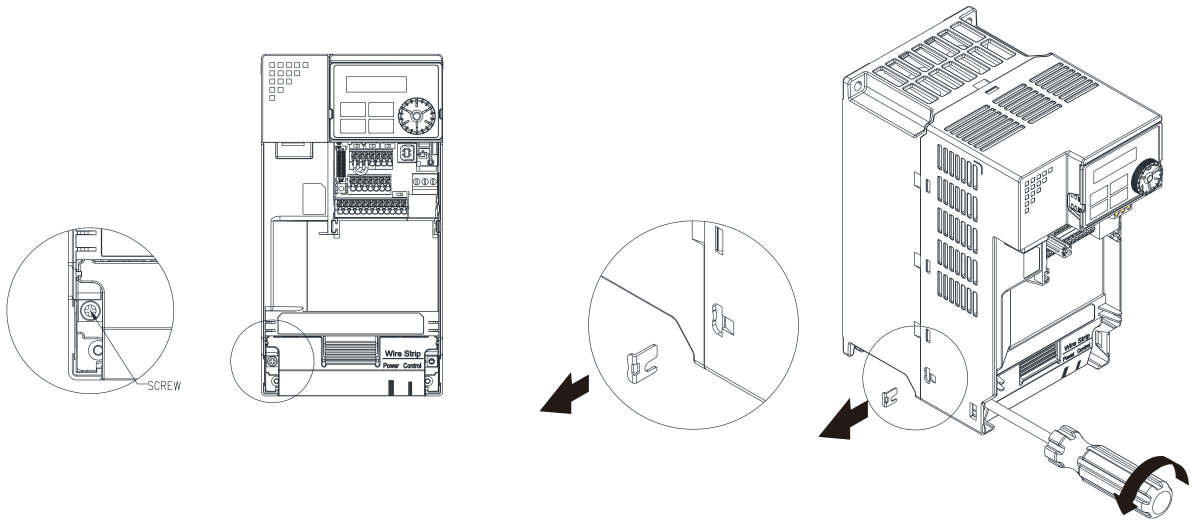
1-5 RFI Jumper

RFI Jumper:

1. The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to prevent the drive from unexpected stop or damage caused by mains surges or voltage spikes. Because the Varistors / MOVs from phase to ground are connected to ground with the RFI jumper, removing the RFI jumper disables the protection.
2. In models with a built-in EMC filter, the RFI jumper connects the filer capacitors to ground to form a return path for high frequency noise in order to isolate the noise from contaminating the mains power. Removing the RFI jumper strongly reduces the effect of the built-in EMC filter. Although a single drive complies with the international standards for leakage current, an installation with several drives with built-in EMC filters can trigger the RCD. Removing the RFI jumper helps, but the EMC performance of each drive is no longer guaranteed.

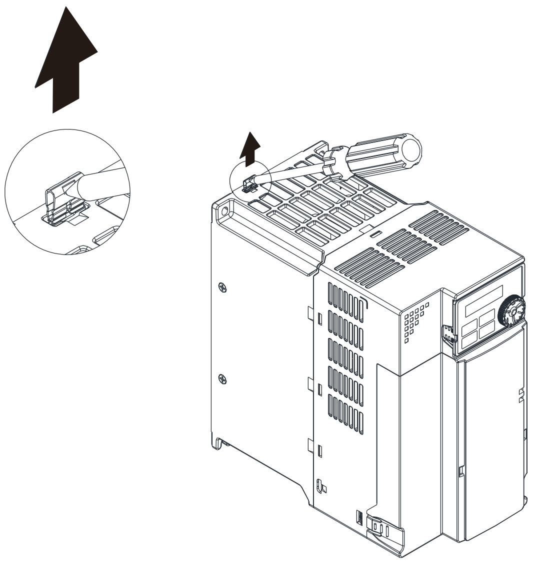
Frame C–F   Screw Torque: 4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]

Loosen the screw and remove the RFI jumper (as shown below). Fasten the screw again after you remove the RFI jumper.



Frame C–F   (model with built-in EMC filter)

Remove the RFI jumper with a screwdriver (as shown below).



Isolating main power from ground:

When the power distribution system of the drive is a floating ground system (IT Systems) or an asymmetric ground system (Corner Grounded TN Systems), you must remove the RFI jumper. Voltage of any phase to the ground for either system may be larger than the voltage specifications of the drive's built-in surge absorber and common-mode capacitance. In this case, connecting RFI jumper to the ground may cause damage to the drive.

Important points regarding ground connection:

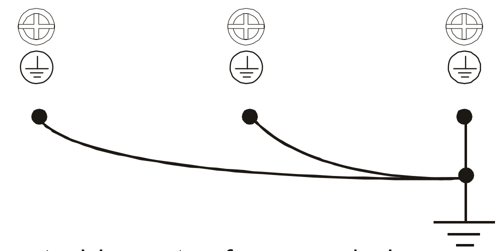
☑ To ensure the safety of personnel, proper operation, and to reduce electromagnetic radiation, you must properly ground the motor and drive during installation.

☑ The diameter of the grounding cables must comply with the local safety regulations.

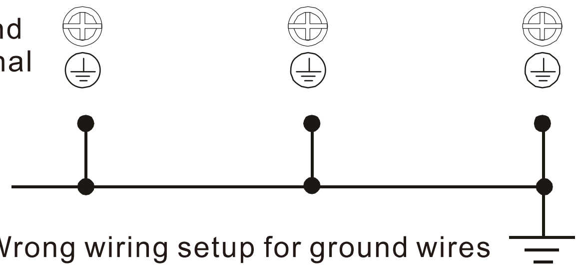
☑ You must connect the shielded cable to the motor drive’s ground to meet safety regulations.

☑ Only use the shielded cable as the ground for equipment when the aforementioned points are met.

☑ When installing multiple drives, do not connect the grounds of the drives in series but connect each drive to ground. The following pictures show the correct and wrong ways to connect the grounds.



Correct wiring setup for ground wires



Wrong wiring setup for ground wires

Pay particular attention to the following points:

☑ Do not remove the RFI jumper while the power is ON.

☑ Removing the RFI jumper also cuts the capacitor conductivity of the surge absorber to ground and the built-in EMC filter capacitors. Compliance with the EMC specifications is no longer guaranteed.

☑ Do not remove the RFI jumper if the mains power is a symmetrical grounded power system in order to maintain the efficiency for EMC circuit.

☑ Remove the RFI jumper when conducting high voltage tests. When conducting a high voltage test to the entire facility, disconnect the mains power and the motor if the leakage current is too high.

Floating Ground System (IT Systems)

A floating ground system is also called IT system, ungrounded system, or high impedance / resistance (greater than 30Ω) grounding system.

☑ Remove the RFI jumper to disconnect the ground cable from the internal filter capacitor and surge absorber.

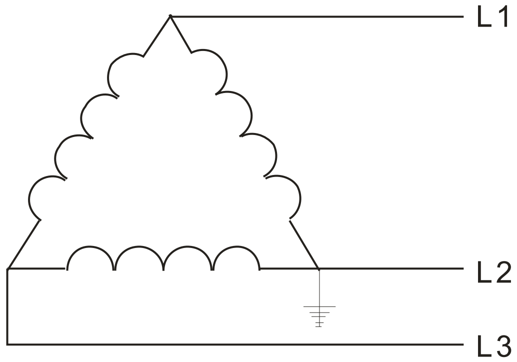
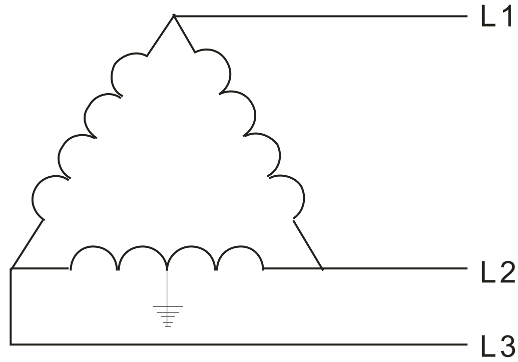
☑ In situations where EMC is required, check for excess electromagnetic radiation affecting nearby low-voltage circuits. In some situations, the adapter and cable naturally provide enough suppression. If in doubt, install an extra electrostatic shielded cable on the power supply side between the main circuit and the control terminals to increase shielding.

☑ Do not install an external RFI / EMC filter. The external EMC filter passes through a filter capacitor and connects power input to the ground. This is very dangerous and damages the motor drive.

Asymmetric Ground System (Corner Grounded TN Systems)

Caution: Do not remove the RFI jumper while power to the input terminal of the drive is ON.

In the following four situations, the RFI jumper must be removed. This is to prevent the system from grounding through the RFI and filter capacitor and damaging the drive.

<table>
<tr><th colspan="2">You must remove the RFI jumper for an asymmetric ground system</th></tr>
<tr><td>1. Grounding at a corner in a triangle configuration

</td><td>2. Grounding at a midpoint in a polygonal configuration

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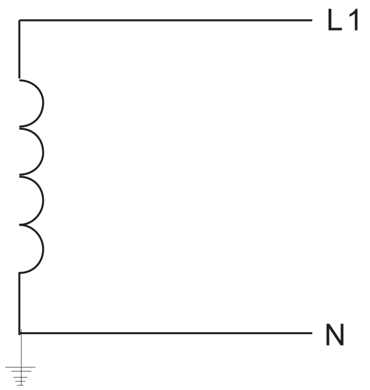
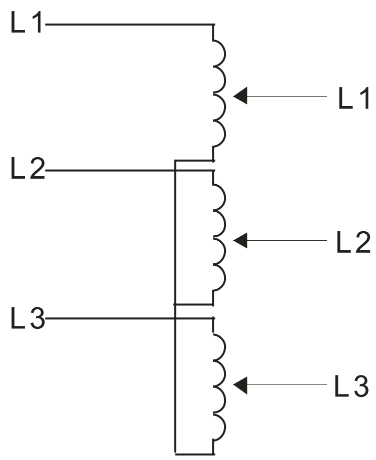
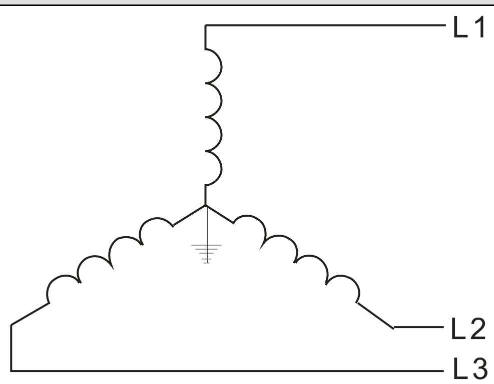
<tr><td>3. Grounding at one end in a single-phase configuration

</td><td>4. No stable neutral grounding in a three-phase autotransformer configuration

</td></tr>
<tr><th colspan="2">You can use the RFI jumper for a symmetrical grounding power system</th></tr>
<tr><td>In a situation with a symmetrical grounding power system, you can use the RFI jumper to maintain the effect of the built-in EMC filter and surge absorber. For example, the diagram on the right is a symmetrical grounding power system.</td><td>
</td></tr>
</table>

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Chapter 2 Dimensions

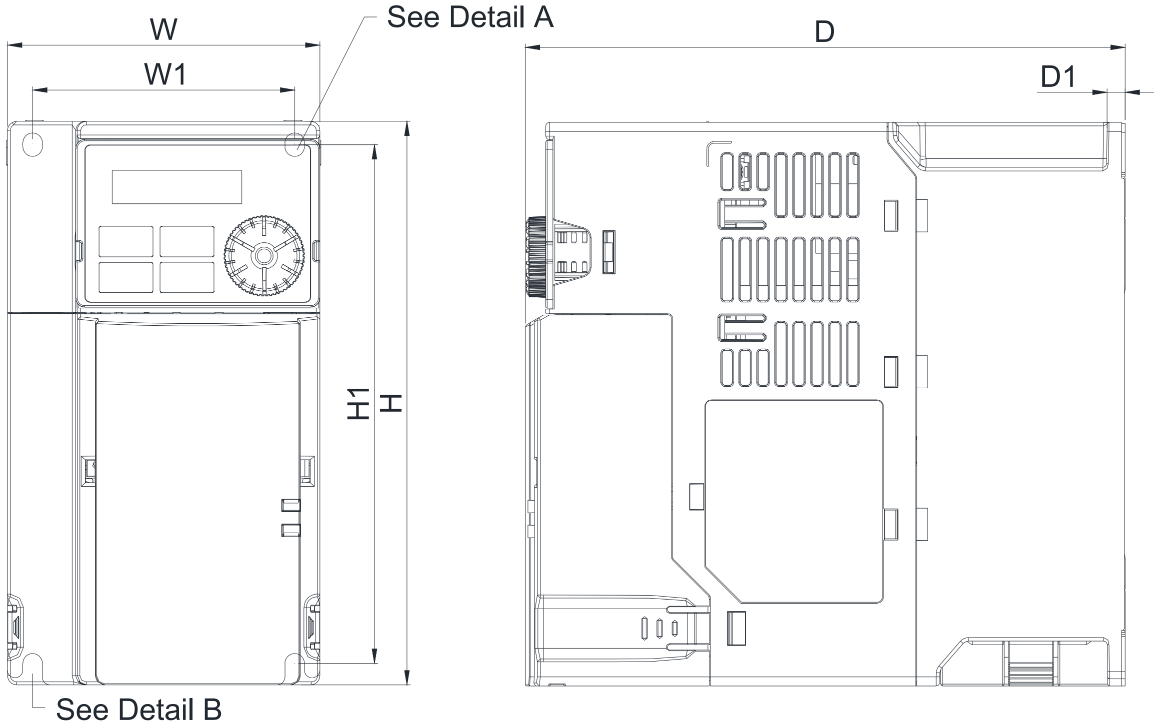
2-1 Frame C

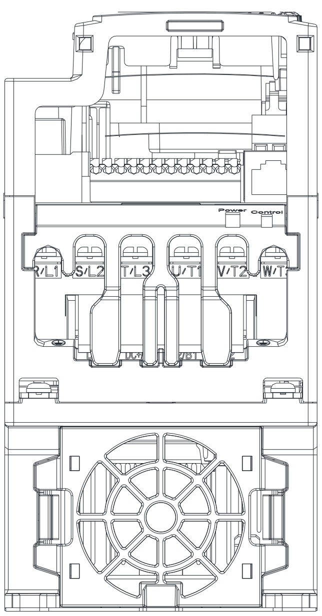
C1: VFD11AMH23ANSLA; VFD17AMH23ANSLA; VFD9A0MH43ANSLA

C2: VFD9A0MH43AFSLA

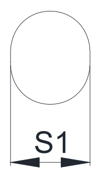
Unit: mm (inch)

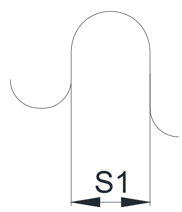
Frame	W	H	D	W1	H1	D1	S1
C1	87.0 (3.43)	157.0 (6.18)	167.0 (6.57)	73.0 (2.87)	144.5 (5.69)	5.0 (0.20)	5.5 (0.22)
C2	87.0 (3.43)	157.0 (6.18)	194.0 (7.64)	73.0 (2.87)	144.5 (5.69)	5.0 (0.20)	5.5 (0.22)





Detail A (Mounting Hole)





Detail B (Mounting Hole)

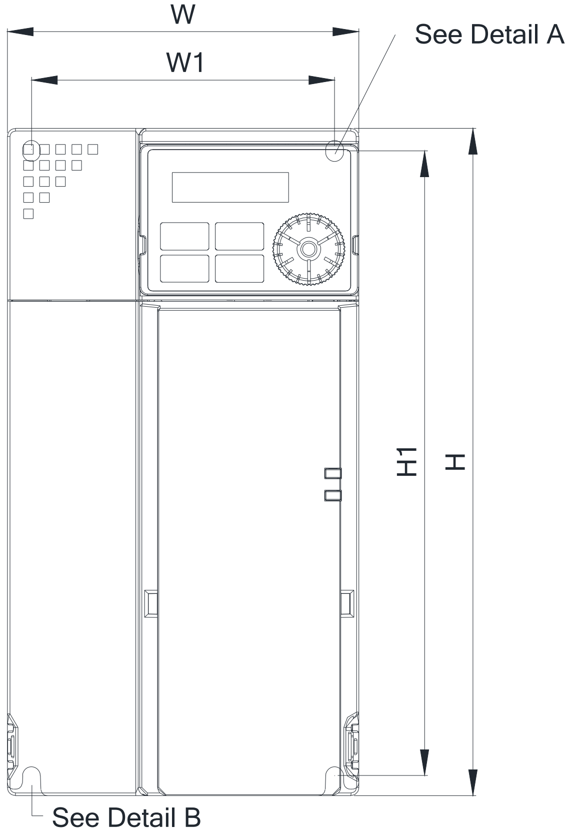
2-2 Frame D

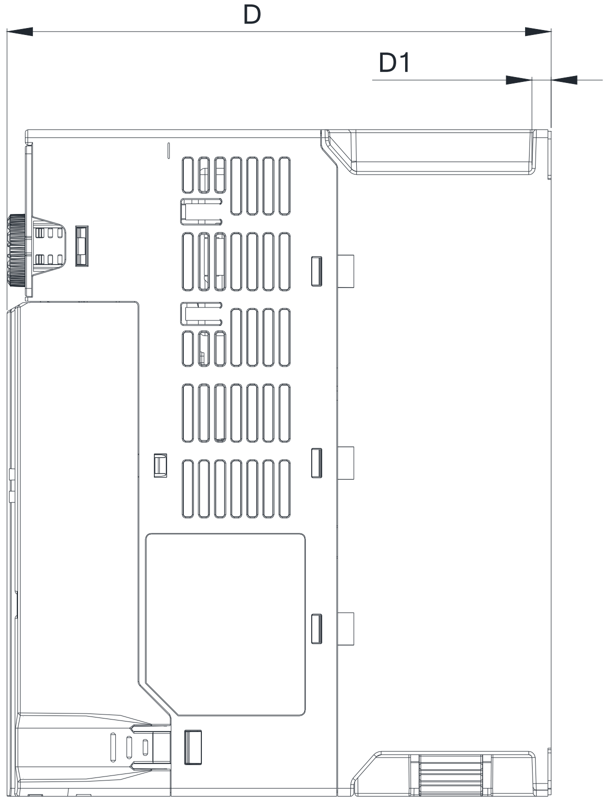
D1: VFD25AMH23ANSLA; VFD13AMH43ANSLA; VFD17AMH43ANSLA

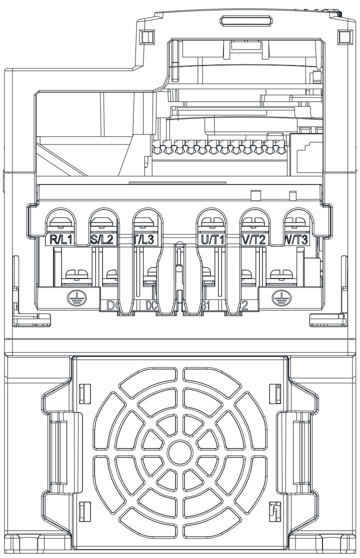
D2: VFD13AMH43AFSLA; VFD17AMH43AFSLA

Unit: mm (inch)

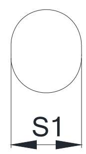
Frame	W	H	D	W1	H1	D1	S1
D1	109.0 (4.29)	207.0 (8.15)	169.0 (6.65)	94.0 (3.70)	193.8 (7.63)	6.0 (0.24)	5.5 (0.22)
D2	109.0 (4.29)	207.0 (8.15)	202.0 (7.95)	94.0 (3.70)	193.8 (7.63)	6.0 (0.24)	5.5 (0.22)

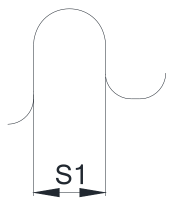






Detail A (Mounting Hole)





Detail B (Mounting Hole)

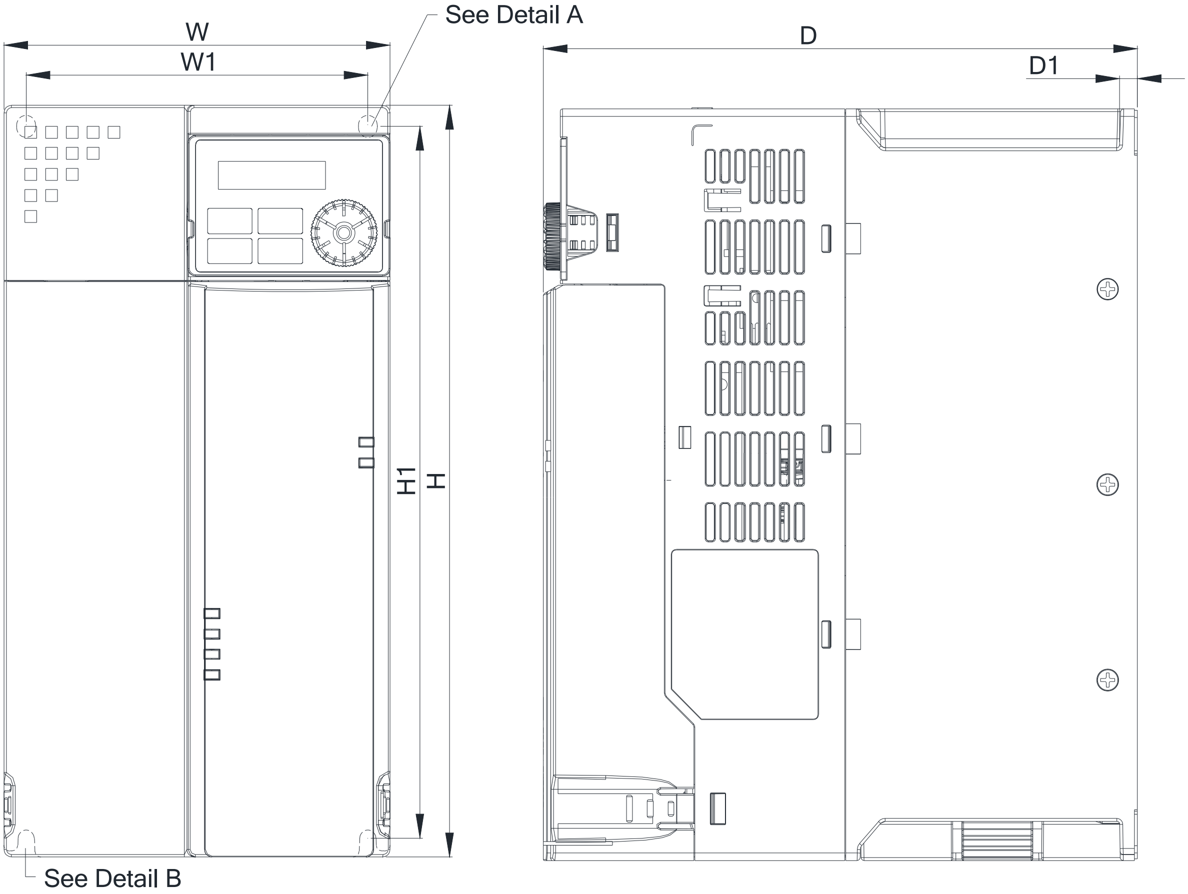
2-3 Frame E

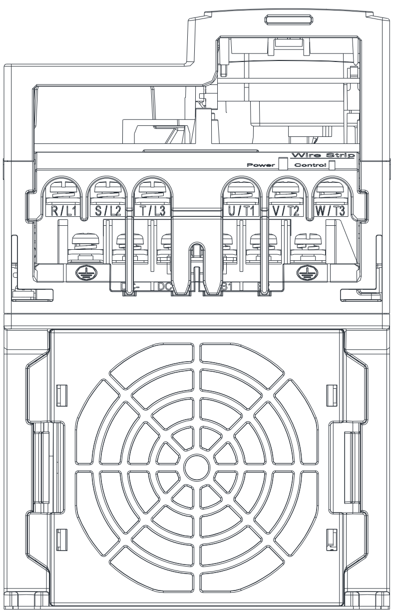
E1: VFD33AMH23ANSLA; VFD49AMH23ANSLA; VFD25AMH43ANSLA; VFD32AMH43ANSLA

E2: VFD25AMH43AFSLA; VFD32AMH43AFSLA

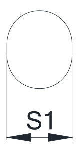
Unit: mm (inch)

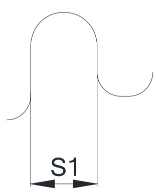
Frame	W	H	D	W1	H1	D1	S1
E1	130.0 (5.12)	250.0 (9.84)	200.0 (7.87)	115.0 (4.53)	236.8 (9.32)	6.0 (0.24)	5.5 (0.22)
E2	130.0 (5.12)	250.0 (9.84)	234.0 (9.21)	115.0 (4.53)	236.8 (9.32)	6.0 (0.24)	5.5 (0.22)





Detail A (Mounting Hole)





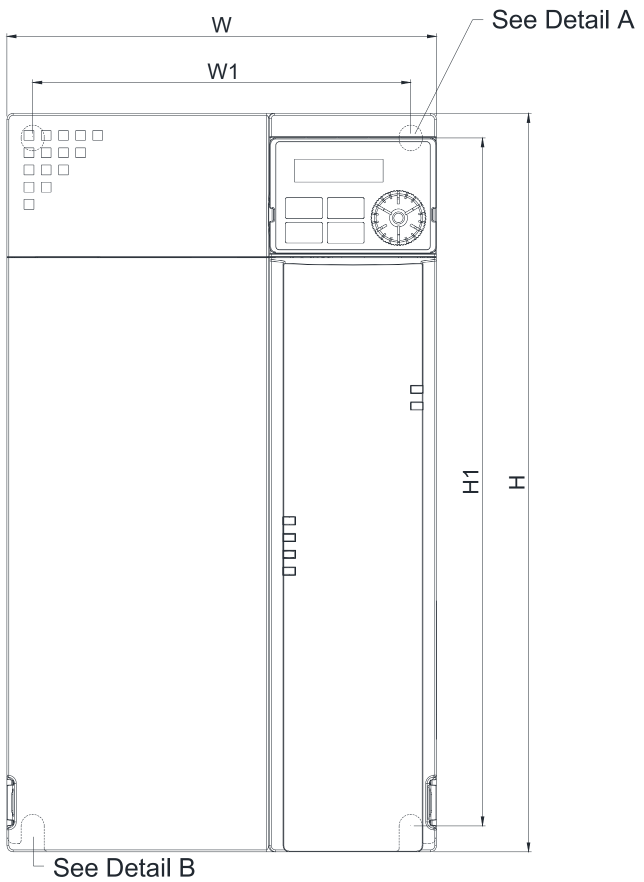
Detail B (Mounting Hole)

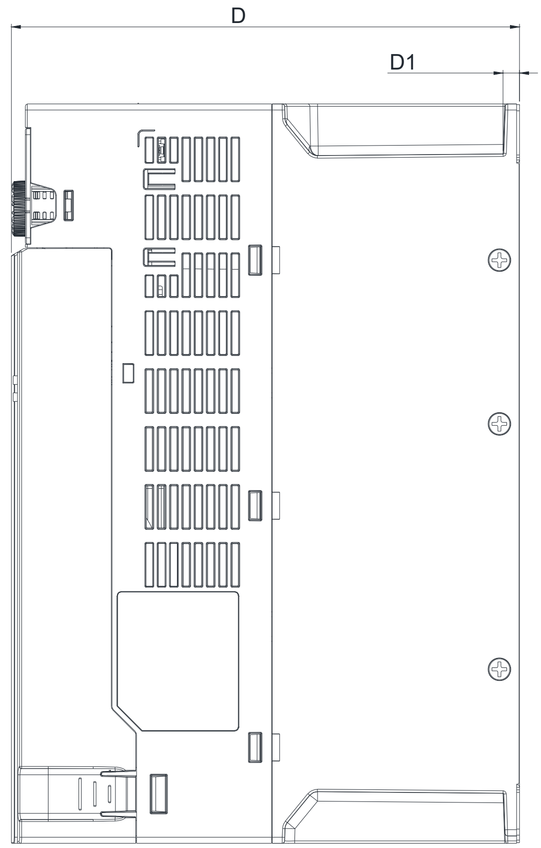
2-4 Frame F

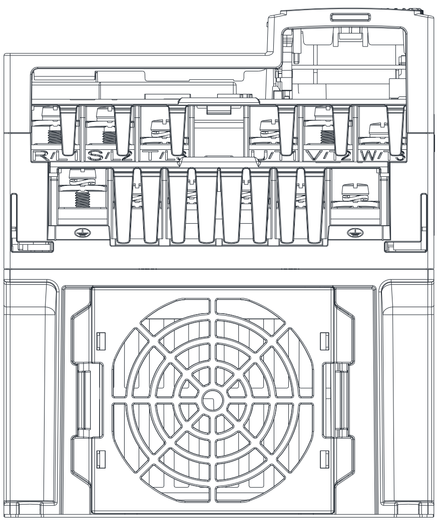
F1: VFD65AMH23ANSLA

Unit: mm (inch)

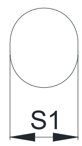
Frame	W	H	D	W1	H1	D1	S1
F1	175.0 (6.89)	300.0 (11.81)	207.0 (8.15)	154.0 (6.06)	279.5 (11.00)	6.5 (0.26)	8.4 (0.33)

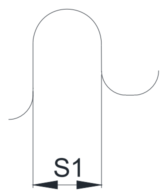






Detail A (Mounting Hole)





Detail B (Mounting Hole)

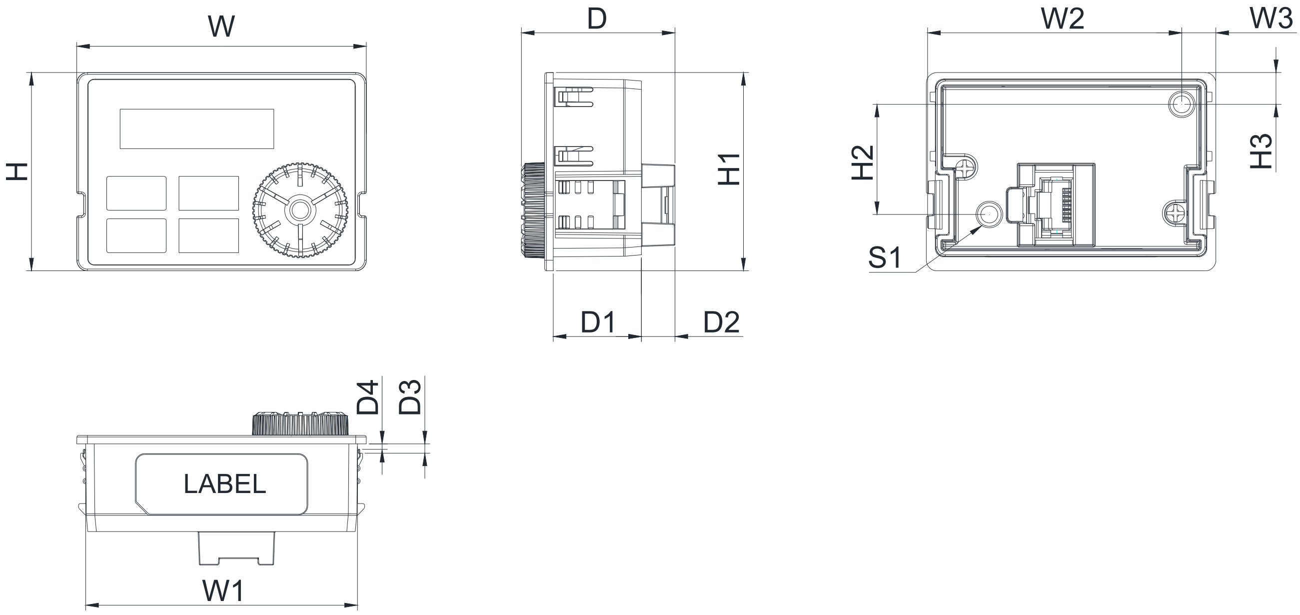
2-5 Digital Keypad

KPMH-LC01

Unit: mm (inch)

W	W1	W2	W3	H	H1	H2
68.0 (2.67)	63.8 (2.51)	45.2 (1.78)	8.0 (0.31)	46.8 (1.84)	42.0 (1.65)	26.0 (1.02)

H3	D	D1	D2	D3	D4	S1
7.5 (0.30)	36.1 (1.41)	22.7 (0.89)	7.9 (0.30)	2.2 (0.09)	1.3 (0.05)	M3*0.5(2X)



Chapter 3 Installation

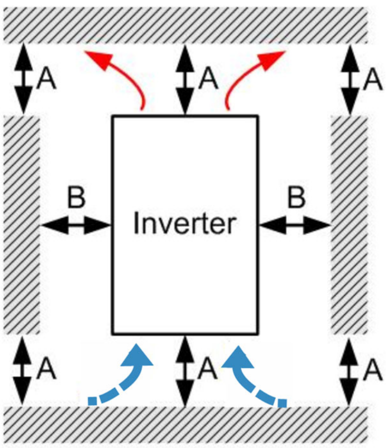
3-1 Mounting Clearance

- ☑ Prevent fiber particles, scraps of paper, shredded wood, sawdust, metal particles, etc. from adhering to the heat sink.
- ☑ Install the AC motor drive in a metal cabinet. When installing one drive below another one, use a metal separator between the AC motor drives to prevent mutual heating and to prevent the risk of accidental fire.
- ☑ Install the AC motor drive in Pollution Degree 2 environments only: normally only non-conductive pollution occurs and temporary conductivity caused by condensation is expected.
- ☑ To ensure the environment to install drives is in Pollution Degree 2, the drives should be installed in an IP54 cabinet or in a pollution-controlled environment. Pollution Degree 2 (IEC / EN 60664-1) is that temporary electric conduction may occur when dew forms, electrical equipment in control panel and thermostatic chamber just causes non-conductive pollution.

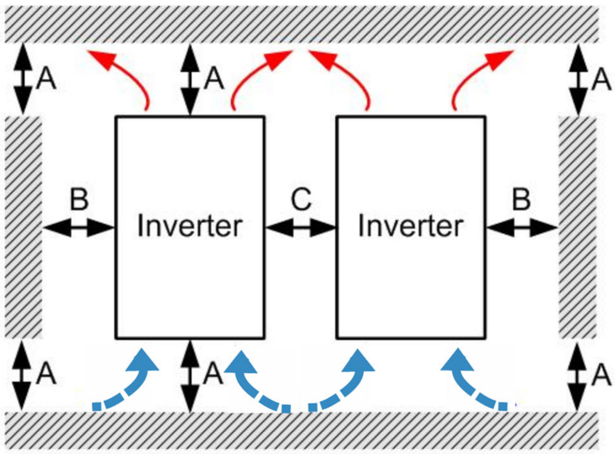
The following figures are for instruction, and the actual drives shall prevail.

Airflow direction: ← inflow ← outflow ↔ distance

Single drive installation



Side-by-side horizontal installation



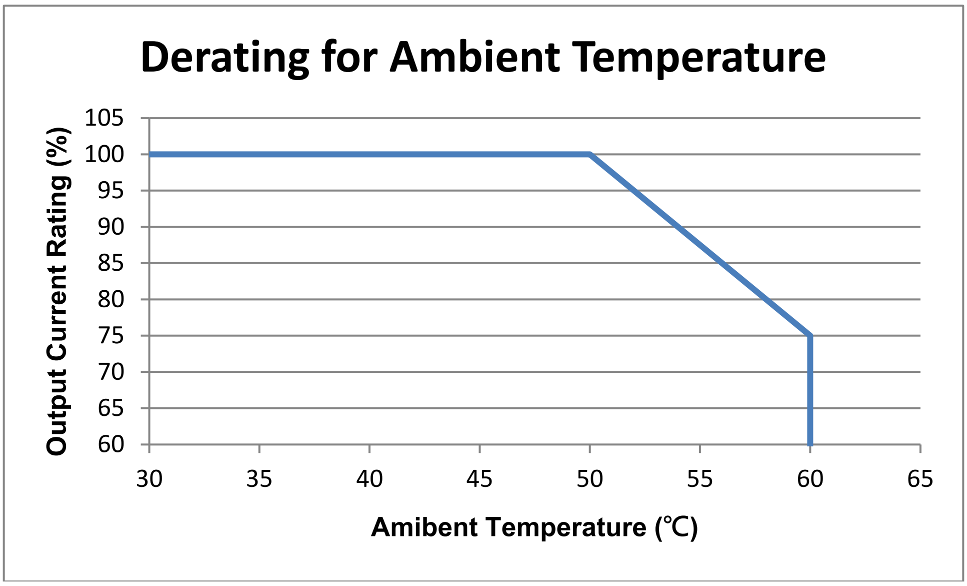
Minimum mounting clearance

Installation method	A (mm)	B (mm)	C (mm)	Ambient temperature (°C)	
				Max. (Without derating)	Max. (Derating)
Single drive installation	50	30	-	50	60
Side-by-side horizontal installation	50	30	30	50	60
Zero stack installation	50	30	0	40	50

NOTE: The minimum mounting clearances A–C in the table above apply to AC motor drives installation. Failing to follow the minimum mounting clearances may cause the fan to malfunction and cause heat dissipation problems.

3-2 Airflow and Power Dissipation

Frame	Airflow rate for cooling			Power Dissipation		
	Model No.	Flow Rate (Unit: cfm)	Flow Rate (Unit: m^3 / hr)	Loss External (Heat sink, unit: W)	Internal (Unit: W)	Total (Unit: W)
C	VFD11AMH23ANSLA	16.0	27.2	76.0	30.7	106.7
	VFD17AMH23ANSLA			108.2	40.1	148.3
	VFD9A0MH43ANSLA VFD9A0MH43AFSLA			93.1	42	135.1
D	VFD25AMH23ANSLA	23.4	39.7	192.8	53.3	246.1
	VFD13AMH43ANSLA VFD13AMH43AFSLA			132.8	39.5	172.3
	VFD17AMH43ANSLA VFD17AMH43AFSLA			164.7	55.8	220.5
E	VFD33AMH23ANSLA	53.7	91.2	244.5	79.6	324.1
	VFD49AMH23ANSLA			374.2	86.2	460.4
	VFD25AMH43ANSLA VFD25AMH43AFSLA			234.5	69.8	304.3
	VFD32AMH43ANSLA VFD32AMH43AFSLA			319.8	74.3	394.1
F	VFD65AMH23ANSLA	67.9	115.2	492.0	198.2	690.2



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Chapter 4 Wiring

After removing the front cover, verify that the power and control terminals are clearly noted. Read the following precautions before wiring.

DANGER

☑ **Turn off the AC motor drive power** before doing any wiring. A charge with hazardous voltages may remain in the DC bus capacitors even after the power has been turned off for a short time. Measure the remaining voltage with a DC voltmeter on +1/DC+ and DC- before doing any wiring. For your safety, do not start wiring before the voltage drops to a safe level (less than 25 V_{DC}). Installing wiring with a residual voltage may cause injuries, sparks and short circuits.

☑ Only qualified personnel familiar with AC motor drives are allowed to perform installation, wiring and commissioning. Make sure the power is turned off before wiring to prevent electric shocks.

☑ Make sure that power is only applied to the R/L1, S/L2 and T/L3 terminals. Failure to comply may result in damage to the equipment. The voltage and current must be in the range indicated on the nameplate (refer to Section 1-1 Nameplate Information for details).

☑ All units must be grounded directly to a common ground terminal to prevent damage from a lightning strike or electric shock and reduce noise interference.

☑ Tighten the screws of the main circuit terminals to prevent sparks caused by screws loosened due to vibration.

CAUTION

☑ For your safety, choose wires that comply with local regulations when wiring.

☑ Check the following items after you finish the wiring:

1. Are all connections correct?
2. Are there any loose wires?
3. Are there any short circuits between the terminals or to ground?

4-1 System Wiring Diagram

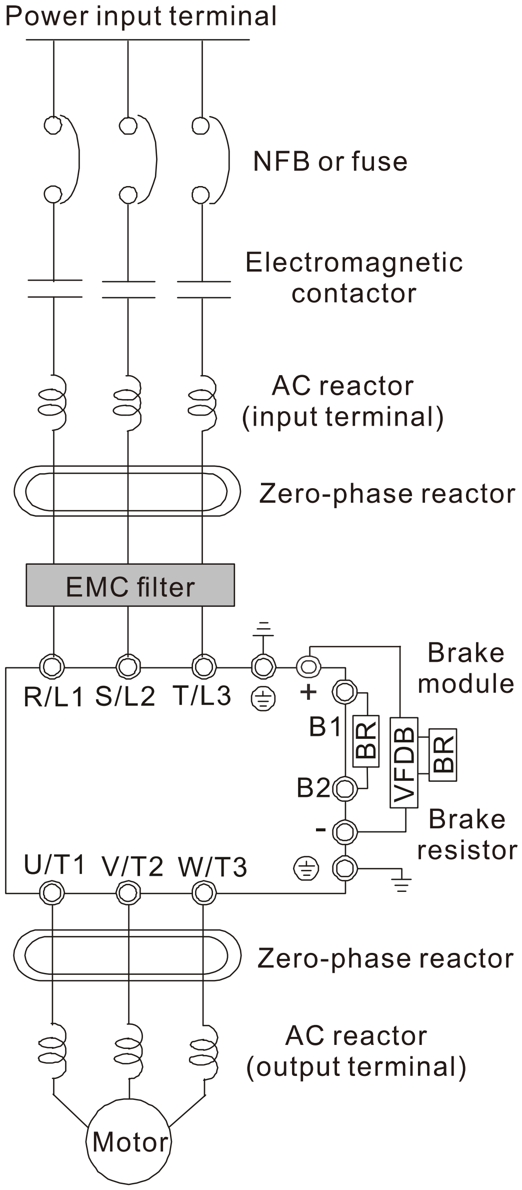


Figure 4-1

NOTE:
Refer to Section 4-2 Wiring Diagram for detailed wiring information.

Power input terminal	Supply power according to the rated power specifications indicated in the manual (refer to Chapter 9 Specification).
NFB or fuse	There may be a large inrush current during power on. Refer to Section 7-2 NFB to select a suitable NFB or Section 7-3 Fuse Specification Chart.
Electromagnetic contactor	Switching the power ON/OFF on the primary side of the electromagnetic contactor can turn the drive ON/OFF, but frequent switching can cause machine failure. Do not switch ON/OFF more than once an hour. Do not use the electromagnetic contactor as the power switch for the drive; doing so shortens the life of the drive.
AC reactor (input terminal)	When the mains power supply capacity is greater than 500 kVA, or when it switches into the phase capacitor, the instantaneous peak voltage and current generated may destroy the internal circuit of the drive. It is recommended that you install an input side AC reactor in the drive. This also improves the power factor and reduces power harmonics. The wiring distance should be within 10 m. Refer to Section 7-4 AC / DC Reactor for details. Refer to Chapter 7-4.
Zero phase reactor	Used to reduce radiated interference, especially in environments with audio devices, and reduce input and output side interference. The effective range is AM band to 10 MHz. Refer to Section 7-5 Zero Phase Reactors for details.
EMC filter	Can be used to reduce electromagnetic interference. Refer to Section 7-6 EMC Filter for details.
Brake module & Brake resistor (BR)	Used to shorten the deceleration time of the motor. Refer to Section 7-1 Brake Resistors and Brake Units Used in AC Motor Drives for details.
AC reactor (output terminal)	The motor cable length affects the size of the reflected wave on the motor end. It is recommended that you install an AC output reactor when the motor wiring length exceeds the value listed in Section 7-4.

Table 4-1

4-2 Wiring

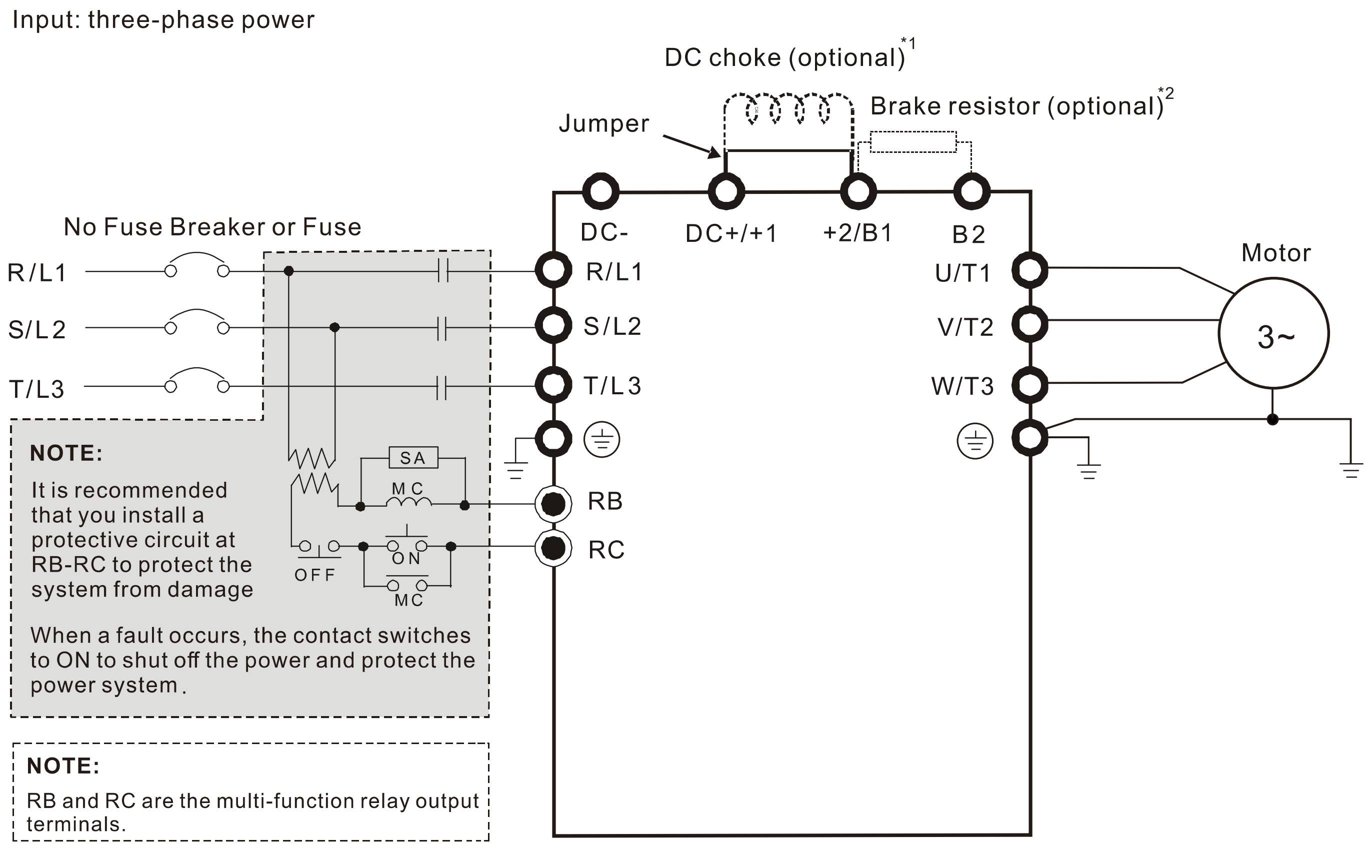


Figure 4-2

*1 Refer to Section 7-4 AC / DC Reactor for more details about the specifications of DC reactor.

*2 Refer to Section 7-1 Brake Resistors and Brake Units Used in AC Motor Drives for more details about the specifications of brake resistor.

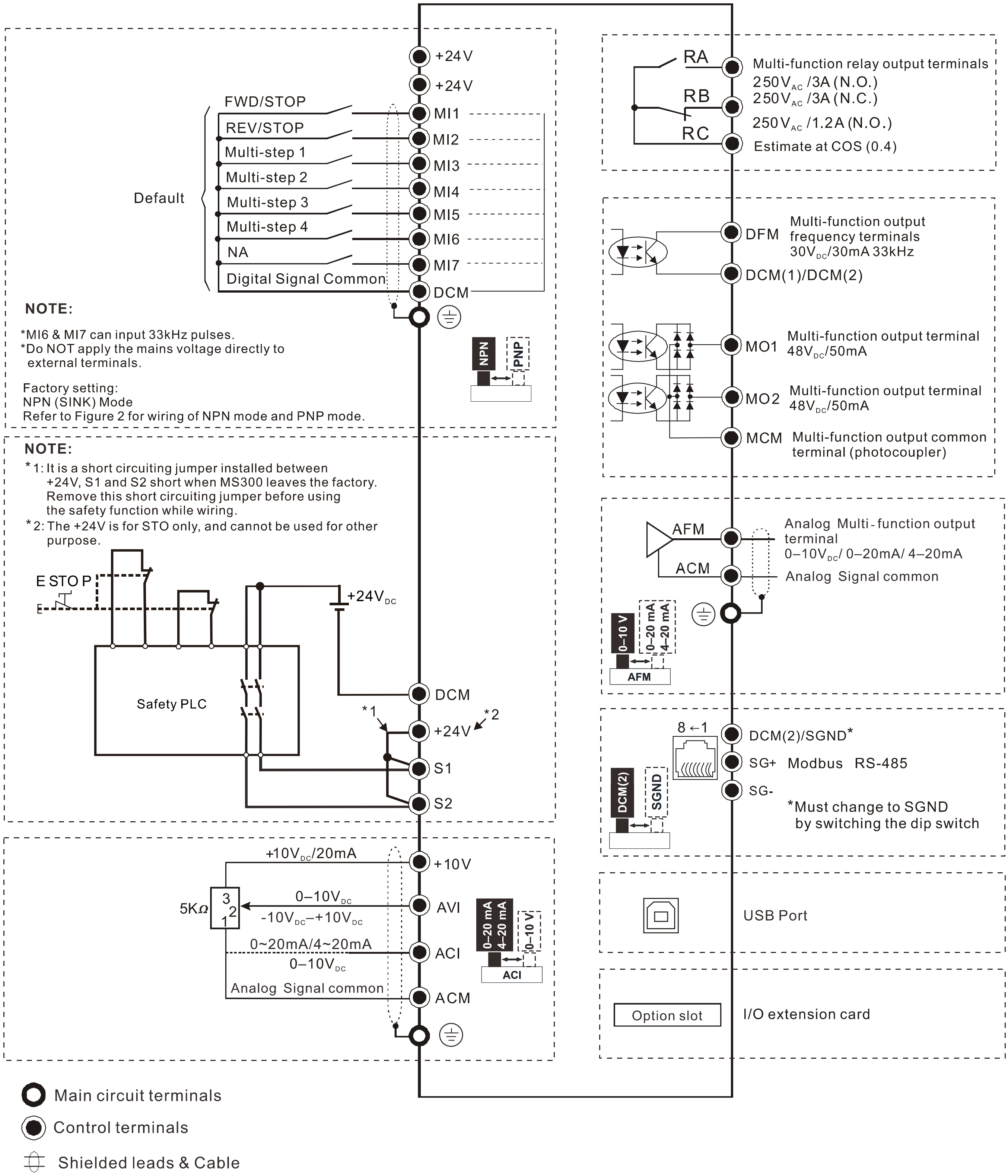

+24V
+24V
FWD/STOP
REV/STOP
Multi-step 1
Multi-step 2
Multi-step 3
Multi-step 4
NA
Digital Signal Common
Default
MI1
MI2
MI3
MI4
MI5
MI6
MI7
DCM
NOTE:
*MI6 & MI7 can input 33kHz pulses.
*Do NOT apply the mains voltage directly to external terminals.
Factory setting:
NPN (SINK) Mode
Refer to Figure 2 for wiring of NPN mode and PNP mode.
NPN
PNP
NOTE:
*1: It is a short circuiting jumper installed between +24V, S1 and S2 short when MS300 leaves the factory. Remove this short circuiting jumper before using the safety function while wiring.
*2: The +24V is for STO only, and cannot be used for other purpose.
E STO P
+24V DC
Safety PLC
DCM
*1
*2
+24V
S1
S2
+10V DC/20mA
+10V
5KΩ
3
2
1
0–10V DC
-10V DC–+10V DC
AVI
0~20mA/4~20mA
0–10V DC
ACI
Analog Signal common
ACM
0–20 mA
4–20 mA
0–10 V
ACI
RA
RB
RC
Multi-function relay output terminals
250V AC /3A (N.O.)
250V AC /3A (N.C.)
250V AC /1.2A (N.O.)
Estimate at COS (0.4)
DFM
Multi-function output frequency terminals
30V DC/30mA 33kHz
DCM(1)/DCM(2)
MO1
Multi-function output terminal
48V DC/50mA
MO2
Multi-function output terminal
48V DC/50mA
MCM
Multi-function output common terminal (photocoupler)
AFM
ACM
Analog Multi-function output terminal
0–10V DC/ 0–20mA/ 4–20mA
Analog Signal common
0–10 V
0–20 mA
4–20 mA
AFM
8←1
DCM(2)/SGND*
SG+
Modbus RS-485
SG-
*Must change to SGND by switching the dip switch
DCM(2)
SGND
USB Port
Option slot
I/O extension card
Main circuit terminals
Control terminals
Shielded leads & Cable

Figure 4-3

SINK (NPN) / SOURCE (PNP) Mode

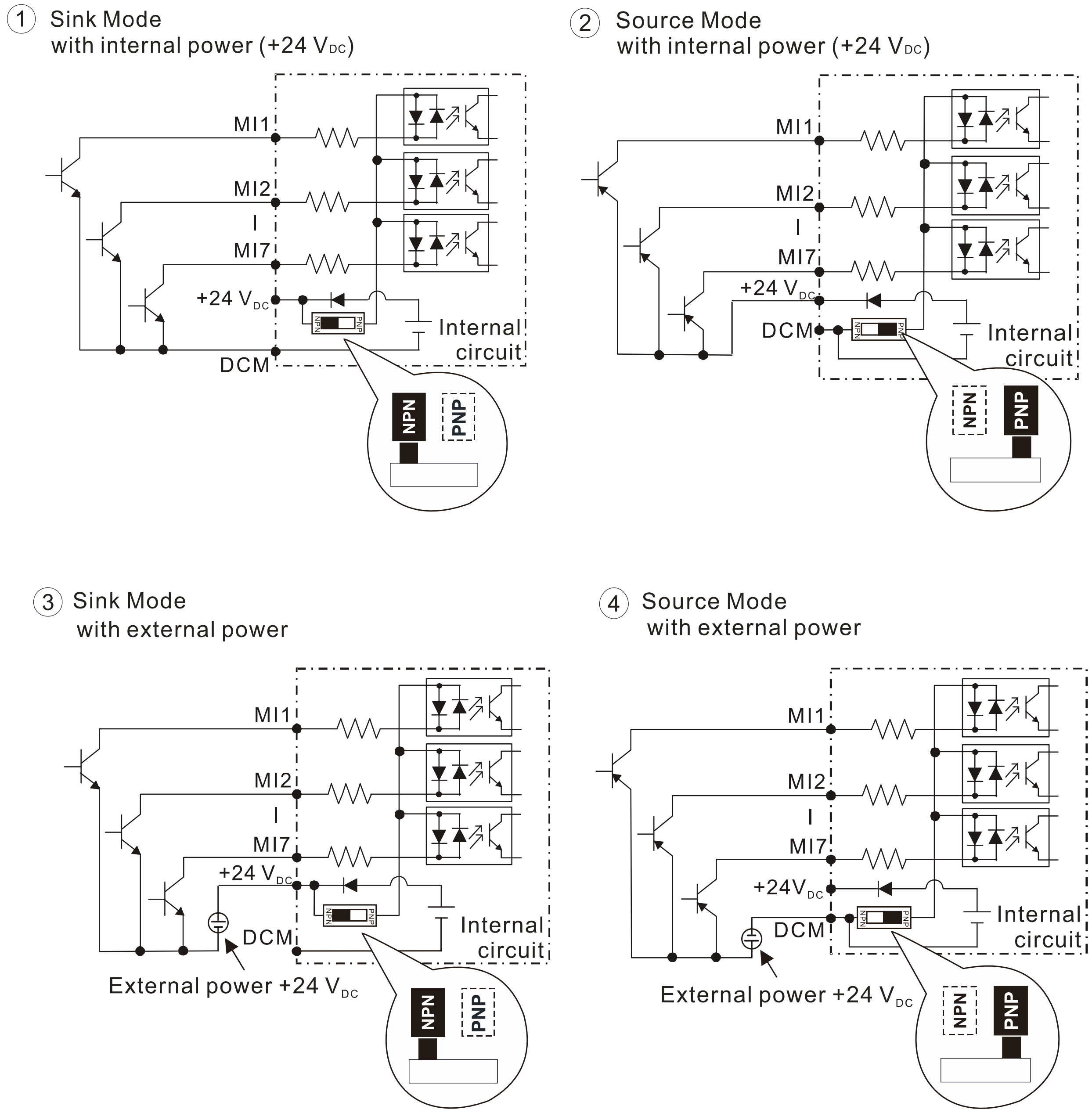
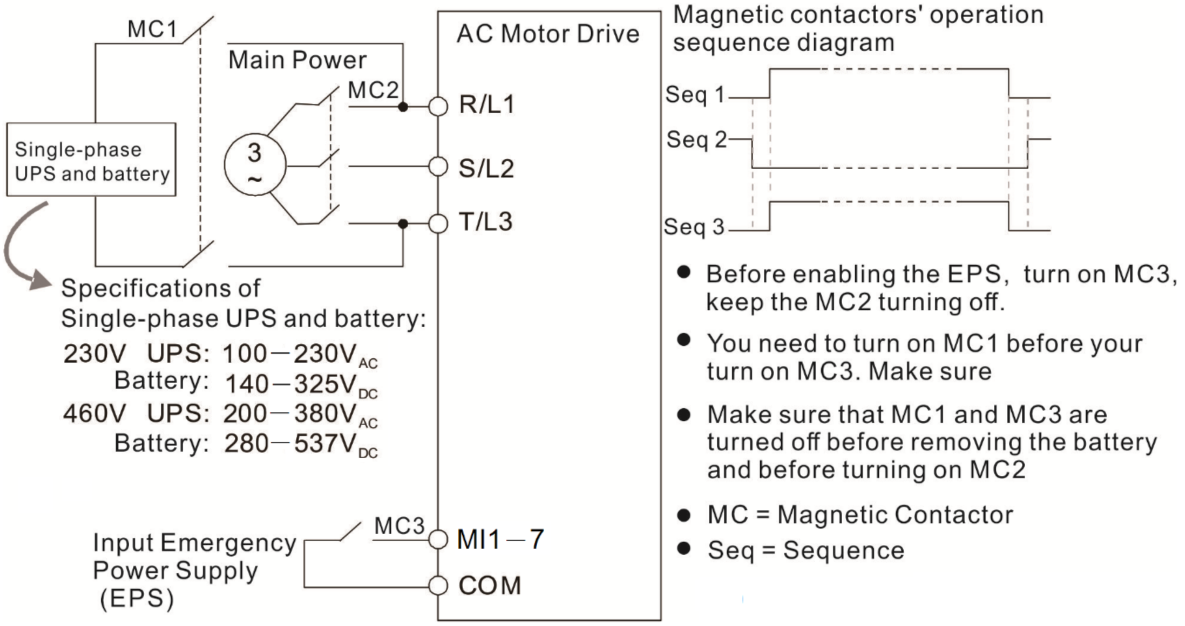
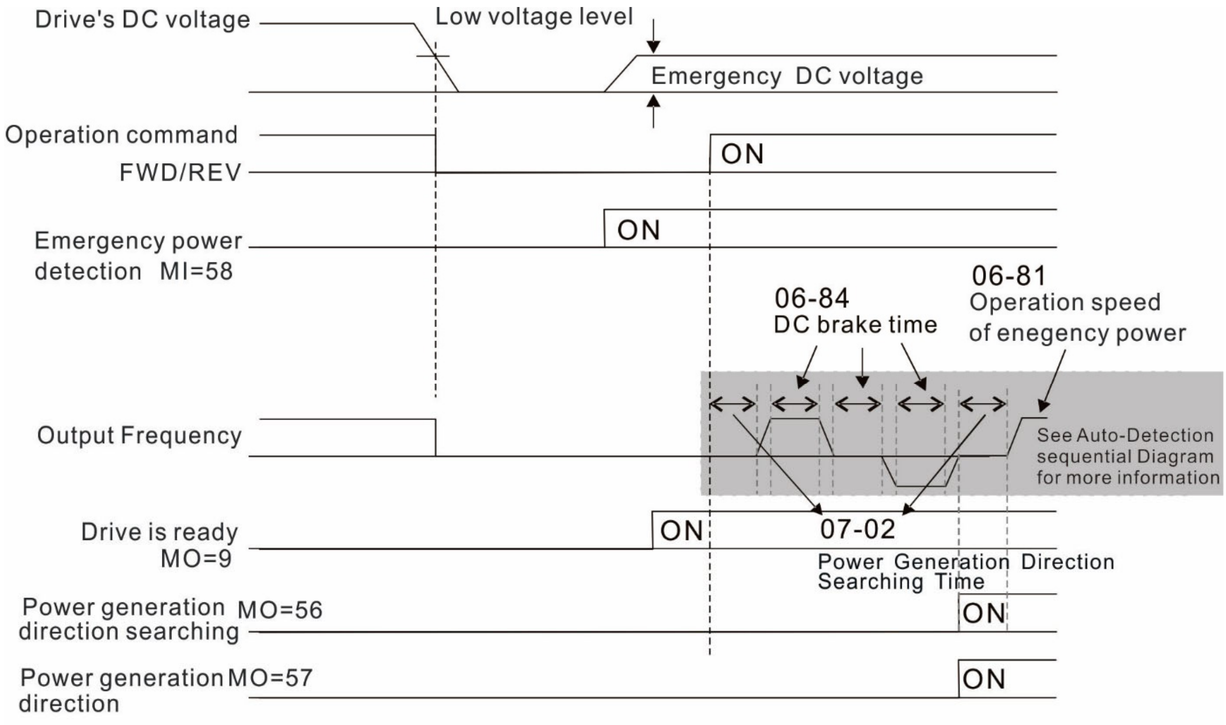


Figure 4-4

Applicable for frame C, D & E:

1. Only the main power can use single-phase UPS or battery.





Sequential Diagram of Elevator's Emergency Power Supply and Power Generating Direction

Notes on Emergency Power Supply (EPS):

1. When the EPS is enabled (MI=58), the cooling fan stop running to prevent voltage decreasing of EPS.
2. When the EPS is enabled, the parameter setting cannot be saved. The system will lose its parameter setting after it is repower on.
3. When the EPS is enabled, the operating speed follows the setting of Pr.06-81.
4. When the EPS is enabled, low voltage protection and phase lose protection are disabled.
5. When the EPS is enabled, the DC-Bus voltage followa the setting of Pr.06-80.

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Chapter 5 Main Circuit Terminals

DANGER

- ☑ Tighten the screws in the main circuit terminal to prevent sparks caused by screws loosened due to vibration.
- ☑ If necessary, use an inductive filter only at the motor output terminals U/T1, V/T2, W/T3 of the AC motor drive. DO NOT use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.
- ☑ DO NOT connect brake resistors directly to +1/DC+ to DC-, +2/B1 to DC- to prevent damage to the drive.
- ☑ Ensure proper insulation of the main circuit wiring in accordance with the relevant safety regulations.

CAUTION

Main power terminals

- ☑ R/L1, S/L2 and T/L3 have no phase-sequence requirement; they can be connected in any sequence.
- ☑ Add a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunctions when the AC motor drive protection function activates. Both ends of the MC should have an R-C surge absorber.
- ☑ Use voltage and current within the specifications in Chapter 09. Refer to Chapter 09 Specifications for details.
- ☑ When using a general GFCI (Ground Fault Circuit Interrupter), select a sensitivity greater than or equal to 200 mA and greater than or equal to 0.1 sec. operation time to avoid nuisance tripping.
- ☑ Use shielded wire or conduit for the power wiring and ground the two ends of the shielding or conduit.
- ☑ DO NOT run and stop the AC motor drives by turning the power ON and OFF. Run and stop the AC motor drives by sending the RUN and STOP commands through the control terminals or the keypad. If you still need to run and stop the AC motor drives by turning the power ON and OFF, do so no more often than ONCE per hour.
- ☑ To comply with UL standards, connect the drive to a three-phase three-wire or three-phase four-wire Wye system type of mains power system.

Output terminals for main circuit

- ☑ Use well-insulated motors to prevent any electric leakage from motors.
- ☑ When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3 respectively, the FWD LED indicator on the digital keypad is ON. This means the AC motor drive executes running forward, and the motor rotates counterclockwise (viewed from the shaft end of the motor, as shown in Figure 5-1).

  On the contrary, when the REV LED indicator lights, the AC motor drive executes running in reverse, and the motor rotates in an opposite direction to Figure 5-1. If the AC motor drive executes running forward but the motor rotates in a reverse direction, exchange any two of the U/T1, V/T2 and W/T3 motor leads.

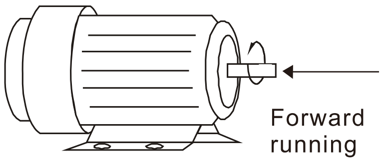


Figure 5-1

Terminals for connecting DC reactor, external brake resistor and DC circuit

☑ Use the terminals, as shown in Figure 5-2, to connect a DC reactor to improve the power factor and reduce harmonics. A jumper is connected to these terminals at the factory. Remove the jumper before connecting the DC reactor.

☑ Tighten the jumper if a DC reactor is not connected and DC+/+1 and +2/B1 terminals are used for common DC bus or brake resistors in order to prevent the AC motor drive from losing power and damage to the terminals. If the jumper is missing due to wiring, refer to the recommended main circuit terminal wire gauge mentioned in Section 5-2 to short-circuit the DC+/+1 and +2/B1 terminals.

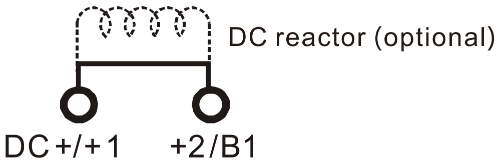


Figure 5-2

☑ Install an external brake resistor for applications in frequent deceleration to stop, short deceleration time (such as high frequency operation and heavy load operation), too low braking torque, or increased braking torque.

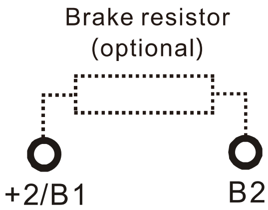


Figure 5-3

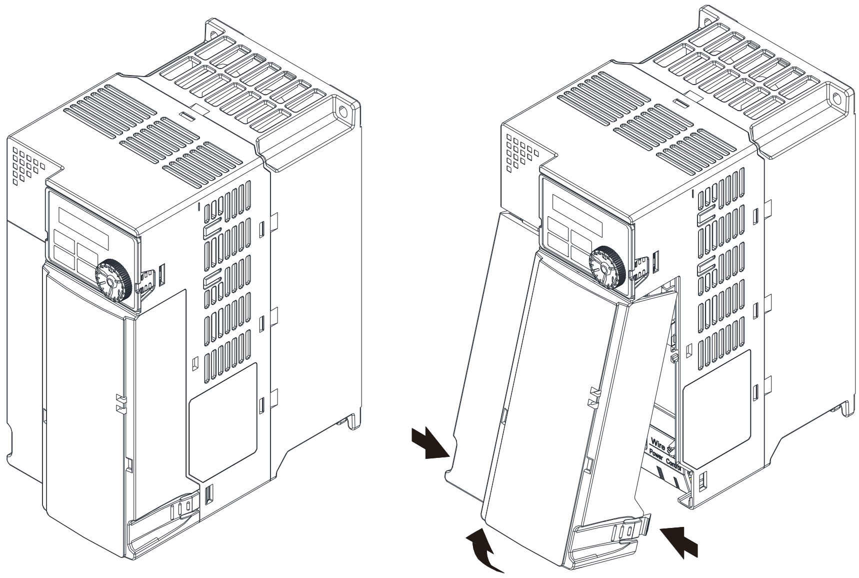
☑ Connect the external brake resistor to +2/B1, B2 terminals of the AC motor drives.

☑ DO NOT connect two ends of the brake resistor directly to DC+/+1 and DC-, +2/B1 to DC- to prevent damage to the drive and to the brake resistor.

☑ When connecting DC+/+1 and DC- in common DC bus applications. Refer to Section 5-2 (Main Circuit Terminal) for the wiring terminal specification and the wire gauge information.

Remove the front cover

- Remove the front cover before wiring the main circuit terminals and control circuit terminals. Remove the cover according to the figure below.
- The example uses the Frame D model. For different frame size models, use the same removing method.



Press the clip on both sides, and take out by rotating.

Figure 5-4

5-1 Main Circuit Diagram

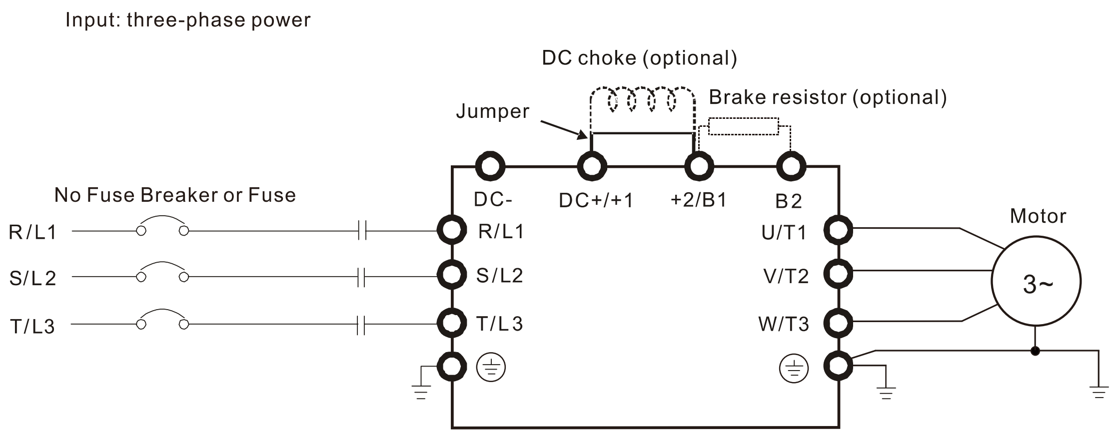


Figure 5-5

Terminals	Descriptions
R/L1, S/L2, T/L3	Mains input terminals three-phase
U/T1, V/T2, W/T3	Motor output terminals for connecting three-phase IM and PM motors
+1, +2	Connections for DC reactor to improve the power factor and harmonics. Remove the jumper when using a DC reactor.
DC+, DC-	Connections for brake unit (VFDB series) Common DC bus
B1, B2	Connections for brake resistor (optional)
⏚	Ground connection, comply with local regulations.

5-2 Main Circuit Terminals

- Use the specified ring lug for main circuit terminal wiring. See Figure 5-6 and Figure 5-7 for ring lug specifications. For other types of wiring, use the wires that comply with the local regulations.
- After crimping the wire to the ring lug (must be UL and CSA approved R/C (YDPU2/8)), install heat shrink tubing rated at a minimum of 600 VAC insulation over the live part. Refer to Figure 5-7.
- Main circuit terminals:
  R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⏚, DC-, DC+/+1, +2/B1, B2

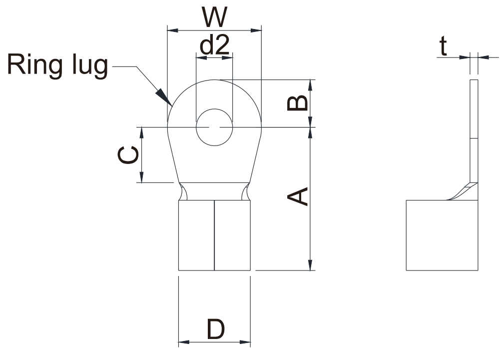


Figure 5-6

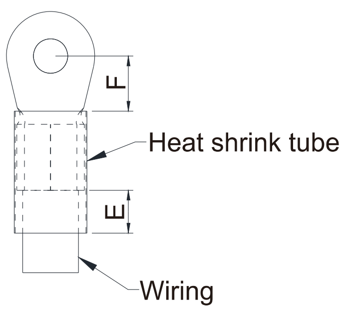


Figure 5-7

Dimensions of Ring Lug

The part # of the ring terminals (produced by K.S. Terminals) in the table below are for reference only. You can buy other ring terminals of your choice to match with different frame sizes.

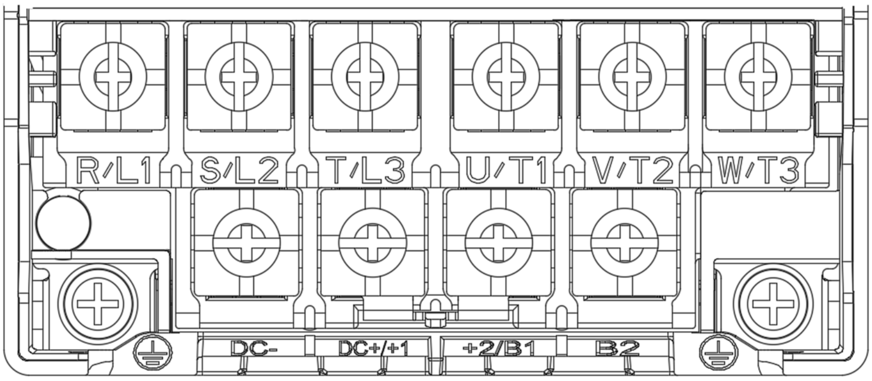
Unit: mm

Frame	AWG*	Vendor P/N	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	t (MAX)
C	12	RNBS5-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	10	RNBS5-4									
	8	RNBS8-4									
D	10	RNBS5-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	8	RNBS8-4									
E	6	RNB14-5	27.1	6.1	10.5	11.5	5.3	13.0	6.5	12.6	1.7
	4	RNBS22-5									
F	2	RNBS38-6	35.0	9.0	13.3	14.0	6.2	13.0	10.0	19.5	1.8

AWG: Refer to the following tables for the wire size specification for models in each frame.

Figure 5-8

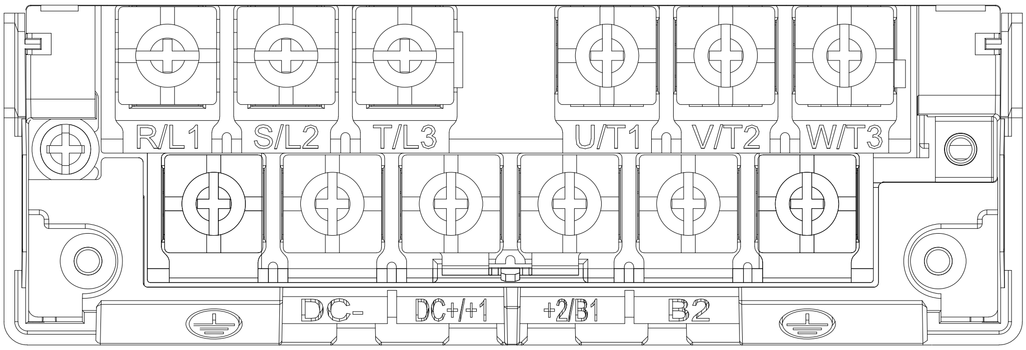
Frame C



- If the installation is in an environment where the ambient temperature is above 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 75°C or 90°C for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

<table>
<tr><th rowspan="2">Models</th><th colspan="3">Main circuit terminals
R/L1, S/L2, T/L3, U/T1, V/T2,
W/T3, DC-, DC+/+1, +2/B1, B2</th><th colspan="3">Terminals
⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Torque (±10%)</th></tr>
<tr><td>VFD11AMH23ANSLA</td><td rowspan="4">10 mm^2
(8 AWG)</td><td>6 mm^2
(10 AWG)</td><td rowspan="4">M4
20 Kg-cm
(17.4 lb-in.)
(1.96 Nm)</td><td>6 mm^2
(10 AWG)</td><td>6 mm^2
(10 AWG)</td><td rowspan="4">M4
20 Kg-cm
(17.4 lb-in.)
(1.96 Nm)</td></tr>
<tr><td>VFD17AMH23ANSLA</td><td>10 mm^2
(8 AWG)</td><td>10 mm^2
(8 AWG)</td><td>10 mm^2
(8 AWG)</td></tr>
<tr><td>VFD9A0MH43ANSLA</td><td rowspan="2">4 mm^2
(12 AWG]</td><td rowspan="2">4 mm^2
(12 AWG)</td><td rowspan="2">4 mm^2
(12 AWG)</td></tr>
<tr><td>VFD9A0MH43AFSLA</td></tr>
</table>

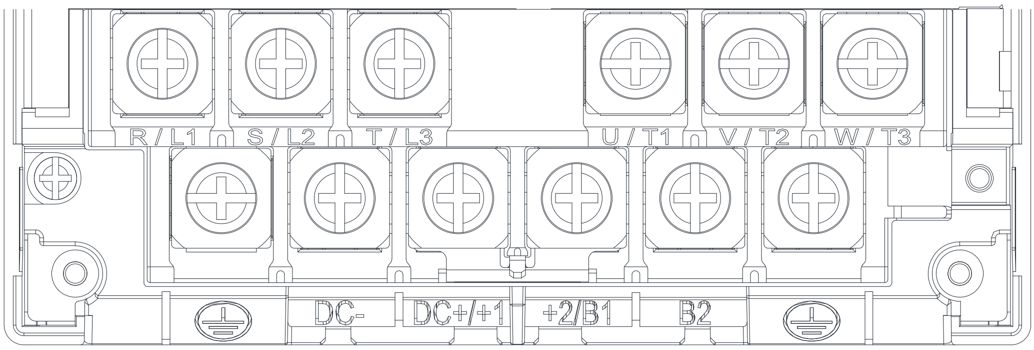
Frame D



- If the installation is in an environment where the ambient temperature is above 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 75°C or 90°C for wiring.
- For VFD25AMH23ANSLA model: If the installation is in an environment where the ambient temperature is above 45°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

<table>
<tr><th rowspan="2">Models</th><th colspan="3">Main circuit terminals
R/L1, S/L2, T/L3, U/T1, V/T2,
W/T3, DC-, DC+/+1, +2/B1, B2</th><th colspan="3">terminals
⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Torque (±10%)</th></tr>
<tr><td>VFD25AMH23ANSLA</td><td rowspan="5">10 mm^2
(8 AWG)</td><td>10 mm^2
(8 AWG)</td><td rowspan="5">M4
20 Kg-cm
(17.4 lb-in.)
(1.96 Nm)</td><td>10 mm^2
(8 AWG)</td><td>10 mm^2
(8 AWG)</td><td rowspan="5">M4
20 Kg-cm
(17.4 lb-in.)
(1.96 Nm)</td></tr>
<tr><td>VFD13AMH43ANSLA</td><td rowspan="2">6 mm^2
(10 AWG)</td><td rowspan="2">6 mm^2
(10 AWG)</td><td rowspan="2">6 mm^2
(10 AWG)</td></tr>
<tr><td>VFD13AMH43AFSLA</td></tr>
<tr><td>VFD17AMH43ANSLA</td><td rowspan="2">10 mm^2
(8 AWG)</td><td rowspan="2">10 mm^2
(8 AWG)</td><td rowspan="2">10 mm^2
(8 AWG)</td></tr>
<tr><td>VFD17AMH43AFSLA</td></tr>
</table>

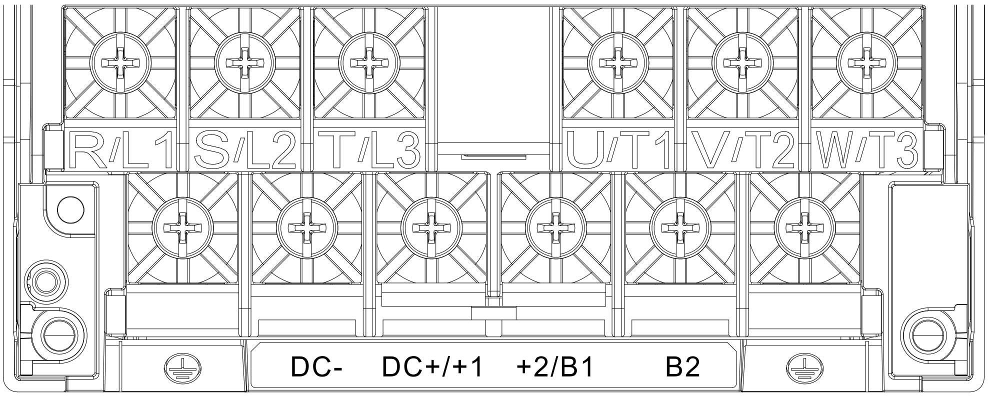
Frame E



- If the installation is in an environment where the ambient temperature is above 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 75°C or 90°C for wiring.
- For VFD33AMH23ANSLA model: If the installation is in an environment where the ambient temperature is above 40°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- For VFD49AMH23ANSLA model: If the installation is in an environment where the ambient temperature is above 35°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- For VFD32AMH43ANSLA, VFD32AMH43AFSLA models: If the installation is in an environment where the ambient temperature is above 45°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.
- ** These drives must be wired with the specified ring lug dimensions.

Models	Main circuit terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2			terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
VFD33AMH23ANSLA	16 mm^2 (6 AWG)	16 mm^2 (6 AWG)	M5 25 Kg-cm (21.7 lb-in.) (2.45 Nm)	16 mm^2 (6 AWG)	16 mm^2 (6 AWG)	M5 25 Kg-cm (21.7 lb-in.) (2.45 Nm)
VFD49AMH23ANSLA**	25 mm^2 (4 AWG)	25 mm^2 (4 AWG)		25 mm^2 (4 AWG)		
VFD25AMH43ANSLA	16 mm^2 (6 AWG)	16 mm^2 (6 AWG)		16 mm^2 (6 AWG)		
VFD25AMH43AFSLA						
VFD32AMH43ANSLA						
VFD32AMH43AFSLA						

Frame F



- For VFD65AMH23ANSLA model: If the installation is in an environment where the ambient temperature is above 35°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Models	Main circuit terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2			terminals ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Torque (±10%)
VFD65AMH23ANSLA	35 mm^2 (2 AWG)	35 mm^2 (2 AWG)	M6 40 Kg-cm (34.7 lb-in.) (3.92 Nm)	35 mm^2 (2 AWG)	16 mm^2 (6 AWG)	M6 40 Kg-cm (34.7 lb-in.) (3.92 Nm)

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Chapter 6 Control Terminals

CAUTION

Analog input terminals (AVI, ACI, ACM)

☑ Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (less than 20 m) with proper grounding. If the noise is inductive, connecting the shield to the ACM terminal can reduce interference.

☑ Use twisted-pair wire for weak analog signals.

☑ If the analog input signals are affected by noise from the AC motor drive, connect a capacitor and a ferrite core as shown the figure below.

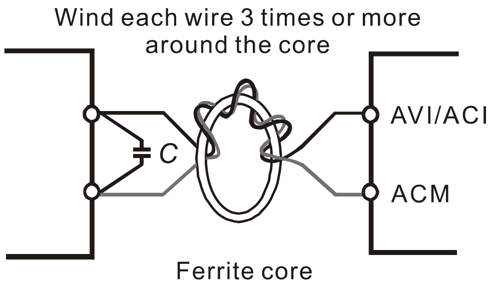


Figure 6-1

Contact input terminals (MI1–MI7, DCM, +24V)

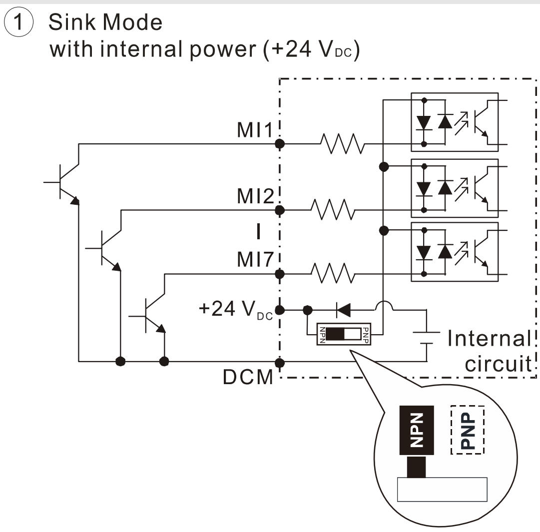


Figure 6-2

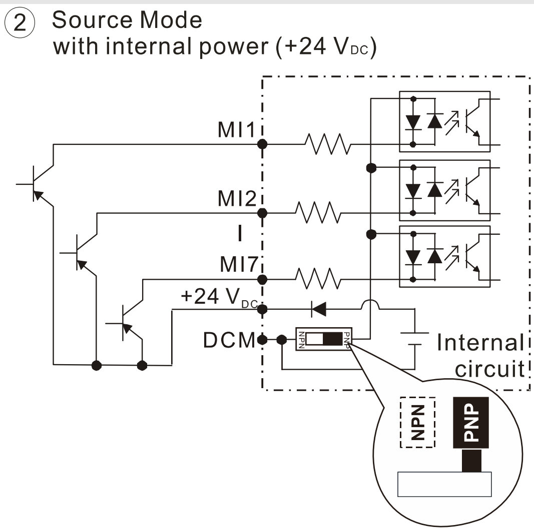


Figure 6-3

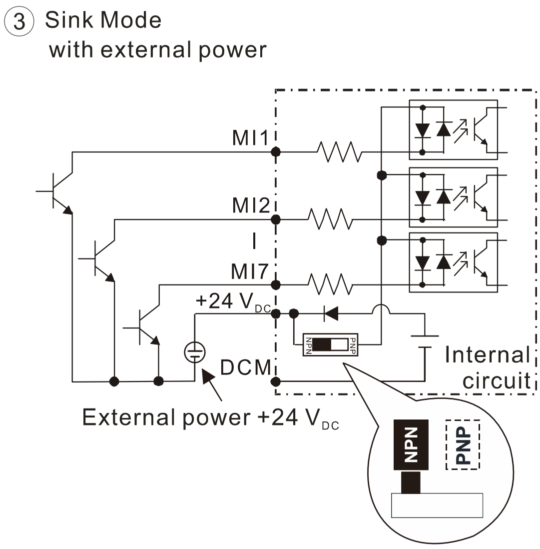


Figure 6-4

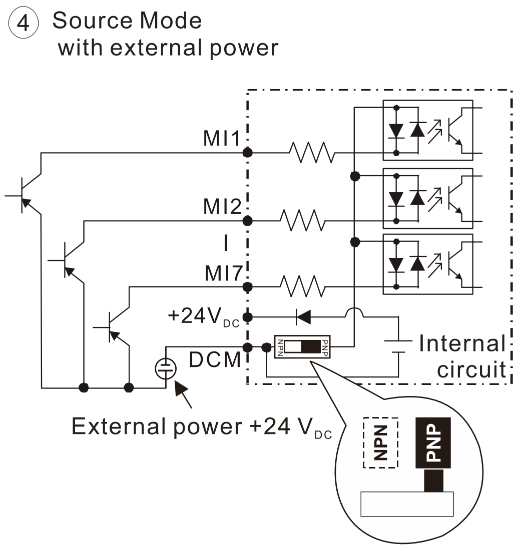


Figure 6-5

	☑ When the photocoupler uses internal power supply, the switch connection for Sink and Source modes shows as Figure 6-2 and Figure 6-3: MI-DCM: Sink mode, MI-+24V: Source mode. **Transistor output terminals (MO1, MO2, MCM)** ☑ Connect the digital outputs to the correct polarity. ☑ When connecting a relay to the digital outputs, connect a surge absorber across the coil and check the polarity.

6-1 Control Terminal Specifications

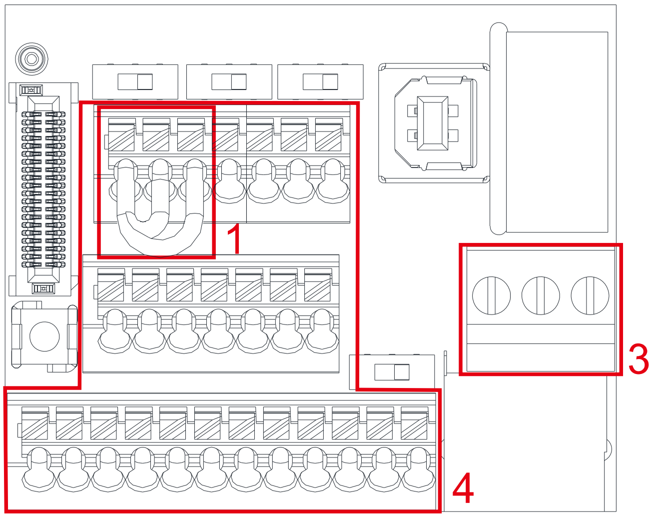


Figure 6-6 Control Terminal Distribution Diagram

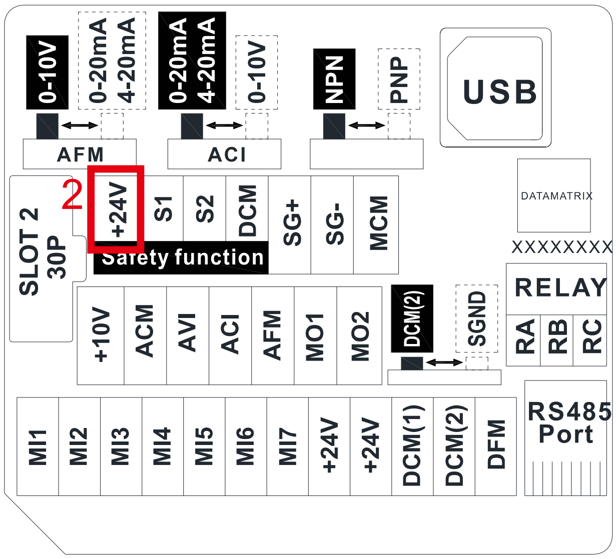


Figure 6-7 Control Terminal Location Map

Wiring precautions:

1. The factory default is +24 V_{DC} / S1 / S2 short-circuited by jumper, as shown in Area 1 in Figure 6-6. Refer to Figure 4-2 in Chapter 4 WIRING for details.
2. Use the +24 V_{DC} power supply of the safety function (as shown in Area 2 in Figure 6-7) for STO only. Do NOT use it for other purposes.
3. The RELAY terminal uses the PCB terminal block (as shown in Area 3 in Figure 6-6):
   - Tighten the wiring with a 3.5 mm (wide) × 0.6 mm (thick) slotted screwdriver.
   - The ideal length of stripped wire at the connection side is 6–7 mm.
   - When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.
4. The Control terminal uses the push-in spring terminal block (as shown in Area 4 in Figure 6-6):
   - When removing wires, use the slotted screwdriver to press down the terminal, and the suggested force is 1.5 kgf.
   - Tighten the wiring with a 2.5 mm (wide) × 0.4 mm (thick) slotted screwdriver.
   - The ideal length of stripped wire at the connection side is 9 mm.
   - When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.

Control Terminals Wiring Specification

Function name	Wiring specification of control terminals	Stripping length (mm)	Max.wire gauge	Min. wire gauge	Torque (±10%)
Repay Terminals	Solid	6－7	1.5mm² (16AWG)	0.2mm² (24AWG)	5 Kg-cm (4.3 Ib-in.) (0.49 Nm)
	Strand				
Control Terminals	Solid	9	0.75mm² (18AWG)	0.25mm² (24AWG)	
	Strand				
	Stranded with ferrules with plastic sleeve	9	0.5mm² (20AWG)		

Table 6-1

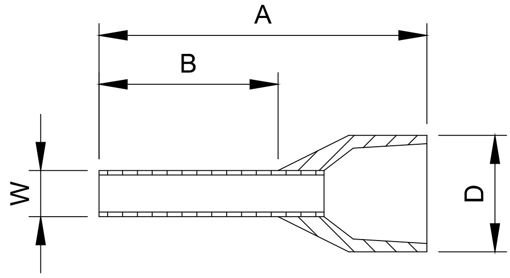
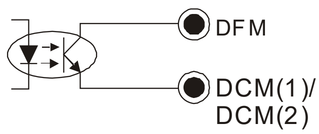


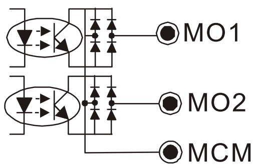
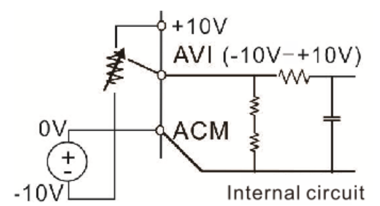
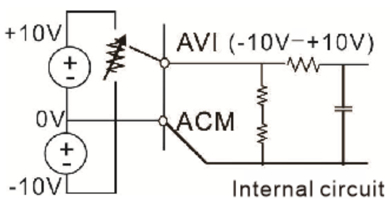
Figure 6-8

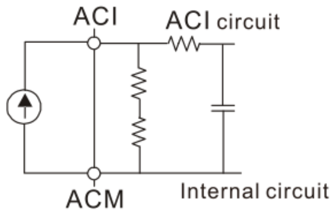
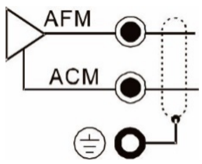
Recommended model and size of crimp terminals Unit: mm

AWG	Vendor	Vendor P/N	A(MAX)	B(MAX)	D(MAX)	W(MAX)
0.2 mm^2 (24AWG)	PHOENIX CONTACT	AI 0,25- 8 YE	12.5	8	2.6	1.1
0.34 mm^2 (22AWG)		AI 0,34- 8 TQ	12.5	8	3.3	1.3
0.5 mm^2 (20AWG)		AI 0,5 - 8 WH	14	8	3.5	1.4
Recommended model and specifications of crimp tool: CRIMPFOX 10S - 1212045, Manufacturer: PHOENIX CONTACT DNT13-0101, Manufacturer: DINKLE						

Table 6-2

Terminals	Terminal Function	Description
+24V	Digital control signal common (Source)	+24V ±10% 100 mA When used in parallel, if the +24V terminal is used with a feedback sensor, unequal current may occur, and there will be a risk of failure.
MI1 — MI7	Multi-function input 1–7	Refer to Pr.02-01–Pr.02-07 to program the multi-function inputs MI1–MI7. Source Mode ON: the activation current is 3.3 mA ≥ 11 V_{DC} OFF: cut-off voltage ≤ 5 V_{DC} Sink Mode ON: the activation current is 3.3 mA ≤ 13 V_{DC} OFF: cut-off voltage ≥ 19 V_{DC} ● When Pr.02-00 = 0, MI1 and MI2 can be programmed. ● When Pr.02-00 ≠ 0, the function of MI1 and MI2 is acc. to Pr.02-00 setting. ● When Pr.02-07 = 0, MI7 is pulse input with max. frequency 33kHz.
DFM	Digital frequency meter  	DFM is a pulse-signal output; Duty-cycle: 50% Min. load impedance R_L: 1 kΩ/100 pf Max. current: 30 mA Max. capacitive load: 100 pF

Terminals	Terminal Function	Description
DCM (1)	Digital frequency signal common (Sink)	Max. voltage: 30 V_{DC} ± 1 % (when 30 V_{DC} /30 mA /R_L = 100 pf) Max. output frequency: 33 kHz Internal current limiting resistor R: ≥ 1KΩ Output load impedance R_L Capacitive load ≤ 100 pf Resistive load ≥ 1 kΩ，resistance determine the output voltage value. DFM-DCM voltage = external voltage * (R_L/ (R_L+R))
DCM (2)	Digital frequency signal common (Sink), it can switch to SGND	
MO1	Multi-function Output 1 (photocoupler)	Programmable open-collector outputs, see Pr. 02-16 and Pr. 02-17.  Max 48 V_{DC} 50 mA
MO2	Multi-function Output 2 (photocoupler)	
MCM	Multi-function Output Common	
RA	Multi-function relay output 1 (Relay N.O. a)	Programmable relay output, see Pr. 02-13. Resistive Load 3 A (N.O.) / 3 A (N.C.) 250 V_{AC} 5 A (N.O.) / 3 A (N.C.) 30 V_{DC} Inductive Load (COS 0.4) 1.2 A (N.O.)/ 1.2 A (N.C.) 250 V_{AC} 2.0 A (N.O.)/ 1.2 A (N.C.) 30 V_{DC} Various kinds of monitor signals output, e.g.: operation, frequency attained, overload indication etc.
RB	Multi-function relay output 1 (Relay N.C. b)	
RC	Multi-function relay common (Relay)	
+10V	Potentiometer power supply	+10.5 ± 0.5 V_{DC} / 20 mA
AVI	Analog voltage input  	Programmable analog input, see Pr.03-00. Impedance: 20 kΩ Range 0－Max. Output Frequency (Pr.01-00): 0– +10V/-10– +10V Range switching by Pr.03-00, Pr.03-28.

Terminals	Terminal Function	Description
ACI	Analog current input 	Programmable analog input, see Pr.03-01. Impedance: 250 Ω Range 0－Max. Output Frequency (Pr. 01-00): 0–20mA/4–20mA/0–10V Range switching by Pr.03-01, Pr.03-29.
AFM	Multi-function analog voltage output 	Switch: The AFM default is 0–10 V (voltage mode). Use the switch and Pr.03-31 to change to current mode (0–20 mA/4–20 mA). You must follow the indication on the back side of the front cover or page 6-1 of the user manual when using the switch. Voltage mode Range: 0–10 V (Pr. 03-31=0) corresponding to the max. operating range of the control object Max. output current : 2 mA Max. Load: 5 kΩ Current mode Range: 0–20 mA (Pr.03-31=1)/4–20 mA (Pr.03-31=2) corresponding to the maximum operating range of the control object Max. load: 500 Ω
ACM	Analog Signal Common	Common for analog terminals
S1, S2	Default: S1/S2 shorted for +24 V Rated voltage: 24 V_{DC} ±10%; Maximum voltage: 30 V_{DC} ±10% Activation current: 6.67 mA ±10%	
DCM	STO activation mode Input voltage level: S1-DCM > 0 V_{DC} or S2-DCM < 5 V_{DC} STO response time ≤ 20 ms. S1/S2 operates until the AC motor drive stops outputting current. STO cut-off mode Input voltage level: S1-DCM > 11 V_{DC} and S2-DCM < 30 V_{DC} Power removal safety function according to EN 954-1 and IEC/EN 61508 Note: refer to Chapter 17 SAFE TORQUE OFF FUNCTION for more information.	
SG+	Modbus RS-485 Note: Please refer to Chapter 12 DESCRIPTION OF PARAMETER SETTINGS for more information.	
SG-		
SGND		

Terminals	Terminal Function	Description
RJ45	Pin1: CAN_H Pin2: CAN_L Pin3, 7: SGND Pin4: SG- Pin5: SG+ Pin6: Reserved Pin8: +10 VS	

Table 6-3

Chapter 7 Optional Accessories

The optional accessories listed in this chapter are available upon request. Installing additional accessories to your drive substantially improves the drive's performance. Select accessories according to your need or contact your local distributor for suggestions.

7-1 All Brake Resistors and Brake Units Used in AC Motor Drives

230V, three-phase

Model	Applicable Motor		125% Braking Torque / 10% ED *1						Max. Braking Torque		
	HP	kW	Braking Torque*2 (kg-m)	Resistor value spec. for each AC motor Drive	Braking Resistor for each Brake Unit			Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
					Part No. *3	Amount	Usage				
VFD11AMH23ANSLA	3	2.2	1.5	300W 70Ω	BR300W070	1	-	5.4	38.0	10	3.8
VFD17AMH23ANSLA	5	3.7	2.5	400W 40Ω	BR400W040	1	-	9.5	19.0	20	7.6
VFD25AMH23ANSLA	7.5	5.5	3.7	1000W 20Ω	BR1K0W020	1	-	19	16.5	23	8.7
VFD33AMH23ANSLA	10	7.5	5.1	1000W 20Ω	BR1K0W020	1	-	19	14.6	26	9.9
VFD49AMH23ANSLA	15	11	7.4	1500W 13Ω	BR1K5W013	1	-	29	12.6	29	11.0
VFD65AMH23ANSLA	20	15	10.2	2000W 8.6Ω	BR1K0W4P3	2	2 in series	44	8.3	46	17.5

460V, three-phase

Model	Applicable Motor		125% Braking Torque /10% ED *1						Max. Braking Torque		
	HP	kW	Braking Torque*2 (kg-m)	Resistor value spec. for each AC motor Drive	Braking Resistor for each Brake Unit			Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
					Part No. *3	Amount	Usage				
VFD9A0MH43ANSLA VFD9A0MH43AFSLA	5	3.7	2.5	400W 150Ω	BR400W150	1		5.1	84.4	9	6.8
VFD13AMH43ANSLA VFD13AMH43AFSLA	7.5	5.5	3.7	1000W 75Ω	BR1K0W075	1		10.2	50.7	15	11.4
VFD17AMH43ANSLA VFD17AMH43AFSLA	10	7.5	5.1	1000W 75Ω	BR1K0W075	1		10.2	40.0	19	14.4
VFD25AMH43ANSLA VFD25AMH43AFSLA	15	11	7.4	1500W 43Ω	BR1K5W043	1		17.6	33.0	23	17.5
VFD32AMH43ANSLA VFD32AMH43AFSLA	20	15	10.2	2000W 32Ω	BR1K0W016	2	2 in series	24	26.2	29	22.0

*[1]: Calculation for standard braking torque is (kW) x 125% x 0.8; where 0.8 is the motor efficiency.
Because of the limited resistor power, the longest operation time for 10% ED is 10 seconds (ON: 10 seconds / OFF: 90 seconds).

*[2]: Calculation for braking resistor is based on a four-pole motor (1800 rpm).

*[3]: Resistors of 400 W or lower should be fixed to the frame and at a surface temperature below 250°C.
Resistors of 1000 W and above should be fixed on a surface with temperature below 350°C. (If the surface temperature is higher than the temperature limit, install extra cooling system or increase the size of the resistor).

NOTE:

1. Select the resistance value, power and brake usage (ED %) according to Delta rules.

Definition for Brake Usage ED%

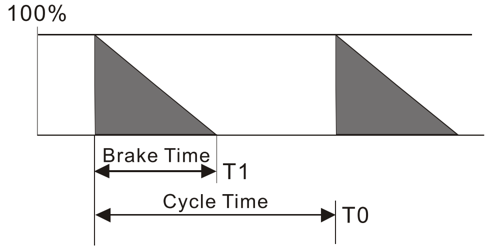
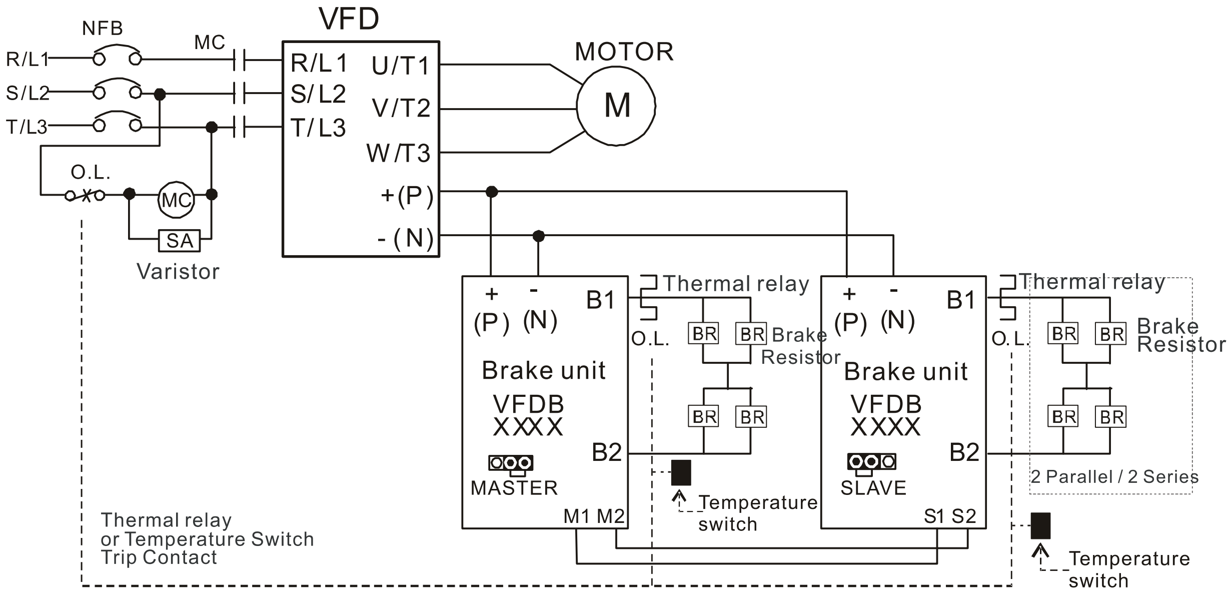


Fig. 7-1

ED% = T1 / T0 x 100 (%)
Explanation: ED (%) is defined to allow enough time for the brake unit and brake resistor to dissipate the heat generated by braking. When the brake resistor gets hot, the resistance increases with the temperature, and the braking torque decreases accordingly.

For safety, install a thermal overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) before the drive for additional protection. The thermal overload relay protects the brake resistor from damage due to frequent or continuous braking. Under such circumstances, turn off the power to prevent damage to the brake resistor, brake unit and drive. Attention: Do NOT interrupt the connection of the brake resistor by switching ON / OFF the power.



- When AC Drive is equipped with a DC reactor, please read user manual for the correct wiring for the brake unit input circuit +(P).
- DO NOT connect input circuit -(N) to the neutral point of the power system.

Fig. 7-2

2. Any damage to the drive or other equipment caused by using brake resistors and brake modules that are not provided by Delta voids the warranty.
3. Consider environmental safety factors when installing the brake resistors. If you use the minimum resistance value, consult local dealers for the power calculation.
4. When using more than two brake units, the equivalent resistor value of the parallel brake unit cannot be less than the value in the column “Minimum Resistor Value (Ω)”. Install the brake unit vertically and leaves 150 mm (5.91 in.) of heat dissipation space on the top and the bottom of the brake unit. Read the wiring information in the brake unit user manual thoroughly prior to operation. Visit the following links to get the instruction sheets for the wiring in the brake unit:
   - VFDB2015 / 2022 / 4030 / 4045 / 5055 Braking Modules Instruction Sheet
     https://downloadcenter.deltaww.com/downloadCenterCounter.aspx?DID=1525&DocPath=1&hl=en-US

- VFDB4110 / 4160 / 4185 Braking Modules Instruction Sheet
  https://downloadcenter.deltaww.com/downloadCenterCounter.aspx?DID=1516&DocPath=1&hl=en-US
- VFDB6055 / 6110 / 6160 / 6200 Braking Modules Instruction Sheet
  https://downloadcenter.deltaww.com/downloadCenterCounter.aspx?DID=8592&DocPath=1&hl=en-US

5. The suggested value in the tables above is for general application. If the AC motor drive requires frequent braking, increases the watts by two to three times.
6. Thermal Overload Relay (TOR): Choosing a thermal overload relay is based on whether its overload capacity is appropriate for the MH300. The standard braking capacity of the MH300 is 10% ED (Tripping time = 10s). As shown in the figure below, the thermal overload relay continuously operates for 10 seconds and it can withstand a 260% overload (Host starting).

   For example, a 460V, 15 kW MH300 has a braking current of 24 A (refer to the tables in this section), so it can use the thermal overload relay with a rated current of 10 A (10 x 260% = 26A > 24A). The specification of each thermal relay may vary among different manufacturers, carefully read the specification before using it.

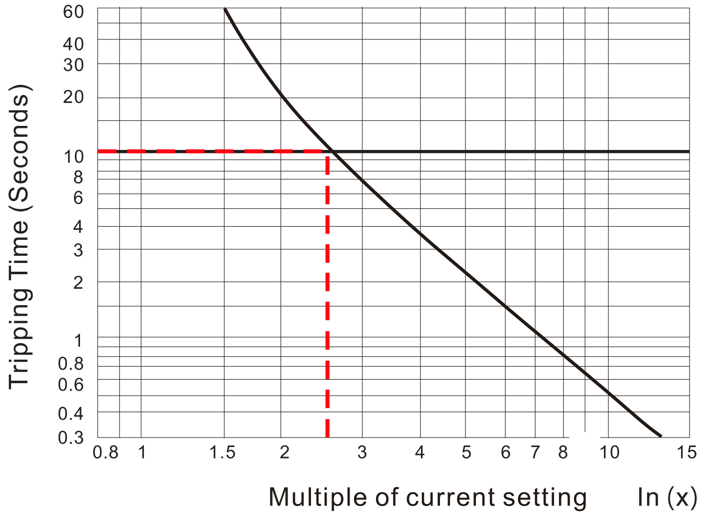


Fig. 7-3

7-2 Non-fuse Circuit Breaker

Comply with UL standard: Per UL 508, paragraph 45.8.4, part a.

Model	Voltage / three-phase	Current Input / Output (Max.)	Breaker Rating Input (A)
VFD11AMH23ANSLA	230V / three-phase	13.2 A / 11.0 A	40
VFD17AMH23ANSLA		20.4 A / 17.0 A	60
VFD25AMH23ANSLA		30.0 A / 25.0 A	63
VFD33AMH23ANSLA		39.6 A / 33.0 A	90
VFD49AMH23ANSLA		58.8 A / 49.0 A	125
VFD65AMH23ANSLA		78.0 A / 65.0 A	160

Model	Voltage / three-phase	Current Input / Output (Max.)	Breaker Rating Input (A)
VFD9A0MH43ANSLA VFD9A0MH43AFSLA	460V / three-phase	9.9 A / 9.0 A	30
VFD13AMH43ANSLA VFD13AMH43AFSLA		14.3 A / 13.0 A	32
VFD17AMH43ANSLA VFD17AMH43AFSLA		19.3 A / 17.5 A	45
VFD25AMH43ANSLA VFD25AMH43AFSLA		27.5 A / 25.0 A	60
VFD32AMH43ANSLA VFD32AMH43AFSLA		35.2 A / 32.0 A	80

7-3 Fuse Specification Chart

☑ It's recommended to use the fuses listed below which are tested. Do not use the fuses exceed the fuse specifications. The AC input fuse specifications are lower than the table listed below are allowed. If use the fuse lower than the specifications, ensure its root mean square value of current (Irms) is larger than the actual input current. If use the AC motor drive with 150% output overload capacity, the corresponding input current should be 1.5 times the value in the table.

☑ UL certified fuses apply to the short-circuit protection at the input side. For the installation in the United States, the branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. Use UL certified fuses to fulfill this requirement.

☑ For the installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. Use UL certified fuses to fulfill this requirement.

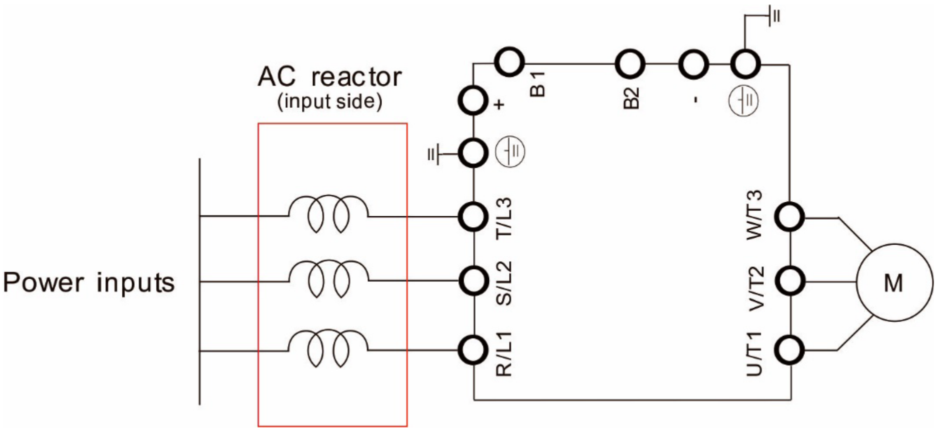
Model	Voltage / three-phase	Current Input / Output (Max.)	Branch Circuit Fuses Output (A)
VFD11AMH23ANSLA	230V / three-phase	13.2 A / 11.0 A	50 Class T JJS-50
VFD17AMH23ANSLA		20.4 A / 17.0 A	78 Class T JJS-80
VFD25AMH23ANSLA		30.0 A / 25.0 A	59.4 Class T JJS-60
VFD33AMH23ANSLA		39.6 A / 33.0 A	79.2 Class T JJS-80
VFD49AMH23ANSLA		58.8 A / 49.0 A	112.2 Class T JJS-110
VFD65AMH23ANSLA		78.0 A / 65.0 A	151.8 Class T JJS-150
VFD9A0MH43ANSLA VFD9A0MH43AFSLA	460V / three-phase	9.9 A / 9.0 A	42 Class T JJS-45
VFD13AMH43ANSLA VFD13AMH43AFSLA		14.3 A / 13.0 A	31.9 Class T JJS-30
VFD17AMH43ANSLA VFD17AMH43AFSLA		19.3 A / 17.5 A	43.56 Class T JJS-45
VFD25AMH43ANSLA VFD25AMH43AFSLA		27.5 A / 25.0 A	61.6 Class T JJS-60
VFD32AMH43ANSLA VFD32AMH43AFSLA		35.2 A / 32.0 A	79.2 Class T JJS-80

7-4 AC / DC Reactor

Installing an AC reactor on the input side of an AC motor drive can increase line impedance, improve the power factor, reduce input current, and reduce interference generated from the motor drive. It also reduces momentary voltage surges or abnormal current spikes. For example, when the main power capacity is higher than 500 kVA, or when using a switching capacitor bank, momentary voltage and current spikes may damage the AC motor drive's internal circuit. An AC reactor on the input side of the AC motor drive protects it by suppressing surges.

Installation

Install an AC input reactor in series with the main power to the three input phases R S T as shown below:



AC input reactor installation diagram

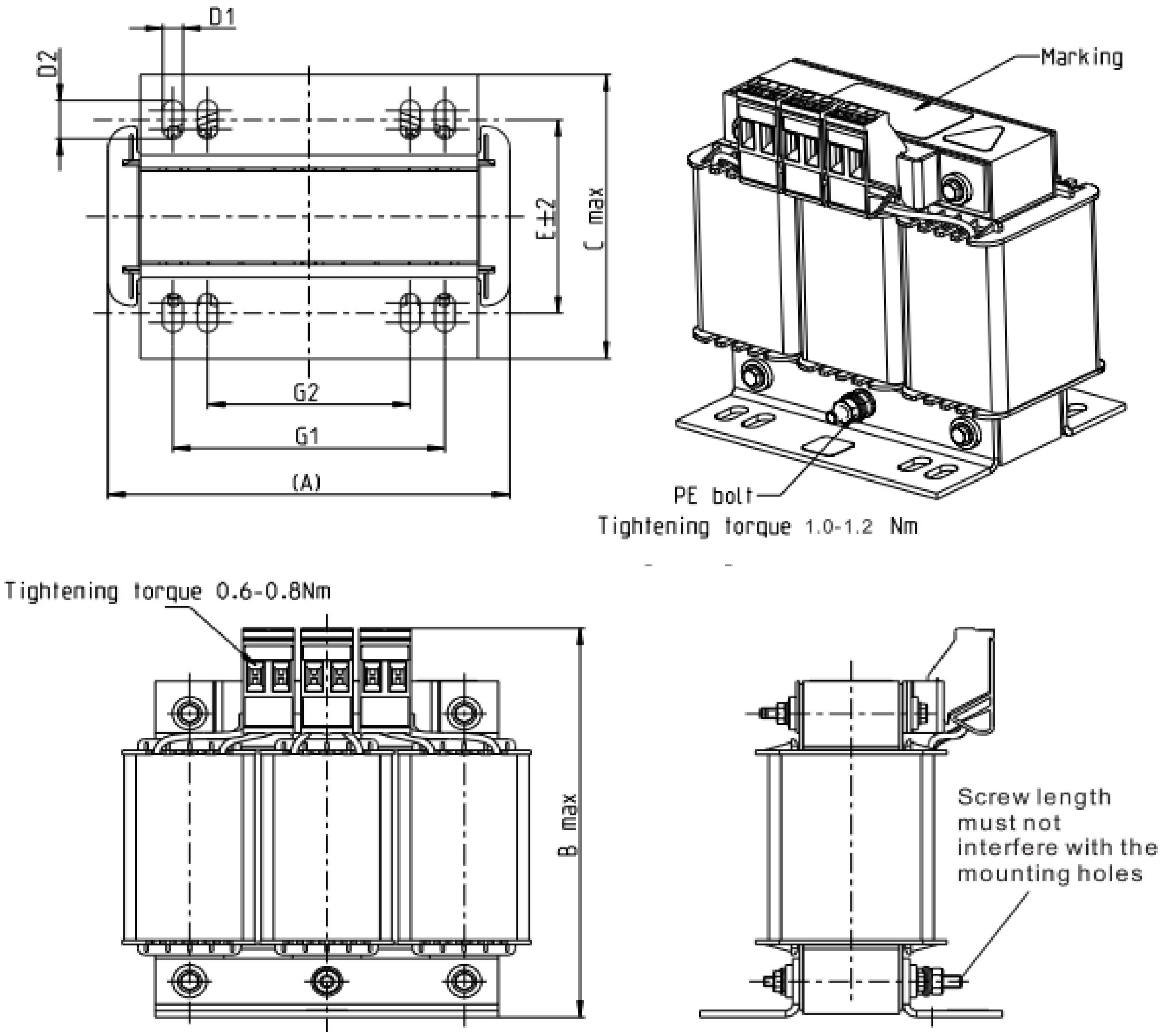
230V, 50–60Hz / Three-phase

Model	Rated Current (A_{rms})	Saturation Current (A_{rms})	AC Reactor		DC Reactor	
			Input/ Output Inductor (mH)	Input Reactor Delta Part #	Inductor (mH)	Delta Part #
VFD11AMH23ANSLA	11.0	22.0	1.152	DR011A0115	2.662	DR011D0266
VFD17AMH23ANSLA	17.0	34.0	0.746	DR017AP746	1.722	DR017D0172
VFD25AMH23ANSLA	25.0	50.0	0.507	DR025AP507	1.172	DR025D0117
VFD33AMH23ANSLA	33.0	66.0	0.32	DR033AP320	0.851	DR033DP851
VFD49AMH23ANSLA	49.0	98.0	0.216	DR049AP215	0.574	DR049DP574
VFD65AMH23ANSLA	65.0	130.0	0.163	DR065AP162	0.432	DR065DP432

460V, 50–60Hz / Three-phase

Model	Rated Current (A_{rms})	Saturation Current (A_{rms})	AC Reactor		DC Reactor	
			Input/ Output Inductor (mH)	Input Reactor Delta Part #	Inductor (mH)	Delta Part #
VFD9A0MH43ANSLA VFD9A0MH43AFSLA	9.0	18.0	2.7	DR009A0270	6.236	DR009D0623
VFD13AMH43ANSLA VFD13AMH43AFSLA	13.0	26.0	1.174	DR018A0117	4.677	DR012D0467
VFD17AMH43ANSLA VFD17AMH43AFSLA	17.5	35.0	1.174	DR018A0117	3.119	DR018D0311
VFD25AMH43ANSLA VFD25AMH43AFSLA	25.0	50.0	0.881	DR024AP881	2.338	DR024D0233
VFD32AMH43ANSLA VFD32AMH43AFSLA	32.0	64.0	0.66	DR032AP660	1.754	DR032D0175

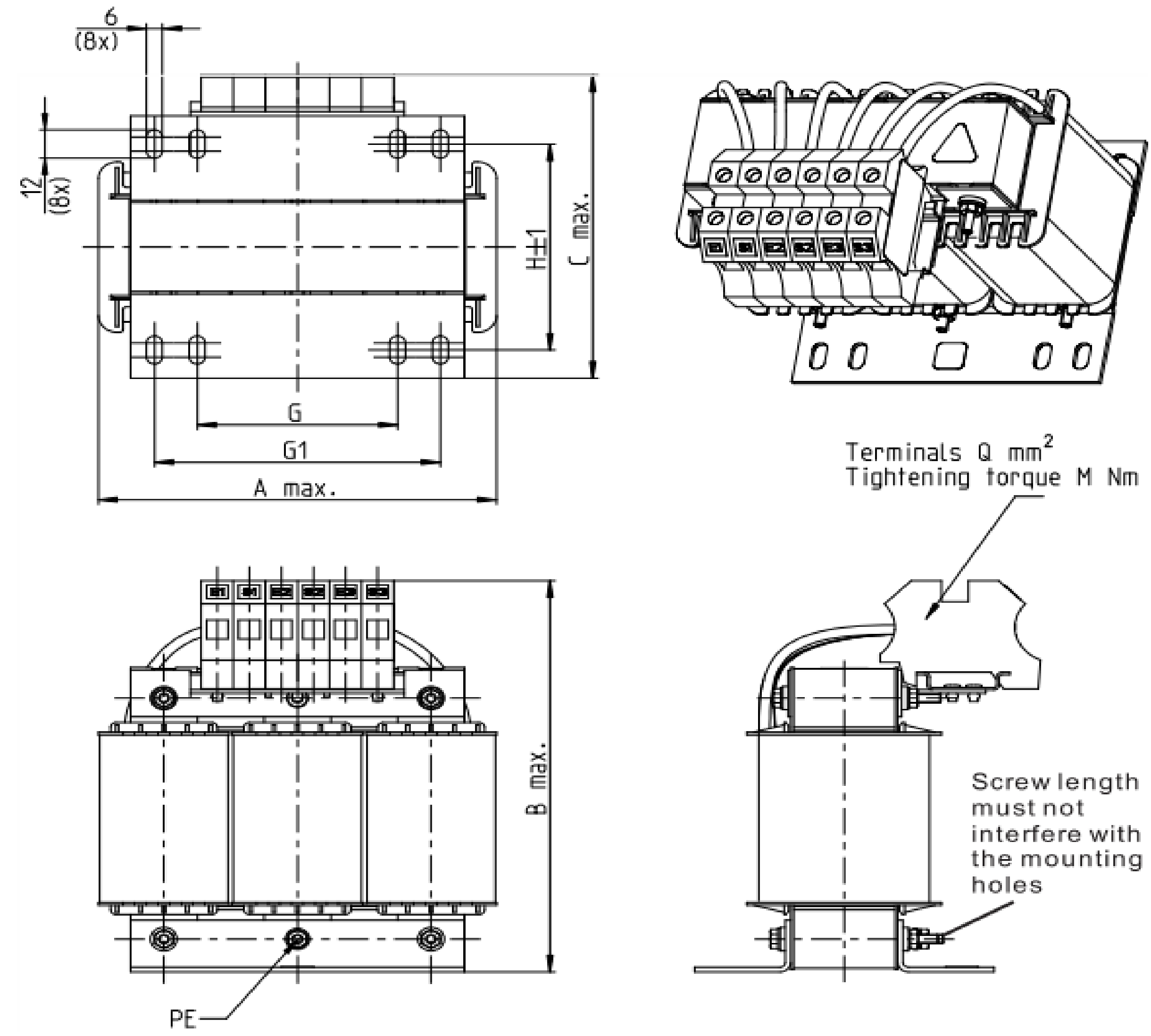
AC input reactor dimension and specification:



Screw Location	Torque
Terminal	5.32–7.09 kg-cm / [6.12–8.16 lb-in.] / [0.6–0.8 Nm]
PE bolt	8.86–10.63 kg-cm / [10.2–12.24 lb-in.] / [1.0–1.2 Nm]

Input AC reactor Delta part #	A	B	C	D1*D2	E	G1	G2	PE D
DR011A0115	120	120	88	6*12	60	80.5	60	M4
DR017AP746	120	120	93	6*12	65	80.5	60	M4
DR025AP507	150	150	112	6*12	88	107	75	M4
DR033AP320	150	150	112	6*12	88	107	75	M4

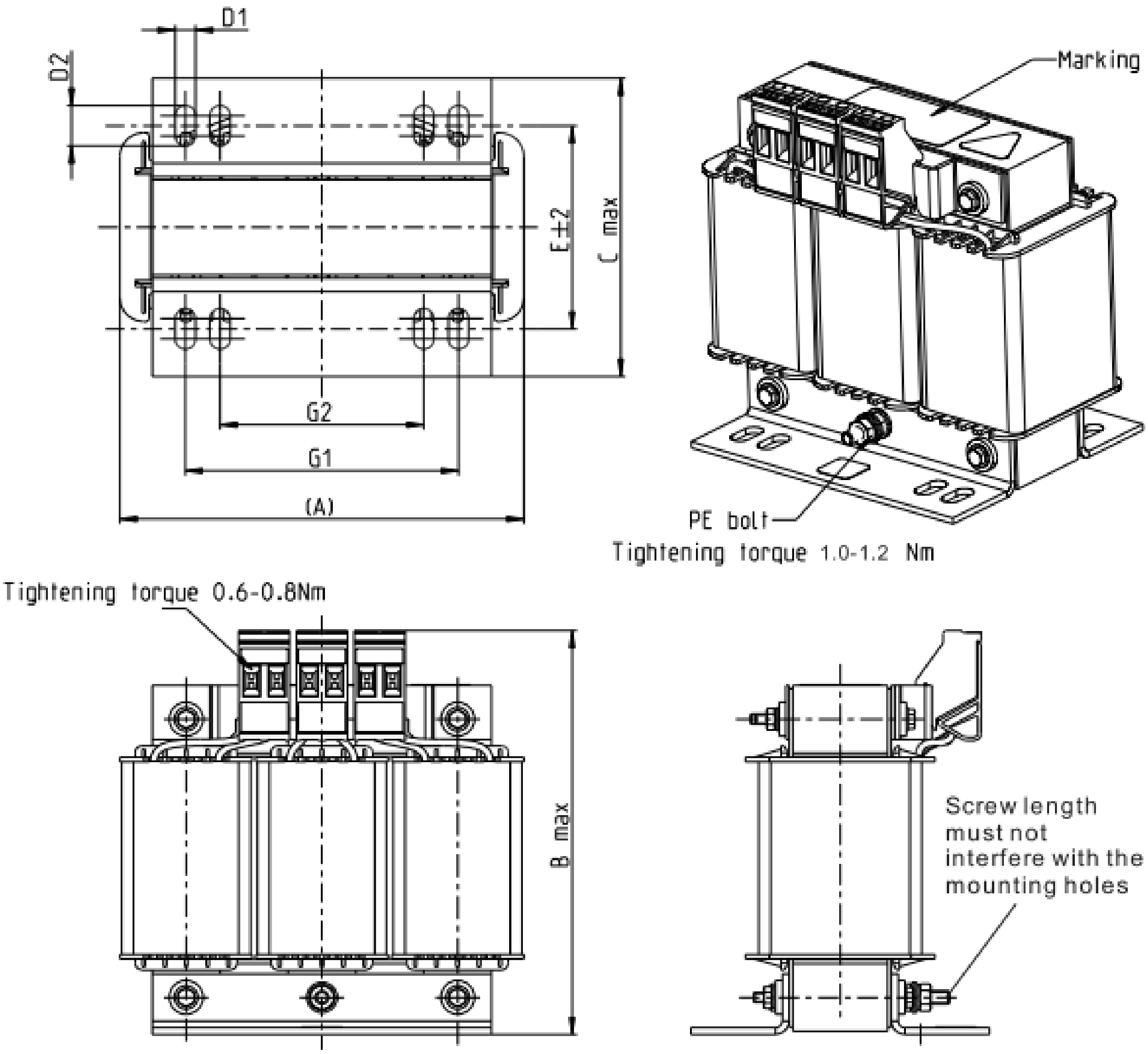
Unit：mm



Screw Location	Torque
Terminal	10.63–12.4 kg-cm / [12.24–14.28 lb-in.] / [1.2–1.4 Nm]

Input AC reactor Delta part #	A	B	C	D1*D2	H	G	G1	Q	M	PE D
DR049AP215	180	195	160	6*12	115	85	122	16	1.2–1.4	M4
DR065AP163	180	205	160	6*12	115	85	122	35	2.5–3.0	M4

Unit：mm



Screw Location	Torque
Terminal	5.32–7.09 kg-cm / [6.12–8.16 lb-in.] / [0.6–0.8 Nm]
PE bolt	8.86–10.63 kg-cm / [10.2–12.24 lb-in.] / [1.0–1.2 Nm]

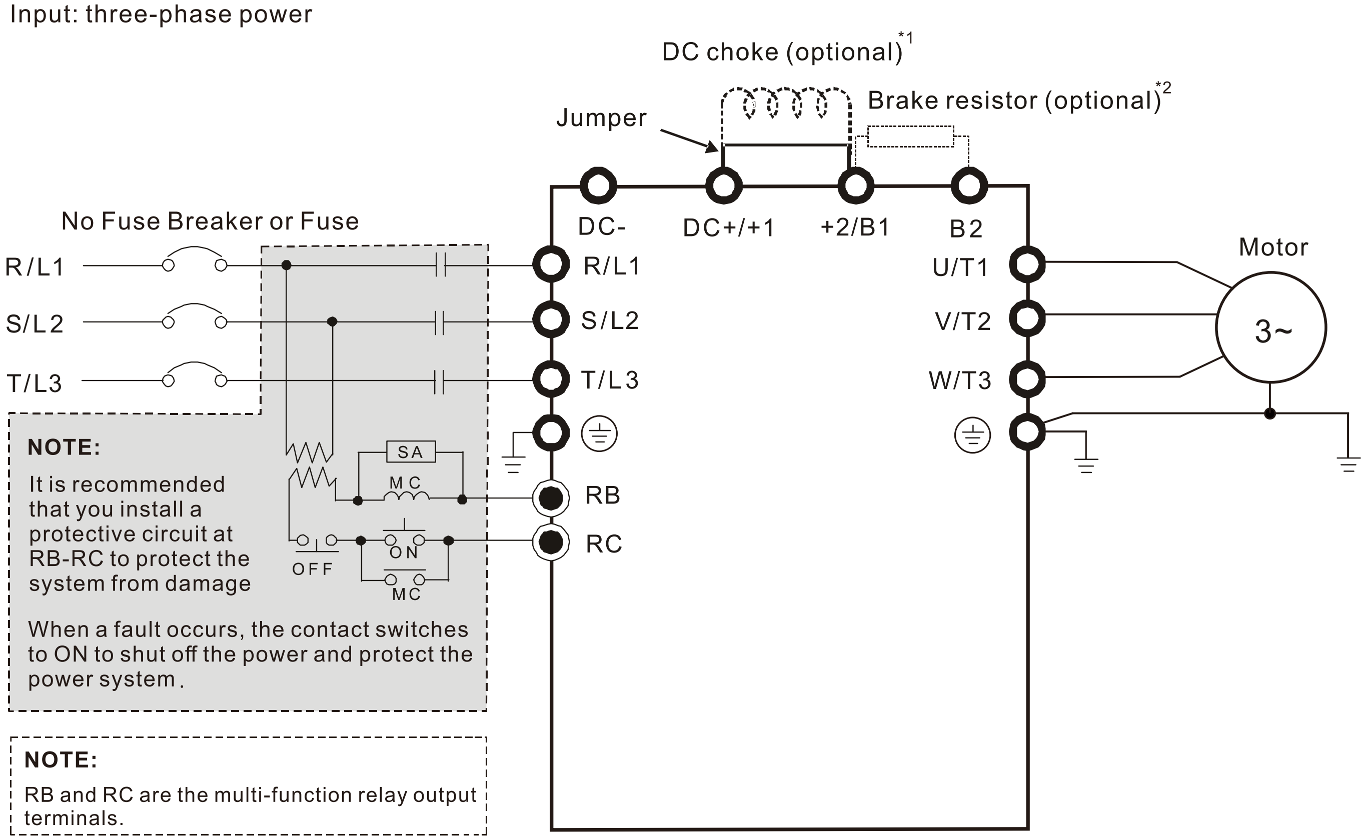
Input AC reactor Delta part #	A	B	C	D1*D2	E	G1	G2	PE D
DR009A0270	150	150	88	6*12	74	107	75	M4
DR018A0117	150	155	112	6*12	88	107	75	M4
DR024AP881	150	155	112	6*12	88	107	75	M4
DR032AP660	180	175	138	6*12	114	122	85	M6

Unit：mm

A DC reactor can also improve the power factor, reduce input current, and reduce interference generated from the motor drive. A DC reactor stabilizes the DC BUS voltage. Compared to an AC input reactor, the advantages are smaller size, lower price, and lower voltage drop (lower power dissipation).

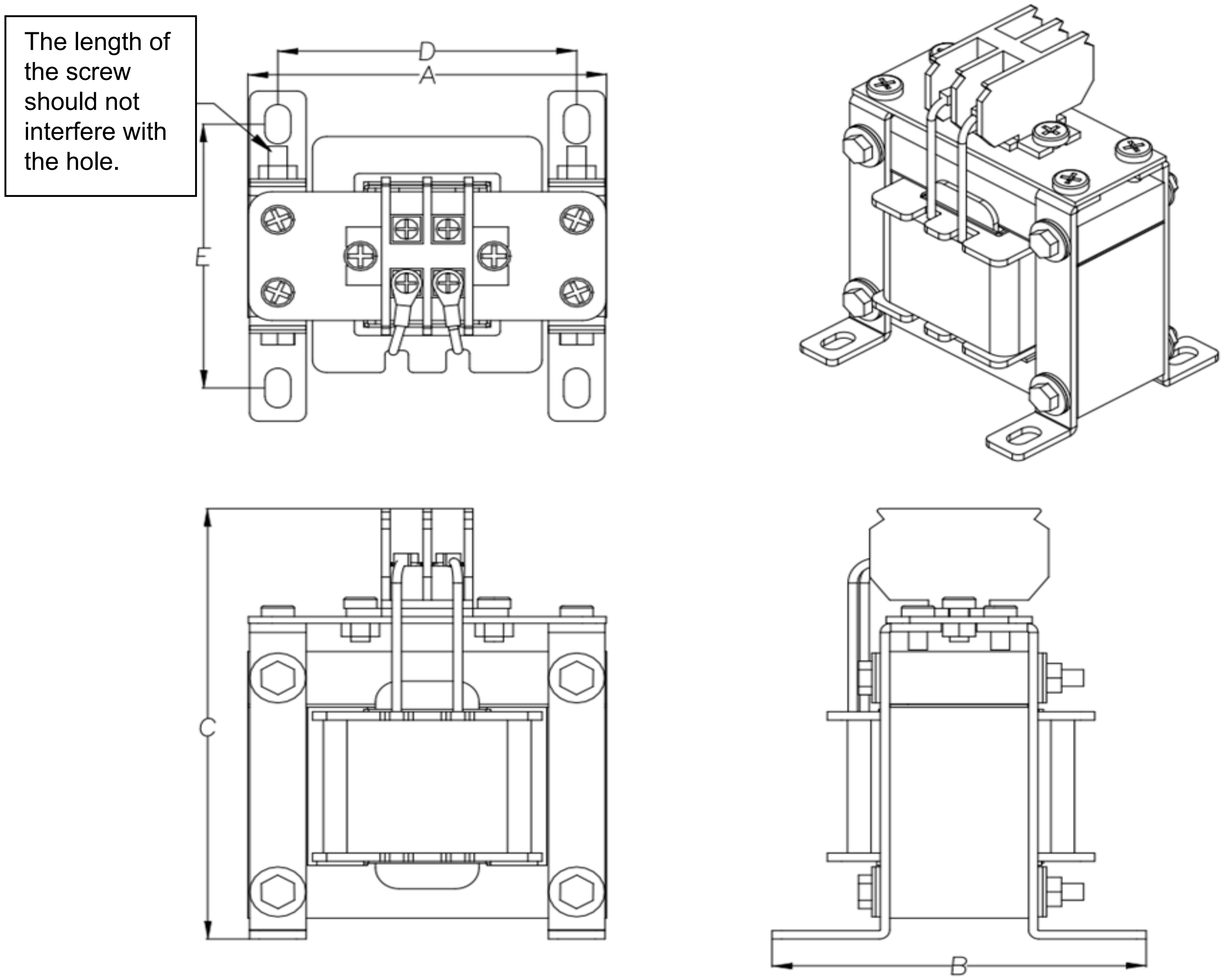
Installation

Install the DC reactor between terminals +1 and +2. Remove the jumper, shown below, before installing the DC reactor.



Wiring of DC reactor

DC reactor dimension and specification:



DC reactor Delta Part #	Rated Current (Arms)	Saturation current (Arms)	DC reactor (mH)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Dimension (mm)
DR011D0266	11	18	2.662	79	92	112	64±2	69.5±2	9.5*5.5
DR017D0172	17	28.8	1.722	79	112	112	64±2	89.5±2	9.5*5.5
DR025D0117	25	43.2	1.172	99	105	128	79±2	82.5±2	9.5*5.5
DR033DP851	33	55.8	0.851	117	110	156	95±2	87±2	10*6.5
DR049DP574	49	84.6	0.574	117	120	157	95±2	97±2	10*6.5
DR065DP432	65	111.6	0.432	117	140	157	95±2	116.5±2	10*6.5
DR009D0623	9	14.58	6.236	79	112	112	64±2	89.5±2	9.5*5.5
DR012D0467	12	19.8	4.677	99	105	128	79±2	82.5±2	9.5*5.5
DR018D0311	18	30.6	3.119	117	110	144	95±2	87±2	10*6.5
DR024D0233	24	41.4	2.338	117	120	144	95±2	97±2	10*6.5
DR032D0175	32	54	1.754	117	140	157	95±2	116.5±2	10*6.5

Length of Motor Cable

1. Leakage current affects the motor and remedies

Due to larger parasitic capacitances in longer motor cables, longer cables increase the leakage current. This can activate the over-current protection and display the incorrect current. In the worst case, it can damage the drive.
If more than one motor is connected to the AC motor drive, the total motor cable length is the sum of the cable length from the AC motor drive to each motor.
For 460V series AC motor drives, when an overload relay is installed between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50 m.
However, the overload relay could still malfunction. To prevent this, install an AC output reactor (optional) to the drive and/or lower the carrier frequency setting (Pr.00-17).

2. Surge voltage affects the motor and remedies

When a PWM signal from an AC motor drive drives the motor, the motor terminals can easily experience surge voltages (dv/dt) due to IGBT switching and cable capacitance. When the motor cable is very long (especially for the 460V series), surge voltages (dv/dt) may reduce motor insulation quality. To prevent this, follow the rules listed below.

   a. Use a motor with enhanced insulation.
   b. Connect an output reactor (optional) to the output terminals of the AC motor drive.
   c. Reduce the motor cable length to the values in the table below.

The suggested motor shielded cable length in the following table complies with IEC 60034-17, which is suitable for motors with a rated voltage ≤ 500 V_{AC} and with an insulation level of ≥ 1.35 kV_{p-p}

230V three-phase Model	Rated current (Arms)	Without AC reactor		With AC reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD11AMH23ANSLA	12.5	50	75	75	115
VFD17AMH23ANSLA	19.5	50	75	75	115
VFD25AMH23ANSLA	27.0	50	75	75	115
VFD33AMH23ANSLA	36.0	100	150	150	225
VFD49AMH23ANSLA	51.0	100	150	150	225
VFD65AMH23ANSLA	69.0	100	150	150	225

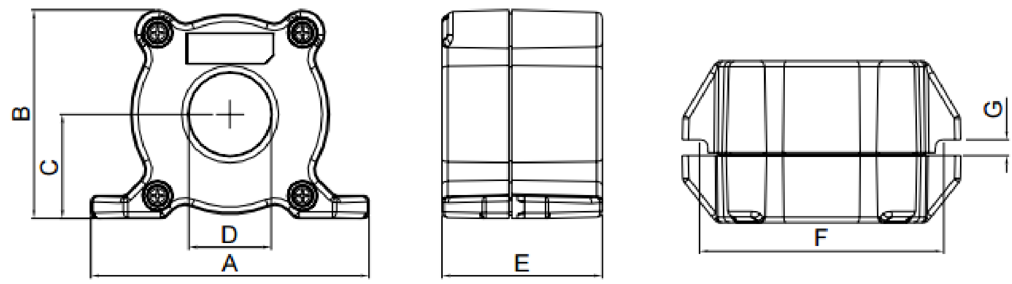
460V three-phase Model	Rated current (Arms)	Without AC reactor		With AC reactor	
		Shielded Cable (meter)	Non-shielded cable (meter)	Shielded Cable (meter)	Non-shielded cable (meter)
VFD9A0MH43ANSLA VFD9A0MH43AFSLA	10.5	50	75	75	115
VFD13AMH43ANSLA VFD13AMH43AFSLA	14.5	50	75	75	115
VFD17AMH43ANSLA VFD17AMH43AFSLA	19.8	100	150	150	225
VFD25AMH43ANSLA VFD25AMH43AFSLA	28.0	100	150	150	225
VFD32AMH43ANSLA VFD32AMH43AFSLA	36.0	100	150	150	225

7-5 Zero Phase Reactors

You can also suppress interference by installing a zero phase reactor at the main input or the motor output of the drive, depending on the location of the interference. Delta provides two types of zero phase reactors to solve interference problems.

A. Casing with mechanical fixed part

This solution is for the main input/motor output side and can withstand higher loading, and be used at higher frequencies. You can get higher impedance by increasing the number of turns.

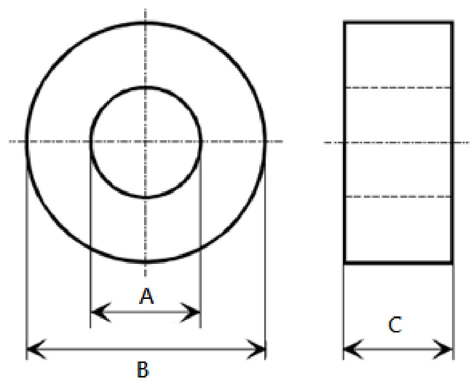


Unit: mm

Model	A	B	C	D	E	F	G(Ø)	To use w/
RF008X00A	99	73	36.5	29	56.5	86	5.5	Motor cable

B. Casing without mechanical fixed part

This solution has higher performance: high initial magnetic permeability, high saturation induction density, low iron loss and perfect temperature characteristic. If the zero phase reactor does not need to be fixed mechanically, use this solution.



Unit: mm

Model	A	B	C
T60006L2040W453	22.5	43.1	18.5
T60006L2050W565	36.3	53.5	23.4

Installation

During installation, pass the cable through at least one zero phase reactor.
Use a suitable cable type (insulation class and wire section) so that the cable passes easily through the zero phase reactor. Do not pass the grounding cable through the zero phase reactor; only pass the motor wire through the zero phase reactor.

With longer motor cables the zero phase reactor can effectively reduce interference at the motor output. Install the zero phase reactor as close to the output of the drive as possible. Figure A shows the installation diagram for a single turn zero phase reactor. If the wire diameter allows several turns, Figure B shows the installation of a multi-turn zero phase reactor. The more turns, the better the noise suppression effect.

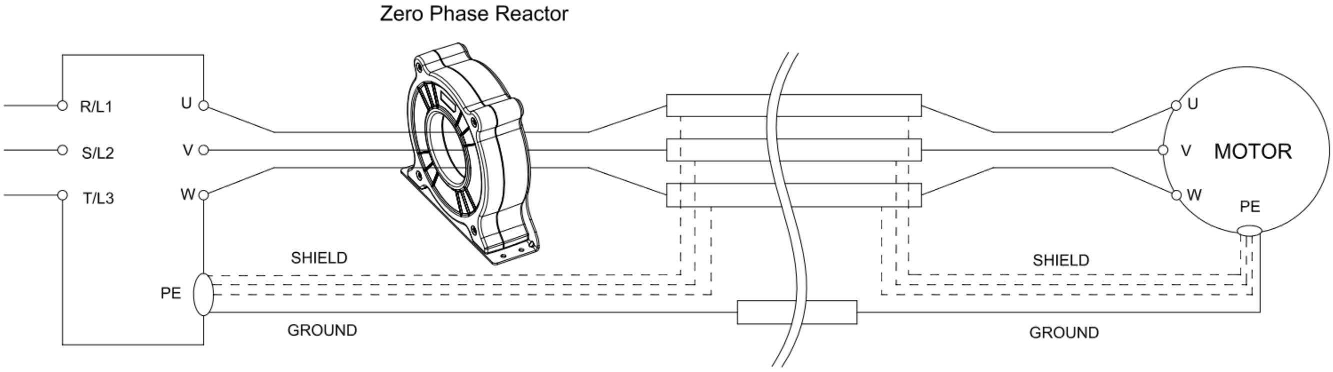


Figure A: Single turn wiring diagram of a shieling wire with a zero phase reactor

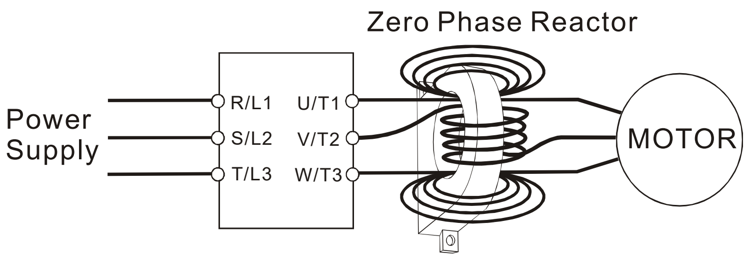


Figure B: Multi-Turn Zero Phase Reactor

Installation notices

Install the zero phase reactor at the output terminal of the frequency converter (U.V.W.).
After the zero phase reactor is installed, it reduces the electromagnetic radiation and load stress emitted by the wiring of the frequency converter. The number of zero phase reactors required for the drive depends on the wiring length and the drive voltage.

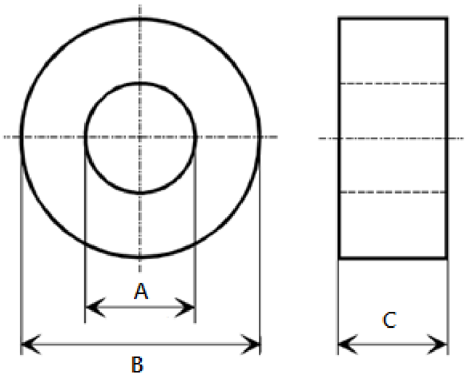
The normal operating temperature of the zero phase reactor should be lower than 85°C (176°F). However, when the zero phase reactor is saturated, its temperature may exceed 85°C (176°F). In this case, increase the number of zero phase reactors to avoid saturation. The following are reasons that might cause saturation of the zero phase reactors: the drive wiring is too long, the drive has several sets of loads, the wiring is in parallel, or the drive uses high capacitance wiring. If the temperature of the zero phase reactor exceeds 85°C (176°F) during the operation of the drive, increase the number of zero phase reactors.

Recommended max. wiring gauge when installing zero phase reactor

Model # of Zero Phase Reactor	Max, Wire Gauge or LUG width	Max. Wire Gauge AWG (1Cx3)		Max. Wire Gauge AWG (1Cx4)	
		75 °C	90 °C	75 °C	90 °C
RF008X00A	13 mm	3 AWG	1 AWG	3 AWG	1 AWG
T600006L2040W453	11 mm	9 AWG	4 AWG	6 AWG	6 AWG
T600006L2050W565	16 mm	1 AWG	2/0 AWG	1 AWG	1/0 AWG

Zero Phase Reactor for Signal Cable

To solve interference problems between signal cables and electric devices, install a zero phase reactor on signal cable. Install it on the signal cable which is the source of the interference to suppress the noise for a better signal. The model names and dimensions are in the table below.

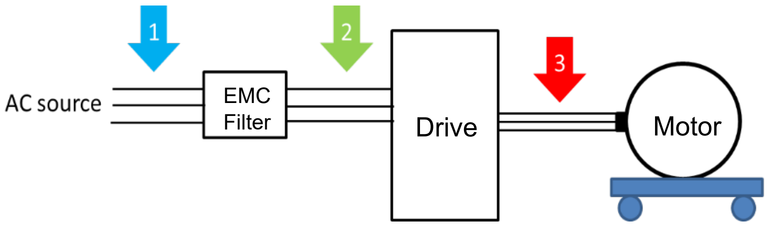


Model	A	B	C
T60004L2016W620	10.7	17.8	8.0
T60004L2025W622	17.5	27.3	12.3

Unit: mm

7-6 EMC Filter

Frame	Model	Input Current (A)	Model -EMC Filter	Model -Zero-phase reactor	Conducted emission						Radiated emission		
					C1-motor cable length-30m			C2-motor cable length-100m			C2-motor cable length-100m		
					Position to place zero-phase reactor								
				DELTA	*1	*2	*3	*1	*2	*3	*1	*2	*3
C	VFD11AMH23ANSLA	15	EMF24AM23B	RF008X00A or RF008X00N		✓	✓		NA			✓	✓
	VFD17AMH23ANSLA	23.4	EMF24AM23B	RF008X00A or RF008X00N		✓	✓		NA			✓	✓
	VFD9A0MH43ANSLA	11.6	EMF12AM43B	RF008X00A or RF008X00N		✓	✓		NA			✓	✓
D	VFD25AMH23ANSLA	32.4	EMF33AM23B	RF004X00A or RF004X00N	✓	✓			NA		✓	✓	
	VFD13AMH43ANSLA	16.0	EMF23AM43B	RF004X00A or RF004X00N	✓	✓	✓		NA		✓	✓	✓
	VFD17AMH43ANSLA	21.8	EMF23AM43B	RF004X00A or RF004X00N	✓	✓	✓		NA		✓	✓	✓
E	VFD33AMH23ANSLA	43.2	B84143D0050R127	RF004X00A or RF004X00N		✓	✓		NA			✓	✓
	VFD49AMH23ANSLA	61.2	B84143D0075R127	RF004X00A or RF004X00N		✓	✓		NA			✓	✓
	VFD25AMH43ANSLA	30.8	B84143D0050R127	RF004X00A or RF004X00N		✓	✓		NA			✓	✓
	VFD32AMH43ANSLA	39.6	B84143D0050R127	RF004X00A or RF004X00N		✓	✓		NA			✓	✓
F	VFD65AMH23ANSLA	82.8	B84143D0090R127	RF004X00A or RF004X00N		✓	✓		NA			✓	✓

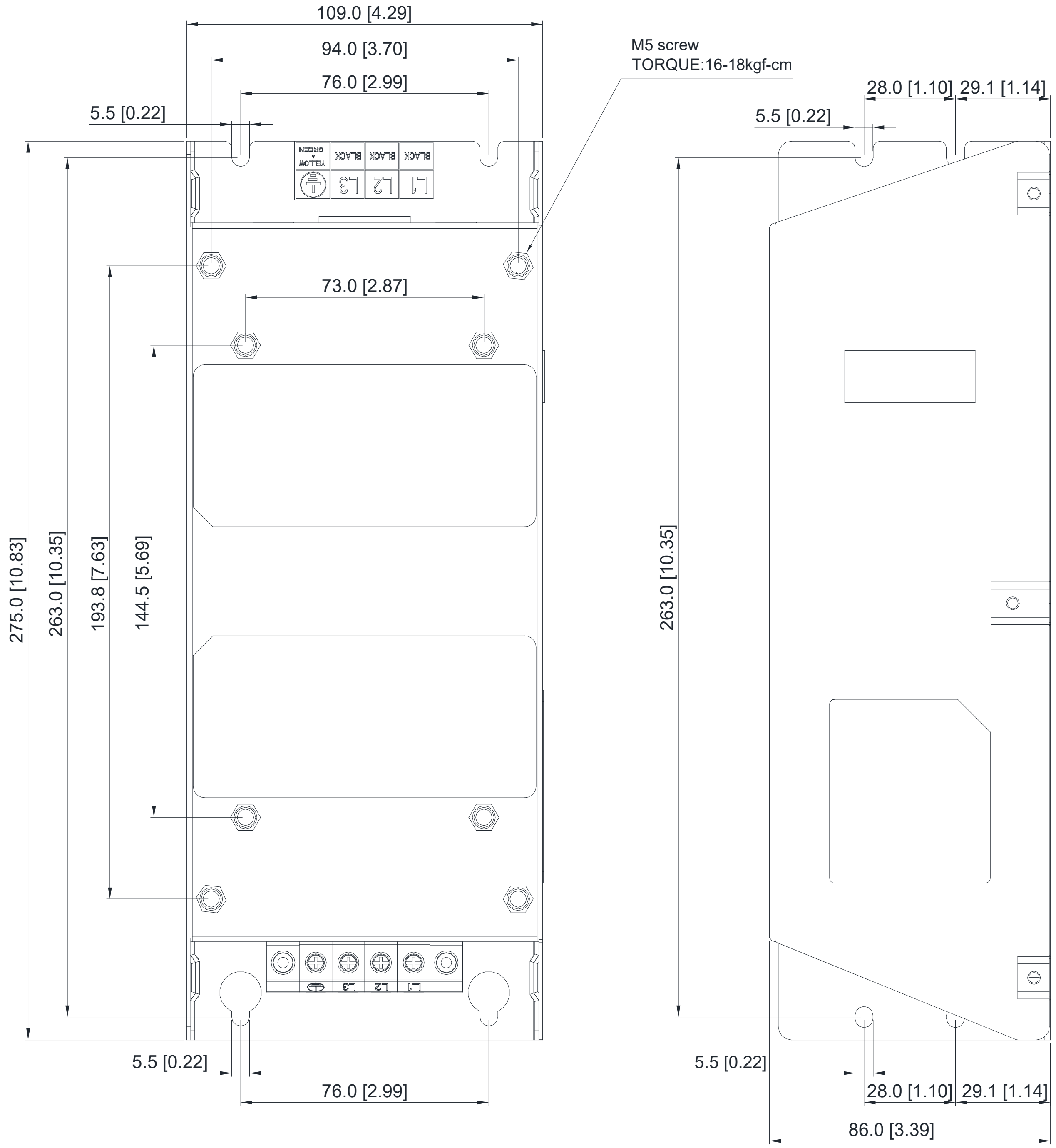


Filter Dimension

EMF24AM23B; EMF33AM23B;

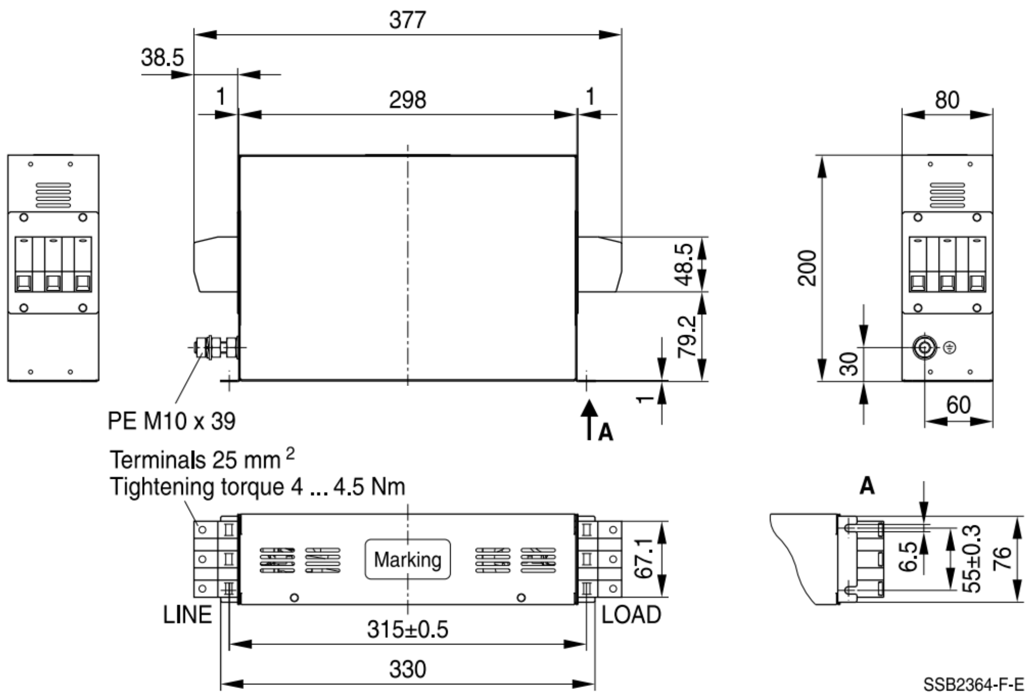
EMF12AM43B; EMF23AM43B;

Screw	Torque
M5 * 4	16–20 kg-cm / [13.9–17.3 lb-in.] / [1.56–1.96 Nm]

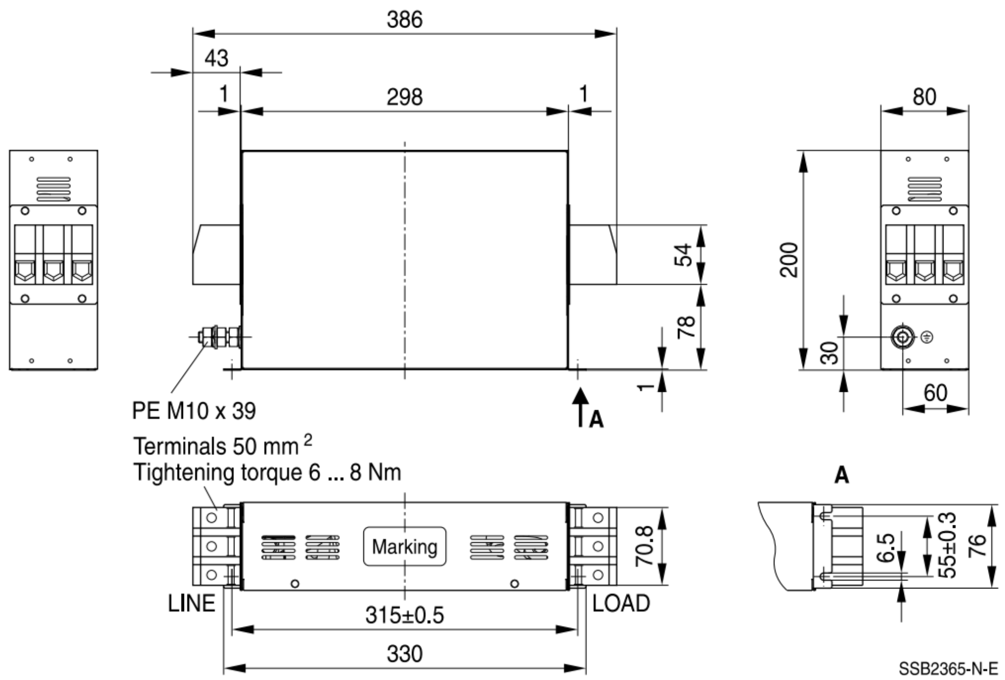


Unit: mm [inch]

TDK B84143D0050R127 (50A)



TDK B84143D0075R127 (75A), TDK B84143D0090R127 (90A)

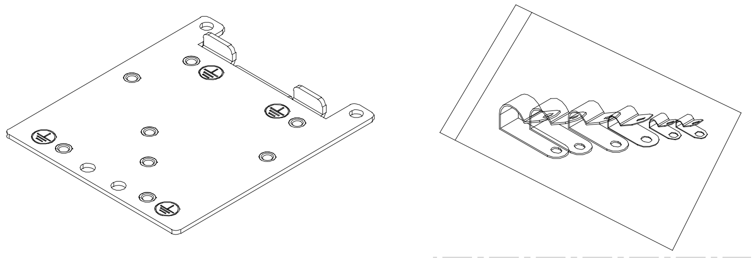
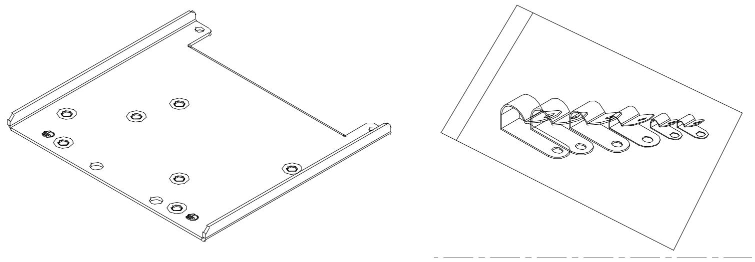
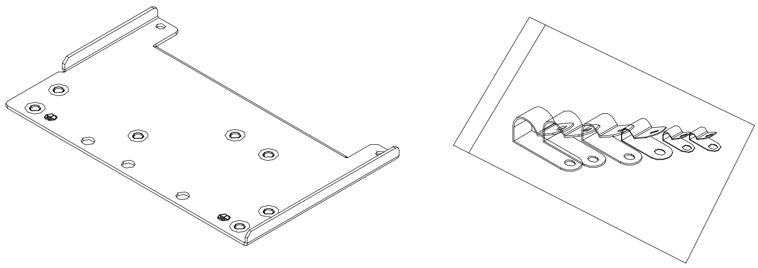
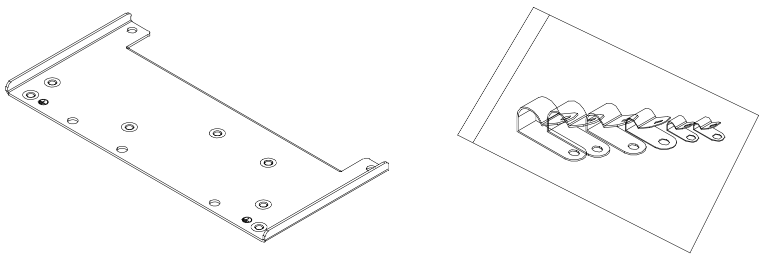


The table below is the maximum shielded cable length for drive models with built-in EMC filters. You can choose the corresponding shielded cable length according to the required noise emission and electromagnetic interference class.

<table>
<tr><th colspan="2">Drive Models with Built-in Filters</th><th rowspan="2">Rated Current (HD)</th><th colspan="2">Compliance with EMC (IEC 61800-3) Class C3</th><th colspan="2">Compliance with EMC (IEC 61800-3) Class C2</th></tr>
<tr><th>Frame</th><th>Models</th><th>Shielded Cable Length</th><th>Fc</th><th>Shielded Cable Length</th><th>Fc</th></tr>
<tr><td>C</td><td>VFD9A0MH43AFSLA</td><td>9</td><td rowspan="5">30 m</td><td rowspan="5">4 kHz</td><td rowspan="5">20 m</td><td rowspan="5">4 kHz</td></tr>
<tr><td rowspan="2">D</td><td>VFD13AMH43AFSLA</td><td>13</td></tr>
<tr><td>VFD17AMH43AFSLA</td><td>17.5</td></tr>
<tr><td rowspan="2">E</td><td>VFD25AMH43AFSLA</td><td>25</td></tr>
<tr><td>VFD32AMH43AFSLA</td><td>32</td></tr>
</table>

7-7 EMC Shield Plate

EMC Shield Plate (for use with shielded cable)

Frame	Model of EMC Shield Plate	Reference figure
C	MKM-EPC	
D	MKM-EPD	
E	MKM-EPE	
F	MKM-EPF	

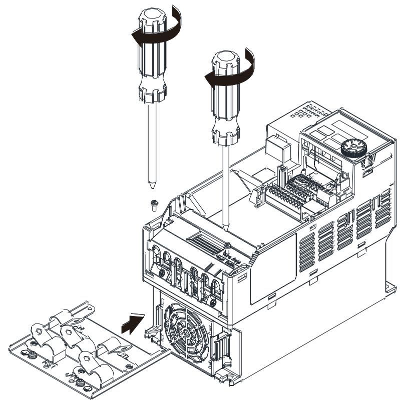
Installation

(Frame D model as an example)

1. As shown on the right figures, fix the iron plate on the AC motor drive.

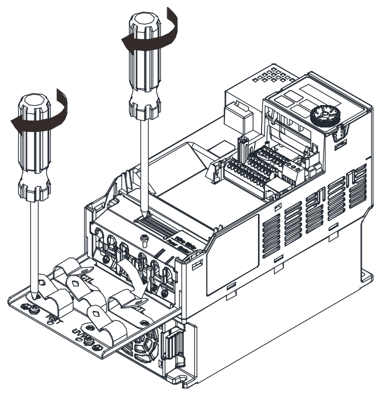
   Torque value:

Frame	Screw	Torque
C	M4	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]
D	M3	4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]
E	M3	4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]
F	M4	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]

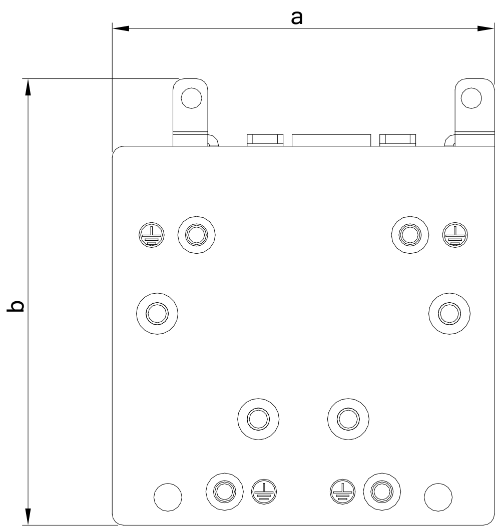


2. After selecting a suitable R-clip according to the wire gauge used, fix the R-clip on the shield plate.

Screw	Torque
M4	6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]

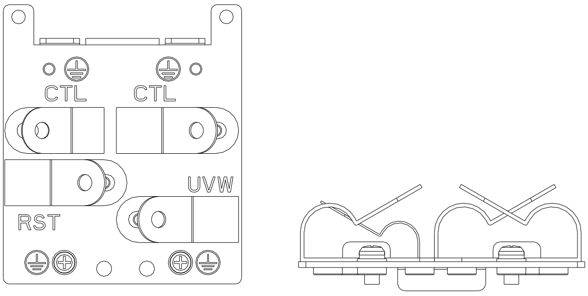
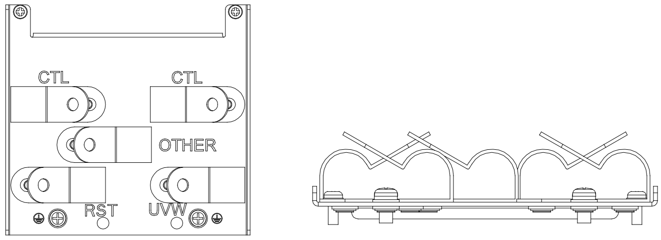
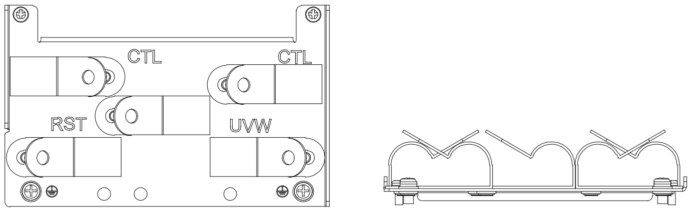
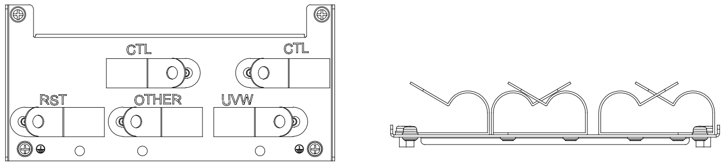


Dimensions of EMC Shield Plate



Model	Dimensions of Shield Plate mm [inch]	
	a	b
MKM-EPC	78.0 [3.07]	91.0 [3.58]
MKM-EPD	103.4 [4.07]	97.0 [3.82]
MKM-EPE	124.3 [4.89]	77.4 [3.05]
MKM-EPF	168.0 [6.61]	80.0 [3.15]

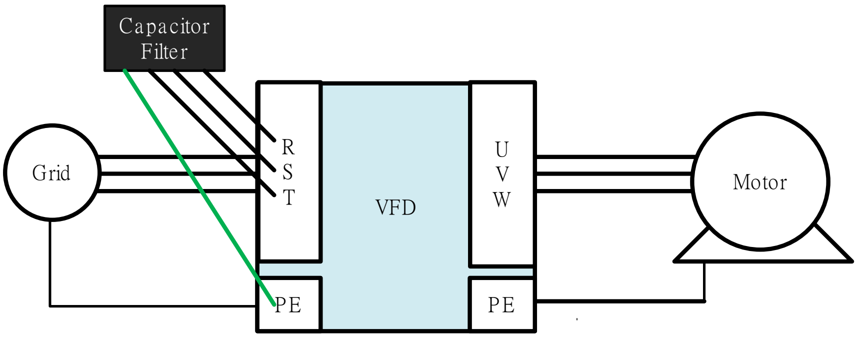
Recommended wire mounting method

Frame	Model of EMC Shield Plate	Reference figure
C	MKM-EPC	
D	MKM-EPD	
E	MKM-EPE	
F	MKM-EPF	

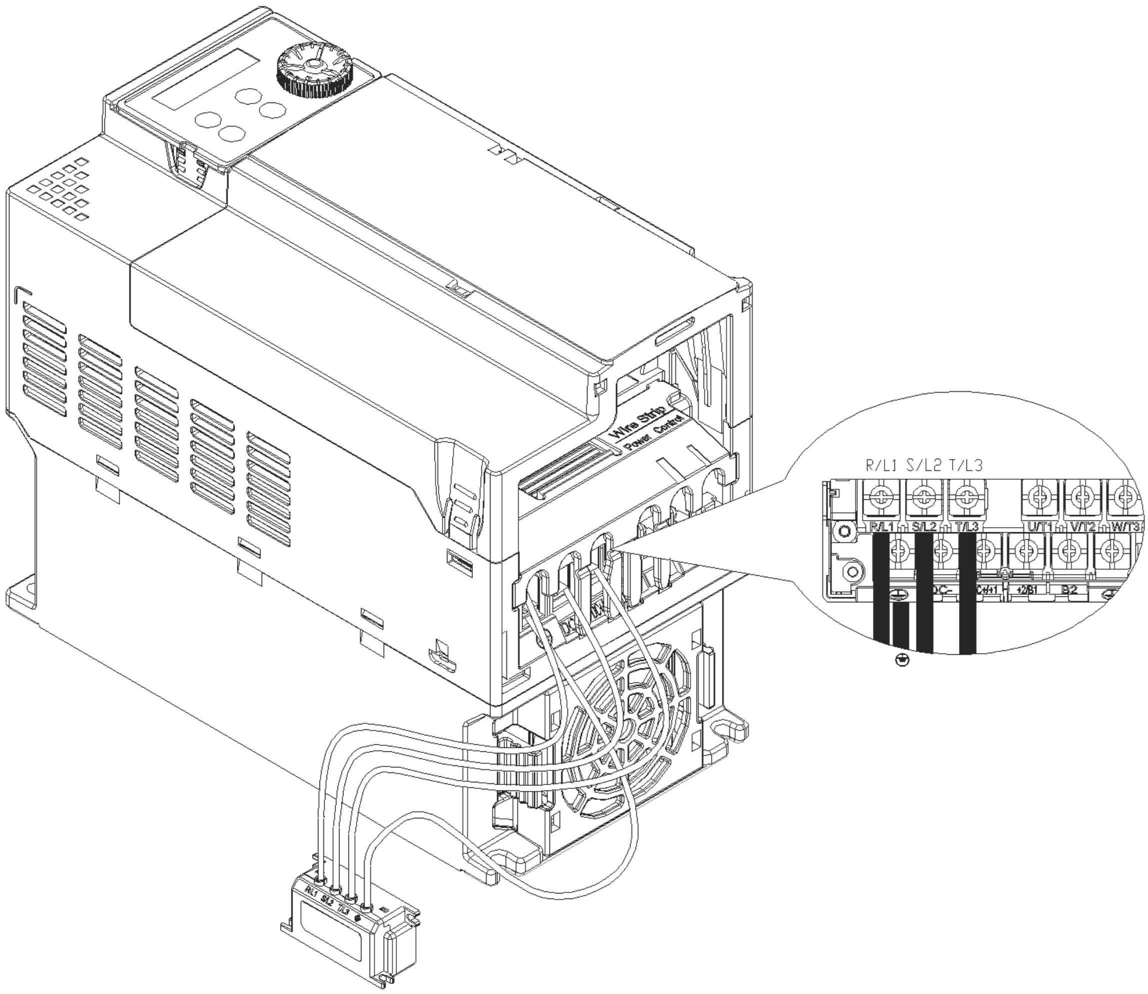
7-8 Capacitive Filter

Installation diagram:

The capacitive filter (CXY101-43A) is a simple filter that supports basic filtering and noise interference reduction.



Capacitive filter and drive wiring figure:



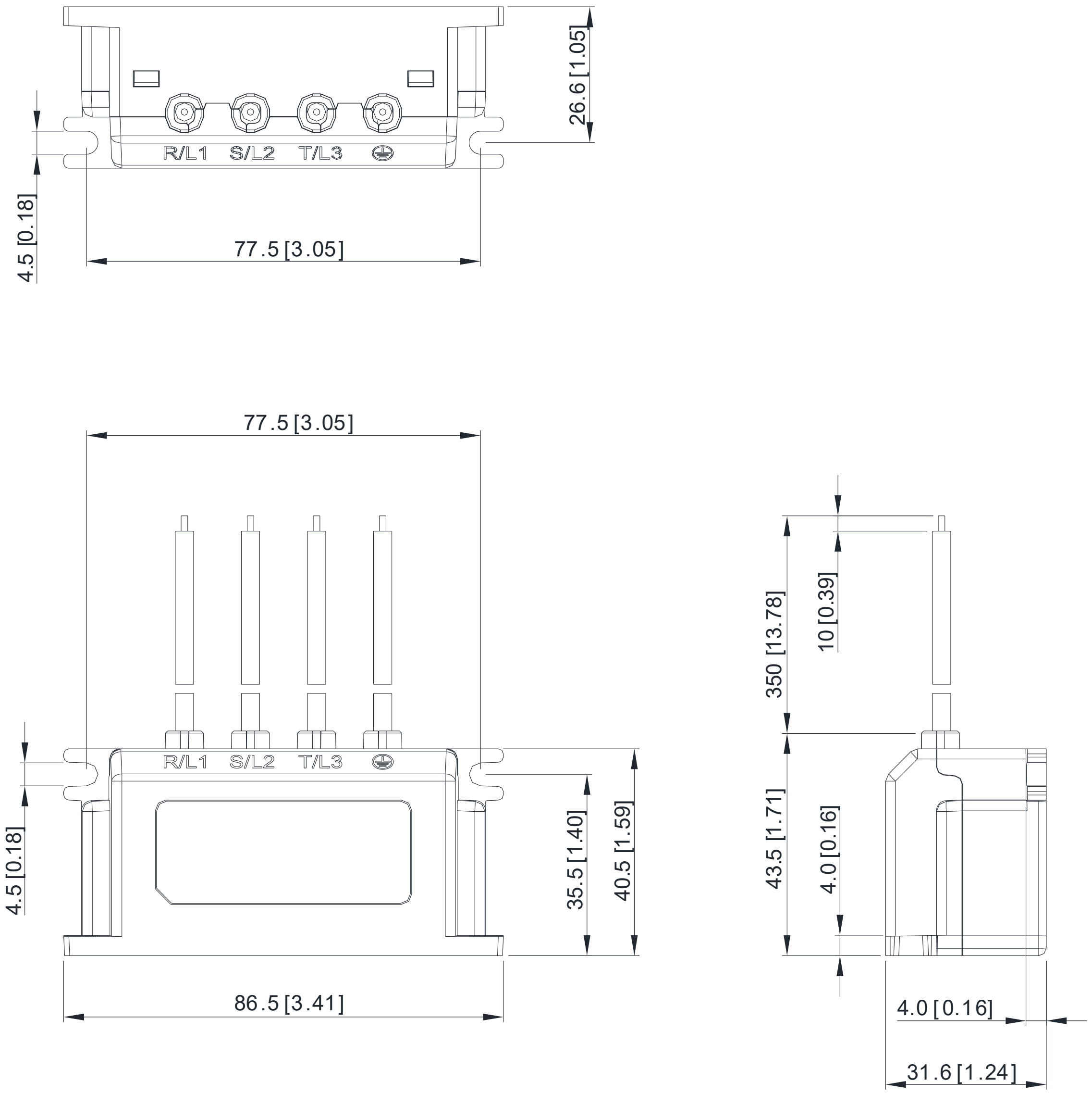
Specification:

Model	Capacitance	Temperature range
CXY101-43A	Cx：1 μF ± 20 % Cy：0.1 μF ± 20 %	-40–+85°C

Dimensions:

CXY101-43A

Unit：mm [inch]

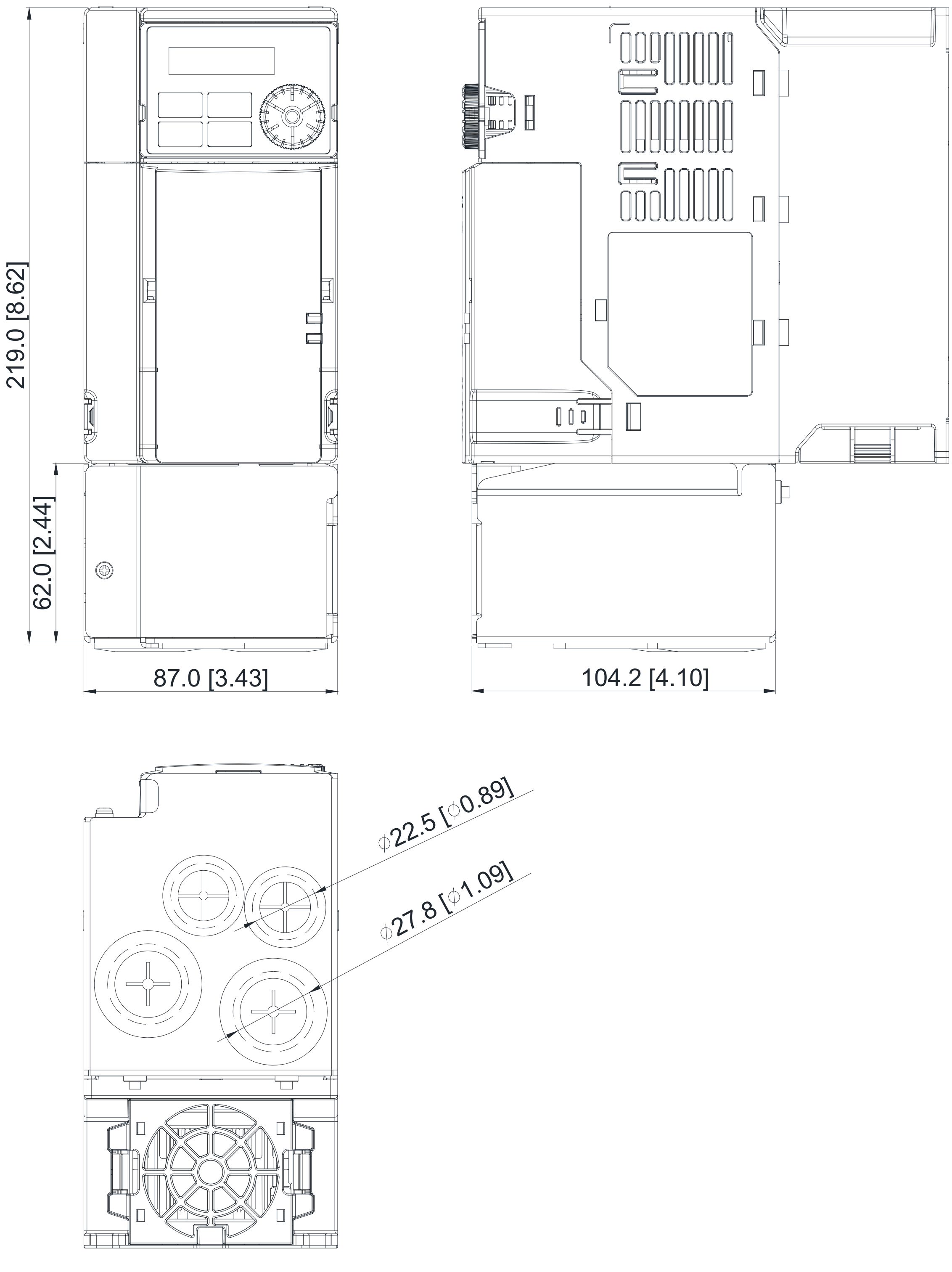


7-9 NEMA Kit

NEMA KIT complies with protection level NEMA 1 / UL Type 1.

Frame C

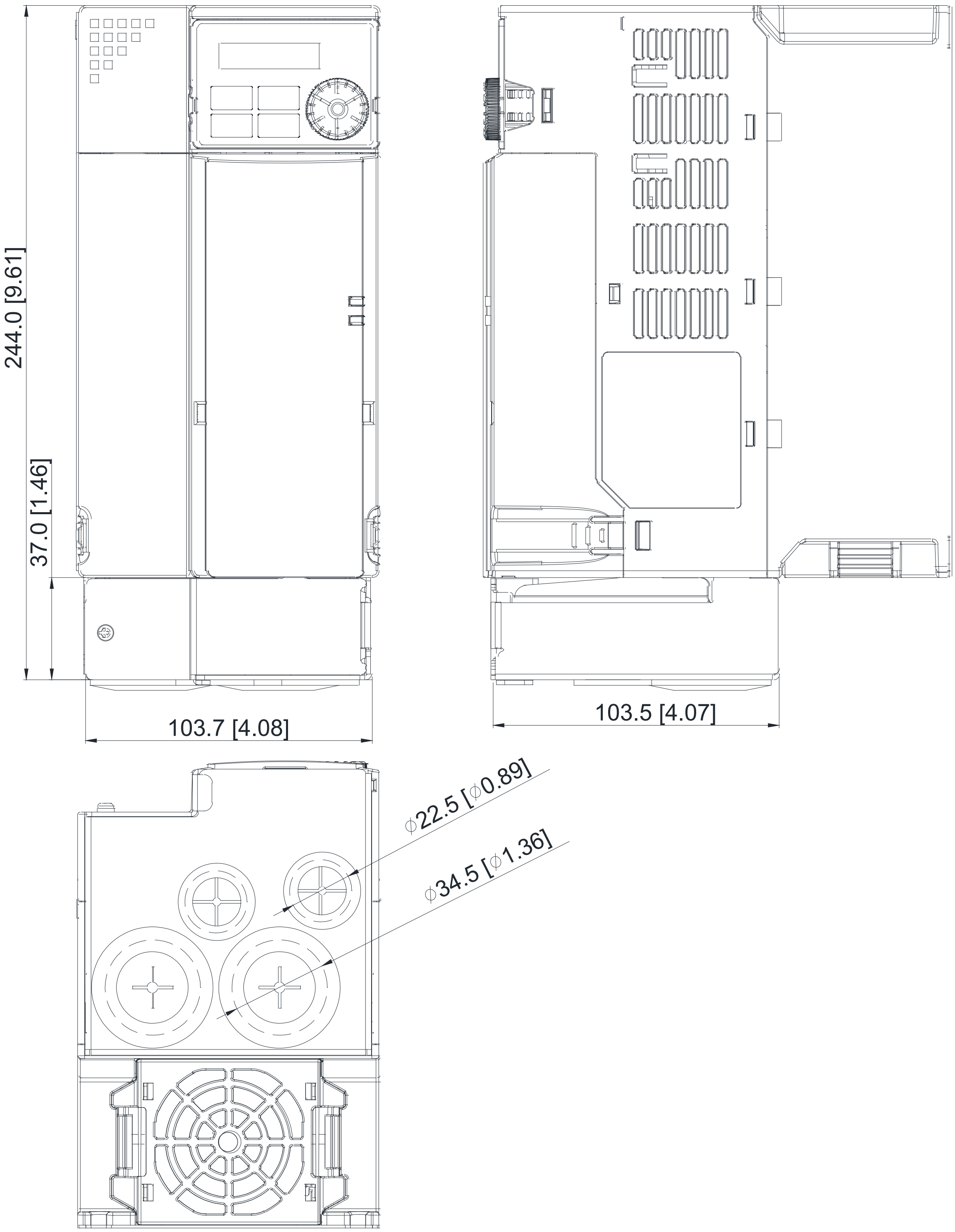
NEMA KIT model: MKMH-CBC



Unit: mm (inch)

Frame D

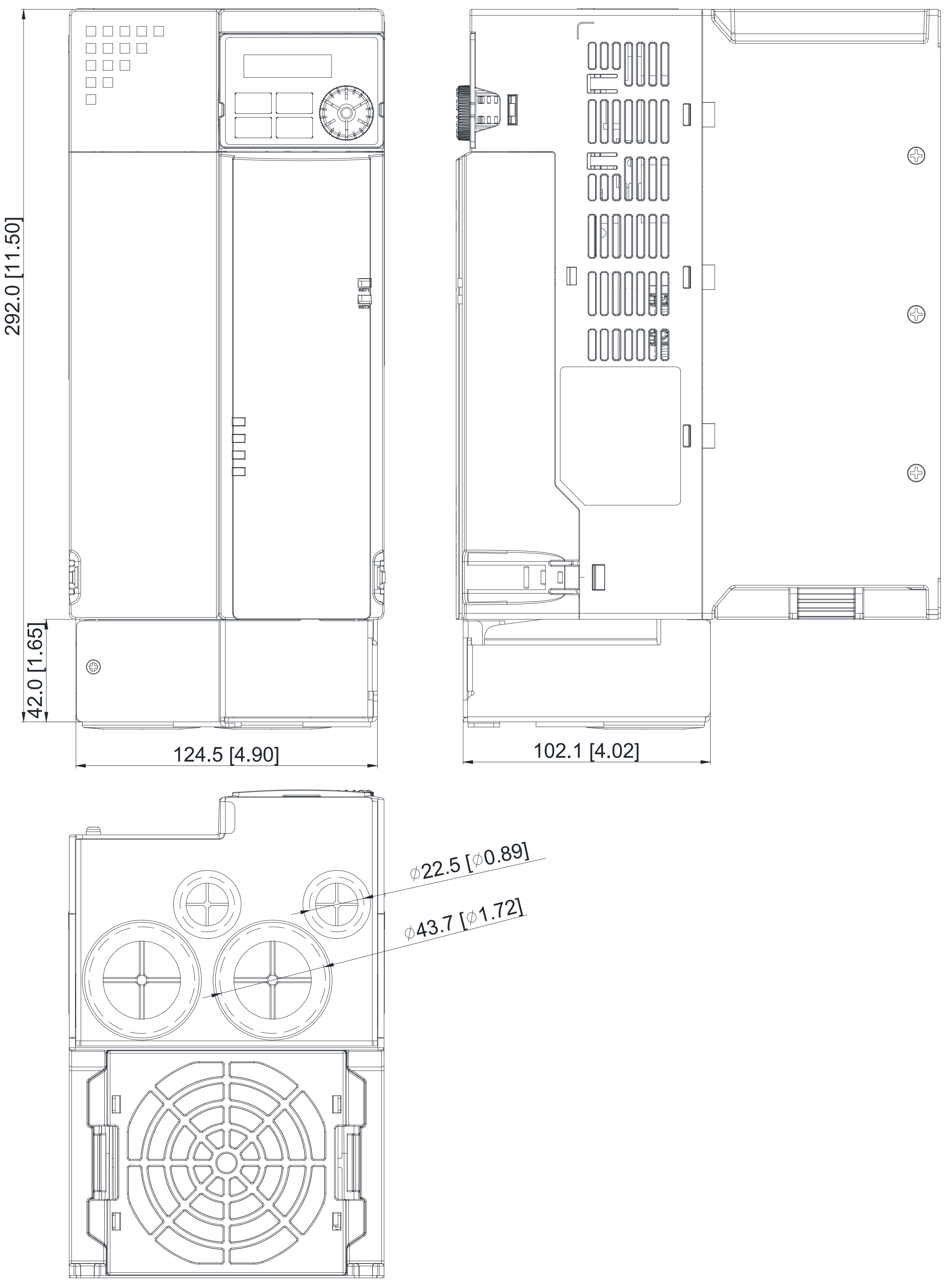
NEMA KIT model: MKMH-CBD



Unit: mm (inch)

Frame E

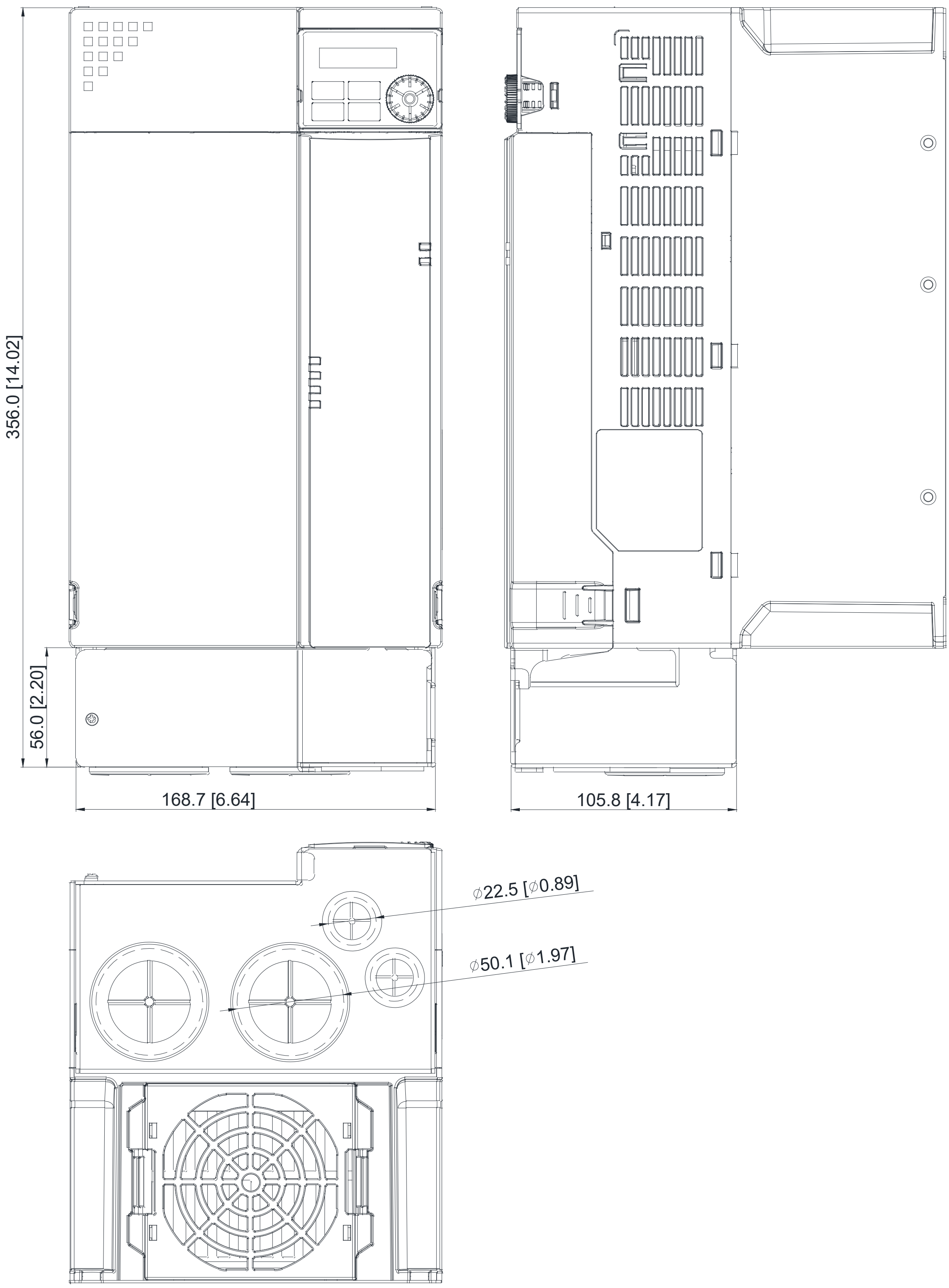
NEMA KIT model: MKMH-CBE



Unit: mm (inch)

Frame F

NEMA KIT model: MKMH-CBF

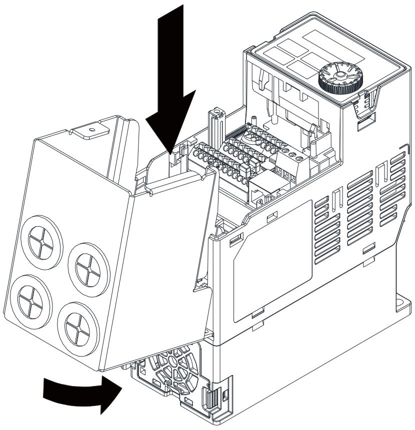
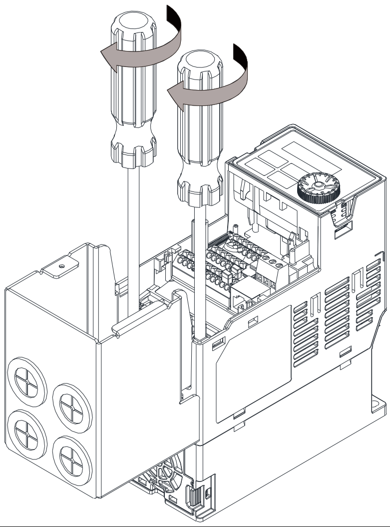
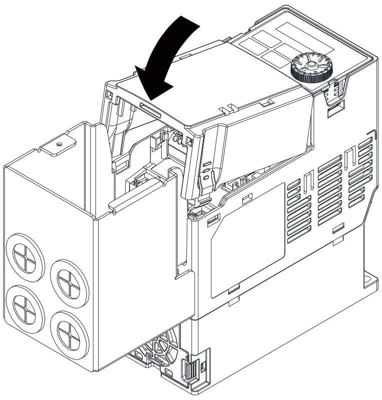
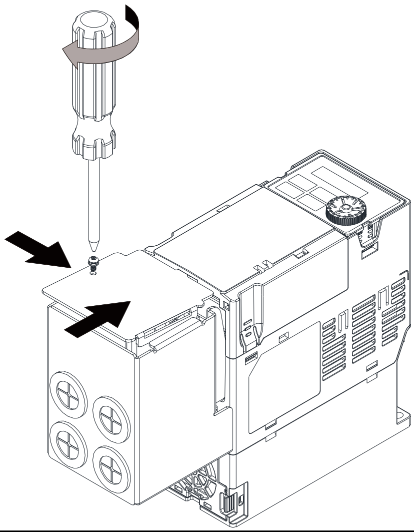
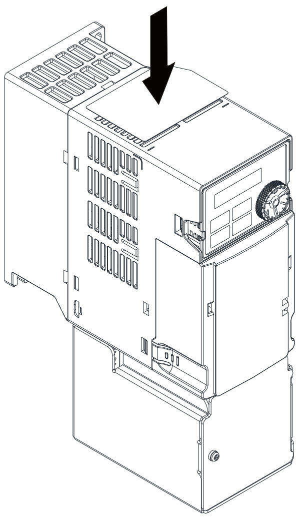


Unit: mm (inch)

Installation

Recommended screw size and torque value: M3: 4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]
M3.5: 4–6 kg-cm / [3.5–5.2 lb-in.] / [0.39–0.59 Nm]
M4: 6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]

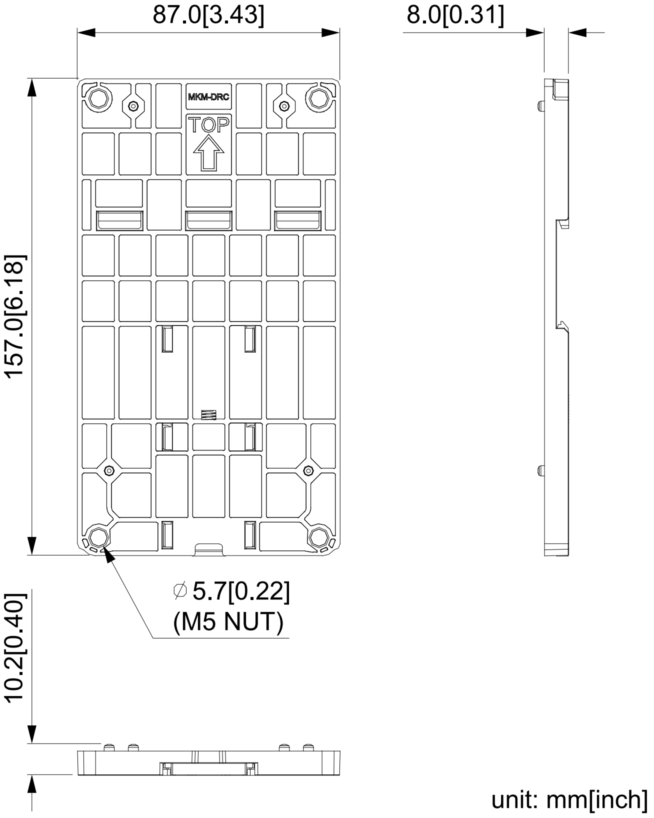
Frame C–F

1) Aim the clips at the slots to assemble the conduit box. 	2) Tighten the screws to connect with the motor. 
3) Install the front cover of the motor. 	4) Install the front cover of the conduit box and tighten the screw. 
5) Attach the dust patch. 	

7-10 DIN-Rail Mounting

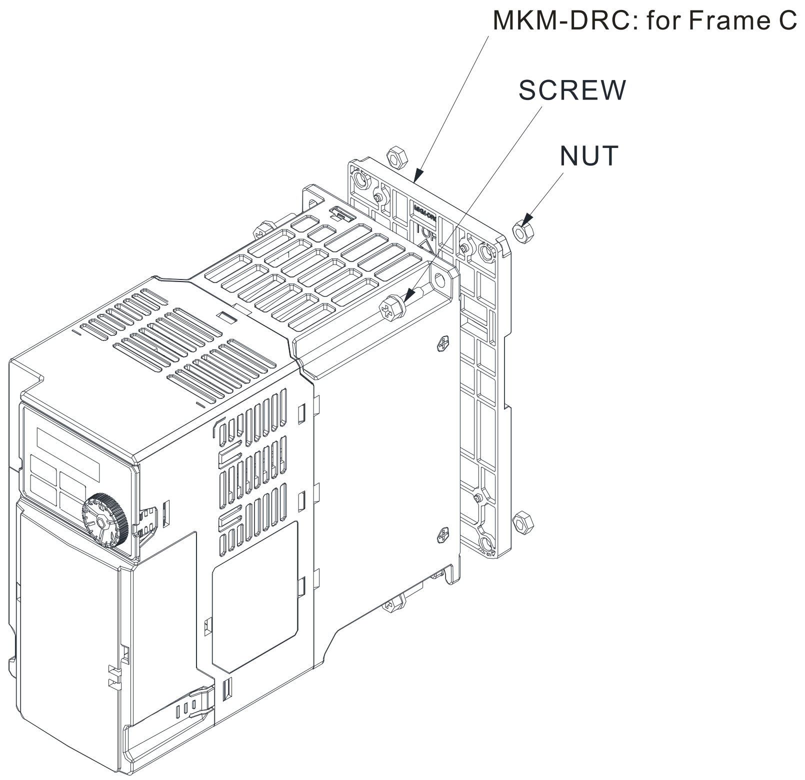
MKM-DRC (Applicable for Frame C)

Screw	Torque
M5 * 4 pcs	10–12 kg-cm (8.7–10.4 lb-in.) (0.98–1.18 Nm)



Installation

Model	Screw	Torque
MKM-DRC	M5 * P0.8 * 4 pcs	18–20 kg-cm / (15.7–17.3 lb-in.) / (1.77–1.96 Nm)



Chapter 8 Option Card

- The option cards in this chapter are optional accessories. Select the applicable option cards for your motor drive, or contact your local distributor for suggestions. The option cards can significantly improve the efficiency of the motor drive.
- To prevent damage to the motor drive during installation, remove the digital keypad and the cover before wiring.
- The option cards do not support hot swapping. Power off the motor drive before you install or remove the option cards.

8-1 Option Card Installation

The mounting position and connection method corresponding to each option card is listed as the table below. For detailed information, refer to following sections.

Option card	Model	Function	Installation method	Connection method	Subsection
I/O + Relay card	EMM-D3R2CA	Digital Card – 3in + Relay (2 sets of C contact)	Front-mounted	Connector	8-1-1

8-1-1 I/O Card Installation

Installation method: Use connector to fit the option card on the control board

1. As shown in the Figure 8-1, switch off the power of the motor drive, and then remove the front cover.
2. Mounting the connector: as shown in the Figure 8-2, aim the adapter / option card at the connector on the control board and then insert it to the connector.
3. Assembling support frame: as shown in the Figure 8-3, aim the two clips at the two slots on the motor drive and then press downward to have the two clips engage the slots.
4. Assembling the adpapter / option card: As shown in the figure 8-4, have the terminal block of the adaper / option facing up, aim the two holes of the adapter / option card to the position column and press downard so that the three clips are engage the adapter / option card.
5. As shown in the Figure 8-5, make sure that three clips are properly engage the adapter / option card and then fasten the screw. (Suggested torque value: 4–6 kg-cm / [3.5–5.2 Ib-in.] / [0.39–0.59 Nm])
6. As shown in the Figure 8-6, assembly is completed.

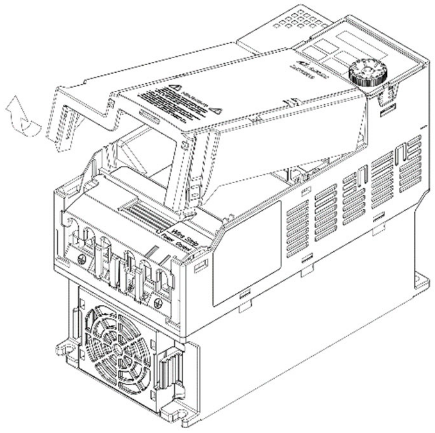


Figure 8-1

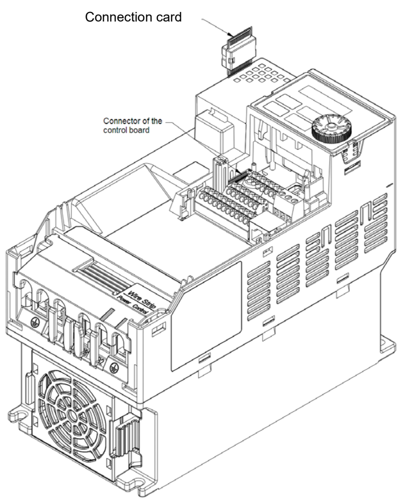


Figure 8-2

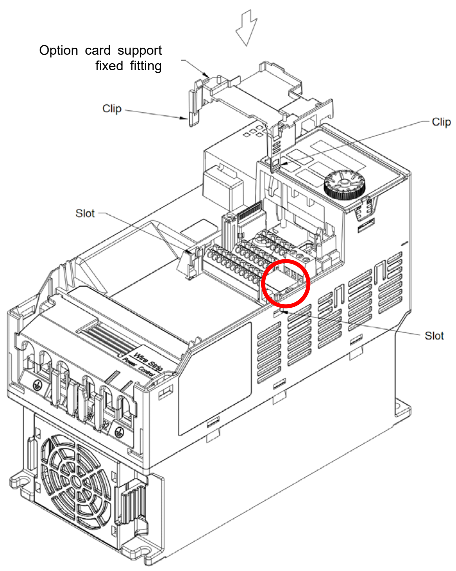


Figure 8-3

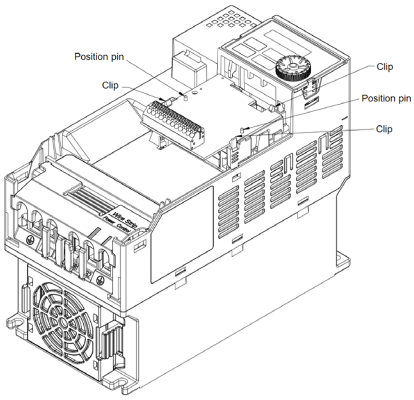


Figure 8-4

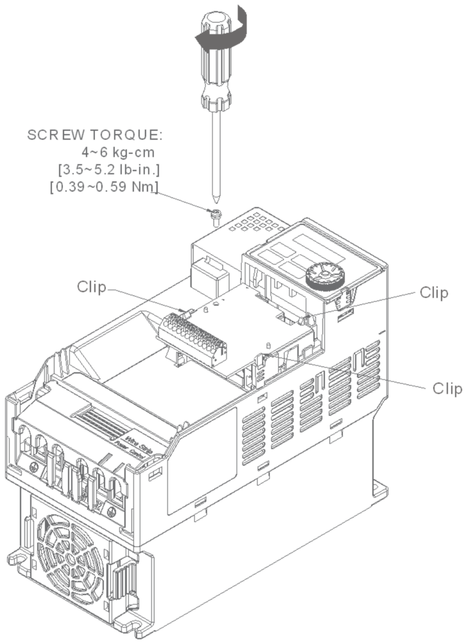


Figure 8-5

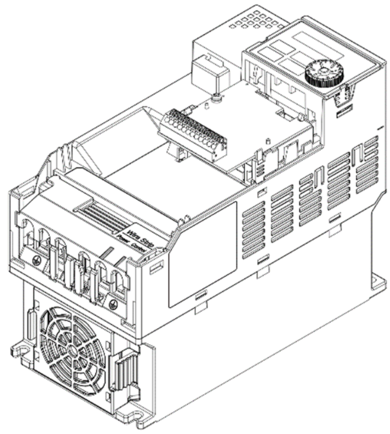


Figure 8-6

NOTE:

- The option cards listed below must connect to ground when wiring. The ground terminal is enclosed with option card as shown in Figure 8-7.

    1. EMM-D3R2CA

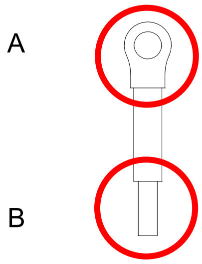


Figure 8-7

- Installation:

  The B side of the ground terminal connects to the ground terminal block on option card as No.4 of EMM-D3R2CA shown in Figure 8-8. See each section in Chapter 8 for ground terminal blocks of the other option cards. The A side of the ground terminal connects to the PE on the drive as the red circles shown in Figure 8-9.

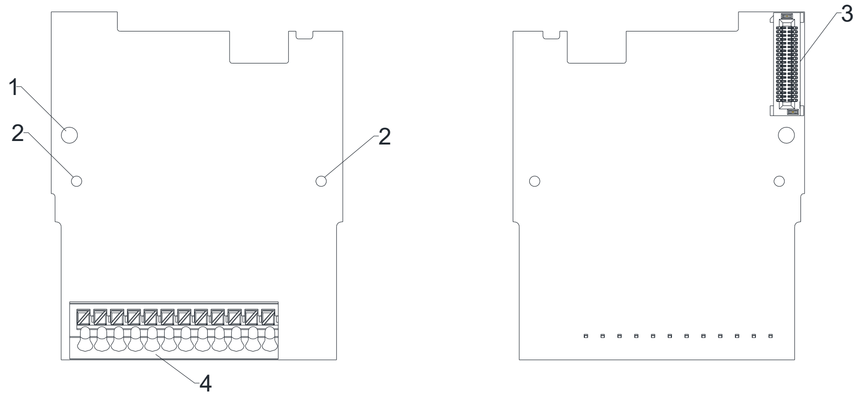
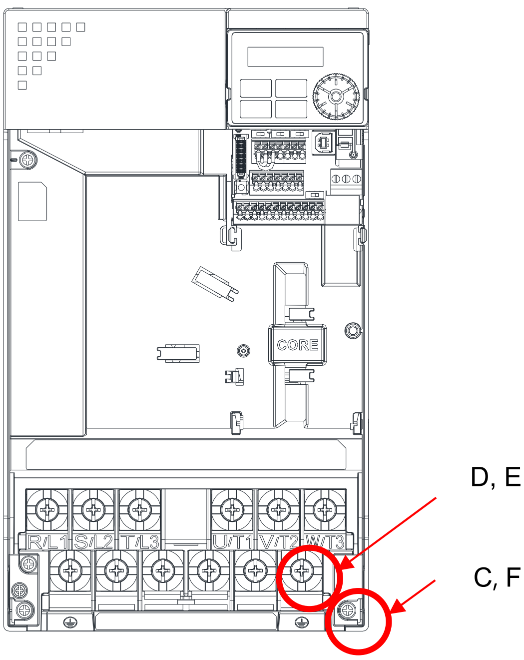


Figure 8-8

Frame C–F



Torque (±10%)

Frame C: 20 kg-cm / [17.4 Ib-in.] / [1.96 Nm]

Frame D: 20 kg-cm / [17.4 Ib-in.] / [1.96 Nm]

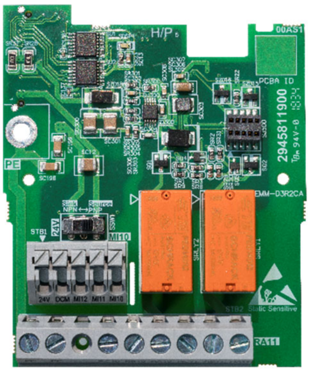
Frame E: 25 kg-cm / [21.7 Ib-in.] / [2.45 Nm]

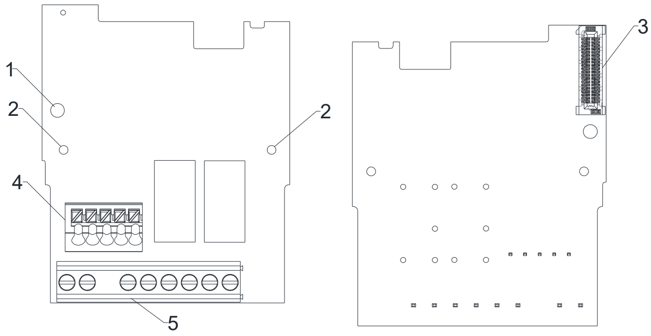
Frame F: 20 kg-cm / [17.4 Ib-in.] / [1.96 Nm]

Figure 8-9

8-2 EMM-D3R2CA

■ **Product Profile**



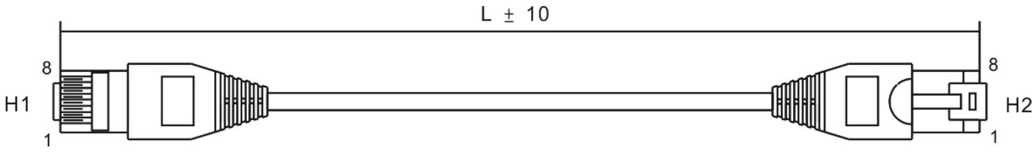


1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Spring Terminal block
5. Screw Terminal block

Wire: 0.25 mm^2 [24 AWG] –1.5 mm^2 [16 AWG]
Stripping length: 6 mm
Torque: 5 kg-cm / [4.3 Ib-in.] / [0.49 Nm]

	Terminals	Descriptions
Digital I/O & Relay Extension Card	24V, DCM	Output power: +24 V_{DC} ± 5 % < 30 mA
	MI10–MI12	Refer to Pr.02-26–Pr.02-28 to program the multi-function inputs MI10–MI12. Source Mode ON: the activation current is 3.3 mA ≥ 11 V_{DC} OFF: cut-off voltage ≤ 5 V_{DC} Sink Mode ON: the activation current is 3.3 mA ≤ 13 V_{DC} OFF: cut-off voltage ≥ 19 V_{DC}
	PE	Grounding terminal. To decrease noise, properly ground this terminal.
	RA10–RA11 RB10–RB11 RC10–RC11	Refer to Pr.02-36–Pr.02-37 to program the multi-function Resistive Load: 3 A (N.O.) / 3A (N.C.) 250 V_{AC} 5 A (N.O.) / 3A (N.C.) 30 V_{AC} Function: outputs the monitor signals, such as drive in operation, frequency reached, or overload indication.

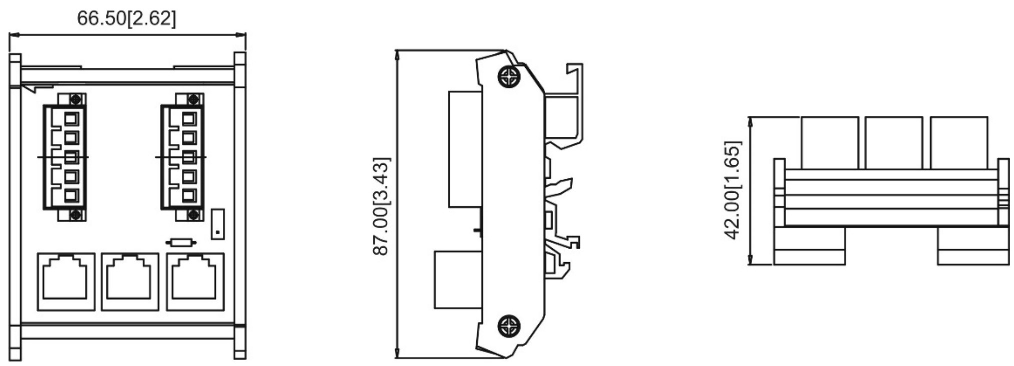
8-3 CANopen Communication Cable / Digital Keypad RJ45 Extension Cable



No.	Part No.	Length (L)	
		mm	inch
1	UC-CMC003-01A	300	11.8
2	UC-CMC005-01A	500	19.6
3	UC-CMC010-01A	1000	39
4	UC-CMC015-01A	1500	59
5	UC-CMC020-01A	2000	78.7
6	UC-CMC030-01A	3000	118.1
7	UC-CMC050-01A	5000	196.8
8	UC-CMC100-01A	10000	393.7
9	UC-CMC200-01A	20000	787.4

- **CANopen Dimension**

Model: TAP-CN03



Unit: mm [inch]

NOTE:

For more information on CANopen, see the CANopen user manual or download related manuals from the Delta website: http://www.deltaww.com/iadownload_acmotordrive

Chapter 9 Specification

9-1 230V Models

230V, three-phase

Frame		C		D	E		F
Model VFD_ _ _ _ _ _ _ _ _SLA		11AMH23AN	17AMH23AN	25AMH23AN	33AMH23AN	49AMH23AN	65AMH23AN
Applicable Motor Output (kW)		2.2	3.7	5.5	7.5	11	15
Applicable Motor Output (HP)		3	5	7.5	10	15	20
Output Rating	Rated Output Capacity (kVA)	4.2	6.5	9.5	12.6	18.7	24.8
	Rated Output Current (A)	11.0	17.0	25.0	33.0	49.0	65.0
	Carrier Frequency (kHz)	2–15 (Default: 8)					
Input Rating	Rated Input Current (A)	13.2	20.4	30.0	39.6	58.8	78.0
	Rated Voltage / Frequency	three-phase, AC 200V–240V (-15 % –+10 %), 50/60 Hz					
	Operating Voltage Range (V_{AC})	170–265					
	Frequency Range (Hz)	47–63					
Weight (kg)		1.24	1.24	2.07	3.97	3.97	6.30
Cooling Method		Fan cooling					
EMC Filter		Optional					
Ingress Protection Rating		IP20					

NOTE:

- The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram for Pr.06-55 for more information.
- When a load is a shock or impact load, use a higher level model.

9-2 460V Models

460V, three-phase

Frame		C		D				E			
Model VFD_ _ _ _ _ _ _ SLA		9A0MH43_ _		13AMH43_ _		17AMH43_ _		25AMH43_ _		32AMH43_ _	
		AN	AF	AN	AF	AN	AF	AN	AF	AN	AF
Applicable Motor Output (kW)		3.7		5.5		7.5		11		15	
Applicable Motor Output (HP)		5		7.5		10		15		20	
Output Rating	Rated Output Capacity (KVA)	6.9		9.9		13.3		19.1		24.4	
	Rated Output Current (A)	9.0		13.0		17.5		25.0		32.0	
	Carrier Frequency (kHz)	2–15 (Default: 8)									
Input Rating	Rated Input Current (A)	9.9		14.3		19.3		27.5		35.2	
	Rated Voltage / Frequency	three-phase AC 380V–480V (-15 % – +10 %), 50/60 Hz									
	Operating Voltage Range (V_{AC})	323–528									
	Frequency Range (Hz)	47–63									
Weight (kg)		1.24	1.84	2.07	2.93	2.07	2.93	3.97	5.19	3.97	5.19
Cooling Method		Fan cooling									
EMC Filter		AN : Optional AF : Built-in									
Ingress Protection Rating		IP20									

NOTE:

- The value of the carrier frequency is set in the factory. To increase the carrier frequency, decrease the current. See the derating curve diagram for Pr.06-55 for more information.
- When a load is a shock or impact load, use a higher level model.

General Specifications

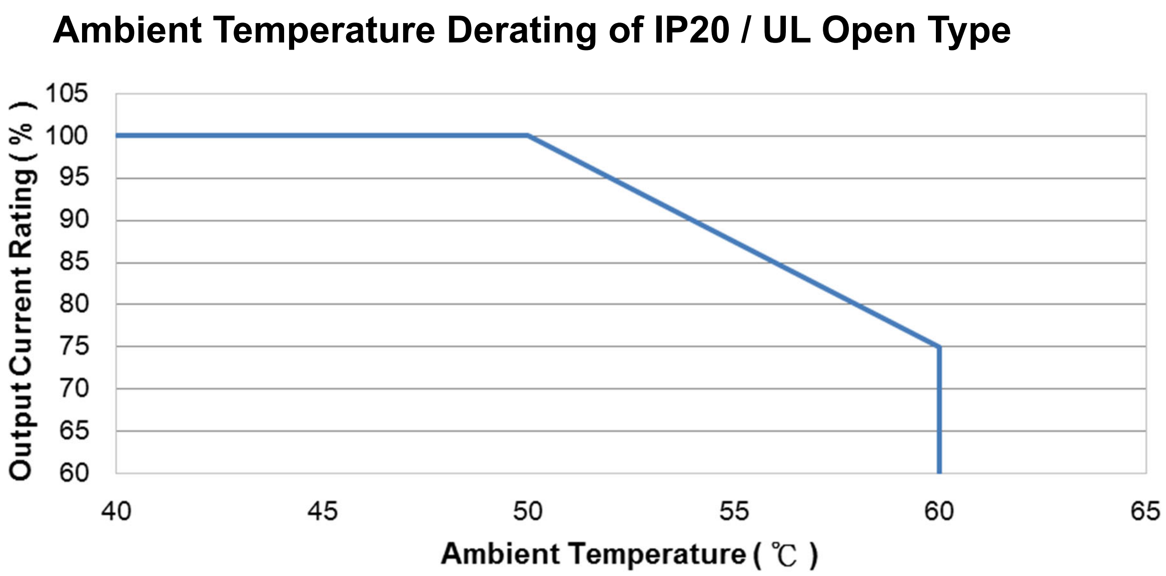
Control Characteristics	Control Method	V/F, SVC
	Applied Motor	IM (Induction Motor)
	Max. Output Frequency	0.00–299.00 Hz
	Starting Torque	150 % / 3 Hz
	Speed Control Range	1: 50
	Overload Capability	150 % 60s, 200 % 3s
	Frequency Setting Signal	0–+10V / +10V – -10V 4–20 mA / 0–+10V 1 channel pulse input (33 kHz), 2 channel pulse output (33 kHz)
	Main Function	Fast start-up, Momentary power loss ride thru, Over-torque detection, 16-step speed (max.), Accel./decal. time switch, S-curve accel/decel, three-wire sequence, JOG frequency, Upper/lower limits for frequency reference, DC injection braking at start and stop, MODBUS and CAN are integrated as standard
Protection Characteristics	Motor Protection	Over-current, Over-voltage, Over-temperature, Phase loss, Over-load
	Stall Prevention	Stall prevention during acceleration, deceleration and running (independent settings)
Accessory	I/O extension cards	EMM-D3R2CA (Digital/Relay Card – 3 input and 2 relay C output)
Certifications		UL, CE, C-Tick, RoHS, REACH, TUV(SIL2)

9-3 Environment for Operation, Storage and Transportation

<table>
<tr><td colspan="5">DO NOT expose the AC motor drive in the bad environment, such as dust, direct sunlight, corrosive/ inflammable gasses, humidity, liquid and vibration environment. The salt in the air must be less than 0.01 mg/ cm^2 every year.</td></tr>
<tr><td rowspan="17">Environment</td><td>Installation location</td><td colspan="3">IEC60364-1/ IEC60664-1 Pollution degree 2, Indoor use only</td></tr>
<tr><td rowspan="5">Surrounding Temperature</td><td rowspan="2">Operation</td><td>IP20 / UL Open Type</td><td>-20–50 °C
-20–60 °C (Derating required)</td></tr>
<tr><td>Installed side by side</td><td>-20–55 °C (Derating required)</td></tr>
<tr><td>Storage</td><td colspan="2">-40–85 °C</td></tr>
<tr><td>Transportation</td><td colspan="2">-20–70 °C</td></tr>
<tr><td colspan="3">Non-condensation, non-frozen</td></tr>
<tr><td rowspan="3">Rated Humidity</td><td>Operation</td><td colspan="2">Max. 90 %</td></tr>
<tr><td>Storage / Transportation</td><td colspan="2">Max. 95 %</td></tr>
<tr><td colspan="3">No condense water</td></tr>
<tr><td rowspan="2">Air Pressure</td><td>Operation</td><td colspan="2">86 –106 kPa</td></tr>
<tr><td>Storage / Transportation</td><td colspan="2">70–106 kPa</td></tr>
<tr><td rowspan="5">Pollution Level</td><td colspan="3">IEC 60721-3-3</td></tr>
<tr><td>Operation</td><td colspan="2">Class 3C2; Class 3S2</td></tr>
<tr><td>Storage</td><td colspan="2">Class 2C2; Class 2S2</td></tr>
<tr><td>Transportation</td><td colspan="2">Class 1C2; Class 1S2</td></tr>
<tr><td colspan="3">Concentrate prohibited</td></tr>
<tr><td>Altitude</td><td colspan="3">Operable at altitude below 1000 m (derating if operated over 1,000 m)</td></tr>
<tr><td rowspan="2">Package Drop</td><td>Storage</td><td rowspan="2" colspan="3">ISTA procedure 1A (according to weight) IEC 60068-2-31</td></tr>
<tr><td>Transportation</td></tr>
<tr><td rowspan="2">Vibration</td><td>Operating</td><td colspan="3">1.0 mm, peak to peak value range from 2–13.2 Hz; 0.7 G–1.0 G range from 13.2–55 Hz; 1.0 G range from 55–512 Hz; Comply with IEC 60068-2-6</td></tr>
<tr><td>Non-operating</td><td colspan="3">2.5 G Peak
5 Hz–2 kHz
0.015" Displacement Max.</td></tr>
</table>

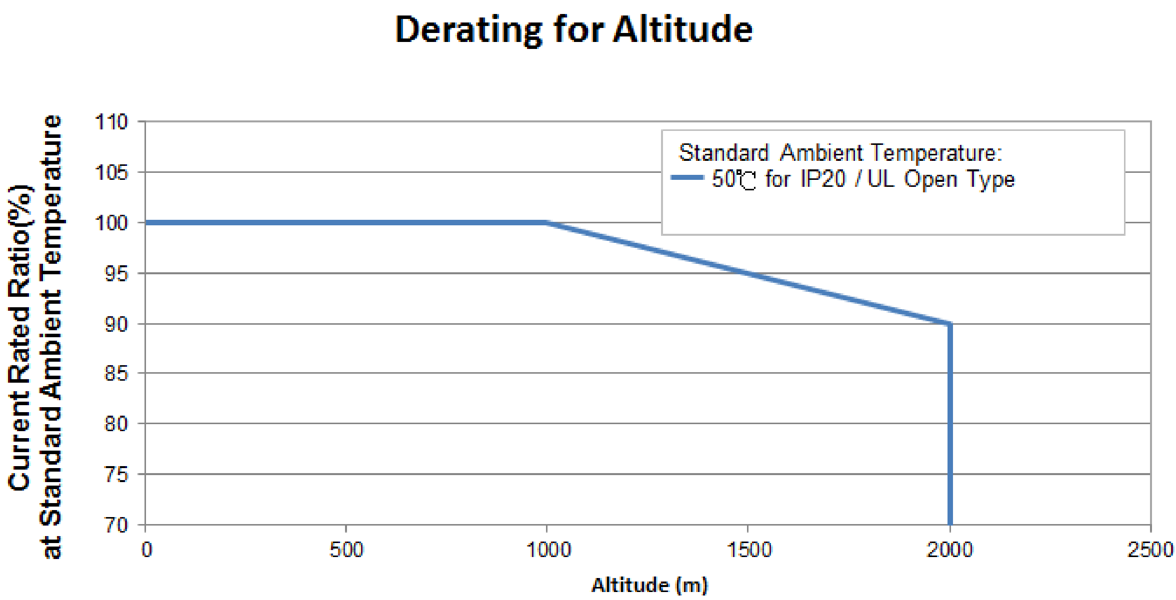
9-4 Derating of Ambient Temperature and Altitude

- **Derating of Ambient Temperature**



At the rated current the ambient temperature is -10˚C–+50°C.
Over 50°C, decrease the rated current 2.5%/°C up to 60°C.

- **Derating of Altitude**



For IP20 / UL Open Type

Current derating at ambient temperature				
Ambient temperature		40 °C	45 °C	50 °C
Operating altitude above sea level (m)	0-1000	100%		
	1001–1500	100%		95%
	1501–2000	100%	95%	90%

Operating Conditions	**Ambient Temperature Limits**
IP20 / UL Open Type	When the AC motor drive is operating at the rated current, the ambient temperature has to be between -20°C– +50 °C. When the temperature is over 50 °C, for every increase by 1 °C, decrease 2.5 % of the rated current. The maximum allowable temperature is 60 °C.
High Altitude	If the AC motor drive is installed at altitude 0–1000 m, follow normal operation restriction. If it is installed at altitude 1000–2000 m, decrease 1 % of rated current or lower 0.5 °C of temperature for every 100 m increase in altitude. Maximum altitude for Corner Grounded is 2000 m. Contact Delta for more information if you need to use this motor drive at an altitude of 2000 m or higher.

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Chapter 10 Digital Keypad

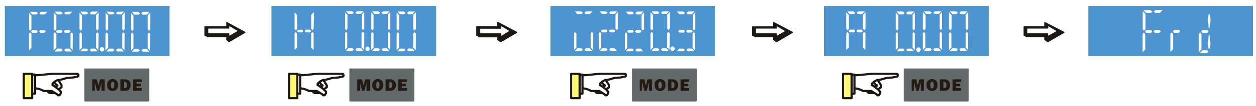
10-1 KPMH-LC01 Keyboard Panel

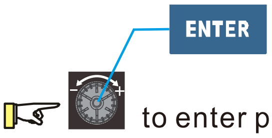
10-2 Descriptions of Keypad Functions

Displayed items	Descriptions
	Displays the present frequency setting for the drive
	Displays the actual frequency output to the motor
	Displays the user-defined output of a physical quantity This example is for parameter Pr.00-04 = 30
	Displays the load current
	Forward command
	Reverse command
	Displays the count value
	Displays a parameter item
	Displays the content of a parameter value
	Displays an external fault
	Displays the data that has been accepted and automatically stored in the internal memory
	Displays the data set that is not accepted or has exceeded the value

10-3 Keypad Operation Process

A. Main Page Selection





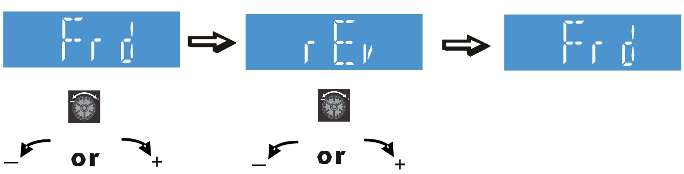
Note: Press in page selection mode to enter parameters setting.

Setting parameters

Note: In the parameter setting mode, you can press MODE to go back to previous action

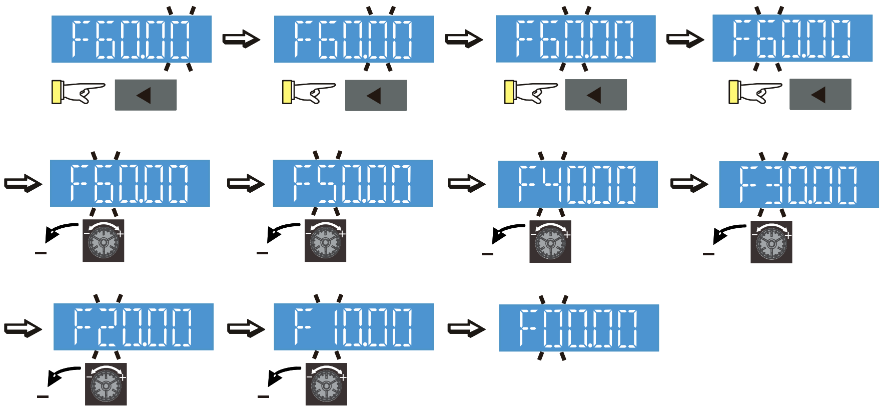
To shift data

Setting direction (When the operation source is the digital keypad.)

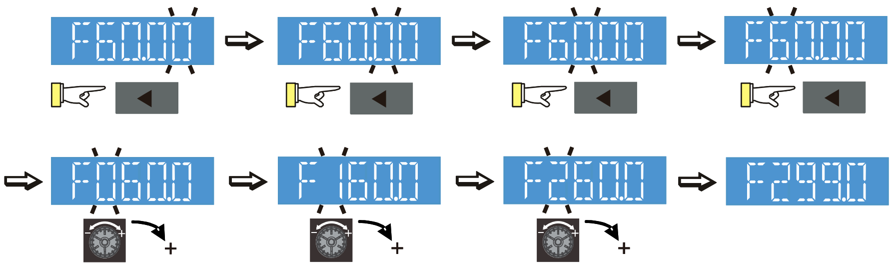


B. F Page (Frequency command setting page)

General Mode 1
(maximum operating frequency Pr.01-00 is 2 digits; for example Pr.01-00 = 60.00 Hz)



General Mode 2
(maximum operating frequency Pr.01-00 is 3 digits; for example Pr.01-00 = 299.0 Hz)



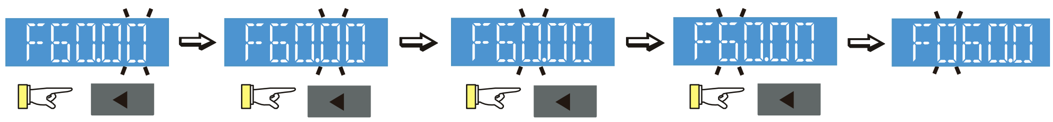
C. Parameter setting

C-1. Unsigned parameter

(Parameter setting range ≥ 0; e.g.: Pr.01-00)

1. Without using the left shift key: rotate the digital dial to select and adjust the parameters.
2. Using the left shift key: After you press the left shift key, and the last digit starts to blink. Press the left shift key to move the blinking cursor to the digit to adjust, and increase the value by rotating the digital dial clockwise. The value goes back to 0 after 9. Decrease the value by rotating the digital dial counter-clockwise. The value goes to 9 after 0.

   For example: the default setting for Pr.01-00 is 60.00. Pressing the left shift key causes the blinking cursor to move one digit to the left:



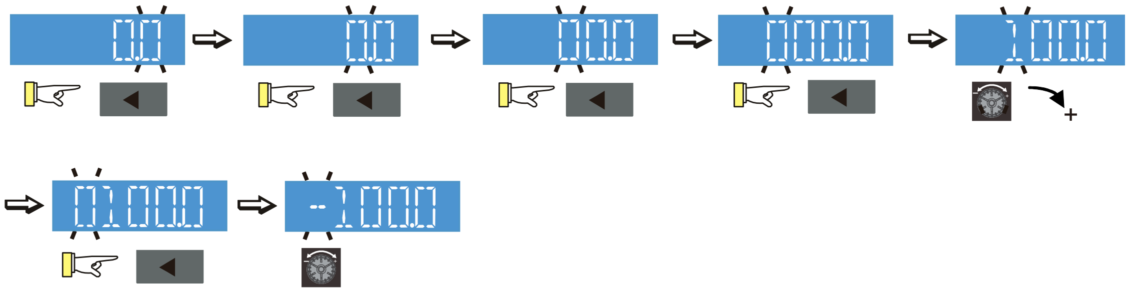
The upper setting limit for Pr.01-00 is 299.00. If you set a value greater than 299.00, “Err” appears after you press the digital dial, and then the keypad shows the upper limit (299.00) for a second to remind you of the incorrect setting. The setting remains as the original value and the cursor returns to the last digit.

C-2. Signed parameter setting status 1

(Parameter setting range can be less than 0, e.g.: Pr.03-03)

1. Without using the left shift key: rotate the digital dial to select and adjust the parameters.
2. Using left shift key: After pressing left shift key, the last digit starts to blink. Press the left shift key to move to the digit to adjust, and increase the value by rotating the digital dial clockwise. The value goes back to 0 after 9. Decrease the value by rotating the digital dial counter-clockwise, and the value goes to 9 after 0.
3. Press left shift button to shift the blinking cursor one digit to the left. When you shift to the first digit and press the digital dial, the digit “0” changes to “-” (minus).

For example: the default setting for Pr.03-03 is 0.0. If the value should be -100, then use the left shift key to shift the blinking cursor to the hundreds digit. Rotate the digital dial clockwise to 1, and then press left shift to move to the first digit. Rotate the digital dial from‘0’ to ‘-’.



The upper limit for Pr.03-03 is 100.0 and lower limit is -100.0. If the value is more than 100.0 or less than -100.0, “Err” appears after you press the digital dial, and then the keypad shows the upper limit (100.0) or lower limit (-100.0) for a second to remind you of the incorrect setting. The setting value remains as the original set value, and the cursor returns to the last digit.

C-3. Signed parameter setting status 2

(Parameter setting range can be less than 0, and the lower limit ≤ -100.00, with two decimal places, e.g. Pr.03-74)

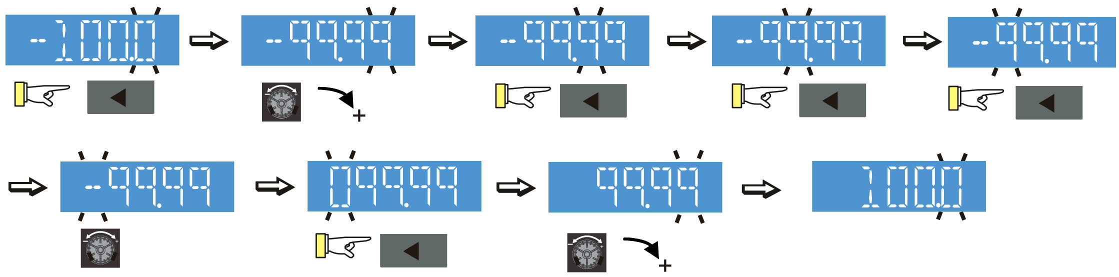
Do not use the left shift key: rotate the digital dial to select and adjust the parameters.

Use the left shift key: After pressing left shift key, and the last digit starts to blink. Press the left shift key to move to the digit to adjust, and then increase the value by rotating the digital dial clockwise. The value goes back to 0 after 9. Decrease the value by rotating the digital dial counter-clockwise, and the value goes to 9 after 0.

Press left shift button to shift the blinking cursor one digit to the left. When you shift to the first digit and press the digital dial, the digit “0” changes to “-” (minus).

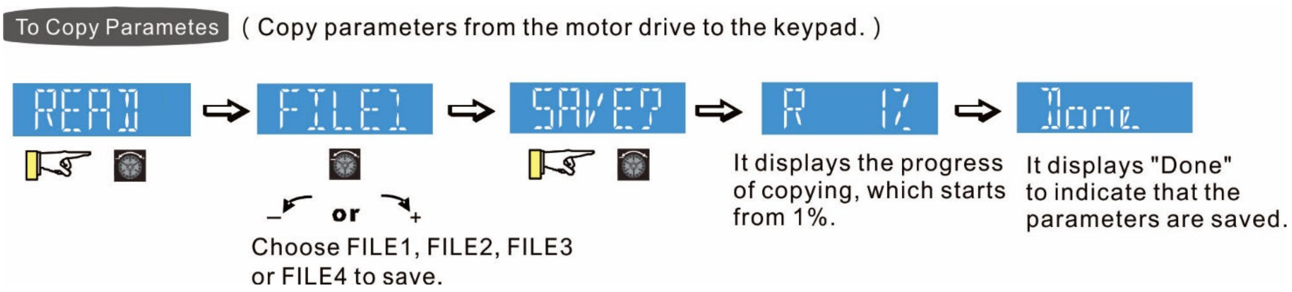
Note: When the parameter value can be set to 2 decimal places, and the set value has hundred digits, then you cannot shift the blinking cursor with the left shift key.

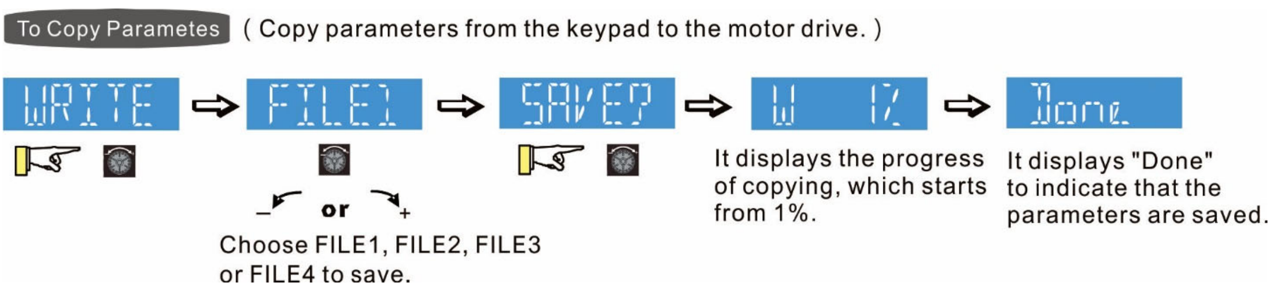
For example: change Pr.03-74 from -100 to 100



The upper limit for Pr.03-74 is 100.00 and lower limit is -100.00. If you set a value of more than 100.0 or less than -100.0, “Err” appears after you press the digital dial, and then the keypad shows the upper limit (100.0) or lower limit (-100.0) (only 1 decimal) for a second to remind you of the incorrect setting. The setting value remains as the original set value. The cursor returns to the last digit.

D. To Copy Parameters





10-4 Reference Table for the 16-segment LED Display of the Digital Keypad

Number	0	1	2	3	4	5	6	7	8	9
16-segment display										
Alphabet	A	a	B	b	C	c	D	d	E	e
16-segment display		-								
Alphabet	F	f	G	g	H	h	I	i	J	j
16-segment display				-						
Alphabet	K	k	L	l	M	m	N	n	O	o
16-segment display		-		-		-				
Alphabet	P	p	Q	q	R	r	S	s	T	t
16-segment display		-						-		
Alphabet	U	u	V	v	W	w	X	x	Y	y
16-segment display								-		-
Alphabet	Z	z								
16-segment display		-								

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Chapter 11 Summary of Parameter Settings

00 Drive Parameters

01 Basic Parameters

02 Digital Input / Output Parameters

03 Analog Input / Output Parameters

04 Multi-step Speed Parameters

05 Motor Parameters

06 Protection Parameters

07 Special Parameters

09 Communication Parameters

10 Speed Feedback Control Parameters

11 Advanced Parameters

This chapter provides a summary of parameter (Pr.) setting ranges and defaults. You can set, change, and reset parameters through the digital keypad.

NOTE:

1. 𝑁: You can set this parameter during operation.
2. See Chapter 12 for more details about parameter settings.

00 Drive Parameters

	Pr.	Parameter Name	Setting Range	Default
	00-00	Identity code of the AC motor drive	206: 230 V, Three-phase, 3 HP 207: 230 V, Three-phase, 5 HP 208: 230 V, Three-phase, 7.5 HP 209: 230 V, Three-phase, 10 HP 210: 230 V, Three-phase, 15 HP 211: 230 V, Three-phase, 20 HP 407: 460 V, Three-phase, 5 HP 408: 460 V, Three-phase, 7.5 HP 409: 460 V, Three-phase, 10 HP 410: 460 V, Three-phase, 15 HP 411: 460 V, Three-phase, 20 HP	Read only
	00-01	Display AC motor drive rated current	Display by models	Read only
	00-02	Parameter reset	0: No function 1: Write protection for parameters 5: Reset kWH display to 0 7: Reset CANopen index (slave) 9: Reset all parameters to defaults with base frequency at 50 Hz 10: Reset all parameters to defaults with base frequency at 150 Hz	0
𝑁	00-03	Start-up display selection	0: F (Frequency command) 1: H (output frequency) 2: U (user-defined, see Pr.00-04) 3: A (output current)	0
𝑁	00-04	Content of multi-function display (user-defined)	0: Display the output current from the drive to the motor (A) (unit: Amps) 1: Display the counter value (c) (unit: CNT) 2: Display the drive's actual output frequency (H.) (unit: Hz) 3: Display the drive's DC bus voltage (V) (unit: V_{DC}) 4: Display the drive's output voltage (E) (unit: V_{AC}) 5: Display the drive's output power angle (n) (unit: deg) 6: Display the drive's output power (P) (unit: kW)	3

Pr.	Parameter Name	Setting Range	Default
		7: Display the motor speed (unit: rpm) 8: Display the drive's estimated output torque percentage, motor's rated torque is 100% (t) (unit: %) 11: Display signal value of AVI analog input terminal (1.) (unit: %) 12: Display signal value of ACI analog input terminal (2.) (unit: %) 14: Display the drive's IGBT temperature (i.) (unit: °C) 15: Display CAP temperature (i.) (unit: °C) 16: Display digital input status (ON / OFF) (i) 17: Display digital output status ON / OFF (o) 18: Display the current multi-step speed (S) 19: Display corresponding CPU digital input pin status (d) 20: Display corresponding CPU digital output pin status (0.) 25: Overload count (0.00–100.00%) (o.) (unit: %) 26: Ground fault (G.) (unit: %) 27: DC bus voltage ripple (r.) (unit: V_{DC}) 30: Display the output of user-defined parameter (U) 35: Control mode: 0 = Speed control mode (SPD) 36: The current operating carrier frequency of the drive (J.) (unit: Hz) 38: Display the drive status (6.) 41: kWH display (J) (unit: kWh) 47: Master frequency value (A) (unit: Hz)	
00-06	Firmware version	Read only	Read only
00-07	Parameter protection password input	0–65535 0–3 (number of incorrect password attempts)	0
00-08	Parameter protection password setting	0–65535 0: No password protection / password is entered correctly (Pr.00-07) 1: Password has been set	0
00-11	Speed control mode	0: VF (IM V/F control) 1: IMVFPG (IM V/F control + Encoder) 2: SVC	0
00-17	Carrier frequency	2–15 kHz	8
00-20	Master frequency command source (AUTO, REMOTE)	0: Inputs from digital keypad 1: Inputs from RS-485 communication 2: Inputs from external analog (Refer to Pr.03-00, 03-01) 3: Inputs from external UP / DOWN terminals (multi-	0

	Pr.	Parameter Name	Setting Range	Default
			function input terminals) 6: CANopen input Note: It is valid only when using with KPC-CC01.	
〆	00-21	Operation command source (AUTO, REMOTE)	0: Digital keypad 1: External terminals 2: Communication RS-485 input 3: CANopen input Note: It is valid only when using with KPC-CC01.	0
〆	00-48	Display filter time (Current)	0.001–65.535 sec.	0.100
〆	00-49	Display filter time (Keypad)	0.001–65.535 sec.	0.100
	00-50	Software version (Date)	Read only	Read only

01 Basic Parameters

	Pr.	Parameter Name	Setting Range	Default
	01-00	Motor 1 maximum operation frequency	0.00–299.00 Hz	60.00/ 50.00
	01-01	Motor 1 rated / base frequency	0.00–299.00 Hz	60.00/ 50.00
	01-02	Motor 1 rated / base voltage	230V models: 0.0 V–255.0 V 460 V models: 0.0 V–510.0 V	220.0 440.0
	01-03	Motor 1 mid-point frequency 1	0.00–299.00 Hz	3.00
✔	01-04	Motor 1 mid-point voltage 1	230 V models: 0.0 V–240.0 V 460 V models: 0.0 V–480.0 V	11.0 22.0
	01-05	Motor 1 mid-point frequency 2	0.00–299.00 Hz	0.50
✔	01-06	Motor 1 mid-point voltage 2	230 V models: 0.0 V–240.0 V 460 V models: 0.0 V–480.0 V	2.0 4.0
	01-07	Motor 1 minimum output frequency	0.00–299.00 Hz	0.00
✔	01-08	Motor 1 minimum output voltage	230 V models: 0.0 V–240.0 V 460 V models: 0.0 V–480.0 V	0.0 0.0
	01-09	Start-up frequency	0.00–299.00 Hz	0.50
✔	01-10	Output frequency upper limit	0.00–299.00 Hz	299.00
✔	01-11	Output frequency lower limit	0.00–299.00 Hz	0.00
✔	01-12	Acceleration time 1	0.00–600.00 sec.	2.00
✔	01-13	Deceleration time 1	0.00–600.00 sec.	2.00
✔	01-14	Acceleration time 2	0.00–600.00 sec.	10.00
✔	01-15	Deceleration time 2	0.00–600.00 sec.	10.00
✔	01-16	Acceleration time 3	0.00–600.00 sec.	10.00
✔	01-17	Deceleration time 3	0.00–600.00 sec.	10.00
✔	01-18	Acceleration time 4	0.00–600.00 sec.	10.00
✔	01-19	Deceleration time 4	0.00–600.00 sec.	10.00
✔	01-20	JOG acceleration time	0.00–600.00 sec.	10.00
✔	01-21	JOG deceleration time	0.00–600.00 sec.	10.00
✔	01-22	JOG frequency	0.00–299.00 Hz	6.00
✔	01-23	First and Fourth acceleration / deceleration frequency	0.00–299.00 Hz	0.00
✔	01-24	S-curve acceleration begin time S1	0.00–25.00 sec.	1.00
✔	01-25	S-curve acceleration arrival time S2	0.00–25.00 sec.	1.00
✔	01-26	S-curve deceleration begin time S3	0.00–25.00 sec.	1.00
✔	01-27	S-curve deceleration arrival time S4	0.00–25.00 sec.	1.00
	01-28	Skip frequency 1 (upper limit)	0.00–299.00 Hz	0.00
	01-29	Skip frequency 1 (lower limit)	0.00–299.00 Hz	0.00

	Pr.	Parameter Name	Setting Range	Default
	01-30	Skip frequency 2 (upper limit)	0.00–299.00 Hz	0.00
	01-31	Skip frequency 2 (lower limit)	0.00–299.00 Hz	0.00
	01-32	Skip frequency 3 (upper limit)	0.00–299.00 Hz	0.00
	01-33	Skip frequency 3 (lower limit)	0.00–299.00 Hz	0.00
	01-34	Zero-speed mode	0: Output waiting 1: Zero-speed operation 2: Fmin (Refer to Pr.01-07)	2
✓	01-46	CANopen quick stop time	0.00–600.00 sec.	1.00
	01-71	Leveling Speed Switch	0.00–299.00 Hz	0.00
✓	01-72	Lower than Leveling Speed S5	0.00–25.00 sec.	1.00
✓	01-73	Deceleration Time when Operating without RUN Command	0.00–25.00 sec.	2.00

02 Digital Input / Output Parameters

<table>
<tr><th>Pr.</th><th>Parameter Name</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>02-00</td><td>Two-wire / Three-wire operation control</td><td>0: No function
1: Two-wire mode 1, power on for operation control
(M1: FWD/STOP, M2: REV/STOP)
2: Two-wire mode 2, power on for operation control
(M1: RUN/STOP, M2: FWD/REV)
3: Three-wire, power on for operation control
(M1: RUN, M2: REV/FWD, M3: STOP)
4: Two-wire mode 1, Quick Start
(M1: FWD/STOP, M2: REV/STOP)
5: Two-wire mode 2, Quick Start
(M1: RUN/STOP, M2: FWD/REV)
6: Three-wire, Quick Start
(M1: RUN, M2: REV/FWD, M3: STOP)
<u>IMPORTANT</u>
1. In the Quick Start mode, terminal output stays in a ready state, and the drive responds to the command immediately.
2. When using the Quick Start function, the output terminal has higher potential voltage.</td><td>1</td></tr>
<tr><td>02-01</td><td>Multi-function input command 1 (MI1)</td><td rowspan="10">0: No function
1: Multi-step speed command 1 / multi-step position command 1
2: Multi-step speed command 2 / multi-step position command 2
3: Multi-step speed command 3 / multi-step position command 3
4: Multi-step speed command 4 / multi-step position command 4
5: Reset
6: JOG operation
7: Acceleration / deceleration speed inhibit
8: 1^{st}, 2^{nd} acceleration / deceleration time selection
9: 3^{rd}, 4^{th} acceleration / deceleration time selection
10: EF Input (Pr.07-20)
11: Base Block (B.B.) input from external
12: Output stop
15: Rotating speed command from AVI
16: Rotating speed command from ACI
18: Forced to stop (Pr.07-20)</td><td>0</td></tr>
<tr><td>02-02</td><td>Multi-function input command 2 (MI2)</td><td>0</td></tr>
<tr><td>02-03</td><td>Multi-function input command 3 (MI3)</td><td>1</td></tr>
<tr><td>02-04</td><td>Multi-function input command 4 (MI4)</td><td>2</td></tr>
<tr><td>02-05</td><td>Multi-function input command 5 (MI5)</td><td>3</td></tr>
<tr><td>02-06</td><td>Multi-function input command 6 (MI6)</td><td>4</td></tr>
<tr><td>02-07</td><td>Multi-function input command 7 (MI7)</td><td>49</td></tr>
<tr><td>02-26</td><td>Multi-function input command 10 (MI10)</td><td>0</td></tr>
<tr><td>02-27</td><td>Multi-function input command 11 (MI11)</td><td>0</td></tr>
<tr><td>02-28</td><td>Multi-function input command 12 (MI12)</td><td>0</td></tr>
</table>

Pr.	Parameter Name	Setting Range	Default
		24: FWD JOG command 25: REV JOG command 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for ∆-connection 38: Disable to write EEPROM function 40: Force coasting to stop 49: Enable Drive 53: Trigger CANopen quick stop 58: Emergency power mode detection 59: Magnetic contactor error detection 60: Mechanical brake error detection 61: Power loss signal 62: Mechanical brake error detection 2	
✎ 02-11	Multi-function input response time	0.000–30.000 sec.	0.005
✎ 02-12	Multi-function input mode selection	0000h–FFFFh (0: N.O.; 1: N.C.)	0000
✎ 02-13 ✎ 02-16 ✎ 02-17 ✎ 02-36 ✎ 02-37 ✎ 02-38	Multi-function output 1 (Relay 1) Multi-function output 2 (MO1) Multi-function output 3 (MO2) Output terminal of extension card (MO10) or (RY10) Output terminal of extension card (MO11) or (RY11) Output terminal of extension card (MO12) or (RY12)	0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (Pr.02-22) 4: Desired frequency reached 2 (Pr.02-24) 5: Zero speed (Frequency command) 6: Zero speed, includes STOP (Frequency command) 7: Over-torque 1 (Pr.06-06–06-08) 9: Drive is ready 10: Low voltage warning (LV) (Pr.06-00) 11: Malfunction indication 12: Mechanical brake signal (Pr.02-39–Pr.02-42) 13: Over-heat warning (Pr.06-15) 16: Slip error (oSL) 19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage 22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation source 25: Forward command	11 0 0 0 0 0

	Pr.	Parameter Name	Setting Range	Default
			26: Reverse command 27: Output when current ≥ Pr.02-41 28: Output when current < Pr.02-41 31: Y-connection for the motor coil 32: Δ-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed includes stop (actual output frequency) 35: Error output selection 1 (Pr.06-23) 36: Error output selection 2 (Pr.06-24) 37: Error output selection 3 (Pr.06-25) 38: Error output selection 4 (Pr.06-26) 40: Speed reached (including STOP) 44: Low current output (use with Pr.06-71–06-73) 45: UVW output magnetic contactor ON/OFF switch 50: Output control for CANopen 56: Power generation direction and status verification 57: Power generation direction 58: EPS MODE 67: Outputs when analog input level reached 75: Motor-controlled magnetic contactor output	
✎	02-18	Multi-function output direction	0000h–FFFFh (0: N.O.; 1: N.C.)	0000h
✎	02-21	Digital output gain (DFM)	1–55	1
✎	02-22	Desired frequency reached 1	0.00–299.00 Hz	60.00/ 50.00
✎	02-23	Width of desired frequency reached 1	0.00–299.00 Hz	2.00
✎	02-24	Desired frequency reached 2	0.00–299.00 Hz	60.00/ 50.00
✎	02-25	Width of desired frequency reached 2	0.00–299.00 Hz	2.00
✎	02-30	Turn On Delay of Magnetic Contactor between Drive and Motor	0.010–65.000 sec.	0.200
✎	02-31	Turn Off Delay of Magnetic Contactor between Drive and Motor	0.010–65.000 sec.	0.200
✎	02-32	Motor Magnetic Contactor Error Detection Time Setting	0.00–10.00 sec.	0.00

	Pr.	Parameter Name	Setting Range	Default
✓	02-33	Mechanical Brake Error Detection Time Setting	0.00–10.00 sec.	0.00
✓	02-35	External operation control selection after reset and reboot	0: Disable 1: Drive runs if the RUN command remains after reset or reboot.	0
	02-39	Brake Release Delay Time When Elevator Starts	0.010–65.000 sec.	0.250
	02-40	Brake Contracting Delay Time When Elevator Stops	0.010–65.000 sec.	0.250
	02-41	Output Current Level Setting for External Terminals	0–100% (Rated current of drive %)	0
✓	02-42	Brake Release Function Option	Bit 0 = 0: No function Bit 0 = 1: Check torque output function switch Bit 1 = 0: No function Bit 1 = 1: Brake control by frequency threshold function switch	0000h
	02-43	Brake Release Frequency	0.00–10.00 Hz	0.00
	02-44	Brake Engage Frequency	0.00–10.00 Hz	0.00
	02-50	Display the status of multi-function input terminals	Monitor the status of multi-function input terminals	Read only
	02-51	Display the status of multi-function output terminals	Monitor the status of multi-function output terminals	Read only
	02-54	Display the Frequency command executed by the external terminal	Read only	Read only
	02-70	IO card type	9: EMM-D3R2CA	Read only
✓	02-71	IO option card failure action selection	0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	1
✓	02-72	IO option card error retry times	0–5 times	5
✓	02-82	Initial Frequency command (F) mode after stop	0: Use current Frequency command 1: Use zero Frequency command 2: Refer to Pr.02-83 to set up	0
✓	02-83	EPS operation frequency	0.00–10.00 Hz	5.00
✓	02-85	Initial frequency command (F) setting after stop	0.00–10.00 Hz	0.00

03 Analog Input / Output Parameters

Pr.	Parameter Name	Setting Range	Default
03-00	AVI analog input selection	0: No function 1: Frequency command	1
03-01	ACI analog input selection		0
03-03	AVI analog input bias	-100.0–100.0%	0.0
03-04	ACI analog input bias	-100.0–100.0%	0.0
03-07	Positive / negative bias mode (AVI)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0
03-08	Positive / negative bias mode (ACI)		
03-10	Reverse setting when analog signal input is negative frequency	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency input is allowed. Positive frequency = run in forward direction; negative frequency = run in reverse direction. The digital keypad or external terminal control cannot switch the running direction.	0
03-11	AVI analog input gain	-500.0–500.0%	100.0
03-12	ACI analog input gain	-500.0–500.0%	100.0
03-15	AVI analog input filter time	0.00–20.00 sec.	0.01
03-16	ACI analog input filter time	0.00–20.00 sec.	0.01
03-18	Analog input addition function	0: Disable (AVI, ACI) 1: Enable	0
03-19	Signal loss selection for analog input 4–20 mA	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display "ACE"	0
03-20	AFM multi-function output	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage	0
03-21	AFM analog output gain	0.0–500.0%	100.0
03-22	AFM analog output in REV direction	0: Absolute value of output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	0

	Pr.	Parameter Name	Setting Range	Default
〆	03-27	AFM output bias	-100.00–100.00%	0.00
〆	03-28	AVI terminal input selection	0: 0–10 V 3: -10–10 V (Pr.03-69–03-74 are valid)	0
〆	03-29	ACI terminal input selection	0: 4–20 mA 1: 0–10 V 2: 0–20 mA	0
〆	03-31	AFM output selection	0: 0–10 V output 1: 0–20 mA output 2: 4–20 mA output	0
〆	03-32	AFM DC output setting level	0.00–100.00%	0.00
〆	03-35	AFM filter output time	0.00–20.00 sec.	0.01
〆	03-39	VR input selection	0: Disable 1: Frequency command	1
〆	03-44	Multi-function MO output by AI level source	0: AVI 1: ACI 3: Extension card input terminal AI10 4: Extension card input terminal AI11	0
〆	03-45	AI upper level 1	-100.00–100.00%	50.00
〆	03-46	AI lower level 2	-100.00–100.00%	10.00
〆	03-57	ACI lowest point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	4.00
〆	03-58	ACI proportional lowest point	0.00–100.00%	0.00
〆	03-59	ACI mid-point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	12.00
〆	03-60	ACI proportional mid-point	0.00–100.00%	50.00
〆	03-61	ACI highest point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	20.00
〆	03-62	ACI proportional highest point	0.00–100.00%	100.00
〆	03-63	AVI voltage lowest point	0.00–10.00 V	0.00
〆	03-64	AVI voltage proportional lowest point	-100.00–100.00%	0.00
〆	03-65	AVI voltage mid-point	0.00–10.00 V	5.00
〆	03-66	AVI voltage proportional mid-point	-100.00–100.00%	50.00
〆	03-67	AVI voltage highest point	0.00–10.00 V	10.00
〆	03-68	AVI voltage proportional highest point	-100.00–100.00%	100.00

	Pr.	Parameter Name	Setting Range	Default
✎	03-69	Negative AVI voltage lowest point	-10.00–0.00 V (valid when Pr.03-28 sets as -10–10 V)	0.00
✎	03-70	Negative AVI voltage proportional lowest point	-100.00–100.00% (valid when Pr.03-28 sets as -10–10 V)	0.00
✎	03-71	Negative AVI voltage mid-point	-10.00–0.00 V (valid when Pr.03-28 sets as -10–10 V)	-5.00
✎	03-72	Negative AVI voltage proportional mid-point	-100.00–100.00% (valid when Pr.03-28 sets as -10–10 V)	-50.00
✎	03-73	Negative AVI voltage highest point	-10.00–0.00 V (valid when Pr.03-28 sets as -10–10 V)	-10.00
✎	03-74	Negative AVI voltage proportional highest point	-100.00–100.00% (valid when Pr.03-28 sets as -10–10 V)	-100.00

04 Multi-step Speed Parameters

Pr.	Parameter Name	Setting Range	Default
04-00	1st step speed frequency	0.00–299.00 Hz	0.00
04-01	2nd step speed frequency	0.00–299.00 Hz	0.00
04-02	3rd step speed frequency	0.00–299.00 Hz	0.00
04-03	4th step speed frequency	0.00–299.00 Hz	0.00
04-04	5th step speed frequency	0.00–299.00 Hz	0.00
04-05	6th step speed frequency	0.00–299.00 Hz	0.00
04-06	7th step speed frequency	0.00–299.00 Hz	0.00
04-07	8th step speed frequency	0.00–299.00 Hz	0.00
04-08	9th step speed frequency	0.00–299.00 Hz	0.00
04-09	10th step speed frequency	0.00–299.00 Hz	0.00
04-10	11th step speed frequency	0.00–299.00 Hz	0.00
04-11	12th step speed frequency	0.00–299.00 Hz	0.00
04-12	13th step speed frequency	0.00–299.00 Hz	0.00
04-13	14th step speed frequency	0.00–299.00 Hz	0.00
04-14	15th step speed frequency	0.00–299.00 Hz	0.00

05 Motor Parameters

Pr.	Parameter Name	Setting Range	Default
05-00	Motor parameter auto-tuning	0: No function 1: Dynamic test for an induction motor (IM) 2: Static test for an induction motor (IM)	0
05-01	Full-load current for an induction motor (A)	10–120% of the drive's rated current	Depending on the model power
05-02	Rated power for an induction motor (kW)	0.00–655.35 kW	Depending on the model power
05-03	Rated speed for an induction motor (rpm)	0–65535 rpm 1710 (60 Hz, 4 poles); 1410 (50 Hz, 4 poles)	1710
05-04	Number of poles for an induction motor	2–20	4
05-05	No-load current for an induction motor (A)	0.00–Pr.05-01 default	Depending on the model power
05-06	Stator resistance (Rs) for an induction motor	0.000–65.535 Ω	Depending on the model power
05-07	Rotor resistance (Rr) for an induction motor	0.000–65.535 Ω	Depending on the model power
05-08	Magnetizing inductance (Lm) for an induction motor	0.0–6553.5 mH	Depending on the model power
05-09	Stator inductance (Lx) for an induction motor	0.0–6553.5 mH	Depending on the model power
05-23	Frequency for Y-connection /Δ-connection switch for an induction motor	0.00–299.00 Hz	60.00
05-24	Y-connection /Δ-connection switch for an induction motor	0: Disable 1: Enable	0
05-25	Delay time for Y-connection /Δ-connection switch for an induction motor	0.000–60.000 sec.	0.200
05-26	Accumulated Watt-second for a motor in low word (W-sec.)	Read only	#.#
05-27	Accumulated Watt-second for a motor in high word (W-sec.)	Read only	#.#

Pr.	Parameter Name	Setting Range	Default
05-28	Accumulated Watt-hour for a motor (W-hour)	Read only	#.#
05-29	Accumulated Watt-hour for a motor in low word (kW-hour)	Read only	#.#
05-30	Accumulated Watt-hour for a motor in high word (kW-hour)	Read only	#.#
05-31	Accumulated motor operation time (minutes)	0–1439	0
05-32	Accumulated motor operation time (days)	0–65535	0

06 Protection Parameters

Pr.	Parameter Name	Setting Range	Default
06-00	Low voltage level	230V: 150.0–220.0 V_{DC} 460V: 300.0–440.0 V_{DC}	180.0 360.0
06-01	Over-voltage stall prevention	0: Disabled 230V: 0.0–450.0 V_{DC} 460V: 0.0–900.0 V_{DC}	380.0 760.0
06-02	Selection for over-voltage stall prevention	0: Traditional over-voltage stall prevention 1: Smart over-voltage stall prevention	0
06-03	Over-current stall prevention during acceleration	0–200% (100% corresponds to the rated current of the drive)	180
06-04	Over-current stall prevention during operation	0–200% (100% corresponds to the rated current of the drive)	180
06-05	Acceleration / deceleration time selection for stall prevention at constant speed	0: By current acceleration / deceleration time 1: By the 1st acceleration / deceleration time 2: By the 2nd acceleration / deceleration time 3: By the 3rd acceleration / deceleration time 4: By the 4th acceleration / deceleration time 5: By auto-acceleration / auto-deceleration	0
06-06	Over-torque detection selection (motor)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
06-07	Over-torque detection level (motor)	10–250% (100% corresponds to the rated current of the drive)	120
06-08	Over-torque detection time (motor)	0.1–60.0 sec.	0.1
06-12	Current limit	0–250% (100% corresponds to the rated current of the drive)	150
06-13	Electronic thermal relay selection 1 (motor)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on shaft) 2: Disable	2
06-14	Electronic thermal relay action time 1 (motor)	30.0–600.0 sec.	60.0
06-15	Temperature level overheat (OH) warning	0.0–110.0ºC	105.0
06-16	Stall prevention limit level	0–100% (refer to Pr.06-03–06-04)	100

Pr.	Parameter Name	Setting Range	Default
06-17	Fault record 1	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during constant speed (ocn) 4: Ground fault (GFF) 6: Over-current at stop (ocS) 7: Over-voltage during acceleration (ovA) 8: Over-voltage during deceleration (ovd) 9: Over-voltage during constant speed (ovn) 10: Over-voltage at stop (ovS) 11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage during constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (orP) 16: IGBT overheat (oH1) 18: TH1 open: IGBT overheat protection error (tH1o) 21: Drive overload (oL) 22: Electronic thermal relay protection 1 (EoL1) 26: Over-torque 1 (ot1) 28: Low current (uC) 31: Memory read-out error (cF2) 33: U-phase current detection error (cd1) 34: V-phase current detection error (cd2) 35: W-phase current detection error (cd3) 36: Clamp current detection error (Hd0) 37: Over-current detection error (Hd1) 40: Auto-tuning error (AUE) 41: PID feedback loss (AFE) 48: Analog current input loss (ACE) 49: External fault input (EF) 50: Emergency stop (EF1) 51: External Base Block (B.B.) 52: Password error (Pcod) 54: Communication error (CE1) 55: Communication error (CE2) 56: Communication error (CE3) 57: Communication error (CE4) 58: Communication time-out (CE10) 61: Y-connection / Δ-connection switch error (ydc) 62: Deceleration energy backup error (dEb)	Read only
06-18	Fault record 2		Read only
06-19	Fault record 3		Read only
06-20	Fault record 4		Read only
06-21	Fault record 5		Read only
06-22	Fault record 6		Read only

Pr.	Parameter Name	Setting Range	Default
		63: Over-slip (oSL) 71: Mechanical brake error 2 (MBF2) 72: Channel 1 (S1–DCM) safety loop error (STL1) 74: Magnetic contactor error (MCF) 75: Mechanical brake error (MBF) 76: Safe Torque Off (STo) 77: Channel 2 (S2–DCM) safety loop error (STL2) 78: Internal loop error (STL3) 79: U-phase over-current before run (Uoc) 80: V-phase over-current before run (Voc) 81: W-phase over-current before run (Woc) 82: U-phase output phase loss (oPL1) 83: V-phase output phase loss (oPL2) 84: W-phase output phase loss (oPL3) 87: Drive overload in low frequency (oL3) 91: Motor output phase loss (MPHL) 101: CANopen software disconnect 1 (CGdE) 102: CANopen software disconnect 2 (CHbE) 104: CANopen hardware disconnect (CbFE) 105: CANopen index setting error (CIdE) 106: CANopen station number setting error (CAdE) 107: CANopen memory error (CFrE) 127: Software version error (CP33) 140: GFF detected when power on (Hd6) 141: GFF before run (BGFF) 142: Auto-tuning error 1 (DC test stage) (AUE1) 143: Auto-tuning error 2 (High frequency test stage) (AUE2) 144: Auto-tuning error 3 (Rotary test stage) (AUE3)	
06-23	Fault output option 1	0–65535 (refer to bit table for fault code)	0
06-24	Fault output option 2	0–65535 (refer to bit table for fault code)	0
06-25	Fault output option 3	0–65535 (refer to bit table for fault code)	0
06-26	Fault output option 4	0–65535 (refer to bit table for fault code)	0
06-31	Frequency command for malfunction	0.00–299.00 Hz	Read only
06-32	Output frequency at malfunction	0.00–299.00 Hz	Read only
06-33	Output voltage at malfunction	0.0–6553.5 V	Read only

	Pr.	Parameter Name	Setting Range	Default
	06-34	DC voltage at malfunction	0.0–6553.5 V	Read only
	06-35	Output current at malfunction	0.00–655.35 Amp	Read only
	06-36	IGBT temperature at malfunction	-3276.7–3276.7°C	Read only
	06-37	Capacitance temperature at malfunction	-3276.7–3276.7°C	Read only
	06-38	Motor speed in rpm at malfunction	-32767–32767 rpm	Read only
	06-40	Status of the multi-function input terminal at malfunction	0000h–FFFFh	Read only
	06-41	Status of the multi-function output terminal at malfunction	0000h–FFFFh	Read only
	06-42	Drive status at malfunction	0000h–FFFFh	Read only
⚡	06-44	STO latch selection	0: STO Latch 1: STO No Latch	0
⚡	06-45	Output phase loss detection action (OPHL)	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	3
⚡	06-46	Detection time for output phase loss	0.000–65.535 sec.	0.500
⚡	06-47	Current detection level for output phase loss	0.00–100.00%	1.00
⚡	06-48	DC brake time for output phase loss	0.000–65.535 sec.	0.000
⚡	06-49	LvX auto-reset	0: Disable 1: Enable	0
⚡	06-53	Detected input phase loss action (OrP)	0: Warn and ramp to stop 1: Warn and coast to stop	0
⚡	06-55	Derating protection	0: constant rated current and limit carrier wave by load current and temperature 1: constant carrier frequency and limit load current by setting carrier wave 2: constant rated current (same as setting 0), but close current limit	0
⚡	06-60	Software detection GFF current level	0.0–6553.5%	60.0

	Pr.	Parameter Name	Setting Range	Default
✓	06-61	Software detection GFF filter time	0.00–655.35 sec.	0.10
	06-63	Operation time of fault record 1 (Days)	0–65535 days	Read only
	06-64	Operation time of fault record 1 (Minutes)	0–65535 min.	Read only
	06-65	Operation time of fault record 2 (Days)	0–65535 days	Read only
	06-66	Operation time of fault record 2 (Minutes)	0–65535 min.	Read only
	06-67	Operation time of fault record 3 (Days)	0–65535 days	Read only
	06-68	Operation time of fault record 3 (Minutes)	0–65535 min.	Read only
	06-69	Operation time of fault record 4 (Days)	0–65535 days	Read only
	06-70	Operation time of fault record 4 (Minutes)	0–65535 min.	Read only
✓	06-71	Low current setting level	0.0–100.0%	0.0
✓	06-72	Low current detection time	0.00–360.00 sec.	0.00
✓	06-73	Low current action	0: No function 1: Warn and coast to stop 2: Warn and ramp to stop by the 2nd deceleration time 3: Warn and continue operation	0
✓	06-74	Number of times to retry after fault	0–10 times	0
✓	06-75	Time interval between retries	0.5–600.0 sec.	10.0
✓	06-77	MO's action when retrying after fault	0: Output 1: No output	0
✓	06-80	Emergency power voltage in operation	280.0–537.0 V_{DC}	300.0
	06-81	Emergency power speed in operation	0.00–299.00 Hz	Read only
	06-82	Emergency power capacity in operation	0.0–100.0 kVA	0.0
✓	06-83	EPS mode selection	0: Operate by current command direction. 1: Run in the running direction of power generation mode. Execute the power generation direction detection when running in power generation mode.	0

	Pr.	Parameter Name	Setting Range	Default
			2: After determining the power generation direction, the host controller sends a running direction command. (When at STOP, the direction of power generation mode (MO = 57) confirmation and the direction of power generation does not maintain.) Execute the power generation direction detection each time whenever running. 3: After determining the power generation direction, the host controller sends a running direction command. (When at STOP, the direction of power generation mode (MO = 57) confirmation and the direction of the power generation does not maintain.) Execute the power generation direction detection only one time when running. 4: Run by the direction of power generation mode. Execute the power generation direction detection when running in normal mode.	
	06-84	Power generation direction search time	0.0–5.0 sec.	1.0
✎	06-85	UPS output delay time	0.0–10.0 sec.	1.0
✎	06-86	Power factor kevel for determining the power generation direction	0.0–150.0°	70.0
	06-87	Reference level of the power factor when running	0.0–200.0°	Read only
	06-88	Power generation direction	0: Forward running 1: Reverse running	Read only
	06-89	Delay time on stopping UPS output	0.0–60.0 sec.	3.0
	06-90	Operation time of fault record 5 (Day)	0–65535 days	Read only
	06-91	Operation time of fault record 5 (Min.)	0–65535 min.	Read only
	06-92	Operation time of fault record 6 (Day)	0–65535 days	Read only
	06-93	Operation time of fault record 6 (Min.)	0–65535 min.	Read only

07 Special Parameters

	Pr.	Parameter Name	Setting Range	Default
✎	07-00	Software brake level	230V: 350.0–450.0 V_{DC} 460V: 700.0–900.0 V_{DC}	370.0 740.0
✎	07-01	DC brake current level	0–100 %	30
✎	07-02	DC brake time at Start-up	0.0–60.0 sec.	0.7
✎	07-03	DC brake time at stop	0.0–60.0 sec.	0.7
✎	07-04	DC brake frequency at stop	0.00–299.00 Hz	0.00
✎	07-05	Voltage increasing gain	1–200 %	100
✎	07-06	Restart after momentary power loss	0: Stop operation 1: Speed tracking by the speed before the power loss 2: Speed tracking by the minimum output frequency	0
✎	07-07	Allowed power loss duration	0.0–20.0 sec.	2.0
✎	07-08	Base block time	0.1–5.0 sec.	0.5
✎	07-09	Current limit of speed tracking	20–200 %	100
✎	07-10	Restart after fault action	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	0
✎	07-11	Number of times of auto-restart after fault	0–10	0
✎	07-12	Speed tracking during start-up	0: Disable 1: Speed tracking by maximum output frequency 2: Speed tracking by motor frequency at start 3: Speed tracking by minimum output frequency	0
✎	07-13	dEb function selection	0: Disable 1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored.	0
✎	07-15	Dwell time at acceleration	0.00–600.00 sec.	0.00
✎	07-16	Dwell frequency at acceleration	0.00–299.00 Hz	0.00
✎	07-17	Dwell time at deceleration	0.00–600.00 sec.	0.00
✎	07-18	Dwell frequency at deceleration	0.00–299.00 Hz	0.00
✎	07-19	Fan cooling control	0: Fan always ON 1: Fan is OFF after the AC motor drive stops for one minute.	3

Pr.	Parameter Name	Setting Range	Default
		2: Fan is ON when the AC motor drive runs; fan is OFF when the AC motor drive stops. 3: Fan turns ON when the temperature reaches around 60°C.	
07-20	Deceleration of emergency or forced stop	0: Coast to stop 1: Stop by the 1^{st} deceleration time 2: Stop by the 2^{nd} deceleration time 3: Stop by the 3^{rd} deceleration time 4: Stop by the 4^{th} deceleration time 5: System deceleration 6: Automatic deceleration	0
07-21	Automatic energy-saving setting	0: Disable 1: Enable	0
07-22	Energy-saving gain	10–1000%	100
07-23	Automatic voltage regulation (AVR) function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0
07-24	Torque command filter time (V/F and SVC control mode)	0.001–10.000 sec.	0.050
07-25	Slip compensation filter time (V/F and SVC control mode)	0.001–10.000 sec.	0.100
07-26	Torque compensation gain	0–10	1
07-27	Slip compensation gain (V/F and SVC control mode)	0.00–10.00 (default value is 1 in SVC mode)	0.00
07-29	Slip deviation level	0.0–100.0% 0: No detection	0
07-30	Slip deviation detection time	0.0–10.0 sec.	1.0
07-31	Slip deviation action	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	0
07-32	Motor shock compensation factor	0–10000	1000
07-33	Auto-restart interval of fault	0.0–6000.0 sec.	60.0
07-34	Slip compensation gain % (power generation mode)	0.0–100.0 %	0.0
07-35	Slip compensation gain % (electricity mode)	0.0–100.0 %	0.0
07-36	Maximum slip frequency	0.00–200.00 Hz	0.00

09 Communication Parameters

	Pr.	Parameter Name	Setting Range	Default
✓	09-00	Communication address	1–254	1
✓	09-01	COM1 transmission speed	4.8–115.2 kbps	9.6
✓	09-02	COM1 transmission fault treatment	0: Warn and continue operation 1: Display error and ramp to stop 2: Display error and coast to stop 3: No warning, no error displayed and continue operation	3
✓	09-03	COM1 time-out detection	0.0–100.0 sec.	0.0
✓	09-04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	1
✓	09-09	Communication response delay time	0.0–200.0 ms	2.0
	09-36	CANopen slave address	0: Disable 1–127	0
	09-37	CANopen speed	0: 1 Mbps 1: 500 Kbps 2: 250 Kbps 3: 125 Kbps 4: 100 Kbps (Delta only) 5: 50 Kbps	0
	09-39	CANopen warning record	bit 0: CANopen software disconnection 1 (CANopen guarding time-out)	0

Pr.	Parameter Name	Setting Range	Default
		bit 1: CANopen software disconnection 2 (CANopen heartbeat time-out) bit 3: CANopen SDO time-out bit 4: CANopen SDO buffer overflow bit 5: CANopen hardware disconnection warning (Can Bus OFF) bit 6: Error protocol for CANopen	
09-40	CANopen decoding method	0: Delta-defined decoding method 1: CANopen standard DS402 protocol	1
09-41	CANopen communication status	0: Node reset 1: Com reset 2: Boot up 3: Pre-operational 4: Operation 5: Stopped	Read only
09-42	CANopen control status	0: Not ready for use 1: Inhibit start 2: Ready to switch on 3: Switched on 4: Enable operation 7: Quick stop active 13: Error reaction activation 14: Error state	Read only
09-43	CANopen reset index	bit 0: CANopen reset, internal address 20XX is 0 bit 1: CANopen reset, internal address 264X is 0 bit 2: CANopen reset, internal address 26AX is 0 bit 3: CANopen reset, internal address 60XX is 0	65535

10 Speed Feedback Control Parameters

Pr.	Parameter Name	Setting Range	Default
10-00	Encoder Type Selection	0: Disable 5: Pulse input (MI7)	0
10-01	Encoder Pulses per Revolution	1–20000	600
10-02	Encoder Input Type Setting	0: Disable 1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees. 2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees. 3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction). 4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction). 5: Single-phase input (MI7) **NOTE:** 1. When the MH300-L inputs the A/B phase pulse, you must connect the MI6 terminal to the A-phase pulse, and the MI7 terminal to the B-phase pulse. 2. When the MH300-L uses unidirectional input, it disables the MI6 function and prohibits any signal connection.	0

11 Advanced Parameters

Pr.	Parameter Name	Setting Range	Default
11-06	ASR1 gain	0–100 Hz	10
11-07	ASR1 integral time	0.000–10.000 sec.	0.100
11-41	PWM mode selection	0: Two-phase 2: Space vector	0
11-42	System control flag	0000–FFFFh	0000

Chapter 12 Descriptions of Parameter Settings

00 Drive Parameters

✍You can set this parameter during operation.

00-00 Identity Code of AC the Motor Drive

Default: Read only

Settings Read only

00-01 Display AC Motor Drive Rated Current

Default: Read only

Settings Read only

- Pr.00-00 displays the identity code of the AC motor drive. Use the following specification table to check if Pr.00-01 setting is the rated current of the AC motor drive. Pr.00-01 corresponds to the identity code of the motor.

	230V, three-phase						460V, three-phase				
Frame	C		D	E		F	C	D		E	
kW	2.2	3.7	5.5	7.5	11	15	3.7	5.5	7.5	11	15
HP	3	5	7.5	10	15	20	5	7.5	10	15	20
Identity Code	**206**	**207**	**208**	**209**	**210**	**211**	**407**	**408**	**409**	**410**	**411**
Rated Current	11	17	25	33	49	65	9	13	17	25	32

00-02 Parameter Reset

Default: 0

Settings 0: No function
1: Write protection for parameters
5: Return kWh display to 0
7: Reset CANopen index (Slave)
9: Reset all parameters to defaults with base frequency at 50 Hz
10: Reset all parameters to defaults with base frequency at 150 Hz

- 1: All parameters are read only except Pr.00-02, 00-07, and 00-08.
  Set Pr.00-02 to 0 before changing other parameter settings.
- 5: You can return the kWh displayed value to 0 even during drive operation.
  For example, you can set Pr.05-26–05-30 to 0.
- 7: Reset the related settings of CANopen slave.
- 9 or 10: Reset all parameters to defaults. If you have set a password (Pr.00-08), unlock the password (Pr.00-07) to clear the password you have set before you reset all parameters.
- For settings of 7, 9, and 10, you must reboot the motor drive after you finish the setting.

✍ 00-03 Start-up Display Selection

Default: 0

Settings 0: F (frequency command)
1: H (output frequency)
2: U (user-defined) see Pr.00-04
3: A (output current)

- This parameter determines the start-up display page. This is the user-defined choice display according to the setting in Pr.00-04.

00-04 Content of Multi-function Display (User-Defined)

Default: 3

Settings
0: Display the output current from the drive to the motor (A) (unit: Amp)
1: Display the counter value (c) (unit: CNT)
2: Display the drive's actual output frequency (H.) (unit: Hz)
3: Display the drive's DC bus voltage (v) (unit: V_{DC})
4: Display the drive's output value (E) (unit: V_{AC})
5: Display the drive's output power angle (n) (unit: deg)
6: Display the drive's output power (P) (unit: kW)
7: Display the motor speed (r) (unit: rpm)
8: Display the drive's estimated output torque%, motor's rated torque is 100% (t) (unit: %)
11: Display signal value of AVI analog input terminal (1.) (unit: %)
12: Display signal value of ACI analog input terminal (2.) (unit: %)
14: Display the drive's IGBT temperature (i.) (unit: °C)
15: Display CAP temperature (i.) (unit: °C)
16: Display digital input status (ON / OFF) (i)
17: Display digital output status (ON / OFF) (o)
18: Display the current multi-step speed (S)
19: Display corresponding CPU digital input pin status (d)
20: Display corresponding CPU digital output pin status (0.)
25: Overload count (0.00–100.00%) (o.) (unit: %)
26: Ground fault GFF (G.) (unit: %)
27: DC bus voltage ripple (r.) (unit: V_{DC})
30: Display the output of user-defined parameter (U)
35: Control mode: 0 = Speed control mode (SPD)
36: The current operating carrier frequency of the drive (J.) (unit: Hz)
38: Display the drive status (6.)
41: kWh display (J) (unit: kWh)
47: Master frequency value (A) (unit: Hz)

Explanation 1

- It can also display negative values when setting analog input bias (Pr.03-03–03-10).
  Example: Assume that AVI input voltage is 0 V, Pr.03-03 is 10.0%, Pr.03-07 is 4 (Bias serves as the center), and Pr.03-10 is 1 allowing negative frequency input.

Explanation 2

Example: If MI1 and MI6 are ON, the following table shows the status of the terminals.
Normally opened contact (N.O.): (0: OFF, 1: ON)

Terminal	MI7	MI6	MI5	MI4	MI3	MI2	MI1
Status	0	1	0	0	0	0	1

- The value is 0000 0000 0010 0001 in binary and 0021H in HEX. When Pr.00-04 is set to 16 or 19, the u page on the keypad displays 0021h.

- The setting 16 is the ON / OFF status of digital input according to Pr.02-12 setting and the setting 19 is the corresponding CPU pin ON / OFF status of the digital input.
- When MI1 / MI2 default setting is two-wire/ three-wire operation control (Pr.02-00 ≠ 0), and MI3 is set as three-wire, it is not affected by Pr.02-12.
- You can set 16 to monitor the digital input status, and then set 19 to check if the circuit is normal.

Explanation 3

Example: Assume that RY: Pr.02-13 is set to 9 (Drive is ready). After the drive is powered on, if there is no other abnormal status, the contact is ON. The display status is shown below.

Normally opened contact (N.O.):

Terminal	MO2	MO1	RY1
Status	0	0	1

- If Pr.00-04 is set to 17 or 20, it displays in hexadecimal “0001h” with LED u page is ON in the keypad.
- The setting 17 is the ON / OFF status of digital output according to Pr.02-18 setting and the setting 20 is the corresponding CPU pin ON / OFF status of the digital output.
- You can set 17 to monitor the digital output status, and then set 20 to check if the circuit is normal.

Explanation 4

- Setting value 8: 100% means the motor rated torque.
  Motor rated torque = (motor rated power x 60 / 2π) / motor rated rotating speed

Explanation 5

- Setting value 25: when displayed value reaches 100.00%, the drive shows “oL” as an overload warning.

Explanation 6

- Setting value 38:
  bit 0: The drive is running forward.
  bit 1: The drive is running backward.
  bit 2: The drive is ready.
  bit 3: Errors occurred on the drive.
  bit 4: The drive is running.
  bit 5: Warnings occurred on the drive.

00-06 Firmware Version

Default: Read only

Settings Read only

✎ 00-07 Parameter Protection Password Input

Default: 0

Settings 0–65535
0–3 (the number of incorrect password attempts)

📖 This parameter allows you to enter your password (which is set in Pr.00-08) to unlock the parameter protection and to make changes to the parameter.

📖 To avoid problems in the future, be sure to write down the password after you set this parameter.

- Pr.00-07 and Pr.00-08 are used to prevent personnel from setting other parameters by accident. If you forget the password, clear the password setting by entering 9999 and pressing the ENTER key, then enter 9999 again and press ENTER within 10 seconds. After decoding, all the settings return to default.
- When setting is under password protection, all the parameters read 0, except Pr.00-08.

00-08 Parameter Protection Password Setting

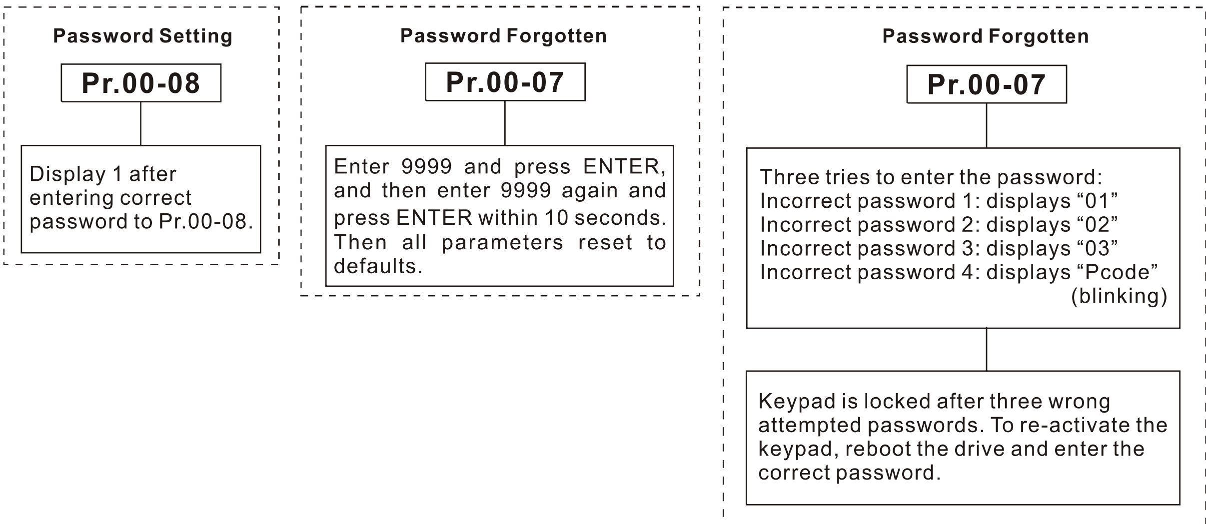
Default: 0

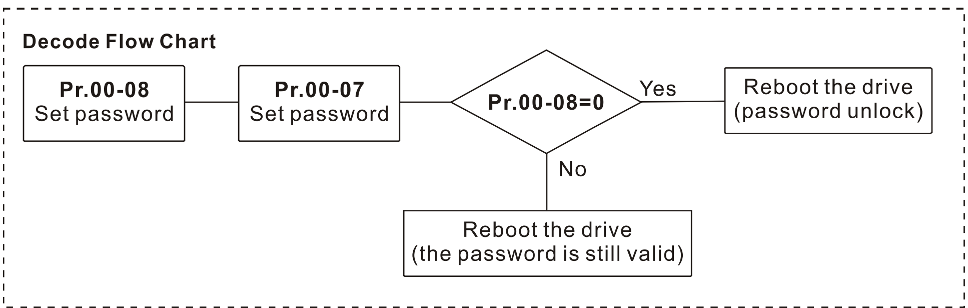
Settings 0-65535

0: No password protection / password entered correctly in Pr.00-07

1: Parameters have been locked

- This parameter is for setting the password protection. Password can be set directly the first time. After you set the password, the value of Pr.00-08 is 1, which means password protection is activated. At this time, if you want to change any of the parameter settings, you must enter the correct password in Pr.00-07 to deactivate the password temporarily, and this would make Pr.00-08 become 0. After you finish setting the parameters, reboot the motor drive and the password is activated again.
- Entering the correct password in Pr.00-07 only temporarily deactivates the password. To permanently deactivate password protection, set Pr.00-08 to 0 manually. Otherwise, password protection is always reactivated after you reboot the motor drive.
- The keypad copy function works only when the password protection is deactivated (temporarily or permanently), and the password set in Pr.00-08 cannot be copied to the keypad. So when copying parameters from the keypad to the motor drive, set the password manually again in the motor drive to activate password protection.





00-11 Speed Control Mode

Default: 0

Settings 0: VF (IM V/F control)

1: IMVFPG (IM V/F control + Encoder)

2: SVC

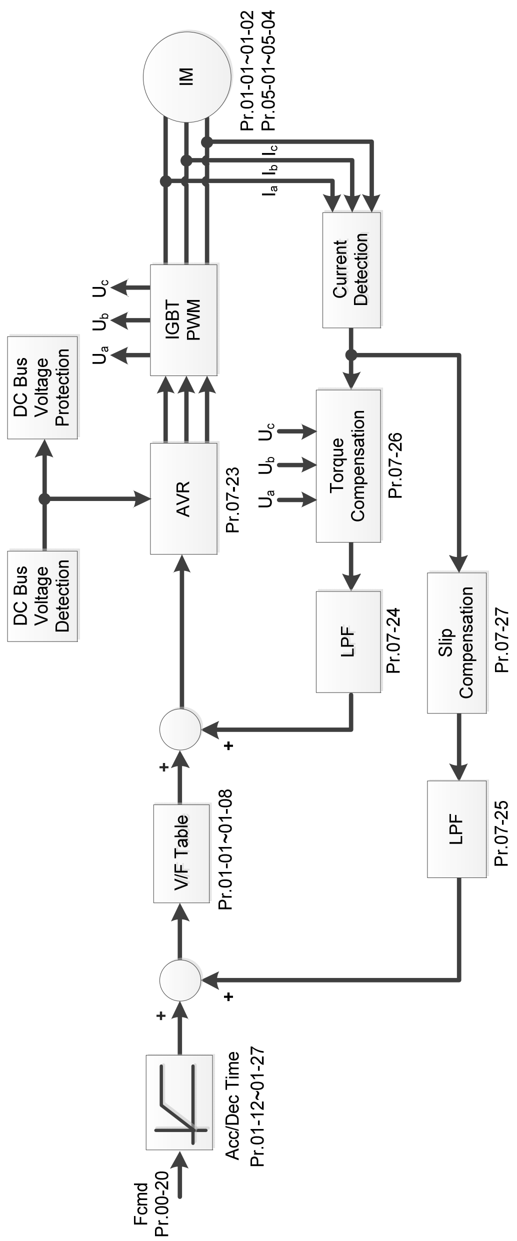
📖 Determines the control mode of the AC motor drive:

0: IM V/F control: you can set the proportion of V/F as required and control multiple motors simultaneously.

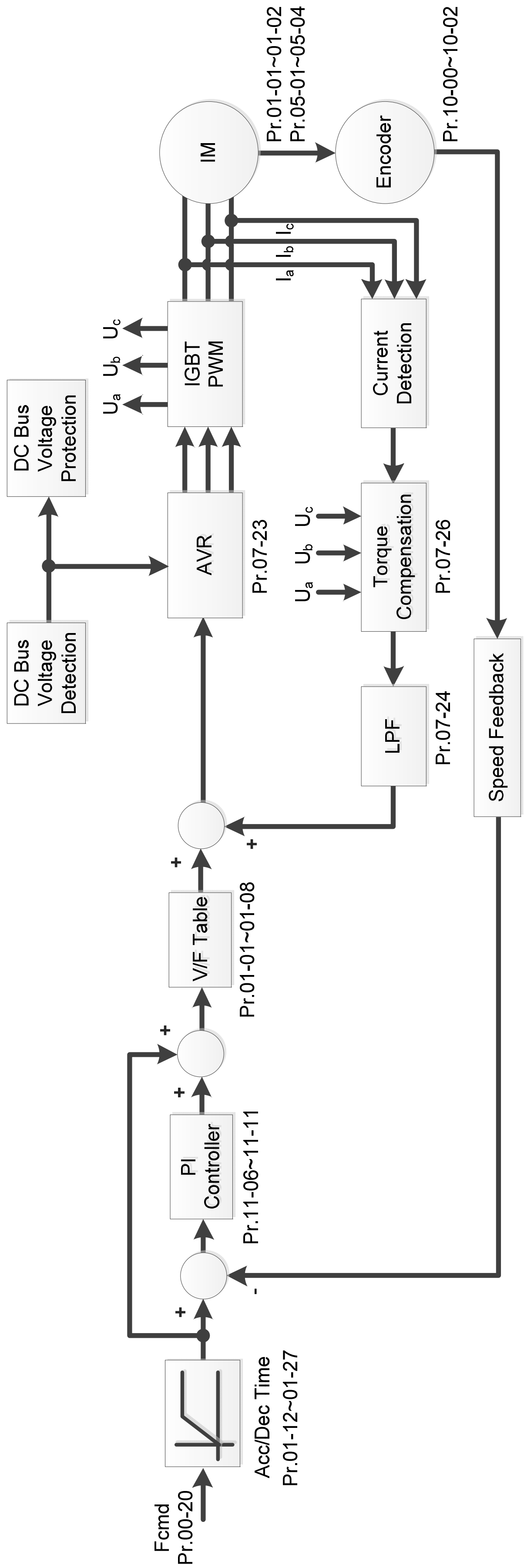
1: IM V/F control + Encoder pulse input: you can use the encoder for closed-loop speed control.

2: IM sensorless vector control: get the optimal control by auto-tuning the motor parameters.

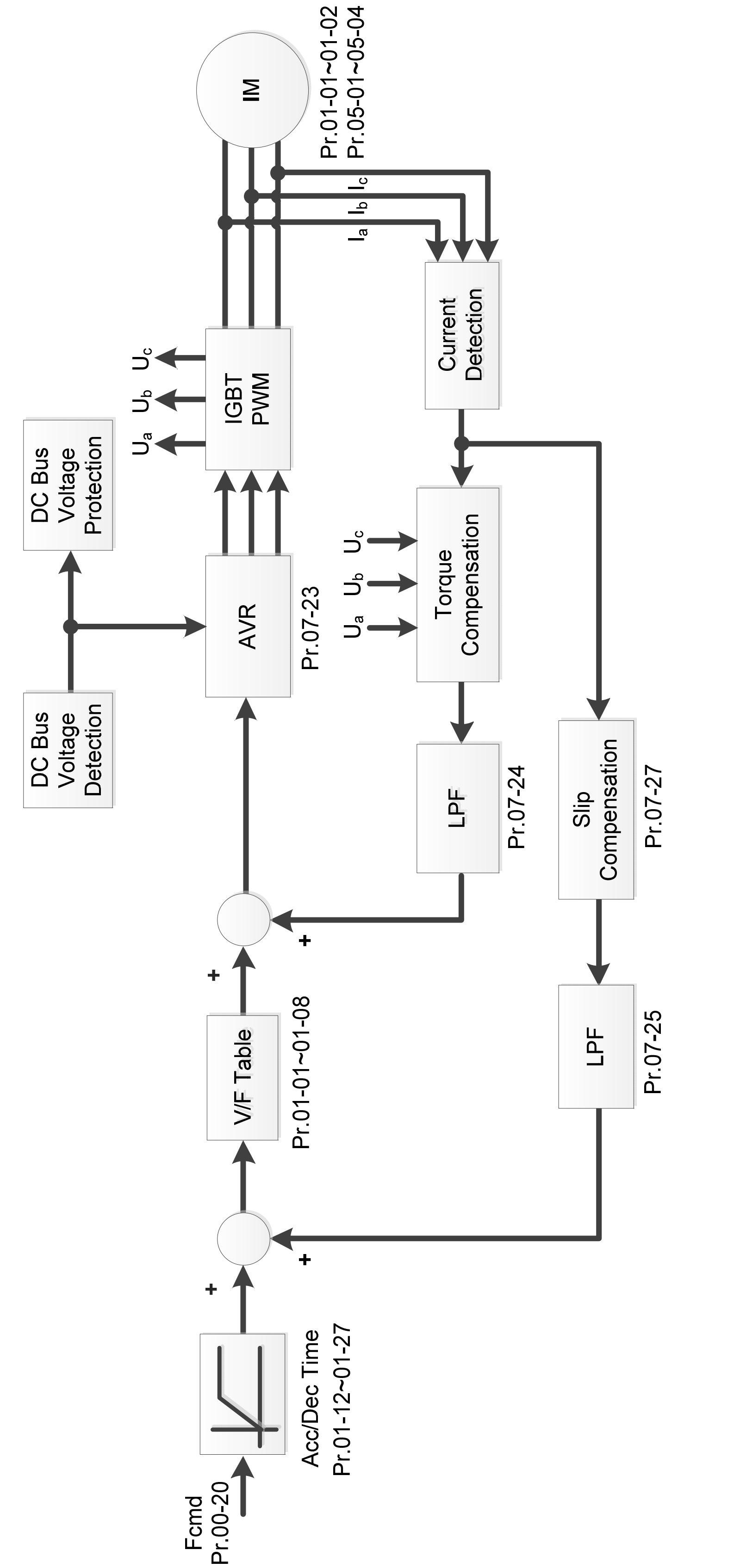
📖 When Pr.00-10 = 0 and you set Pr.00-11 to 0, the V/F control diagram is as follows:



📖 When Pr.00-10 = 0 and you set Pr.00-11 to 1, the V/F control + encoder diagram is as follows:



📖 When Pr.00-10 = 0 and you set Pr.00-11 to 2, the sensorless vector control diagram is as follows:

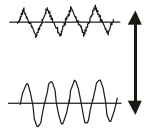


00-17 Carrier Frequency

Default: 8

Settings 2–15 kHz

- This parameter determines the PWM carrier frequency for the AC motor drive.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise or Leakage Current	Heat Dissipation	Current Wave
2 kHz	Significant	Minimal	Minimal	
8 kHz	↕	↕	↕	
15 kHz	Minimal	Significant	Significant	

- From the above table, the PWM carrier frequency has significant influences on the electromagnetic noise, the AC motor drive heat dissipation, and the motor acoustic noise. Therefore, if the surrounding noise is greater than the motor noise, lower the carrier frequency to reduce the temperature rise. Although the motor has quiet operation in the higher carrier frequency, consider the entire wiring and interference.
- When the carrier frequency is higher than the default, decrease the carrier frequency to protect the drive. Refer to Pr.06-55 for related setting and details.

00-20 Master Frequency Command Source (AUTO, REMOTE)

Default: 0

Settings 0: Inputs from digital keypad
1: Inputs from RS-485 communication
2: Inputs from external analog (refer to Pr.03-00, Pr.03-01)
3: Inputs from external UP / DOWN terminals (multi-function input terminals)
6: CANopen input
NOTE: It is valid only when using with KPC-CC01.

- You can switch the AUTO / HAND mode with the keypad KPC-CC01 (optional).
- Pr.00-20 and Pr.00-21 are for setting the frequency source and operation source in AUTO mode. Pr.00-30 and Pr.00-31 are for setting the frequency source and operation source in HAND mode.
- The default for the frequency source or operation source is for AUTO mode. It returns to AUTO mode whenever you cycle the power. If you use a multi-function input terminal to switch between AUTO and HAND mode, the highest priority is the multi-function input terminal. When the external terminal is OFF, the drive does not accept any operation signal and cannot execute JOG.

00-21 Operation Command Source (AUTO, REMOTE)

Default: 0

Settings 0: Digital keypad
1: External terminals
2: RS-485 communication
3: CANopen inout
NOTE: It is valid only when using with KPC-CC01.

- Determines the operation frequency source in AUTO, REMOTE mode.
- When you control the operation command by the keypad KPC-CC01 (optional), keys RUN, STOP and JOG (F1) are valid.

✓ 00-48 Display Filter Time (Current)

Default: 0.100

Settings 0.001–65.535 sec.

- Minimizes the current fluctuation displayed by digital keypad.

✓ 00-49 Display Filter Time (Keypad)

Default: 0.100

Settings 0.001–65.535 sec.

- Minimizes the value fluctuation displayed by digital keypad.

00-50 Software Version (Date)

Default: Read only

Settings Read only

- Displays the current drive software version by date.

01 Basic Parameters

✎ You can set this parameter during operation.

01-00 Motor 1 Maximum Operation Frequency

Default: 60.00 / 50.00

Settings 00.00–299.00 Hz

- Determines the drive's maximum operation frequency range. This setting corresponds to the maximum value for the analog input frequency setting signal (0–10 V, 4–20 mA, 0–20 mA, ±10 V).

01-01 Motor 1 Rated / Base Frequency

Default: 60.00 / 50.00

Settings 00.00–299.00 Hz

- Set this value according to the motor's rated frequency from the motor's nameplate. If the motor's rated frequency is 60 Hz, set the value to 60 Hz. If the motor's rated frequency is 50 Hz, set the value to 50 Hz.

01-02 Motor 1 Rated / Base Voltage

Default: 220.0 / 440.0

Settings 230V models: 0.0–255.0 V
460V models: 0.0–510.0 V

- Set this value according to the rated voltage of the motor from the motor's nameplate. If the motor's rated voltage is 220 V, set the value to 220.0 V. If the motor's rated voltage is 200 V, set the value to 200.0 V.
- There are a wide variety of motors, but the power system for each country is different. The convenient and economical way to solve this problem is to use an AC motor drive, which can deal with different voltages and frequencies, while supporting the original characteristics and life of the motor.

01-03 Motor 1 Mid-point Frequency 1

Default: 3.00

Settings 0.00–299.00 Hz

✎ 01-04 Motor 1 Mid-point Voltage 1

Default: 11.0 / 22.0

Settings 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-05 Motor 1 Mid-point Frequency 2

Default: 0.50

Settings 0.00–299.00 Hz

✎ 01-06 Motor 1 Mid-point Voltage 2

Default: 2.0 / 4.0

Settings 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

01-07 Motor 1 Minimum Output Frequency

Default: 0.50

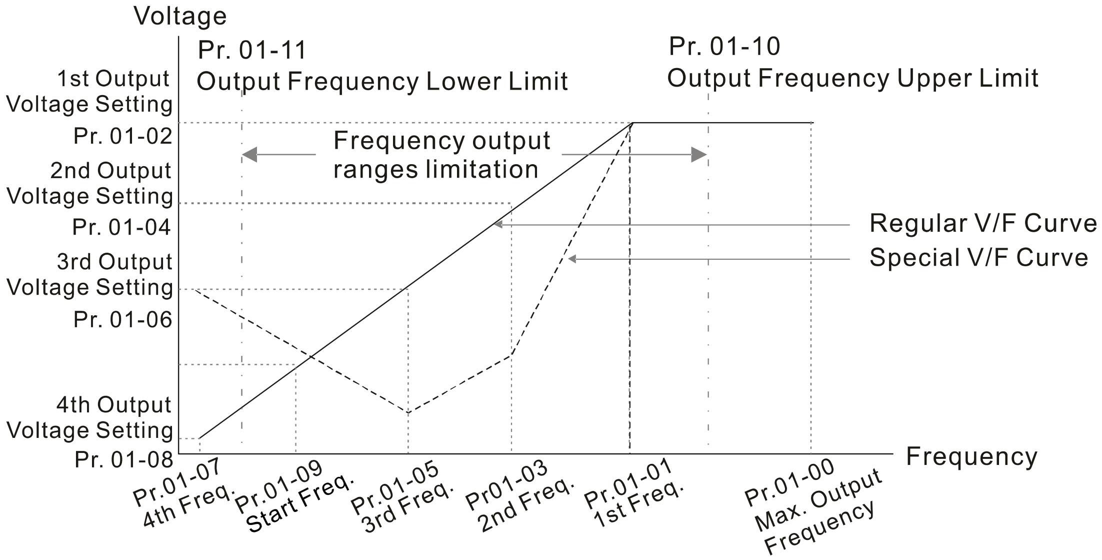
Settings 0.00–299.00 Hz

01-08 Motor 1 Minimum Output Voltage

Default: 0.0 / 0.0

Settings 230V models: 0.0–240.0 V
460V models: 0.0–480.0 V

- The V/F curve setting is usually set by the motor's allowable loading characteristics. If the loading characteristics exceeds the loading limit of the motor, you must pay more attention to the heat dissipation, dynamic balance, and bearing lubrication of the motor.
- If the voltage is too high when the motor is at low frequencies, it may cause motor damage, overheating, and may trigger stalling or over-current protection. To prevent motor damage or motor fault, be careful when you set the voltage.
- The diagram below shows the V/F curve for motor 1.



V/F Curve and The Related Parameters

01-09 Start-up Frequency

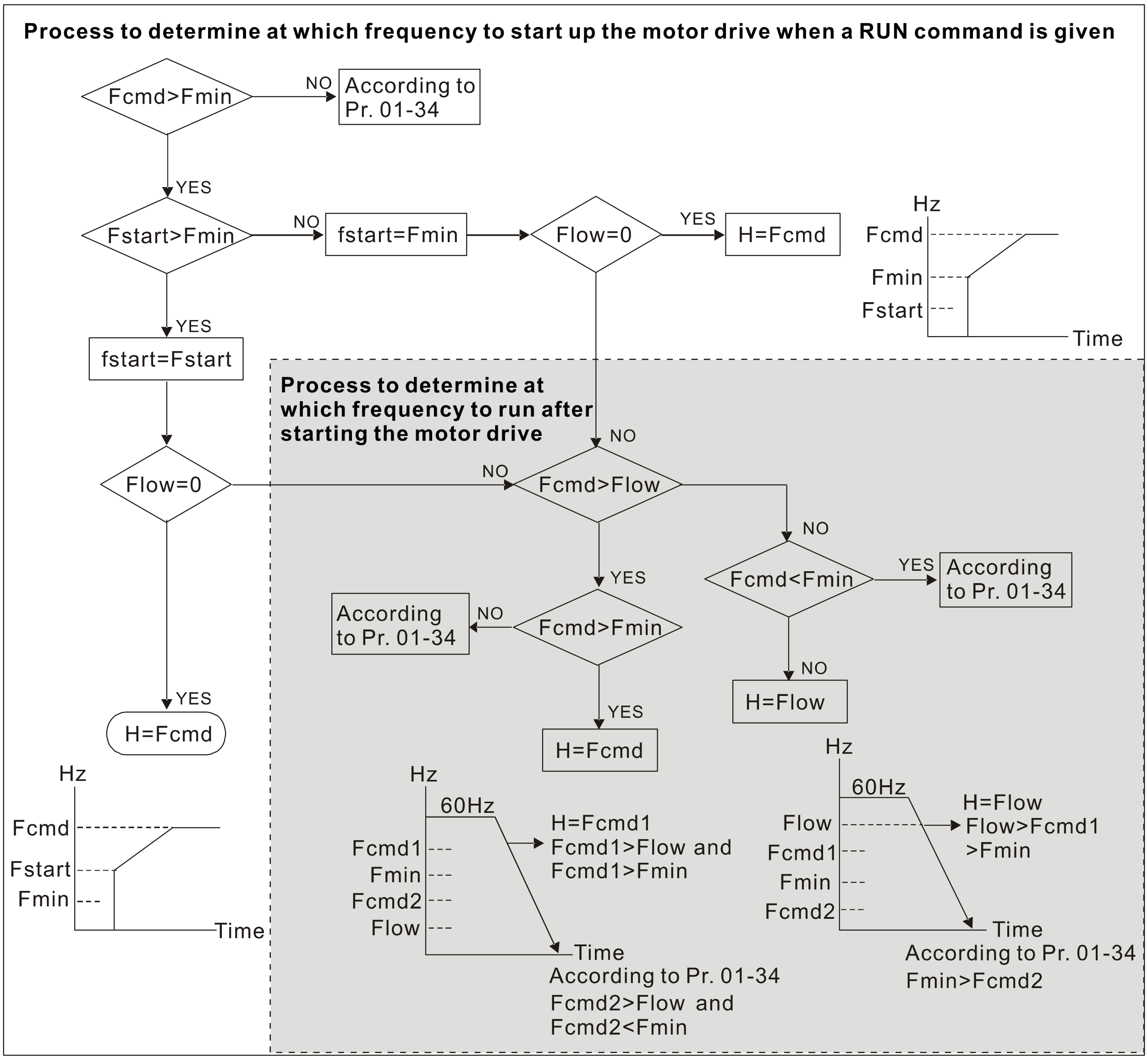
Default: 0.50

Settings 0.00–299.00 Hz

- When the starting frequency is higher than the minimum output frequency, the drive's output is from the starting frequency to the setting frequency. Refer to the following diagram for details.

  Fcmd = frequency command;
  Fstart = start frequency (Pr.01-09);
  fstart = actual start frequency of drive;
  Fmin = 4th output frequency setting (Pr.01-07);
  Flow = output frequency lower limit (Pr.01-11)
- When Fcmd > Fmin and Fcmd < Fstart:

  If Flow < Fcmd, drive runs directly by Fcmd.
  If Flow ≥ Fcmd, drive runs by Fcmd, then rises to Flow according to acceleration time.
- The output frequency goes directly to 0 when decelerating to Fmin.



01-10 Upper Frequency Limit

Default: 299.00

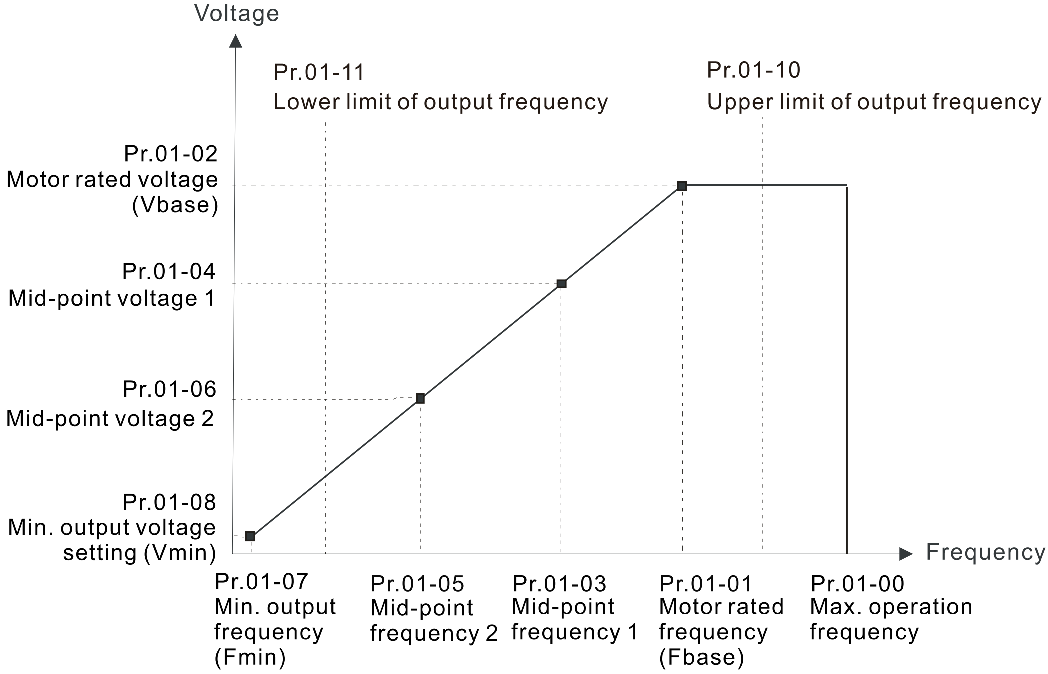
Settings 0.00–299.00 Hz

01-11 Lower Frequency Limit

Default: 0.00

Settings 0.00–299.00 Hz

- If the frequency setting is higher than the upper limit (Pr.01-10), the drive runs with the upper frequency limit. If the frequency setting is lower than lower limit (Pr.01-11) and higher than minimum frequency (Pr.01-07), the drive runs with the lower frequency limit. Set the upper frequency limit > lower frequency limit (Pr.01-10 setting value must be > Pr.01-11 setting value).
- If the PID control is enabled for the drive, the drive's output frequency may exceed frequency command but is still limited by this setting.
- Related parameters: Pr.01-00 Maximum Operation Frequency.



- When the drive starts, it operates from the minimum output frequency (Pr.01-07) and accelerates to the setting frequency. It is not limited by the lower limit frequency.
- Use the settings of upper and lower frequency limit to prevent operator's misuse, overheating caused by operating at a too low frequency, or damage caused by excessive speed.
- If the upper frequency limit setting is 50 Hz and the frequency setting is 60 Hz, the maximum output frequency is 50 Hz.
- If the lower frequency limit setting is 10 Hz and the minimum operation frequency setting (Pr.01-07) is 1.5 Hz, the drive operates at 10 Hz when the frequency command is greater than Pr.01-07 and less than 10 Hz. If the frequency command is less than Pr.01-07, the drive stays in ready status with no output.

01-12 Acceleration Time 1

Default: 2.00

01-13 Deceleration Time 1

Default: 2.00

01-14 Acceleration Time 2

01-15 Deceleration Time 2

01-16 Acceleration Time 3

01-17 Deceleration Time 3

01-18 Acceleration Time 4

01-19 Deceleration Time 4

01-20 JOG Acceleration Time

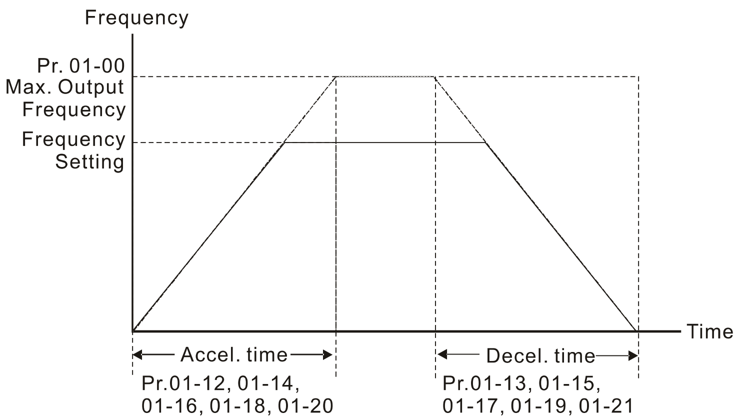
01-21 JOG Deceleration Time

Default: 10.00

Settings 0.00–600.00 sec.

- Use the acceleration time to determine the time required for the AC motor drive to accelerate from 0 Hz to maximum output frequency (Pr.01-00).

- Select the acceleration and deceleration time 1, 2, 3, and 4 with the multi-function input terminals settings. The defaults are acceleration and deceleration time 1. With the enabled torque limits and stall prevention functions, the actual acceleration and deceleration time are longer than the above action time.
- Note that setting the acceleration and deceleration time too short may trigger the protection function (Pr.06-03 Over-current Stall Prevention during Acceleration or Pr.06-01 Over-voltage Stall Prevention).
- Note that setting the acceleration time too short may cause motor damage or trigger drive protection due to over-current during acceleration.
- Note that setting the deceleration time too short may cause motor damage or trigger drive protection due to over-current during deceleration or over-voltage.
- Use suitable brake resistors (refer to Chapter 07 Optional Accessories) to decelerate in a short time and prevent over-voltage.
- When you enable Pr.01-24–Pr.01-27 (S-curve acceleration and deceleration begin and arrival time), the actual acceleration and deceleration time are longer than the setting.



Acceleration / Deceleration Time

01-22 JOG Frequency

Default: 6.00

Settings 0.00–299.00 Hz

- You can use both the external terminal JOG and F1 key on the optional keypad KPC-CC01 to set the JOG function. When the JOG command is ON, the AC motor drive accelerates from 0 Hz to the JOG frequency (Pr.01-22). When the JOG command is OFF, the AC motor drive decelerates from the JOG frequency to stop. The JOG acceleration and deceleration time (Pr.01-20, Pr.01-21) are the time to accelerate from 0.0 Hz to the JOG frequency (Pr.01-22). You cannot execute the JOG command when the AC motor drive is running. When the JOG command is executing, other operation commands are invalid.

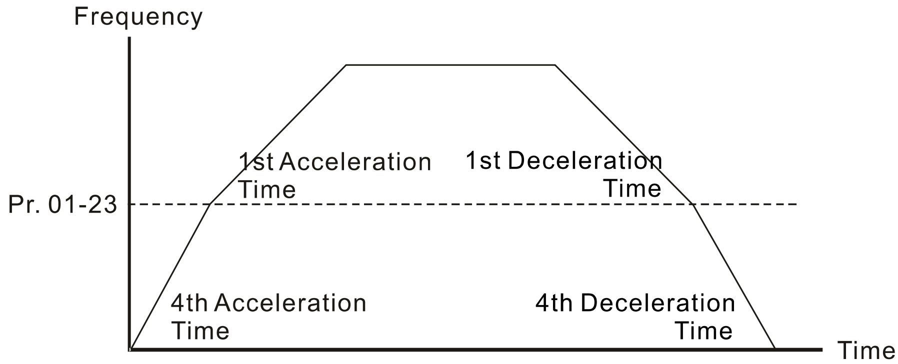
01-23 First and Fourth Acceleration / Deceleration Exchange Frequency

Default: 0.00

Settings 0.00–299.00 Hz

- This function does not require the external terminal switching function; it switches the acceleration and deceleration time automatically by the Pr.01-23 setting. If you set the external terminal, it is based on the external terminal first, and not on Pr.01-23.

- Use this parameter to set the switch frequency between acceleration and deceleration slope. The First / Fourth Accel. / Decel. slope is calculated by the Max. Operation Frequency (Pr.01-00) / acceleration / deceleration time.
- Example: When the Max. Operation Frequency (Pr.01-00) = 80 Hz, and Switch Frequency between First and Fourth Accel. / Decel. (Pr.01-23) = 40 Hz:
  a. If Acceleration Time 1 (Pr.01-02) = 10 sec., Acceleration Time 4 (Pr.01-18) = 6 sec., then the acceleration time is 3 sec. for 0–40 Hz and 5 sec. for 40–80 Hz.
  b. If Deceleration Time 1 (Pr.01-13) = 8 sec., Deceleration Time 4 (Pr.01-19) = 2 sec., then the deceleration time is 4 sec. for 80–40 Hz and 1 sec. for 40–0 Hz.



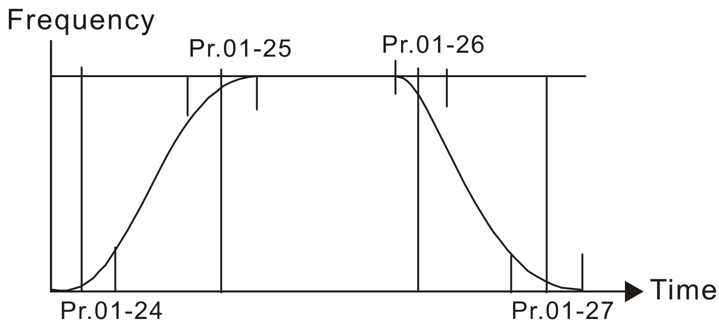
1st/4th Acceleration/Deceleration Frequency Switching

01-24	S-curve for Acceleration Begin Time 1
01-25	S-curve for Acceleration Arrival Time 2
01-26	S-curve for Deceleration Begin Time 1
01-27	S-curve for Deceleration Arrival Time 2

Default: 1.00

Settings 0.00–25.00 sec.

- Sets a slow start when the drive begins to accelerate at the start. The acceleration and deceleration curve adjust the S-curve acceleration and deceleration according to the parameter value. When you enable this function, the drive has a different acceleration and deceleration curve based on the acceleration and deceleration time.
- The S-curve function is disabled when you set the acceleration and deceleration time to 0.
- When Pr.01-12, 01-14, 01-16, 01-18 ≥ Pr.01-24 and Pr.01-25, the actual acceleration time = Pr.01-12, 01-14, 01-16, 01-18 + (Pr.01-24 + Pr.01-25) ÷ 2.
- When Pr.01-13, 01-15, 01-17, 01-19 ≥ Pr.01-26 and Pr.01-27, the actual deceleration time = Pr.01-13, 01-15, 01-17, 01-19 + (Pr.01-26 + Pr.01-27) ÷ 2.

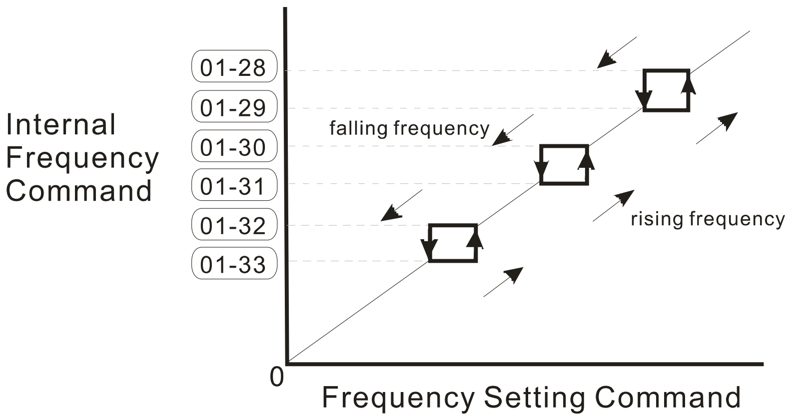


01-28	Skip Frequency 1 (Upper Limit)
01-29	Skip Frequency 1 (Lower Limit)
01-30	Skip Frequency 2 (Upper Limit)
01-31	Skip Frequency 2 (Lower Limit)
01-32	Skip Frequency 3 (Upper Limit)
01-33	Skip Frequency 3 (Lower Limit)

Default: 0.00

Settings 0.00–299.00 Hz

- Sets the AC drive's skip frequency. The drive's frequency setting skips these frequency ranges. However, the frequency output is continuous. There are no limits for these six parameters, and you can combine them. Pr.01-28 does not need to be greater than Pr.01-29; Pr.01-30 does not need to be greater than Pr.01-31; Pr.01-32 does not need to be greater than Pr.01-33. Pr.01-28–01-33 can be set as required. There is no size distinction among these six parameters.
- These parameters set the skip frequency ranges for the AC motor drive. You can use this function to avoid frequencies that cause mechanical resonance. The skip frequencies are useful when a motor has resonance vibration at a specific frequency bandwidth. Skipping this frequency avoids the vibration. There are three frequency skip zones available.
- You can set the Frequency command (F) within the range of skip frequencies. Then the output frequency (H) is limited to the lower limit of skip frequency ranges.
- When accelerating and decelerating, the output frequency still passes through the skip frequency ranges.



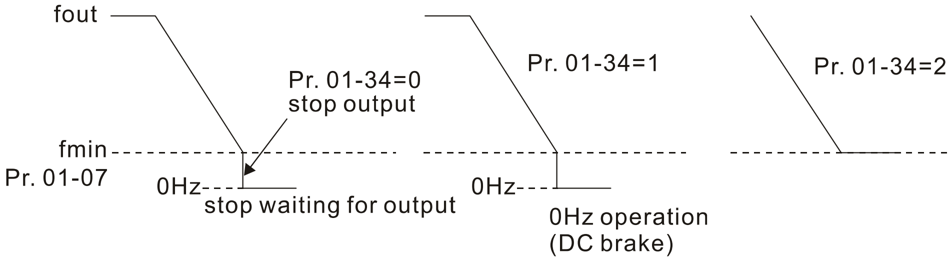
01-34	Zero-speed Mode

Default: 2

Settings 0: Output waiting
1: Zero-speed operation
2: Fmin (refer to Pr.01-07)

- When the frequency command of drive is less than Fmin (Pr.01-07, Pr.01-41), the drive operates using this parameter.
- 0: the AC motor drive is in waiting mode without voltage output from terminals U, V, W.
- 1: the drive executes the DC brake by Vmin (Pr.01-08 and Pr.01-42) in V/F, FOC sensorless, and SVC modes. And it executes zero-speed operation in VFPG and FOCPG mode.

- 2: the AC motor drive runs using Fmin (Pr.01-07, Pr.01-41) and Vmin (Pr.01-08, Pr.01-42) in V/F, VFPG, SVC, FOC sensorless and FOCPG modes.
- In V/F and SVC modes:



01-46 CANopen Quick Stop Time

Default: 1.00

Settings 0.00–600.00 sec.

- Use this to set the time to decelerate from the maximum operation frequency (Pr.01-00) to 0.00 Hz by CANopen control.

01-71 Leveling Speed Switch

Default: 0.00

Settings 0.00–299.00 Hz

- When the drive decelerates from S4 to S5, it switches the frequency to reach a smooth stop.
- Sets the speed for Pr.01-07 to the same as that for elevator.

01-72 Lower than Leveling Speed S5

Default: 1.00

Settings 0.00–25.00 sec.

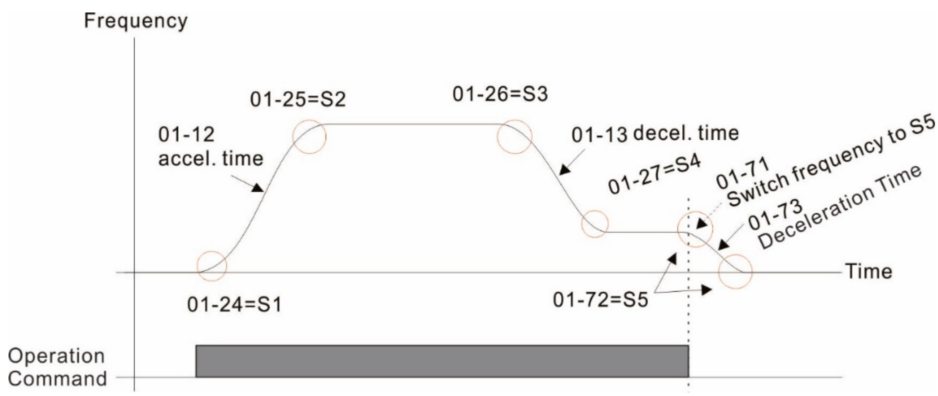
- It activates S-curve deceleration. The drive's deceleration curves act at different speed according to the original deceleration time.
- The Actual Deceleration Time = Pr.01-73 deceleration time + Pr.01-72.

01-73 VF Separated Mode, Voltage Input Source Selection

Default: 2.00

Settings 0.00–25.00 sec.

- When you cancel RUN command, the drive decelerates according to the dEB deceleration time in this parameter setting.



Actual Elevator Curve and Parameter Configuration Diagram

02 Digital Input / Output Parameters

✓ You can set this parameter during operation.

02-00 Two-wire / Three-wire Operation Control

Default: 1

Settings 0: No function

1: Two-wire mode 1, power on for operation control
(M1: FWD / STOP, M2: REV / STOP)

2: Two-wire mode 2, power on for operation control
(M1: RUN / STOP, M2: FWD / REV)

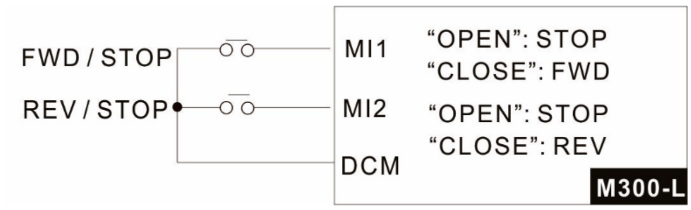
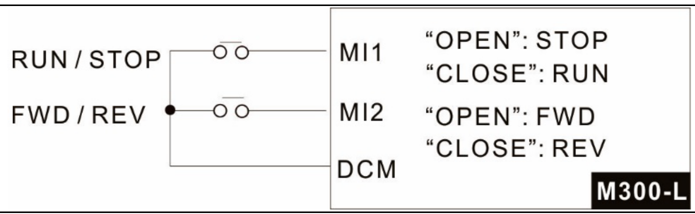
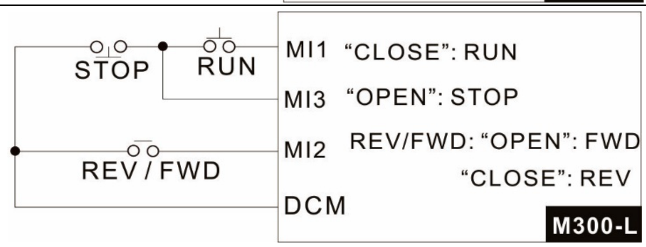
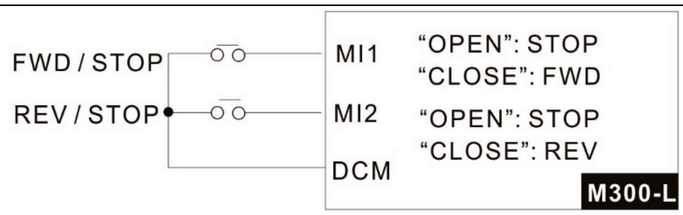
3: Three-wire, power on for operation control
(M1: RUN, M2: REV / FWD, M3: STOP)

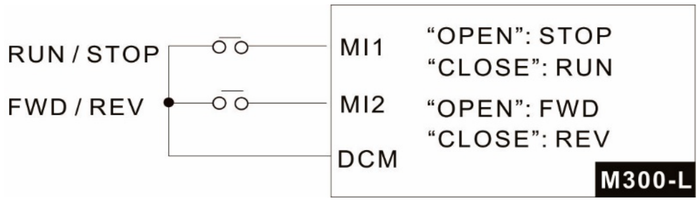
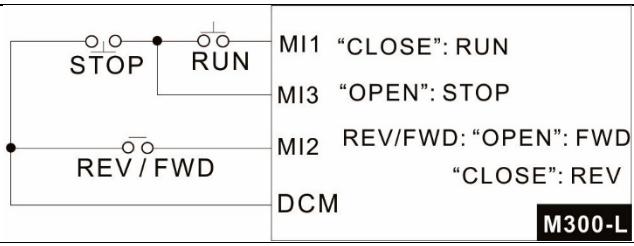
4: Two-wire mode 1, Quick Start
(M1: FWD / STOP, M2: REV / STOP)

5: Two-wire mode 2, Quick Start
(M1: RUN / STOP, M2: FWD / REV)

6: Three-wire, Quick Start
(M1: RUN, M2: REV / FWD, M3: STOP)

- In the Quick Start function, the output remains ready for operation. The drive responds to the Start command immediately.
- When using the Quick Start function, there is greater potential voltage on the output terminals.
- This parameter sets the configuration of the external drive operation control and the Quick Start function. There are six different control modes listed in the following table.

Pr.02-00	External terminal control circuits
Setting value: 1 Two-wire FWD / STOP REV / STOP	
Setting value: 2 Two-wire RUN / STOP FWD / REV	
Setting value: 3 Three-wire	
Setting value: 4 Two-wire Quick Start	

<table>
<tr><th>Pr.02-00</th><th>External terminal control circuits</th></tr>
<tr><td>Setting value: 5
Two-wire
Quick Start</td><td>
</td></tr>
<tr><td>Setting value: 6
Three-wire
Quick Start</td><td>
</td></tr>
</table>

02-01 Multi-function Input Command 1 (MI1)

Default: 0

02-02 Multi-function Input Command 2 (MI2)

Default: 0

02-03 Multi-function Input Command 3 (MI3)

Default: 1

02-04 Multi-function Input Command 4 (MI4)

Default: 2

02-05 Multi-function Input Command 5 (MI5)

Default: 3

02-06 Multi-function Input Command 6 (MI6)

Default: 4

02-07 Multi-function Input Command 7 (MI7)

Default: 49

02-26 Input Terminal of extension card (MI10)

Default: 0

02-27 Input Terminal of extension card (MI11)

Default: 0

02-28 Input Terminal of extension card (MI12)

Default: 0

Settings 0: No function

1: Multi-step speed command 1 / multi-step position command 1

2: Multi-step speed command 2 / multi-step position command 2

3: Multi-step speed command 3 / multi-step position command 3

4: Multi-step speed command 4 / multi-step position command 4

5: Reset

6: JOG operation [by external control or KPC-CC01 (optional)]

7: Acceleration / deceleration speed inhibit

8: The first and second acceleration / deceleration time selection

9: The third and fourth acceleration / deceleration time selection

10: External Fault (EF) input (Pr.07-20)
11: Base Block (B.B.) input from external
12: Output stops
15: Rotating speed command from AVI
16: Rotating speed command from ACI
18: Forced to stop (Pr.07-20)
24: FWD JOG command
25: REV JOG command
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for Δ-connection
38: Disable to write EEPROM function
40: Force coasting to stop
49: Enable Drive
53: Trigger CANopen quick stop
58: Emergency power mode detection
59: Magnetic contactor error detection
60: Mechanical brake error detection
61: Power loss signal
62: Mechanical brake error detection 2

- This parameter selects the functions for each multi-function terminal.
- When Pr.02-00 = 0, you can set multi-function options with the multi-function input terminals MI1, MI2.
- When Pr.02-00 ≠ 0, the multi-function input terminals MI1, MI2 work in accordance with the setting values for Pr.02-00.

  Example:

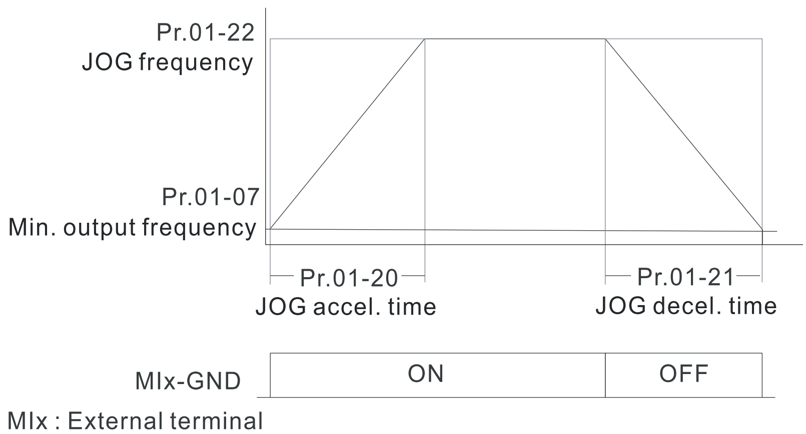
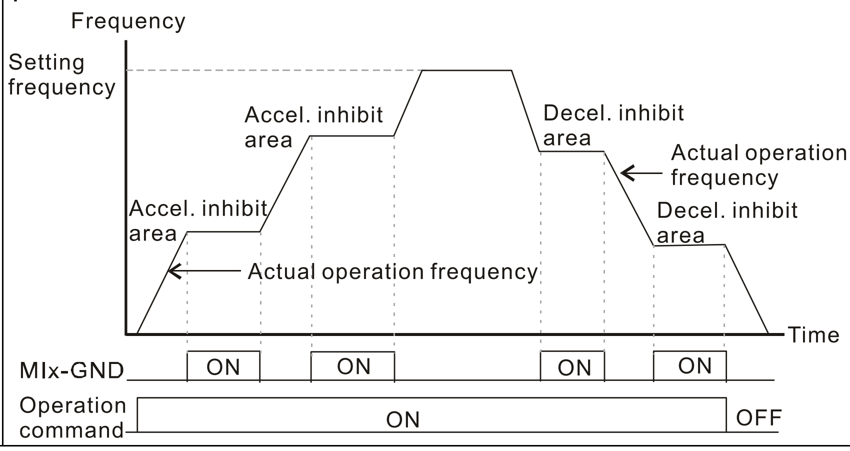
  If Pr.02-00 = 1: multi-function input terminal MI1 = FWD / STOP,
  multi-function input terminal MI2 = REV / STOP.

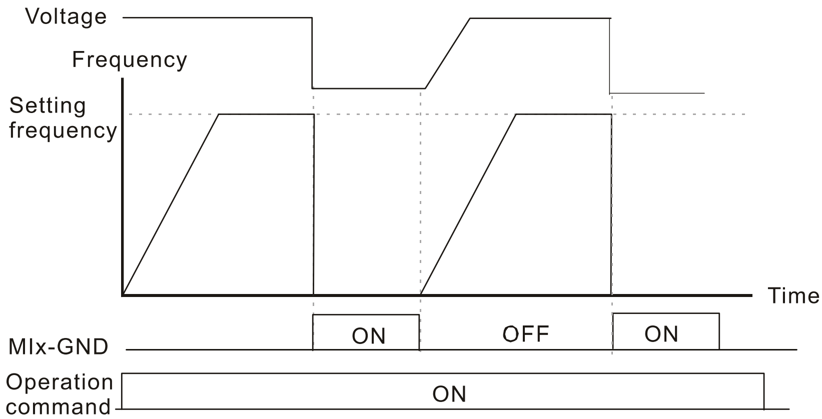
  If Pr.02-00 = 2: multi-function input terminal MI1 = RUN / STOP,
  multi-function input terminal MI2 = FWD / REV.
- When multi-function input terminal MI7 = 0, MI7 is designated as a pulse input terminal.
- If Pr.02-00 is set to three-wire operation control, terminal MI3 is for the STOP contact. The function set previously for this terminal is automatically invalid.

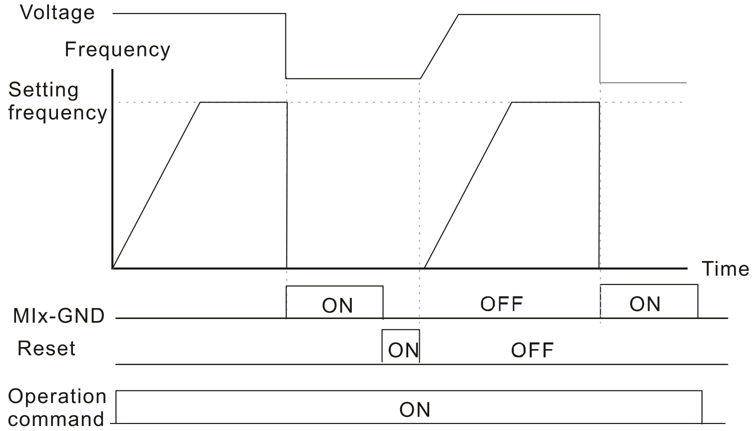
Summary of function settings

Take the normally opened contact (N.O.) for example, ON: contact is closed, OFF: contact is open.

Settings	Functions	Descriptions
0	No function	
1	Multi-step speed command 1 / multi-step position command 1	You can set 15 steps of speed or 15 positions with the digital status of these 4 terminals. You can use 16-steps of speed if you include the master speed when setting as 15 steps of speed (refer to Parameter Group 04 Multi-step Speed Parameters).
2	Multi-step speed	

Settings	Functions	Descriptions
	command 2 / multi-step position command 2	
3	Multi-step speed command 3 / multi-step position command 3	
4	Multi-step speed command 4 / multi-step position command 4	
5	Reset	Use this terminal to reset the drive after clearing a drive fault.
6	JOG operation	This function is valid when the source of the operation command is the external terminals. The JOG operation executes when the drive stops completely. While running, you can still change the operation direction, and the STOP key on the keypad* and the STOP command from communications are valid. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to Pr.01-20–Pr.01-22 for details. * : This function is valid when Pr.00-32 is set to 1. 
7	Acceleration / deceleration speed inhibit	When you enable this function, the drive stops acceleration or deceleration immediately. After you disable this function, the AC motor drive starts to accelerate or decelerate from the inhibit point. 

Settings	Functions	Descriptions
8	The first and second acceleration / deceleration time selection	You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selections.
9	The third and fourth acceleration / deceleration time selection	
10	External Fault (EF) input (Pr.07-20)	For external fault input. The drive decelerates according to the Pr.07-20 setting, and the keypad shows "EF" (it shows the fault record when an external fault occurs). The drive keeps running until the fault is cleared (terminal status restored) after RESET.
11	Base Block (B.B.) input from external	ON: the output of the drive stops immediately. The motor is in free run and the keypad displays the B.B. signal. Refer to Pr.07-08 for details.
12	Output stops	ON: the output of the drive stops immediately, and the motor is in free run status. The drive is in output waiting status until the switch is turned to OFF, and then the drive restarts and runs to the current setting frequency. 
15	Rotating speed command from AVI	ON: force the source of the frequency to be AVI. If the rotating speed commands are set to AVI and ACI at the same time, the priority is AVI > ACI.
16	Rotating speed command from ACI	ON: force the source of the frequency to be ACI. If the rotating speed commands are set to AVI and ACI at the same time, the priority is AVI > ACI.
18	Forced to stop	ON: the drive ramps to stop according to the Pr.07-20 setting.
24	FWD JOG command	This function is valid when the source of the operation command is external terminal. ON: the drive executes forward JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.

Settings	Functions	Descriptions
25	REV JOG command	This function is valid when the source of the operation command is external terminal. ON: the drive executes reverse JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.
28	Emergency stop (EF1)	ON: the output of the drive stops immediately, displays "EF1" on the keypad, and the motor is in free run status. The drive keeps running until the fault is cleared after you press RESET on the keypad (EF: External Fault). 
29	Signal confirmation for Y-connection	When the control mode is V/F, ON: the drive operates by the first V/F.
30	Signal confirmation for ∆-connection	When the control mode is V/F, ON: the drive operates by the second V/F.
38	Disable to write EEPROM function	ON: writing to EEPROM is disabled. Changed parameters are not saved after power off.
40	Force coasting to stop	ON: during operation, the drive free runs to stop.
49	Enable drive	When the drive is enabled, the RUN command is valid. When the drive is disabled, the RUN command is invalid. When the drive is operating, the motor coasts to stop. This function varies with MO=45.
53	Trigger CANopen Quick Stop	When this function is enabled under CANopen control, it changes to Quick Stop. Refer to Chapter 15 CANopen Overview for more details.
58	Emergency power mode detection	If the drive runs during power lose and detects DC voltage is lower than Lv limit, the drive stops running. At this time, shut down the normal power supply magnetic contactor, generate the emergency power, then set the terminal of this parameter setting to closed and enter RUN command again. The drive runs according to the internal secured frequency set.
59	Detection of Magnetic contactor	Uses for magnetic contactor ON / OFF feedback signal. When the drive receives RUN command after Pr.02-30 release

Settings	Functions	Descriptions
		time, it switches its corresponding multi-function output terminal (setting value = 75) to ON. Then the drive begins to confirm whether the contact for this parameter setting receives magnetic contactor's normal signal (closed) according to Pr.02-32 magnetic contactor detection time. If the drive does not close within Pr.02-32 release time, it means that magnetic contactor is abnormal, and the drive displays error code 74 (MCF).
60	Mechanical brake error detection	When the drive receives RUN command after Pr.02-39 release time, it switches its corresponding multi-function output terminal (setting value = 12) to ON. Then the drive begins to confirm whether the contact for this parameter setting receives brake's normal signal (closed) according to Pr.02-33 mechanical brake detection time. If the drive does not close within Pr.02-33 release time, it means that mechanical brake is abnormal, and the drive displays error code 75 (MBF).
61	Power down signal	When system power loses, host controller must enter this signal to inform the drive. When the drive receives this signal after Pr.06-85 sec., MO = 58 signal closes.
62	Mechanical brake error detection 2	When the drive receives RUN command after Pr.02-39 release time, it switches its corresponding multi-function output terminal (setting value = 12) to ON. Then the drive begins to confirm whether the contact for this parameter setting receives brake's normal signal (closed) according to Pr.02-33 mechanical brake detection time. If the drive does not close within Pr.02-33 release time, it means that mechanical brake is abnormal, and the drive displays error code 71 (MBF2).

02-11 Multi-function Input Response Time

Default: 0.005

Settings 0.000–30.000 sec.

- Use this parameter to set the response time of the digital input terminals MI1–MI7.
- This function is to delay and confirm the digital input terminal signal. The time for delay is also the time for confirmation. The confirmation prevents interference that could cause error in the input to the digital terminals. But in the meanwhile, it delays the response time though confirmation improves accuracy.

02-12 Multi-function Input Mode Selection

Default: 0000

Settings 0000h–FFFFh (0: N.O.; 1: N.C.)

- This parameter setting is in hexadecimal.

- This parameter sets the status of the multi-function input signal (0: normally open; 1: normally closed) and it is not affected by the status of SINK / SOURCE.
- bit 0–bit 6 correspond to MI1–MI7.
- The default for bit 0 (MI1) is FWD terminal, and the default for bit 1 (MI2) is REV terminal. You cannot use this parameter to change the input mode when Pr.02-00 ≠ 0.
- You can change the terminal ON / OFF status through communications.
  For example: MI3 is set to 1 (multi-step speed command 1) and MI4 is set to 2 (multi-step speed
- command 2). Then the forward + second step speed command = $1001_2 = 9_{10}$.
- As long as Pr.02-12 = 9 is set through communications, there is no need to wire any multi-function terminal to run forward with the second step speed.

bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
MI7	MI6	MI5	MI4	MI3	MI2	MI1

- Use Pr.11-42 bit 1 to select whether the FWD / REV terminal is controlled by Pr.02-12 bit 0 and bit 1.

02-13 Multi-function Output 1 (Relay1)

Default: 11

02-16 Multi-function Output 2 (MO1)

Default: 0

02-17 Multi-function Output 3 (MO2)
02-36 Output Terminal of Extension Card (MO10) or (RY10)
02-37 Output Terminal of Extension Card (MO11) or (RY11)
02-38 Output Terminal of Extension Card (MO12) or (RY12)

Default: 0

Settings 0: No function
1: Indication during RUN
2: Operation speed reached
3: Desired frequency reached 1 (Pr.02-22)
4: Desired frequency reached 2 (Pr.02-24)
5: Zero speed (Frequency command)
6: Zero speed, includes STOP (Frequency command)
7: Over-torque 1 (Pr.06-06–06-08)
9: Drive is ready
10: Low voltage warning (Lv) (Pr.06-00)
11: Malfunction indication
12: Mechanical brake signal (Pr. 02-39–Pr. 02-42)
13: Over-heat warning (Pr.06-15)
16: Slip error (oSL)
19: External interrupt B.B. input (Base Block)
20: Warning output
21: Over-voltage
22: Over-current stall prevention

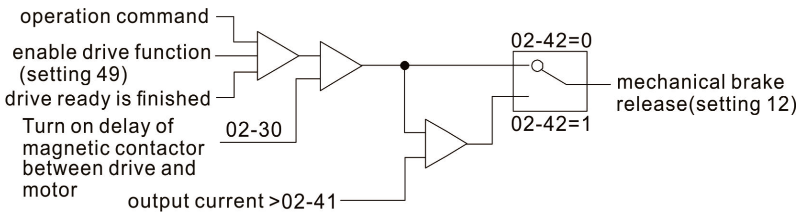
23: Over-voltage stall prevention
24: Operation source
25: Forward command
26: Reverse command
27: Output when current ≥ Pr.02-41
28: Output when current < Pr.02-41
31: Y-connection for the motor coil
32: ∆-connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed include STOP (actual output frequency)
35: Error output selection 1 (Pr.06-23)
36: Error output selection 2 (Pr.06-24)
37: Error output selection 3 (Pr.06-25)
38: Error output selection 4 (Pr.06-26)
40: Speed reached (including STOP)
44: Low current output (use with Pr.06-71–Pr.06-73)
45: UVW output electromagnetic valve ON / OFF switch
50: Output control for CANopen
56: Power generation direction and status verify
57: Power generation direction
58: EPS MODE
67: Outputs when analog input level reached
75: Motor-controlled magnetic contactor output

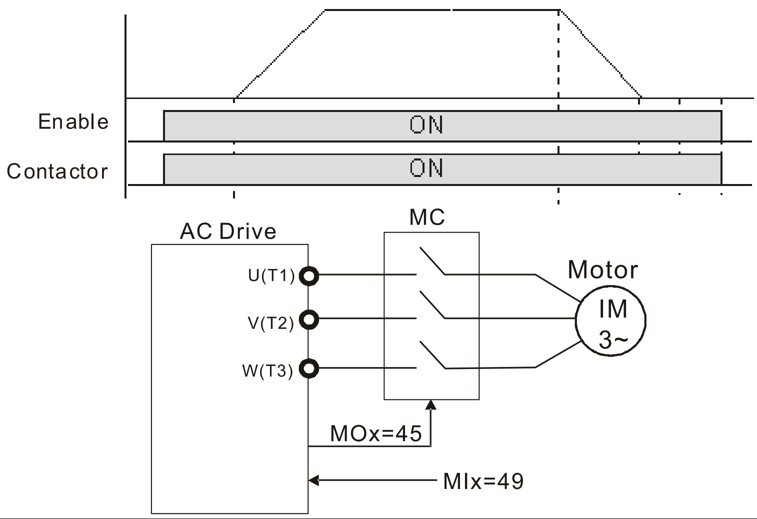
📖 Use this parameter to set the function of the multi-function terminals.

Summary of function settings

Take the normally open contact (N.O.) for example, ON: contact is closed, OFF: contact is open.

Settings	Functions	Descriptions
0	No Function	Output terminal with no function
1	Indication during RUN	Activates when the drive is not in STOP.
2	Operation speed reached	Activates when output frequency of the drive reaches the setting frequency.
3	Desired frequency reached 1 (Pr.02-22)	Activates when the desired frequency (Pr.02-22) is reached.
4	Desired frequency reached 2 (Pr.02-24)	Activates when the desired frequency (Pr.02-24) is reached.
5	Zero speed (Frequency command)	Activates when frequency command = 0 (the drive must be in RUN status).
6	Zero speed, includes STOP (Frequency command)	Activates when frequency command = 0 or stopped.

Settings	Functions	Descriptions
7	Over-torque 1	Activates when the drive detects over-torque. Pr.06-07 sets the over-torque detection level (motor 1), and Pr.06-08 sets the over-torque detection time (motor 1). Refer to Pr.06-06–06-08.
9	Drive is ready	Activates when the drive is ON with no error detected.
10	Low voltage warn (Lv)	Activates when the DC bus voltage is too low (refer to Pr.06-00 Low Voltage Level).
11	Malfunction indication	Activates when fault occurs (except Lv stop).
12	Mechanical brake signal	When the drive runs after Pr.02-39 delay time, this contact is closed. Use this function with DC brake and use ”b”(N.C) contact. (Refer to Pr.02-39–Pr.02-42) 
13	Over-heat warning	Activates when IGBT or heat sink overheats; to prevent the drive from shutting down due to over-heating (refer to Pr.06-15).
16	Slip error (oSL)	Activates when the slip error is detected.
19	External interrupt B.B. input (Base Block)	Activates when external interrupt (B.B.) stop output occurs in the drive.
20	Warning output	Activates when a warning is detected.
21	Over-voltage	Activates when over-voltage is detected.
22	Over-current stall prevention	Activates when over-current stall prevention is detected.
23	Over-voltage stall prevention	Activates when over-voltage stall prevention is detected.
24	Operation source	Activates when the source of operation command is not controlled by the digital keypad (Pr.00-21 ≠ 0).
25	Forward command	Activates when the operation direction is forward.
26	Reverse command	Activates when the operation direction is reverse.
27	Output when current ≥ Pr.02-41	Activates when current is ≥ Pr.02-41
28	Output when current < Pr.02-41	Activates when current is < Pr.02-41
31	Y-connection for the motor coil	Activates when Pr.05-24 = 1, the frequency output is lower than Pr.05-23 minus 2 Hz, and the time is longer than Pr.05-25.
32	∆-connection for the motor coil	Activates when Pr.05-24 = 1, the frequency output is higher than Pr.05-23 plus 2 Hz, and the time is longer than Pr.05-25.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>33</td><td>Zero speed
(actual output frequency)</td><td>Activates when the actual output frequency is 0
(the drive is in RUN mode).</td></tr>
<tr><td>34</td><td>Zero speed includes stop (actual output frequency)</td><td>Activates when the actual output frequency is 0 or stopped.</td></tr>
<tr><td>35</td><td>Error output selection 1
(Pr.06-23)</td><td>Activates when Pr.06-23 is ON.</td></tr>
<tr><td>36</td><td>Error output selection 2
(Pr.06-24)</td><td>Activates when Pr.06-24 is ON.</td></tr>
<tr><td>37</td><td>Error Output Selection 3
(Pr.06-25)</td><td>Activates when Pr.06-25 is ON.</td></tr>
<tr><td>38</td><td>Error Output Selection 4
(Pr.06-26)</td><td>Activates when Pr.06-26 is ON.</td></tr>
<tr><td>40</td><td>Speed reached
(including STOP)</td><td>Activates when the output frequency reaches the setting frequency or stopped.</td></tr>
<tr><td>44</td><td>Low current output</td><td>Use this function with Pr.06-71–Pr.06-73.</td></tr>
<tr><td>45</td><td>UVW output electromagnetic valve ON / OFF switch</td><td>Use this function with external terminal input = 49 (drive enabled) and external terminal output = 45 (electromagnetic valve enabled), and then the electromagnetic valve is ON or OFF according to the status of the drive.

</td></tr>
<tr><td>50</td><td>Output control for CANopen</td><td>Control the multi-function output terminals through CANopen. The mapping table of the CANopen DO is shown in the following table:
<table>
<tr><th>Physical Terminal</th><th>Setting for Related Parameters</th><th>Attribute</th><th>Corresponding Index</th></tr>
<tr><td>RY1</td><td>Pr.02-13 = 50</td><td>RW</td><td>2026-41
bit 0 of initial value 0x01</td></tr>
<tr><td>MO1</td><td>Pr.02-16 = 50</td><td>RW</td><td>2026-41
bit 3 of initial value 0x01</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 50</td><td>RW</td><td>2026-41
bit 4 of initial value 0x01</td></tr>
</table>
Refer to subsection 15-3-5 for more information.</td></tr>
</table>

Settings	Functions	Descriptions
56	Power generation direction and status verify	When finish searching the power generating mode, this switch will be closed.
57	Power generation direction	When the running direction of the power generating mode is forward, this switch will be closed.
58	EPS MODE	When receiving signals from the upper drive, (Pr.02-01 =61), there will be a few seconds of delay (Pr.06-85), then this switch will be closed.
67	Outputs when analog input level reached	The multi-function output terminals operate when the analog input level is between the high level and the low level. Pr.03-44: Select one of the analog input channels (AVI, ACI) to be compared. Pr.03-45: The high level for the analog input, default is 50%. Pr.03-46: The low level for the analog input, default is 10%. If analog input > Pr.03-45, the multi-function output terminal operates. If analog input < Pr.03-46, the multi-function output terminal stops output.
75	Motor-controlled magnetic contactor output	When the drive receives that multi-function input terminal is set to 49 (drive enable), this contact is closed. (Refer to Pr.02-30 and Pr.02-31)

02-18 Multi-function Output Direction

Default: 0000h

Settings 0000h–FFFFh (0: N.O.; 1: N.C.)

- This parameter is in hexadecimal.
- This parameter is set by a bit. If the bit is 1, the corresponding multi-function output acts in an opposite way.
  Example:
  Assume Pr.02-13 = 1 (indication when the drive is operating). If the output is positive, the bit is set to 0, and then Relay is ON when the drive runs and is OFF when the drive stops. On the contrary, if the output is negative, and the bit is set to 1, then the Relay is OFF when the drive runs and is ON when the drive stops.

bit 4	bit 3	bit 2	bit 1	bit 0
MO2	MO1	Reserved	Reserved	RY

02-21 Digital Output Gain (DFM)

Default: 1

Settings 1–55

- Sets the signal for the digital output terminals (DFM-DCM) and the digital frequency output (pulse, work period = 50%). The output pulse per second = output frequency × Pr.02-21.

✓ 02-22 Desired Frequency Reached 1

Default: 60.00 / 50.00

Settings 0.00–299.00 Hz

✓ 02-23 The width of the desired frequency reached 1

Default: 2.00

Settings 0.00–299.00 Hz

✓ 02-24 Desired Frequency Reached 2

Default: 60.00 / 50.00

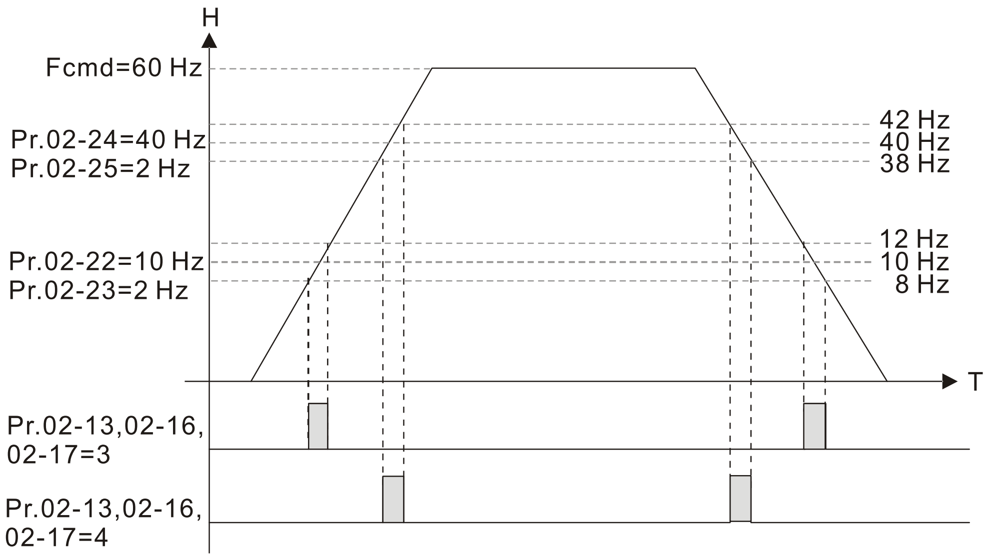
Settings 0.00–299.00 Hz

✓ 02-25 The width of the desired frequency reached 2

Default: 2.00

Settings 0.00–299.00 Hz

- Once the output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3 or 4 (Pr.02-13, Pr.02-16, and Pr.02-17), this multi-function output terminal is “closed”.



✓ 02-30 Turn On Delay of Magnetic Contactor between Drive and Motor

✓ 02-31 Turn Off Delay of Magnetic Contactor between Drive and Motor

Default: 0.200

Settings 0.010–65.000 sec.

✓ 02-32 Magnetic Contactor Error Detection Time Setting

✓ 02-33 Magnetic Brake Error Detection Time Setting

Default: 0.00

Settings 0.00–10.00 sec.

Magnetic Contactor Feedback Error

1. MI terminal setting 59 (magnetic contactor feedback signal)
2. MO terminal setting 75 (magnetic contactor output signal)
3. Pr.02-32 (Magnetic Contactor Error Detection Time Setting)

4. When magnetic contactor output signal and feedback signal are not in the same level and exceeds the setting time for Pr.02-32, “Magnetic contactor error (MCF)” displays with an error code 74.
5. Homing condition: magnetic contactor output signal and feedback signal are in the same level.

Mechanical Brake Feedback Error

1. MI terminal setting 60 and 62 (mechanical brake feedback signals)
2. MO terminal setting 12 (mechanical brake output signal)
3. Pr.02-33 (Mechanical Brake Error Detection Time Setting)
4. When mechanical brake output signal and feedback signal are not in the same level and exceeds the setting time for Pr.02-33, “Mechanical brake error (MBF)” displays with an error code 75 and “Mechanical brake error 2 (MBF2)” displays with an error code 71.
5. Homing condition: mechanical brake output signal and feedback signal are in the same level.

⌿ 02-35 External Operation Control Selection after Reset and Reboot

Default: 0

Settings 0: Disable

1: Drive runs if the RUN command remains after reset or reboot.

Set value as 1:

Pay attention that the drive will execute the running command by itself in the following status.

- Status 1: After the drive is powered on and the external terminal for RUN stays ON, the drive runs.
- Status 2: After clearing a fault once a fault is detected and the external terminal for RUN stays ON, you can run the drive by pressing the RESET key.

⌿ 02-39 Brake Release Delay Time When Elevator Starts
⌿ 02-40 Brake Contracting Delay Time When Elevator Stops

Default: 0.250

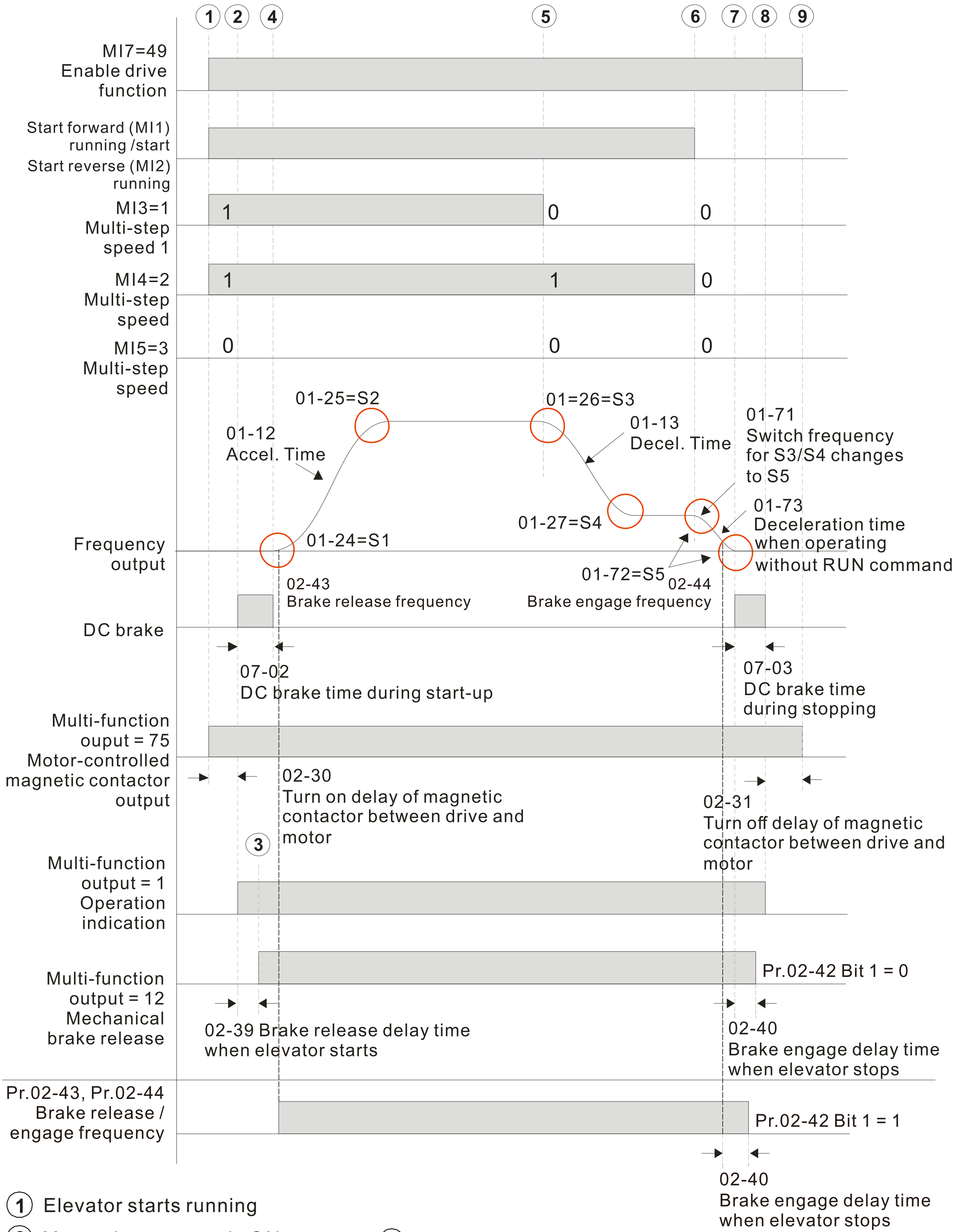
Settings 0.010–65.000 sec.

Start-up Time Sequence

As below diagram shows, magnetic contactor attracts when the drive is enabled. After Pr.02-30 delay time, DC brake starts to make the drive output and maintain motor’s speed at 0. The mechanical brake releases after Pr.02-39 delay time. Elevator starts to lift (rotation speed starts increasing) when DC brake stops (Pr.07-02).

Stop Time Sequence

As below diagram shows, DC brake starts when elevator stops to lift (rotation speed decreases to 0) to make the drive output and maintain the motor’s speed at 0. The mechanical brake contracts after Pr.02-40 delay time. When DC brake stops (Pr.07-03) and after Pr.02-31 delay time, motor magnetic contactor releases and time sequence stops.



1 Elevator starts running
2 Magnetic contactor is ON
3 Brake release
4 End of <DC brake time at start-up>
5 Start of deceleration
6 End of creeping
7 Start of <DC brake time at stop>
8 End of <DC brake time at stop>
9 Motor release

Elevator Timing Diagram

02-41 Output Current Level Setting for External Terminals

Default: 0

Settings 0–100% (Rated current of drive %)

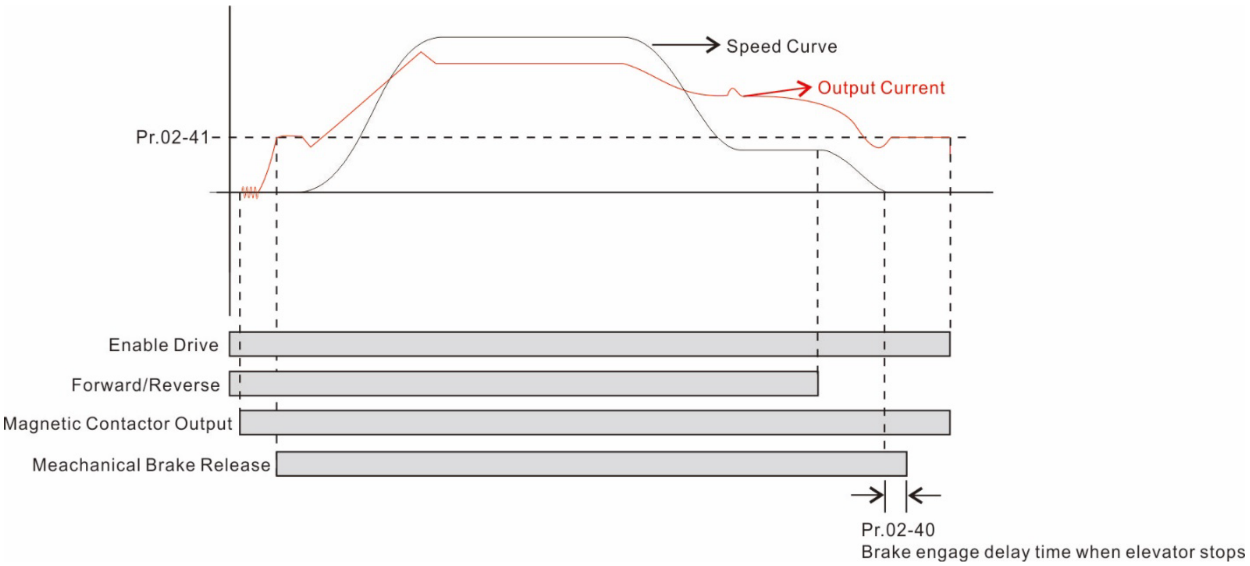
- When output current is >= Pr.02-41, it will activate multi-function output terminal (Pr.02-13, 16, 17, 36, 37, 38 is set to 27).
- When output current is < Pr.02-41, it will activate multi-function output terminal (Pr.02-13, 16, 17, 36, 37, 38 is set to 28).

02-42 Brake Release Function Option

Default: 0000h

Settings	Bit 0 = 0: No function
	Bit 0 = 1: Check torque output function switch
	Bit 1 = 0: No function
	Bit 1 = 1: Brake control by frequency threshold function switch

- Bit 0: When the drive receives the operation signal, the drive checks if there is a torque output. When enabled, the drive releases mechanical brake after confirming that there is torque output.



Sequence Diagram

- Bit 1: See the elevator timing diagram on page 12-02-15.
- Roll-back solution:
  1. Set contactor delay and DC brake (Pr.07-01 and Pr.07-03) constant time during stop.
  2. Set Pr.02-42 Bit 1=1.
  3. Set frequencies for brake release and brake engage (Pr.02-43 and Pr.02-44) to solve roll-back issue.

02-43 Brake Release Frequency

Default: 0.00

Settings 0.00–10.00 Hz

Use this function with Pr.02-42 Bit 1 =1.

02-44 Brake Engage Frequency

Default: 0.00

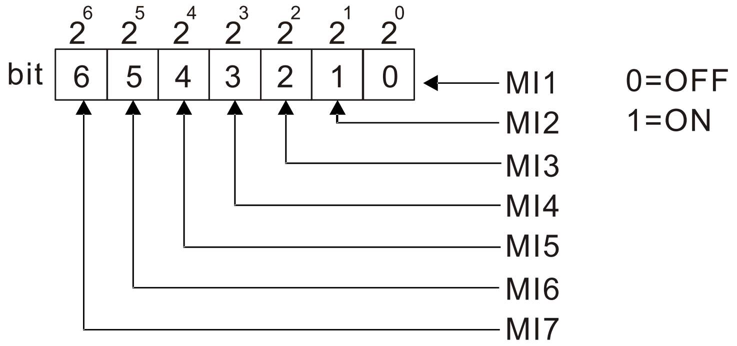
Settings 0.00–10.00 Hz

Use this function with Pr.02-42 Bit 1 =1.

02-50 Display the Status of the Multi-function Input Terminal

Default: Read only

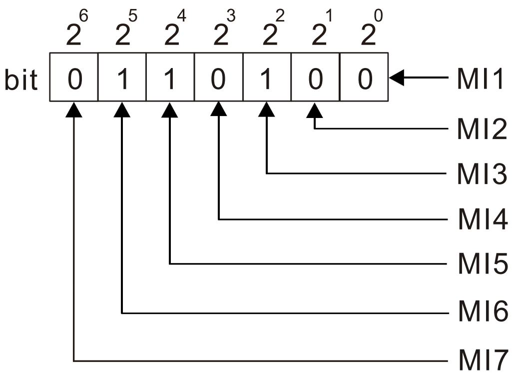
Settings Monitor the status of the Multi-function Input Terminal



NOTE
$2^6 = 64$ $2^5 = 32$ $2^4 = 16$
$2^3 = 8$ $2^2 = 4$ $2^1 = 2$ $2^0 = 1$

Example:

When Pr.02-50 displays 0034h (hex) (that is, the value is 52 (decimal) and 0110100 (binary)), it means that MI3, MI5 and MI6 are ON.



0=OFF
1=ON

Setting

$= \text{bit } 5 \times 2^5 + \text{bit } 4 \times 2^4 + \text{bit } 2 \times 2^2$

$= 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^2$

$= 32 + 16 + 4$

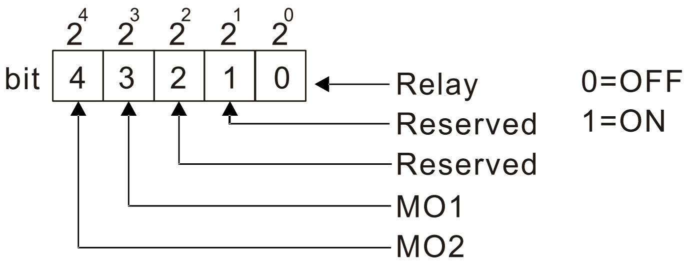
$= 52$

NOTE
$2^6 = 64$ $2^5 = 32$ $2^4 = 16$
$2^3 = 8$ $2^2 = 4$ $2^1 = 2$ $2^0 = 1$

02-51 Display the Status of the Multi-function Output Terminal

Default: Read only

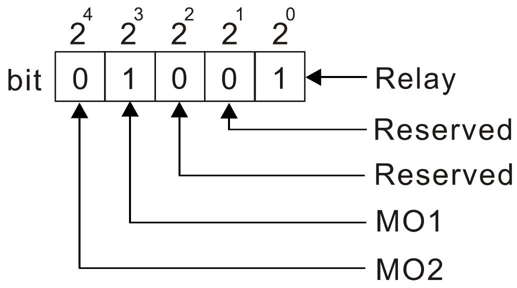
Settings Monitor the status of the Multi-function Output Terminal



NOTE
$2^4 = 16$ $2^3 = 8$ $2^2 = 4$
$2^1 = 2$ $2^0 = 1$

📖 Example:

When Pr.02-51 displays 0009h (hex) (that is, the value is 9 (decimal) and 01001 (binary)), it means that Relay and MO1 are ON.



0=OFF
1=ON

Setting

$= \text{bit } 3 \times 2^3 + \text{bit } 0 \times 2^0$

$= 1 \times 2^3 + 1 \times 2^0$

$= 8 + 1$

$= 9$

NOTE
$2^4 = 16$ $2^3 = 8$ $2^2 = 4$
$2^1 = 2$ $2^0 = 1$

02-54 Display the Frequency Command Executed by the External Terminal

Default: Read only

Settings 0.00–299.00 Hz (Read only)

📖 When you set the source of the frequency command as the external terminal, if Lv or fault occurs, the external terminal frequency command is saved in this parameter.

02-70 IO Card Types

Default: Read only

Settings 09: EMM-D3R2CA

✎ 02-71 IO Option Card Failure Action Selection

Default: 1

Settings 0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No Warning

✎ 02-72 IO Option Card Error Retry Times

Default: 5

Settings 0–5 times

✎ 02-82 Initial Frequency Command (F) Mode after Stop

Default: 0

Settings 0: Use current Frequency command
1: Use zero Frequency command
2: Refer to Pr.02-85 to set up

✐ 02-83 EPS Operation Frequency

Default: 5.00

Settings 0.00–10.00 Hz

- Sets the elevator's running speed when using Emergency Power Supply (EPS).
- When elevator uses EPS, it runs at Pr.02-83, and the maximum running speed should not be larger than Pr.06-81 (Emergency Power Speed in Operation). If you set Pr.02-83 to be larger than Pr.06-81, the elevator runs at Pr.06-81 setting value.

✐ 02-85 Initial Frequency Command (F) Setting after Stop

Default: 0.00

Settings 0.00–10.00 Hz

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03 Analog Input / Output Parameters

✎ You can set this parameter during operation.

✎ 03-00 AVI Analog Input Selection

Default: 1

✎ 03-01 ACI Analog Input Selection

Default: 0

Settings 0: No function
1: Frequency command

- When you use analog input as the PID reference target input, you must set Pr.00-20 to 2 (external analog input).
  Setting method 1: Pr.03-00–03-01 set 1 as frequency command.
- When you use the frequency command, the corresponding value for 0– ±10 V / 4–20 mA is 0–maximum operation frequency (Pr.01-00).
- When the settings for Pr.03-00 and Pr.03-01 are the same, the AVI input is selected first.

✎ 03-03 AVI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding AVI voltage for the external analog input 0.

✎ 03-04 ACI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding ACI current for the external analog input 0.

✎ 03-07 AVI Positive / Negative Bias Mode

✎ 03-08 ACI Positive / Negative Bias Mode

Default: 0

Settings 0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

- In a noisy environment, use negative bias to provide a noise margin. Do NOT use less than 1 V to set the operation frequency.

✎ 03-10 Reverse Setting when Analog Signal Input is Negative Frequency

Default: 0

Settings 0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction.
1: Negative frequency input is allowed. Positive frequency = run in forward direction; negative frequency = run in reverse direction. The digital keypad or external terminal control cannot switch the running direction.

- Use this parameter only for AVI or ACI analog input.

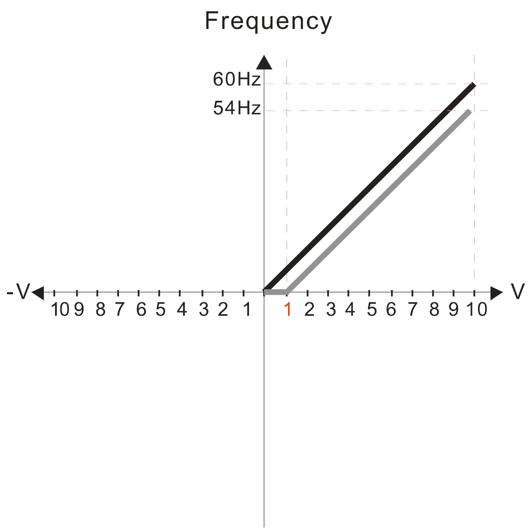
Requirements for negative frequency (reverse running)

1. Pr.03-10 = 1
2. Bias mode = Bias serves as the center
3. Corresponded analog input gain < 0 (negative); this makes the input frequency negative.

In using the additional analog input function (Pr.03-18 = 1), when the analog signal is negative after the addition, you can set this parameter to allow or not allow the reverse direction. The result after adding is restricted by the "Condition for negative frequency (reverse running)".

In the diagram below, black line is voltage-frequency curve with no bias; gray line is voltage-frequency curve with bias.

Diagram 01



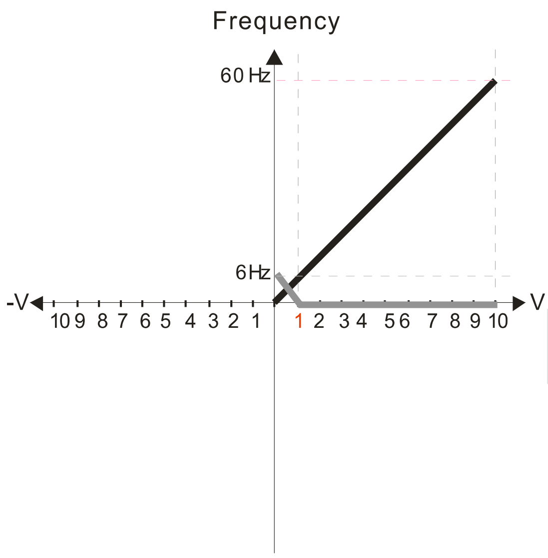
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 02



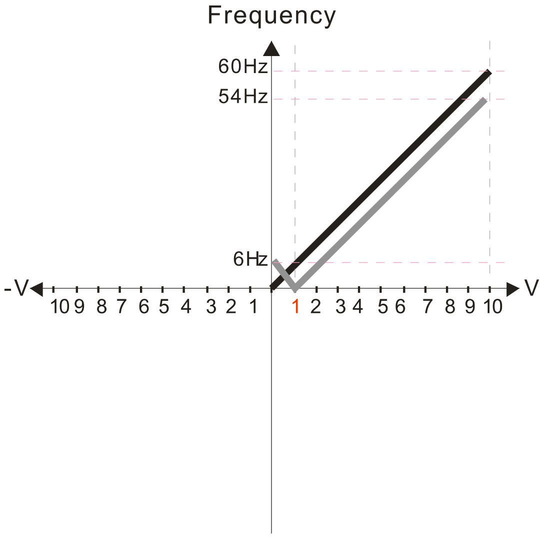
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 03



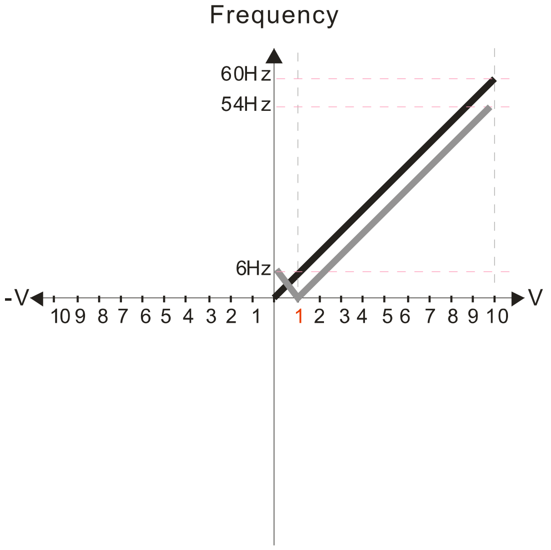
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 04



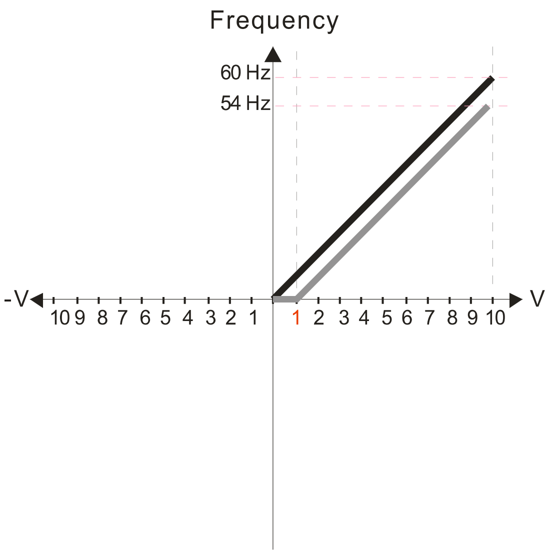
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 05



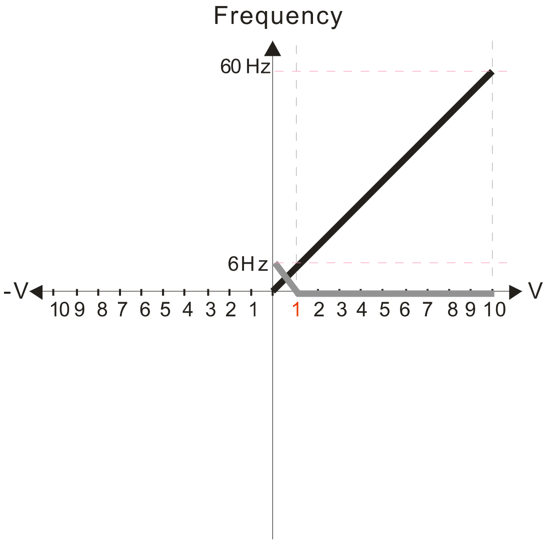
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 06



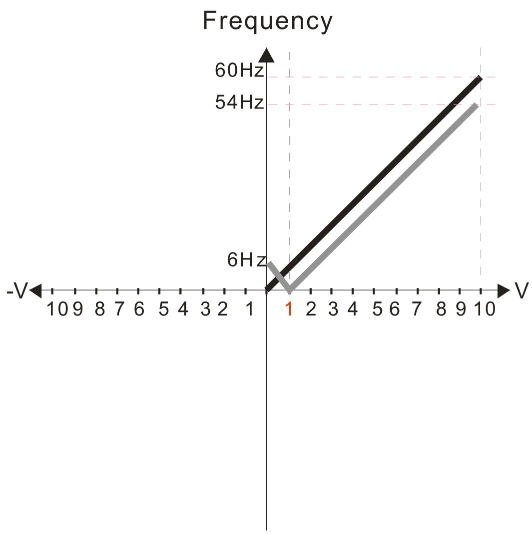
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 07



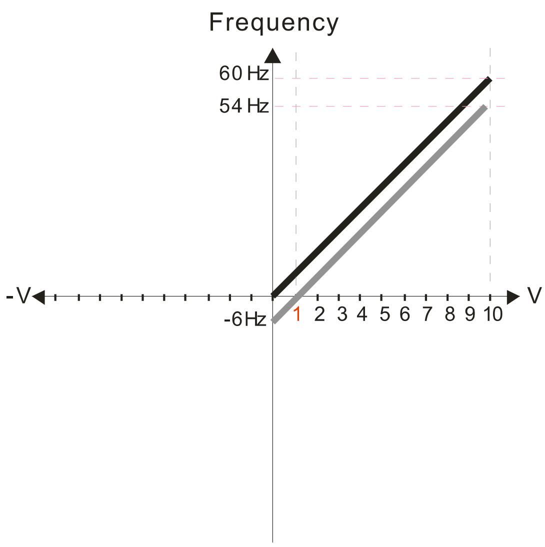
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 08



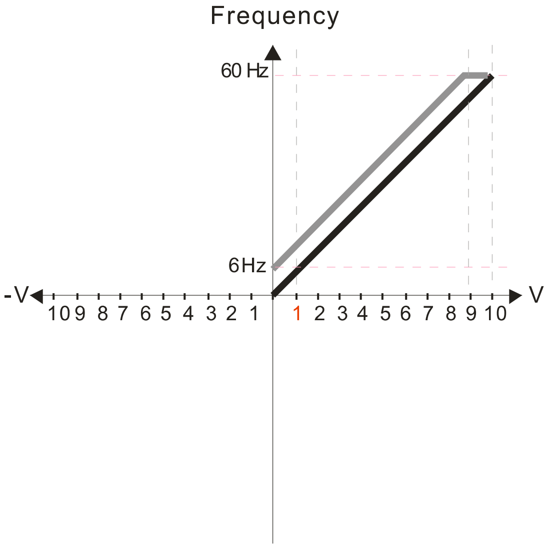
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 09



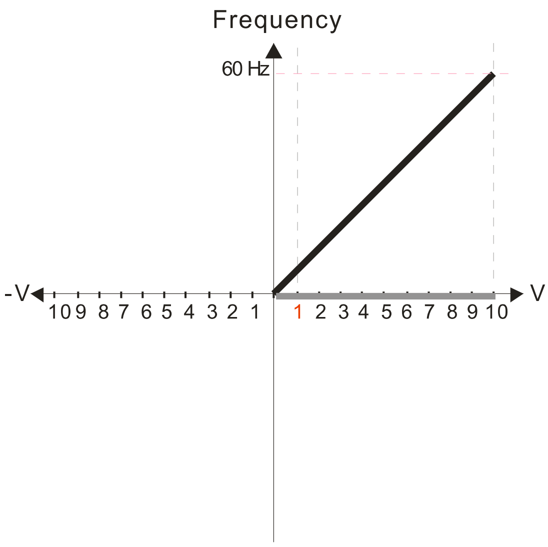
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 10



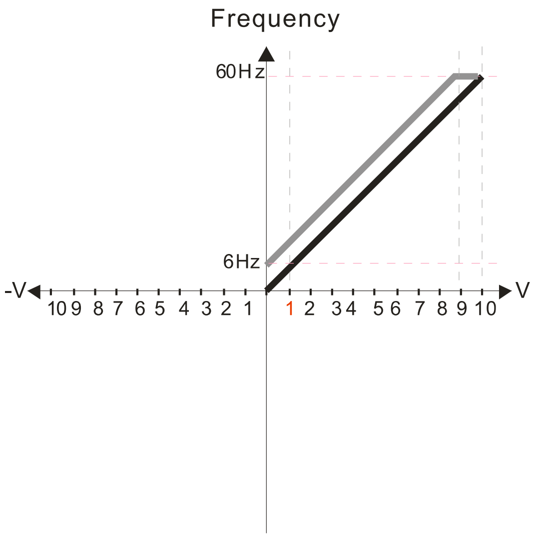
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 11



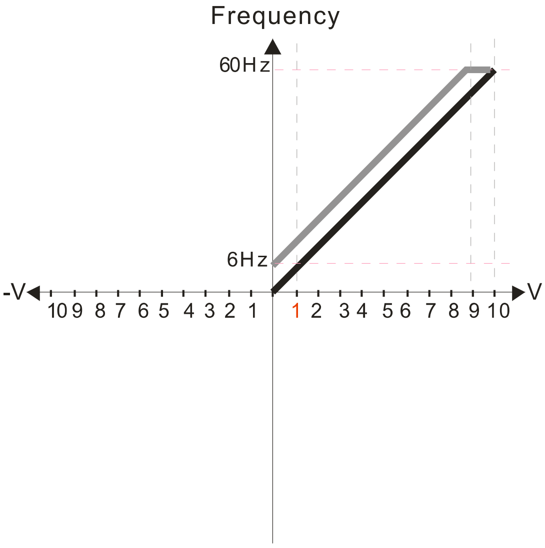
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 12



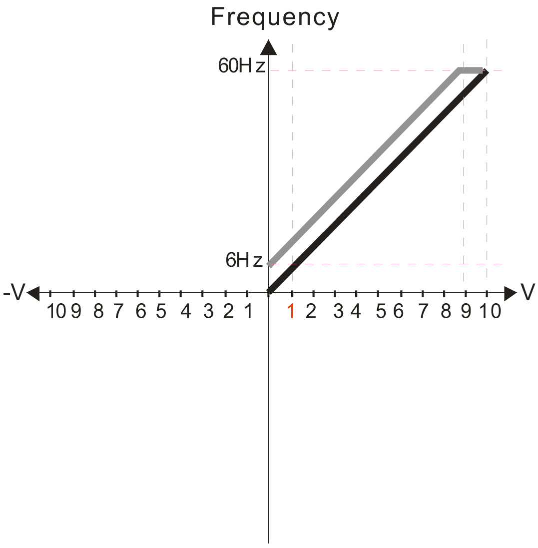
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 13



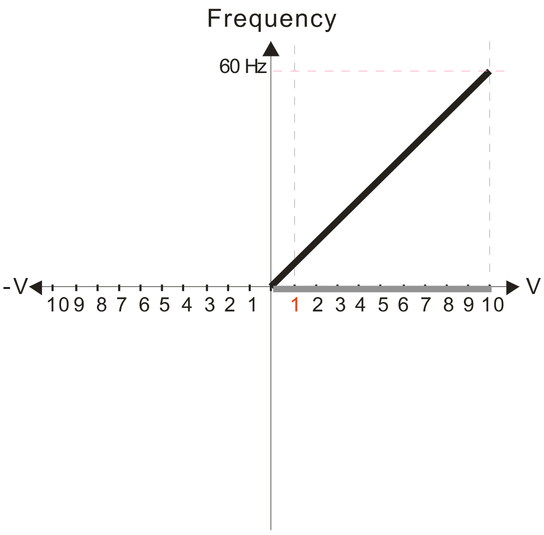
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 14



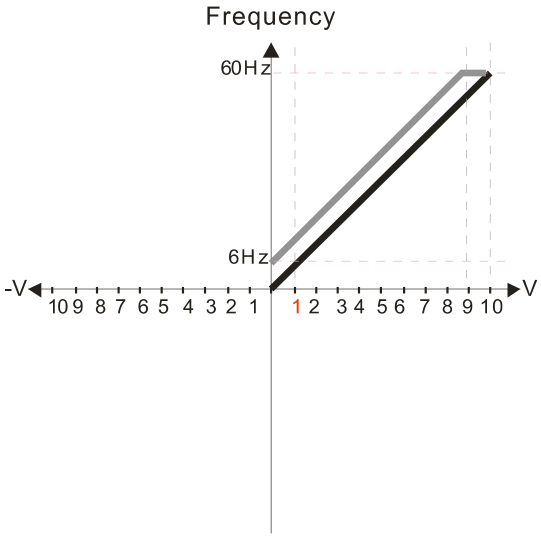
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 15



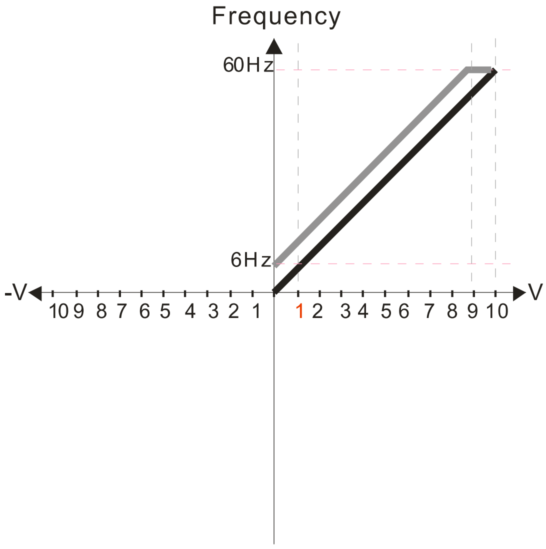
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 16



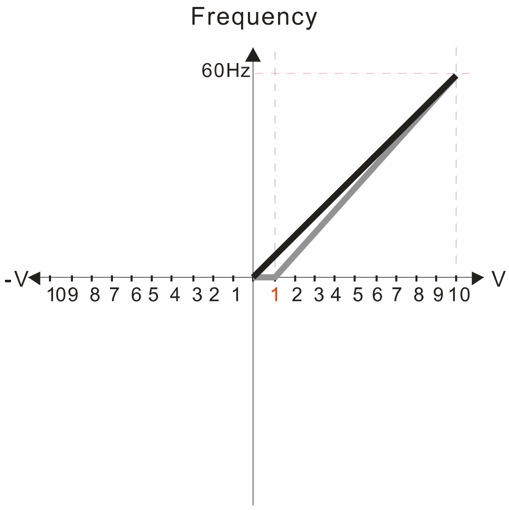
Pr.03-03=-10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 100%

Diagram 17



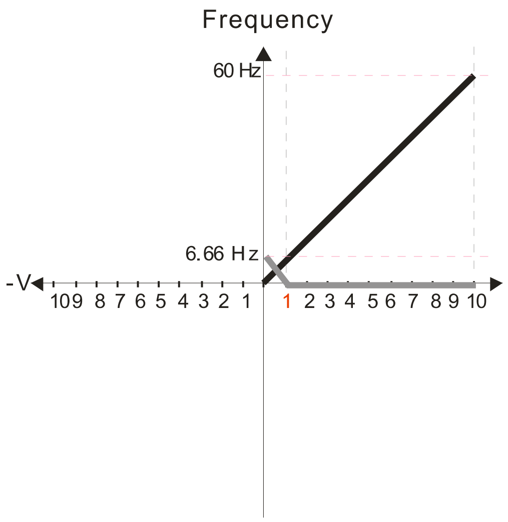
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 18



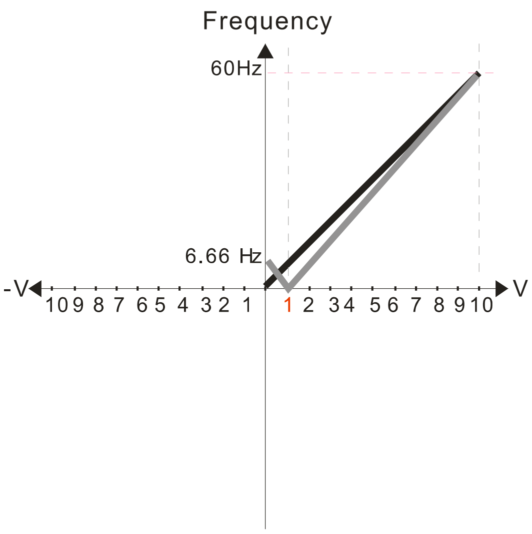
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 19



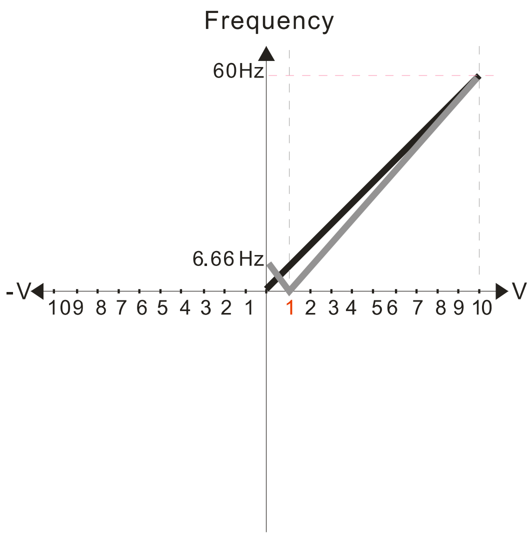
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 20



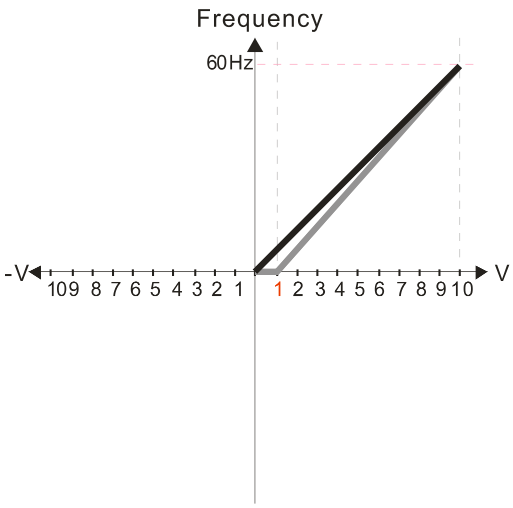
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 21



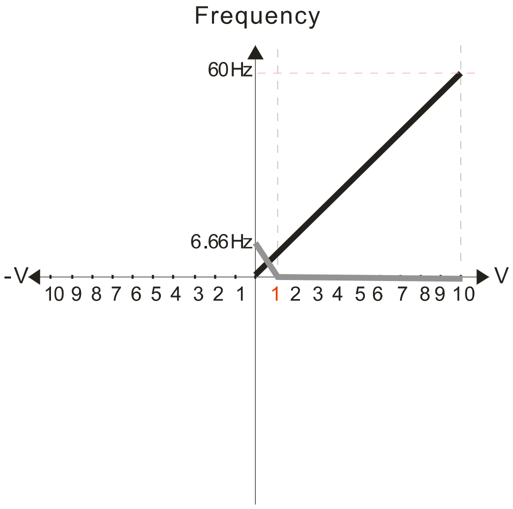
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 22



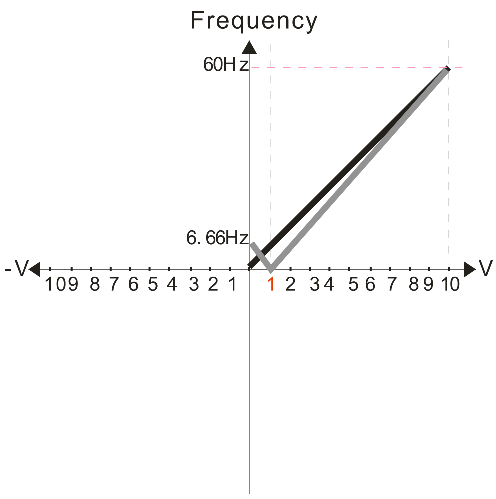
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 23



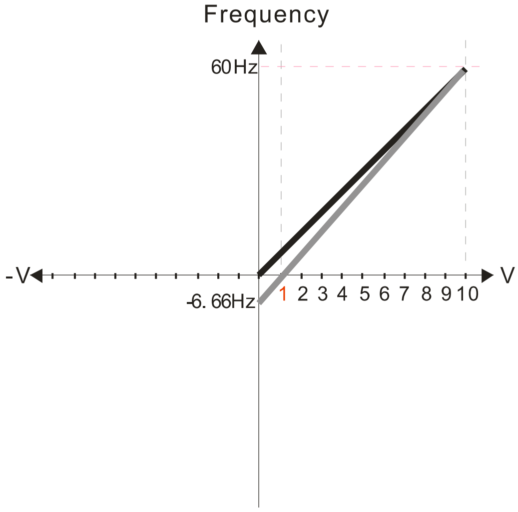
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 24



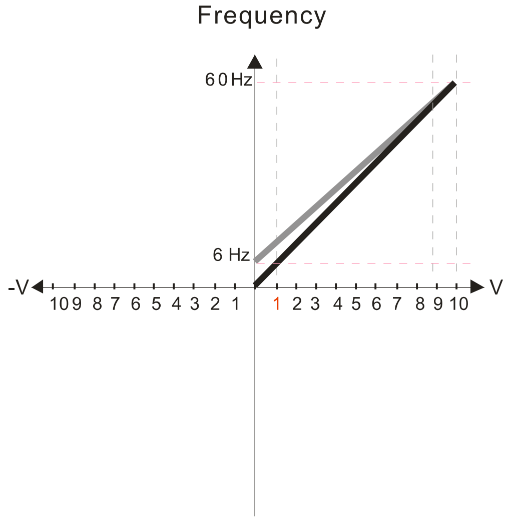
Pr.03-03=10%
Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Pr.03-11 Analog input Gain (AVI) = 111.1%
10/9 = 111.1%

Diagram 25



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

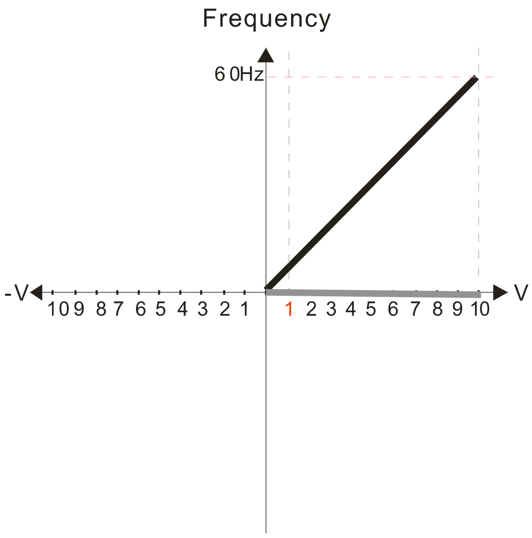
$$\frac{60-6\text{Hz}}{10\text{V}} = \frac{6-0\text{ Hz}}{(0-X\text{ V})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\%$$

$$= -11.1\ \%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\ \%$$

Diagram 26

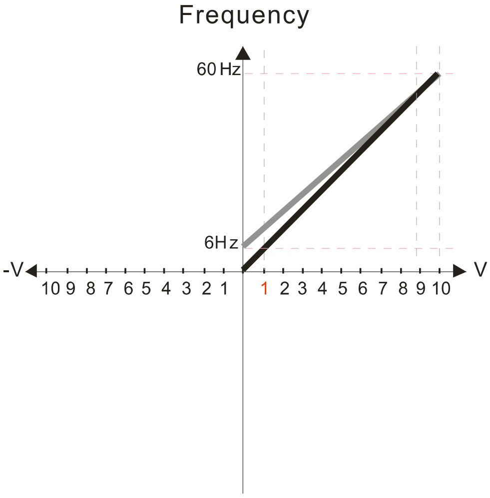


Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Diagram 27



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

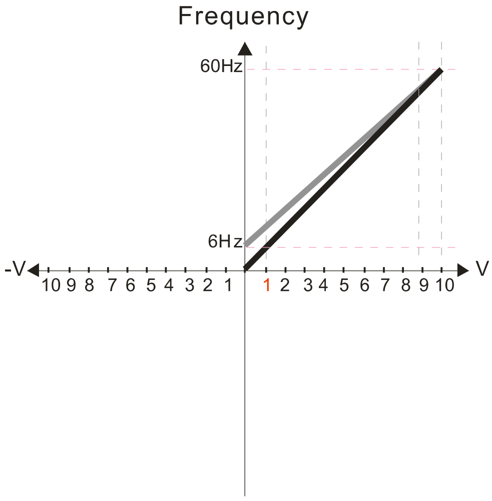
Calculate the bias:

$$\frac{60-6Hz}{10V}=\frac{6-0Hz}{(0-XV)} \quad XV=\frac{100}{-9}=-1.11V \quad \therefore 03\text{-}03=\frac{-1.11}{10}\times 100\% = -11.1\%$$

Calculate the gain:

$$Pr.03\text{-}11=\frac{10V}{11.1V}\times 100\% = 90.0\%$$

Diagram 28



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

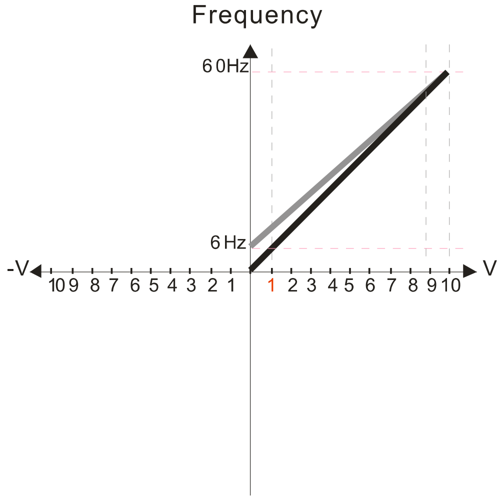
Calculate the bias:

$$\frac{60-6Hz}{10V}=\frac{6-0Hz}{(0-XV)} \quad XV=\frac{100}{-9}=-1.11V \quad \therefore 03\text{-}03=\frac{-1.11}{10}\times 100\% = -11.1\%$$

Calculate the gain:

$$Pr.03\text{-}11=\frac{10V}{11.1V}\times 100\% = 90.0\%$$

Diagram 29



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

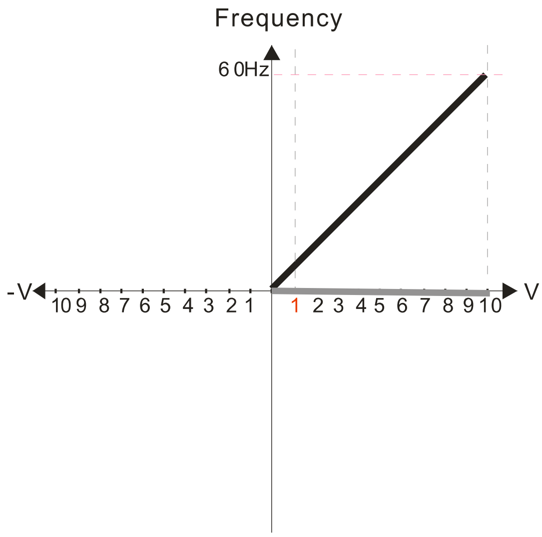
$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\%$$

$$= -11.1\ \%$$

Calculate the gain:

$$\text{Pr.03-11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

Diagram 30

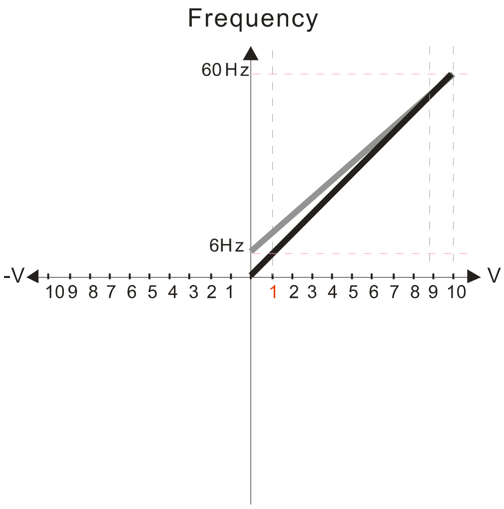


Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Diagram 31



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

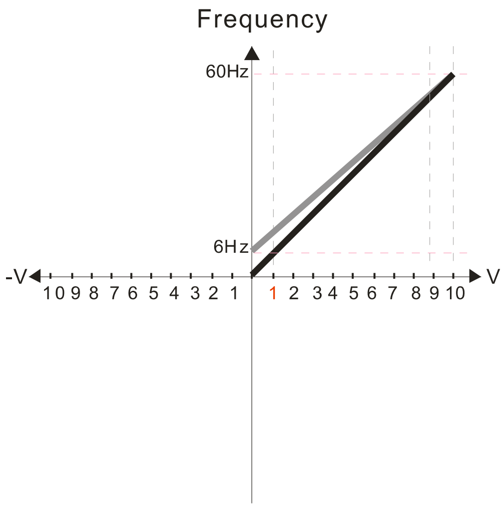
Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\ \%$$

Calculate the gain:

$$\text{Pr.}03\text{-}11 = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\ \%$$

Diagram 32



Pr.03-07–03-08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\ \%$$

Calculate the gain:

$$\text{Pr.}03\text{-}11 = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\ \%$$

03-11 AVI Analog Input Gain
03-12 ACI Analog Input Gain

Default: 100.0

Settings -500.0–500.0%

Use Pr.03-03–03-12 when the Frequency command source is the analog voltage or current signal.

03-15 AVI Analog Input Filter Time
03-16 ACI Analog Input Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

- Use these input delays to filter a noisy analog signal.
- When the time constant setting is too large, the control is stable, but the control response is slow. When the time constant setting is too small, the control response is faster, but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

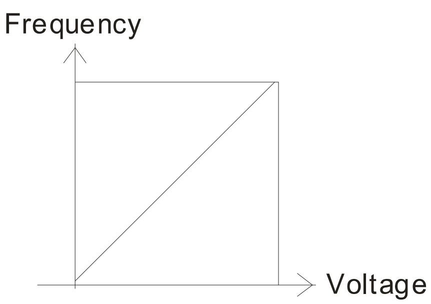
03-18 Analog Input Addition Function

Default: 0

Settings 0: Disable (AVI, ACI)

1: Enable

- When Pr.03-18 = 1:
  Example: Pr.03-00 = Pr.03-01 = 1, frequency command = AVI + ACI
- When Pr.03-18 = 0 and the analog input selection settings (Pr.03-00 and Pr.03-01) are the same, AVI has priority over ACI. In other words, when Pr.03-00 and Pr.03-01 are both set to 1 (Frequency command), the drive ignores the setting value from ACI but execute the frequency command according to the setting value from AVI.



$$\text{Fcmd}=[(\text{ay}\pm\text{bias})\times\text{gain}]\times\frac{\text{Fmax(01-00)}}{\text{10V or 16mA or 20mA}}$$

Fcmd: the corresponding frequency of 10V or 20mA

ay : 0~10V, 4~20mA, 0~20mA

bias : Pr.03-03, Pr. 03-04

gain : Pr.03-11, Pr.03-12

03-19 Signal Loss Selection for the Analog Input 4–20 mA

Default: 0

Settings 0: Disable

1: Continue operation at the last frequency

2: Decelerate to 0 Hz

3: Stop immediately and display “ACE”

- Determines the treatment when the 4–20 mA signal is lost, when ACIc (Pr.03-29 = 0).
- When Pr.03-29 ≠ 0, the voltage input to ACI terminal is 0–10 V or 0–20 mA, and Pr.03-19 is invalid.
- When the setting is 1 or 2, the keypad displays the warning code “ANL”. It keeps blinking until the ACI signal is recovered.
- When the motor drive stops, the warning condition does not continue to exist, so the warning disappears.

03-20 AFM Multi-function Output

Default: 0

Settings 0–4

Function Chart

Settings	Functions	Descriptions
0	Output frequency (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
1	Frequency command (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
2	Motor speed (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
3	Output current (rms)	(2.5 × rated current) is processed as 100%.
4	Output voltage	(2 × rated voltage) is processed as 100%.

03-21 AFM Analog Output Gain

Default: 100.0

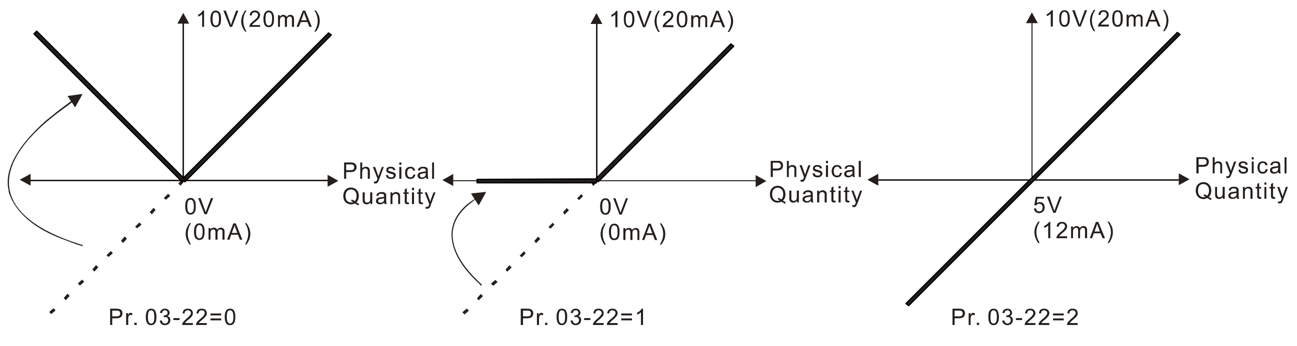
Settings 0.0–500.0%

- Adjusts the voltage level outputted to the analog meter from the analog signal (Pr.03-20) output terminal AFM of the drive.

03-22 AFM Analog Output in REV Direction

Default: 0

Settings 0: Absolute value of output voltage
1: Reverse output 0 V; forward output 0–10 V
2: Reverse output 5–0 V; forward output 5–10 V



Selections for the analog output direction

03-27 AFM Output Bias

Default: 0.00

Settings -100.00–100.00%

- Example 1: AFM 0–10 V is set to the output frequency, the output equation is
  10 V × (output frequency / Pr.01-00) × Pr.03-21 + 10 V × Pr.03-27
- Example 2: AFM 0–20 mA is set to the output frequency, the output equation is
  20 mA × (output frequency / Pr.01-00) × Pr.03-21 + 20 mA × Pr.03-27
- Example 3: AFM 4–20 mA is set to the output frequency, the output equation is
  4 mA + 16 mA × (output frequency / Pr.01-00) × Pr.03-21 + 16 mA × Pr.03-27
- This parameter sets the corresponding voltage for the analog output 0.

03-28 AVI Terminal Input Selection

Default: 0

Settings 0: 0–10 V
3: -10–10 V (Pr.03-69–03-74 are valid)

03-29 ACI Terminal Input Selection

Default: 0

Settings 0: 4–20 mA
1: 0–10 V
2: 0–20 mA

When you change the input mode, verify that the external terminal switch position (ACI) is correct.

03-31 AFM Output Selection

Default: 0

Settings 0: 0–10 V output
1: 0–20 mA output
2: 4–20 mA output

03-32 AFM DC Output Setting Level

Default: 0.00

Settings 0.00–100.00%

03-35 AFM Output Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

03-39 VR Input Selection

Default: 1

Settings 0: Disable
1: Frequency command

03-44 Multi-function MO Output by AI Level Source

Default: 0

Settings 0: AVI
1: ACI
3: Extension card input terminal AI10
4: Extension card input terminal AI11

03-45 AI Upper Level 1

Default: 50.00

Settings -100.00–100.00%

03-46 AI Lower Level 2

Default: 10.00

Settings -100.00–100.00%

- Multi-function output terminal 67 must work with Pr.03-44 to select input channels. When analog input level is higher than Pr.03-45, multi-function output acts; when analog input level is lower than Pr.03-46, multi-function output terminals stop outputting.
- When setting levels, AI upper level must be higher than AI lower level.

03-57 ACI Lowest Point

Default: 4.00

Settings Pr.03-29 = 1, 0.00–10.00 mA
Pr.03-29 ≠ 1, 0.00–20.00 mA

03-58 ACI Proportional Lowest Point

Default: 0.00

Settings 0.00–100.00%

03-59 ACI Mid-point

Default: 12.00

Settings Pr.03-29 = 1, 0.00–10.00 mA
Pr.03-29 ≠ 1, 0.00–20.00 mA

03-60 ACI Proportional Mid-point

Default: 50.00

Settings 0.00–100.00%

03-61 ACI Highest Point

Default: 20.00

Settings Pr.03-29 = 1, 0.00–10.00 mA
Pr.03-29 ≠ 1, 0.00–20.00 mA

03-62 ACI Proportional Highest Point

Default: 100.00

Settings 0.00–100.00%

- When Pr.03-29 = 1, the ACI setting is 0–10 V and the unit is voltage (V).
  When Pr.03-29 ≠ 1, the ACI setting is 0–20 mA or 4–20 mA and the unit is current (mA).
- When you set the analog input ACI to the Frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).
- The requirement for these three parameters (Pr.03-57, Pr.03-59 and Pr.03-61) is Pr.03-57 < Pr.03-59 < Pr.03-61. The values for three proportional points (Pr.03-58, Pr.03-60 and Pr.03-62) have no limits. Values between two points are calculated by a linear equation.
- The output % becomes 0% when the ACI input value is lower than lowest point setting.
  For example:
  If Pr.03-57 = 2 mA; Pr.03-58 = 10%, then the output becomes 0% when the AVI input is ≤ 2 mA. If the ACI input swings between 2 mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

03-63 AVI Voltage Lowest Point

Default: 0.00

Settings 0.00–10.00 V

03-64 AVI Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%

03-65 AVI Voltage Mid-point

Default: 5.00

Settings 0.00–10.00 V

03-66 AVI Proportional Mid-point

Default: 50.00

Settings -100.00–100.00%

03-67 AVI Voltage Highest Point

Default: 10.00

Settings 0.00–10.00 V

03-68 AVI Proportional Highest Point

Default: 100.00

Settings -100.00–100.00%

- When you set the positive voltage AVI to the Frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency) and the motor runs in the forward direction.
- The requirement for these three parameters (Pr.03-63, Pr.03-65 and Pr.03-67) is Pr.03-63 < Pr.03-65 < Pr.03-67. The values for three proportional points (Pr.03-64, Pr.03-66 and Pr.03-68) have no limits. Values between two points are calculated by a linear equation.
- The output % becomes 0% when the positive voltage AVI input value is lower than lowest point setting.
  For example:
  If Pr.03-63 = 1 V; Pr.03-64 = 10%, then the output becomes 0% when the AVI input is ≤ 1 V.
  If the AVI input swings between 1 V and 1.1 V, the drive's output frequency oscillates between 0% and 10%.

03-69 Negative AVI Voltage Lowest Point

Default: 0.00

Settings -10.00–0.00 V

03-70 Negative AVI Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%

03-71 Negative AVI Voltage Mid-point

Default: -5.00

Settings 0.00–10.00 V

03-72 Negative AVI Proportional Mid-point

Default: -50.00

Settings -100.00–100.00%

✓ 03-73 Negative AVI Voltage Highest Point

Default: -10.00

Settings 0.00–10.00 V

✓ 03-74 Negative AVI Proportional Highest Point

Default: -100.00

Settings -100.00–100.00%

- Pr.03-69–Pr.03-74 are valid when Pr.03-28 sets as -10–10 V.
- When you set the negative voltage AVI to the Frequency command, -100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency) and the motor runs in the reverse direction.
- The requirement for these three parameters (Pr.03-69, Pr.03-71 and Pr.03-73) is Pr.03-69 < Pr.03-71 < Pr.03-73. The values for three proportional points (Pr.03-70, Pr.03-72 and Pr.03-74) have no limits. Values between two points are calculated by a linear equation.
- The output % becomes 0% when the negative AVI input value is lower than the lowest point setting.

For example:

If Pr.03-69 = -1 V; Pr.03-70 = 10%, then the output becomes 0% when the AVI input is ≥ -1 V.

If the AVI input swings between -1 V and -1.1 V, drive's output frequency oscillates between 0% and 10%.

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04 Multi-step Speed Parameters

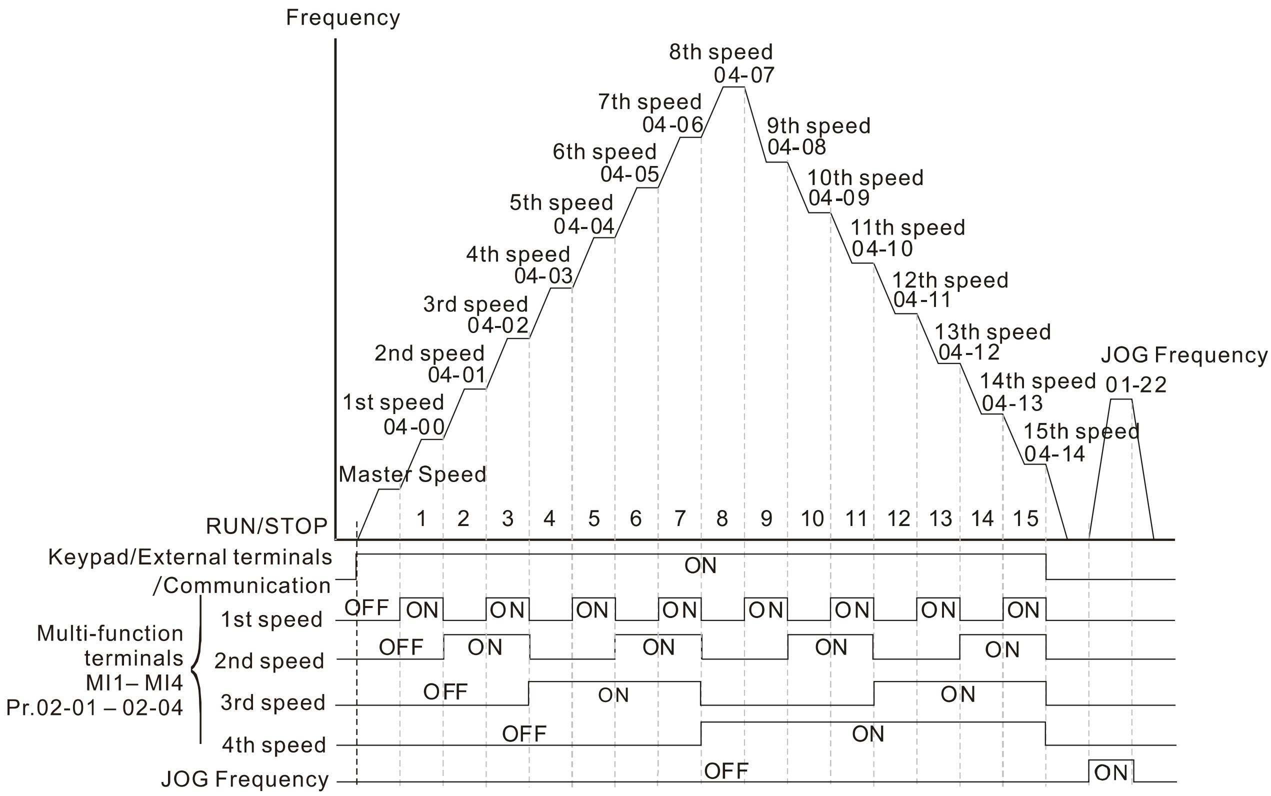
〄 You can set this parameter during operation.

〄	**04-00**	1st Step Speed Frequency
〄	**04-01**	2nd Step Speed Frequency
〄	**04-02**	3rd Step Speed Frequency
〄	**04-03**	4th Step Speed Frequency
〄	**04-04**	5th Step Speed Frequency
〄	**04-05**	6th Step Speed Frequency
〄	**04-06**	7th Step Speed Frequency
〄	**04-07**	8th Step Speed Frequency
〄	**04-08**	9th Step Speed Frequency
〄	**04-09**	10th Step Speed Frequency
〄	**04-10**	11th Step Speed Frequency
〄	**04-11**	12th Step Speed Frequency
〄	**04-12**	13th Step Speed Frequency
〄	**04-13**	14th Step Speed Frequency
〄	**04-14**	15th Step Speed Frequency

Default: 0.00

Settings 0.00–299.00 Hz

- Use the multi-function input terminals (refer to settings 1–4 of Pr.02-01–02-07 and Pr.02-26–02-28 Multi-function Input Command) to select the multi-step speed command (the maximum is 15th step speed). Pr.04-00 to 04-14 sets the multi-step speed frequency as shown in the following diagram.
- The external terminal/digital keypad / communication controls the RUN and STOP commands with Pr.00-21.
- You can set each multi-step speed between 0.00–299.00 Hz during operation.
- Explanation for the timing diagram of the multi-step speed and external terminals
- The related parameter settings are:
  1. Pr.04-00–04-14: sets the 1st–15th multi-step speed (to set the frequency of each step speed).
  2. Pr.02-01–02-07 and Pr.02-26–02-28: sets the multi-function input terminals (multi-step speed command 1–4).
- Related parameters:
  - Pr.01-22 JOG frequency setting
  - Pr.02-01 multi-function input command 1 (MI1)
  - Pr.02-02 multi-function input command 2 (MI2)
  - Pr.02-03 multi-function input command 3 (MI3)
  - Pr.02-04 multi-function input command 4 (MI4)



Multi-speed via External Terminals

05 Motor Parameters

✓ You can set this parameter during operation.

05-00 Motor Parameter Auto-tuning

Default: 0

Settings 0: No function
1: Dynamic test for induction motor (IM)
2: Static test for induction motor (IM)

05-01 Full-load Current for Induction Motor (A)

Default: Depending on the model power

Settings 10–120% of the drive's rated current

- Sets this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.
  Example: The rated current for a 7.5 HP (5.5 kW) motor is 25 A. The default is 22.5 A.
  The setting range is 2.5–30 A. (25 × 10% = 2.5 A and 25 × 120% = 30 A).

✓ 05-02 Rated Power for Induction Motor (kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

- Sets the rated power for motor 1. The default is the drive's power value.

✓ 05-03 Rated Speed for Induction Motor 1 (rpm)

Default: 1710

Settings 0–65535 rpm
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

- Sets the rated speed for the motor as indicated on the motor nameplate.

05-04 Number of Poles for Induction Motor

Default: 4

Settings 2–20

- Sets the number of poles for the motor (must be an even number).
- Set up Pr.01-01 and Pr.05-03 before setting up Pr.05-04 to make sure the motor operates normally.

05-05 No-load Current for Induction Motor (A)

Default: Depending on the model power

Settings 0.00–Pr.05-01 default

- The default is 40% of the motor's rated current.

05-06 Stator Resistance (Rs) for Induction Motor

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-07 Rotor Resistance (Rr) for Induction Motor

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-08 Magnetizing Inductance (Lm) for Induction Motor

Default: Depending on the model power

Settings 0.0–6553.5 mH

05-09 Stator Inductance (Lx) for Induction Motor

Default: Depending on the model power

Settings 0.0–6553.5 mH

✎ 05-23 Frequency for Y-connection / Δ-connection Switch for an Induction Motor

Default: 60.00

Settings 0.00–299.00 Hz

05-24 Y-connection / Δ-connection Switch for an Induction Motor

Default: 0

Settings 0: Disable

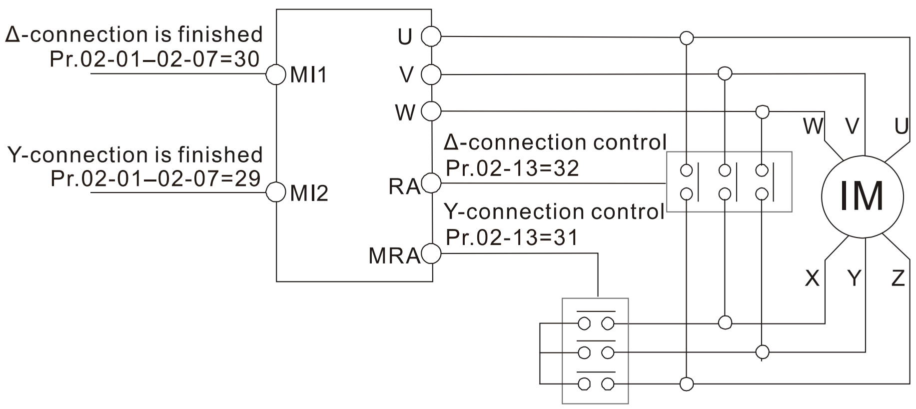
1: Enable

✎ 05-25 Delay Time for Y-connection / Δ-connection Switch for an Induction Motor

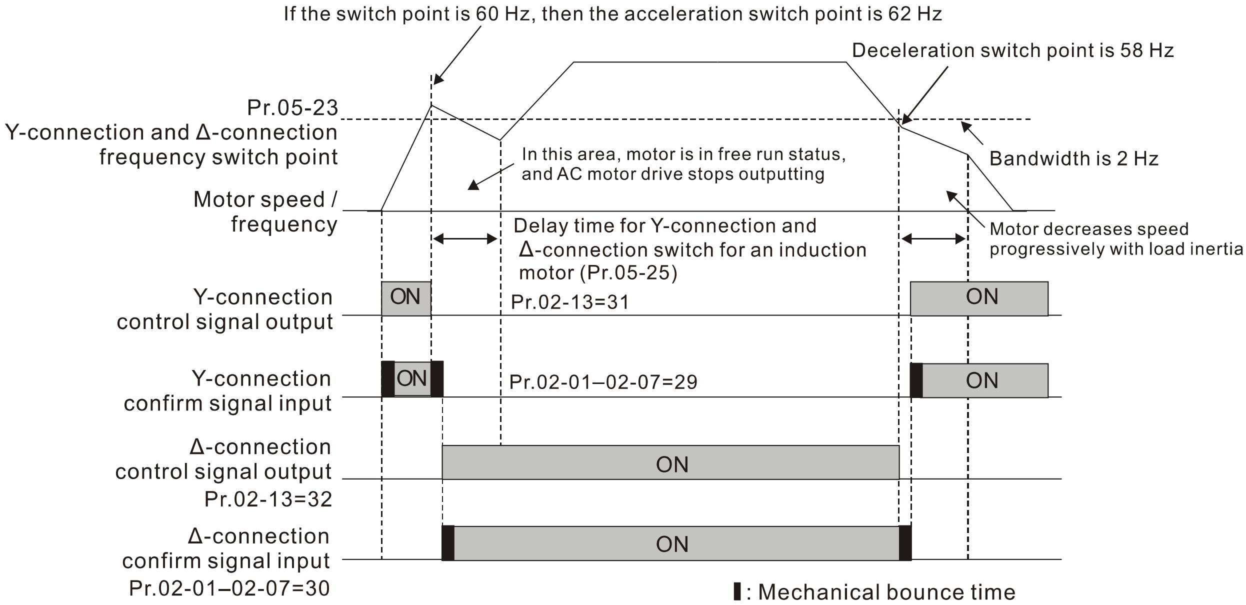
Default: 0.200

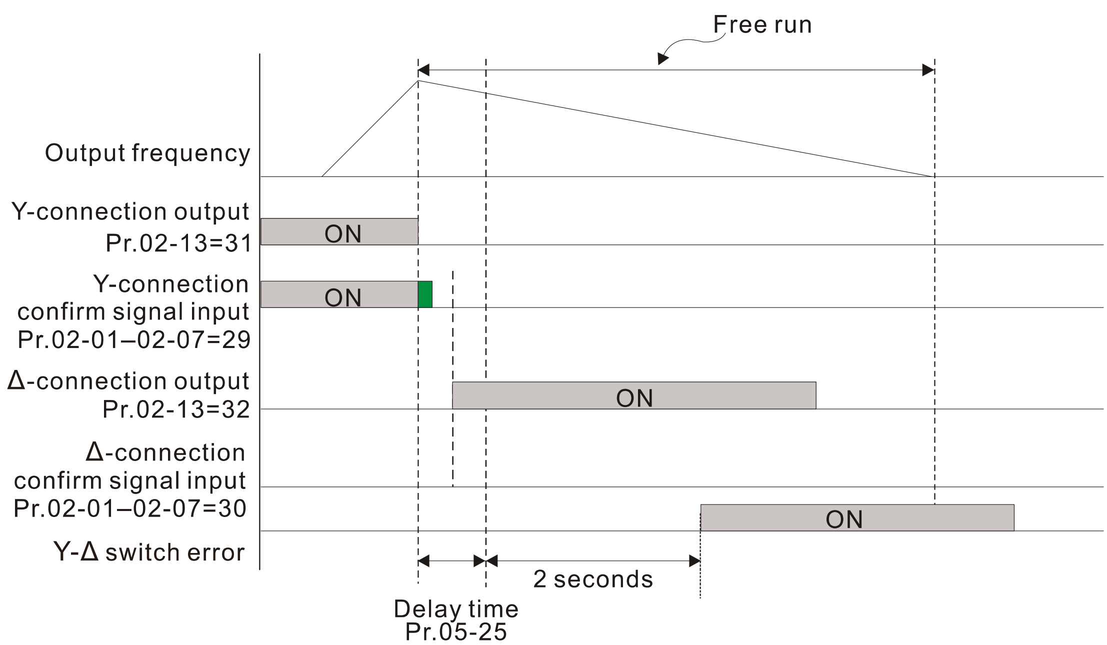
Settings 0.000–60.000 sec.

- You can apply Pr.05-23–Pr.05-25 in a wide range of motors, and the motor coil executes the Y-connection / Δ-connection switch as required. The wide range motors are related to the motor design. In general, the motor has higher torque with low speed Y-connection and has higher speed with high speed Δ-connection
- Pr.05-24 enables and disables the switch of Y-connection / Δ-connection.
- When you set Pr.05-24 as 1, the drive uses the Pr.05-23 setting and current motor frequency and switches the current motor to Y-connection or Δ-connection. You can switch the relevant motor parameter settings simultaneously.
- Pr.05-25 sets the switch delay time of Y-connection / Δ-connection.
- When the output frequency reaches the Y-connection / Δ-connection switch frequency, the drive delays according to Pr.05-25 before activating the multi-function output terminals.



Y-Δ connection switch: can be used for wide range motor
Y-connection for low speed: higher torque can be used for rigid tapping
Δ-connection for high speed: higher torque can be used for high-speed drilling





05-26	Accumulated Watt-second for a Motor in Low Word (W-sec.)
05-27	Accumulated Watt-second for a Motor in High Word (W-sec.)
05-28	Accumulated Watt-hour for a Motor (W-hour)
05-29	Accumulated Watt-hour for a Motor in Low Word (kW-hour)
05-30	Accumulated Watt-hour for a Motor in High Word (kW-hour)

Default: #.#

Settings Read only

- Pr.05-26–05-30 records the amount of power the motors consume. The accumulation begins when the drive is activated and the record is saved when the drive stops or turns OFF. The amount of consumed watts continues to accumulate when the drive is activated again. To clear the accumulation, set Pr.00-02 as 5 to return the accumulation record to 0.
- The accumulated total watts of the motor per second = Pr.05-27 × 65536 + Pr.05-26
  Example: when Pr.05-26 = 2548.1 and Pr.05-27 = 15.2, the accumulated total watts of the motor per second = 15.2 × 65536 + 2548.1 = 996147.2 + 2548.1 = 998695.3
- The accumulated total kilowatts of the motor per hour = Pr.05-30 × 65536 + Pr.05-29
  Example: when Pr.05-29 = 3361.4 and Pr.05-30 = 11.2, the accumulated total kilowatts of the motor per hour = 11.2 × 65536 + 3361.4 = 734003.2 + 3361.4 = 737364.6

05-31 Accumulated Motor Operation Time (Min.)

Default: 0

Settings 0–1439

05-32 Accumulated Motor Operation Time (Day)

Default: 0

Settings 0–65535

- Use Pr.05-31 and Pr.05-32 to record the motor operation time. To clear the operation time, set Pr.05-31 and Pr.05-32 as 00. An operation time shorter than 60 seconds is not recorded.

06 Protection Parameters

✓ You can set this parameter during operation.

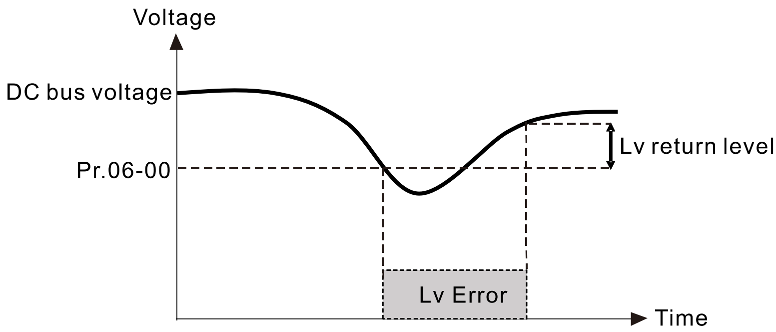
✓ 06-00 Low Voltage Level

Default: 180.0 / 360.0

Settings 230V models: 150.0–220.0 V_{DC}

460V models: 300.0–440.0 V_{DC}

- Sets the Low Voltage (Lv) level. When the DC bus voltage is lower than Pr.06-00, the drive stops output and the motor free runs to a stop.
- If the Lv fault is triggered during operation, the drive stops output and the motor free runs to a stop. There are three Lv faults, LvA (Lv during acceleration), Lvd (Lv during deceleration), and Lvn (Lv in constant speed) that are triggered according to the status of acceleration or deceleration. You must press RESET to clear the LV fault. The drive automatically restarts if you set to restart after momentary power loss (refer to Pr.07-06 Restart after Momentary Power Loss and Pr.07-07 Allowed Power Loss Duration for details).
- If the Lv fault is triggered when the drive is in STOP status, the drive displays LvS (Lv during stop), which is not recorded, and the drive restarts automatically when the input voltage is higher than the Lv level of 30 V (230V models) or 60 V (460V models).



✓ 06-01 Over-voltage Stall Prevention

Default: 380.0 / 760.0

Settings 0: Disabled

230V models: 0.0–450.0 V_{DC}

460V models: 0.0–900.0 V_{DC}

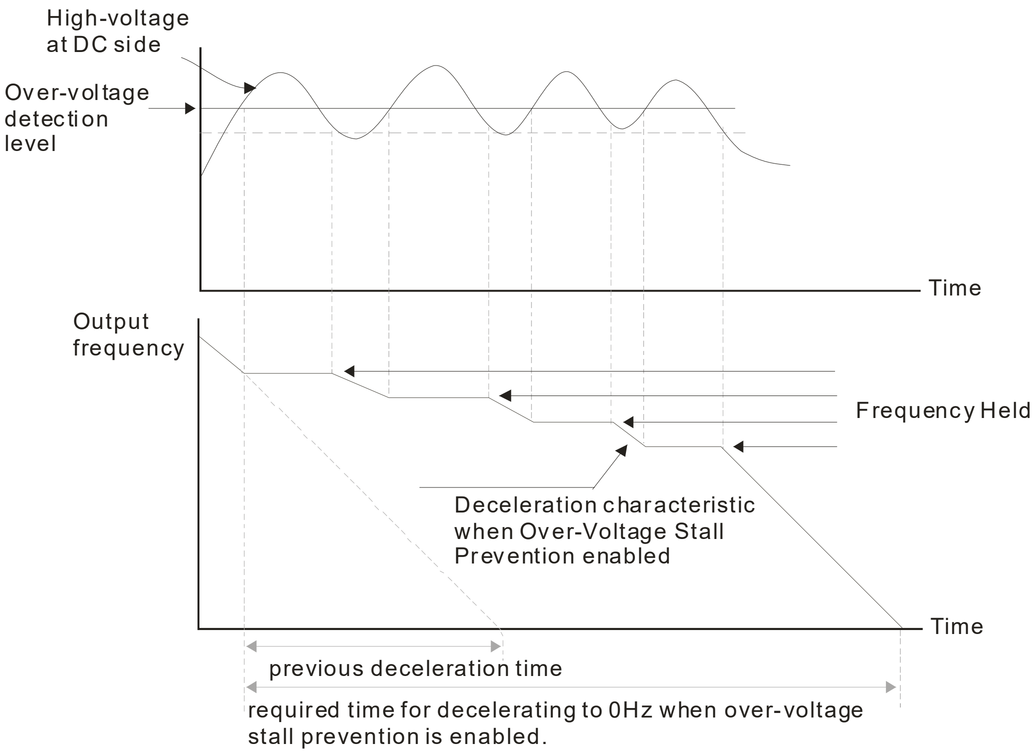
- Setting Pr.06-01 to 0.0 disables the over-voltage stall prevention function (connected with braking unit or braking resistor). Use this setting when braking units or resistors are connected to the drive.
- Setting Pr.06-01 to a value > 0 enables the over-voltage stall prevention. This setting refers to the power supply system and loading. If the setting is too low, then over-voltage stall prevention is easily activated, which may increase deceleration time.
- Related parameters:
  - Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4
  - Pr.02-13 Multi-function Output 1 (Relay 1)
  - Pr.02-16–Pr.02-17 Multi-function Output 2–3 (MO1, 2)
  - Pr.06-02 Selection for Over-voltage Stall Prevention

06-02 Selection for Over-voltage Stall Prevention

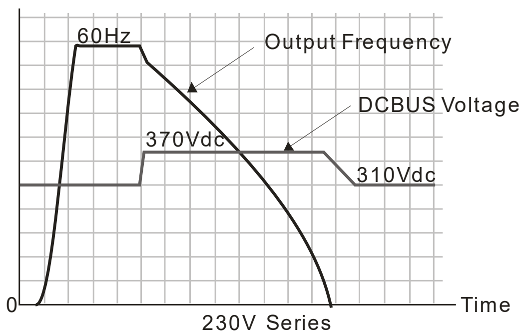
Default: 0

Settings 0: Traditional over-voltage stall prevention
1: Smart over-voltage stall prevention

- Use this function when you are unsure about the load inertia. When stopping under normal load, the over-voltage does not occur during deceleration and meet the deceleration time setting. Sometimes it may not stop due to over-voltage during decelerating to STOP when the load regenerative inertia increases. In this case, the AC motor drive extends the deceleration time automatically until the drive stops.
- When you set Pr.06-02 to 0, during deceleration the motor exceeds the synchronous speed due to load inertia. In this case, the motor becomes an electrical generator. The DC BUS voltage may exceed its maximum allowable value due to motor regeneration in some situations, such as loading inertia being too high or deceleration time being set too short. When you enable traditional over-voltage stall prevention and the DC BUS voltage detected is too high, the drive stops decelerating (output frequency remains unchanged) until the DC BUS voltage drops below the setting value.



- When you set Pr.06-02 to 1, to use smart over-voltage stall prevention during deceleration, the drive maintains the DC BUS voltage when decelerating and prevents the drive from OV.



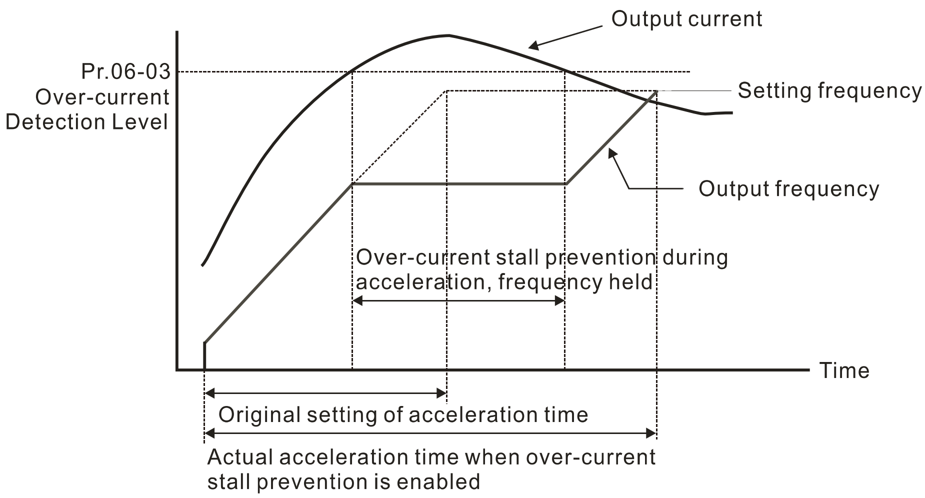
- When you enable the over-voltage stall prevention, the drive's deceleration time is longer than the setting. If you encounter any problem with deceleration time, refer to the following guides for troubleshooting.
  1. Increase the deceleration time to a suitable value.
  2. Install a brake resistor (refer to Section 7-1 All Brake Resistors and Brake Units Used in AC Motor Drives for details) to dissipate the electrical energy that is generated from the motor.
- Related parameters:
  Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4, Pr.02-13 Multi-function Output 1 (Relay 1), Pr.02-16–Pr.02-17 Multi-function Output 2–3 (MO1, 2), and Pr.06-01 Over-voltage Stall Prevention.

06-03 Over-current Stall Prevention during Acceleration

Default: 180

Settings 0–200% (100% corresponds to the rated current of the drive)

- If the motor load is too large or the drive's acceleration time is too short, the output current of the drive may be too high during acceleration, and it may cause motor damage or trigger protection functions (OL or OC). Use this parameter to prevent these situations.
- During acceleration, the output current of the drive may increase abruptly and exceed the setting value of Pr.06-03. In this case, the drive stops accelerating and keeps the output frequency constant, and then continues to accelerate until the output current decreases.



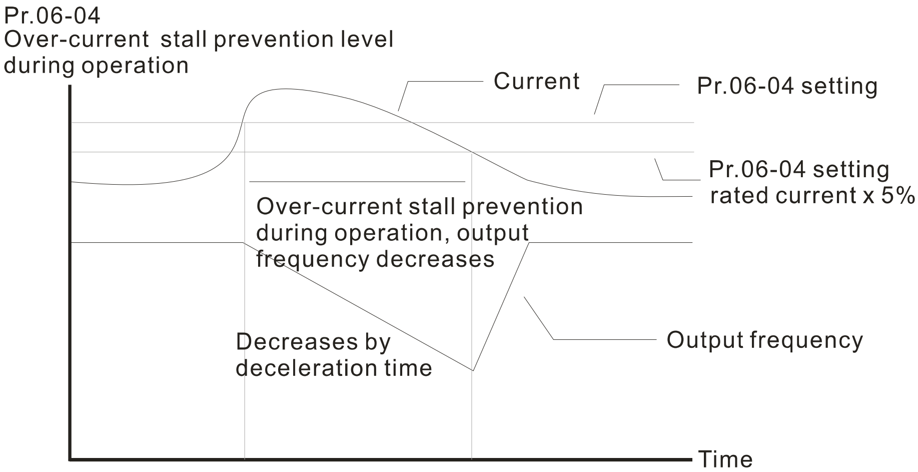
- When you enable the over-current stall prevention, the drive's acceleration time is longer than the setting.
- When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the Pr.06-03 setting value.
- When you encounter any problem with the acceleration time, refer to the following guides for troubleshooting.
  1. Increase the deceleration time to a suitable value.
  2. Sets related parameters:
     - Pr.01-12, 01-14, 01-16, 01-18 Acceleration Time 1–4)
     - Pr.02-13 Multi-function Output 1 (Relay 1)
     - Pr.02-16–02-17 Multi-function Output 2–3 (MO1, 2)

06-04 Over-current Stall Prevention during Operation

Default: 180

Settings 0–200% (100 % corresponds to the rated current of the drive)

- This is a protection for the drive to decrease output frequency automatically when the motor over-loads abruptly during constant motor operation.
- If the output current exceeds the setting value for Pr.06-04 when the drive is operating, the drive decreases output frequency (according to Pr.06-05) to prevent the motor from stalling. If the output current is lower than the setting value for Pr.06-04, the drive accelerates (according to Pr.06-05) again to the setting frequency.



Over-current stall prevention at constant speed

06-05 Acceleration / Deceleration Time Selection for Stall Prevention at Constant Speed

Default: 0

Settings 0: By current acceleration / deceleration time
1: By the 1st acceleration / deceleration time
2: By the 2nd acceleration / deceleration time
3: By the 3rd acceleration / deceleration time
4: By the 4th acceleration/deceleration time
5: By auto-acceleration / auto-deceleration

- Sets the acceleration / deceleration time selection when stall prevention occurs at constant speed.

06-06 Over-torque Detection Selection (Motor)

Default: 0

Settings 0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN

06-07 Over-torque Detection Level (Motor)

Default: 120

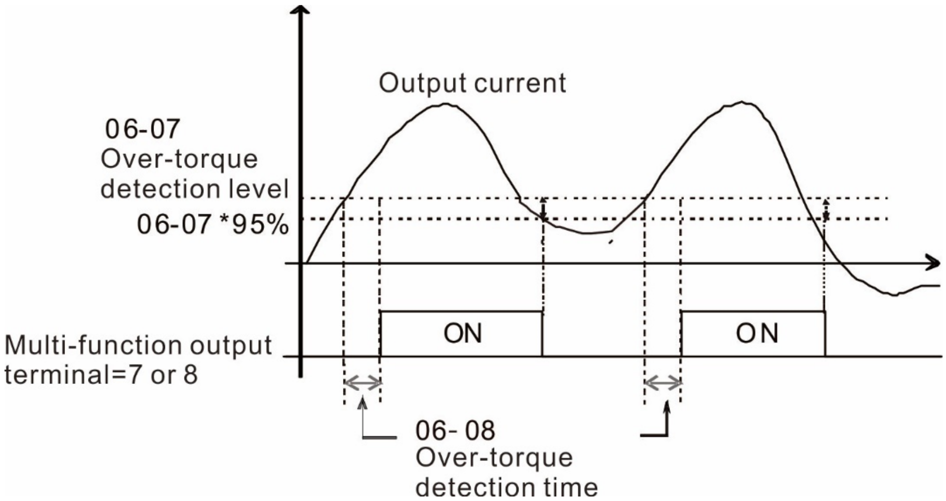
Settings 10–250% (100% corresponds to the rated current of the drive)

06-08 Over-torque Detection Time (Motor)

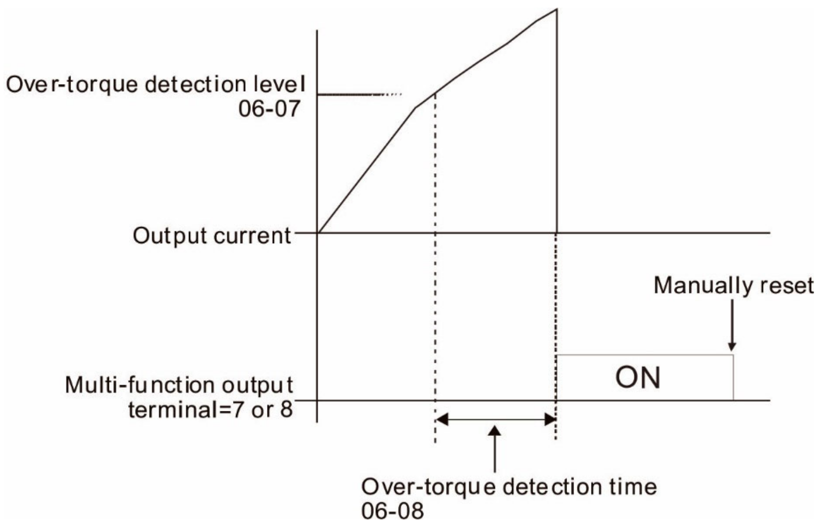
Default: 0.1

Settings 0.1–60.0 sec.

- When the output current exceeds the over-torque detection level (Pr.06-07) and also exceeds the over-torque detection time (Pr.06-08), the over-torque detection follows the setting of Pr.06-06.
- When you set Pr.06-06 to 1 or 3, an ot1 warning displays while the drive keeps running. The warning remains on until the output current is smaller than 5% of the over-torque detection level.



- When you set Pr.06-06 to 2 or 4, an ot1 warning displays and the drive stops running after over-torque detection. The drive keeps running after you manually reset it.



06-12 Current Limit

Default: 150

Settings 0–250% (100% corresponds to the rated current of the drive)

- Sets the maximum output current of the drive.

✎ 06-13 Electronic Thermal Relay Selection 1 (Motor)

Default: 2

Settings 0: Inverter motor (with external forced cooling)

1: Standard motor (motor with fan on the shaft)

2: Disable

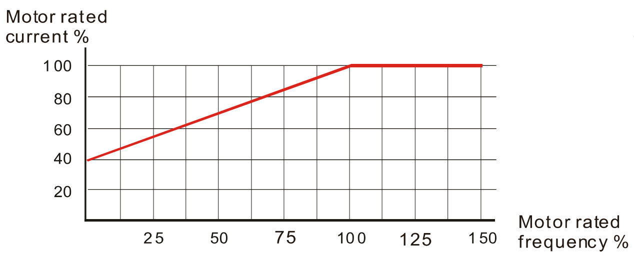
- Prevents self-cooled motor from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.
- Setting the parameter to 0 is suitable for an inverter motor (motor fan using an independent power supply). For this kind of motor, there is no significant correlation between cooling capacity and motor speed. Therefore, the action of electronic thermal relays remains stable in low speed to ensure the load capability of the motor in low speed.
- Setting the parameter to 1 is suitable for standard motor (motor fan is fixed on the rotor shaft). For this kind of motor, the cooling capacity is lower in low speed; therefore, the action of an electronic thermal relay reduces the action time to ensure the life of motor.
- When the power is cycled frequently, if the power is switched OFF, the electronic thermal relay protection is reset; therefore, even setting the parameter to 0 or 1 may not protect the motor well. If there are several motors connected to one drive, install an electronic thermal relay in each motor.

✎ 06-14 Electronic Thermal Relay Action Time 1 (Motor)

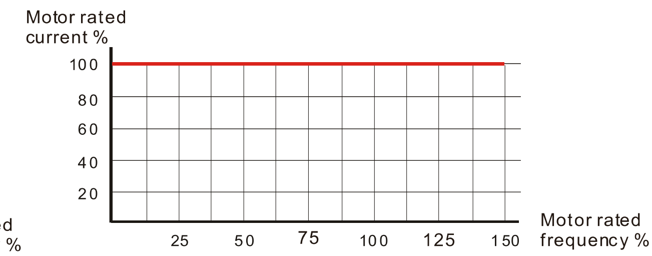
Default: 60.0

Settings 30.0–600.0 sec.

- Set the parameter to 150% of motor rated current and use with the setting of Pr.06-14 to prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL1", and the motor free runs to stop.
- Use this parameter to set the action time of the electronic thermal relay. It works based on the I2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent the motor from overheating.



Motor cooling curve with shaft-fixed fan

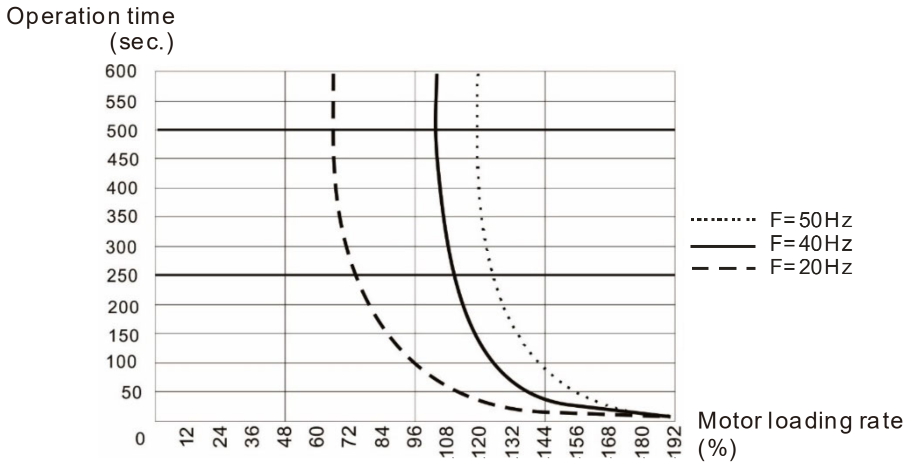


Motor cooling curve with independent fan

- The action of the electronic thermal relay depends on the settings for Pr.06-13.
  1. Pr.06-13 sets to 0 (using inverter motor):
     When the output current of the drive is higher than 150% of motor rated current (refer to the motor cooling curve with independent fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds Pr.06-14.
  2. Pr.06-13 is set to 1 (using standard motor):
     When the output current of the drive is higher than 150% of the motor rated current (refer to the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The

electronic thermal relay acts when the accumulated time exceeds Pr.06-14.

📖 The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following chart:



06-15 Temperature Level Ove-heat (OH) Warning

Default: 105

Settings 0.0–110.0ºC

📖 The default of this parameter is 105ºC. When using Sensorless control mode, the OH warning is disabled if Pr.06-15 is not reduced. When the temperature reaches 100ºC, the drive stops with an IGBT overheat fault.

06-16 Stall Prevention Limit Level

Default: 100

Settings 0–100% (Refer to Pr.06-03, Pr.06-04)

📖 Sets the over-current stall prevention level when the motor's operation frequency is larger than Pr.01-01 (base frequency).

📖 Example: When Pr.06-03 = 150%, Pr.06-04 = 100% and Pr.06-16 = 80%.
The over-current stall prevention level during acceleration:
Pr.06-03 * Pr.06-16 = 150 x 80% = 120%.
The over-current stall prevention level during operation:
Pr.06-04 * Pr.06-16 = 100 x 80% = 80%.

06-17 Fault Record 1
06-18 Fault Record 2
06-19 Fault Record 3
06-20 Fault Record 4
06-21 Fault Record 5
06-22 Fault Record 6

Default: 0

Display
0: No fault record

1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
6: Over-current at stop (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage at constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage at constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
18: IGBT temperature detection failure (tH1o)
21: Drive over-load (oL)
22: Electronic thermal relay protection 1 (EoL1)
26: Over-torque 1 (ot1)
28: Under current (uC)
31: Memory read-out error (cF2)
33: U-phase current detection error (cd1)
34: V-phase current detection error (cd2)
35: W-phase current detection error (cd3)
36: Clamp current detection error (Hd0)
37: Over-current detection error (Hd1)
40: Auto-tuning error (AUE)
41: PID feedback loss (AFE)
48: Analog current input loss (ACE)
49: External fault input (EF)
50: Emergency stop (EF1)
51: External base block (B.B.)
52: Password error (Pcod)
54: Communication error (CE1)
55: Communication error (CE2)
56: Communication error (CE3)
57: Communication error (CE4)
58: Communication time-out (CE10)
61: Y-connection / Δ-connection switch error (ydc)
62: Deceleration energy backup error (dEb)
63: Over-slip (oSL)
71: Mechanical brake error 2 (MBF2)

72: Channel 1 (S1–DCM) safety loop error (STL1)
74: Magnetic contactor error (MCF)
75: Mechanical brake error (MBF)
76: Safe torque off (STo)
77: Channel 2 (S2–DCM) safety loop error (STL2)
78: Internal loop error (STL3)
79: U-phase Over-current before run (Uoc)
80: V-phase Over-current before run (Voc)
81: W-phase Over-current before run (Woc)
82: U-phase output phase loss (oPL1)
83: V-phase output phase loss (oPL2)
84: W-phase output phase loss (oPL3)
87: Drive overload in low frequency (oL3)
91: Motor output phase loss (MPHL)
101: CANopen software disconnect 1 (CGdE)
102: CANopen software disconnect 2 (CHbE)
104: CANopen hardware disconnect (CbFE)
105: CANopen index setting error (CidE)
106: CANopen slave station setting error (CAdE)
107: CANopen memory error(CFrE)
127: Firmware version error (CP33)
140: GFF detected when power on (Hd6)
141: GFF before run (BGFF)
142: Auto-tuning error 1 (DC test stage) (AUE1)
143: Auto-tuning error 2 (High frequency test stage) (AUE2)
144: Auto-tuning error 3 (Rotary test stage) (AUE3)

- When the fault occurs and forces stopping, the fault is recorded in this parameter.
- During stop with low voltage Lv (LvS warning), there is no error record. During operation with mid-low voltage Lv (LvA, Lvd, Lvn error), there is a record.
- When dEb function is valid and enabled, the drive executes dEb and records fault code 62 to Pr.06-17–Pr.06-22 simultaneously.

06-23 Fault Output Option 1
06-24 Fault Output Option 2
06-25 Fault Output Option 3
06-26 Fault Output Option 4

Default: 0

Settings 0–65535 (refer to bit table for fault code)

- Use these parameters with multi-function output terminal (set to 35–38) for the specific requirement. When the fault occurs, the corresponding terminals activate. Convert the binary value to decimal value before you enter the value for Pr.06-23–Pr.06-26.

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
0: No fault record							
1: Over-current during acceleration (ocA)	●						
2: Over-current during deceleration (ocd)	●						
3: Over-current during constant speed (ocn)	●						
4: Ground fault (GFF)	●						
5: IGBT short circuit between upper bridge and lower bridge (occ)	●						
6: Over-current at stop (ocS)	●						
7: Over-voltage during acceleration (ovA)		●					
8: Over-voltage during deceleration (ovd)		●					
9: Over-voltage during constant speed (ovn)		●					
10: Over-voltage at stop (ovS)		●					
11: Low-voltage during acceleration (LvA)		●					
12: Low-voltage during deceleration (Lvd)		●					
13: Low-voltage during constant speed (Lvn)		●					
14: Low-voltage at stop (LvS)		●					
15: Phase loss protection (orP)		●					
16: IGBT overheating (oH1)			●				
17: Heatsink overheating (oH2)			●				
18: IGBT temperature detection failure (tH1o)			●				
21: Drive over-load (oL)			●				
22: Electronic thermal relay protection 1 (EoL1)			●				
23: Electronic thermal relay protection 2 (EoL2)			●				
24: Motor overheating (PTC / PT100 / KTY-84) (oH3)			●				
26: Over-torque 1 (ot1)			●				
27: Over-torque 2 (ot2)			●				
28: Under current (uC)	●						
29: Limit error (LiT)						●	
31: EEPROM read error (cF2)				●			
33: U-phase error (cd1)				●			
34: V-phase error (cd2)				●			
35: W-phase error (cd3)				●			
36: cc (current clamp) hardware failure (Hd0)				●			
37: oc (over-current) hardware failure (Hd1)				●			
40: Auto-tuning error (AUE)				●			
41: PID loss ACI (AFE)					●		
42: PG feedback error (PGF1)					●		
43: PG feedback loss (PGF2)					●		
44: PG feedback stall (PGF3)					●		
45: PG slip error (PGF4)					●		
48: ACI loss (ACE)					●		
49: External fault input (EF)						●	

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
50: Emergency stop (EF1)						●	
51: External Base Block (bb)						●	
52: Enter wrong password three times and locked (Pcod)				●			
54: Illegal command (CE1)							●
55: Illegal data address (CE2)							●
56: Illegal data value (CE3)							●
57: Data is written to read-only address (CE4)							●
58: Modbus transmission time-out (CE10)							●
61: Y-connection/Δ-connection switch error (ydc)						●	
62: Deceleration Energy Backup Error (dEb)		●					
63: Over-slip (oSL)						●	
65: Hardware error of PG card (PGF5)					●		

06-31 Frequency Command for Malfunction

Default: Read only

Settings 0.00–299.00 Hz

📖 When a malfunction occurs, check the current Frequency command. If it happens again, it overwrites the previous record.

06-32 Output Frequency at Malfunction

Default: Read only

Settings 0.00–299.00 Hz

📖 When a malfunction occurs, check the current output frequency. If it happens again, it overwrites the previous record.

06-33 Output Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

📖 When a malfunction occurs, check the current output voltage. If it happens again, it overwrites the previous record.

06-34 DC bus Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

📖 When a malfunction occurs, check the current DC voltage. If it happens again, it overwrites the previous record.

06-35 Output Current at Malfunction

Default: Read only

Settings 0.00–655.35 Amp

📖 When a malfunction occurs, check the current output current. If it happens again, it overwrites the previous record.

06-36 IGBT Temperature at Malfunction

Default: Read only

Settings -3276.7–3276.7°C

📖 When a malfunction occurs, check the current IGBT temperature. If it happens again, it overwrites the previous record.

06-37 Capacitance Temperature at Malfunction

Default: Read only

Settings -3276.7–3276.7°C

📖 When a malfunction occurs, check the current capacitance temperature. If it happens again, it overwrites the previous record.

06-38 Motor Speed in rpm at Malfunction

Default: Read only

Settings -32767–32767 rpm

📖 When a malfunction occurs, check the current motor speed in rpm. If it happens again, it overwrites the previous record.

06-40 Status of the Multi-function Input Terminal at Malfunction

Default: Read only

Settings 0000h–FFFFh

06-41 Status of the Multi-function Output Terminal at Malfunction

Default: Read only

Settings 0000h–FFFFh

📖 When a malfunction occurs, check the current status of the multi-function input/output terminals. If it happens again, it overwrites the previous record.

06-42 Drive Status at Malfunction

Default: Read only

Settings 0000h–FFFFh

📖 When a malfunction occurs, check the current drive status (communication address 2101H). If it happens again, it overwrites the previous record.

✓ 06-44 STO Latch Selection

Default: 0

Settings 0: STO Latch

1: STO no Latch

📖 Pr.06-44 = 0: STO Alarm Latch. After you clear the cause of the STO Alarm, use a Reset command to clear the STO Alarm.

📖 Pr.06-44 = 1: STO Alarm no Latch. After you clear the cause of the STO Alarm, the STO Alarm clears automatically.

📖 All of the STL1–STL3 errors are “Alarm Latch” mode (in STL1–STL3 mode, the Pr.06-44 function is not effective).

06-45 Output Phase Loss Detection Action (OPHL)

Default: 3

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning

- The OPHL protect function is active when the setting is not 3.

06-46 Detection Time for Output Phase Loss

Default: 0.500

Settings 0.000–65.535 sec.

06-47 Current Detection Level for Output Phase Loss

Default: 1.00

Settings 0.00–100.00%

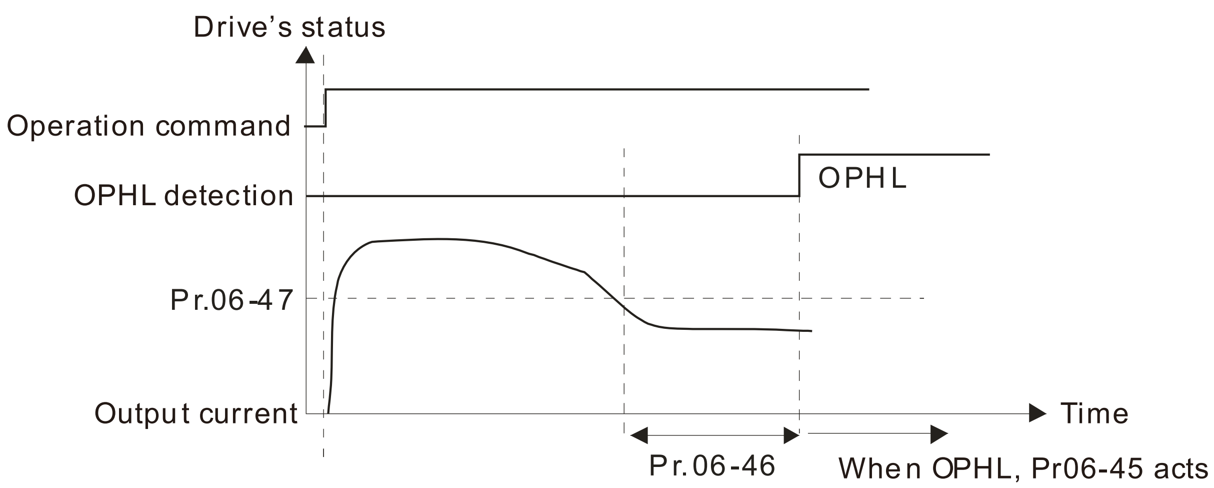
06-48 DC Brake Time for Output Phase Loss

Default: 0.000

Settings 0.000–65.535 sec.

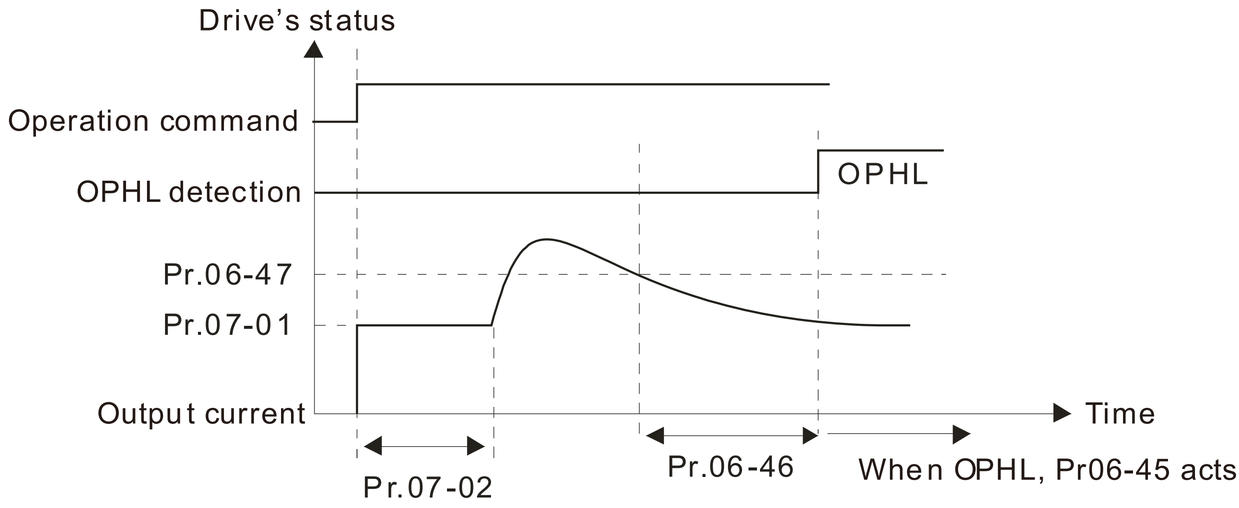
- Setting Pr.06-48 to 0 disables the OPHL detection function.
- Status 1: The drive is in operation

When any phase is less than the Pr.06-47 setting, and exceeds the Pr.06-46 setting time, the drive executes according to the Pr.06-45 setting.



- Status 2: The drive is in STOP; Pr.06-48 = 0; Pr.07-02 ≠ 0

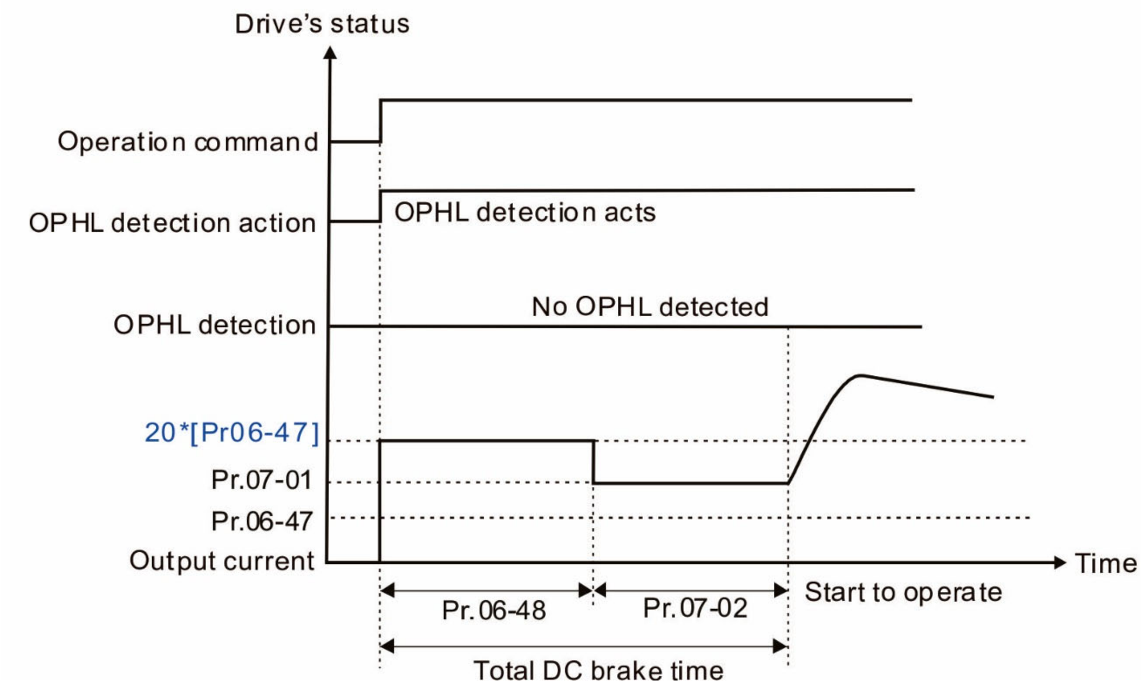
After the drive starts, the DC brake operates according to Pr.07-01 and Pr.07-02. During this period, OPHL detection is not active. After the DC brake action is completed, the drive starts to run, and enables the OPHL protection as mentioned above for status 1.



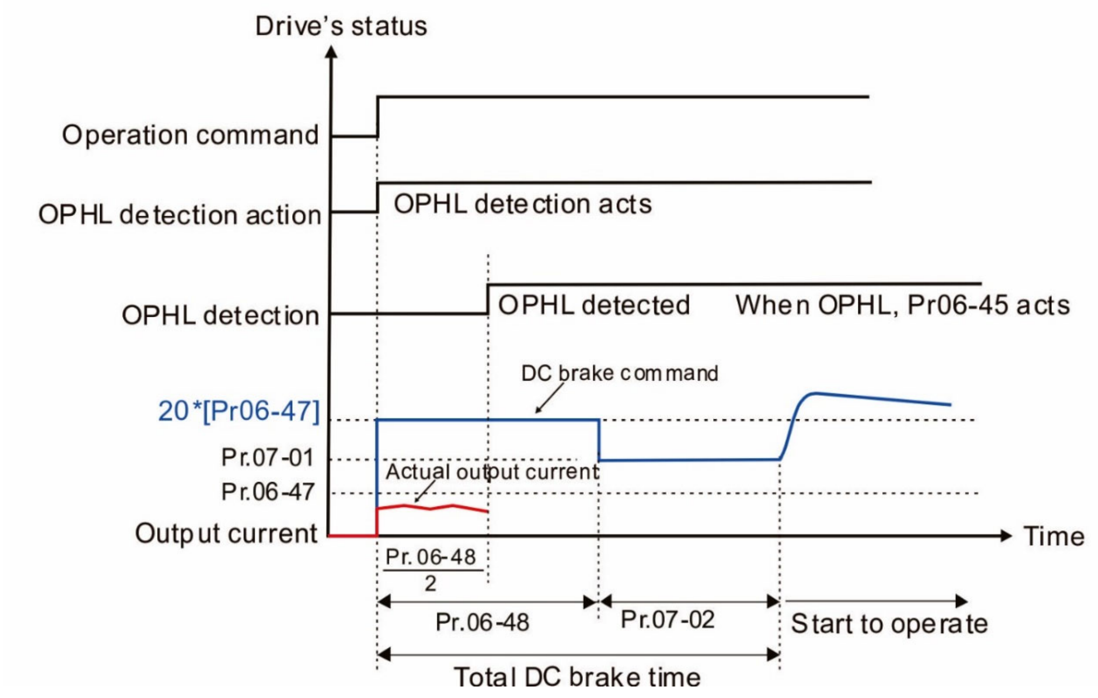
Status 3: The drive is in STOP; Pr.06-48 ≠ 0; Pr.07-02 ≠ 0

When the drive starts, it executes Pr.06-48 first, and then executes Pr.07-02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the Pr.06-47 setting value in Pr.06-48 setting time; the other is the Pr.07-01 setting value in Pr.07-02 setting time. In this period, if an OPHL happens within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.

Status 3-1: Pr.06-48 ≠0, Pr.07-02 ≠ 0 (No OPHL detected before operation)



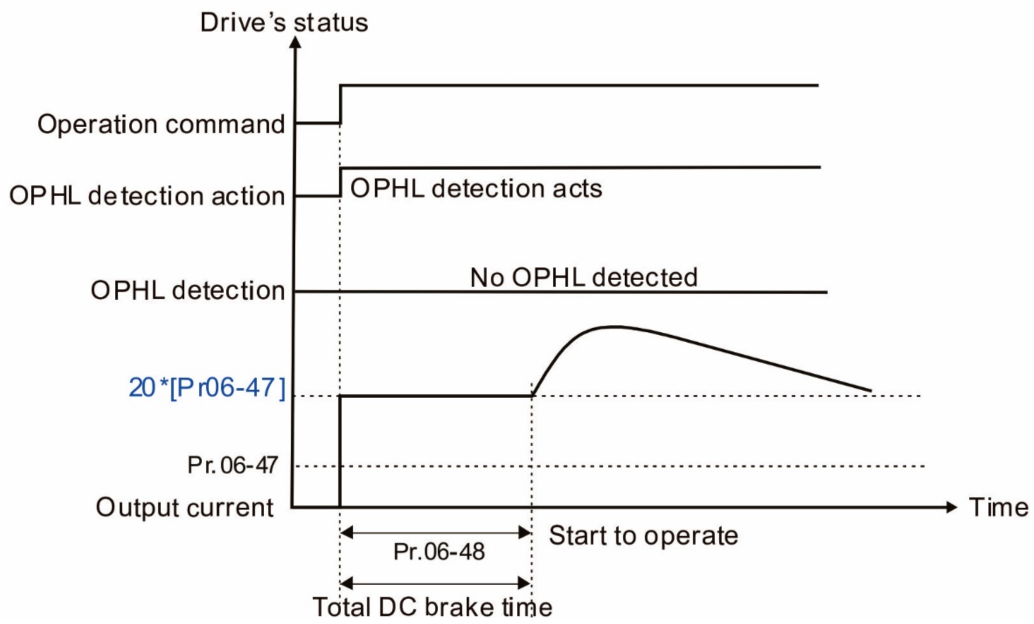
Status 3-2: Pr.06-48 ≠0, Pr.07-02 ≠ 0 (OPHL detected before operation)



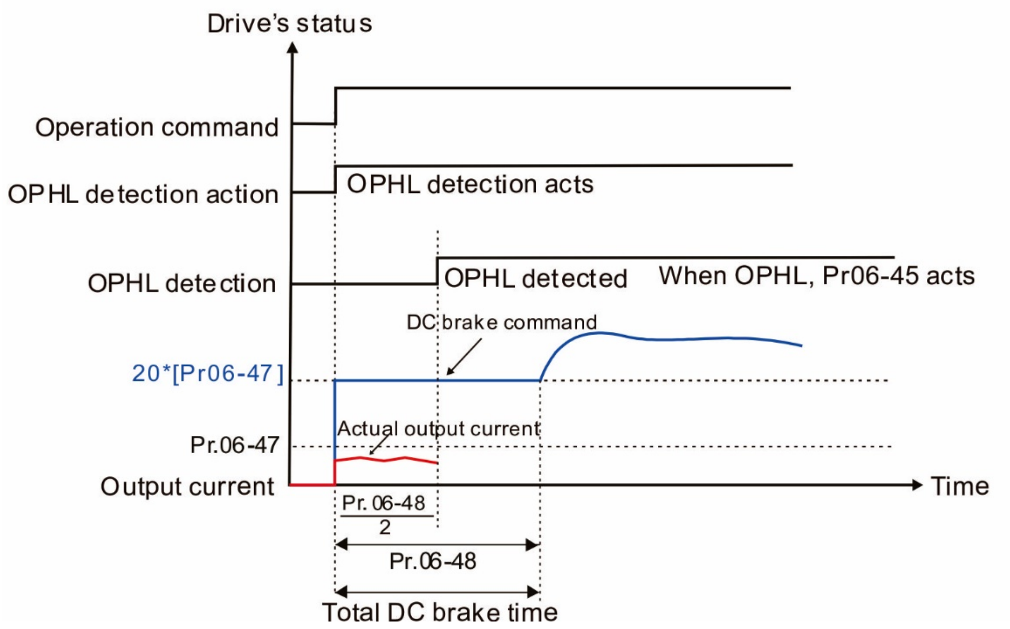
📖 Status 4: The drive is in STOP; Pr.06-48 ≠ 0; Pr.07-02 = 0

When the drive starts, it executes Pr.06-48 as the DC brake. The DC brake current level is 20 times the Pr.06-47 setting value. In this period, if an OPHL happens within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.

Status 4-1: Pr.06-48 ≠0, Pr.07-02 = 0 (No OPHL detected before operation)



Status 4-2: Pr.06-48 ≠0, Pr.07-02 = 0 (OPHL detected before operation)



06-49 LvX Auto-reset

Default: 0

Settings 0: Disable

1: Enable

06-53 Treatment for Phase Loss Protection (OrP)

Default: 0

Settings 0: Fault and ramp to stop

1: Fault and coast to stop

📖 The drive executes the input phase loss protection according to Pr.06-53.

06-55 Derating Protection

Default: 0

Settings 0: Constant rated current and limit carrier wave by load current and temperature

1: Constant carrier frequency and limit load current by setting carrier wave

2: Constant rated current (same as setting 0), but close current limit

📖 Allowable maximum output frequency and the minimum carrier wave limit in control mode:

For VF and SVC modes:
When the maximum output frequency is 299 Hz, the minimum carrier wave is 6 k.

📖 Setting 0:

When the operating point is greater than the derating curve (when the operating carrier wave is greater than the rated carrier wave), the rated current is constant, and carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and overload time. If overloads are not frequent, and the concern is only about the carrier frequency operating with the rated current for a long time, and changes to the carrier wave due to short overload are acceptable, set to 0. Refer to the following diagram for the level of carrier frequency.

📖 Setting 1:

When the operating point exceeds derating curve 1, the carrier frequency is fixed to the set value. Select this mode if the change of carrier wave and motor noise caused by ambient temperature and frequent overload are not acceptable. Refer to Pr.00-17.

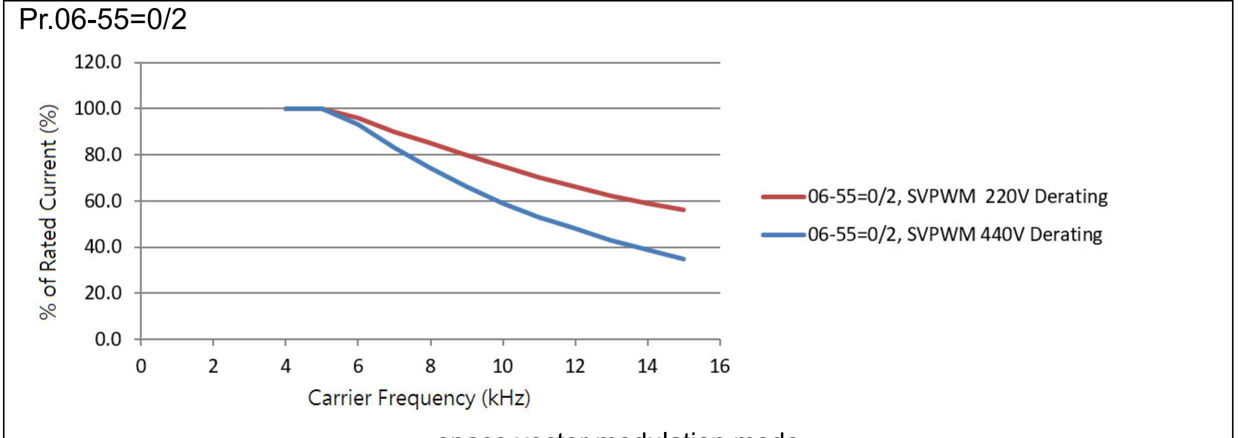
📖 Setting 2:

The protection method and action are the same as setting it to 0, but this disables the current limit when output current is the derating ratio ×180 % (default value).
The advantage is that this can provide a higher starting output current when the carrier frequency setting is higher than the default. The disadvantage is that the carrier wave derates easily when it overloads.

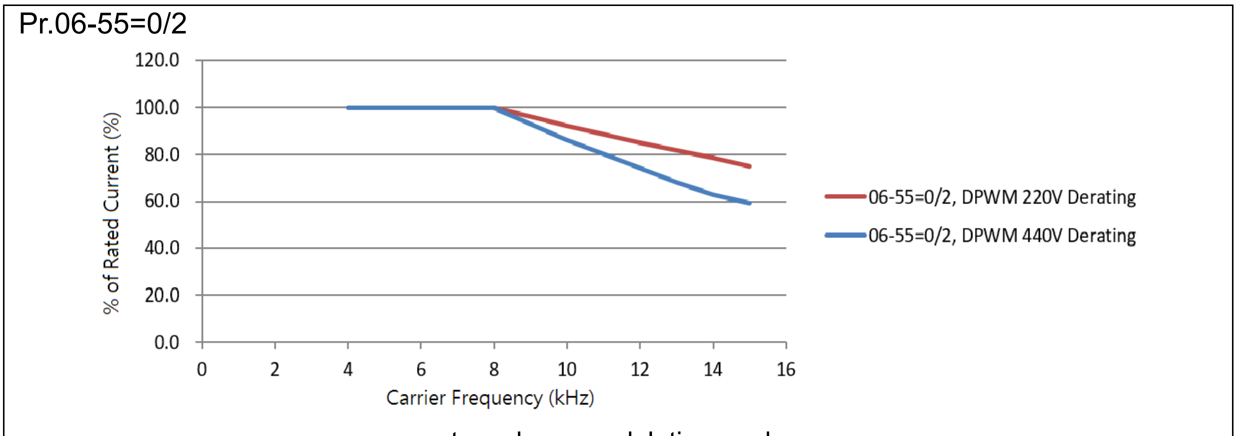
📖 Example: when Pr.06-55 = 0 or 1, over-current stall prevention level = ratio*Pr.06-03. When Pr.06-55 = 2, over-current stall prevention level = Pr.06-03. Use with the setting for Pr.00-17.

📖 The derating is also affected by the ambient temperature. Refer to the ambient temperature derating curve.

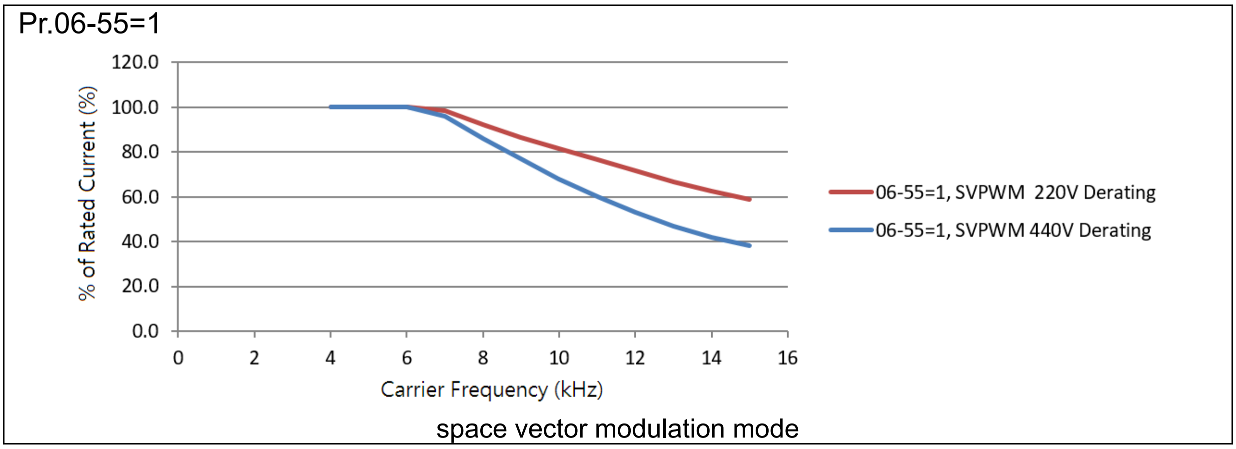
Ambient temperature derating curve for general control

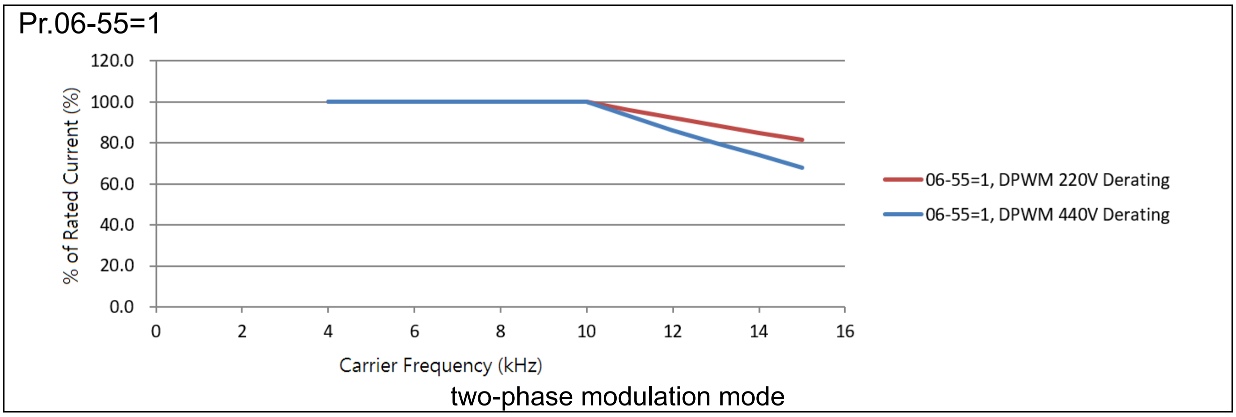


space vector modulation mode



two-phase modulation mode





06-60 Software Detection GFF Current Level

Default: 60.0

Settings 0.0–6553.5%

06-61 Software Detection GFF Filter Time

Default: 0.10

Settings 0.00–655.35 sec.

When the drive detects that the unbalanced three-phase output current is higher than the setting for Pr.06-60, GFF protection activates. The drive then stops output.

06-63 Operation Time of Fault Record 1 (Day)
06-65 Operation Time of Fault Record 2 (Day)
06-67 Operation Time of Fault Record 3 (Day)
06-69 Operation Time of Fault Record 4 (Day)
06-90 Operation Time of Fault Record 5 (Day)
06-92 Operation Time of Fault Record 6 (Day)

Default: Read only

Settings 0–65535 days

06-64 Operation Time of Fault Record 1 (Min.)
06-66 Operation Time of Fault Record 2 (Min.)
06-68 Operation Time of Fault Record 3 (Min.)
06-70 Operation Time of Fault Record 4 (Min.)
06-91 Operation Time of Fault Record 5 (Min.)

06-93 Operation Time of Fault Record 6 (Min.)

Default: Read only

Settings 0–65535 min.

📖 If there is any malfunction when the drive operates, Pr.06-17–06-22 records the malfunctions, and Pr.06-63–06-70 records the operation time for four sequential malfunctions. Check if there is any problem with the drive according to the interval of the recorded fault.

Example:

The first error: ocA occurs after motor drive operates for 1000 minutes.

The second error: ocd occurs after another 1000 minutes.

The third error: ocn occurs after another 1000 minutes.

The fourth error: ocA occurs after another 1000 minutes.

The fifth error: ocd occurs after another 1000 minutes.

The sixth error: ocn occurs after another 1000 minutes.

Then Pr.06-17–06-22 and Pr.06-63–06-70 are recorded as follows:

	1st fault	2nd fault	3rd fault	4th fault	5th fault	6th fault
Pr.06-17	ocA	ocd	ocn	ocA	ocd	ocn
Pr.06-18	0	ocA	ocd	ocn	ocA	ocd
Pr.06-19	0	0	ocA	ocd	ocn	ocA
Pr.06-20	0	0	0	ocA	ocd	ocn
Pr.06-21	0	0	0	0	ocA	ocd
Pr.06-22	0	0	0	0	0	ocA
Pr.06-63	1000	560	120	1120	680	240
Pr.06-64	0	1	2	2	3	4
Pr.06-65	0	1000	560	120	1120	680
Pr.06-66	0	0	1	2	2	3
Pr.06-67	0	0	1000	560	120	1120
Pr.06-68	0	0	0	1	2	2
Pr.06-69	0	0	0	1000	560	120
Pr.06-70	0	0	0	0	1	2

※ By examining the time record, you can see that that the last fault (Pr.06-17) happened after the drive ran for 4 days and 240 minutes.

✎ 06-71 Low Current Setting Level

Default: 0.0

Settings 0.0–100.0%

✎ 06-72 Low Current Detection Time

Default: 0.00

Settings 0.00–360.00 sec.

✎ 06-73 Low Current Action

Default: 0

Settings 0: No function

1: Fault and coast to stop

2: Fault and ramp to stop by the second deceleration time

3: Warn and continue operation

📖 The drive operates according to the setting for Pr.06-73 when the output current is lower than the setting for Pr.06-71 and when the time of the low current exceeds the detection time for Pr.06-72. Use this parameter with the external multi-function output terminal 44 (for low current output).

The low current detection function does not execute when drive is in sleep or standby status.

06-74 Number of Times to Retry after Fault

Default: 0

Settings 0–10 times

06-75 Time Interval between Retries

Default: 10.0

Settings 0.5–600.0 sec.

06-77 MO's Action when Retrying after Fault

Default: 0

Settings 0: Output

1: No output

06-81 Emergency Power Speed in Operation

Default: Read only

Settings 0.00–299.00 Hz

- Sets the elevator's maximum running speed when using Emergency Power Supply (EPS).
- You can set the elevator's running speed during EPS by using Pr.02-83, but the running speed should not be larger than Pr.06-81 setting value.

06-82 Emergency Power Capacity in Operation

Default: 0.0

Settings 0.00–100.0 kVA

- The power capacity for the external emergency power.
- When using EPS as an emergency power system, you must enter the power capacity of emergency power. When using emergency power, the drive calculates elevators' running speed according to the calculation formula below.

$$V_{eps\_max} = \frac{06-82 \times 0.5}{\sqrt{3} \times I_{motor\_rated}}$$

$$f_{eps\_limit} = \frac{V_{eps\_max}}{01-02} \times 01 - 01 \times 0.5$$

$I_{motor\_rated} = 05-01$ (Induction Motor)

When Frequency command > fEPS, the running speed of EPS emergency power: fEPS.

When Frequency command ≤ fEPS, the running speed of EPS emergency power: runs according to the current Frequency command.

06-83 EPS Mode Selection

Default: 0

Settings 0: Operate by current command direction

1: Run in the running direction of power generation mode. Execute the power generation direction detection when running in power generation mode.

2: After determining the power generation direction, the host controller sends a running direction command. (When at STOP, the direction of power generation mode (MO = 57) confirmation and the direction of power generation does not maintain.) Execute the power generation direction detection each time whenever running.

3: After determining the power generation direction, the host controller sends a running direction command. (When at STOP, the direction of power generation mode (MO = 57) confirmation and the direction of the power generation maintain.) Execute the power generation direction detection only one time when running.

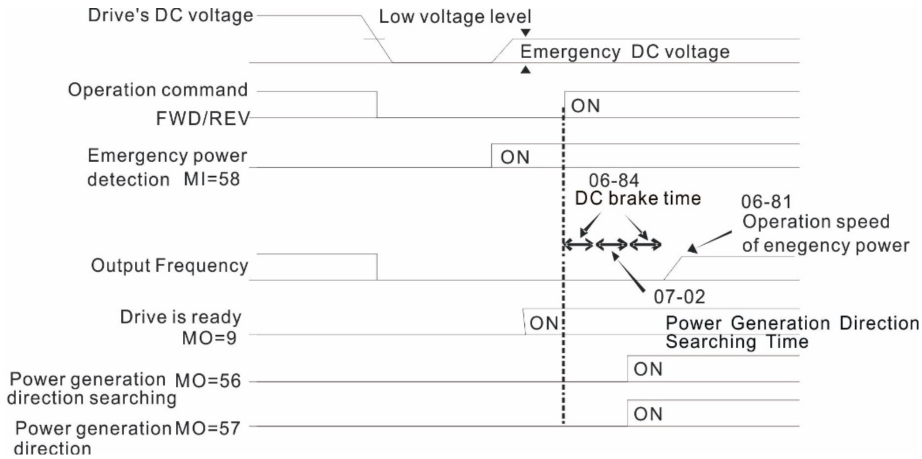
4: Run by the direction of power generation mode. Execute the power generation direction detection when running in normal mode.

- This parameter is enabled when the EPS function at the external terminal is activated.
- 4: (the motor has a gear box.)
  1. Run in normal mode and when reaching the largest power factor, the value of this power factor is recorded in Pr.06-87.
  2. The value of the power factor detected at the direction of the power generation is compared to the setting value at Pr.06-86. If the detected power factor is larger than Pr.06-86, the current moving direction (upward or downward) is recorded in Pr.06-88
  3. Therefore, when in EPS mode, the elevator moves in the direction stored in Pr.06-88.

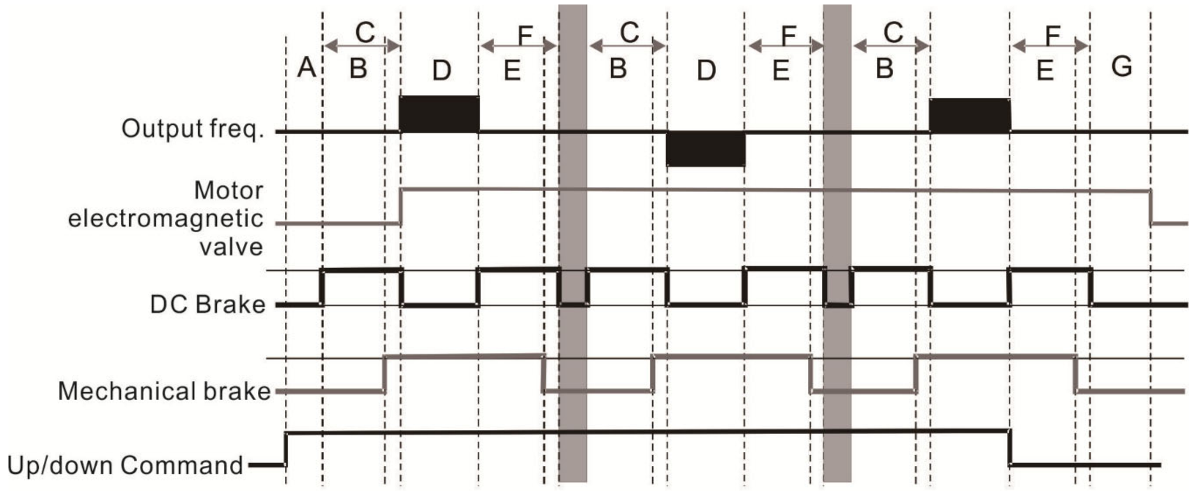
  Related parameters: Pr.02-01–Pr.02-07 multi-function input terminal (58: Emergency power mode detection), Pr.02-16–Pr.02-17 multi-function output terminals (56: Power generation direction and status verification, 57: Power generation direction), Pr.02-30 Turn On Delay of Magnetic Contactor between Drive and Motor, Pr.02-31 Turn Off Delay of Magnetic Contactor between Drive and Motor, Pr.02-39 Brake Release Delay Time When Elevator Starts, Pr.02-40 Brake Contracting Delay Time When Elevator Stops, Pr.07-01 DC Brake Current Level, Pr.07-02 DC Brake Time at Start-up and Pr.07-03 DC Brake Time at Stop.

- If parameter = 1, when you enter FWD or REV running signal, the drive automatically detects the elevator's load status to make the elevator run in power re-generation direction (motor is the electricity generator) according to the running direction after detection rather than the user's current command direction in order to avoid voltage decrease in EPS emergency power.

  V/F and SVC control mode: within the time limit for Pr.06-84, the drive uses FWD and REV to determine the elevator's load status to make the elevator run in power re-generation direction (motor is the electricity generator). (Refer to the auto-detection time sequence diagram below)



Time Sequence Diagram for Elevators' Emergency Power Supply and Power Generation



A 02-30: Magnetic Contactor (MC) ON Delay Time Between Drive and Motor;
B 02-39: Mechanical Brake Release Delay Time When Elevator Starts;
C 07-02: DC Brake Time at RUN;
D 06-84: Electricity Generation Direction Search Time;
E 02-40: Mechanical Brake Contracting Delay Time When Elevator Stops;
F 07-03: DC Brake Time at Stop;
G 02-31: Magnetic Contactor (MC) OFF Delay Time Between Drive and Motor

Auto-detection Time Sequence Diagram

✓ 06-84 Power Generation Direction Search Time

Default: 1.0

Settings 0.0–5.0 sec.

📖 Time for detecting power generation direction.

✓ 06-85 UPS Output Delay Time

Default: 1.0

Settings 0.0–10.0 sec.

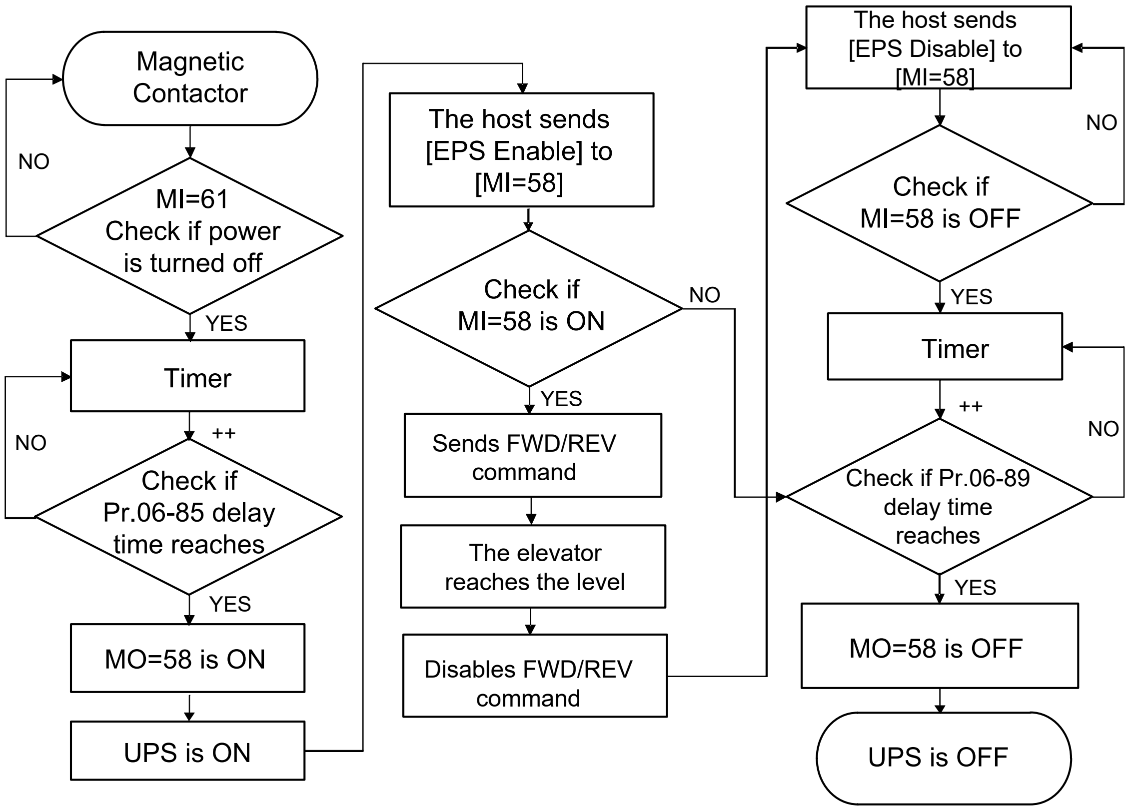
✓ 06-89 Delay Time on Stopping UPS Output

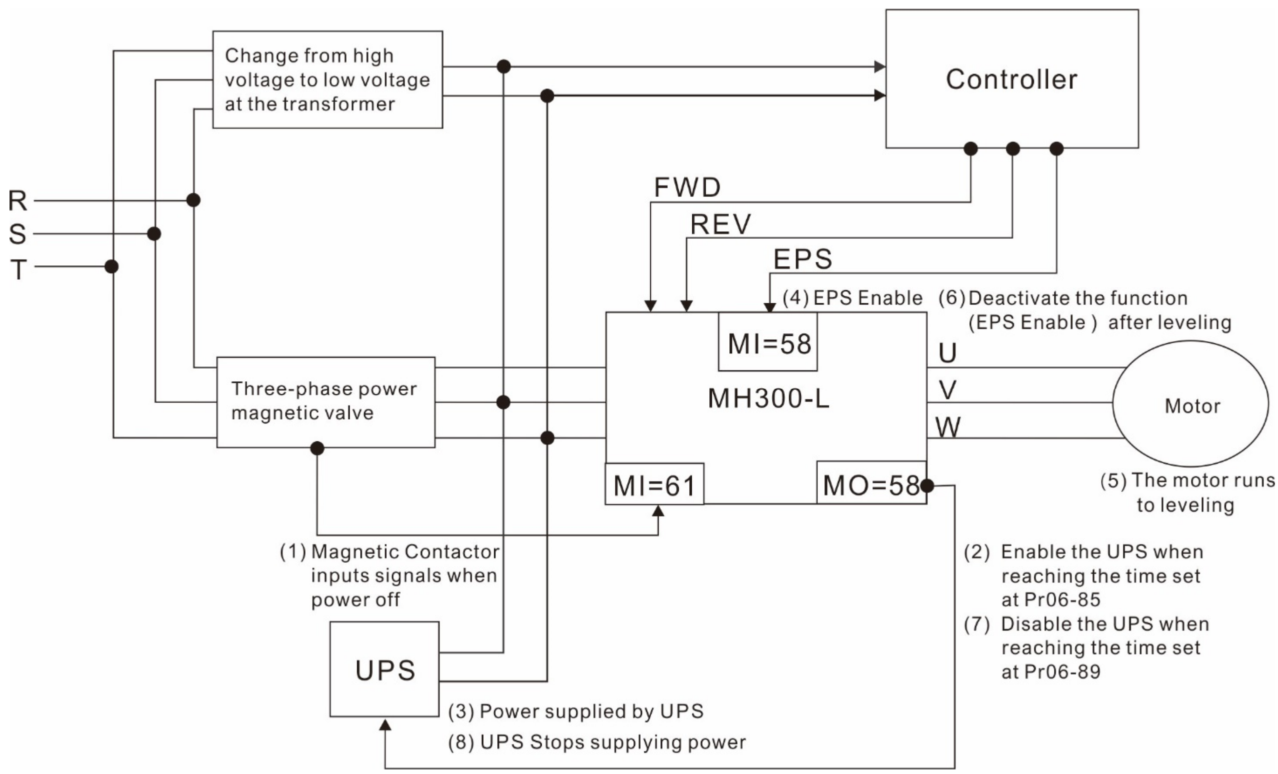
Default: 3.0

Settings 0.0–60.0 sec.

📖 Pr.06-85: When the power loses, the magnetic contactor outputs a MI signal to notify the motor drive to enable UPS function. After Pr.06-85 delay time, a MO signal activates the UPS magnetic contactor.

- Pr.06-89: When the controller disables the emergency power mode, the MO signal stops outputting after Pr.06-89 delay time to deactivate the UPS function.
- Related parameters: Pr.02-01–Pr.02-07 multi-function input terminal (61: Power loss signal), Pr.02-16–Pr.02-17 multi-function output terminal (58: EPS mode).





✔ 06-86 Power Factor Level for Determining the Power Generation Direction

Default: 70.0

Settings 0.0–150.0 °

- If power factor is larger than the setting value in this parameter when running, the power generation direction is the running direction.

✔ 06-87 Reference Level of the Power Factor when Running

Default: Read only

Settings 0.0–200.0 °

- The largest power factor when running.

✔ 06-88 Power Generation Direction

Default: Read only

Settings 0: Forward running
1: Reverse running

07 Special Parameters

✓ You can set this parameter during operation.

✓ 07-00 Software Brake Chopper Action Level

Default: 370.0 / 740.0

Settings 230V models: 350.0–450.0 V_{DC}

460V models: 700.0–900.0 V_{DC}

- Sets the brake transistor level for the DC bus voltage. Choose a suitable brake resistor to achieve the best deceleration. Refer to Chapter 7 Optional Accessories for information about brake resistors.

✓ 07-01 DC Brake Current Level

Default: 30

Settings 0–100%

- Sets the level of the DC brake current output to the motor during start-up and stop. When you set the DC brake current percentage, the rated current is regarded as 100%. Start with a low DC brake current level, and increase it slowly until the proper brake torque is reached. However, to avoid burning the motor, the DC brake current can NOT exceed the rated current. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.

✓ 07-02 DC Brake Time at Start-up

Default: 0.7

Settings 0.0–60.0 sec.

- The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. If you use the drive with the motor rotating, it may cause motor damage or trigger drive protection due to over-current. This parameter outputs DC current, generating torque to force the motor stop to get a stable start before motor operation. This parameter determines the duration of the DC brake current output to the motor when the drive starts up. Setting this parameter to 0.0 disables the DC brake at start-up.

✓ 07-03 DC Brake Time at STOP

Default: 0.7

Settings 0.0–60.0 sec.

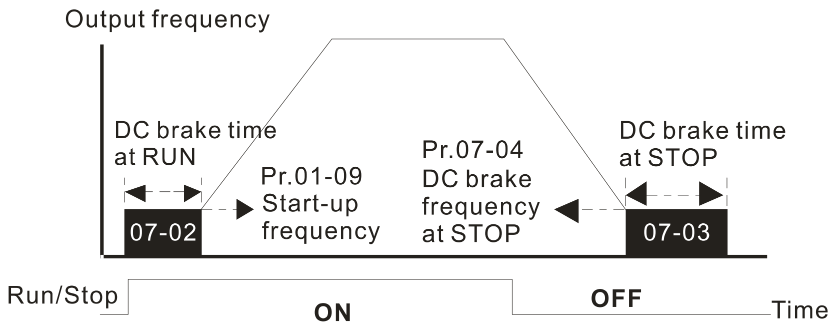
- The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. This parameter outputs DC current, generating torque to force the drive stop after the drive stops output to make sure that the motor stops.

✓ 07-04 DC Brake Frequency at STOP

Default: 0.00

Settings 0.00–299.00 Hz

- This parameter determines the start frequency of the DC brake before the drive ramps to stop. When this setting is less than Pr.01-09 (Start-up Frequency), the start frequency of the DC brake starts from the minimum frequency.



DC Brake Output Timing Diagram

📖 Use the DC brake before running the motor when the load is movable at stop, such as with fans and pumps. The motor is in free operating status and in unknown rotation direction before the drive starts up. Execute the DC brake before you start the motor.

📖 Use DC Brake at STOP when you need to brake the motor quickly or to control the positioning, such as with cranes or cutting machines.

✎ 07-05 Voltage Increasing Gain

Default: 100

Settings 1–200%

📖 When using speed tracking, adjust Pr.07-05 to slow down the increasing voltage gain if there are errors such as oL or oc; however, the speed tracking time will be longer.

✎ 07-06 Restart after Momentary Power Loss

Default: 0

Settings 0: Stop operation
1: Speed tracking by the speed before the power loss
2: Speed tracking by the minimum output frequency

📖 Determines the operation mode when the drive restarts from a momentary power loss.

📖 The power system connected to the drive may power off momentarily for many reasons. This function allows the drive to keep outputting after the drive is repowered and does not cause the drive to stop.

📖 1: Frequency tracking begins before momentary power loss and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is a lot of inertia with little resistance on the motor load. For example, in equipment with a large inertia flywheel, there is NO need to wait until the flywheel stops completely after a restart to execute the operation command; therefore, it saves time.

📖 2: Frequency tracking starts from the minimum output frequency and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is little inertia and large resistance.

✎ 07-07 Allowed Power Loss Duration

Default: 2.0

Settings 0.0–20.0 sec.

📖 Determines the maximum time of allowable power loss. If the duration of a power loss exceeds this parameter setting, the AC motor drive stops output.

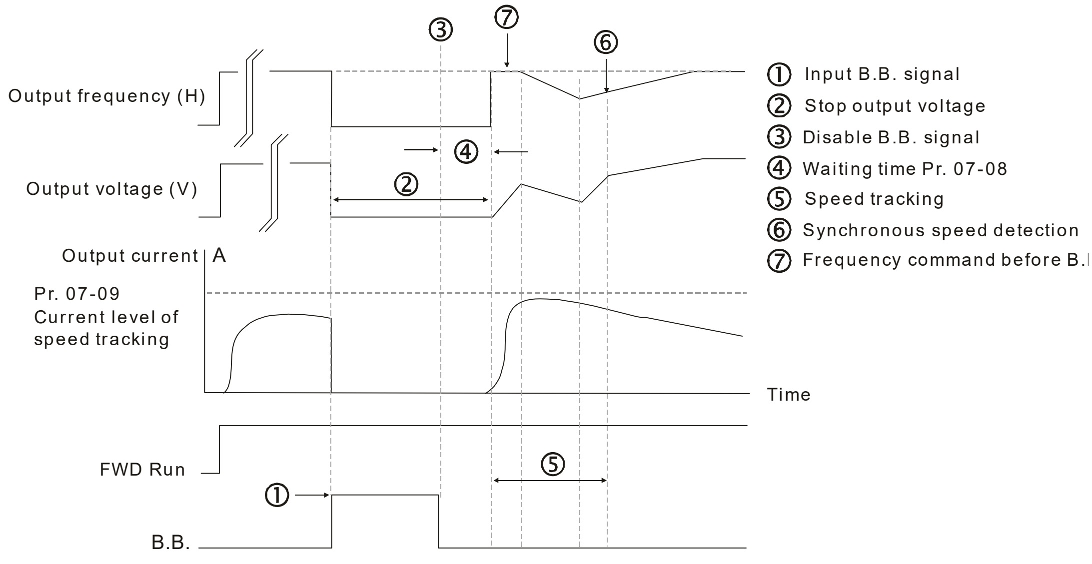
- Pr.07-06 is valid when the maximum allowable power loss time is ≤ 20 seconds and the AC motor drive displays “Lv”. If the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is ≤ 20 seconds, the operation mode set in Pr.07-06 does not execute.

07-08 Base Block Time

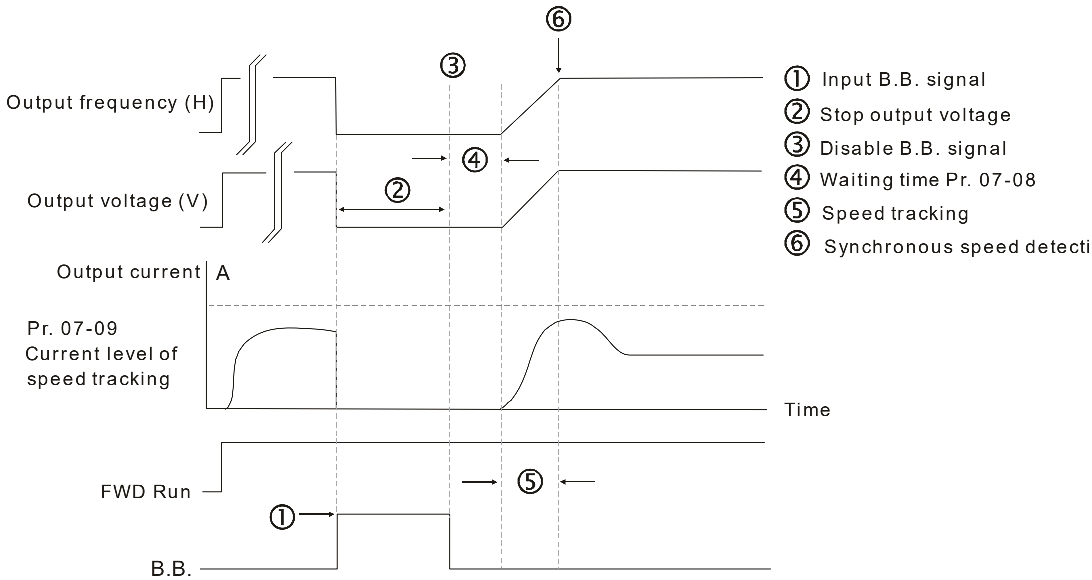
Default: 0.5

Settings 0.1–5.0 sec.

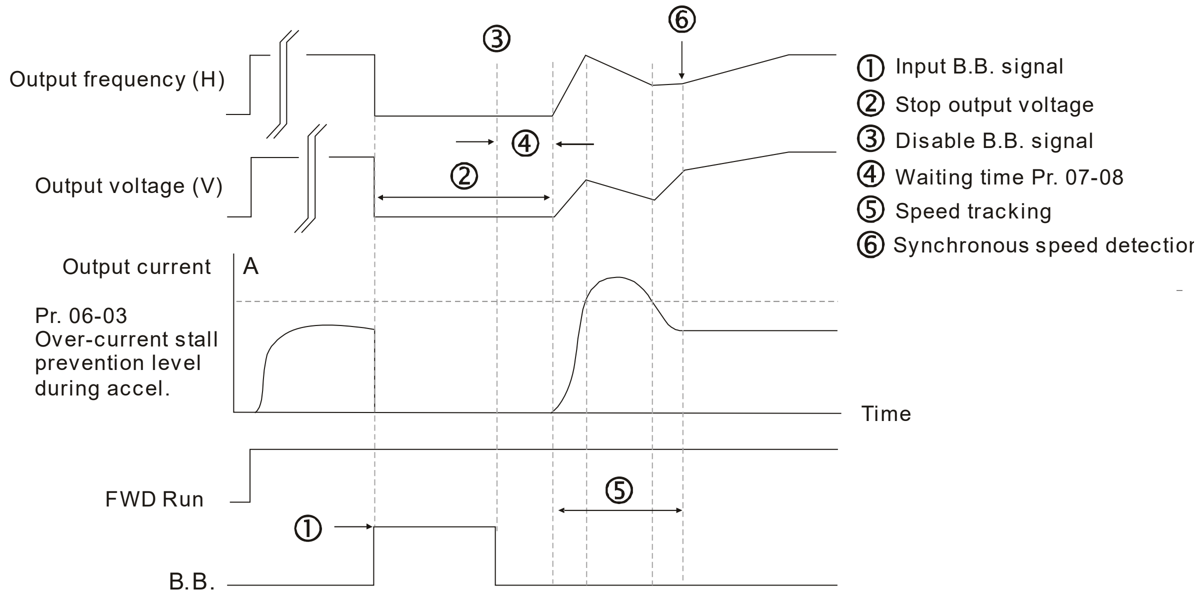
- When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by Pr.07-08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual voltage at the output side to decrease to 0 V before activating the drive again.



B.B. Speed tracking: from last output frequency



B.B. Speed tracking: from minimum output frequency



Over-current stall prevention

07-09 Current Limit of Speed Tracking

Default: 100

Settings 20–200%

- The AC motor drive executes speed tracking only if the output current is greater than the value set in Pr.07-09.
- The maximum current for speed tracking affects the synchronous time. The larger the parameter setting is, the faster the synchronization occurs. However, if the parameter setting is too large, the overload protection function may be activated.

07-10 Restart after Fault Action

Default: 0

Settings 0: Stop operation
1: Speed tracking by current speed
2: Speed tracking by minimum output frequency

- Faults include: bb, oc, ov, occ. To restart after oc, ov, occ, you can NOT set Pr.07-11 to 0.

07-11 Number of Times of Auto-restart after Fault

Default: 0

Settings 0–10

- After fault (allowed fault: oc, ov, occ) occurs, the AC motor drive can reset and restart automatically up to 10 times.
- If the number of faults exceeds the Pr.07-11 setting, the drive does not reset and restart until you press “RESET” manually and execute the operation command again.

✎ 07-12 Speed Tracking during Start-up

Default: 0

Settings 0: Disable
1: Speed tracking by maximum output frequency
2: Speed tracking by motor frequency at start
3: Speed tracking by minimum output frequency

- Speed tracking is suitable for punch, fans and other large inertia loads. For example, a mechanical punch usually has a large inertia flywheel, and the general stop method is coast to stop. If it needs to be restarted again, the flywheel may take 2–5 minutes or longer to stop. This parameter setting allows you to start the flywheel operating again without waiting until the flywheel stops completely.

✎ 07-13 dEb Function Selection

Default: 0

Settings 0: Disable
1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored.
2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored.

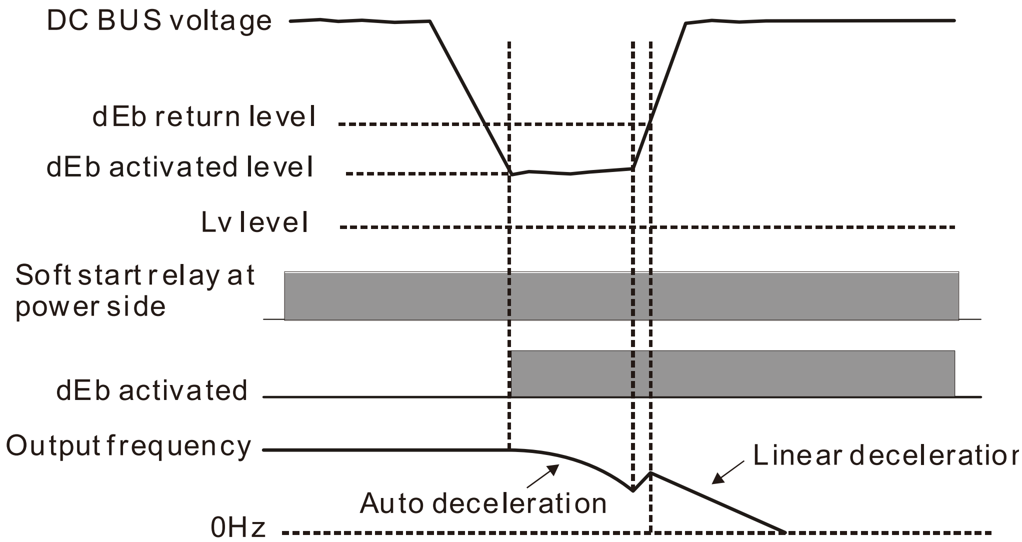
- dEb (Deceleration Energy Backup) lets the motor decelerate to stop when momentary power loss occurs. When the power loss is instantaneous, use this function to let the motor decelerate to zero speed. If the power recovers at this time, the drive restarts the motor after the dEb return time.
- Lv return level: Default value depends on the drive power model.
  Frame C, D = Pr.06-00 + 60 V / 30 V (220V models)
  Frame E and above = Pr.06-00 + 80 V / 40 V (220V models)
- Lv level: Default is Pr.06-00.
- During dEb operation, other protection, such as ryF, ov, oc, occ, and EF may interrupt it, and these error codes are recorded.
- The STOP (RESET) command does not work during the dEb auto-deceleration, and the drive continues decelerating to stop. To make the drive coast to stop immediately, use another function (EF) instead.
- The B.B. function does not work when executing dEb. The B.B. function is enabled after the dEb function finishes.
- Even though the Lv warning does not display during the dEb operation, if the DC BUS voltage is lower than the Lv level, MO = 10 (Low voltage warning) still operates.
- The following explains the dEb action:
  When the DC voltage drops below dEb setting level, the dEb function starts to work (soft start relay remains closed), and the drive executes auto-deceleration.

- **Situation 1:**

  Momentary power loss, or power current too low and unstable, or power supply sliding down because of sudden heavy load.

  Pr.07-13 = 1 and power recovers.

  When the power recovers and DC BUS voltage exceeds the dEb return level, the drive linearly decelerates to 0 Hz and stops. The keypad displays the "dEb" warning until you manually reset it, so that you can see the reason for the stop.

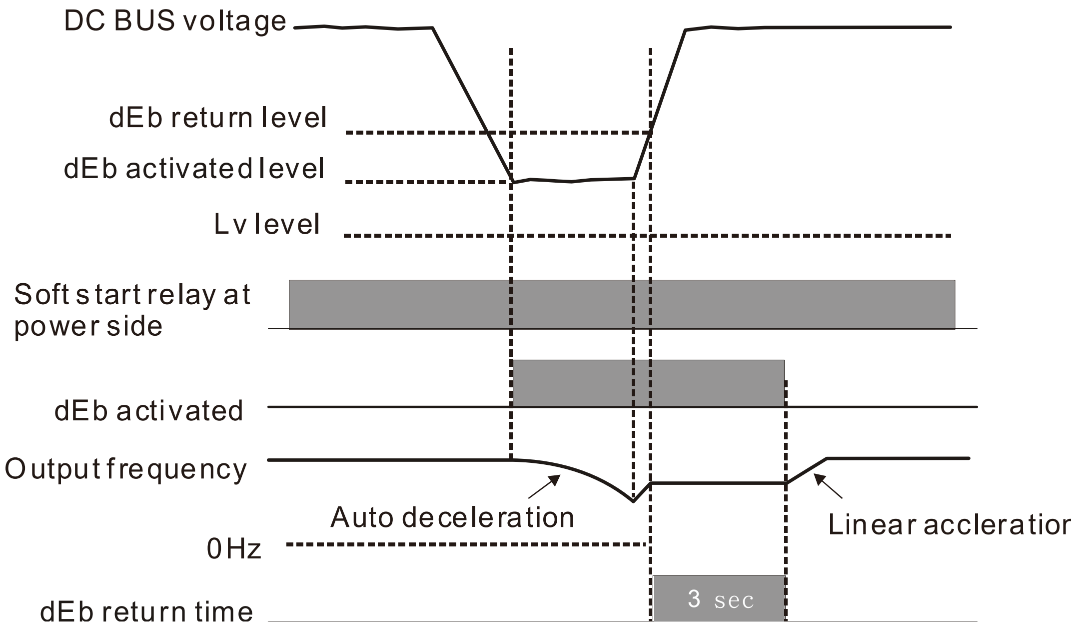


- **Situation 2:**

  Momentary power loss, or power current too low and unstable, or power supply sliding down because of sudden heavy load.

  Pr.07-13 = 2 and power recovers.

  During the dEb deceleration (includes 0 Hz run), if the power recovers higher than dEb return level, the drive maintains the frequency for three seconds and then accelerates again. The dEb warning on the keypad clears automatically.

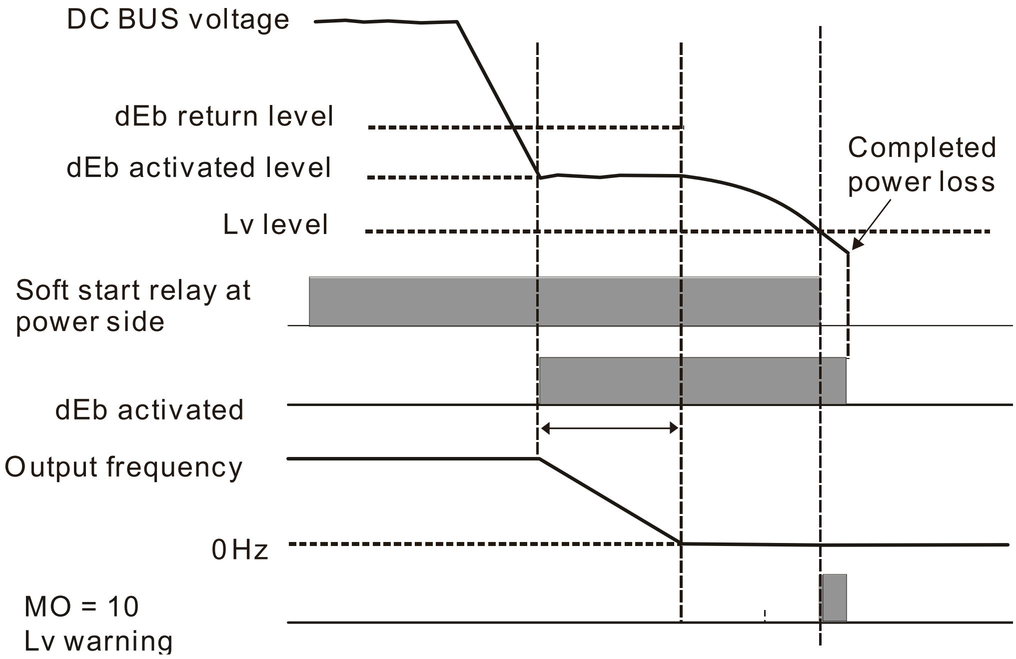


- **Situation 3:**

  Power supply unexpected shut down / power loss.

  Pr.07-13 = 1 and power does not recover.

  The keypad displays the "dEb" warning and stops after decelerating to the lowest running frequency. When the DC BUS voltage is lower than the Lv level, the drive disconnects the soft start relay until the power completely runs out.



- **Situation 4:**

  Power supply unexpected shut down / power loss.

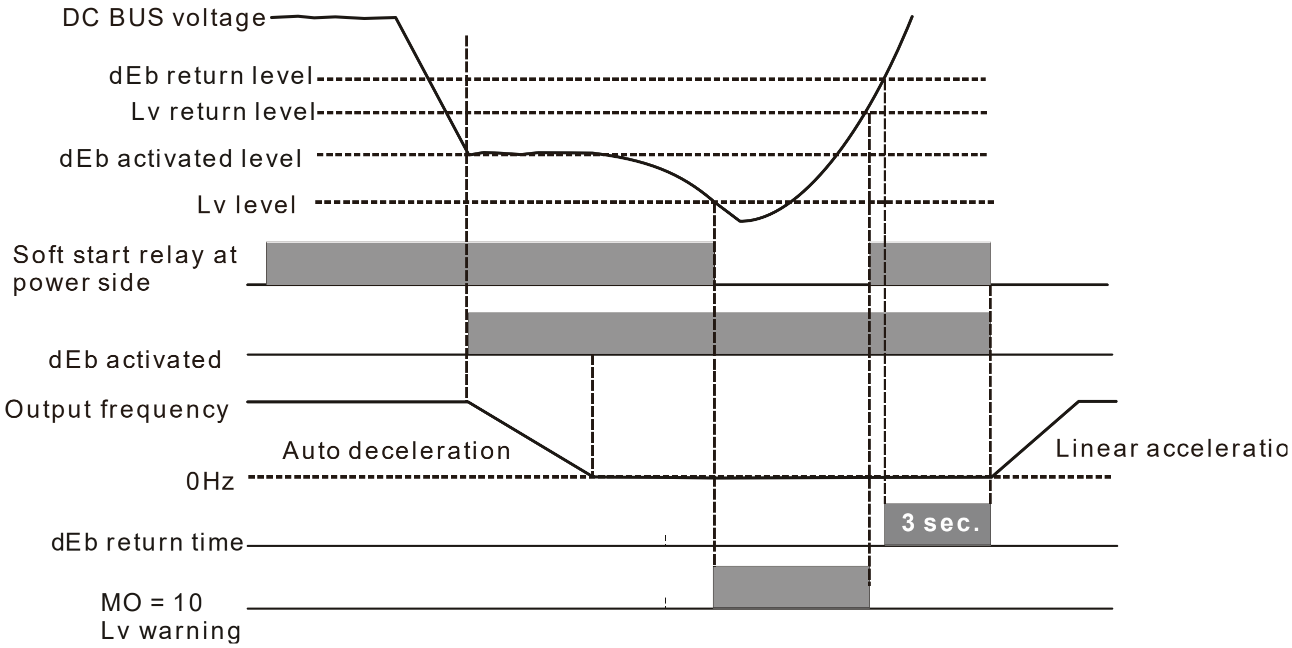
  Pr.07-13 = 2 and power does not recover.

  The drive decelerates to 0 Hz. The DC BUS voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The keypad displays "dEb" warning until the drive completely runs out of power.

- **Situation 5:**

  Pr.07-13 = 2 and power recovers after the DC BUS voltage is lower than the Lv level.

  The drive decelerates to 0 Hz. The DC BUS voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The soft start relay closes again after the power recovers and the DC BUS voltage is higher than the Lv return level. When the DC BUS voltage is higher than the dEb return level, the drive maintains the frequency for three seconds and starts to accelerate linearly, and the dEb warning on the keypad clears automatically.



07-15 Dwell Time at Acceleration

Default: 0.00

Settings 0.00–600.00 sec.

07-17 Dwell Time at Deceleration

Default: 0.00

Settings 0.00–600.00 sec.

07-16 Dwell Frequency at Acceleration

Default: 0.00

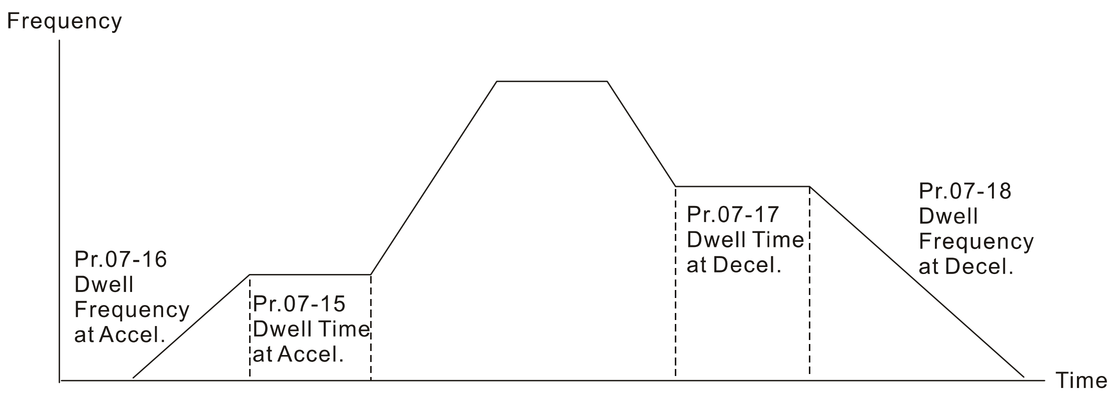
Settings 0.00–299.00 Hz

07-18 Dwell Frequency at Deceleration

Default: 0.00

Settings 0.00–299.00 Hz

- The Dwell temporarily maintains stable output frequency. Use this parameter for cranes, elevators, and so on.
- When the load is heavier, use Pr.07-15–Pr.07-18 to avoid ov or oc protection.



Dwell at acceleration / deceleration

07-19 Fan Cooling Control

Default: 3

Settings 0: Fan is always ON
1: Fan is OFF after the AC motor drive stops for one minute.
2: Fan is ON when AC motor drive runs; fan is OFF when AC motor drive stops.
3: Fan turns ON when the temperature (IGBT) reaches around 60°C

- Use this parameter to control the fan.
- 0: Fan runs immediately when the drive power is turned ON.
- 1: Fan runs when AC motor drive runs. One minute after AC motor drive stops, the fan is OFF.
- 2: Fan runs when AC motor drive runs and stops immediately when AC motor drive stops.
- 3: Fan is ON when the IGBT or capacitance temperature is higher than 60°C.
  Fan is OFF when the the IGBT and capacitance temperature are both lower than 40°C, and the drive stops running.

07-20 Deceleration of Emergency or Forced Stop

Default: 0

Settings 0: Coast to stop
1: Stop by the 1st deceleration time
2: Stop by the 2nd deceleration time
3: Stop by the 3rd deceleration time
4: Stop by the 4th deceleration time
5: System deceleration
6: Automatic deceleration

- When the multi-function input terminal is set to EF input (setting 10) or forced to stop (setting 18) and the terminal contact is ON, the drive stops according to the setting of this parameter.

07-21 Automatic Energy-saving Setting

Default: 0

Settings 0: Disable
1: Enable

- When energy-saving is enabled, the motor acceleration operates with full voltage. During constant speed operation, it automatically calculates the best voltage value according to the load power. This function is not suitable for fluctuating loads or loads which are nearly full during operation.
- When the output frequency is constant (that is, constant operation), the output voltage decreases automatically as the load decreases. Therefore, the drive operates with minimum multiplication of voltage and current (electric power).

07-22 Energy-saving Gain

Default: 100

Settings 10–1000%

- When Pr.07-21 is set to 1, use this parameter to adjust the energy-saving gain. The default is

100%. If the result is not satisfactory, adjust it by decreasing the setting value. If the motor oscillates, then increase the setting value.

- In certain applications such as high speed spindles, the temperature rise in the motor is a major concern. When the motor is not in working state, reduce the motor current to a lower level. Reduce this parameter setting to meet this requirement.

07-23 Automatic Voltage Regulation (AVR) Function

Default: 0

Settings 0: Enable AVR
1: Disable AVR
2: Disable AVR during deceleration

- The rated voltage of a 220V motor is usually AC 200 V, 60 Hz / 50 Hz, and the input voltage of the AC motor drive may vary from AC 180 V to 264 V, 50 Hz / 60 Hz. Therefore, when the AC motor drive is used without the AVR function, the output voltage is the same as the input voltage. When the motor runs at the voltage exceeding 12%–20% of the rated voltage, it causes higher temperatures, damaged insulation, and unstable torque output, which result in losses due to shorter motor lifetime.
- The AVR function automatically regulates the output voltage of the AC motor drive to the motor rated voltage. For example, if the V/F curve is set at AC 200 V, 50 Hz and the input voltage is at AC 200–264 V, then the drive automatically reduces the output voltage to the motor to a maximum of AC 200 V, 50 Hz. If the input voltage is at AC 180–200 V, the output voltage to motor and input power are in direct proportion.
- 0: When the AVR function is enabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage does NOT change when the DC bus voltage changes.
- 1: When the AVR function is disabled, the drive calculates the output voltage according to the actual DC bus voltage. The DC bus voltage changes the output voltage and may cause insufficient or over-current or shock.
- 2: The drive disables the AVR function when decelerating to stop and may accelerate to brake.
- When the motor ramps to stop, the deceleration time is shorter when setting this parameter to 2 with auto-acceleration and deceleration, and the deceleration is quicker and more stable.

07-24 Torque Command Filter Time (V/F and SVC Control Mode)

Default: 0.050

Settings 0.001–10.000 sec.

- When the setting is too long, the control is stable, but the control response is delayed. When the setting is too short, the response is quicker, but the control may be unstable. Adjust the setting according to the stability of the control and response times.

07-25 Slip Compensation Filter Time (V/F and SVC Control Mode)

Default: 0.100

Settings 0.001–10.000 sec.

- Change the compensation response time with Pr.07-24 and Pr.07-25.

- If you set Pr.07-24 and Pr.07-25 to 10 seconds, the compensation response time is the slowest; however, the system may be unstable if you set the time too short.

✎ 07-26 Torque Compensation Gain

Default: 1

Settings IM: 0–10 (when Pr.05-33 = 0)

- With a large motor load, a part of drive output voltage is absorbed by the stator winding resistor; therefore, the air gap magnetic field is insufficient. This causes insufficient voltage at motor induction and results in excessive output current but insufficient output torque. Auto-torque compensation can automatically adjust the output voltage according to the load and keep the air gap magnetic fields stable to get the optimal operation.
- In the V/F control, the voltage decreases in direct proportion with decreasing frequency. It reduces the torque decrease at low speed due to the AC while the DC resistor is unchanged. The auto-torque compensation function increases the output voltage at low frequency to get a higher starting torque.
- When the compensation gain is set too high, it may cause motor over-flux and result in a too large output current, overheating the motor or triggering the protection function.

✎ 07-27 Slip Compensation Gain (V/F and SVC Control Mode)

Default: 0.00

(Default value is 1 in SVC mode)

Settings 0.00–10.00

- The induction motor needs constant slip to produce magnetic torque. It can be ignored at higher motor speeds, such as rated speed or 2–3 % of slip.
- In operation, the slip and the synchronous frequency are in reverse proportion to produce the same magnetic torque. The slip is larger with the reduction of the synchronous frequency. The motor may stop when the synchronous frequency decreases to a specific value. Therefore, the slip seriously affects the motor speed accuracy at low speed.
- In another situation, when you use an induction motor with the drive, the slip increases when the load increases. It also affects the motor speed accuracy.
- Use this parameter to set the compensation frequency, and reduce the slip to maintain the synchronous speed when the motor runs at the rated current in order to improve the accuracy of the drive. When the drive output current is higher than Pr.05-05 (No-load Current of Induction Motor 1 (A)), the drive compensates the frequency with this parameter.
- This parameter is set to 1.00 automatically when Pr.00-11 (Speed Control Method) is changed from V/F mode to vector mode. Apply the slip compensation after load and acceleration. Increase the compensation value from small to large gradually; add the output frequency with motor rated slip x Pr.07-27 (Slip Compensation Gain) when the motor is at the rated load. If the actual speed ratio is slower than expected, increase the parameter setting value; otherwise, decrease the setting value.

✓ 07-29 Slip Deviation Level

Default: 0

Settings 0.0–100.0%

0: No detection

✓ 07-30 Slip Deviation Detection Time

Default: 1.0

Settings 0.0–10.0 sec.

✓ 07-31 Slip Deviation Action

Default: 0

Settings 0: Warn and continue operation

1: Fault and ramp to stop

2: Fault and coast to stop

3: No warning

- Parameters Pr.07-29–Pr.07-31 set the allowable slip level/time and the over-slip action when the drive is running.

✓ 07-32 Motor Shock Compensation Factor

Default: 1000

Settings 0–10000

- If there are current wave motions in the motor in some specific area, setting this parameter can effectively improve this situation.

✓ 07-33 Auto-restart Interval of Fault

Default: 60.0

Settings 0.0–6000.0 sec.

- When a reset / restart occurs after a fault, the drive uses Pr.07-33 as a timer and starts counting the number of faults within this time period. Within this period, if the number of faults does not exceed the setting for Pr.07-11, the counting clears and starts from 0 when the next fault occurs.

✓ 07-34 Slip Compensation Gain % (Power Generation Mode)

07-35 Slip Compensation Gain % (Electricity Mode)

Default: 0.0

Settings 0.0–100.0 %

- In V/F mode, you do not have to set Pr.07-27. You can set Pr.07-34 and Pr.07-35 directly according to different compensation needs for power generation mode and electricity mode.
- In SVC mode, you must set Pr.07-27 first, and then set Pr.07-34 and Pr.07-35 according to different compensation needs for power generation mode and electricity mode.
- In V/F mode, multiply the result from dividing the output current and rated current by the slip level, and then multiply this result by the percentage of Pr.07-34 and Pr.07-35 again to gain the slip level. In SVC mode, multiply the slip compensation generating from parameters for motor winding, output current, rated current and no-load current by the percentage of Pr.07-34 and Pr.07-35 to gain the slip compensation level.

📖 Related parameters:

- Pr.05-05 No-load Current for an Induction Motor (A)
- Pr.07-27 Slip Compensation Gain

✎ 07-36 Maximum Slip Frequency

Default: 0.00

Settings 0.00–200.0 Hz

📖 Limits the upper limits for the slip.

📖 If the settings for this parameter are too high, the feedback error malfunctions.

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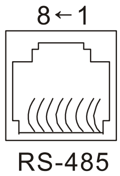
09 Communication Parameters

When using the communication interface, the diagram on the right shows the communication port pin definitions. We recommend that you connect the AC motor drive to your PC by using Delta IFD6530 or IFD6500 as a communication converter.



Modbus RS-485
PIN 1: CAN_H
PIN 2: CAN_L
PIN 3, 7: SGND
PIN 4: SG-
PIN 5: SG+
PIN 6: Reserved
PIN 8: +10VS

✔ You can set this parameter during operation.

✔ 09-00 Communication Address

Default: 1

Settings 1–254

- If RS-485 serial communication controls the AC motor drive, you must set the communication address for this drive in this parameter. Each AC motor drive's communication address must be different.

✔ 09-01 COM1 Transmission Speed

Default: 9.6

Settings 4.8–115.2 Kbps

- Sets the transmission speed of the computer and the drive.
- Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, 57.6 Kbps, or 115.2 Kbps; otherwise, the transmission speed is set to the default 9.6 Kbps.

✔ 09-02 COM1 Transmission Fault Treatment

Default: 3

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: No warning, no fault, and continue operation

- Sets the response for Modbus communication errors in with the host. Set the detection time in Pr.09-03.
- When a transmission error occurs (for example, the error code CE10 is displayed), the error remains even if the transmission status returns to normal and does not clear automatically. In this case, set a reset command (Reset) to clear the error.

✔ 09-03 COM1 Time-out Detection

Default: 0.0

Settings 0.0–100.0 sec.

- Sets the communication time-out.

09-04 COM1 Communication Protocol

Default: 1

Settings
1: 7, N, 2 (ASCII)
2: 7, E, 1 (ASCII)
3: 7, O, 1 (ASCII)
4: 7, E, 2 (ASCII)
5: 7, O, 2 (ASCII)
6: 8, N, 1 (ASCII)
7: 8, N, 2 (ASCII)
8: 8, E, 1 (ASCII)
9: 8, O, 1 (ASCII)
10: 8, E, 2 (ASCII)
11: 8, O, 2 (ASCII)
12: 8, N, 1 (RTU)
13: 8, N, 2 (RTU)
14: 8, E, 1 (RTU)
15: 8, O, 1 (RTU)
16: 8, E, 2 (RTU)
17: 8, O, 2 (RTU)

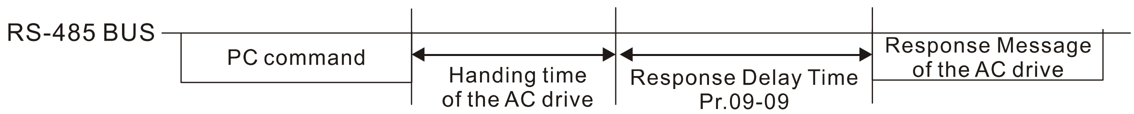
- Control by PC (Computer Link)
  When using the RS-485 serial communication interface, you must specify each drive's communication address in Pr.09-00. The computer then implements control using the drives' individual addresses.
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters.

09-09 Communication Response Delay Time

Default: 2.0

Settings 0.0–200.0 ms

- Sets the response delay time after the AC motor drive receives a communication command as shown in the following.



09-36 CANopen Slave Address

Default: 2

Settings
0: Disable
1–127

09-37 CANopen Speed

Default: 0

Settings 0: 1 Mbps

1: 500 kbps
2: 250 kbps
3: 125 kbps
4: 100 kbps (Delta only)
5: 50 kbps

09-39 CANopen Warning Record

Default: 0

Settings bit 0: CANopen software disconnection 1 (CANopen Guarding Time-out)
bit 1: CANopen software disconnection 2 (CANopen Heartbeat Time-out)
bit 3: CANopen SDO time-out
bit 4: CANopen SDO buffer overflow
bit 5: CANopen hardware disconnection warning (Can Bus OFF)
bit 6: Error protocol for CANopen

09-40 CANopen Decoding Method

Default: 1

Settings 0: Use Delta-defined decoding method
1: Use CANopen Standard DS402 protocol

09-41 CANopen Communication Status

Default: Read Only

Settings 0: Node Reset State
1: Com Reset State
2: Boot up State
3: Pre-operation State
4: Operation State
5: Stop State

09-42 CANopen Control Status

Default: Read Only

Settings 0: Not ready for use state
1: Inhibit start state
2: Ready to switch on state
3: Switched on state
4: Enable operation state
7: Quick stop active state
13: Error reaction activation state
14: Error state

09-43 CANopen Reset Index

Default: 65535

Settings bit 0: CANopen reset, the internal address 20XX is 0
bit 1: CANopen reset, the internal address 264X is 0
bit 2: CANopen reset, the internal address 26AX is 0
bit 3: CANopen reset, the internal address 60XX is 0

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10 Speed Feedback Control Parameters

✎ You can set this parameter during operation.

10-00 Encoder Type Selection

Default: 0

Settings 0: Disable

5. Pulse input (MI7)

- When you use MI7 single-phase pulse input as speed feedback, you must use it with Pr.10-00 =5 and Pr.10-02 = 5. The drive calculates the MI7 single-phase pulse input speed when the control modes are VF, VFPG, SVC.
- When you use MI6 and MI7 two-phase pulse input as speed feedback, you must use them with Pr.10-00 = 5 and Pr.10-02 = 1–4. The drive calculates the MI6 and MI7 two-phase pulse input speed when the control modes are VF, VFPG, SVC.

10-01 Encoder Pulses per Revolution

Default: 600

Settings 1–20000

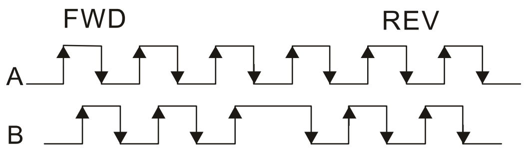
- This parameter sets the encoder pulses per revolution (ppr). It is a feedback control signal source when using PG. The encoder sets the number of pulses for the motor rotating through one rotation. The A / B phase cycle generates the pulse number.
- This setting is also the encoder resolution. The speed control is more accurate with higher resolution.

10-02 Encoder Input Type Setting

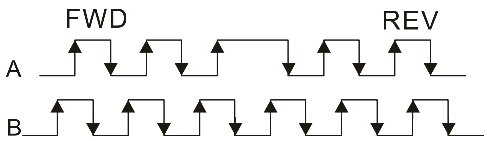
Default: 0

Settings 0: Disable

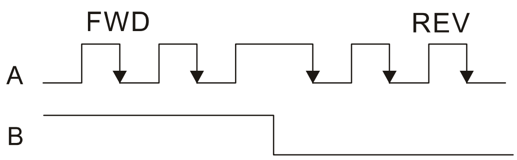
1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees.



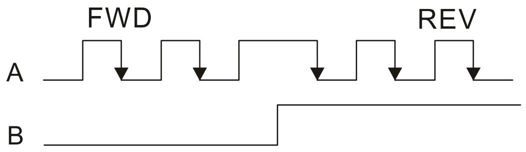
2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees.



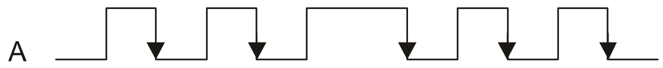
3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction).



4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction).



5: Single-phase input (MI7)



NOTE:

1: When the MH300-L inputs the A / B phase pulse, you must connect the MI6 terminal to the A-phase pulse, and the MI7 terminal to the B-phase pulse.

2: When the MH300-L uses single-phase input, it disables the MI6 function and prohibits any signal connection.

11 Advanced Parameters

In this parameter group, ASR stands for Adjust Speed Regulator.

⚡ You can set this parameter during operation.

⚡ 11-06 ASR1 Gain

Default: 10

Settings 0–100 Hz

⚡ 11-07 ASR1 Integral Time

Default: 0.100

Settings 0.000–10.000 sec.

11-41 PWM Mode Selection

Default: 0

Settings 0: Two-phase

2: Space vector

- Two-phase mode: effectively reduces the drive power components losses and provides better performance in long wire applications.
- Space vector mode: effectively reduces the power loss and electromagnetic noise of the motor.

⚡ 11-42 System Control Flag

Default: 0000

Settings 0000–FFFFh

bit No.	Function	Description
0	Reserved	
1	FWD / REV action control	0: FWD / REV cannot be controlled by Pr.02-12 bit 0 & 1. 1: FWD / REV can be controlled by Pr.02-12 bit 0 & 1.

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Chapter 13 Warning Codes

KPMH-LC01 digital keypad

ID No.	Display	Descriptions
1	CE1	Modbus function code error (illegal function code) Corrective Actions ■ Check if the function code is correct. (function code must be 03, 06, 10, 63)
2	CE2	Modbus data address error (illegal data address (00 H to 254 H)) Corrective Actions ■ Check if the communication address is correct.
3	CE3	Modbus data error (illegal data value) Corrective Actions ■ Check if the data value exceeds the maximum or minimum value.
4	CE4	Modbus communication error (data is written to read-only address) Corrective Actions ■ Check if the communication address is correct.
5	CE10	Modbus transmission time-out
6	CP10	Keypad transmission time-out
7	SE1	Keypad COPY error 1 Keypad simulation error: includes communication delays, communication error (keypad received error FF86) and parameter value error.
8	SE2	Keypad COPY error 2 Keypad simulation done: parameter write error.

<table>
<tr><th>ID No.</th><th>Display</th><th>Descriptions</th></tr>
<tr><td>9</td><td>oH1</td><td>IGBT is over-heated above protection level 3~10 HP: 90°C
<table>
<tr><td>Frame</td><td>MH300-L</td><td>OH1</td></tr>
<tr><td>C</td><td>VFD11AMH23ANSLA</td><td>100</td></tr>
<tr><td>C</td><td>VFD17AMH23ANSLA</td><td rowspan="2">105</td></tr>
<tr><td>D</td><td>VFD25AMH23ANSLA</td></tr>
<tr><td>E</td><td>VFD33AMH23ANSLA</td><td rowspan="3">115</td></tr>
<tr><td>E</td><td>VFD49AMH23ANSLA</td></tr>
<tr><td>F</td><td>VFD65AMH23ANSLA</td></tr>
<tr><td>C</td><td>VFD9A0MH43ANSLA</td><td rowspan="2">115</td></tr>
<tr><td>C</td><td>VFD9A0MH43AFSLA</td></tr>
<tr><td>D</td><td>VFD13AMH43ANSLA</td><td rowspan="2">105</td></tr>
<tr><td>D</td><td>VFD13AMH43AFSLA</td></tr>
<tr><td>D</td><td>VFD17AMH43ANSLA</td><td rowspan="2">110</td></tr>
<tr><td>D</td><td>VFD17AMH43AFSLA</td></tr>
<tr><td>E</td><td>VFD25AMH43ANSLA</td><td rowspan="4">115</td></tr>
<tr><td>E</td><td>VFD25AMH43AFSLA</td></tr>
<tr><td>E</td><td>VFD32AMH43ANSLA</td></tr>
<tr><td>E</td><td>VFD32AMH43AFSLA</td></tr>
</table>
Corrective Actions
■ Ensure that the ambient temperature falls within the specified temperature range.
■ Make sure the ventilation holes are not obstructed.
■ Remove any foreign objects from the heat sink and check for possible dirt in the heat sink.
■ Check the fan and clean it.
■ Provide enough space for adequate ventilation.</td></tr>
<tr><td>12</td><td>AnL</td><td>ACI signal loss when Pr.03-19 is set to 1 or 2.</td></tr>
<tr><td>13</td><td>uC</td><td>Low current</td></tr>
<tr><td>14</td><td>AUE</td><td>Motor parameters auto-tuning error
Corrective Actions
■ Verify that the motor wiring is correct.
■ Verify that the motor capacity and parameters are correct.</td></tr>
<tr><td>19</td><td>PHL</td><td>Input phase loss</td></tr>
</table>

ID No.	Display	Descriptions
20	ot1	When the output current exceeds the over-torque detection level (Pr.06-07) and also exceeds Pr.06-08; when Pr.06-06 is set as 1 or 3, the keypad displays a warning without an error record; when Pr.06-06 is set as 2 or 4, it displays an error, stops running and displays an error record. Corrective Actions ■ Check if the motor is overloaded. ■ Verify that the motor rated current in Pr.05-01 is correct. ■ Increase the motor capacity.
22	oH3	Motor over-heating
24	oSL	Over-slip
25	tUn	Auto tuning processing
28	OPHL	Output phase loss
30	SE3	Keypad COPY error 3 Keypad copy between different power range drives
89	MPHL	Motor output phase loss Corrective Actions ■ Unbalanced three-phase impedance of the motor. Replace the motor. ■ Check if the motor wiring is incorrect. ■ Check if a single-phase motor is used. ■ Check if the current sensor is broken. ■ Check if temporary power supply is used or any grounding fault. ■ Make sure the capacity of the drive matches the motor. ■ Any abnormal motor current spikes or drops may trigger MPHL.

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Chapter 14 Error Codes

KPMH-LC01 digital keypad

* Refer to settings for Pr.06-17–Pr.06-22.

ID No.	Display	Descriptions
1	ocA	Over-current during acceleration (output current exceeds triple the rated current during acceleration). Corrective Actions ■ Short-circuit at motor output: check for possible poor insulation at the output. ■ Acceleration time is too short: increase acceleration time. ■ AC motor drive output power is too low: replace the AC motor drive with a higher power model.
2	ocd	Over-current during deceleration (output current exceeds triple the rated current during deceleration). Corrective Actions ■ Short-circuit at motor output: check for possible poor insulation at the output. ■ Deceleration time is too short: increase the deceleration time. ■ AC motor drive output power is too low: replace the AC motor drive with a higher power model.
3	ocn	Over-current during steady operation (output current exceeds triple the rated current during constant speed). Corrective Actions ■ Short-circuit at motor output: check for possible poor insulation at the output. ■ AC motor drive output power is too low: replace the AC motor drive with a higher power model.

ID No.	Display	Descriptions
4	GFF	Ground fault. When one of the output terminal(s) is grounded, the short circuit current is more than 50% of the AC motor drive rated current. NOTE: the short circuit protection is provided for the AC motor drive protection, not to protect you. Corrective Actions ■ Check the wiring connections between the AC motor drive and the motor for possible short circuits, as well as the connections to ground. ■ Check whether the IGBT power module is damaged. ■ Check for possible poor insulation at the output.
6	ocS	Over-current at stop. Hardware failure in current detection. Corrective Actions ■ Return the unit to the default.
7	ovA	DC BUS over-voltage during acceleration (230V: 450 V_{DC}; 460V: 900 V_{DC}) Corrective Actions ■ Check if the input voltage spiked above the rated AC motor drive input voltage range. ■ Check for possible voltage transients. ■ If the DC BUS is over-voltage due to the regenerative voltage, increase the acceleration time or add an optional brake resistor.
8	ovd	DC BUS over-voltage during deceleration (230V: 450 V_{DC}; 460V: 900 V_{DC}) Corrective Actions ■ Check if the input voltage spiked above the rated AC motor drive input voltage range. ■ Check for possible voltage transients. ■ If the DC BUS is over-voltage due to regenerative voltage, increase the deceleration time or add an optional brake resistor.
9	ovn	DC BUS over-voltage at constant speed (230V: 450 V_{DC}; 460V: 900 V_{DC}) Corrective Actions ■ Check if the input voltage spiked above the rated AC motor drive input voltage range. ■ Check for possible voltage transients.
10	ovS	Over-voltage at stop. Hardware failure in voltage detection. Corrective Actions ■ Check if the input voltage spiked above the rated AC motor drive input voltage range. ■ Check for possible voltage transients.

ID No.	Display	Descriptions
11	LvA	DC BUS voltage is less than Pr.06-00 during acceleration. Corrective Actions ■ Check if the input voltage is normal. ■ Check for possible sudden changes in load. ■ Check the setting of Pr.06-00.
12	Lvd	DC BUS voltage is less than Pr.06-00 during deceleration. Corrective Actions ■ Check if the input voltage is normal. ■ Check for possible sudden changes in load. ■ Check the setting of Pr.06-00.
13	Lvn	DC BUS voltage is less than Pr.06-00 at constant speed. Corrective Actions ■ Check if the input voltage is normal. ■ Check for possible sudden changes in load. ■ Check the setting of Pr.06-00.
14	LvS	DC BUS voltage is less than Pr.06-00 at stop. Corrective Actions ■ Check if the input voltage is normal. ■ Check for possible sudden changes in load. ■ Check the setting of Pr.06-00.
15	orP	Phase loss protection Corrective Actions ■ Check if there is any phase loss in the three-phase model or in the one-phase input application.
16	oH1	IGBT is overheated above the protection level. Corrective Actions ■ Ensure that the ambient temperature falls within the specified temperature range. ■ Make sure the ventilation holes are not obstructed. ■ Remove any foreign objects from the heat sink and check for possible dirt in the heat sink. ■ Check the fan and clean it. ■ Provide enough space for adequate ventilation.
18	tH1o	IGBT Hardware Error Corrective Actions ■ Return the unit to the default.
21	oL	Overload; the AC motor drive detects excessive drive output current. Corrective Actions ■ Check if the motor is overloaded. ■ Change to the next power level with a higher value for the AC motor drive model.

ID No.	Display	Descriptions
22	EoL1	Electronic thermal relay 1 protection Corrective Actions ■ Check the setting of the electronic thermal relay (Pr.06-14). ■ Change to the next power level with a higher value for the motor model.
26	ot1	When the output current exceeds the over-torque detection level (Pr.06-07) and also exceeds Pr.06-08; when Pr.06-06 is set as 1 or 3, the keypad displays a warning without an error record; when Pr.06-06 is set as 2 or 4, it displays an error, stops running, and displays an error record. Corrective Actions ■ Check if the motor is overloaded. ■ Verify that the motor rated current in Pr.05-01 is correct. ■ Increase the motor capacity.
28	uC	Low current detection. Corrective Actions ■ Check Pr. 06-71, Pr. 06-72, Pr. 06-73.
31	cF2	Cannot read internal EEPROM. Corrective Actions ■ Press the RESET key to reset to the default. ■ If the fault code still displays on the keypad, return the unit to the default.
33	cd1	U-phase current error Corrective Actions ■ Cycle the power to the drive. ■ If the fault code still displays on the keypad, return the unit to the default.
34	cd2	V-phase current error Corrective Actions ■ Cycle the power to the drive. ■ If the fault code still displays on the keypad, return the unit to the default.
35	cd3	W-phase current error Corrective Actions ■ Cycle the power to the drive. ■ If the fault code still displays on the keypad, return the unit to the default
36	Hd0	CC (current clamp) hardware error Corrective Actions ■ Cycle the power. ■ If the fault code still displays on the keypad, return the unit to the default.
37	Hd1	OC hardware error Corrective Actions ■ Cycle the power. ■ If the fault code still displays on the keypad, return the unit to the default.

ID No.	Display	Descriptions
40	AUE	Motor parameters auto-tuning error Corrective Actions ■ Verify that the motor wiring is correct. ■ Verify that the motor capacity and parameters are correct. ■ Try auto-tuning again.
48	ACE	ACI loss Corrective Actions ■ Check the wiring for ACI. ■ Check if the ACI signal is less than 4 mA.
49	EF	External Fault: when the multi-function input terminal (EF) is active, the AC motor drive stops output. Corrective Actions ■ Press the RESET key after you clear the fault.
50	EF1	Emergency stop: when the multi-function input terminal (EF1) is active, the AC motor drive stops output. Corrective Actions ■ Press the RESET key after you clear the fault.
51	bb	External Base Block: when the multi-function input terminal (B.B.) is active, the AC motor drive stops output. Corrective Actions ■ Deactivate the external input terminal (B.B.) to operate the AC motor drive again.
52	Pcod	Keypad is locked after you enter the wrong password three times. Corrective Actions ■ Refer to Pr.00-07 and Pr.00-08. ■ Cycle the power, and then enter the correct password.
54	CE1	Modbus function code error (illegal function code) Corrective Actions ■ Check if the function code is correct (function code must be 03, 06, 10, 63).
55	CE2	Modbus data address error (illegal data address 00 H–254 H) Corrective Actions ■ Check if the data address is correct.
56	CE3	Modbus data error (illegal data value) Corrective Actions ■ Check if the data value exceeds the maximum or minimum value.
57	CE4	Modbus communication error (data is written to read-only address) Corrective Actions ■ Check if the communication address is correct.

ID No.	Display	Descriptions
58	CE10	Modbus transmission time-out Corrective Actions ■ Check if the host controller transmits the communication command within the setting time (Pr.09-03). ■ Check the communication wiring and grounding. Use a 90-degree wiring layout or separation from main circuit to prevent interference. ■ Check that the setting for Pr.09-02 is the same as the host controller. ■ Check the condition of the communication cable or replace with a new cable.
59	CP10	Keypad transmission time-out
61	Ydc	Y-connection / Δ-connection switch error Corrective Actions ■ Check the wiring of the Y-connection / Δ-connection. ■ Check the parameter settings.
62	dEb	Pr.07-13 is not set to 0 and there is a momentary power off or power cut. The keypad displays dEb during acceleration or deceleration to stop. Corrective Actions ■ Set Pr.07-13 to 0. ■ Check if the input power is stable.
63	oSL	Motor slip exceeds Pr.07-29 setting and exceeds Pr.07-30 time setting. Corrective Actions ■ Check if the motor parameter is correct and decrease the load if overloaded. ■ Check the settings for Pr.07-29 and Pr.07-30.
71	MBF2	Mechanical brake error 2 Corrective Actions ■ Check if the mechanical brake signal is correct. ■ Check if the detection time setting of mechanical brake (Pr.02-33) is correct.
72	STL1	S1–DCM internal loop detection error Corrective Actions ■ Check the wiring of the S1 terminal. ■ Reset the emergency switch (ON: activated) and cycle the power. ■ Check that the input voltage maintains at least 11 V. ■ Check the wiring of the S1 and +24 V terminals. ■ After you make sure all the wiring is correct, if STL1 fault still exists after cycling the power, please contact Delta.

ID No.	Display	Descriptions
74	MCF	Magnetic contactor error Corrective Actions ■ Check if the signal of magnetic contactor is correct. ■ Check if the setting of Pr.02-32 is correct.
75	MBF	Mechanical brake error Corrective Actions ■ Check if the mechanical brake signal is correct. ■ Check if the detection time setting of mechanical brake (Pr.02-33) is correct.
76	STo	Safe Torque Off function active Corrective Actions ■ Check the wiring of the S1 and S2 terminals. ■ Reset the emergency switch (ON: activated) and cycle the power. ■ Check that the input voltage maintains at least 11 V. ■ Check the wiring of the S1 / S2 and +24 V terminals. ■ After you make sure all the wiring is correct, if STO fault still exists after cycling the power, please contact Delta.
77	STL2	S2–DCM internal loop detection error Corrective Actions ■ Check the wiring of the S2 terminal. ■ Reset the emergency switch (ON: activated) and cycle the power. ■ Check that the input voltage maintains at least 11 V. ■ Check the wiring of the S2 and +24 V terminals. ■ After you make sure all the wiring is correct, if STL2 fault still exists after cycling the power, please contact Delta.
78	STL3	S1–DCM & S2–DCM internal loop detection error Corrective Actions ■ After you make sure all the wiring is correct, if STL3 fault still exists after cycling the power, please contact Delta.
79	Aoc	U-phase short circuit
80	boc	V-phase short circuit
81	coc	W-phase short circuit

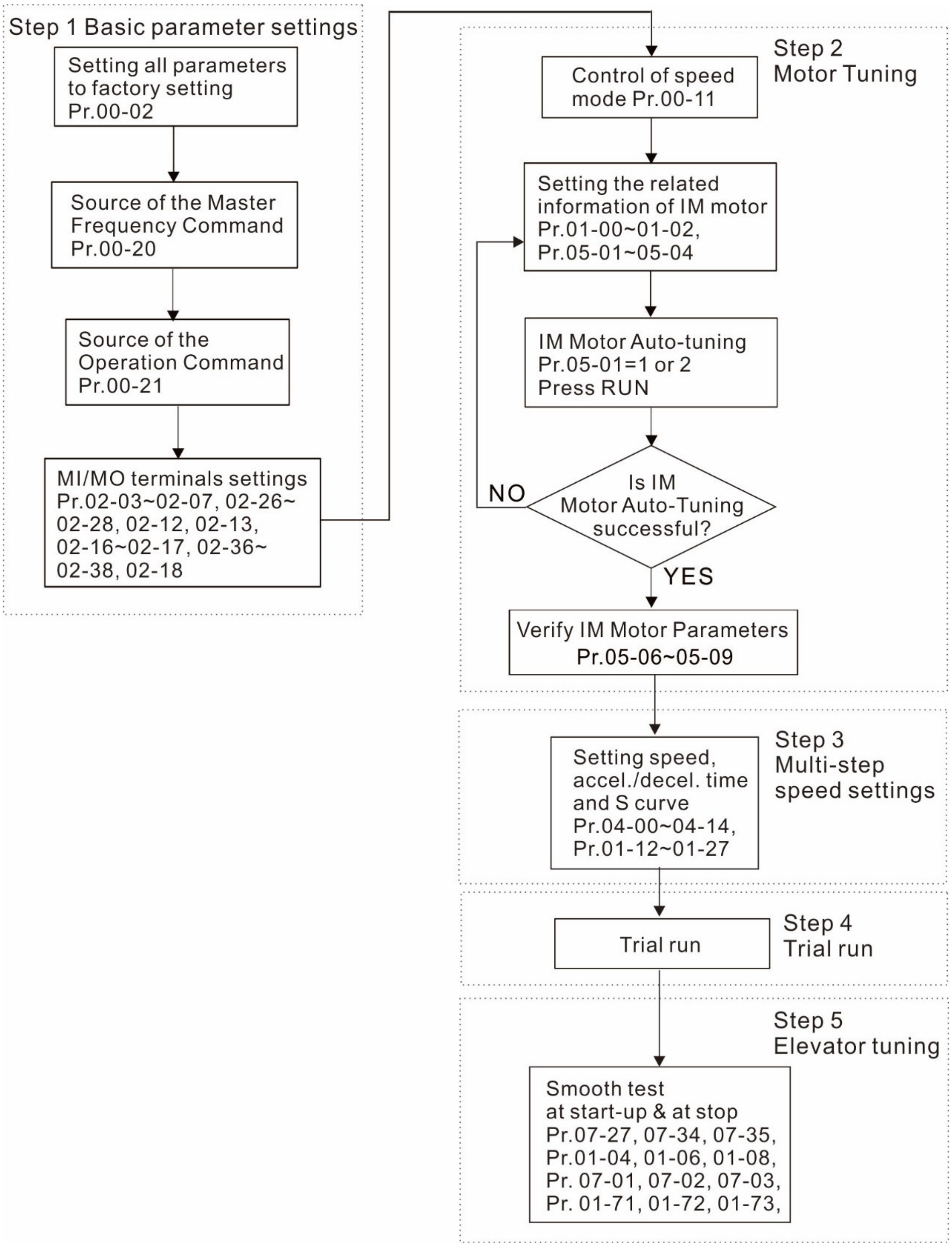
ID No.	Display	Descriptions
82	oPL1	Output phase loss 1 (Phase U) Output phase loss 2 (Phase V) Output phase loss 3 (Phase W) Corrective Actions ■ Check the motor internal wiring and change the motor if there is still an error. ■ Check the cable condition. ■ Choose a three-phase motor, and make sure the capacity of the drive and motor match. ■ Check the control board cable. ■ Verify that the three-phase current is balanced. If it is balanced and the OPHL fault still exists, return the unit to the default.
83	oPL2	
84	oPL3	
87	oL3	Over-load protection at low frequency
91	MPHL	Motor output phase loss Corrective Actions ■ Unbalanced three-phase impedance of the motor. Replace the motor. ■ Check if the motor wiring is incorrect. ■ Check if a single-phase motor is used. ■ Check if the current sensor is broken. ■ Check if temporary power supply is used or any grounding fault. ■ Make sure the capacity of the drive matches the motor. ■ Any abnormal motor current spikes or drops may trigger MPHL.
101	CGdE	CANopen guarding error Corrective Actions ■ Increase the guarding time (Index 100C). ■ Check the communication wiring and grounding. Use a 90-degree wiring layout or separation from the main circuit to prevent interference. ■ Make sure the communication wiring is serial. ■ Use a dedicated CANopen cable and install a terminating resistor. ■ Check the condition of the communication cable or replace with a new cable.
102	CHbE	CANopen heartbeat error Corrective Actions ■ Increase the Heartbeat time (Index 1016). ■ Check the communication wiring and grounding. Use a 90-degree wiring layout or separation from the main circuit to prevent interference. ■ Make sure the communication wiring is serial. ■ Use a dedicated CANopen cable and install a terminating resistor. ■ Check the condition of the communication cable or replace with a new cable.

ID No.	Display	Descriptions
104	CbFE	CANopen bus off error Corrective Actions ■ Re-install the CANopen card. ■ Check the communication wiring and grounding. Use a 90-degree wiring layout or separation from the main circuit to prevent interference. ■ Make sure the communication wiring is serial. ■ Use a dedicated CANopen cable and install a terminating resistor. ■ Check the condition of the communication cable or replace with a new cable.
105	CIdE	CANopen index error Corrective Actions ■ Reset the CANopen index (Pr.00-02 = 7).
106	CAdE	CANopen station address error Corrective Actions ■ Disable CANopen (Pr.09-36 = 0). ■ Reset the CANopen setting (Pr.00-02 = 7). ■ Reset the station address (Pr.09-36).
107	CFrE	CANopen memory error Corrective Actions ■ Disable CANopen (Pr.09-36 = 0). ■ Reset the CANopen setting (Pr.00-02 = 7). ■ Reset the station address (Pr.09-36).
111	ictE	InnerCOM time-out failure
121	CP20	Internal communication error Corrective Actions ■ If the fault still appears after pressing RESET, return the unit to the default.
123	CP22	Internal communication error Corrective Actions ■ If the fault still appears after pressing RESET, return the unit to the default.
124	CP30	Internal communication error Corrective Actions ■ If the fault still appears after pressing RESET, return the unit to the default.
126	CP32	Internal communication error Corrective Actions ■ If the fault still appears after pressing RESET, return the unit to the default.
127	CP33	Firmware version error
140	Hd6	GFF detected at power on

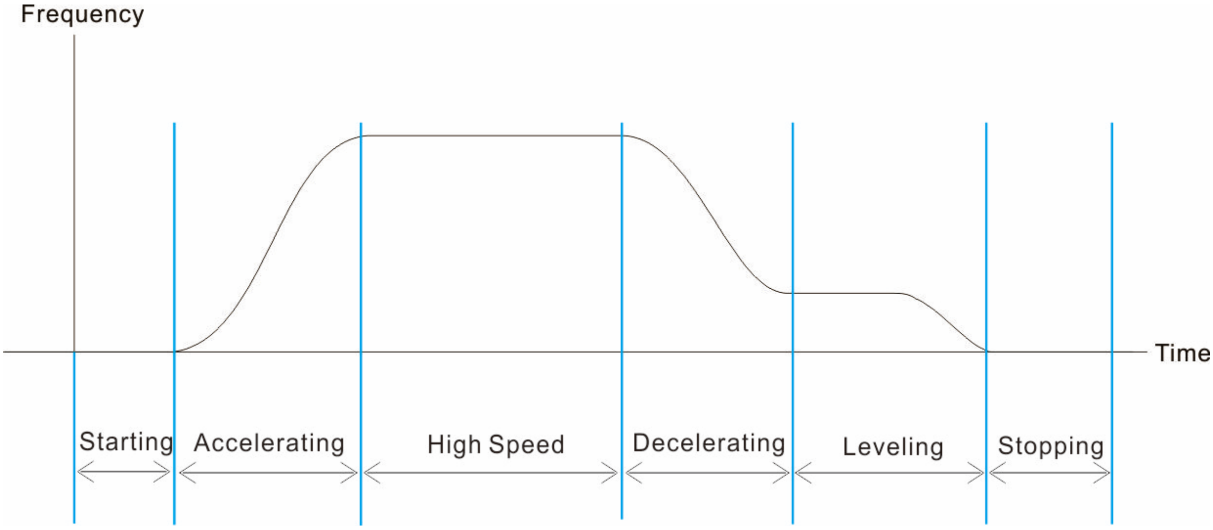
ID No.	Display	Descriptions
141	b4GFF	GFF occurs before running
142	AuE 1	Auto-tune error 1 (in DC test stage)
143	AuE2	Auto-tune error 2 (high frequency test stage)
144	AuE3	Auto-tune error 3 (rotary test stage)

Chapter 15 Auto-tuning Process

■ Flow chart



■ Fine-tuning for Elevators' Performance



Stage	Function	Pr.	Explanation	Settings	Default
Starting	Delay Time	02-30	Turn On Delay of Magnetic Contactor between Drive and Motor	0.010–65.000 sec.	0.200
		02-39	Brake Release Delay Time When Elevator Starts	0.010–65.000 sec.	0.250
	Roll Back Adjustment	07-01	DC Brake Current Level	0–100 %	30
		07-02	DC Brake Time at Start-up	0.0–60.0 sec.	0.7
		02-42	Brake Release Function Option	Bit 0 = 0: No function Bit 0 = 1: Check torque output function switch Bit 1 = 0: No function Bit 1 = 1: Brake control by frequency threshold function switch	0000h
	Start-up Adjustment	01-04	Mid-point Voltage 1 of Motor 1	230V series:0.0–240.0 V 460V series:0.0–480.0 V	11.0 22.0
		01-06	Mid-point Voltage 2 of Motor 1	230V series:0.0–240.0 V 460V series:0.0–480.0 V	2.0 4.0
		01-08	Minimum Output Voltage of Motor 1	230V series:0.0–240.0 V 460V series:0.0–480.0 V	0.0 0.0
	Torque Check	02-41	Output Current Level Setting for External Terminals	0–100%	0
Accelerating	Multi-Step Speed	01-12	Acceleration Time 1	0.00–600.00 sec.	2.00
		01-24	S-curve Acceleration Begin Time S1	0.00–25.00 sec.	1.00
		01-25	S-curve Acceleration Arrival Time S2	0.00–25.00 sec.	1.00

Stage	Function	Pr.	Explanation	Settings	Default
Decelerating	Multi-Step Speed	01-13	Deceleration Time 1	0.00–600.00 sec.	2.00
		01-26	S-curve Deceleration Begin Time S3	0.00–25.00 sec.	1.00
		01-27	S-curve Deceleration Arrival Time S4	0.00–25.00 sec.	1.00
Leveling	Elevator Parking	01-71	Leveling Speed Switch	0.00–299.00 Hz	0.00
		01-72	Lower than Leveling Speed S5	0.00–25.00 sec.	1.00
		01-73	Deceleration Time when Operating without RUN Command	0.00–25.00 sec.	2.00
Stopping	Delay Time	02-40	Brake Contracting Delay Time When Elevator Stops	0.010–65.000 sec.	0.250
		02-31	Turn Off Delay of Magnetic Contactor between Drive and Motor	0.010–65.000 sec.	0.200
	Roll Back Adjustment	07-01	DC Brake Current Level	0–100 %	30
		07-03	DC Brake Time at Stop	0.0–60.0 sec.	0.7
		02-42	Brake Release Function Option	Bit 0 = 0: No function Bit 0 = 1: Check torque output function switch Bit 1 = 0: No function Bit 1 = 1: Brake control by frequency threshold function switch	0000h
	Torque Check	02-41	Output Current Level Setting for External Terminals	0–100% (Rated current of drive %)	0

■ Explanations for the Auto-tuning Steps

Step1. Basic Parameters Settings

- Make sure that Pr.00-00 (identity code of the AC motor drive) matches with the nameplate indicated on the AC motor drive.
- Reset all parameters to defaults (set Pr.00-02 to 9 or 10).

Pr.00-02 Parameter Reset	0: No function 1: Parameter write protection 5: Reset kWH display to 0 7: Reset CANopen index (slave) 9: All parameters are reset to defaults. (Base frequency = 50 Hz) 10: All parameters are reset to defaults. (Base frequency = 60 Hz)

- Master Frequency Command Source: User-defined. (Pr.00-20)

Pr.00-20 Master Frequency Command Source	0: Digital keypad 1: RS-485 serial communication 2: External analog input (Refer to Pr.03-00) 3: External UP / DOWN terminal 6: CANopen input Note: It is valid only when using with KPC-CC01.

- Operation Command Source: User-defined. (Pr.00-21)

Pr.00-21 Operation Command Source	0: Digital keypad 1: External terminals 2: Communication RS-485 input 3: CANopen input Note: it is valid only when using with KPC-CC01.

- MI/MO External Terminal Settings
  Refer to Pr.02-01–Pr.02-07 for the external input terminals MI1–MI7.
  NOTE: The default for Pr.02-07 is 49 (Enable Drive). Disable this function if you do not need to use it.

Pr.02-01–Pr.02-07	0: No function 1: multi-step speed command 1 / multi-step position command 1 2: multi-step speed command 2 / multi-step position command 2 3: multi-step speed command 3 / multi-step position command 3 4: multi-step speed command 4 / multi-step position command 4 5: Reset 6: JOG operation

	7: Acceleration / deceleration speed inhibit 8: 1st, 2nd acceleration / deceleration time selection 9: 3rd, 4th acceleration / deceleration time selection 10: EF input (Pr.07-20) 11: Base Block (B.B.) input from external 12: Output stop 15: Rotating speed command form AVI 16: Rotating speed command form ACI 18: Forced to stop (Pr.07-20) 24: FWD JOG command 25: REV JOG command 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for ∆-connection 38: Disable EEPROM writing function 40: Force coasting to stop 49: Enable Drive 53: Trigger CANopen quick stop 58: Emergency power mode detection 59: Magnetic contactor error detection 60: Mechanical brake error detection 61: Power loss signal 62: Mechanical brake error detection 2

Refer to Pr.02-16 and Pr.02-17 for the settings for MO1–MO7.

Pr.02-16–Pr.02-17	0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (Pr.02-22) 4: Desired frequency reached 2 (Pr.02-24) 5: Zero speed (Frequency command) 6: Zero speed, include STOP (Frequency command) 7: Over-torque (Pr.06-06–06-08) 9: Drive is ready 10: Low voltage warning (LV) (Pr.06-00) 11: Malfunction indication 12: Mechanical brake signal (Pr.02-39, Pr.02-40) 13: Over-heat warning (Pr.06-15) 16: Slip error (oSL) 19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage

	22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation source 25: Forward command 26: Reverse command 27: Output when current ≥ Pr.02-41 28: Output when current < Pr.02-41 31: Y-connection for the motor coil 32: △-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed includes stop (actual output frequency) 35: Error output selection 1 (Pr.06-23) 36: Error output selection 2 (Pr.06-24) 37: Error output selection 3 (Pr.06-25) 38: Error output selection 4 (Pr.06-26) 40: Speed reached (including STOP) 44: Low current output (use with Pr.06-71–Pr.06-73) 45: UVW output magnetic contactor ON/OFF switch 50: Output control for CANopen 56: Power generation direction and status verification 57: Power generation direction 58: EPS MODE 67: Analog input level reached 75: Motor-controlled magnetic contactor output

Step 2. Motor tuning

- Set the parameters according to the motor type (IM)
- Motor auto-tuning: Set the Operation Command source to the digital keypad (Pr.00-21=0, refer to step 1)
- Control method: Set Pr.00-11.

Pr.00-11 Speed Control Mode	0: VF (IM V/F control) 2: SVC

- Enter the motor nameplate information into Pr.01-00–01-02.

Pr.01-00 Maximum Operation Frequency of Motor 1	0.00–299.00 Hz

Pr.01-01 Output Frequency of Motor 1	0.00–299.00 Hz

Pr.01-02 Output Voltage of Motor 1	230V series: 0.0–255.0 V 460V series: 0.0–510.0 V

【IM (Induction Motor)】

- Motor auto-tuning: Set the Operation Command source to the digital keypad (Pr.00-21=0, refer to step 1) and set Pr.05-00=2

Pr.05-00 Motor Parameter Auto-tuning	0: No function 1: Dynamic test for an induction motor (IM) 2: Static test for an induction motor (IM)

NOTE 1: You do not need to release the brake in this auto-tuning operation. Make sure that the magnetic contactor is ON when it is installed between the AC motor drive and the motor. When Pr.05-00 is set to 2, you must enter the motor no-load current in Pr.05-05. The digital keypad displays the warning message “Auto tuning” until auto-tuning is finished. Then, it saves the measured results in Pr.05-06–Pr.05-09.

NOTE 2: The automatic measurement of an IM motor (induction motor) can also perform dynamic measurements.

Pr.05-01 Full-load Current for an Induction Motor (A)	10–120 % of the drive’s rated current
Pr.05-02 Rated Power for an Induction Motor (kW)	0.00–655.35 kW

Pr.05-03 Rated Speed for an Induction Motor (rpm)	0–6553 rpm

Pr.05-04 Number of Poles for an Induction Motor	2–20

Step 3. Multi-Step Speed settings

Multi-step speed settings

- Confirm the total number of speed steps (high speed, middle speed, low speed, creep, inspection and level auto-learning)
- Make sure that the step speed settings and the corresponding terminal actions for the multi-function input commands are correct (MI3–MI6).
- Set the multi-step speeds in Pr.04-00–Pr.04-14

Pr.04-00 to Pr.04-14 settings	1st Step Speed Frequency	0.00–299.00 Hz
	2nd Step Speed Frequency	0.00–299.00 Hz
	3rd Step Speed Frequency	0.00–299.00 Hz
	4th Step Speed Frequency	0.00–299.00 Hz
	5th Step Speed Frequency	0.00–299.00 Hz
	6th Step Speed Frequency	0.00–299.00 Hz
	7th Step Speed Frequency	0.00–299.00 Hz
	8th Step Speed Frequency	0.00–299.00 Hz
	9th Step Speed Frequency	0.00–299.00 Hz
	10th Step Speed Frequency	0.00–299.00 Hz
	11th Step Speed Frequency	0.00–299.00 Hz
	12th Step Speed Frequency	0.00–299.00 Hz
	13th Step Speed Frequency	0.00–299.00 Hz
	14th Step Speed Frequency	0.00–299.00 Hz
	15th Step Speed Frequency	0.00–299.00 Hz

NOTE:

It is recommended that you set the maximum operating frequency to the half of maximum operating frequency before confirming each step speed setting and the corresponding terminal actions for the multi-function input commands.

- Set the acceleration/deceleration with Pr.01-23 = 08 (first and second acceleration/ deceleration time selection) and = 09 (third and fourth acceleration/deceleration time selection) for the multi-function input command Pr.02-01–02-07.
- Set the acceleration/deceleration time: Pr.01-12–Pr.01-19.

Pr.01-12 to Pr.01-19 settings	Acceleration Time 1	0.00–600.00 sec.
	Deceleration Time 1	0.00–600.00 sec.
	Acceleration Time 2	0.00–600.00 sec.
	Deceleration Time 2	0.00–600.00 sec.
	Acceleration Time 3	0.00–600.00 sec.
	Deceleration Time 3	0.00–600.00 sec.
	Acceleration Time 4	0.00–600.00 sec.
	Deceleration Time 4	0.00–600.00 sec.

NOTE:

It is recommended that you set the Pr.01-73 (deceleration time) to the smallest value for the trial run to ensure all the actions are correct, then increase it for the final test.

- JOG Acceleration/Deceleration Time Setting: Pr.01-20–Pr.01-22

Pr.01-20 to Pr.01-22 settings	JOG Acceleration Time	0.00–600.00 sec.
	JOG Deceleration Time	0.00–600.00 sec.
	JOG Frequency	0.00–600.00 sec.

- S-curve Setting: Pr.01-24–Pr.01-34, Pr.01-71, Pr.01-72

Pr.01-24–Pr.01-34, Pr.01-71, Pr.01-72 settings	S-curve Acceleration Begin Time S1	0.00–25.00 sec.
	S-curve Acceleration Arrival Time S2	0.00–25.00 sec.
	S-curve Deceleration Begin Time S3	0.00–25.00 sec.
	S-curve Deceleration Arrival Time S4	0.00–25.00 sec.
	Zero-speed mode	0: Output waiting 1: Zero-speed operation 2: Fmin (refer to Pr.01-07)
	Leveling Speed Switch	0.00–299.00 Hz
	Lower than Leveling Speed S5	0.00–25.00 sec.

NOTE:

It is recommended that you set the S-curve time to 0 for the trial run to ensure all the actions are correct, and then increase it for the final test.

Step 4. Trial run

Use the trial run after you complete Step 1 to Step 3 above to check if the motor runs normally after executing the inspection with a loaded motor. At the same time, check if the multi-function output terminal operations are correct (such as whether the action of the brake release and magnetic contactor match the host controller).

Also check the speed, current value, and check for noise in the carriage and other noise sources when switching between each step.

Step 5. Elevator tuning

1. **Enable slip compensation**

   To disable the slip compensation, set Pr.07-27 = 0, Pr.07-34 = 0 and Pr.07-35 = 0.
   To enable the slip compensation, set Pr.07-27 > 0, Pr.07-34 > 0 and Pr.07-35 > 0.
   Adjust the settings in Pr.07-27, Pr.07-34 and Pr.07-35.

Pr.07-27 Slip Compensation Gain	0.00–10.00

Pr.07-34 Slip compensation gain % (Power generation mode)	0.0–100.0%

Pr.07-35 Slip compensation gain % (Electricity mode)	0.0–100.0%

2. **Start-up Adjustment**

   Adjust the minimum output voltage to avoid start-up failure.
   V/F control: Adjust settings in Pr.01-04, Pr.01-06, Pr.01-08.
   SVC control: Adjust settings in Pr.01-08.

Pr.01-04 Mid-point voltage 1 of motor 1	230 V series: 0.0 V–240.0 V 460 V series: 0.0 V–480.0 V

Pr.01-06 Mid-point voltage 2 of motor 1	230 V series: 0.0 V–240.0 V 460 V series: 0.0 V–480.0 V

Pr.01-08 Minimum output voltage of motor 1	230 V series: 0.0 V–240.0 V 460 V series: 0.0 V–480.0 V

3. Adjust DC brake

Adjust settings in Pr.07-01, Pr.07-02, Pr.07-03.

Pr.07-01 DC brake current level	0–100 %

Pr.07-02 DC brake time at start-up	0.0–60.0 sec.

Pr.07-03 DC brake time at stop	0.0–60.0 sec.

4. Adjust elevator parking

Adjust settings in Pr.01-71, Pr.01-72, Pr.01-73.

Pr.01-71 Leveling Speed Switch	0.00–299.00 Hz

Pr.01-72 Lower than Leveling Speed S5	0.00–25.00 sec.

Pr.01-73 Deceleration Time when Operating without RUN Command	0.00–25.00 sec.

Frequently Asked Questions (FAQs)

- Roll-Back Solution:

1. Bit1: See the elevator timing diagram on page 12-02-15 in Parameter Group 2 in Chapter 12.
2. Set contactor delay and DC brake (Pr.07-01 and Pr.07-03) constant time during stop.
3. Set Pr.02-42 Bit 1=1.
4. Set frequencies for brake release and brake engage (Pr.02-43 and Pr.02-44) to solve roll-back issue.

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Chapter 16 CANopen Overview

The built-in CANopen function is a kind of remote control. You can control the AC motor drive using the CANopen protocol. CANopen is a CAN-based higher layer protocol that provides standardized communication objects, including real-time data (Process Data Objects, PDO), configuration data (Service Data Objects, SDO), and special functions (Time Stamp, Sync message, and Emergency message). It also has network management data, including Boot-up message, NMT message, and Error Control message. Refer to the CiA website http://www.can-cia.org/ for details. The content of this instruction sheet may be revised without prior notice. Consult our distributors or download the most updated version at http://www.delta.com.tw/industrialautomation.

Delta CANopen supported functions:

- Supports CAN2.0A Protocol
- Supports CANopen DS301 V4.02
- Supports DSP-402 V2.0

Delta CANopen supported services:

- PDO (Process Data Objects): PDO1–PDO4
- SDO (Service Data Objects):
  Initiate SDO Download;
  Initiate SDO Upload;
  Abort SDO;
  You can use the SDO message to configure the slave node and access the Object Dictionary in every node.
- SOP (Special Object Protocol):
  Supports default COB-ID in Predefined Master/Slave Connection Set in DS301 V4.02;
  Supports SYNC service;
  Supports Emergency service.
- NMT (Network Management):
  Supports NMT module control;
  Supports NMT Error control;
  Supports Boot-up.

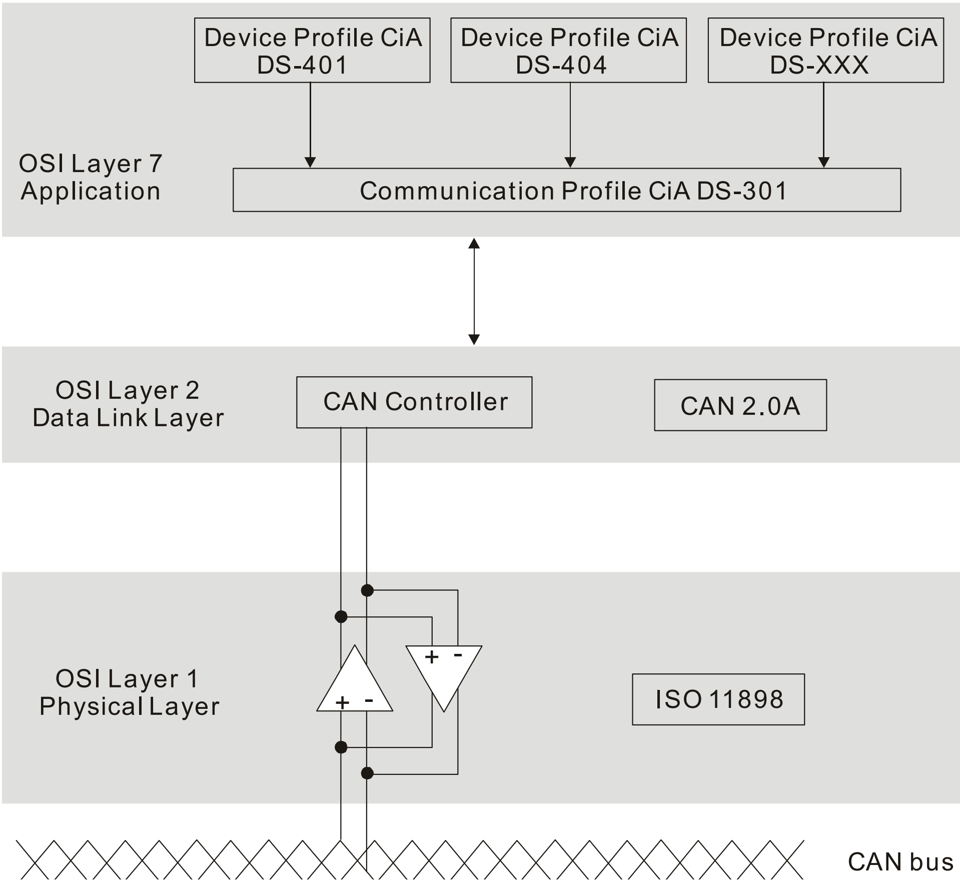
Delta CANopen does not support this service:

- Time Stamp service

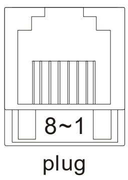
16-1 CANopen Overview

● CANopen Protocol

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks such as handling systems. Version 4.02 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover the application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).



RJ45 Pin Definition



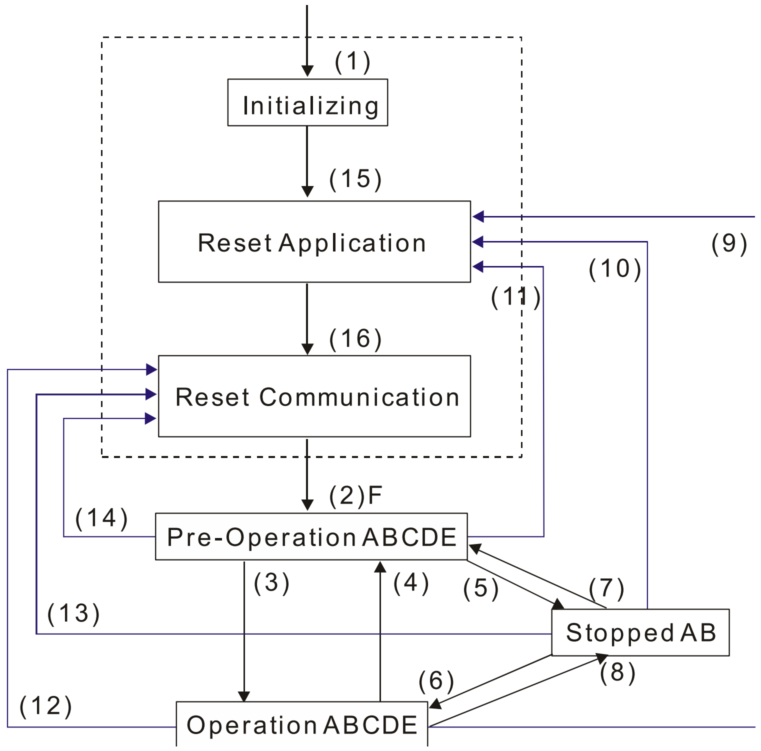
PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground / 0 V /V-
6	CAN_GND	Ground / 0 V /V-

CANopen Communication Protocol contains the following services:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Objects)
- EMCY (Emergency Object)

NMT (Network Management Object)

The Network Management (NMT) follows a Master/Slave structure for executing NMT service. A network has only one NMT master, and the other nodes are slaves. All CANopen nodes have a present NMT state, and the NMT master can control the state of the slave nodes. The following shows the state diagram of a node:



(1) After power is applied, start in the auto-initialization state
(2) Automatically enter the pre-operational state
(3) (6) Start remote node
(4) (7) Enter the pre-operational state
(5) (8) Stop remote node
(9) (10) (11) Reset node
(12) (13) (14) Reset communication
(15) Automatically enter reset application state
(16) Automatically enter reset communication state

A: NMT
B: Node Guard
C: SDO
D: Emergency
E: PDO
F: Boot-up

	Initializing	Pre-Operational	Operational	Stopped
PDO			○	
SDO		○	○	
SYNC		○	○	
Time Stamp		○	○	
EMCY		○	○	
Boot-up	○			
NMT		○	○	○

SDO (Service Data Objects)

Use SDO to access the Object Dictionary in every CANopen node using the Client/Server model. One SDO has two COB-IDs (request SDO and response SDO) to upload or download data between two nodes. There is no data limit for SDOs to transfer data, but it must transfer data by segment when the data exceeds four bytes with an end signal in the last segment. The MH300-L series does not currently support segment transmission.

The Object Dictionary (OD) is a group of objects in a CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path in the OD is the index and sub-index; each object has a unique index in the OD, and has a sub-index if necessary. The following shows the request and response frame structure of SDO communication:

PDO (Process Data Objects)

PDO communication can be described by the producer/consumer model. Each node of the network listens to the messages of the transmission node and distinguishes whether the message has to be processed or not after receiving the message. A PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and an RxPDO. PDOs are transmitted in a non-confirmed mode. All transmission types are listed in the following table:

Type Number	PDO				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0		○	○		
1–240	○		○		
241–251	Reserved				
252			○		○
253				○	○
254				○	
255				○	

Type number 0 indicates the synchronous aperiodic message between two PDO transmissions.
Type number 1-240 indicates the number of SYNC message between two PDO transmissions.
Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.
Type number 253 indicates the data is updated immediately after receiving RTR.
Type number 254: Delta CANopen does not support this transmission format.
Type number 255 indicates the data is an asynchronous aperiodic transmission.

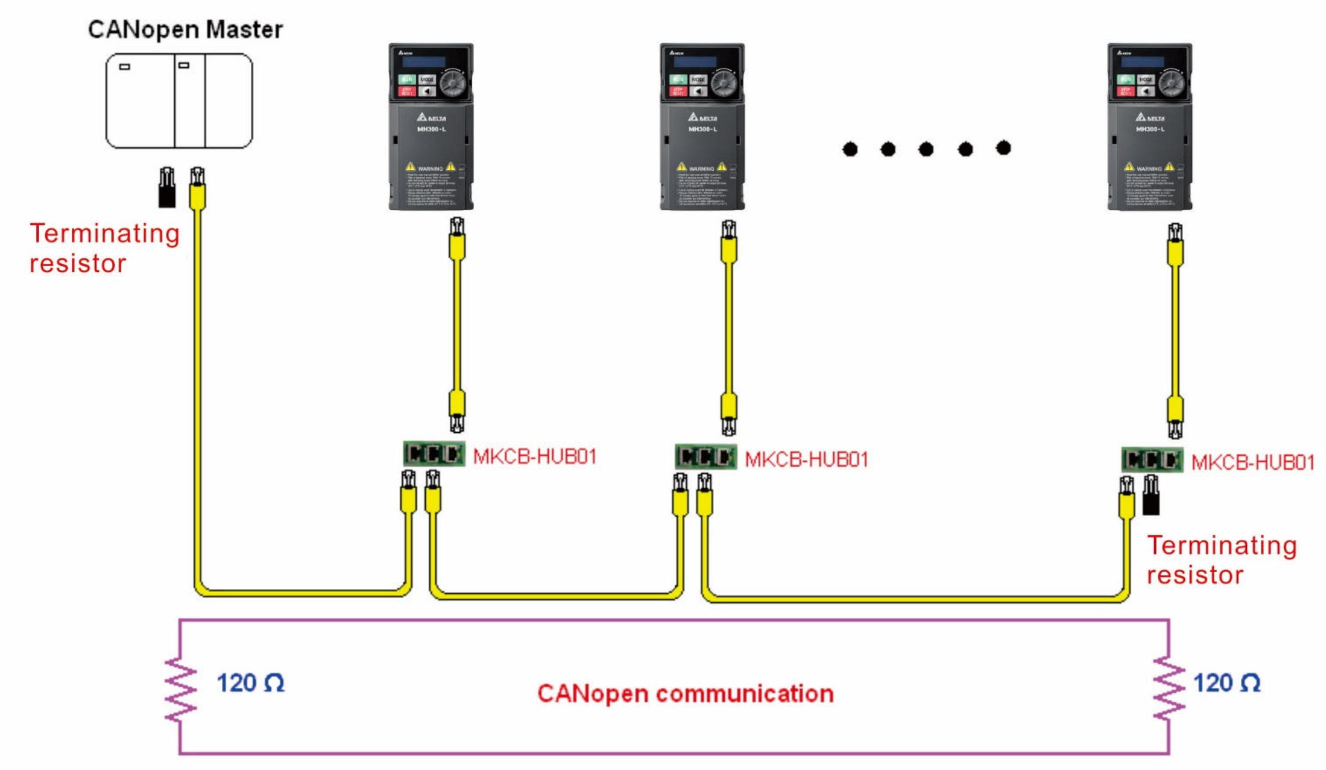
All PDO transmission data must be mapped to the index with Object Dictionary.

EMCY (Emergency Object)

When errors occur inside the hardware, an emergency object is triggered. An emergency object is only sent when an error occurs. As long as there is nothing wrong with the hardware, there is no emergency object warning of an error message.

16-2 Wiring for CANopen

Use an external CANopen communication splitter box (MKCB-HUB01) for built-in CANopen wiring to connect CANopen to an MH300-L. The link uses an RJ45 cable. You must terminate the two farthest ends with 120 Ω terminating resistors as shown in the picture below.



16-3 CANopen Communication Interface Descriptions

16-3-1 CANopen Control Mode Selection

There are two control modes for CANopen: the DS402 standard (Pr.09-40 set to 1) is the default, and the Delta's standard setting (Pr.09-40 set to 0). The following table shows the control mode definitions:

CANopen control mode	Control mode Speed		Operation control		Other	
	Index	Description	Index	Description	Index	Description
DS402 Pr.09-40=1	6042-00	Target rotating speed (RPM)	6040-00	Operation Command	605A-00	Quick stop processing mode
	-----	-----	-----	-----	605C-00	Disable operation processing mode
Delta Standard Pr.09-40=0	2060-03	Target rotating speed (Hz)	2060-01	Operation Command	-----	-----
	-----	-----	-----	-----	-----	-----

You can use some indices in either DS402 or Delta's standard.
For example:
1. Indices that are defined as RO attributes.
2. The corresponding index of available parameter groups: (2000-00–200E-XX)
3. Accelerating/Decelerating Index: 604F 6050

16-3-2 DS402 Standard Control Mode

16-3-2-1 Related set up for an AC motor drive (following the DS402 standard)

If you want to use the DS402 standard to control the motor drive, follow these steps:
1. Wire the hardware (refer to Section 16-2 Wiring for CANopen).
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr.00-20 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set DS402 for the control mode: Pr.09-40 = 1
5. Set the CANopen station: set the CANopen station (range 1–127, 0 is the disable CANopen slave function) with Pr.09-36. Note: set Pr.00-02 = 7 to reset if the station number error CAdE or CANopen memory error CFrE appears.
6. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 M (0), 500 K (1), 250 K (2), 125 K (3), 100 K (4) or 50 K (5)).
7. Set the multiple input functions to Quick Stop. You can also choose enable or disable; the default setting is disabled. If it is necessary to enable the function, set MI terminal to 53 in one of the following parameters: Pr.02-01–02-07 or Pr.02-26–02-28. Note: This function is available in DS402 only.

16-3-2-2 The status of the motor drive (by following DS402 standard)

According to the DS402 definition, the motor drive is divided into 3 blocks and 9 statuses as described below.

3 blocks

1. Power Disable: without PWM output
2. Power Enable: with PWM output
3. Fault: one or more errors have occurred.

9 status

1. Start: power on
2. Not Ready to Switch On: the motor drive is initiating.
3. Switch On Disable: occurs when the motor drive finishes initiating.
4. Ready to Switch On: warming up before running.
5. Switch On: the motor drive has the PWM output, but the reference command is not effective.
6. Operation Enable: able to control normally.
7. Quick Stop Active: when there is a Quick Stop request, stop running the motor drive.
8. Fault Reaction Active: the motor drive detects conditions which might trigger error(s).
9. Fault: one or more errors have occurred in the motor drive.

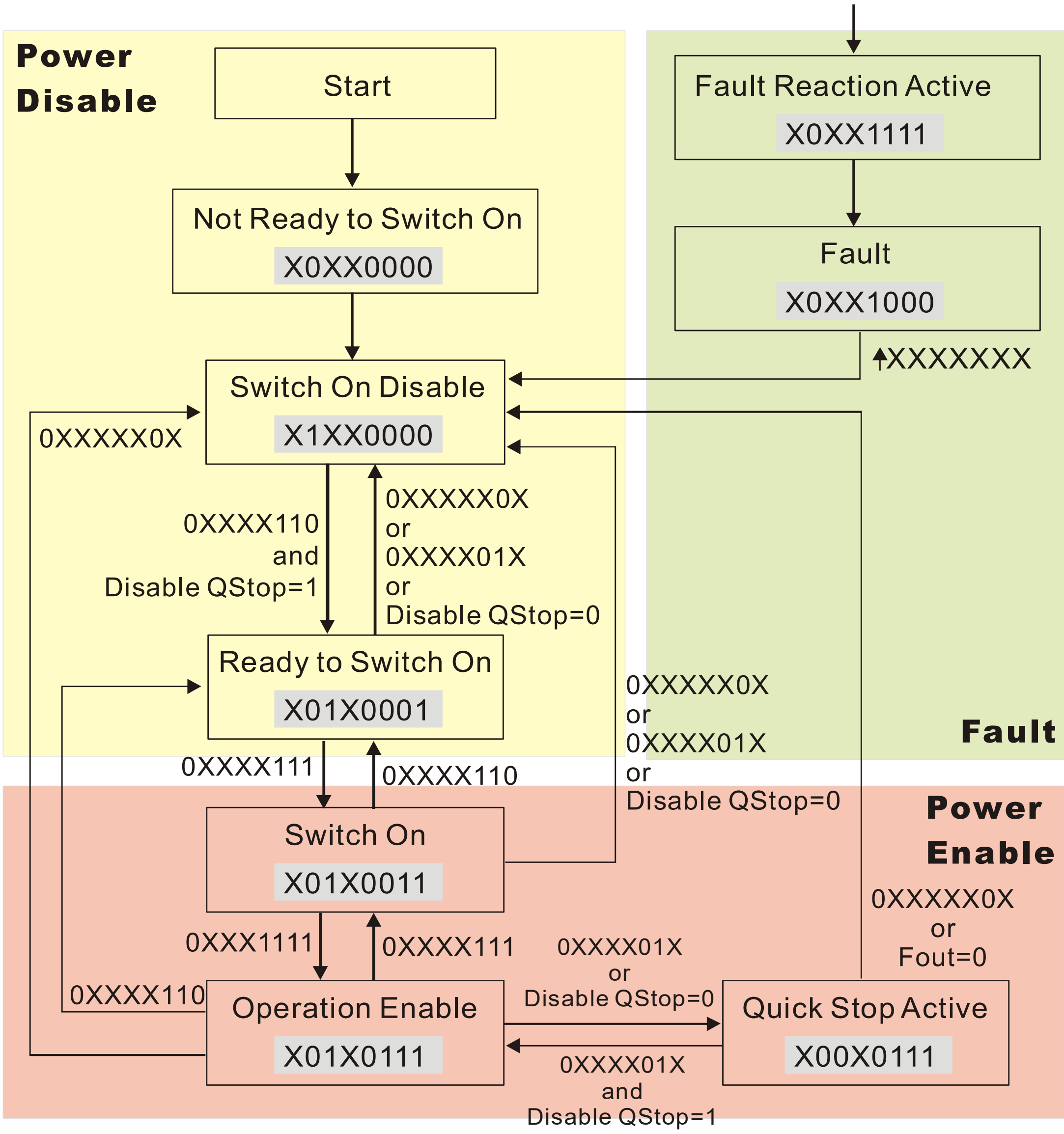
When the motor drive turns on and finishes the initiation, it remains in Ready to Switch On status. To control the operation of the motor drive, change to Operation Enable status. To do this, set the control word's bit0–bit3 and bit7 of the Index 6040H and pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described below:

Index 6040

15–9	8	7	6–4	3	2	1	0
Reserved	Halt	Fault Reset	Operation	Enable operation	Quick Stop	Enable Voltage	Switch On

Index 6041

15–14	13–12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Operation	Internal limit active	Target reached	Remote	Reserved	Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on



Set command 6040 = 0xE, and then set another command 6040 = 0xF. Then you can switch the motor drive to Operation Enable. The Index 605A determines the direction of the lines from Operation Enable when the control mode changes from Quick Stop Active. When the setting value is 5–7, both lines are active, but when the setting value of 605A is not 5–7, once the motor drive is switched to Quick Stop Active, it is not able to switch back to Operation Enable.

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	note
605Ah	0	Quick stop option code	2	RW	S16		No		0: Disable drive function 1: Slow down on slow down ramp 2: Slow down on quick stop ramp 5: Slow down on slow down ramp and stay in Quick Stop 6: Slow down on quick stop ramp and stay in Quick Stop 7: Slow down on the current limit and stay in Quick Stop

When the control section switches from Power Enable to Power Disable, use 605C to define the stop method.

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	note
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable the drive function.

16-3-2-3 Various mode control method (by following DS402 standard)

Speed mode:

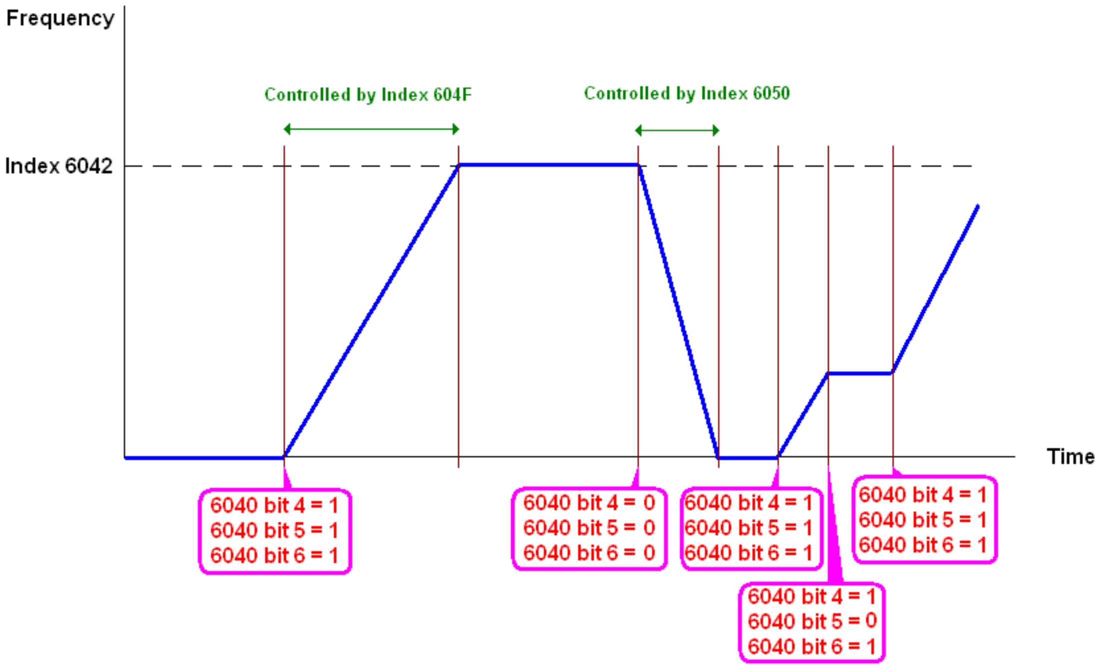
1. Set MH300-L to speed control mode: set Index6060 to 2.
2. Switch to Operation Enable mode: set 6040 = 0xE, and then set 6040 = 0xF.
3. Set the target frequency: set target frequency for 6042, since the operation unit of 6042 is rpm, a transform is required:

   $$n = f \times \frac{120}{p}$$

   n: rotation speed (rpm) (rounds/minute)
   p: number of poles in the motor (Pole)
   f: rotation frequency (Hz)

   For example:
   Set 6042H = 1500 (rpm), if the number of poles is 4 (Pr.05-04 or Pr.05-16), then the motor drive's operation frequency is 1500 (120/4) = 50 Hz. The 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter-clockwise.
4. To set acceleration and deceleration: use 604F (Acceleration) and 6050 (Deceleration).
5. Trigger an ACK signal: in the speed control mode, the bit 6–4 of Index 6040 needs to be controlled. It is defined below:

	Index 6040			SUM
	bit 6	bit 5	bit 4	
Speed mode (Index 6060 = 2)	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0 Hz.



NOTE 01: Read 6043 to get the current rotation speed (unit: rpm).

NOTE 02: Read bit 10 of 6041 to find if the rotation speed has reached the targeting value (0: Not reached; 1: Reached).

16-3-3 By Using Delta Standard

16-3-3-1 Related set up for an AC motor drive

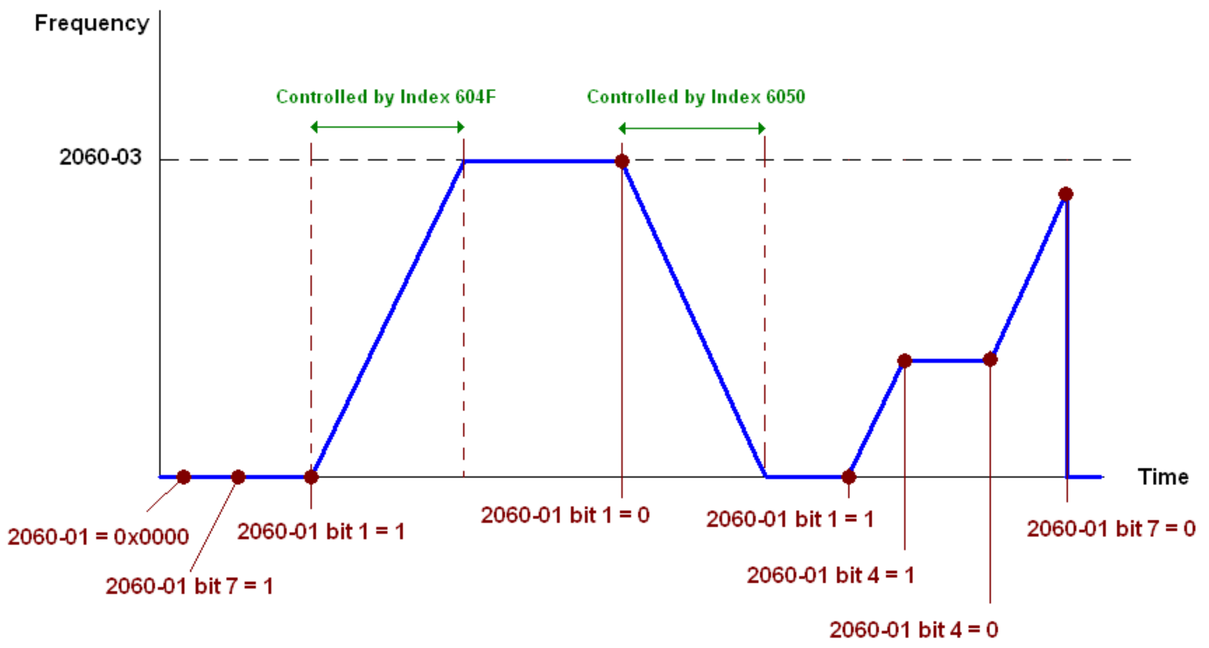
Follow the steps below:

1. Wire the hardware (refer to Section 16-2 Wiring for CANopen).
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr.00-20 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set Delta Standard as the control mode: Pr.09-40 = 0.
5. Set the CANopen station: set Pr.09-36; the range is between 1–127. When Pr.09-36 = 0, the CANopen slave function is disabled. Note: if an error appears (CAdE or CANopen memory error) as you complete the station setting, set Pr.00-02 = 7 to reset.
6. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 M (0), 500 K (1), 250 K (2), 125 K (3), 100 K (4) and 50 K (5)).

16-3-3-2 Various mode control method

Speed Mode:

1. Set MH300-L to speed control mode: set index 6060 = 2 or index 2060-02 = 0.
2. Set the target frequency: set 2060-03, unit is Hz, with 2 decimal places. For example, 1000 is 10.00 Hz.
3. Operation control: set 2060-01 = 008H for server on, and set 2060-01 = 0081H for running.



16-3-4 DI/DO AI are controlled through CANopen

To control the DO of the motor drive through CANopen, follow these steps:

1. Define the DO to be controlled by CANopen. For example, set Pr.02-13 = 50 to control RY1.
2. To control DO, use control Index 2026-41. To set RY1 as ON, set bit 0 of Index 2026-41 = 1, then RY1 outputs 1. To control AFM output = 50.00%, set Index 2026-A1 = 5000, then AFM outputs 50%.

The following table shows the mapping of CANopen DI DO AI:

DI:

Terminal	Related Parameters	R/W	Mapping Index
MI 1	Pr.02-01	RO	2026-01 bit 2
MI 2	Pr.02-02	RO	2026-01 bit 3
MI 3	Pr.02-03	RO	2026-01 bit 4
MI 4	Pr.02-04	RO	2026-01 bit 5
MI 5	Pr.02-05	RO	2026-01 bit 6
MI 6	Pr.02-06	RO	2026-01 bit 7
MI 7	Pr.02-07	RO	2026-01 bit 8
MI 10	Pr.02-26	RO	2026-01 bit 10
MI 11	Pr.02-27	RO	2026-01 bit 11
MI 12	Pr.02-28	RO	2026-01 bit 12

DO:

Terminal	Related Parameters	R/W	Mapping Index
RY1	Pr.02-13 = 50	RW	2026-41 bit 0
MO1	Pr.02-16 = 50	RW	2026-41 bit 3
MO2	Pr.02-17 = 50	RW	2026-41 bit 4
MO10 (RY10)		RW	2026-41 bit 5
MO11 (RY11)		RW	2026-41 bit 6
MO12 (RY12)		RW	2026-41 bit 7

AI:

Terminal	Related Parameters	R/W	Mapping Index
AVI	==	RO	Value of 2026-61
ACI	==	RO	Value of 2026-62
AI10	==	RO	Value of 2026-64
AI11	==	RO	Value of 2026-65

16-4 CANopen Supporting Index

CANopen Remote IO mapping

Index	Sub	R/W	Definition
2026H	01h	R	Each bit corresponds to different input terminals.
	02h	R	Each bit corresponds to different input terminals.
	03h–40h	R	Reserved
	41h	RW	Each bit corresponds to different output terminals.
	42h–60h	R	Reserved
	61h	R	AVI (%)
	62h	R	ACI (%)
	63h	R	Reserved
	64h		AI10 (%)
	65h		AI11 (%)
	66h–A0h	R	Reserved
	A1h	RW	AFM (%)

Index 2026-01	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit8	bit9	bit10	bit11	bit12	bit13	bit14	bit15
1	MI1	MI2	MI3	MI4	MI5	MI6	MI7									
2											MI10	MI11	MI12			

1: Control broad I/O

2: Add external card, EMM-D3R2CA (D1022 = 9)

Index 2026-41	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit8	bit9	bit10	bit11	bit12	bit13	bit14	bit15
1	RY1			MO1	MO2											
2						RY10	RY11									

1: Control broad I/O

2: Add external card, EMM-D3R2CA (D1022 = 9)

Delta Standard Mode

Index	sub	R/W	Size	Descriptions			Speed Mode
				bit	Definition	Priority	
2060h	00h	R	U8				
	01h	RW	U16	0	Ack	4	0: fcmd =0 1: fcmd = Fset (Fpid)
				1	Dir	4	0: FWD run command 1: REV run command
				2			
				3	Halt		0: Drive runs until target speed is reached 1: Drive stops by declaration setting
				4	Hold		0: Drive runs until target speed is reached 1: Frequency stop at current frequency
				5	JOG		0: JOG OFF Pulse 1: JOG RUN
				6	QStop		Quick Stop
				7	Power		0: Power OFF 1: Power ON
				14–8	Cmd SW		Multi-step frequency switching
				15			Pulse 1: Fault code cleared
	02h	RW	U16				
	03h	RW	U16				Speed command (unsigned decimal)
	04h	RW	U16				
	05h	RW	S32				
	06h	RW					
	07h	RW	U16				
	08h	RW	U16				
2061h	01h	R	U16	0	Arrive		Frequency reached
				1	Dir		0: Motor FWD run 1: Motor REV run
				2	Warn		Warning
				3	Error		Error detected
				4			
				5	JOG		JOG
				6	QStop		Quick stop
				7	Power ON		Switch ON
				15–8			
	02h	R					
	03h	R	U16				Actual output frequency
	04h	R					
	05h	R	S32				Actual position (absolute)
	06h	R					
	07h	R	S16				Actual torque

DS402 Standard

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	Note
6007h	0	Abort connection option code	2	RW	S16		Yes		0: No action 2: Disable voltage 3: Quick Stop
603Fh	0	Error code	0	R0	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	R0	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	10000	RW	U32	1ms	Yes	vl	Unit must be 100 ms, and check if the setting is 0.
6050h	0	vl slow down time	10000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	1000	RW	U32	1ms	Yes	vl	
605Ah	0	Quick stop option code	2	RW	S16		No		0: Disable drive function 1: Slow down on slow down ramp 2: Slow down on quick stop ramp 5: Slow down on slow down ramp and stay in QUICK STOP 6: Slow down on quick stop ramp and stay in QUICK STOP
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable the drive function
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above

16-5 CANopen Fault Codes

①	Fault
②	ocA
③	Oc at accel

HAND

① Display error signal

② Abbreviation for error code

The code displays as shown on KPMH-LC01

③ Display error description

* Refer to settings for Pr.06-17–Pr.06–22.

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
1	HAND Fault ocA Oc at accel	0001H	Over-current during acceleration	1	2213H
2	HAND Fault ocd Oc at decel	0002H	Over-current during deceleration	1	2213H
3	HAND Fault ocn Oc at normal SPD	0003H	Over-current during steady operation	1	2214H
4	HAND Fault GFF Ground fault	0004H	Ground fault. When one of the output terminal(s) is grounded, the short circuit current is more than 50% of the AC motor drive rated current. Note: the short circuit protection is provided for the AC motor drive protection, not to protect you.	1	2240H
6	HAND Fault ocS Oc at stop	0006H	Over-current at stop. Hardware failure in current detection.	1	2214H
7	HAND ovA Ov at accel	0007H	Over-current during acceleration. Hardware failure in current detection.	2	3210H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
8	HAND Fault ovd Ov at decel	0008H	Over-current during deceleration. Hardware failure in current detection.	2	3210H
9	HAND Fault ovn Ov at normal SPD	009H	DC BUS over-voltage at constant speed.	2	3210H
10	HAND Fault ovS Ov at stop	000AH	Over-voltage at stop. Hardware failure in voltage detection.	2	3210H
11	HAND Fault LvA Lv at accel	000BH	DC BUS voltage is less than Pr.06-00 during acceleration.	2	3220H
12	HAND Fault Lvd Lv at decel	000CH	DC BUS voltage is less than Pr.06-00 during deceleration.	2	3220H
13	HAND Fault Lvn Lv at normal SPD	000DH	DC BUS voltage is less than Pr.06-00 at constant speed.	2	3220H
14	HAND Fault LvS Lv at stop	000EH	DC BUS voltage is less than Pr.06-00 at stop.	2	3220H
15	HAND Fault OrP Phase Lacked	000FH	Phase loss protection	2	3130H
16	HAND Fault oH1 IGBT over heat	0010H	IGBT is overheated above the protection level.	3	4310H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
18	HAND Fault tH1o Thermo 1 open	0012H	IGBT over-heating protection error	3	FF00H
21	HAND Fault oL Inverter oL	0015H	Overload; the AC motor drive detects excessive drive output current.	1	2310H
22	HAND Fault EoL1 Thermal relay 1	0016H	Electronic thermal relay 1 protection	1	2310H
26	HAND Fault ot1 Over torque 1	001AH	When the output current exceeds the over-torque detection level (Pr.06-07) and also exceeds Pr.06-08; when Pr.06-06 is set as 1 or 3, the keypad displays a warning without an error record; when Pr.06-06 is set as 2 or 4, it displays an error, stops running and displays an error record.	3	8311H
28	HAND Fault uC Under torque 1	001CH	Low current detection	1	8321H
31	HAND Fault cF2 EEPROM read Err	001FH	Cannot read internal EEPROM.	5	5530H
33	HAND Fault cd1 Ias sensor Err	0021H	U-phase current error	1	FF04H
34	HAND Fault cd2 Ibs sensor Err	0022H	V-phase current error	1	FF05H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
35	HAND Fault cd3 Ics sensor Err	0023H	W-phase current error	1	FF06H
36	HAND Fault Hd0 cc HW Error	0024H	CC (current clamp) hardware error	5	FF07H
37	HAND Fault Hd1 oc HW Error	0025H	OC hardware error	5	FF08H
40	HAND Fault AUE Auto tuning Err	0028H	Motor parameters auto-tuning error	1	FF21H
48	HAND Fault ACE ACI loss	0030H	ACI loss	1	FF25H
49	HAND Fault EF External Fault	0031H	External Fault; when the multi-function input terminal (EF) is active, the AC motor drive stops output.	5	9000H
50	HAND Fault EF1 Emergency stop	0032H	Emergency stop; when the multi-function input terminal (EF1) is active, the AC motor drive stops output.	5	9000H
51	HAND Fault bb Base block	0033H	External Base Block; when the multi-function input terminal (B.B.) is active, the AC motor drive stops output.	5	9000H
52	HAND Fault Pcod Password Error	0034H	Keypad is locked after you enter the wrong password three times.	5	FF26H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
54	HAND Fault cE1 Modbus CMD err	0036H	Modbus function code error (illegal function code)	4	7500H
55	HAND Fault cE2 Modbus ADDR err	0037H	Modbus data address error [illegal data address (00 H–254 H)]	4	7500H
56	HAND Fault cE3 Modbus DATA err	0038H	Modbus data error (illegal data value)	4	7500H
57	HAND Fault cE4 Modbus slave FLT	0039H	Modbus communication error (data is written to read-only address)	4	7500H
58	HAND Fault cE10 Modbus time out	003AH	Modbus transmission time-out	4	7500H
59	HAND Fault CP10 Keypad Time Out	003BH	Keypad transmission time-out	4	7500H
61	HAND Fault ydc Y-delta connect	003DH	Y-connection / Δ-connection switch error	2	3330H
62	HAND Fault dEb Dec. Energy back	003EH	Energy regeneration when decelerating	2	FF27H
63	HAND Fault oSL Over slip Error	003FH	Motor slip exceeds Pr.07-29 setting and exceeds Pr.07-30 time setting.	7	FF28H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
72	HAND Fault STL1 STO Loss 1	0048H	S1–DCM internal loop detection error	5	FF30H
74	HAND Fault MCF Control Fail	004AH	Magnetic contactor error	5	FF2FH
75	HAND Fault MBF Mech. Brake Fail	004BH	Mechanical brake error	5	7110H
76	HAND Fault STo STO	004CH	Safe Torque Off function active	5	FF31H
77	HAND Fault STL2 STO Loss 2	004DH	S2–DCM internal loop detection error	5	FF32H
78	HAND Fault STL3 STO Loss 3	004EH	S1–DCM & S2–DCM internal loop detection error	5	FF33H
79	HAND Fault Aoc U phase oc	0050H	U-phase short circuit	1	FF2BH
80	HAND Fault boc V phase oc	0051H	V-phase short circuit	1	FF2CH
81	HAND Fault coc W phase oc	0050H	W-phase short circuit	1	FF2DH

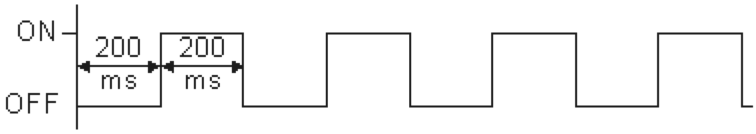
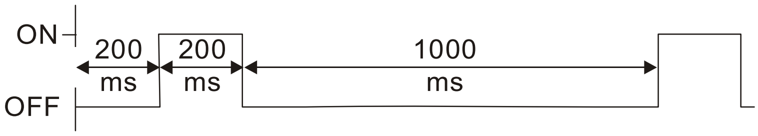
Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
82	HAND Fault oPL1 U phase lacked	0052H	Output phase loss 1 (Phase U)	2	2331H
83	HAND Fault oPL2 V phase lacked	0053H	Output phase loss 2 (Phase V)	2	2332H
84	HAND Fault oPL3 W phase lacked	0054H	Output phase loss 3 (Phase W)	2	2333H
87	HAND Fault oL3 Derating Error	0057H	Over-load protection at low frequency	0	8A00H
101	HAND Fault CGdE Guarding T-out	0065H	CANopen guarding error	4	8130H
102	HAND Fault CHbE Heartbeat T-out	0066H	CANopen heartbeat error	4	8130H
104	HAND Fault CbFE CAN/S bus off	0068H	CANopen bus off error	4	8140H
105	HAND Fault CIdE CAN/S Idx exceed	0069H	CANopen index error	4	8100H
106	HAND Fault CAdE CAN/S add. set	006AH	CANopen station address error	4	8100H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
107	HAND Fault CFrE CAN/S FRAM fail	006BH	CANopen memory error	4	8100H
111	HAND Fault ictE InrCOM Time Out	006FH	InrCOM internal communication special error code	4	7500H
127	HAND Fault CP33 CP 33	0081H	Firmware version error	7	FF3CH
140	HAND Fault Hd6 GFF HW error	008EH	GFF detected at power on	1	2240H
141	HAND Fault BGFF BeforeRUN GFF	0090H	GFF occurs before running	1	2240H
142	HAND Fault AUE1 Auto tuning Err1	0091H	Auto-tune error 1 (in DC test stage)	1	FF3DH
143	HAND Fault AUE2 Auto tuning Err2	0092H	Auto-tune error 2 (high frequency test stage)	1	FF3EH
144	HAND Fault AUE3 Auto tuning Err3	0093H	Auto-tune error 3 (rotary test stage)	1	FF3FH

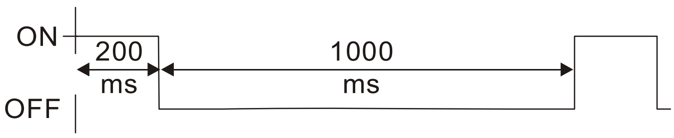
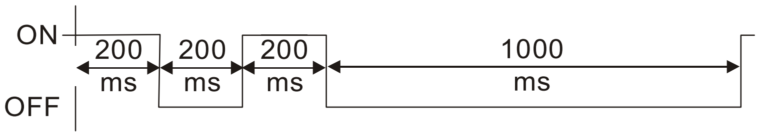
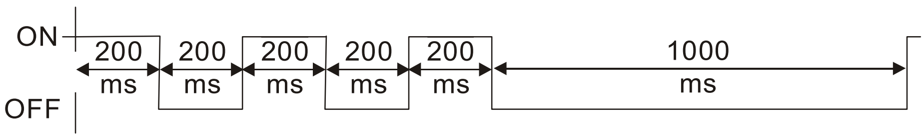
16-6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.

RUN LED:

LED status	Condition	CANopen Status
OFF	Keep lighting off	Initial
Blinking		Pre-operation
Single flash		Stopped
ON	Keep lighting on	Operation

ERR LED:

LED status	Condition / Status
OFF	No Error
Single flash	One Message failure 
Double flash	Guarding failure or heartbeat failure 
Triple flash	SYNC failure 
ON	Bus off

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Chapter 17 Safe Torque Off Function

17-1 Basic Function Description

MH300-L series provides a Safe Torque Off (STO, Safe Torque Off) function. Through the dual-channel S1 and S2 signal input to turn off IGBT switching, thereby preventing the generation of motor torque in order to achieve safe stop. Please refer to Figure 1 for the circuit diagram of Safe Torque Off function.

MH300-L Safe Torque Off function meets the following international specifications:

ISO 13849-1: 2015 Category 3 PL d
IEC 61508 SIL2
EN 62061 SIL CL 2
EN 60204-1 Category 0

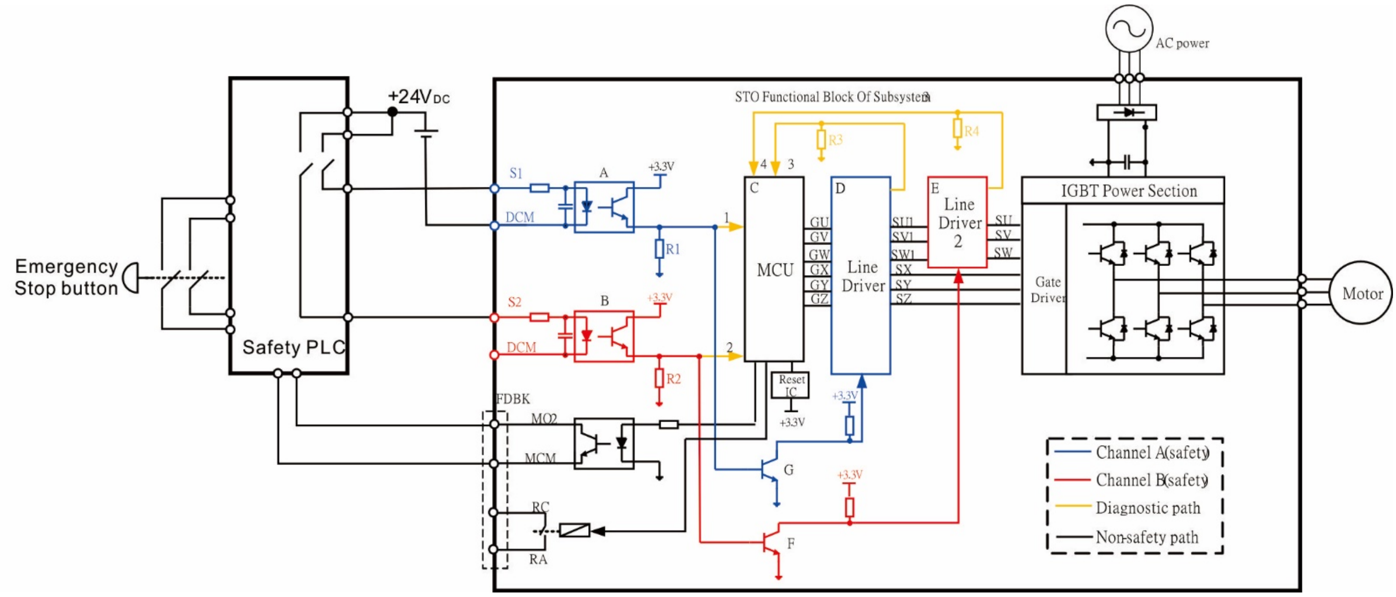

Figure 1: The circuit diagram of Safe Torque Off function

17-2 Safe Torque Off Terminal Function Description

As mentioned earlier STO (Safe torque off) related terminal functions are described in Table 1 below.

Terminals	Terminal Function	Specifications
+24V	When the STO function is not used, the STO function can be disabled by shorting S1 and S2 with + 24 V	Output voltage range: +24 V ± 10 % Output voltage capacity: 100 mA
S1	Signal input of STO function channel 1	**<u>S1–DCM / S2–DCM</u>** Rated input voltage: +24 V_{DC} ± 10 %; Max. input voltage: +30 V_{DC} ± 10 % Rated input current: 6.67 mA ± 10 % **<u>STO activation mode</u>** Input voltage level: 0 V_{DC} < S1–DCM and S2–DCM < 5 V_{DC} STO response time: ≤ 20 ms (time required for S1 / S2 operate till the drive stop outputting) **<u>STO cut-off mode</u>** Input voltage level: 11 V_{DC} < S1–DCM and S2–DCM < 30 V_{DC}
S2	Signal input of STO function channel 2	
DCM	Reference ground of S1 and S2 signal	

Table 1: Terminal function description

Action logic and keypad display after S1 / S2 signal input are described in Table 2 below.

Signal	**Status**			
S1–DCM	ON	ON	OFF	OFF
S2–DCM	ON	OFF	ON	OFF
Drive output	Ready to output	STL2 mode (Torque output off)	STL1 mode (Torque output off)	STO mode (Torque output off)
Error displayed on keypad	No error displayed	STL2	STL1	STO

Table 2: Description of action logic and keypad display

- STO means channel 1 and 2 operate simultaneously and enter Safe Torque Off.
- STL1 means channel 1 operates.
- STL2 means channel 2 operates.
- STL3 means there is error detected in the internal circuit of channel 1 or channel 2.
- S1–DCM / S2–DCM ON: means S1–DCM / S2–DCM inputs a power supply > 11 V_{DC}.
- S1–DCM / S2–DCM OFF: means S1–DCM / S2–DCM inputs a power supply < 5 V_{DC}.

17-3 Wiring Diagram

17-3-1 Internal circuit diagram of safe control loop is shown in Figure2.

17-3-2 Terminals of the safe control loop + 24V-S1-S2 are short-circuited together with jumper wire at the factory, as shown in Figure 2.

17-3-3 The safe control loop wiring diagram is as follows:

1. Remove the jumper wire of +24V-S1-S2.
2. The wiring as shown in Figure 3 below. Normally, the switch ESTOP contact must be closed, thereby the drive can output without error displayed.
3. In STO mode, the switch ESTOP is turned on. The drive stops outputting and keypad displays STO.

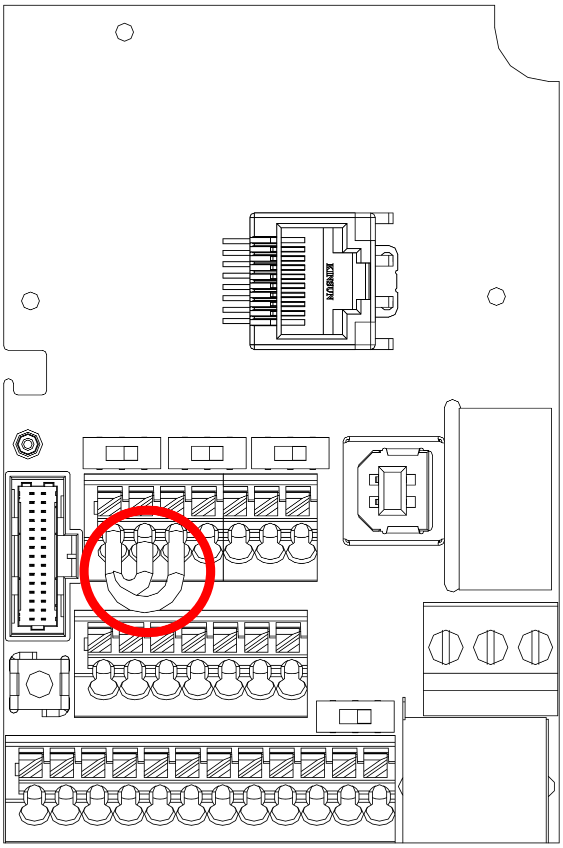

Figure 2

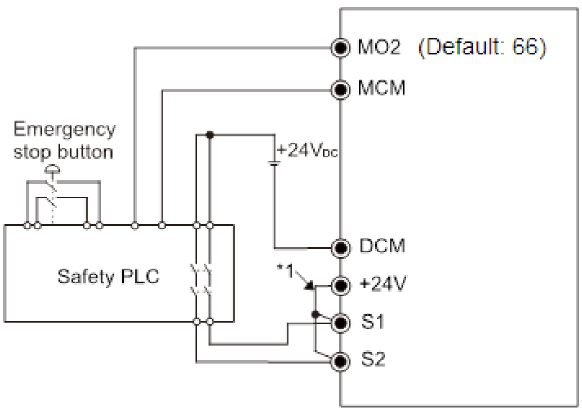

Figure 3

NOTE

*1 is factory jumper wire of +24V-S1-S2. To use the Safety function, please remove this jumper wire. Conversely, if the Safety function is disabled, then +24V-S1-S2 should be short-circuit with jumper wire.

17-4 Failure Rate of the Drive Safety Function

Please refer to Table 3 below for relevant safe parameters of safe loop:

Item	Definition	Standard	Performance
SFF	Safe failure fraction	IEC61508	S1–DCM = 88.35 % S2–DCM = 88.2 %
HFT (Type A subsystem)	Hardware fault tolerance	IEC61508	1
SIL	Safety integrity level	IEC61508	SIL 2
		IEC62061	SILCL 2
PFH	Average frequency of dangerous failure [h-1]	IEC61508	1.36×10^{-9}
PFD_{av}	Probability of dangerous failure on demand	IEC61508	5.99×10^{-6}
PTI	Proof test interval	IEC61508	1 year
Category	Category	ISO13849-1	Category 3
PL	Performance level	ISO13849-1	d
$MTTF_d$	Mean time to dangerous failure	ISO13849-1	High
DC	Diagnostic coverage	ISO13849-1	Low

Table 3: Relevant safe parameters of safe loop

17-5 Reset the Parameter Settings

Pr. 06-44 can be used to set the reset method when an STO alarm occurs.

06-44 STO Latch Selection

Default: 0

Settings 0: STO Latch
1: STO no Latch

- Pr. 06-44 = 0 STO Alarm Latch: after the reason of STO Alarm is cleared, a Reset command is needed to clear STO Alarm.
- Pr. 06-44 = 1 STO Alarm no Latch: after the reason of STO Alarm is cleared, the STO Alarm will be cleared automatically.
- All of STL1–STL3 error are “Alarm latch” mode (in STL1–STL3 mode, the Pr. 06-44 function is not effective).

17-6 Timing Diagram Description

The following timing diagram shows the status of relevant signals under different conditions:

17-6-1 Normal operation status

As shown in Figure 4: When S1–DCM and S2–DCM is ON (STO function is not required), the drive will execute “Operating” or “Output Stop” according to RUN command.

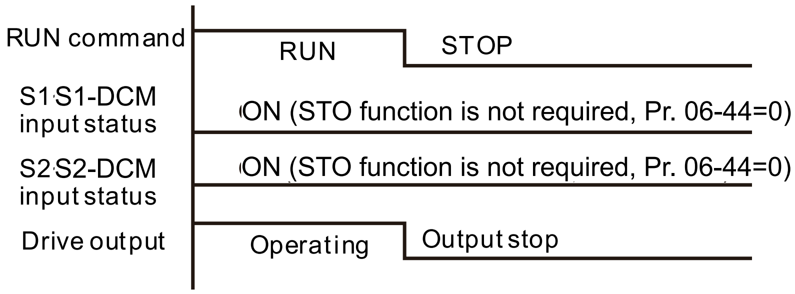

Figure **4**

17-6-2-1 STO, Pr. 06-44=0, Pr. 02-35=0 (Selection of external control operation after reset / power on, 0=not valid)

As shown in Figure 5: When both of S1–DCM and S2–DCM are OFF during operation (STO function is required), the drive will stop outputting when enter safe mode regardless of Run command is ON or OFF status.

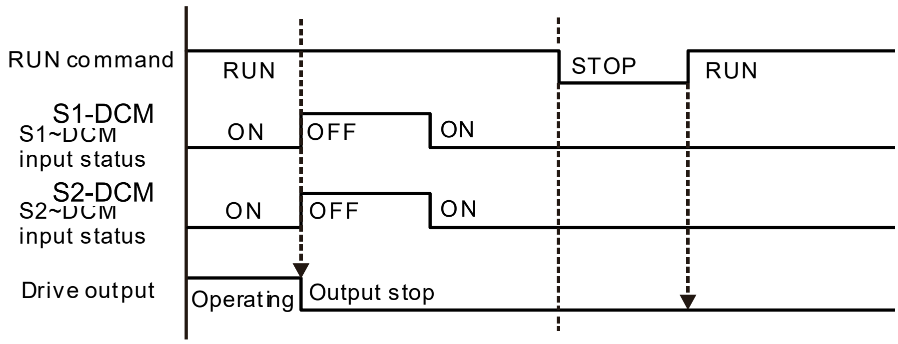

Figure **5**

17-6-2-2 STO, Pr. 06-44=0, Pr. 02-35=1 (Selection of external control operation after reset / power on, 1= the drive will execute RUN if command exists after reset)

As shown in Figure 6, the action is the same as in Figure 5. However, because Pr. 02-35=1, if RUN command still exists after reset, the drive will execute run command again immediately.

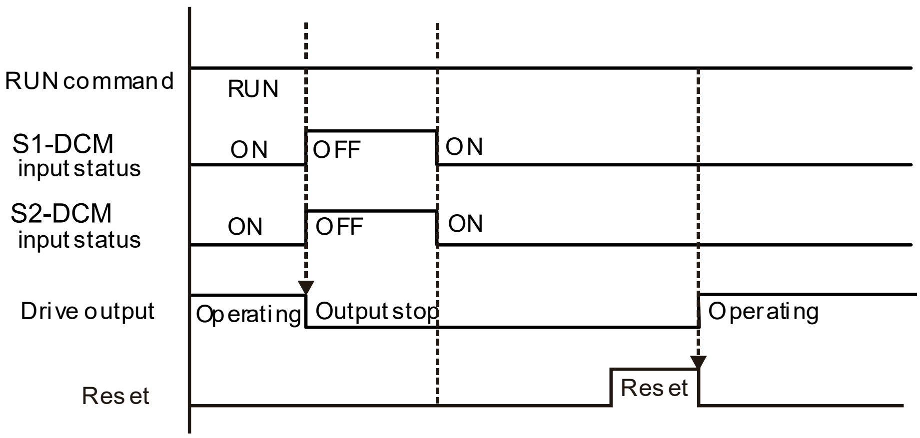

Figure 6

17-6-3 STO, Pr. 06-44=1

As shown in Figure 7: When both of S1–DCM and S2–DCM are OFF during operation (STO function is required), the drive will stop outputting. When the S1 / S2 status is restored (ON), the STO automatic alarm is automatically cleared. The drive can output when RUN command is released again.

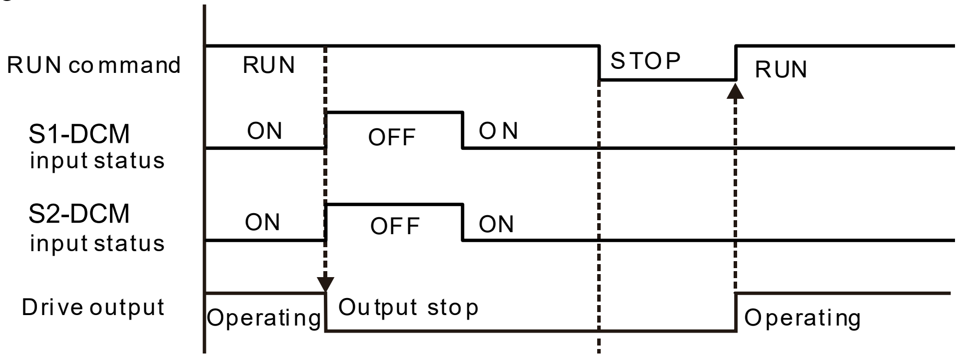

Figure 7

17-6-4 STL1, Pr. 06-44=0 or 1

As shown in Figure 8: When S1–DCM is OFF during operation (STO function is required) and S2–DCM is ON (STO function is not required), the drive will stop outputting and keypad will show STL1 error. However, STL1 error cannot be reset even if the S1 status is restored (ON) regardless of the parameter setting. Turn the power on after power off to reset, thereby the drive can restore to normal standby state.

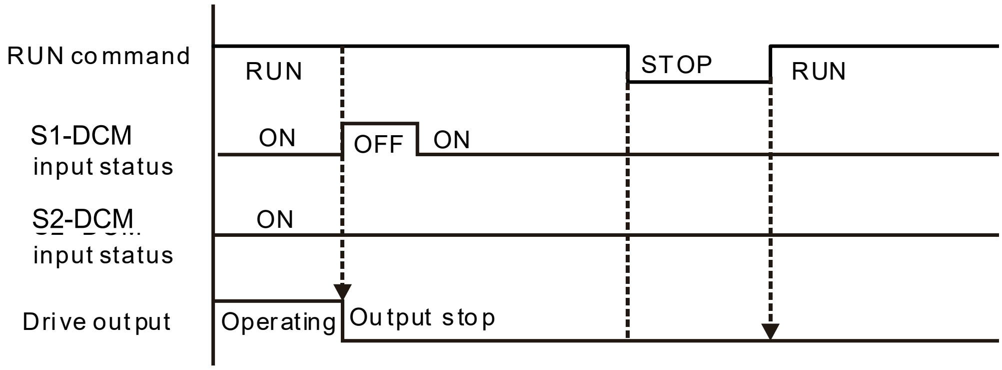

Figure 8

17-6-5 STL2, Pr. 06-44=0 or 1

As shown in Figure 9: When S1–DCM is ON during operation (STO function is not required) and S2–DCM is OFF (STO function is required), the drive will stop outputting and keypad will show STL2 error. However, STL2 error cannot be reset even if the S2 status is restored (ON) regardless of the parameter setting. Turn the power on after power off to reset, thereby the drive can restore to normal standby state.

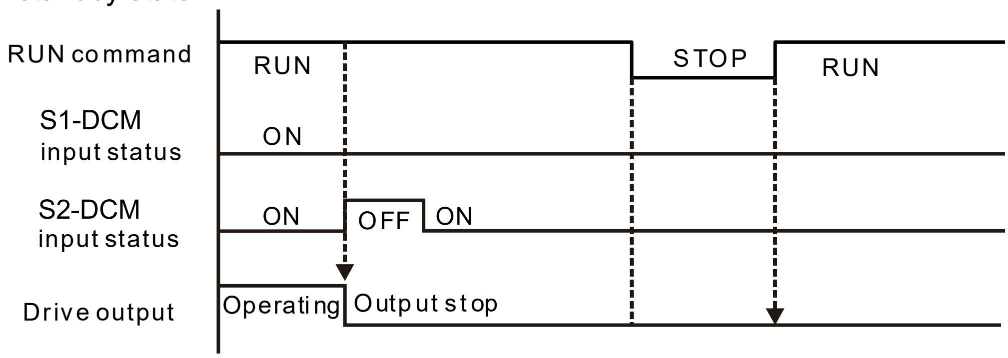

Figure 9

17-7 Error Code and Troubleshooting Instructions

17-7-1 Error Code Description

Refer to Pr.06-17–Pr.06-22 for fault record, wherein STO relevant error code is 72/76/77/78, the definition is as follows and Table 4:

06-17	Fault Record 1
06-18	Fault Record 2
06-19	Fault Record 3
06-20	Fault Record 4
06-21	Fault Record 5
06-22	Fault Record 6

Default: 0

Display
72: Channel 1 (S1–DCM) safety loop error (STL1)
76: Safe torque off (STo)
77: Channel 2 (S2–DCM) safety loop error (STL2)
78: Internal loop error (STL3)

Error code	Name	Description
76 (STO)	Safe torque off	Safe torque off function active
72 (STL1)	Channel 1 (S1–DCM) safety loop error	S1[This page intentionally left blank]DCM internal loop detected error
77 (STL2)	Channel 2 (S2–DCM) safety loop error	S2[This page intentionally left blank]DCM internal loop detected error
78 (STL3)	Internal loop error	S1[This page intentionally left blank]DCM and S2–DCM internal loop detected error

Table 4: Error code description

17-7-2 Troubleshooting Instructions

Refer to the following instructions for troubleshooting when STO / STL1 / STL2 / STL3 shows on keypad. (Refer to Chapter 14 Error Codes)

ID No.	KPMH-LC01 Display	Descriptions
72	STL1	S1–DCM internal loop detected error Corrective Actions ■ Check wiring of S1 terminal. ■ Reset emergency switch (ON: activated) and re-power ■ Check the input voltage to maintain at least 11 V. ■ Check the wiring of S1 and +24 V terminal. ■ After make sure all the wiring is correct, if STL1 fault still exists after re-power, please contact Delta.
76	STo	Safe torque off function active Corrective Actions ■ Check wiring of S1 and S2 terminal. ■ Reset emergency switch (ON: activated) and re-power. ■ Check the input voltage to maintain at least 11 V. ■ Check the wiring of S1 / S2 and +24 V terminal. ■ After make sure all the wiring is correct, if STO fault still exists after re-power, please contact Delta.
77	STL2	S2–DCM internal loop detected error. Corrective Actions ■ Check wiring of S2 terminal. ■ Reset emergency switch (ON: activated) and re-power. ■ Check the input voltage to maintain at least 11 V. ■ Check the wiring of S2 and +24 V terminal. ■ After make sure all the wiring is correct, if STL2 fault still exists after re-power, please contact Delta.
78	STL3	Internal loop detected error. Corrective Actions ■ After make sure the wiring is correct, if STL3 fault still exists after re-power, please contact Delta.

17-8 Test and Fault Confirmation

After wiring in accordance with Section 18-3 Wiring Diagram, please follow the steps below to check whether STO and related detection function are normal.

1. When the drive is powered on, make sure that S1–DCM and S2–DCM voltage falls between 11–30 V_{DC}, at this time, the drive should enter standby mode and waits for RUN command. There is no error displayed on keypad.
2. Press RUN command on the drive, use the emergency button or other methods to make S1–DCM and S2–DCM voltage falls between 0–5 V_{DC} simultaneously after the output frequency is reached, at this time, the drive should enter torque stop mode STO and stop outputting voltage. Keypad displays STO error, and the response time of S1 and S2 signals to the drive stops outputting voltage should be ≤ 20 ms. Then restore S1–DCM and S2–DCM voltage to 11–30 V_{DC}, press RESET button on keypad and STO error will be cleared. The drive should enter standby mode and waits for RUN command.
3. Press RUN command on the drive, use the emergency button or other methods to make S1–DCM voltage fall between 0–5 V_{DC}, and S2–DCM voltage maintain between 11–30 V_{DC} after the output frequency is reached, at this time, the drive should enter torque stop mode STL1 and stop outputting voltage. Keypad displays ST1 error, and the response time of S1 signals to the drive stops outputting voltage should be ≤ 20 ms. Then restore S1–DCM voltage to 11–30 V_{DC}, however press RESET button on keypad cannot clear STL1 error, the drive needs to be re-powered. Make sure that S1–DCM and S2–DCM voltage falls between 11–30 V_{DC} and then re-power the drive, thus STL1 error will be cleared. The drive should enter standby mode and waits for RUN command.
4. Press RUN command on the drive, please use the emergency button or other methods to make S2–DCM voltage fall between 0–5 V_{DC}, and S1–DCM voltage maintain between 11–30 V_{DC} after the output frequency is reached, at this time, the drive should enter torque stop mode STL2 and stop outputting voltage. Keypad displays ST2 error, and the response time of S2 signals to the drive stops outputting voltage should be ≤ 20 ms. Then restore S2–DCM voltage to 11–30 V_{DC}, however press RESET button on keypad cannot clear STL1 error, the drive needs to be re-powered. Make sure S1–DCM and S2–DCM voltage falls between 11–30 V_{DC} and then re-power the drive, thus STL2 error will be cleared. The drive should enter standby mode and waits for RUN command.
5. If the above four steps can be conducted normally in sequence with no other error, then the safe torque off function loop is normal, as shown in Table 5 below. However, if there are situations differ from the above four steps or if STL3 occurs, the safe torque off function loop is abnormal. Please refer to 18-7 Error Code and Troubleshooting Instructions.

Signal	Status			
S1–DCM	ON	ON	OFF	OFF
S2–DCM	ON	OFF	ON	OFF
Drive output	Ready to output	STL2 mode	STL1 mode	STO mode
Error displayed on keypad	No error displayed	STL2	STL1	STO
Response time	N.A	≤ 20 ms		
RESET mechanism	N.A	Re-power the drive	Re-power the drive	Can be RESET directly

Table 5

- STO means channel 1 and 2 operate simultaneously and enter Safe Torque Off.
- STL1 means channel 1 operates.
- STL2 means channel 2 operates.
- STL3 means there is error detected in the internal circuit of channel 1 or channel 2.
- S1–DCM / S2–DCM ON: means S1–DCM / S2–DCM inputs a power supply > 11 V_{DC}.
- S1– DCM / S2–DCM OFF: means S1–DCM / S2–DCM inputs a power supply < 5 V_{DC}.

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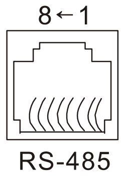
Appendix A. Modbus Protocol

- This appendix helps users to control by computers and monitor drive parameters and status through Modbus by using RS-485 serial communication interface
- When using the communication interface, the diagram on the right shows the communication port pin definitions. It is recommended that you connect the AC motor drive to your PC by using Delta IFD6530 or IFD6500 as a communication converter.



Modbus RS-485
PIN 1: CAN_H
PIN 2: CAN_L
PIN 3, 7: SGND
PIN 4: SG-
PIN 5: SG+
PIN 6: Reserved
PIN 8: +10VS

- The default communication formats for communication port:
  1. Modbus ASCII mode
  2. 9600 bps serial communication baud rates
  3. 7-bit data character
  4. No calibration
  5. 2 stop bit
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex)

A-1 Code Description

The communication protocol is in hexadecimal, ASCII: "0"…"9", "A"…"F", every hexadecimal value represents an ASCII code. The following table shows some examples.

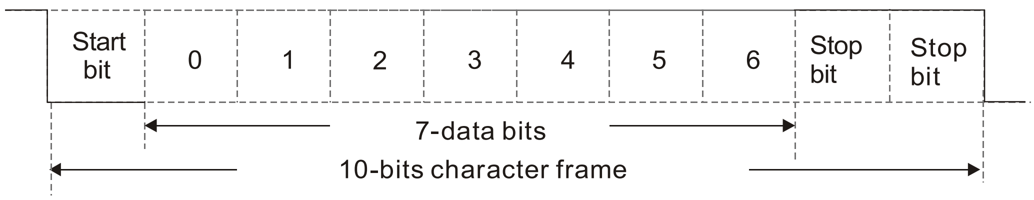
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

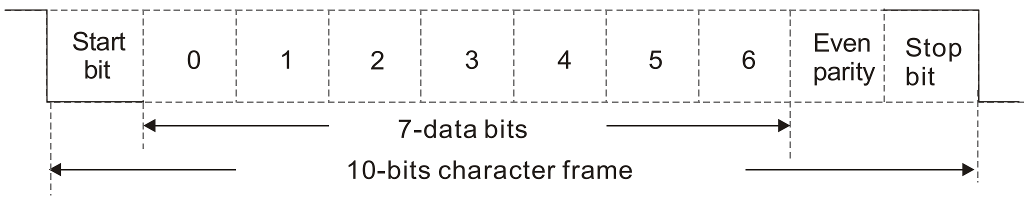
A-2 Data Format

10-bit character frame (For ASCII):

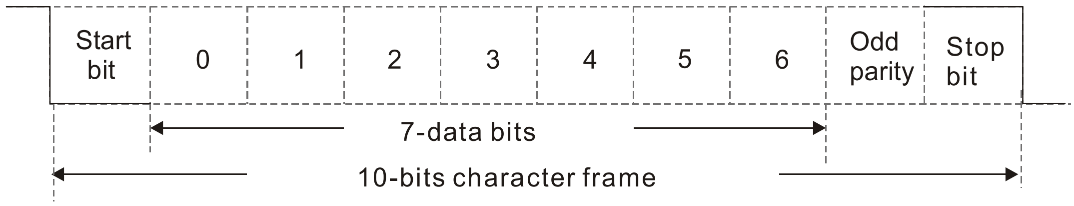
(7, N, 2)



(7, E, 1)

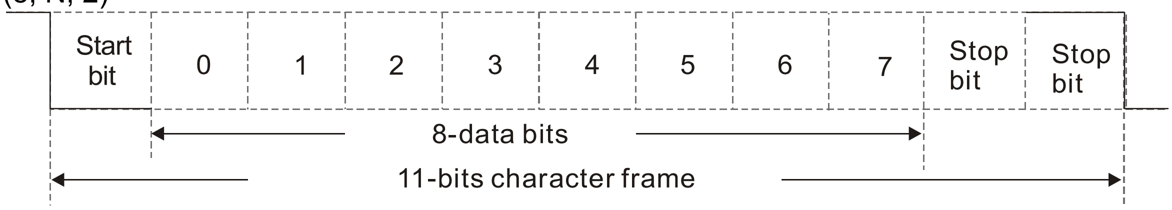


(7, O, 1)

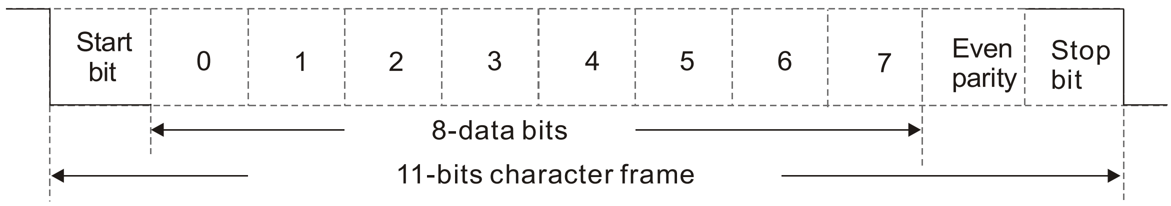


11-bit character frame (For RTU):

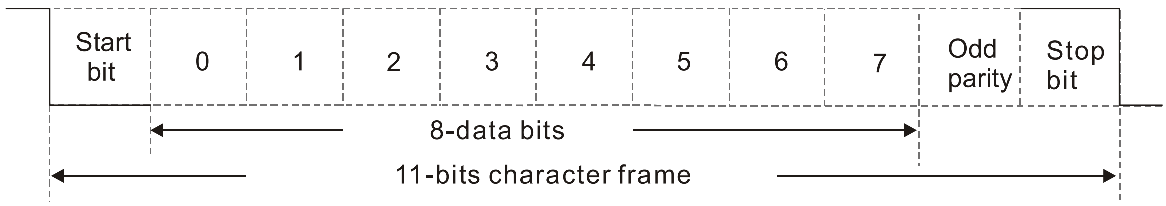
(8, N, 2)



(8, E, 1)



(8, O, 1)



A-3 Communication Protocol

1. Communication data frame

ASCII mode:

STX	Start character = ':' (3AH)
Address High	Communication address: one 8-bit address consists of 2 ASCII codes
Address Low	
Function High	Command code: one 8-bit command consists of 2 ASCII codes
Function Low	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
…….	
DATA 0	
LRC Check High	LRC checksum: one 8-bit checksum consists of 2 ASCII codes
LRC Check Low	
END High	End characters: END Hi = CR (0DH), END Lo = LF(0AH)
END Low	

RTU mode:

START	Defined by a silent interval of larger than / equal to 3.5 char
Address	Communication address: 8-bit binary address
Function	Command code: 8-bit binary command
DATA (n-1)	Contents of data: N × 8-bit data, n ≤ 16
…….	
DATA 0	
CRC Check Low	CRC checksum: one 16-bit CRC checksum consists of 2 8-bit binary characters
CRC Check High	
END	Defined by a silent interval of larger than / equal to 3.5 char

2. Communication address (Address)

   00H: broadcast to all AC motor drives

   01H: AC motor drive of address 01

   0FH: AC motor drive of address 15

   10H: AC motor drive of address 16

   :

   FEH: AC motor drive of address 254

3. Function (function code) and data (data characters)

   03H: read data from a register

   Example: Reading two continuous data from register address 2102H, AMD address is 01H.

ASCII mode:

Command Message

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting register	'2'
	'1'
	'0'
	'2'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'7'
END	CR
	LF

Response Message

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of register (count by byte)	'0'
	'4'
Content of starting register 2102H	'1'
	'7'
	'7'
	'0'
Content of register 2103H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Command Message

Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by word)	00H
	02H
CRC Check Low	6FH
CRC Check High	F7H

Response Message

Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	00H
CRC Check Low	FEH
CRC Check High	5CH

4. 06H: single write, write single data to a register.

Example: Writing data 6000 (1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command Message

STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Target register	'0'
	'1'
	'0'
	'0'
Register content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

Response Message

STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Target register	'0'
	'1'
	'0'
	'0'
Register content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Command Message

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low	86H
CRC Check High	22H

Response Message

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low	86H
CRC Check High	22H

5. 10H: write multiple registers (can write at most 20 sets of data simultaneously).
Example: Set the multi-step speed of an AC motor drive (address is 01H),
Pr.04-00 = 50.00 (1388H), Pr.04-01 = 40.00 (0FA0H.)

ASCII mode:

Command Message

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘5’
	‘0’
	‘0’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
Number of register (count by byte)	‘0’
	‘4’
The first data content	‘1’
	‘3’
	‘8’
	‘8’
The second data content	‘0’
	‘F’
	‘A’
	‘0’
LRC Check	‘9’
	‘A’
END	CR
	LF

Response Message

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘5’
	‘0’
	‘0’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘E’
	‘8’
END	CR
	LF

RTU mode:

Command Message

ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
Quantity of data (byte)	04
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	‘9’
CRC Check High	‘A’

Response Message

ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

6. Checksum

ASCII mode (LRC Check):

LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2’s-complement negation of the sum.

Example:

01H + 03H + 21H + 02H + 00H + 02H = 29H, the 2’s-complement negation of 29H is D7H.

RTU mode (CRC Check):

CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1: Load a 16-bit register (called CRC register) with FFFFh.

Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3: Examine the LSB of CRC register.

Step 4: If the LSB of CRC register is 0, shift the CRC register one bit to the right, fill MSB with zero, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right, fill MSB with zero, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

Step 5: Repeat step 3 and 4 until you perform eight shifts. This processes a complete 8-bit byte.

Step 6: Repeat step 2 through 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, that is, the lower order byte is transmitted first.

7. The following is an example of CRC generation using C language.

Unsigned char* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

unsigned int crc_chk(unsigned char* data, unsigned char length)

```
{
        int j;
        unsigned int reg_crc=0xffff;
        while(length--){
              reg_crc ^= *data++;
              for(j=0;j<8;j++){
                    if(reg_crc & 0x01){    /* LSB(b0)=1 */
                          reg_crc=(reg_crc>>1) ^ 0xa001;
                    }else{
                          reg_crc=reg_crc >>1;
                    }
              }
        }
        return reg_crc;                              // return register CRC
 }
```

A-4 Address List

1. ASCII
   (1) Reads one or more parameter values: 3Ah (start bit‘ **:** ’) + 30h 31h (station address 01) + 30h 33h (function code 03h) + 30h 30h xxh xxh–32h 36h xxh xxh (Modbus address 00xxh–26xxh) + xxh xxh xxh xxh (reading length 1) + LRC (checksum) + CR/LF
   (2) Writes one parameter value: 3Ah (start bit‘ **:** ’) + 30h 31h (station address 01) + 30h 36h (function code 06h) + 30h 30h xxh xxh–32h 36h xxh xxh(Modbus address 00xxh–26xxh) + xxh xxh xxh xxh (writing value) + LRC (checksum) + CR/LF
   (3) Writes 20 parameter values: 3Ah (start bit‘ **:** ’) + 30h 31h (station address 01) + 31h 30h (function code 10h) + 30h 30h xxh xxh–32h 36h xxh xxh (Modbus address 00xxh–26xxh) + 30h 30h 31h 34h (word data length) + 30h 30h 32h 38h(byte data length) + xxh xxh xxh xxh (the first writing value) + ... + xxh xxh xxh xxh (the 20th writing value) + LRC (checksum) + CR/LF
2. RTU
   (1) Reads one or more parameter values: 01h (station address 01) + 03h (function code 03h) + 00xxh–26xxh (Modbus address) + xxxxh (reading length) + CRC (checksum)
   (2) Writes one parameter value: 01h (station address 01) + 06h (function code 06h) + 00xxh–26xxh (Modbus address) + xxxxh (writing value) + CRC (checksum)
   (3) Writes 20 parameter values: 01h (station address 01) + 10h (function code 10h) + 00xxh–26xxh (Modbus address) + 0014h (data length, count by word) + 0028h (data length, count by byte) + xxxxh (the first writing value) + ... + xxxxh (the 20th writing value) + CRC (checksum)

3. AC motor drive parameters (GGnnH): communication station address is Pr.09-00 setting value

Modbus Address	Attribute (Function Code)	Description
GGnnH	R(03H) / W(06H, 10H)	GG means parameter group, nn means parameter number. For example, the Modbus address of Pr.04-10 is 040AH when reading by Delta VFDsoft.

4. Control command (20xx): communication station address is Pr.09-00 setting value

<table>
<tr><th>Function Name</th><th>Modbus Address</th><th>Attribute (Function Code)</th><th>Size</th><th colspan="3">Description</th></tr>
<tr><td rowspan="15">Operation command</td><td rowspan="15">2000H</td><td rowspan="15">R (03H) / W (06H, 10H)</td><td rowspan="15">U16</td><td rowspan="4">bit1–0</td><td>00B: No function</td><td rowspan="9">1. Remains the status specified by a first command until a second command is received.
2. Valid only when operation command source is set to communication (Pr.00-03=2).</td></tr>
<tr><td>01B: Stop</td></tr>
<tr><td>10B: Run</td></tr>
<tr><td>11B: JOG + Run</td></tr>
<tr><td>bit3–2</td><td>Reserved</td></tr>
<tr><td rowspan="4">bit5–4</td><td>00B: No function</td></tr>
<tr><td>01B: FWD</td></tr>
<tr><td>10B: REV</td></tr>
<tr><td>11B: Change direction</td></tr>
<tr><td rowspan="4">bit7–6</td><td>00B: 1st accel. / decel.</td><td rowspan="6">1. Valid only when 2000h bit12 is set to 1.
2. Obtain the current running speed by reading 2107h.</td></tr>
<tr><td>01B: 2nd accel. / decel.</td></tr>
<tr><td>10B: 3rd accel. / decel.</td></tr>
<tr><td>11B: 4th accel. / decel.</td></tr>
<tr><td>bit11–8</td><td>0000B: zero step speed</td></tr>
<tr><td></td><td>0001B: 1st step speed</td></tr>
</table>

Function Name	Modbus Address	Attribute (Function Code)	Size	Description		
			U16	bit11–8	0010B: 2nd step speed	
					0011B: 3rd step speed	
					0100B: 4th step speed	
					0101B: 5th step speed	
					0110B: 6th step speed	
					0111B: 7th step speed	
					1000B: 8th step speed	
					1001B: 9th step speed	
					1010B: 10th step speed	
					1011B: 11th step speed	
					1100B: 12th step speed	
					1101B: 13th step speed	
					1110B: 14th step speed	
					1111B: 15th step speed	
				bit12	1: Enable bit06–11 function	
				bit15	Reserved	
Frequency command	2001H	R (03H) / W (06H, 10H)		Frequency command (XXX.XX Hz). There are two decimal places for general-purpose drives.		
Fault / control command source	2002H	R (03H) / W (06H, 10H)		bit0	1: External Fault (E.F.) ON	To trigger an external fault to the drive to make it stop running. Drive's stop method can be set through drive parameters.
				bit1	1: Reset	To clear the fault status
				bit2	1: Base block (B.B) ON	To trigger an external base block to the drive to suspend the operation. When bit = 0 and clear BB situation, the drive returns to the previous operation.

5. Status monitor read only (21xx): communication station address is Pr.09-00 setting value

<table>
<tr><th>Function Name</th><th>Modbus Address</th><th>Attribute (Function Code)</th><th>Size</th><th colspan="2">Description</th></tr>
<tr><td>Fault status</td><td>2100H</td><td>R(03H)</td><td rowspan="13">U16</td><td colspan="2">bit7–0: Fault code
bit15–8: Warning code</td></tr>
<tr><td rowspan="7">Drive operation status</td><td rowspan="7">2101H</td><td rowspan="7">R(03H)</td><td>bit1–0</td><td>Status of RUN / STOP
00B: Drive fully stops
(RUN indicator is OFF / STOP indicator is ON)
01B: Drive is stopping
(RUN indicator flashes / STOP indicator is ON)
10B: Drive is in standby status
(RUN indicator is ON / STOP indicator flashes)
11B: Drive is running
(RUN indicator is ON / STOP indicator is OFF)</td></tr>
<tr><td>bit2</td><td>1: JOG command</td></tr>
<tr><td>bit4–3</td><td>Operation direction
00B: FWD
(REV indicator is OFF / FWD indicator is ON)
01B: from REV to FWD
(REV indicator flashes / FWD indicator is ON)
10B: from FWD to REV
(REV indicator is ON / FWD indicator flashes)
11B: REV
(REV indicator is ON / FWD indicator is OFF)</td></tr>
<tr><td>bit8</td><td>1: Master frequency controlled by communication interface</td></tr>
<tr><td>bit9</td><td>1: Master frequency controlled by analog / external terminal signal</td></tr>
<tr><td>bit10</td><td>1: Operation command controlled by communication interface</td></tr>
<tr><td>bit11</td><td>1: Parameter locked</td></tr>
<tr><td>Frequency command</td><td>2102H</td><td>R(03H)</td><td colspan="2">Drive’s frequency command (XXX.XX Hz)</td></tr>
<tr><td>Output frequency</td><td>2103H</td><td>R(03H)</td><td colspan="2">Drive’s output frequency (XXX.XX Hz)</td></tr>
<tr><td>Output current</td><td>2104H</td><td>R(03H)</td><td colspan="2">Drive’s output current (XX.XX A). Decimal places can be referred by the high byte of 211F</td></tr>
<tr><td>DC bus voltage</td><td>2105H</td><td>R(03H)</td><td colspan="2">Drive’s DC bus voltage (XXX.X V)</td></tr>
<tr><td>Output voltage</td><td>2106H</td><td>R(03H)</td><td colspan="2">Drive’s output voltage (XXX.X V)</td></tr>
<tr><td>Multi-step speed status</td><td>2107H</td><td>R(03H)</td><td colspan="2">Drive’s current running speed step given by multi-step speed command (0 is main speed)</td></tr>
<tr><td>Counter value</td><td>2109H</td><td>R(03H)</td><td>U16</td><td colspan="2">The present value of MI</td></tr>
</table>

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Output power factor angle	210AH	R(03H)		Drive's output power factor angle (XXX.X°) (0.0–180.0°)
Power output	210FH	R(03H)		Drive's output power (X.XXX kW)
Multi-function display	2116H	R(03H)		Display the low word value (Pr.00-04) of user-defined items, the value is low 16 bits data.
Maximum user-defined value	211BH	R(03H)		Maximum Operation Frequency (Pr.01-00) or Maximum User-defined Value (Pr.00-26) ● When Pr.00-26 is 0, this value is equal to Pr.01-00 setting ● When Pr.00-26 is not 0, and the command source is keypad, this value = Pr.00-24 × Pr.00-26 / Pr.01-00 ● When Pr.00-26 is not 0, and the command source is 485, this value = Pr.09-10 × Pr.00-26 / Pr.01-00
Output current digit	211FH	R(03H)		High byte: Current digit (display)

6. Status monitor read only (22xx): communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Output current	2200H	R(03H)	U16	Display output current (A). When current is higher than 655.35, it shifts the decimal as (XXX.X A). The decimal can refer to High byte of 211F.
Counter value	2201H	R(03H)		Display counter value (c)
Output frequency	2202H	R(03H)		Actual output frequency (XXXXX Hz)
DC bus voltage	2203H	R(03H)		DC bus voltage (XXX.X V)
Output voltage	2204H	R(03H)		Output voltage (XXX.X V)
Power factor angle	2205H	R(03H)		Power angle (XXX.X)
Power output	2206H	R(03H)		Display actual motor speed kW of U, V, W (XXXX.X kW)
AVI analog input	220BH	R(03H)		Display signal of AVI analog input terminal, 0–10 V corresponds to 0.00–100.00% (1.) (see NOTE 2 in Pr.00-04)
ACI analog input	220CH	R(03H)		Display signal of ACI analog input terminal, 4–20 mA / 0–10 V corresponds to 0.00–100.00% (2.) (see NOTE 2 in Pr.00-04)
IGBT temperature	220EH	R(03H)		IGBT temperature of drive power module (XXX.XºC)
Digital input status	2210H	R(03H)		The status of digital input (ON/OFF), refer to Pr.02-12. (see NOTE 3 in Pr.00-04)
Digital output status	2211H	R(03H)		The status of digital output (ON/OFF), refer to Pr.02-18. (see NOTE 4 in Pr.00-04)
Multi-step speed	2212H	R(03H)		The multi-step speed that is executing (S)
The co-rresponding CPU pin status of digital input	2213H	R(03H)		The corresponding CPU pin status of digital input (d.) (see NOTE 3 in Pr.00-04)
The co-rresponding CPU pin status of digital output	2214H	R(03H)		The corresponding CPU pin status of digital output (O.) (see NOTE 4 in Pr.00-04)
GFF	221AH	R(03H)		GFF (XXX.XX%)
DC bus voltage ripples	221BH	R(03H)		DCBUS voltage ripples (XXX.X V)
Magnetic pole zone	221DH	R(03H)		Number of poles of a permanent magnet motor
Display of user-defined output	221EH	R(03H)		User page displays the value in physical measure
Pr.00-05 gain value	221FH	R(03H)		Output Value of Pr.00-05 (XXX.XX Hz)
Number of motor runs	2220H	R(03H)		Number of motor runs when drive operates (saves when drive stops, and resets to zero when operating.)
Operating position of the motor	2221H	R(03H)		Operating position of the motor (saves when drive stops, and resets to zero when operating.)
Running speed of fan	2222H	R(03H)		Fan speed of the drive (XXX%)
Control mode	2223H	R(03H)		Control mode of the drive 0: speed mode 1: torque mode
Frequency of carrier wave	2224H	R(03H)		Carrier frequency of the drive (XX kHz)
Drive status	2226H	R(03H)		Drive status
				bit1~0: 00b: No direction 01b: Forward 10b: Reverse

Function Name	Modbus Address	Attribute (Function Code)	Size	Description	
				bit1~0	00b: No direction 01b: Forward 10b: Reverse
				bit3~2	01b: Drive ready 10b: Error
				bit4	0b: Motor drive did not output 1b: Motor drive did output
				bit5	0b: No alarm 1b: Alarm
kWh	2229H	R(03H)		kWh display (XXXX.X)	

A-5 Exception Response

When the drive is using the communication connection, if an error occurs, the drive responds to the error code and sets the highest bit (bit 7) of the command code to 1 (function code AND 80H) then responds to the control system to signal that an error occurred.

If the keypad displays “CE-XX” as a warning message, “XX” is the error code at that time. Refer to the table of error codes for communication error for reference.

ASCII mode

STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘0’
	‘2’
LRC Check	‘7’
	‘7’
END	CR
	LF

RTU mode

Address	01H
Function	86H
Exception code	02H
CRC Check Low	C3H
CRC Check High	A1H

The explanation of exception codes:

Error code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Failure to execute this function code

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Appendix B. Revision History

New Information	
Description	Affected Chapter / Section
Add IO option card related parameters	Pr.02-71, 02-72
Add a new parameter number for initial frequency command (F) setting after stop function	Pr.02-85
Add fault retry function related parameters	Pr.06-74, 06-75, 06-77
Add VFPG control mode related parameters	1. Pr.00-11: setting value = 1 2. Parameter Group 10: 10-00, 10-01, 10-02 3. Parameter Group 11: 11-06, 11-07
Add a new function for detecting the drive output phase loss named MPHL	1. Pr.06-17–Pr.06-22: no.91 2. Chapter 13 3. Chapter 14

Updated Information	
Description	Affected Chapter / Section
Correct upper limit of the maximum output frequency of drive to be 299.00 Hz	1. 1-1 Nameplate 2. Chapter 9: General Specifications 3. 10-3: General Mode 2 in B. parts 4. Parameter Group 01: 01-00, 01-01, 01-03, 01-05, 01-07, 01-09, 01-10, 01-11, 01-22, 01-23, 01-28, 01-29, 01-30, 01-31, 01-32, 01-33, 01-71 5. Parameter Group 02: 02-22, 02-23, 02-23, 02-24, 02-25, 02-83, 02-85 6. Parameter Group 04: 04-00, 04-01, 04-02, 04-03, 04-04, 04-05, 04-06, 04-07, 04-08, 04-09, 04-10, 04-11, 04-12, 04-13, 04-14 7. Parameter Group 05: 05-23 8. Parameter Group 06: 06-31, 06-32, 06-81 9. Parameter Group 07: 07-04, 07-16, 07-18
Delete PLC related parameters	1. 10-2: PLC0 2. 10-3: Setting PLC Mode 3. Pr.00-02: setting value = 6 4. Pr.00-19 5. Pr.02-01~02-07, 02-26~02-28: setting value = 51, 52 6. Pr.02-52 7. Pr.02-53 8. Pr.03-30 9. Pr.04-50–Pr.04-69 10. Pr.09-33 11. Pr.09-35
Change the corresponding parameter number for the parameter named Initial Frequency Command (F) Setting after Stop	Pr.02-82: setting value = 2
Change the parameter name	Pr.02-83
Revise SINK(NPN) / SOURCE(PNP) mode wiring to be the same as MH300	1. Chapter 4 2. Chapter 6
Revise the specification of the ring lug	5-2 Main Circuit Terminals
Revise the corresponding zero-phase reactor for EMC filter	7-6 EMC Filter
Move Modbus protocol related information in Pr.09-04 to be a new chapter	Appendix A

Smarter. Greener. Together.

Industrial Automation Headquarters

Delta Electronics, Inc.
Taoyuan Technology Center
No.18, Xinglong Rd., Taoyuan District,
Taoyuan City 330477, Taiwan
TEL: +886-3-362-6301 / FAX: +886-3-371-6301

Asia

Delta Electronics (Shanghai) Co., Ltd.
No.182 Minyu Rd., Pudong Shanghai, P.R.C.
Post code : 201209
TEL: +86-21-6872-3988 / FAX: +86-21-6872-3996
Customer Service: 400-820-9595

Delta Electronics (Japan), Inc.
Industrial Automation Sales Department
2-1-14 Shibadaimon, Minato-ku
Tokyo, Japan 105-0012
TEL: +81-3-5733-1155 / FAX: +81-3-5733-1255

Delta Electronics (Korea), Inc.
1511, 219, Gasan Digital 1-Ro., Geumcheon-gu,
Seoul, 08501 South Korea
TEL: +82-2-515-5305 / FAX: +82-2-515-5302

Delta Energy Systems (Singapore) Pte Ltd.
4 Kaki Bukit Avenue 1, #05-04, Singapore 417939
TEL: +65-6747-5155 / FAX: +65-6744-9228

Delta Electronics (India) Pvt. Ltd.
Plot No.43, Sector 35, HSIIDC Gurgaon,
PIN 122001, Haryana, India
TEL: +91-124-4874900 / FAX: +91-124-4874945

Delta Electronics (Thailand) PCL.
909 Soi 9, Moo 4, Bangpoo Industrial Estate (E.P.Z),
Pattana 1 Rd., T.Phraksa, A.Muang,
Samutprakarn 10280, Thailand
TEL: +66-2709-2800 / FAX: +66-2709-2827

Delta Electronics (Australia) Pty Ltd.
Unit 2, Building A, 18-24 Ricketts Road,
Mount Waverley, Victoria 3149 Australia
Mail: IA.au@deltaww.com
TEL: +61-1300-335-823 / +61-3-9543-3720

Americas

Delta Electronics (Americas) Ltd.
5101 Davis Drive, Research Triangle Park, NC 27709, U.S.A.
TEL: +1-919-767-3813

Delta Electronics Brazil Ltd.
Estrada Velha Rio-São Paulo, 5300 Eugênio de
Melo - São José dos Campos CEP: 12247-004 - SP - Brazil
TEL: +55-12-3932-2300 / FAX: +55-12-3932-237

Delta Electronics International Mexico S.A. de C.V.
Gustavo Baz No. 309 Edificio E PB 103
Colonia La Loma, CP 54060
Tlalnepantla, Estado de México
TEL: +52-55-3603-9200

EMEA

Delta Electronics (Netherlands) B.V.
Sales: Sales.IA.EMEA@deltaww.com
Marketing: Marketing.IA.EMEA@deltaww.com
Technical Support: iatechnicalsupport@deltaww.com
Customer Support: Customer-Support@deltaww.com
Service: Service.IA.emea@deltaww.com
TEL: +31(0)40 800 3900

Delta Electronics (Netherlands) B.V.
Automotive Campus 260, 5708 JZ Helmond, The Netherlands
Mail: Sales.IA.Benelux@deltaww.com
TEL: +31(0)40 800 3900

Delta Electronics (Netherlands) B.V.
Coesterweg 45, D-59494 Soest, Germany
Mail: Sales.IA.DACH@deltaww.com
TEL: +49 2921 987 238

Delta Electronics (France) S.A.
ZI du bois Challand 2, 15 rue des Pyrénées,
Lisses, 91090 Evry Cedex, France
Mail: Sales.IA.FR@deltaww.com
TEL: +33(0)1 69 77 82 60

Delta Electronics Solutions (Spain) S.L.U
Ctra. De Villaverde a Vallecas, 265 1º Dcha Ed.
Hormigueras – P.I. de Vallecas 28031 Madrid
TEL: +34(0)91 223 74 20

Carrer Llacuna 166, 08018 Barcelona, Spain
Mail: Sales.IA.Iberia@deltaww.com

Delta Electronics (Italy) S.r.l.
Via Meda 2–22060 Novedrate(CO)
Piazza Grazioli 18 00186 Roma Italy
Mail: Sales.IA.Italy@deltaww.com
TEL: +39 039 8900365

Delta Greentech Elektronik San. Ltd. Sti. (Turkey)
Şerifali Mah. Hendem Cad. Kule Sok. No:16-A
34775 Ümraniye – İstanbul
Mail: Sales.IA.Turkey@deltaww.com
TEL: + 90 216 499 9910

Eltek Dubai (Eltek MEA DMCC)
OFFICE 2504, 25th Floor, Saba Tower 1,
Jumeirah Lakes Towers, Dubai, UAE
Mail: Sales.IA.MEA@deltaww.com
TEL: +971(0)4 2690148

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