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DELTA_IA-MDS_VFD-ED_UM_EN_20230614

Digitized Automation for a Changing World

Delta Elevator Drive
VFD-ED Series User Manual

www.deltaww.com

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(Translation of the original instructions)

READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

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

☑ Even if the power has been turned off, a charge may still remain in the DC-link capacitors with hazardous voltages before the POWER LED is OFF. Do NOT touch the internal circuits and components.

☑ 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 U/T1, V/T2, and W/T3 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 for AC motor drive must be ≤ 240V for 230V models (480V for 460V models) and the mains supply current capacity must be ≤ 5000A RMS (≤ 10000A RMS for the ≥ 40HP (30kW) models).

☑ 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: 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: 00
Firmware Version: V1.11 (Refer to Pr.00-06 on the product for the firmware version.)
Issued Date: June, 2023

Chapter 1 Introduction

After you receive the AC motor drive, check 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 corresponds with the part number indicated on the nameplate.
2. Make sure that the voltage for the wiring is in the range indicated on the nameplate. Install the AC motor drive according to this manual.
3. Before applying the power, make sure that all the devices, including power, motor, control board and digital keypad are connected correctly.
4. When wiring the AC motor drive, make sure that the wiring for input terminals “R/L1, S/L2, T/L3” and output terminals “U/T1, V/T2, W/T3” is correct to prevent drive damage.
5. When power is applied, select the language and set parameter groups with the digital operation panel (KPED-LE01). When executing a trial run, begin with a low speed and then gradually increase the speed until reaching the desired speed.

1-1 Nameplate Information

This example uses the 15HP/11kW 230V, three-phase motor drive.

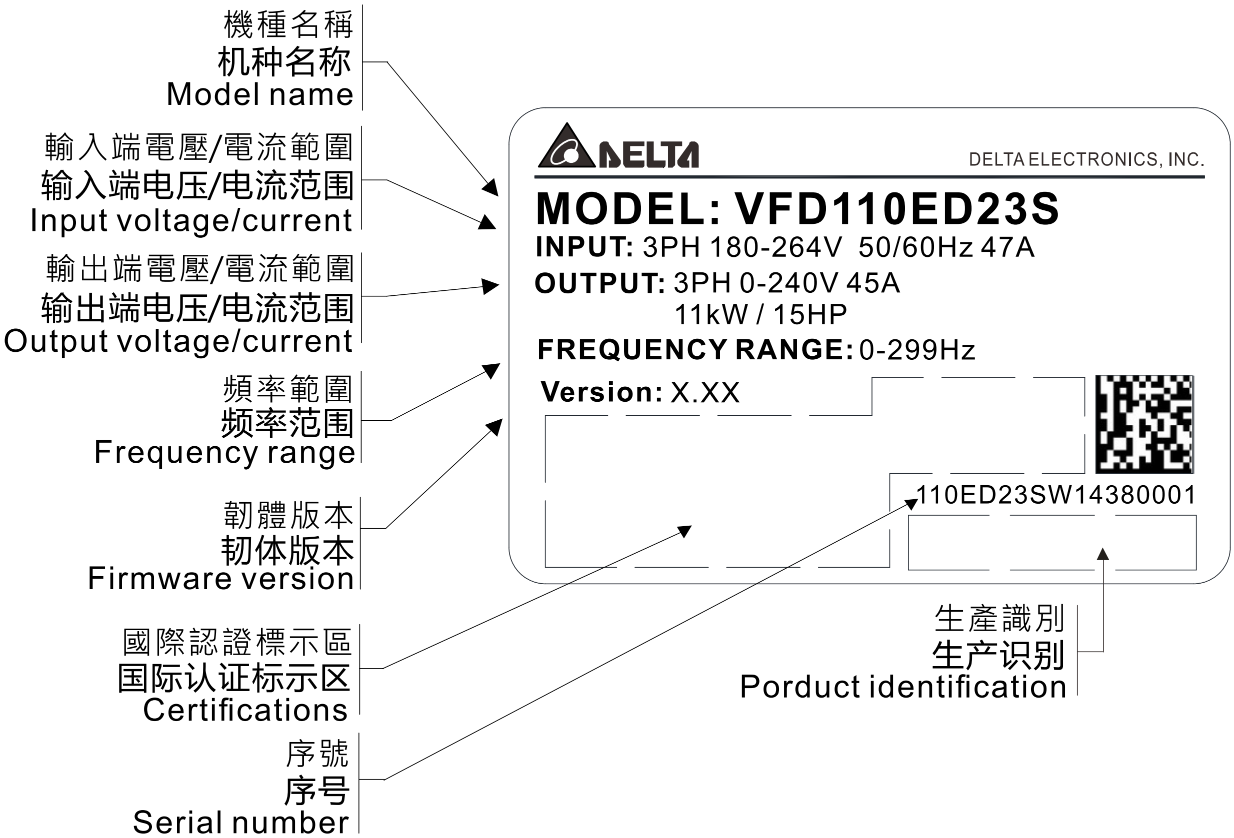


Figure 1-1

1-2 Model Name

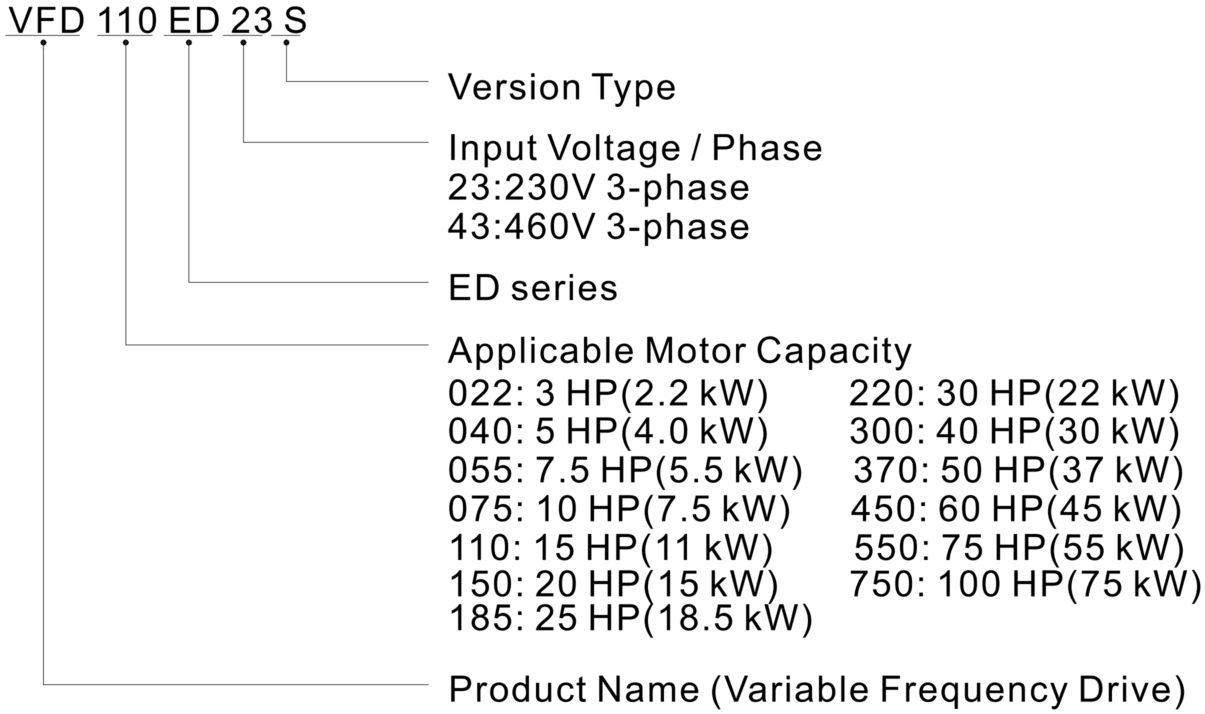


Figure 1-2

1-3 Serial Number

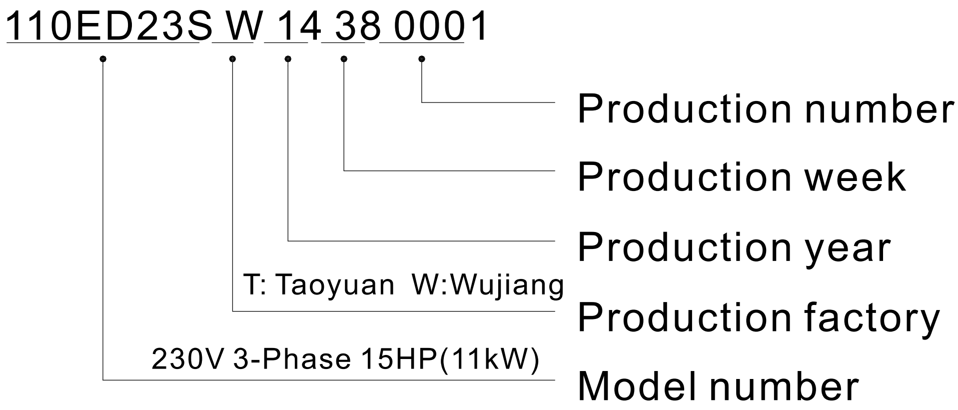


Figure 1-3

1-4 Apply After-sales Service by Mobile Device

1-4-1 Location of Service Link Label

Frame B

Figure 1-4 below shows the service link label (service label) that is located on the side of the case.

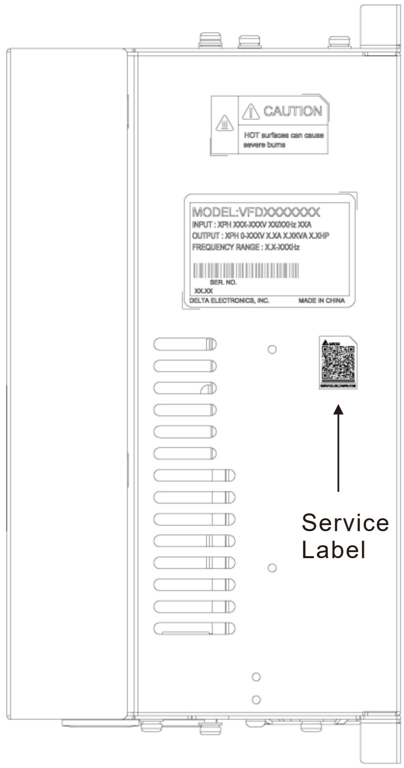


Figure 1-4

Frame C

Remove the front cover of the case to find the service link label (service label) located on the upper left corner as shown in Figure 1-5 below.

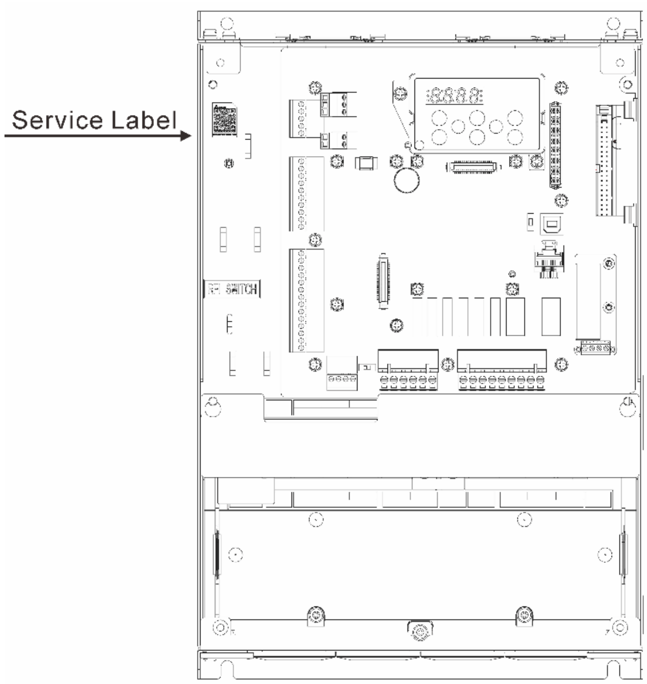


Figure 1-5

Frame D

Remove the front cover of the case to find the service link label (service label) located on the upper left corner as shown in Figure 1-6 below.

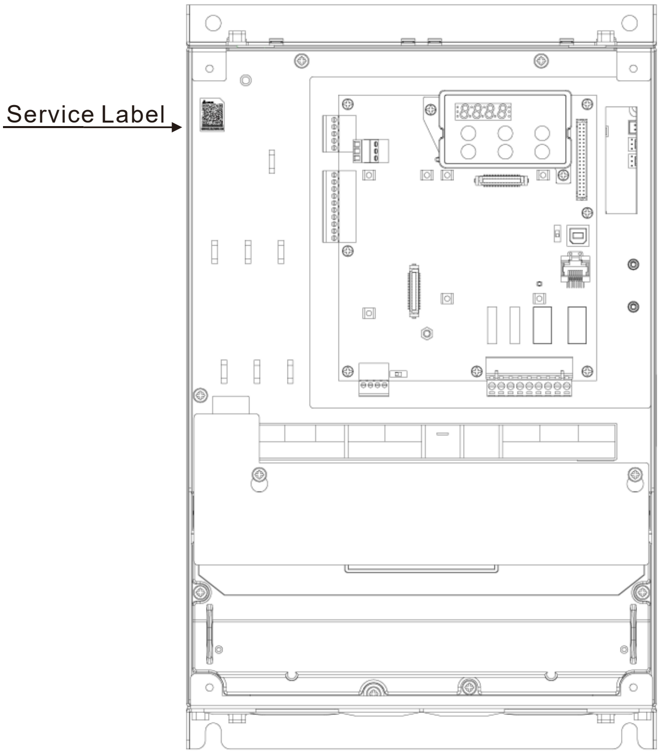


Figure 1-6

Frame E

Remove the front cover of the case to find the service link label (service label) located on the upper left corner as shown in Figure 1-7 below.

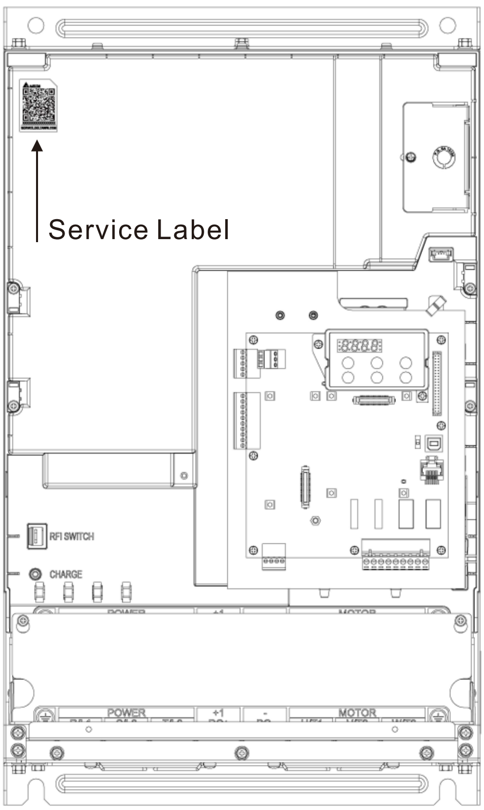


Figure 1-7

1-4-2 Service Link Label

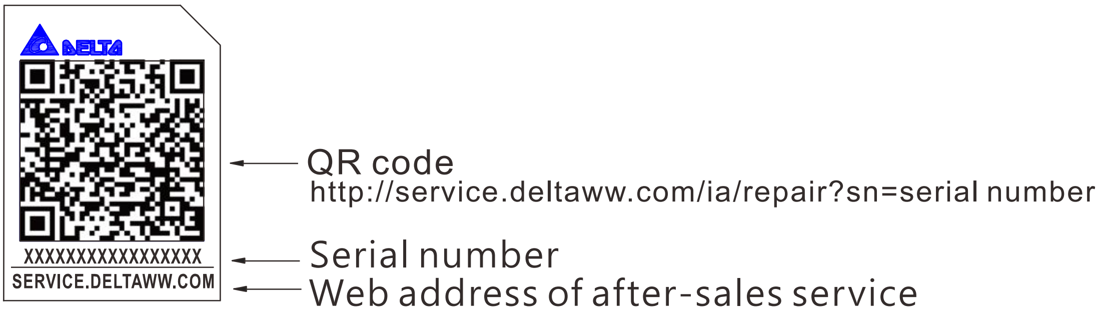


Figure 1-8

Scan QR Code to request service

1. Find the QR code sticker (as Figure 1-8 shows above).
2. Run the QR code reader App on your smartphone.
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 in the information in the columns marked with an orange star.
6. Enter the CAPTCHA and click **Submit** to complete the request.

Cannot find the QR Code?

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

1-5 RFI Switch

The AC motor drive may emit electrical noise. You can use the RFI (Radio Frequency Interference) switch to suppress interference on the power line. The RFI switches on Frames B, C, D, E are at similar locations. Open the drive's top cover to remove the RFI switch as shown in Figure 1-9 below.

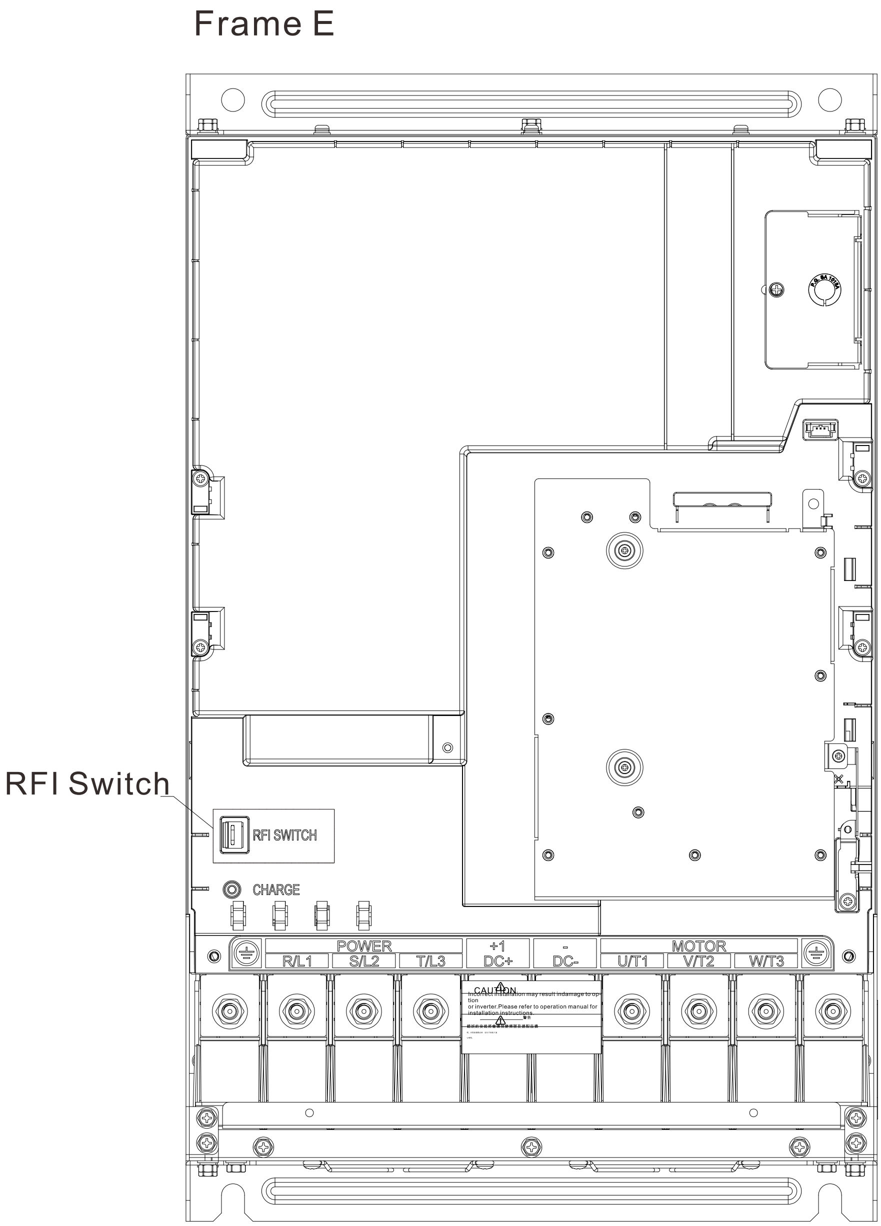


Figure 1-9

NOTE: The RFI switches on Frame s B/C/D/E are at similar locations.

Isolating main power from ground

When the power distribution system for the motor drive is a floating ground system (IT Systems) or an asymmetric ground system (Corner Grounded TN Systems), you must remove the RFI switch. Removing the switch also cuts off the internal RFI capacitor (filter capacitor) between the system's frame and the central circuits to avoid damaging the central circuits and reduces the ground leakage current.

Important points regarding ground connection

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

☑ The diameter of the grounding cables must meet the size specified by 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 above points are met.

☑ When installing multiple sets of motor drives, do not connect the motor drives' grounds in series. See the following image.

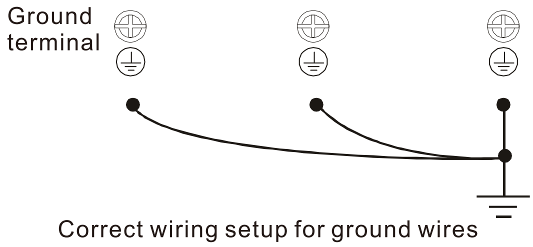


Figure 1-10

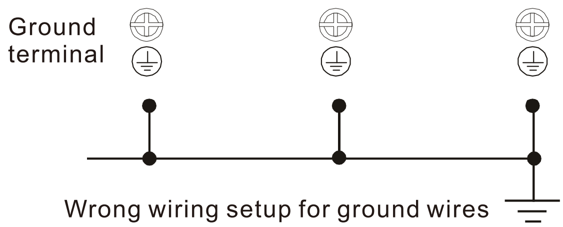


Figure 1-11

Pay particular attention to the following points

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

☑ Make sure the main power is OFF before removing the RFI switch.

☑ Removing the RFI switch also cuts the capacitor conductivity. Gap discharge may occur once the transient voltage exceeds 1000 V.

NOTE: If you remove the RFI switch, you remove the reliable electrical isolation. In other words, all controlled inputs and outputs become low-voltage terminals with basic electrical isolation. Also, when you remove the internal RFI switch, the motor drive is no longer electromagnetic compatible (EMC).

☑ Do not remove the RFI switch if the main power is a grounded power system.

☑ You must remove the RFI switch when conducting high voltage tests. When conducting a high voltage test for the entire facility, disconnect the main power and the motor if the leakage current is too high.

Floating Ground System (IT Systems)

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

☑ Disconnect the ground cable from the internal EMC filter.

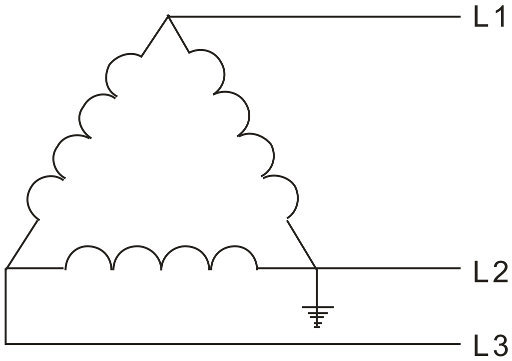
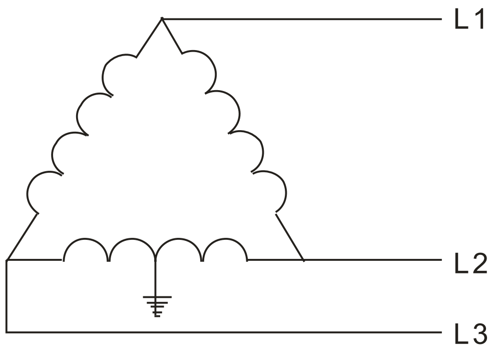
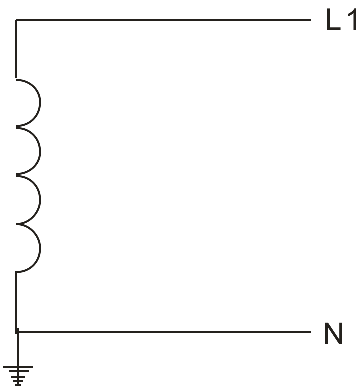
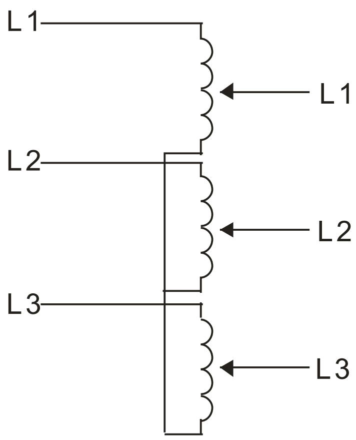
☑ In situations where EMC is required, check for excess electromagnetic radiation affecting nearby low-voltage circuits. In some situations, the adapter and cable naturally provide enough suppression. If in doubt, install an extra electrostatic shielded cable on the power supply side between the main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

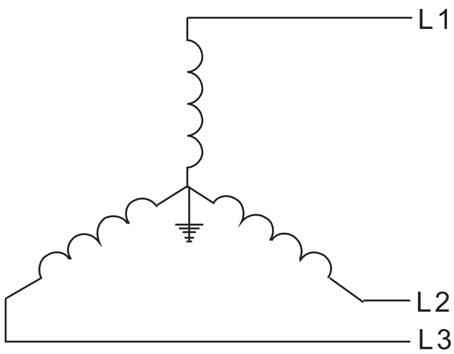
☑ Do not install an external RFI/EMC filter. The external EMC filter passes through a filter capacitor and connects power input to the ground. This is very dangerous and damages the motor drive.

Asymmetric Ground System (Corner Grounded TN Systems)

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

In the following four situations, you must remove the RFI switch. This is to prevent the system from grounding through the RFI capacitor and damaging the motor drive.

Conditions for removing the RFI switch	
1. Grounding at a corner in a triangle configuration  Figure 1-12	2. Grounding at a midpoint in a polygonal configuration  Figure 1-13
3. Grounding at one end in a single-phase configuration  Figure 1-14	4. No stable neutral grounding in a three-phase autotransformer configuration  Figure 1-15

Using the RFI switch	
In the situation as the diagram on the right shows, you can use the RFI switch to pass through RFI capacitor to make an internal grounding and reduce electromagnetic radiation. In a situation with higher requirements for electromagnetic compatibility and a symmetrical grounding power system, you can install an EMC filter. For example, Figure 1-16 on the right is a symmetrical grounding power system.	 Figure 1-16

1-6 Dimensions

Frame B

VFD022ED21S, VFD037ED21S, VFD040ED23S/43S

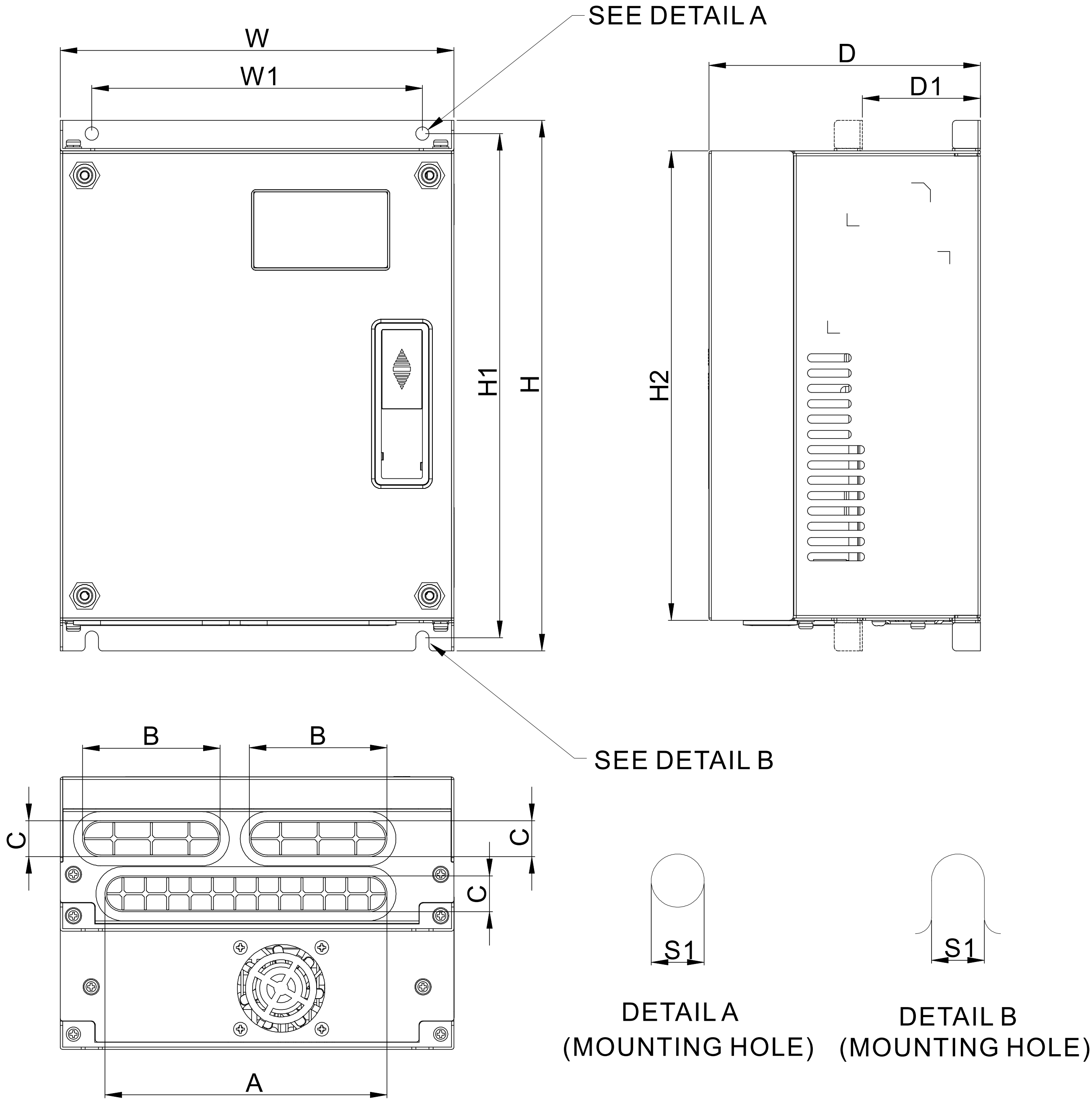


Figure 1-17

Unit: mm (inch)

Frame	W	W1	H	H1	H2	D	D1*	S1	A	B	C
B	193.5 (7.60)	162.5 (6.39)	260.0 (10.22)	247.0 (9.71)	230.0 (9.04)	133.5 (5.25)	58.0 (2.28)	6.5 (0.26)	138.6 (5.46)	67.2 (2.66)	17.6 (0.69)

*D1: This dimension is for flange mounting application reference.

Frame C

VFD055ED23S/43S, VFD075ED23S/43S, VFD110ED23S/43S, VFD150ED43S, VFD185ED43S

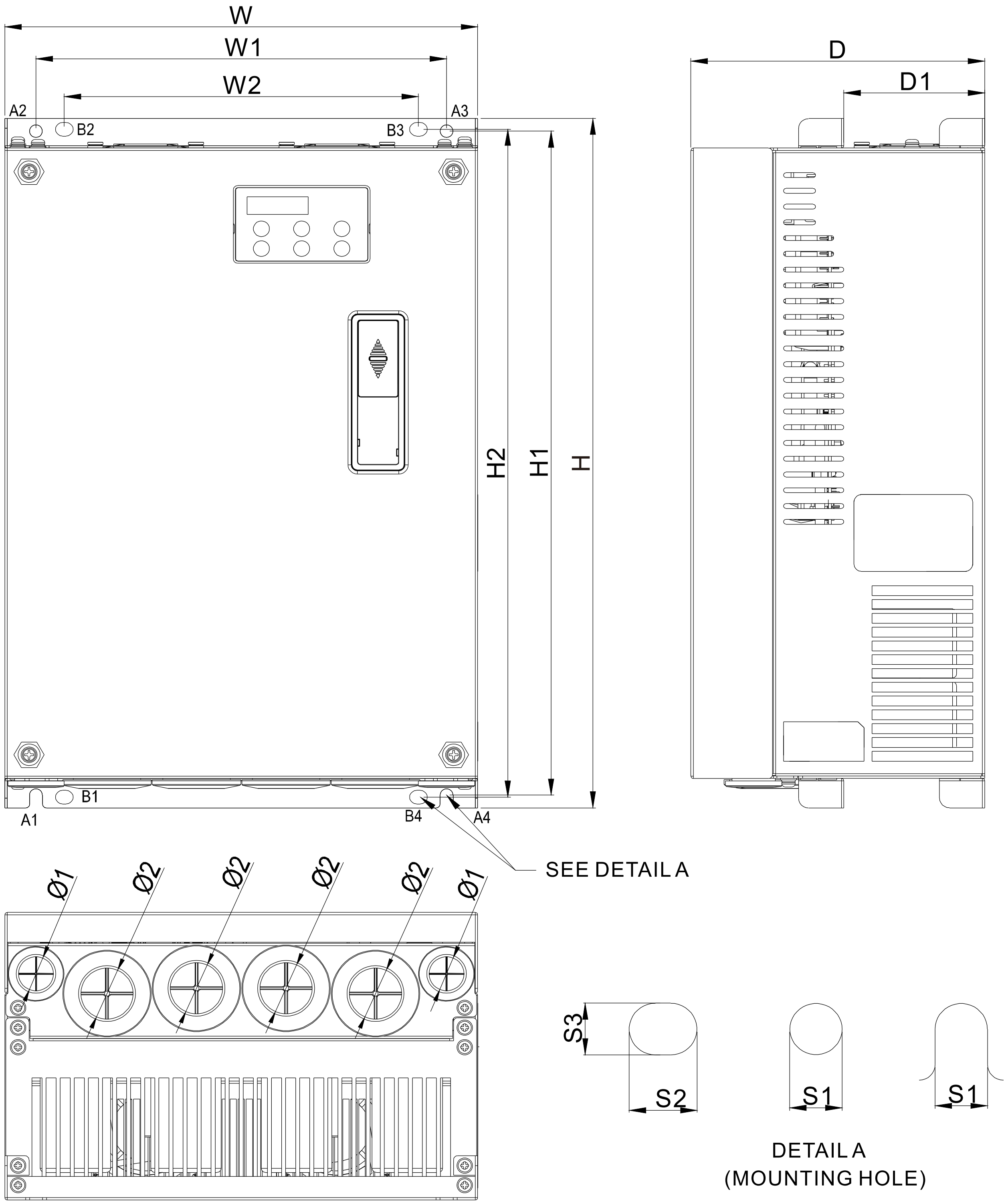


Figure 1-18

Unit: mm (inch)

Frame	W	W1	W2	H	H1	H2	D	D1*	S1	S2	S3	Ø1	Ø2
C	235.0 (9.25)	204.0 (8.03)	176.0 (6.93)	350.0 (13.78)	337.0 (13.27)	320.0 (15.60)	146.0 (5.75)	70.0 (2.76)	6.5 (0.26)	9.0 (0.35)	7.0 (0.28)	19.7 (0.78)	28.3 (1.11)

NOTE: A1–A4 and B1–B4 can be used for screwdriver installation; B1–B4 can also be used for sleeve installation

*D1: This dimension is for flange mounting application reference.

Frame D

VFD150ED23S, VFD185ED23S, VFD220ED23S/43S, VFD300ED43S

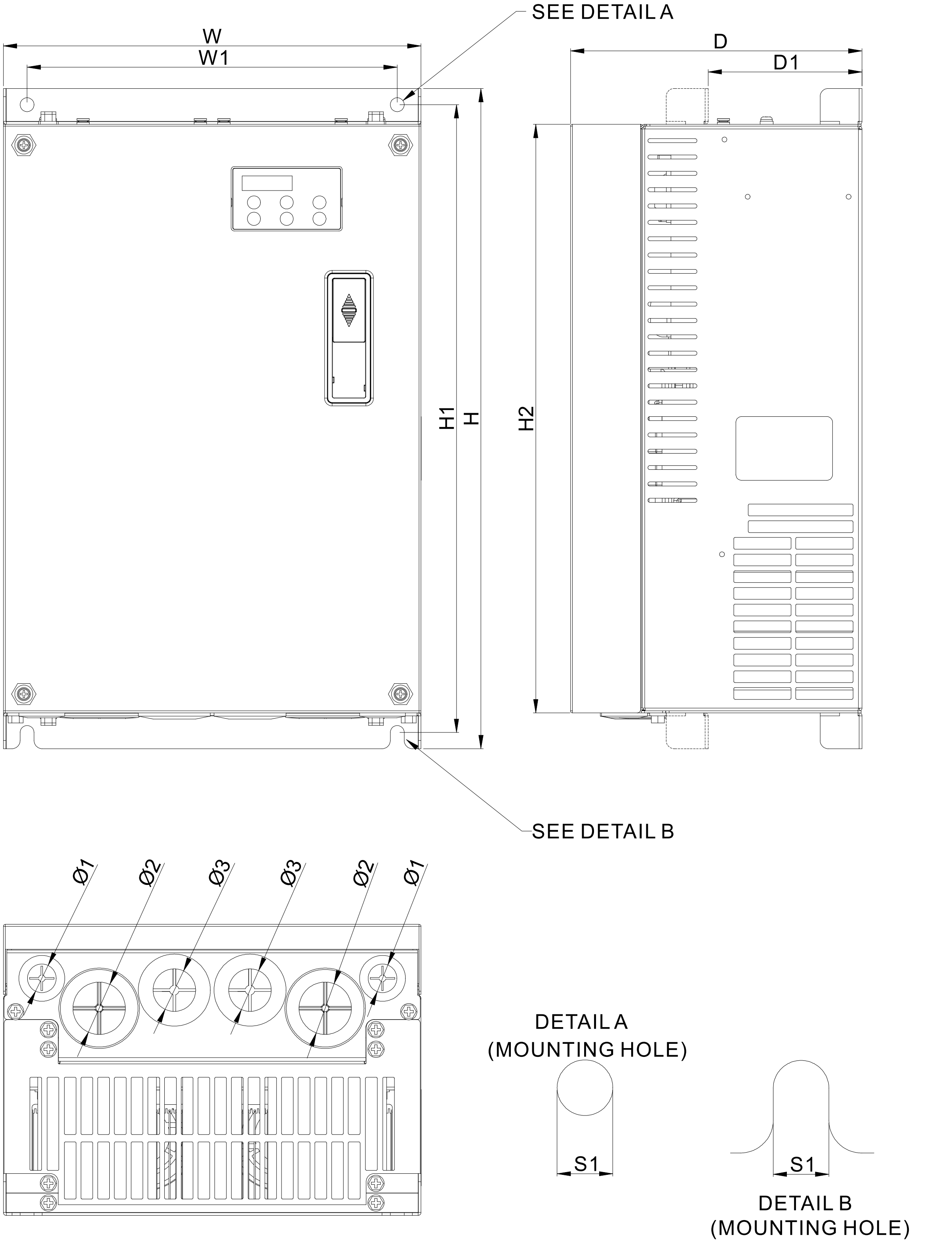


Figure 1-19

Unit: mm (inch)

Frame	W	W1	H	H1	H2	D	D1*	S1	Ø1	Ø2	Ø3
D	255.0 (10.04)	226.0 (8.90)	403.8 (15.90)	384.0 (15.12)	360.0 (14.17)	178.0 (7.01)	94.0 (3.70)	8.5 (0.33)	17.5 (0.69)	32.0 (1.26)	26.0 (1.02)

*D1: This dimension is for flange mounting application reference.

Frame E

VFD300ED23S, VFD370ED23S/43S, VFD450ED43S, VFD550ED43S, VFD750ED43S

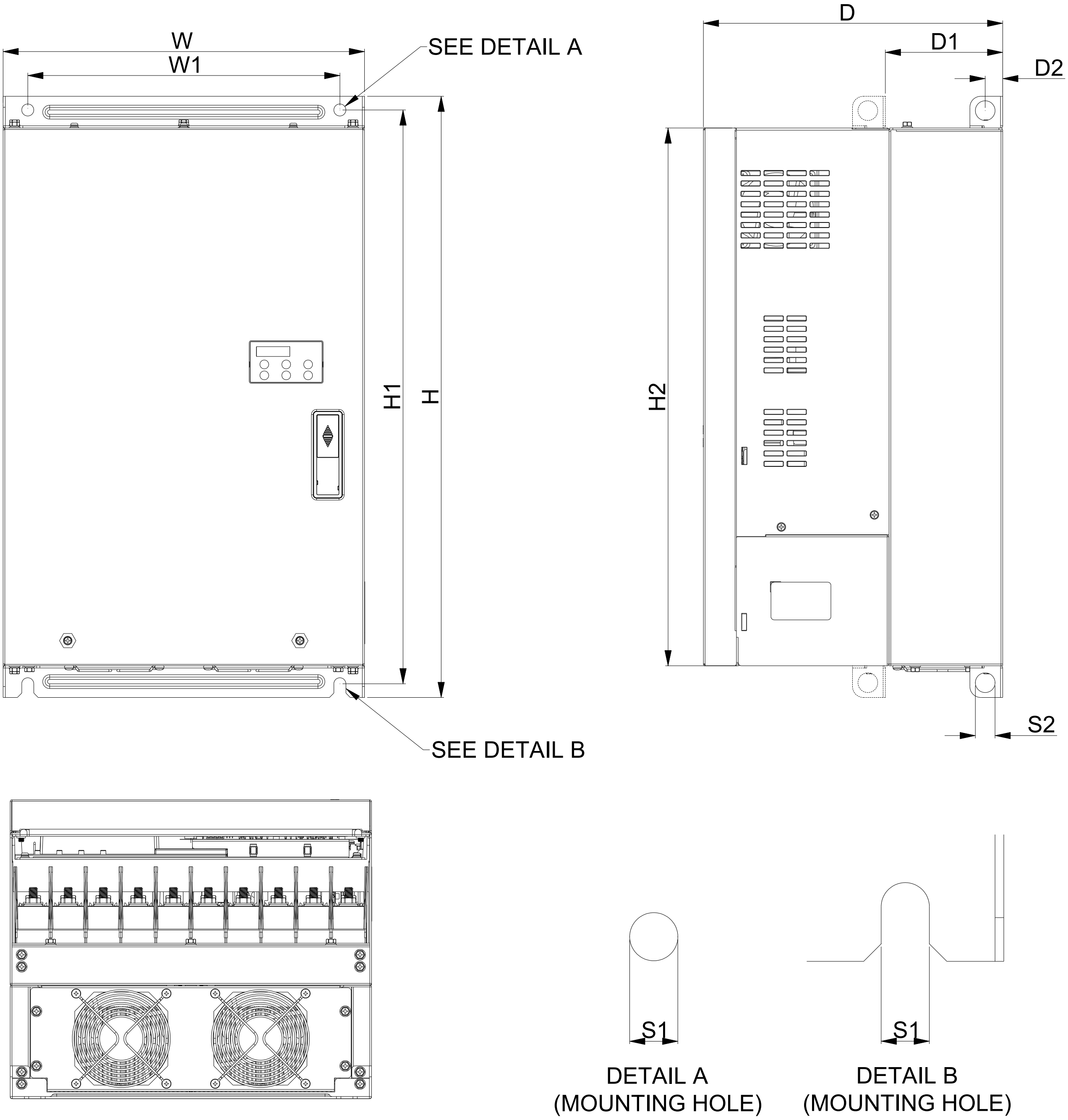


Figure 1-20

Unit: mm (inch)

Frame	W	W1	H	H1	H2	D	D1*	D2	S1	S2
E	330.0 (12.99)	285.0 (11.22)	550.0 (21.65)	525.0 (20.67)	492.0 (19.37)	273.4 (10.76)	107.2 (4.22)	16.0 (0.63)	11.0 (0.43)	18.0 (0.71)

*D1: This dimension is for flange mounting application reference.

Built-In Keyboard Panel

KPED-LE01 Unit: mm [inch]

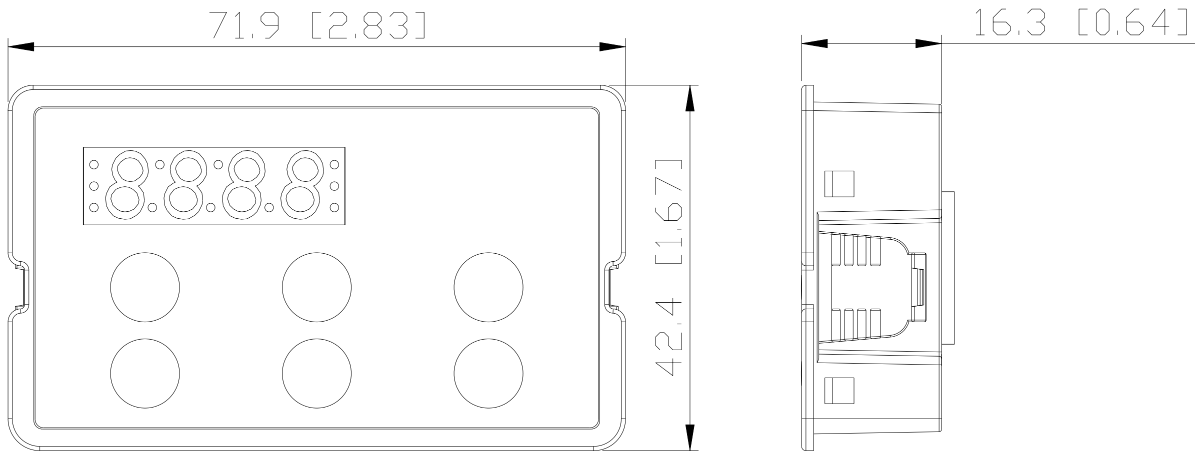


Figure 1-21

Chapter 2 Installation

2-1 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 to prevent the risk of fire.

☑ Install the AC motor drive in a Pollution Degree 2 (IEC 60664-1) environment with clean and circulating air. A clean and circulating environment means air without polluting substances and dust.

The motor drives' figures shown below are for reference only. The actual motor drives may look different.

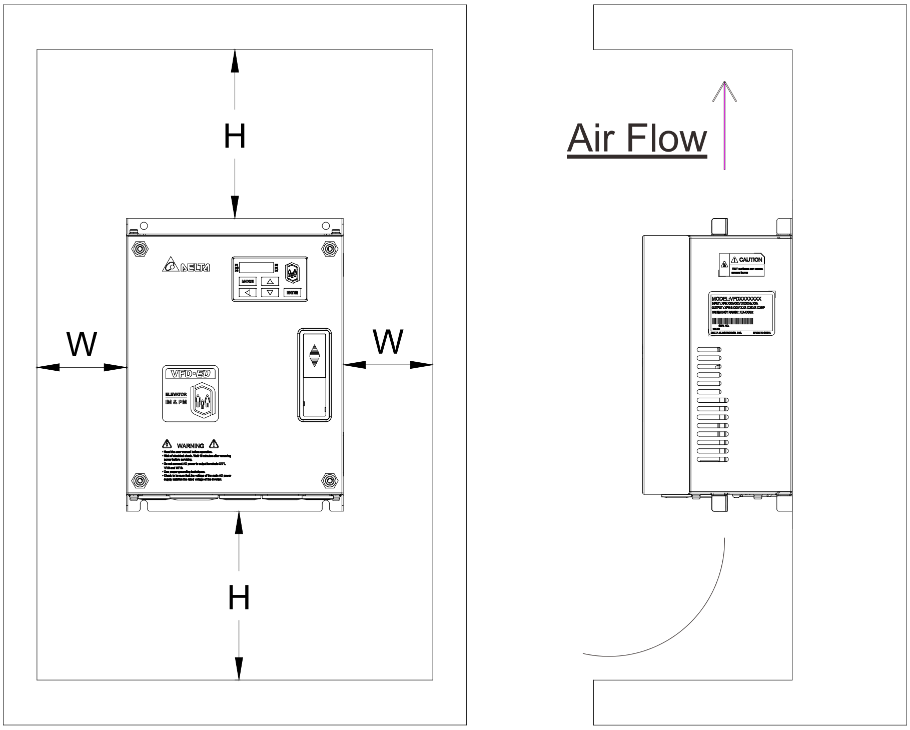


Figure 2-1

Minimum Mounting Clearance

Frame	Capacity	Model No.	W (Width) mm (inch)	H (Height) mm (inch)
B	3.0–5.0 HP (2.2–4 kW)	VFD022ED21S, VFD037ED21S, VFD040ED23S/43S	50 (2)	150 (6)
C	7.5–15 HP (5.5–11 kW)	VFD055ED23S/43S, VFD075ED23S/43S, VFD110ED23S/43S, VFD150ED43S, VFD185ED43S	75 (3)	175 (7)
D	20–40 HP (15–30 kW)	VFD150ED23S, VFD185ED23S, VFD220ED23S/43S, VFD300ED43S	75 (3)	200 (8)
E	40–100 HP (30–75 kW)	VFD300ED23S, VFD370ED23S/43S, VFD450ED43S, VFD550ED43S, VFD750ED43S	75 (3)	200 (8)

Table 2-1

NOTE: The minimum mounting clearances stated in Table 2-1 apply to AC motor drives frame B, C, D and E. Failure to follow the minimum mounting clearances may cause the motor drive fan to malfunction and cause heat dissipation problems.

2-2 Airflow and Power Dissipation

Model No.	Airflow Rate for Cooling						Power Dissipation for AC Motor Drive		
	Flow Rate (cfm)			Flow Rate (m^3/hr)			Power Dissipation (W)		
	External	Internal	Total	External	Internal	Total	Loss External (Heat Sink)	Internal	Total
VFD022ED21S	13.7	-	13.7	23.3	-	23.3	60	36	96
VFD037ED21S	23.9	-	23.9	40.7	-	40.7	84	46	130
VFD040ED23S	23.9	-	23.9	40.7	-	40.7	133	49	182
VFD055ED23S	48.5	-	48.5	82.4	-	82.4	212	67	279
VFD075ED23S	48.5	-	48.5	82.4	-	82.4	292	86	379
VFD110ED23S	47.9	-	47.9	81.4	-	81.4	355	121	476
VFD150ED23S	64.6	-	64.6	109.8	-	109.8	490	161	651
VFD185ED23S	102.3	-	102.3	173.8	-	173.8	638	184	822
VFD220ED23S	102.8	-	102.8	174.7	-	174.7	723	217	939
VFD300ED23S	179	30	209	304	51	355	932	186	1118
VFD370ED23S	179	30	209	304	51	355	1112	222	1334
VFD040ED43S	13.7	-	13.7	23.3	-	23.3	123	42	165
VFD055ED43S	48.5	-	48.5	82.4	-	82.4	185	55	240
VFD075ED43S	48.5	-	48.5	82.4	-	82.4	249	71	320
VFD110ED43S	47.9	-	47.9	81.4	-	81.4	337	94	431
VFD150ED43S	46.1	-	46.1	78.4	-	78.4	302	123	425
VFD185ED43S	46.1	-	46.1	78.4	-	78.4	391	139	529
VFD220ED43S	102.8	-	102.8	174.7	-	174.7	642	141	783
VFD300ED43S	83.7	-	83.7	142.2	-	142.2	839	180	1019
VFD370ED43S	179	30	209	304	51	355	803	252	1055
VFD450ED43S	179	30	209	304	51	355	1014	270	1284
VFD550ED43S	179	30	209	304	51	355	1244	275	1519
VFD750ED43S	186	30	216	316	51	367	1541	338	1878
	● The required airflow shown in Table 2-2 is for installing a single drive in a confined space. ● When installing multiple drives, the required air volume should be the required air volume for a single drive X the number of the drives.						● The heat dissipation shown in Table 2-2 is for installing a single drive in a confined space. ● When installing multiple drives, volume of heat dissipation should be the heat dissipated for a single drive X the number of the drives. ● Heat dissipation for each model is calculated by rated voltage, current and default carrier.		

Table 2-2

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Chapter 3 Wiring

After removing the front cover, verify if the power and control terminals are clearly noted. Read the following precautions to avoid wiring mistakes.

DANGER	☑ Turn off the AC motor drive power before installing any wiring. A hazardous charge may still remain in the DC bus capacitors after the power has been turned off. Measure the remaining voltage before wiring. For your safety, do not perform any wiring before the voltage drops to a safe level < 25 V_{DC}. Performing a wiring installation while voltage remains may cause 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 shock. ☑ 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 should be within the range indicated on the AC motor drive nameplate (see Section 1-1 Nameplate Information). ☑ All the units must be grounded directly to a common ground terminal to prevent damage from a lightning strike or electric shock. ☑ Make sure you correctly tighten the main circuit terminal screws to prevent sparks from screws that have been loosened due to vibration.
CAUTION	☑ When wiring, choose wires that comply with local regulations for your safety. ☑ Check the following items after finishing 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?

3-1 System Wiring Diagram

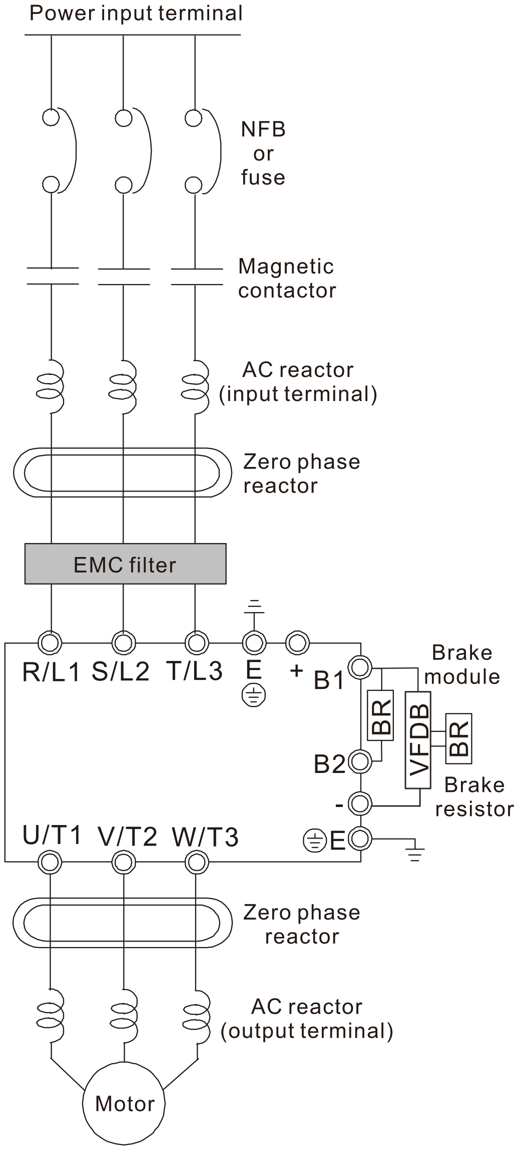

Figure 3-1

NOTE: For details, see the wiring diagrams in Section 3-2.

Power input terminal	Supply power according to the rated power specifications indicated in the user manual (see Chapter 8 Specifications).
NFB or fuse	There may be a large inrush current during power-on. See Section 6-2 NFB to select a suitable NFB or Section 6-3 Fuse Specification Chart for a fuse.
Magnetic contactor	Switching the power ON/OFF on the primary side of the magnetic 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 magnetic contactor as the power switch for the drive; doing so shortens the life of the drive.
AC reactor (Input terminal)	When the main power supply capacity is greater than 1000 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 AC reactor at input side in the drive. This also improves the power factor and reduces power harmonics. The wiring distance should be within 10 m. See Section 6-4 AC/DC Reactor for details.
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. See Section 6-5 Zero Phase Reactor for details.
EMC filter	Can be used to reduce electromagnetic interference. See Section 6-6 EMC Filter for details.
Brake module & Brake resistor (BR)	Used to shorten the deceleration time of the motor. See Section 6-1 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 20 meters. See Section 6-4 AC/DC Reactor for details.

Table 2-1

3-2 Wiring

3-2-1 Wiring Diagram

Frame B Wiring Diagram

Input: Three-phase power

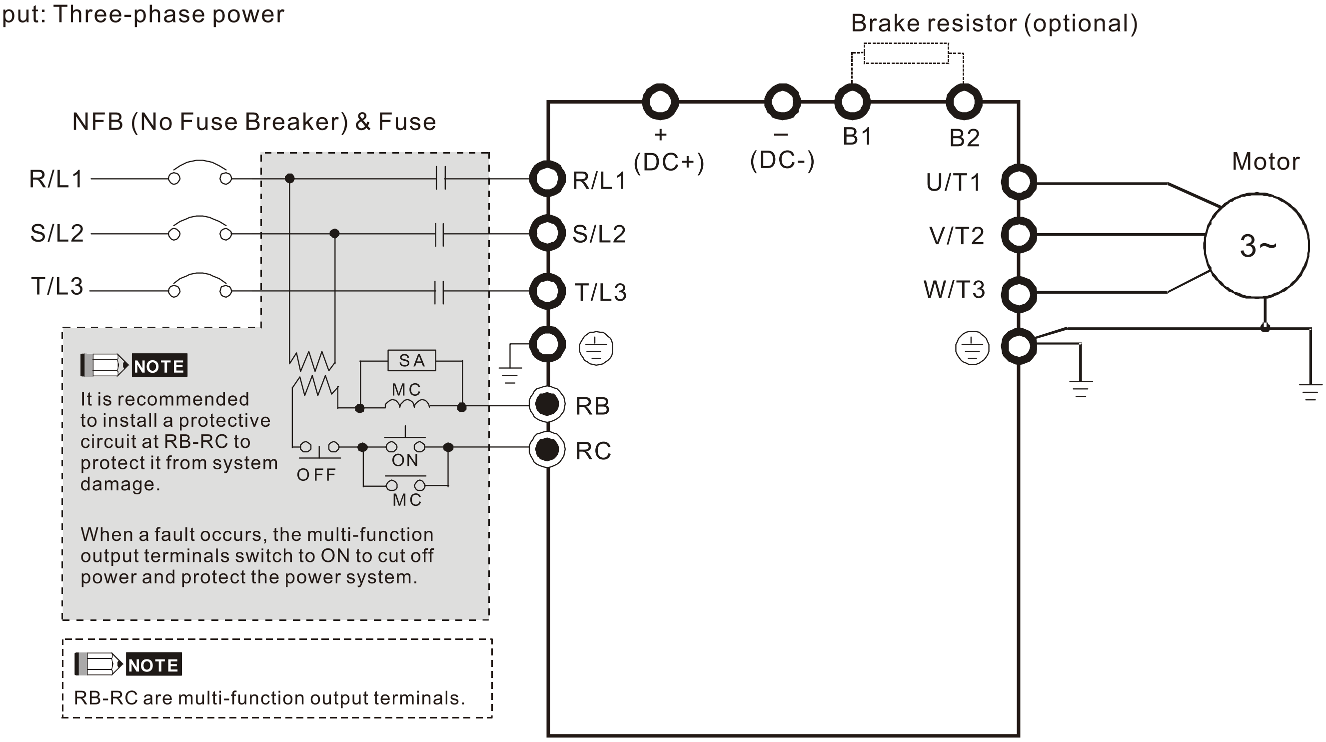

Figure 3-2

Frame C & D Wiring Diagram

Input: Three-phase power

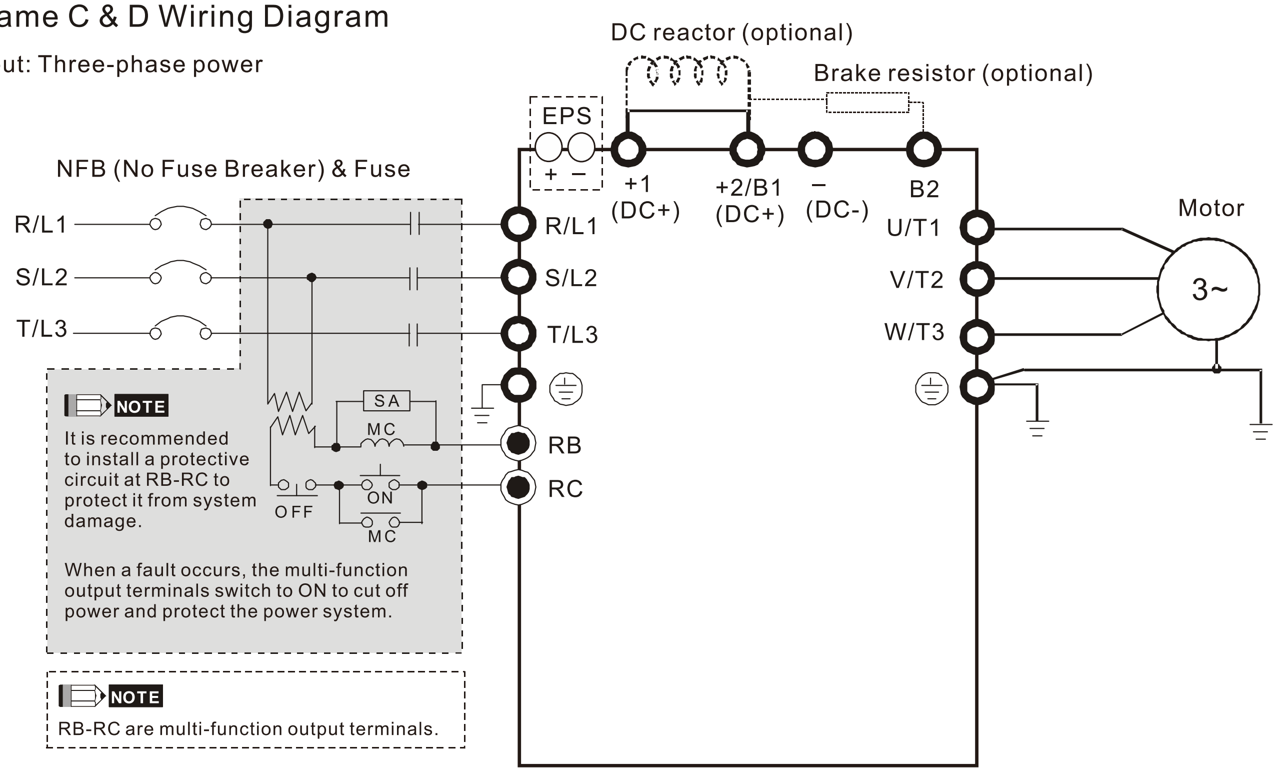

Figure 3-3

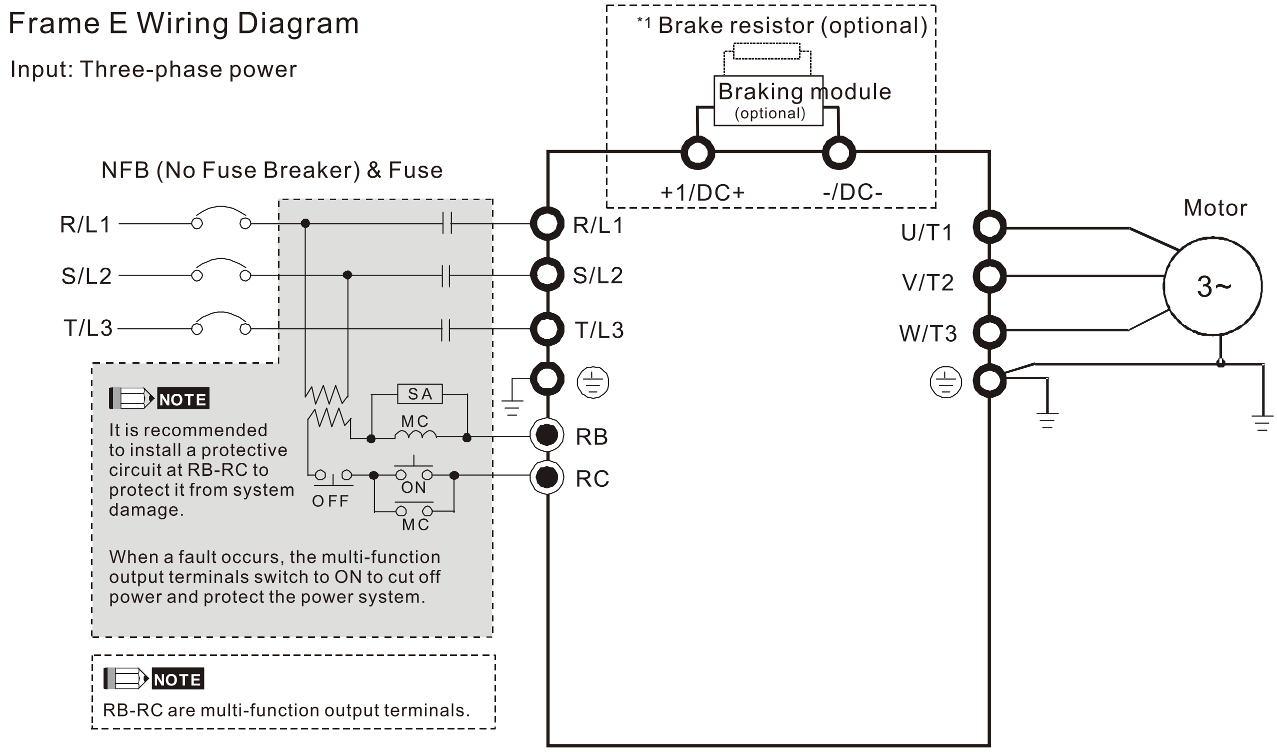

Figure 3-4

NOTE:

1. *1: See Section 6-1 Brake Resistors & Brake Units Used in AC Motor Drives for details
2. For details on EPS wiring, see Section 3-2-3 Emergency Power Supply (EPS) System Wiring Diagrams.

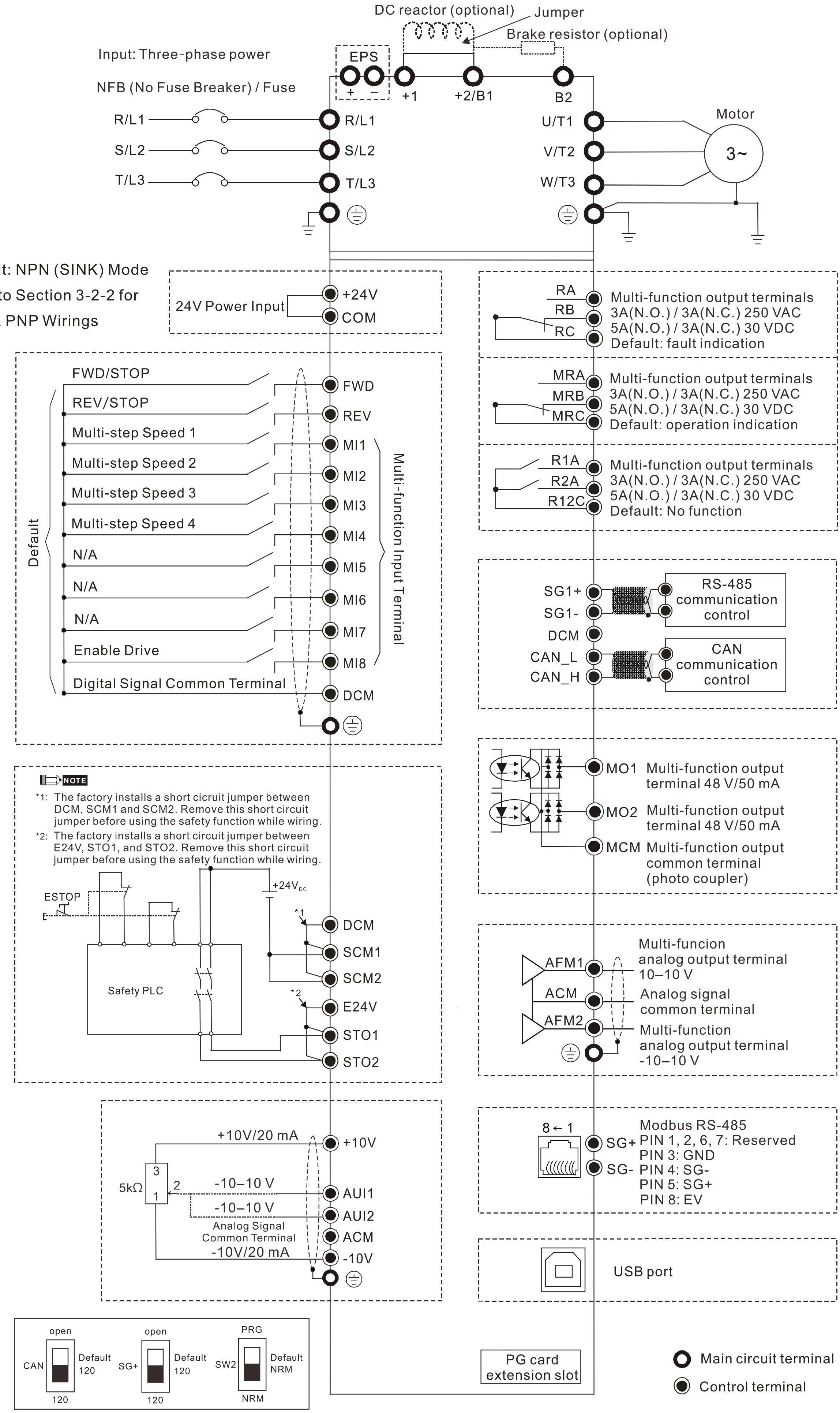
DC reactor (optional)
Jumper
Brake resistor (optional)
Input: Three-phase power
NFB (No Fuse Breaker) / Fuse
EPS
+1
+2/B1
B2
R/L1
S/L2
T/L3
U/T1
V/T2
W/T3
Motor
3~
Default: NPN (SINK) Mode
Refer to Section 3-2-2 for
NPN & PNP Wirings
24V Power Input
+24V
COM
FWD/STOP
REV/STOP
Multi-step Speed 1
Multi-step Speed 2
Multi-step Speed 3
Multi-step Speed 4
N/A
N/A
N/A
Enable Drive
Digital Signal Common Terminal
Default
FWD
REV
MI1
MI2
MI3
MI4
MI5
MI6
MI7
MI8
DCM
Multi-function Input Terminal
RA
RB
RC
Multi-function output terminals
3A(N.O.) / 3A(N.C.) 250 VAC
5A(N.O.) / 3A(N.C.) 30 VDC
Default: fault indication
MRA
MRB
MRC
Multi-function output terminals
3A(N.O.) / 3A(N.C.) 250 VAC
5A(N.O.) / 3A(N.C.) 30 VDC
Default: operation indication
R1A
R2A
R12C
Multi-function output terminals
3A(N.O.) / 3A(N.C.) 250 VAC
5A(N.O.) / 3A(N.C.) 30 VDC
Default: No function
SG1+
SG1-
DCM
CAN_L
CAN_H
RS-485 communication control
CAN communication control
NOTE
*1: The factory installs a short circuit jumper between DCM, SCM1 and SCM2. Remove this short circuit jumper before using the safety function while wiring.
*2: The factory installs a short circuit jumper between E24V, STO1, and STO2. Remove this short circuit jumper before using the safety function while wiring.
ESTOP
+24V DC
*1
*2
Safety PLC
DCM
SCM1
SCM2
E24V
STO1
STO2
MO1 Multi-function output terminal 48 V/50 mA
MO2 Multi-function output terminal 48 V/50 mA
MCM Multi-function output common terminal (photo coupler)
AFM1
ACM
AFM2
Multi-funcion analog output terminal 10–10 V
Analog signal common terminal
Multi-function analog output terminal -10–10 V
+10V/20 mA
5kΩ
3
2
1
-10–10 V
-10–10 V
Analog Signal Common Terminal
-10V/20 mA
+10V
AUI1
AUI2
ACM
-10V
8←1
SG+
SG-
Modbus RS-485
PIN 1, 2, 6, 7: Reserved
PIN 3: GND
PIN 4: SG-
PIN 5: SG+
PIN 8: EV
USB port
open
CAN
Default 120
120
open
SG+
Default 120
120
PRG
SW2
Default NRM
NRM
PG card extension slot
Main circuit terminal
Control terminal

Figure 3-5

3-2-2 Switch between Two Modes: SINK (NPN) / SOURCE (PNP)

① Sink Mode
with internal power (+24V$_{DC}$)

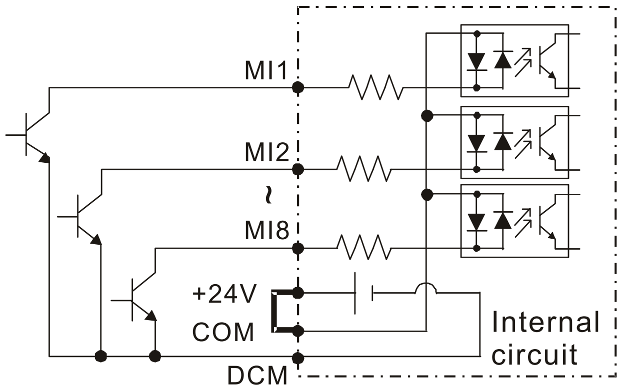

Figure 3-6

② Source Mode
with internal power (+24V$_{DC}$)

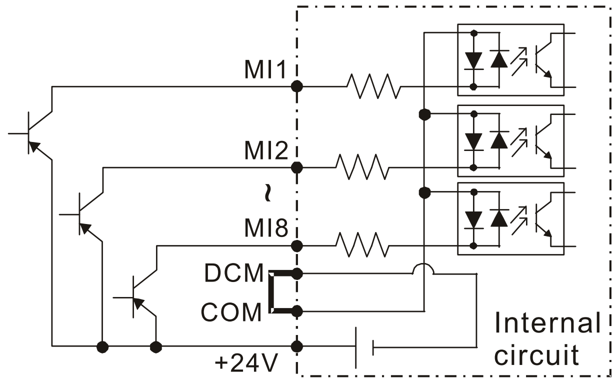

Figure 3-7

③ Sink Mode
with external power

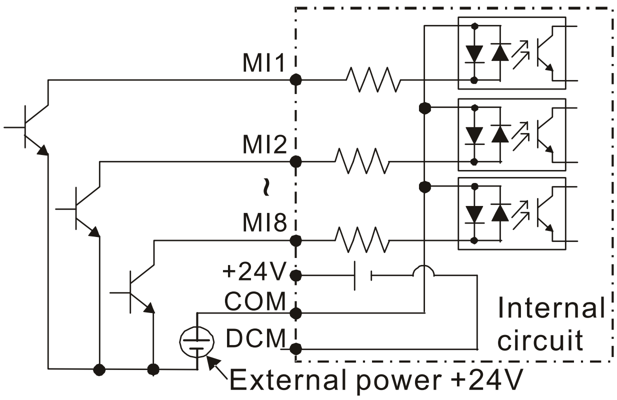

Figure 3-8

④ Source Mode
with external power

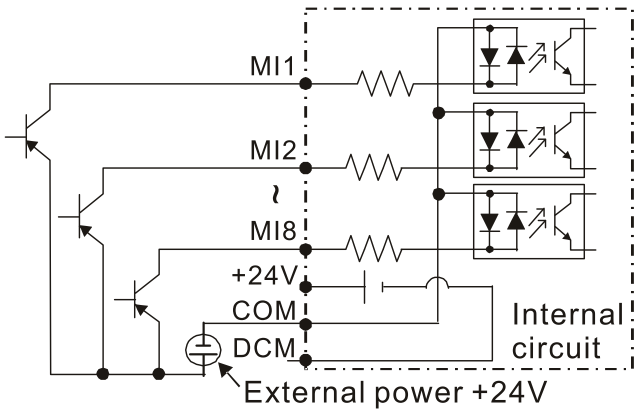

Figure 3-9

3-2-3 Emergency Power Supply (EPS) system wiring diagrams

Frames B, C, D & E

1. Single-phase UPS or battery can only be used on the main power supply side

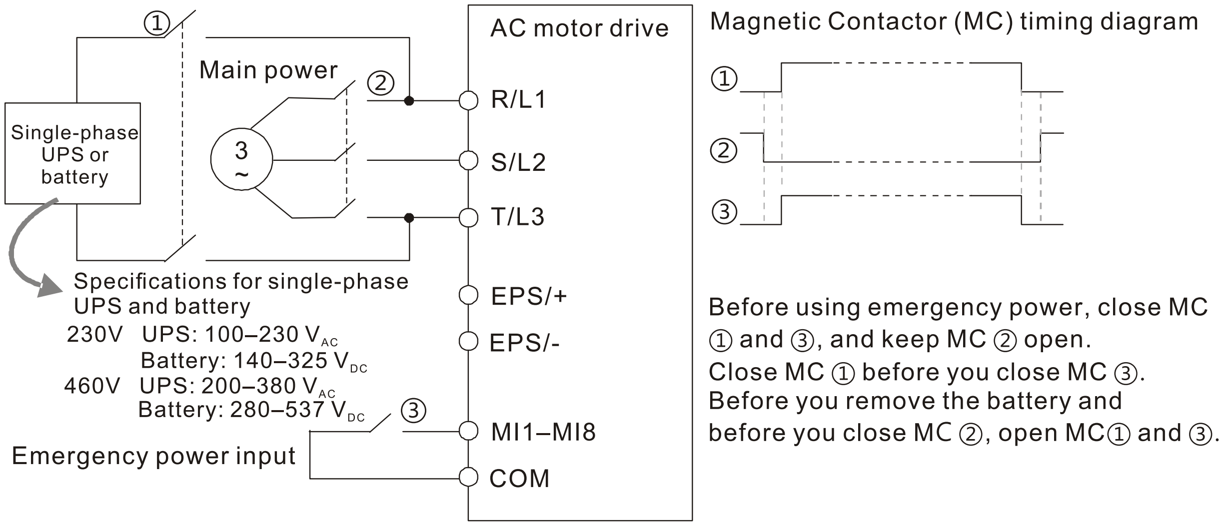

Figure 3-10

Frames C & D

2. When the voltage of the main power supply is lower than 140 V_{DC} (230V models) / 280 V_{DC} (460V models), connect the control power to single-phase UPS or battery.

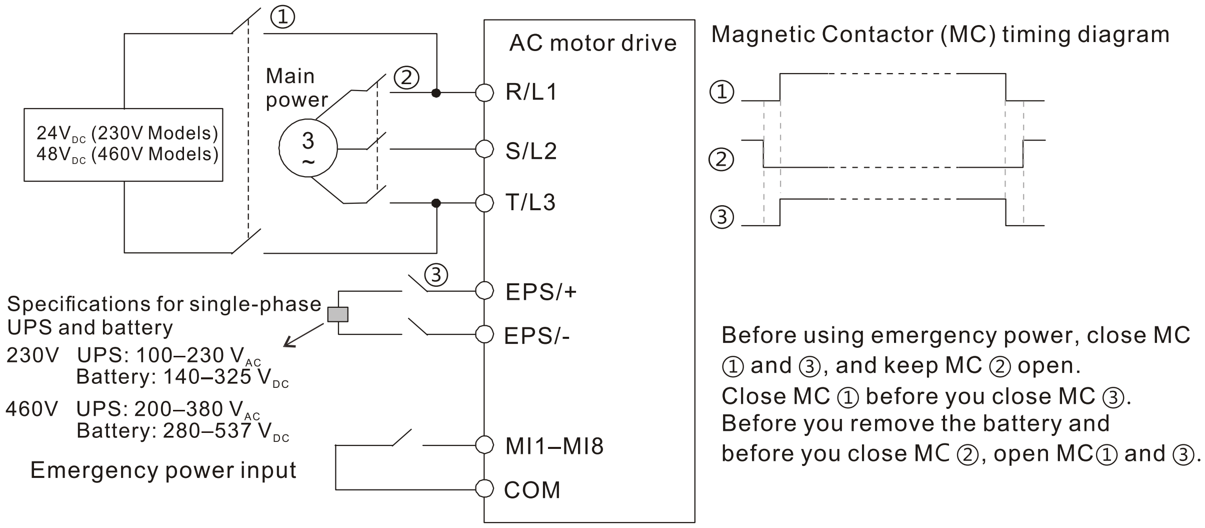

Figure 3-11

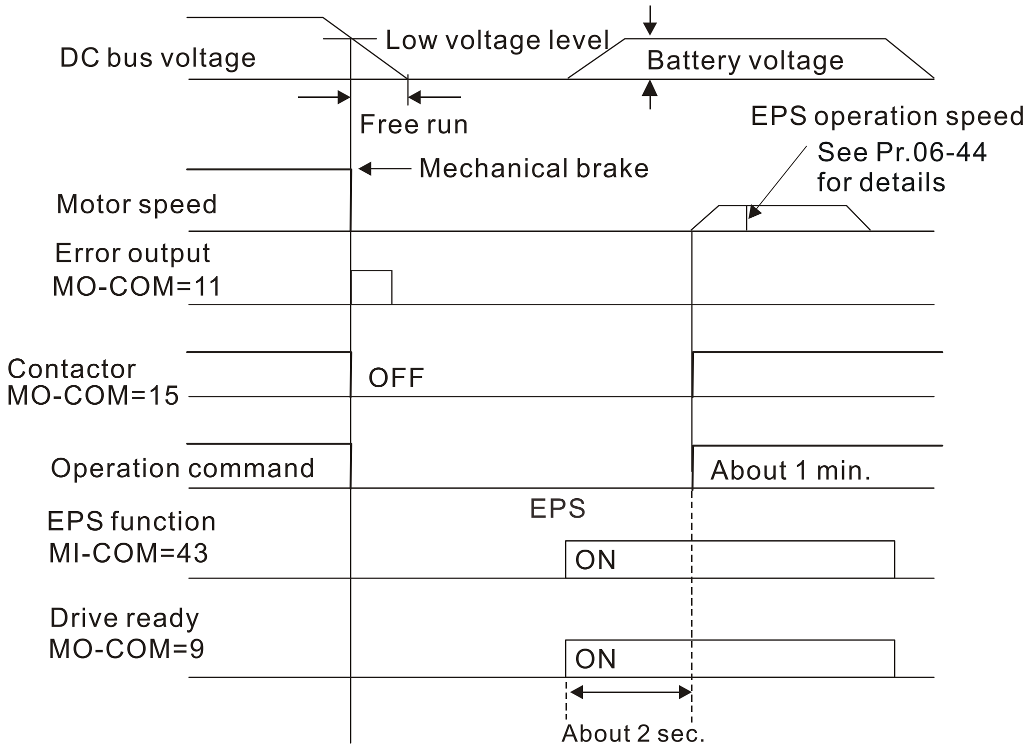

Figure 3-12

NOTE:

When EPS is enabled (MI=43):

- Do NOT make the fan run in case voltage drops during EPS.
- Parameter settings cannot be saved and will be lost after cycling power.
- Set the running speed through Pr.06-44.
- Functions of low voltage and phase loss protection are unavailable.
- Set the DC bus voltage through Pr.06-29.

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Chapter 4 Main Circuit Terminals

DANGER

☑ Tighten the screws in the main circuit terminal to prevent sparks caused by screws loosened due to vibration.
☑ Ensure proper insulation of the main circuit wiring in accordance with the relevant safety regulations.

CAUTION

Main input power terminals

☑ Do not connect a three-phase model to single-phase power. R/L1, S/L2 and T/L3 have no phase-sequence requirement and can be connected in any sequence.
☑ You must install a NFB between the three-phase power input terminals and the main circuit terminals (R/L1, S/L2, T/L3). 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 8.
☑ When using a general ELB (Earth Leakage Breaker), select a current sensor with sensitivity of 200 mA or above and not less than 0.1 second operation time to avoid nuisance tripping. When choosing an ELB designed for the AC motor drive, choose a current sensor with sensitivity of 30 mA or above.
☑ 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.

Output terminals of the main circuit

☑ When it is necessary to install a filter at the output side of the AC motor drive terminals U/T1, V/T2, W/T3, use an inductance filter. Do not use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance) capacitors.
☑ DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of AC motor drives.
☑ Use well-insulated motors to prevent any electric leakage from the motors.

Use terminals [+1, +2] for connecting a DC reactor.
Use terminals [+1, +2/B1] for connecting a DC bus.

☑ Use these terminals to connect a DC reactor to improve the power factor and reduce harmonics. A jumper is connected to these terminals at the factory. Remove that jumper before connecting to a DC reactor.

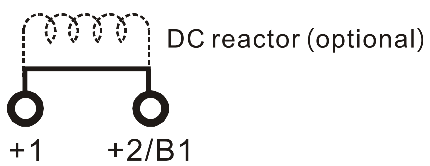


Figure 4-1

☑ Models above 22 kW do not have a built-in brake resistor. To improve resistance braking, connect an optional external brake resistor.
☑ When not in use, leave terminals +2/B1, [-] open.
☑ Short-circuiting [B2] or [-] to [+2/B1] damages the motor drive. Do NOT short-circuit those terminals.

4-1 Main Circuit Diagram

Frame B

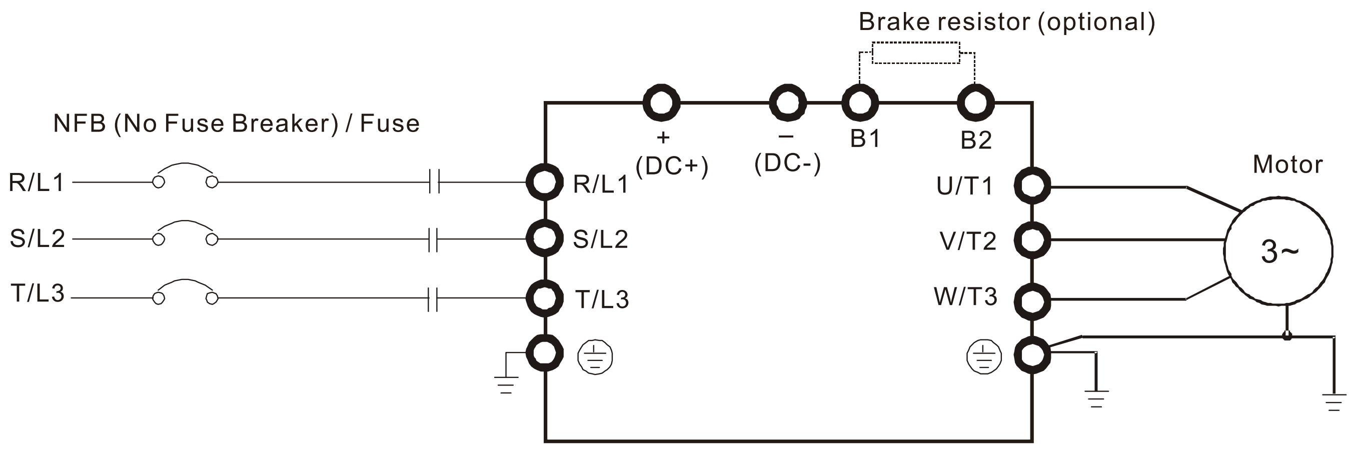


Figure 4-2

Frames C & D

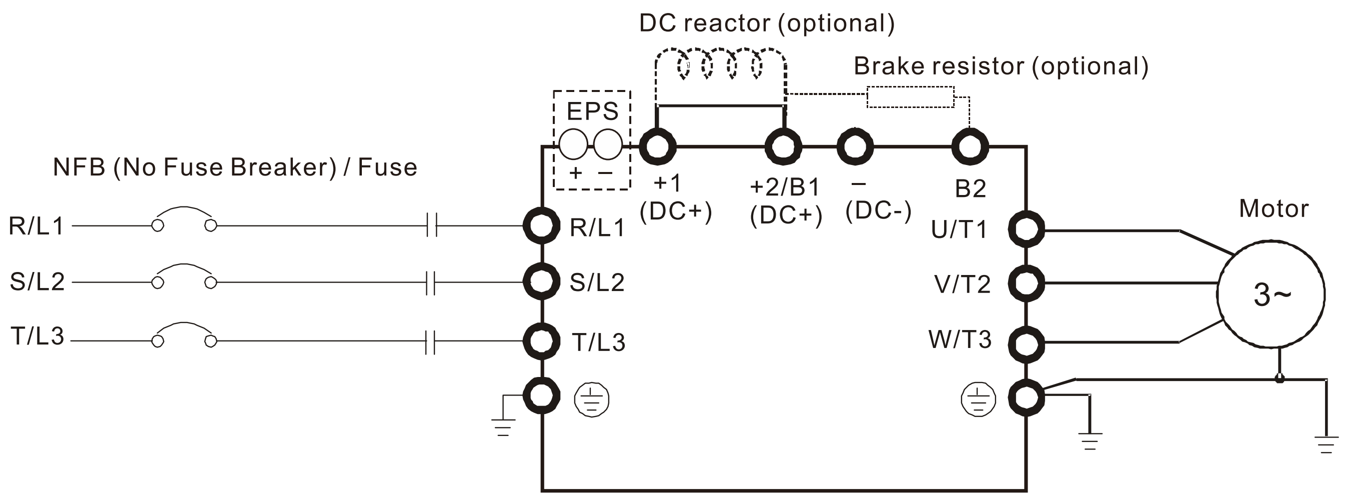


Figure 4-3

Frame E

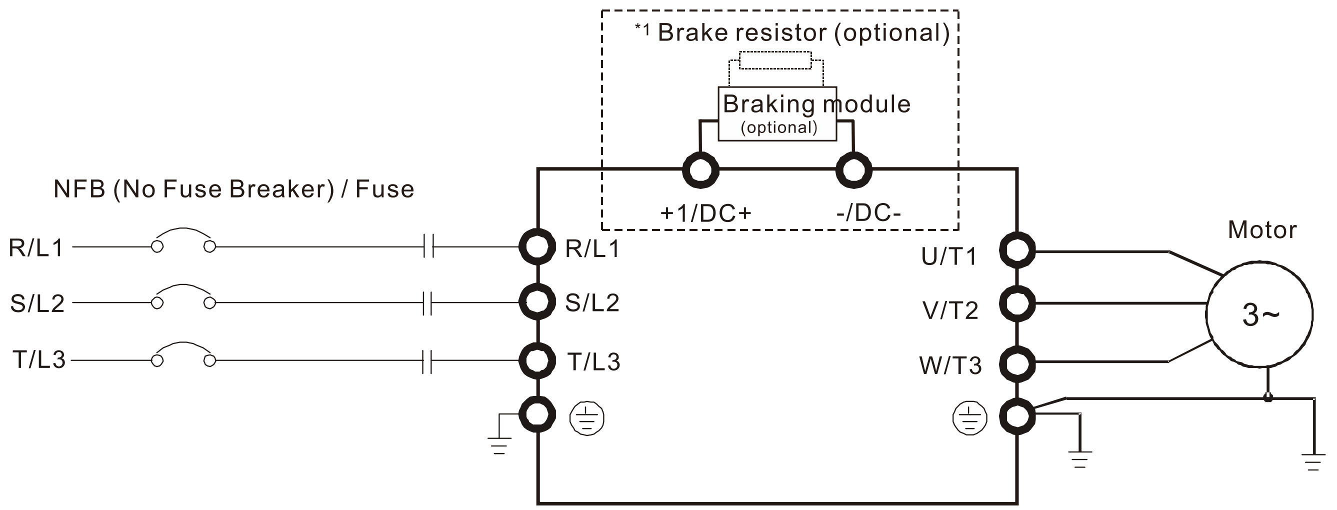


Figure 4-4

Terminals	Descriptions
EPS (+, -)	Backup power/ Emergency power connection terminal. **NOTE:** EPS (Emergency Power Supply) input terminal supports only Frame C and Frame D.
R/L1, S/L2, T/L3	AC line input terminals (three-phase)
U/T1, V/T2, W/T3	AC motor drive output terminals for connecting a three-phase induction motor.
+1, +2/B1	Connections for DC reactor to improve the power factor. Remove the jumper before installing a DC reactor (Frame E has a built-in DC reactor).
+2/B1, B2	Connections for brake resistor (optional).
⏚	Ground connection; comply with local regulations.

Table 4-1

4-2 Main Circuit Terminal Specifications

Frame B

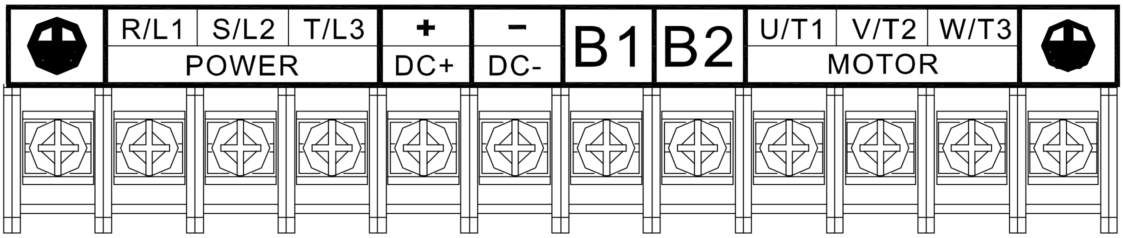


Figure 4-5

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, +(DC+), -(DC-), B1, B2			Terminal ⏚		
	Min. Wire Gauge	Max. Wire Gauge	Screw Size & Tightening Torque (±10%)	Min. Wire Gauge	Max. Wire Gauge	Screw Size & Tightening Torque (±10%)
VFD022ED21S	2.1 mm² (14 AWG)	5.3 mm² (10 AWG)	M4 18 kg-cm (15.6 lb-in.) (1.7 N-m)	2.1 mm² (14 AWG)	5.3 mm² (10 AWG)	M4 18 kg-cm (15.6 lb-in.) (1.7 N-m)
VFD040ED43S						
VFD037ED21S	3.3 mm² (12 AWG)			3.3 mm² (12 AWG)		
VFD040ED23S						

Table 4-2

NOTE:

- For UL installation compliance, select copper wires with voltage rating of 600V and temperature resistance of 75°C.
- Choose terminal wire size as Figure 4-6 shows.
- Use insulated heat shrink tubing that is resistant to at least 600V to comply with UL and CSA regulations (600 V, YDPU2), as Figure 4-7 shows.
- If you install at Ta 50°C environment, use copper wires with voltage rating of 600V and temperature resistance of 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires with voltage rating of 600V and temperature resistance of 90°C or above.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

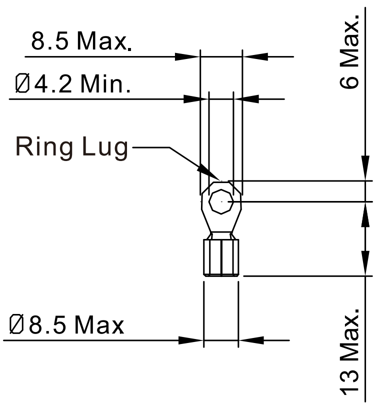


Figure 4-6

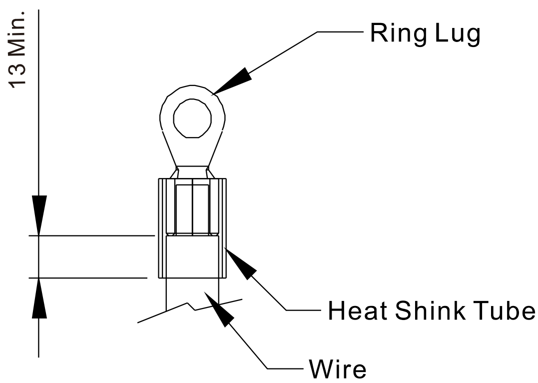


Figure 4-7

Frame C

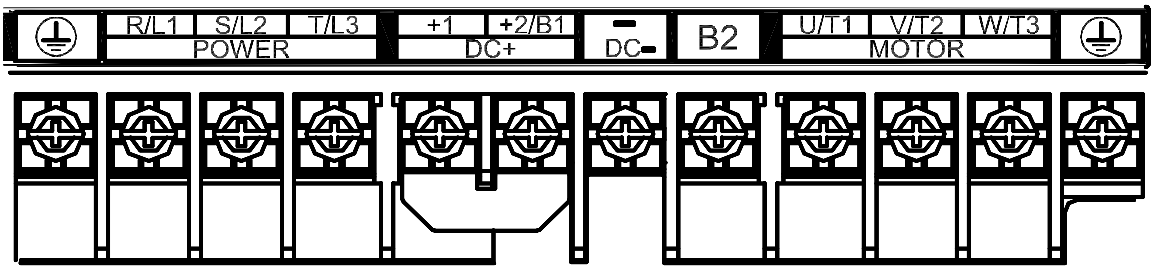


Figure 4-8

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, +1, +2/B1, -, B2			Terminal ⏚		
	Min. Wire Gauge	Max. Wire Gauge	Screw Size & Tightening Torque (±10%)	Min. Wire Gauge	Max. Wire Gauge	Screw Size & Tightening Torque (±10%)
VFD055ED23S	3.3 mm² (10 AWG)	13.3 mm² (6 AWG)	M5 30 kg-cm (26 lb-in.) (2.9 N-m)	3.3 mm² (10 AWG)	13.3 mm² (6 AWG)	M5 30 kg-cm (26 lb-in.) (2.9 N-m)
VFD110ED43S						
VFD055ED43S	3.3 mm² (12 AWG)			3.3 mm² (12 AWG)		
VFD075ED43S						
VFD075ED23S	8.4 mm² (8 AWG)			8.4 mm² (8 AWG)		
VFD150ED43S						
VFD185ED43S						
VFD110ED23S	13.3 mm² (6 AWG)			13.3 mm² (6 AWG)		

Table 4-3

NOTE:

- For UL installation compliance, select copper wires with voltage rating of 600V and temperature resistance of 75°C.
- Choose terminal wire size as Figure 4-9 shows.
- Use insulated heat shrink tubing that is resistant to at least 600V to comply with UL and CSA regulations (600 V, YDPU2), as Figure 4-10 shows.
- If you install at Ta 50°C environment, use copper wires with voltage rating of 600V and temperature resistance of 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires with voltage rating of 600V and temperature resistance of 90°C or above.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

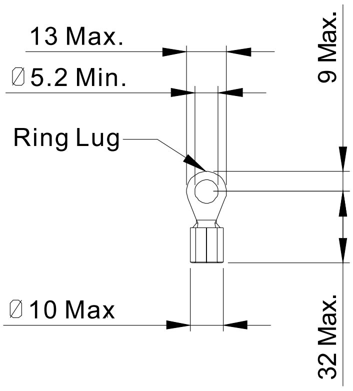


Figure 4-9

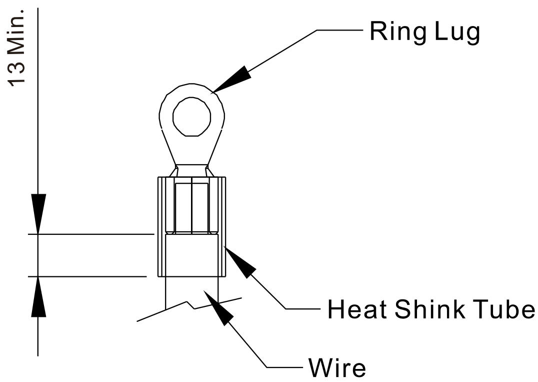


Figure 4-10

Frame D

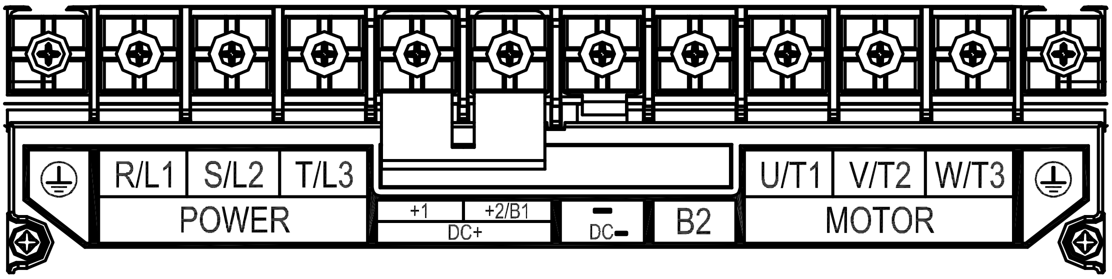


Figure 4-11

<table>
<tr><th rowspan="2">Model</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3,
+1, +2/B1, -, B2</th><th colspan="3">Terminal ⏚</th></tr>
<tr><th>Min. Wire Gauge</th><th>Max. Wire Gauge</th><th>Screw Size & Tightening Torque (±10%)</th><th>Min. Wire Gauge</th><th>Max. Wire Gauge</th><th>Screw Size & Tightening Torque (±10%)</th></tr>
<tr><td>VFD150ED23S</td><td rowspan="2">21.1 mm²
(4 AWG)</td><td rowspan="5">33.6 mm²
(2 AWG)</td><td rowspan="5">M6
50 kg-cm
(43.4 lb-in.)
(4.9 N-m)</td><td rowspan="2">16 mm²
(6 AWG)</td><td rowspan="5">33.6 mm²
(2 AWG)</td><td rowspan="5">M6
50 kg-cm
(43.4 lb-in.)
(4.9 N-m)</td></tr>
<tr><td>VFD300ED43S</td></tr>
<tr><td>VFD185ED23S</td><td>26.7 mm²
(3 AWG)</td><td>16 mm²
(6 AWG)</td></tr>
<tr><td>VFD220ED43S</td><td>13.3 mm²
(6 AWG)</td><td>13.3 mm²
(6 AWG)</td></tr>
<tr><td>VFD220ED23S</td><td>33.6 mm²
(2 AWG)</td><td>16 mm²
(6 AWG)</td></tr>
</table>

Table 4-4

NOTE:

- For UL installation compliance, select copper wires with voltage rating of 600V and temperature resistance of 75°C.
- Choose terminal wire size as Figure 4-12 shows.
- Use insulated heat shrink tubing that is resistant to at least 600V to comply with UL and CSA regulations (600 V, YDPU2), as Figure 4-13 shows.
- If you install at Ta 50°C environment, use copper wires with voltage rating of 600V and temperature resistance of 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires with voltage rating of 600V and temperature resistance of 90°C or above.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

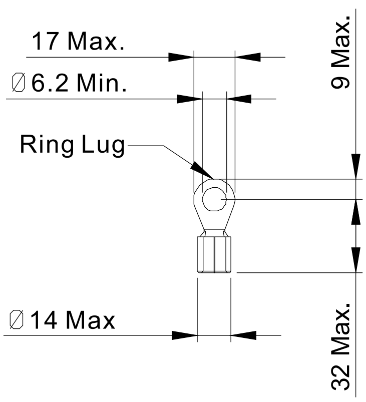


Figure 4-12

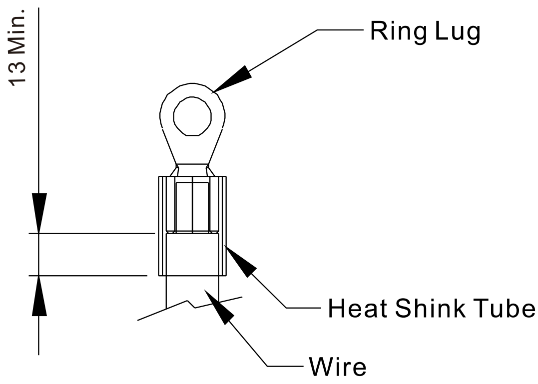


Figure 4-13

Frame E

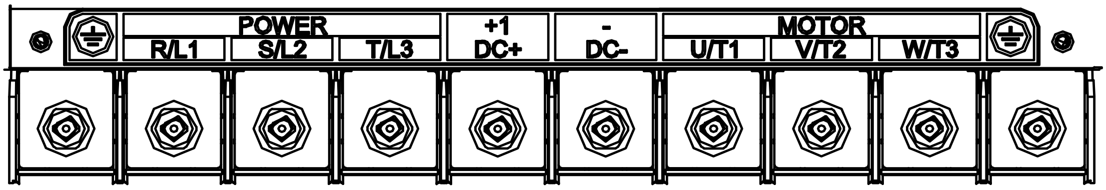


Figure 4-14

Model	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, +1(DC+), -(DC-)			Terminal ⏚		
	Min. Wire Gauge	Max. Wire Gauge	Screw Size & Tightening Torque (±10%)	Min. Wire Gauge	Max. Wire Gauge	Screw Size & Tightening Torque (±10%)
VFD370ED43S	53.5 mm² (1/0 AWG)	152 mm² (300 MCM)	M8 200 kg-cm (173 lb-in.) (19.6 N-m)	33.6 mm² (2 AWG)	152 mm² (300 MCM)	M8 200 kg-cm (173 lb-in.) (19.6 N-m)
VFD450ED43S	67.4 mm² (2/0 AWG)			53.5 mm² (1/0 AWG)		
VFD300ED23S	107 mm² (4/0 AWG)			53.5 mm² (1/0 AWG)		
VFD550ED43S						
VFD370ED23S	152 mm² (300 MCM)			85.0 mm² (3/0 AWG)		
VFD750ED43S						

Table 4-5

NOTE:

- For UL installation compliance, select copper wires with voltage rating of 600V and temperature resistance of 75°C.
- Choose terminal wire size as Figure 4-15 shows.
- Use insulated heat shrink tubing that is resistant to at least 600V to comply with UL and CSA regulations (600 V, YDPU2), as Figure 4-16 shows.
- If you install at Ta 50°C environment, use copper wires with voltage rating of 600V and temperature resistance of 75°C or 90°C.
- If you install at Ta 50°C above environment, use copper wires with voltage rating of 600V and temperature resistance of 90°C or above.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

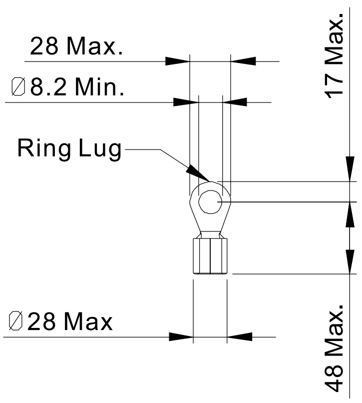


Figure 4-15

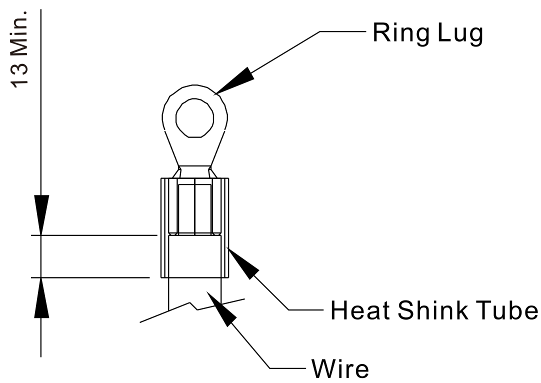


Figure 4-16

Chapter 5 Control Terminals

5-1 Remove the Cover before Wiring

Remove the top cover before wiring the multi-function input and output terminals

NOTE: The motor drives' figures shown below are for reference only. The actual motor drives may look different.

Frame B, C and D

Step 1: Loosen the four screws

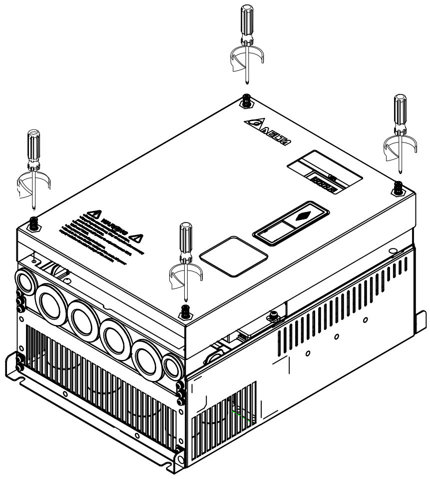


Figure 5-1

Step 2: Remove the top cover

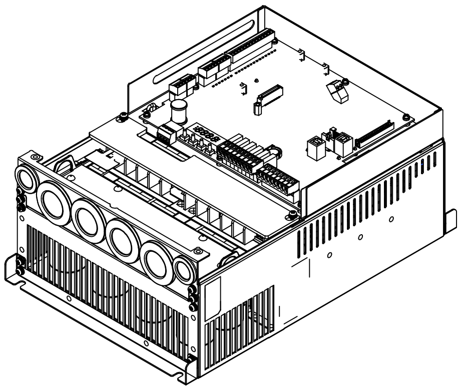


Figure 5-2

Step 3: Attach the top cover, and then tighten the four screws using torque force 15 kgf-cm.

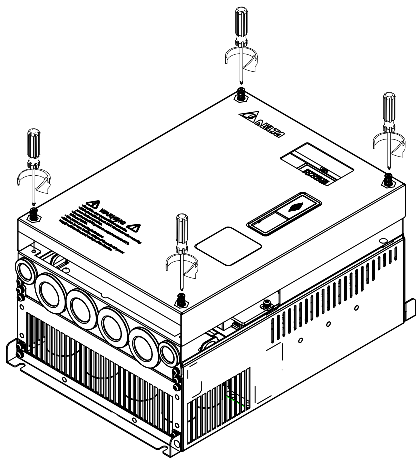
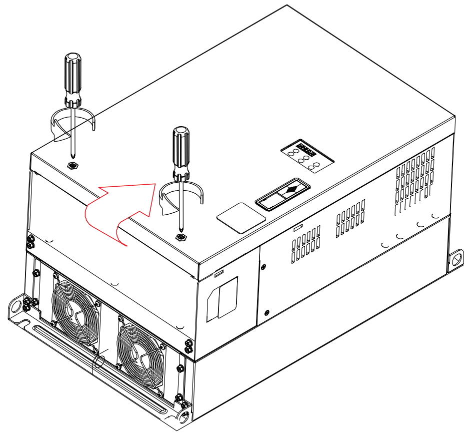
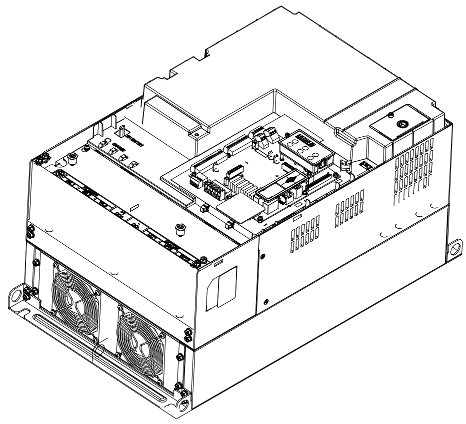
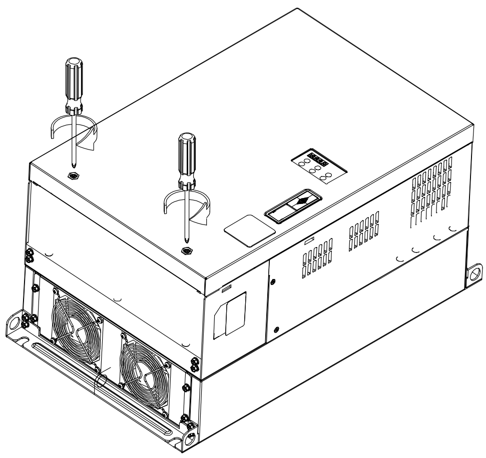


Figure 5-3

Frame E

Step 1: Loosen the two screws in the direction as the arrow shows	 Figure 5-4
Step 2: Remove the top cover	 Figure 5-5
Step 3: Attach the top cover, and then tighten the two screws using torque force 15 kgf-cm.	 Figure 5-6

5-2 Control Terminal Specifications

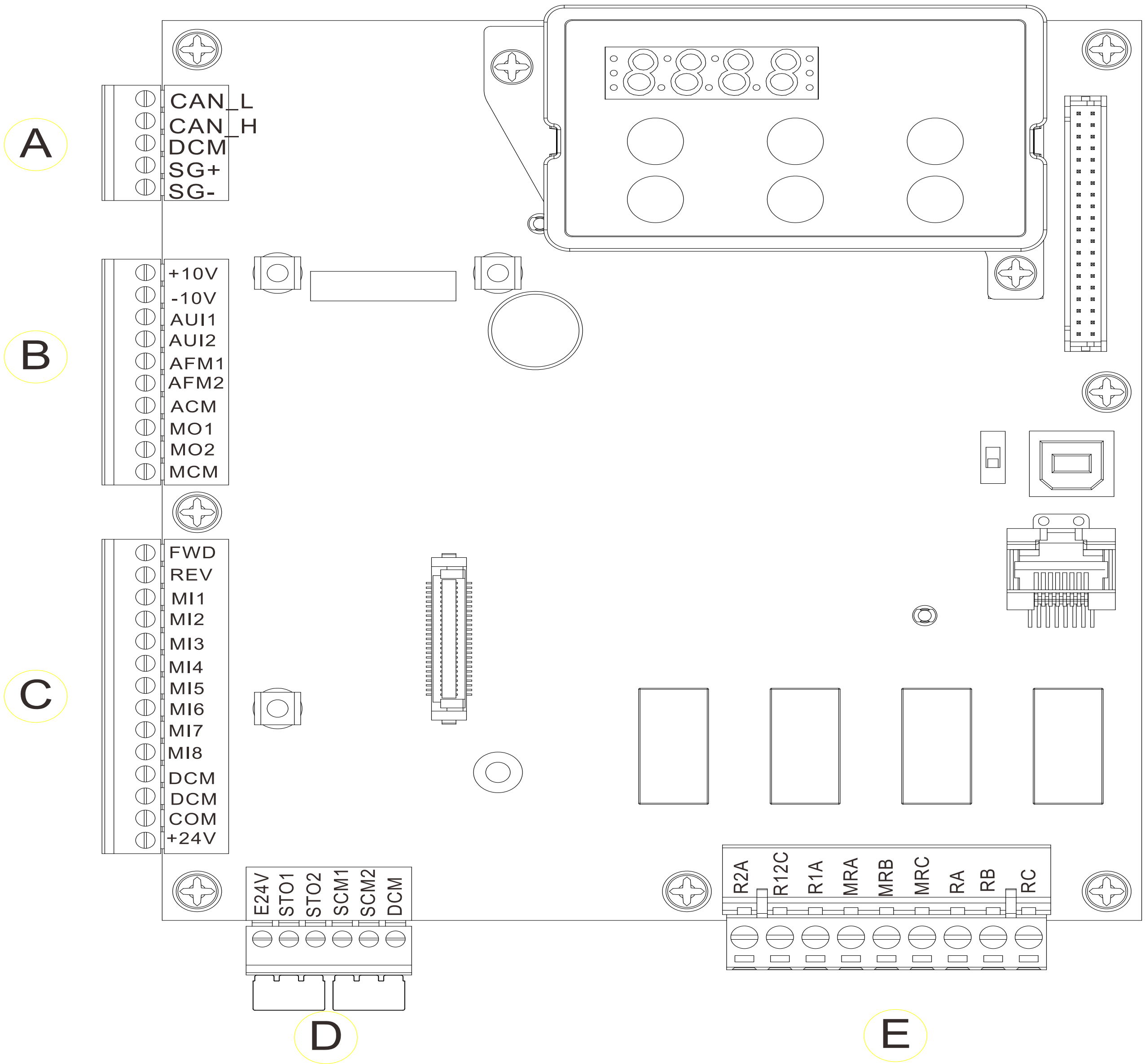


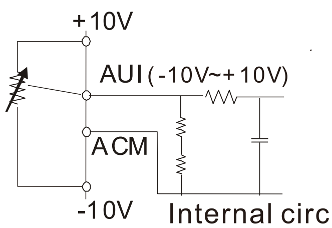
Figure 5-7

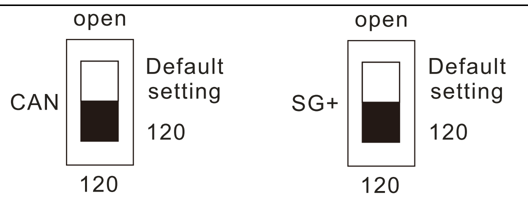
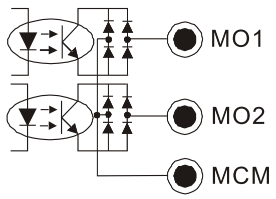
Terminal Socket	Wire Gauge	Torque Force (±10 %)
A	0.2–2.5 mm² (28–14 AWG)	2 kg-cm / (1.7 Ib-in.) / (0.20 Nm)
B		
C		
D	-	2 kg-cm / (1.7 Ib-in.) / (0.20 Nm)
E	0.2–4.0 mm² (28–12 AWG)	5.2 kg-cm / (4.5 Ib-in.) / (0.51 Nm)

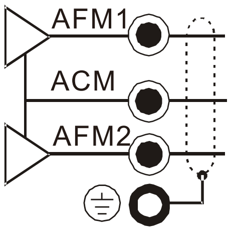
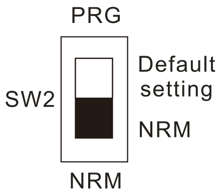
Table 5-1

NOTE: To comply with UL standards, use copper wires in the installation that are able to withstand 600V, 75ºC environments.

5-3 Control Circuit Terminals

<table>
<tr><th>Terminals</th><th>Terminal Function</th><th>Default (NPN mode)</th></tr>
<tr><td>+24 V /
E24 V</td><td>Digital control signal common terminal (Source)</td><td>+24V ± 5% 200 mA</td></tr>
<tr><td>COM</td><td>Digital control signal common terminal (Sink)</td><td>Common terminal for multi-function input terminals</td></tr>
<tr><td>FWD</td><td>Forward-Stop command</td><td>FWD-DCM:
ON = run in forward
OFF = decelerate to stop</td></tr>
<tr><td>REV</td><td>Reverse-Stop command</td><td>REV-DCM:
ON = run in reverse
OFF = decelerate to stop</td></tr>
<tr><td>MI1
–
MI8</td><td>Multi-function input 1–8</td><td>Refer to parameters Pr.02-01–Pr.02-08 to program the multi-function inputs MI1–MI8.
Source mode:
● Rated load: 24 V_{DC} / 9.6 mA
● Source Mode (PNP)
N.O. (ON, 1): ≥ 17 V_{DC}
N.C. (OFF, 0): ≤ 5 V_{DC}
● Sink Mode (NPN)
N.O. (ON, 1): ≤ 7 V_{DC}
N.C. (OFF, 0): ≥ 19 V_{DC}</td></tr>
<tr><td>DCM</td><td>Digital frequency signal common terminal</td><td></td></tr>
<tr><td>SCM1</td><td colspan="2" rowspan="4">The default is short-circuited (E24V/STO1/STO2).
The default is short-circuited (SCM1/SCM2/DCM).
Power cutoff safety function for EN954-1 and IEC/EN61508.
When STO1–SCM1 and STO2–SCM2 are ON, the activation current is 3.3 mA ≥ 11 V_{DC}.</td></tr>
<tr><td>SCM2</td></tr>
<tr><td>STO1</td></tr>
<tr><td>STO2</td></tr>
<tr><td>+10 V</td><td>Potentiometer power supply</td><td>Power supply for analog frequency setting: +10 V_{DC} 20 mA</td></tr>
<tr><td>-10 V</td><td>Potentiometer power supply</td><td>Power supply for analog frequency setting: -10 V_{DC} 20 mA</td></tr>
<tr><td>AUI1</td><td rowspan="2">Analog voltage frequency command
</td><td rowspan="2">Impedance: 20 kΩ
Range: -10–10 V_{DC} = 0–Maximum Output Frequency (Pr.01-00)</td></tr>
<tr><td>AUI2</td></tr>
</table>

Terminals	Terminal Function	Default (NPN mode)
ACM	Analog signal common terminal control	Analog signal common terminal
RA	Multi-function relay output A (N.O.)	User-defined function Resistive Load 3 A (N.O.) / 3 A (N.C.) 250 V_{AC} 5 A (N.O.) / 3 A (N.C.) 30 V_{DC} (minimum 5 V_{DC}, 10 mA) To output different kinds of monitoring signals such as motor drive in operation, frequency reached, and overload indication.
RB	Multi-function relay output A (N.C.)	
RC	Multi-function relay output B (Default: error indication)	
MRA	Multi-function output terminal (N.O.)	
MRB	Multi-function output terminal (N.C.)	
MRC	Multi-function output terminal (Default: operating indication)	
R1A	Multi-function output terminal A (N.O.)	
R2A	Multi-function output terminal A (N.O.)	
R12C	Multi-function output terminal (Default: no function)	
SG1+	Modbus RS-485	SG1+ switch: terminator 120 ohm (default) / open
SG1-	Modbus RS-485	
		
CAN_L	CAN Bus	DIP switch: terminator 120 ohm (default) / open
CAN_H	CAN Bus	
MO1	Multi-function output terminal 1 (photo coupler)	The AC motor drive outputs various monitoring signals, such as drive in operation, frequency reached, and overload indication through a transistor (open collector). 
MO2	Multi-function output terminal 2 (photo coupler)	
MCM	Multi-function output common terminal (photo coupler)	Maximum 48V_{DC} 50mA
AFM1		0-10 V, max. output current: 2 mA, max. load: 5 kΩ -10–10 V, max. output current: 2 mA, max. load: 5 kΩ

Terminals	Terminal Function	Default (NPN mode)
AFM2		Maximum output current: 2 mA Resolution: 0–10 V, corresponds to the maximum operating frequency. Range: 0–10 V→ -10–10 V
RJ45	PINS 1, 2, 6, 7: Reserved PIN 3: SGND PIN 4: SG- PIN 5: SG+ PIN 8: EV	
SW2	Switching USB port	 DIP switch: NRM (default) / PRG (use this side of the switch to update firmware). Updating firmware should be done by qualified motor drive service personnel only. Do NOT try to update the firmware by yourself.

NOTE: NRM = Normal

Table 5-2

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Chapter 6 Optional Accessories

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

6-1 Brake Resistors and Brake Units Used in AC Motor Drives

Recommended Model Selection

Voltage	Delta's Motor Drive Model	IM 10% ED*1			PM 30% ED*2		
		Min. Resistor Value*3 (Ω)	Suggested Resistor Value*4 (Ω)	Suggested Braking Power (kW)	Min. Resistor Value (Ω)	Suggested Resistor Value (Ω)	Suggested Braking Power (kW)
230V	VFD022ED21S	38.0	70.0	0.3	38.0	50.0	1.0
	VFD037ED21S	19.0	30.0	0.5	19.0	32.0	1.5
	VFD040ED23S	19.0	30.0	0.5	19.0	32.0	1.5
	VFD055ED23S	15.6	20.0	1.0	15.6	25.0	2.0
	VFD075ED23S	11.5	20.0	1.0	11.5	16.7	3.0
	VFD110ED23S	9.5	13.0	1.5	9.5	12.5	4.0
	VFD150ED23S	8.3	10.0	2.0	8.3	10.0	5.0
	VFD185ED23S	5.8	8.0	2.0	5.8	7.8	7.5
	VFD220ED23S	5.8	6.6	3.0	5.8	6.5	9.0
	VFD300ED23S	4.8	5.1	4.0	4.8	5.0	10.0
	VFD370ED23S	3.2	3.9	4.8	3.2	3.6	14.0
460V	VFD040ED43S	54.3	100.0	0.5	54.3	100.0	2.0
	VFD055ED43S	48.4	75.0	1.0	48.4	100.0	2.0
	VFD075ED43S	39.4	75.0	1.0	39.4	60.0	3.0
	VFD110ED43S	30.8	43.0	1.5	30.8	50.0	4.0
	VFD150ED43S	25.0	32.0	2.0	25	39.0	6.0
	VFD185ED43S	20.8	32.0	2.0	20.8	26.0	7.2
	VFD220ED43S	19.0	26.0	3.0	19.0	26.0	9.0
	VFD300ED43S	14.1	20.0	4.0	14.1	19.5	12.0
	VFD370ED43S	12.7	14.3	4.5	13.8	15.6	15.0
	VFD450ED43S	12.7	13.0	6.0	10.3	13.0	18.0
	VFD550ED43S	9.5	10.2	8.0	6.9	9.8	19.2
	VFD750ED43S	6.3	7.2	9.0	6.4	7.1	26.4

Table 6-1

*1 The brake resistor should be able to endure 10 times the overload capacity.

*2 The brake resistor should be able to endure 3.3 times the overload capacity.

*3 If you choose other brake resistors instead of Deltas, calculate the maximum power and average power of t he selected braking power to ensure that they meet the requirements. Maximum power: Vb^2/R; average power: Vb^2/R x ED%. (Vb stands for braking voltage; R stands for brake resistor value.)

*4 The calculation of the brake resistor value and braking power is based on Delta's brake resistor.

IM Elevator System (Using Delta's Brake Resistor)

Voltage	Applicable Delta's Motor Drive		125% Braking Torque/10% ED*1							Max. Braking Torque		
	HP	Model	Braking Torque*2 (kg-m)	Brake Unit VFDB	Brake Unit #	Delta's Brake Resistor*3 Part No.	Delta's Brake Resistor*3 #	Delta's Brake Resistor*3 Configuration	Braking Current (A)*4	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
230V	3	VFD022ED21S	1.5			BR300W070	1		5.4	38.0	10.0	3.8
230V	5	VFD037ED21S	2.5			BR500W030	1		12.7	19.0	20.0	7.6
230V	5	VFD040ED23S	2.5			BR500W030	1		12.7	19.0	20.0	7.6
230V	7.5	VFD055ED23S	3.7			BR1K0W020	1		19.0	15.6	24.4	9.3
230V	10	VFD075ED23S	5.1			BR1K0W020	1		19.0	11.5	33.0	12.5
230V	15	VFD110ED23S	7.5			BR1K5W013	1		29.2	9.5	40.0	15.2
230V	20	VFD150ED23S	10.2			BR1K0W020	2	2 parallel	38.0	8.3	46.0	17.5
230V	25	VFD185ED23S	12.2			BR1K0W016	2	2 parallel	47.5	5.8	66.0	25.1
230V	30	VFD220ED23S	14.9			BR1K5W3P3	2	2 in series	57.6	5.8	66.0	25.1
230V	40	VFD300ED23S	20.3	2015	2	BR1K0W5P1	4	2 in series 2 parallel	74.5	4.8	80.0	30.4
230V	50	VFD370ED23S	25.1	2022	2	BR1K2W3P9	4	2 in series 2 parallel	97.4	3.2	120.0	45.6
460V	5	VFD040ED43S	2.7			BR500W100	1		7.6	54.3	14.0	10.6
460V	7.5	VFD055ED43S	3.7			BR1K0W075	1		10.1	48.4	15.7	11.9
460V	10	VFD075ED43S	5.1			BR1K0W075	1		10.1	39.4	19.3	14.7
460V	15	VFD110ED43S	7.5			BR1K5W043	1		17.7	30.8	24.7	18.8
460V	20	VFD150ED43S	10.1			BR1K0W016	2	2 in series	23.8	25.0	30.4	23.1
460V	25	VFD185ED43S	12.5			BR1K0W016	2	2 in series	23.8	20.8	36.5	27.7
460V	30	VFD220ED43S	14.9			BR1K5W013	2	2 in series	29.2	19.0	40.0	30.4
460V	40	VFD300ED43S	20.3			BR1K0W020	4	2 in series 2 parallel	38.0	14.1	54.0	41.0
460V	50	VFD370ED43S	25.0	4045	1	BR1K5W043	3	3 parallel	53.0	12.7	60.0	45.6
460V	60	VFD450ED43S	30.4	4045	1	BR1K5W013	4	2 in series 2 parallel	58.5	12.7	60.0	45.6
460V	75	VFD550ED43S	37.2	4030	2	BR1K0W5P1	8	4 in series 2 parallel	74.5	9.5	80.0	60.8
460V	100	VFD750ED43S	50.7	4045	2	BR1K5W043	6	6 parallel	106.0	6.3	120.0	91.2

Table 6-2

*1 Calculation of 125% braking torque: (kW)*125%*0.8; where 0.8 is the motor efficiency.
Since there is a resistor power consumption limit, the longest operation time for 10% ED is 10 seconds (ON: 10 seconds / OFF: 90 seconds).

*2 The calculation of the brake resistor is based on a four-pole motor (1800 rpm).

*3 To dissipate heat, mount a resistor of 400 W or lower to a frame to keep the surface temperature below 250°C (482°F). Fix a resistor of 1000 W or higher to a surface to keep the surface temperature below 600°C (1112°F). (If the resistor temperature is higher than 350°C, install extra cooling. If the resistor temperature is higher than the temperature limit, increase the size of the resistor.)

*4 The calculation of the braking current is based on Delta's brake resistor and default braking voltage ($220V_{AC}$: $380V_{DC}$; $440V_{AC}$: $760V_{DC}$).

PM Elevator System (Using Delta's Brake Resistor)

Voltage	Applicable Delta's Motor Drive		125% Braking Torque/30% ED*1							Max. Braking Torque		
	HP	Model	Braking Torque*2 (kg-m)	Brake Unit VFDB	Brake Unit #	Delta's Brake Resistor *3 Part No.	Delta's Brake Resistor *3 #	Delta's Brake Resistor *3 Configuration	Braking Current (A)*4	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
230V	3	VFD022ED21S	1.5			BR1K0W050	1		7.6	38.0	10.0	3.8
	5	VFD037ED21S	2.5			BR1K0W016	2	2 in series	11.9	19.0	20.0	7.6
	5	VFD040ED23S	2.5			BR1K0W016	2	2 in series	11.9	19.0	20.0	7.6
	7.5	VFD055ED23S	3.7			BR1K0W050	2	2 parallel	15.2	15.6	24.4	9.3
	10	VFD075ED23S	5.1			BR1K0W050	3	3 parallel	22.8	11.5	33.0	12.5
	15	VFD110ED23S	7.5			BR1K0W050	4	4 parallel	30.4	9.5	40.0	15.2
	20	VFD150ED23S	10.2			BR1K0W050	5	5 parallel	38.0	8.3	46.0	17.5
	25	VFD185ED23S	12.2			BR1K5W039	5	5 parallel	48.7	5.8	66.0	25.1
	30	VFD220ED23S	14.9			BR1K5W039	6	6 parallel	58.5	5.8	66.0	25.1
	40	VFD300ED23S	20.3	2015	2	BR1K0W050	10	10 parallel	76.0	4.8	80.0	30.4
	50	VFD370ED23S	25.1	2022	2	BR1K0W050	14	14 parallel	106.4	3.2	120.0	45.6
460V	5	VFD040ED43S	2.7			BR1K0W050	2	2 in series	7.6	54.3	14.0	10.6
	7.5	VFD055ED43S	3.7			BR1K0W050	2	2 in series	7.6	48.4	15.7	11.9
	10	VFD075ED43S	5.1			BR1K0W020	3	3 in series	12.7	39.4	19.3	14.7
	15	VFD110ED43S	7.5			BR1K0W050	4	2 in series 2 parallel	15.2	30.8	24.7	18.8
	20	VFD150ED43S	10.1			BR1K5W039	4	2 in series 2 parallel	19.5	25.0	30.4	23.1
	25	VFD185ED43S	12.5			BR1k2W039	6	2 in series 3 parallel	29.2	20.8	36.5	27.7
	30	VFD220ED43S	14.9			BR1K5W039	6	2 in series 3 parallel	29.2	19.0	40.0	30.4
	40	VFD300ED43S	20.3			BR1K5W039	8	2 in series 4 parallel	39.0	14.1	54.0	41.0
	50	VFD370ED43S	25.0	4045	1	BR1K5W039	10	2 in series 5 parallel	48.7	13.8	55.0	41.8
	60	VFD450ED43S	30.4	4030	2	BR1K5W039	12	2 in series 6 parallel	58.5	10.3	74.0	56.2
	75	VFD550ED43S	37.2	4045	2	BR1k2W039	16	2 in series 8 parallel	77.9	6.9	110.0	83.6
	100	VFD750ED43S	50.7	4110	1	BR1k2W039	22	2 in series 11 parallel	107.2	6.4	118.0	89.7

Table 6-3

*1 Calculation of 125% braking torque: (kW)*125%*0.8; where 0.8 is the motor efficiency.
Since there is a resistor power consumption limit, the longest operation time for 30% ED is 30 seconds (ON: 30 seconds / OFF: 70 seconds).

*2 The calculation of the brake resistor is based on a four-pole motor (1800 rpm).

*3 To dissipate heat, mount a resistor of 400 W or lower to a frame to keep the surface temperature below 250°C (482°F). Fix a resistor of 1000 W or higher to a surface to keep the surface temperature below 600°C (1112°F). (If the resistor temperature is higher than 350°C, install extra cooling. If the resistor temperature is higher than the temperature limit, increase the size of the resistor.)

*4 The calculation of the braking current is based on Delta's brake resistor and default braking voltage (220V_{AC}: 380V_{DC}; 440V_{AC}: 760V_{DC}).

NOTE:

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

   Definition for Brake Usage ED%

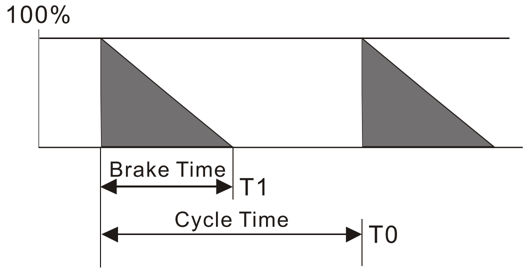


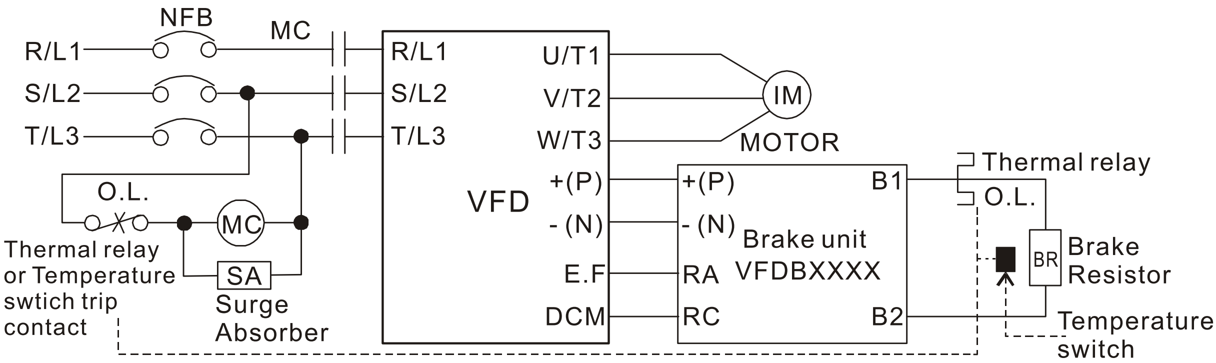
Figure 6-1

ED% = T1/T0 x 100 (%)

Explanation:

Brake usage ED (%) is the amount of time needed for the brake unit and brake resistor to dissipate heat generated by braking. When the brake resistor heats up, the resistance increases with temperature, and braking torque decreases accordingly.

For safety, install a thermal overload relay between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) at the drive mains input for additional protection. The thermal overload relay protects the brake resistor from overheat damage due to frequent or continuous braking. Under such circumstances, turn off the power to prevent damage to the brake resistor and the drive. **NOTE:** Never use it to disconnect the brake resistor.



■ When the drive is equipped with a DC reactor, read the user manual for the correct wiring for the brake unit input circuit +(P).

■ DO NOT connect the input circuit -(N) to the neutral point of the power system.

Figure 6-2

2. Any damage to the drive or other equipment caused by using brake resistors and brake units 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 your local dealers for the power calculation.
4. When using more than two brake units, the equivalent resistor value of parallel brake unit cannot be less than the value in the column “Min. Resistor Value (Ω)”. Read the wiring information in the brake unit instruction sheet 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
     http://www.deltaww.com/Products/PluginWebUserControl/downloadCenterCounter.aspx?DID=1574&DocPath=1&hl=zh-TW
   - VFDB4110 / 4160 / 4185 Braking Modules Instruction Sheet
     http://www.deltaww.com/Products/PluginWebUserControl/downloadCenterCounter.aspx?DID=1562&DocPath=1&hl=zh-TW
   - VFDB6055 / 6110 / 6160 / 6200 Braking Modules Instruction Sheet
     http://www.deltaww.com/Products/PluginWebUserControl/downloadCenterCounter.aspx?DID=8594&DocPath=1&hl=zh-TW

5. The selection tables are for normal use. If the AC motor drive requires frequent braking, increase the Watts by two to three times.
6. Thermal Overload Relay (TOR):
   Thermal overload relay selection is based on its overload capacity. A standard braking capacity of the VFD-ED is 10%ED (Tripping time = 10s). As shown in the graph below, a 460V, 11 kw VFD-ED requires the thermal relay to take 260% overload capacity for 10 seconds (hot starting) and the braking current is 17.7 A. In this case, select a thermal overload relay larger than 17.7 / 2.6 = 6.8 (A). The specification of each thermal relay may vary among different manufacturers. Carefully read the specification before using it.

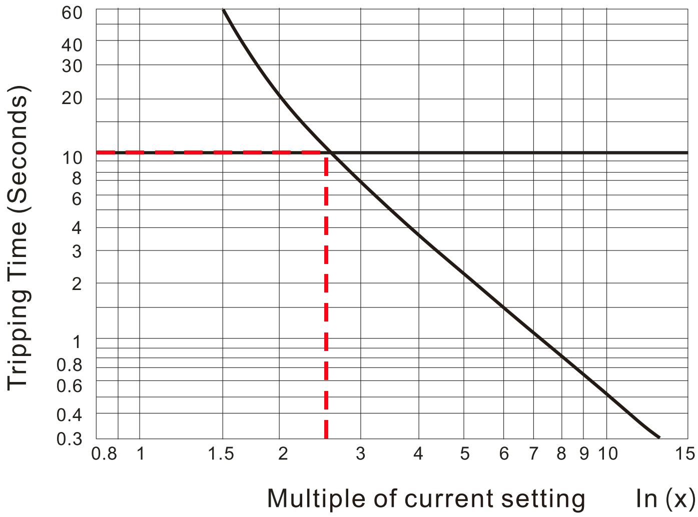


Figure 6-3

6-2 Non-fuse Circuit Breaker

Comply with the UL standard: Per UL 508, paragraph 45.8.4, part a. The rated current of a breaker shall be two to four times the maximum rated input current of the AC motor drive.

Single-phase/Three-phase	
Model	Recommended non-fuse breaker (A)
VFD022ED21S*	50
VFD037ED21S*	75
VFD040ED23S	40
VFD055ED23S	50
VFD075ED23S	60
VFD110ED23S	100
VFD150ED23S	125
VFD185ED23S	150
VFD220ED23S	175
VFD300ED23S	250
VFD370ED23S	300
*: Single-phase models	

Table 6-4

Three-phase	
Model	Recommended non-fuse breaker (A)
VFD040ED43S	30
VFD055ED43S	35
VFD075ED43S	40
VFD110ED43S	50
VFD150ED43S	60
VFD185ED43S	75
VFD220ED43S	100
VFD300ED43S	125
VFD370ED43S	150
VFD450ED43S	200
VFD550ED43S	250
VFD750ED43S	350

Table 6-5

6-3 Fuse Specification Chart

Fuse specifications lower than the table below are allowed.

Model	Input Current (A)	Line Fuse	
		I (A)	Bussmann P/N
VFD022ED21S	26	60	JJN-60
VFD037ED21S	37	90	JJN-90
VFD040ED23S	20	50	JJN-50
VFD055ED23S	23	60	JJN-60
VFD075ED23S	30	80	JJN-80
VFD110ED23S	47	125	JJN-125
VFD150ED23S	56	150	JJN-150
VFD185ED23S	73	175	JJN-175
VFD220ED23S	90	225	JJN-225
VFD300ED23S	132	300	JJN-300
VFD370ED23S	161	400	JJN-400
VFD040ED43S	11.5	35	JJS-35
VFD055ED43S	14	40	JJS-40
VFD075ED43S	17	45	JJS-45
VFD110ED43S	24	60	JJS-60
VFD150ED43S	30	80	JJS-80
VFD185ED43S	37	90	JJS-90
VFD220ED43S	47	110	JJS-110
VFD300ED43S	58	150	JJS-150
VFD370ED43S	80	200	JJS-200
VFD450ED43S	100	250	JJS-250
VFD550ED43S	128	300	JJS-300
VFD750ED43S	165	400	JJS-400

Table 6-6

6-4 AC / DC Reactor

AC Input 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, increase system capacity, 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 peak 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 between the main power and the three input phases R S T, as shown in the figure below:

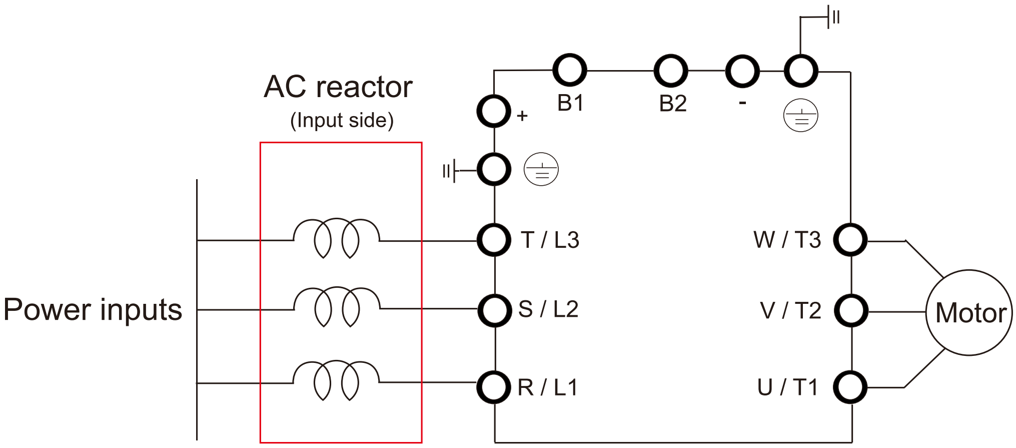


Figure 6-4 Connecting an AC Input Reactor

DC Reactor

A DC reactor can also increase line impedance, improve the power factor, reduce input current, increase system power, and reduce interference generated from the motor drive. A DC reactor stabilizes the DC bus voltage. Compared with an AC input reactor, a DC reactor is in smaller size, lower price, and lower voltage drop (lower power dissipation).

Installation

Install a DC reactor between terminals +1(DC+) and +2/B1(DC+). Remove the DC reactor jumper, as shown in the figure below, before installing a DC reactor.

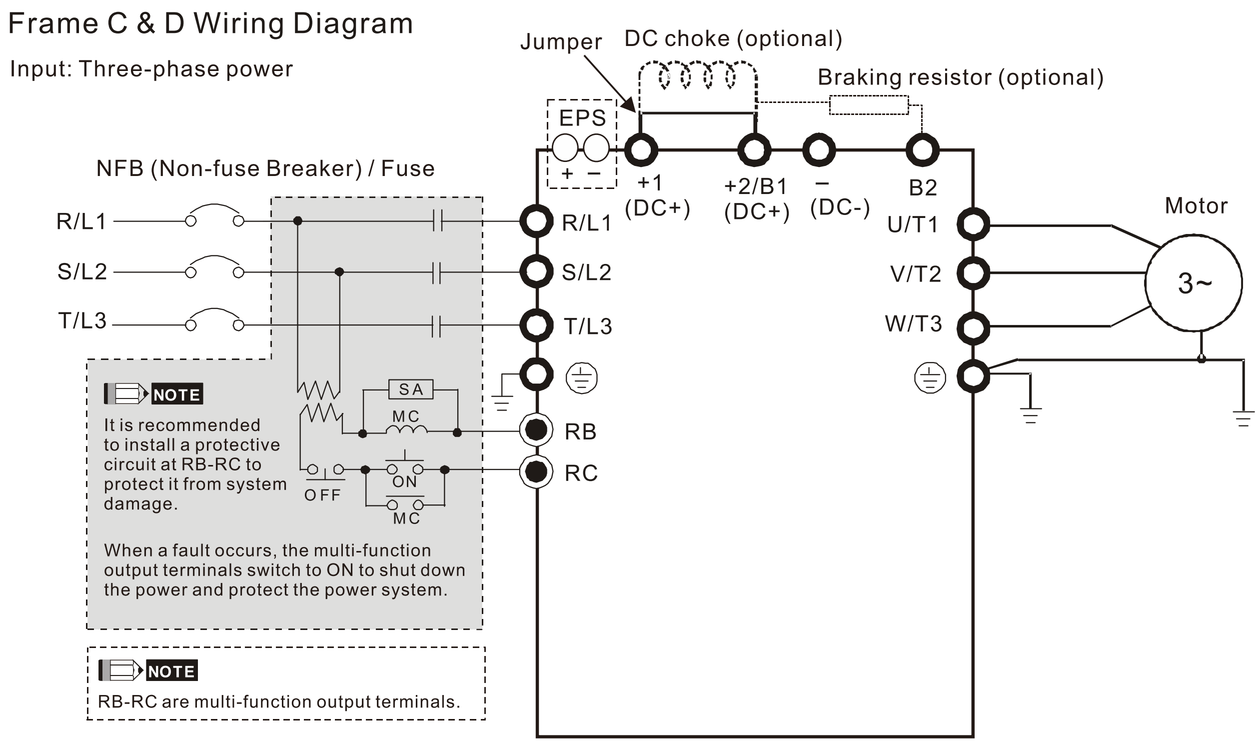


Figure 6-5 Installing a DC Reactor

THD (Total Harmonic Distortion)

The table below shows the THDi specification when using Deltas drives (three-phase power models) to work with AC/DC reactors.

Motor Drive Spec. / Reactors in Series Spec.	Models without AC/DC Reactors	Models without Built-in DC Reactors			Models with Built-in DC Reactors	
		3% Input AC Reactor	5% Input AC Reactor	4% DC Reactor	3% Input AC Reactor	5% Input AC Reactor
5th	73.3%	38.5%	30.8%	25.5%	27.01%	25.5%
7th	52.74%	15.3%	9.4%	18.6%	9.54%	8.75%
11th	7.28%	7.1%	6.13%	7.14%	4.5%	4.2%
13th	0.4%	3.75%	3.15%	0.48%	0.22%	0.17%
THDi	91%	43.6%	34.33%	38.2%	30.5%	28.4%

NOTE:

Table 6-7

1. THDi may vary due to different installation conditions and environment (wires, motors).
2. For three-phase power models, Delta provides 4% DC reactors and 3% AC reactors. Refer to the following sections to select your applicable reactors.

AC Output Reactor

When using drives in long wiring output application, ground fault (GFF), over-current (OC) and motor over-voltage (OV) often occur. GFF and OC cause errors due to the drives self -protective mechanism; over-voltage damages motor insulation.

The excessive length of the output wires makes the grounded stray capacitance too large, increase the three-phase output common mode current, and the reflected wave of the long wires makes the motor dv / dt and the motor terminal voltage too high. Thus, installing a reactor on the drive's output side can increases the high-frequency impedance to reduce the dv / dt and terminal voltage to protect the motor.

Installation

Install an AC output reactor in series between the three output phases U V W and the motor, as shown in the figure below:

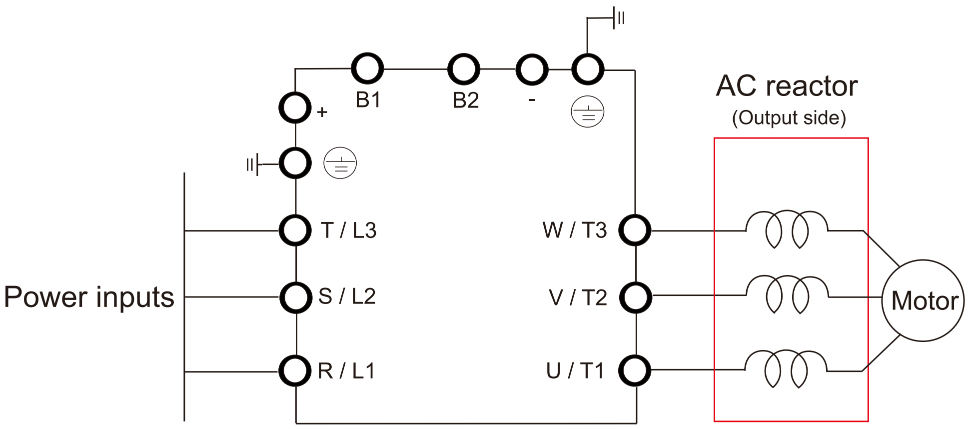


Figure 6-6 Connecting an AC Output Reactor

Applicable Reactors

200V–230V / 50–60 Hz (Single-phase power)

Model	Rated Current (Arms)	Saturation Current (Arms)	AC Input Reactors (mH)	AC Input Reactors (Delta Part#)	AC Output Reactors (mH)	AC Output Reactors (Delta Part #)
VFD022ED21S	12	24	1.172	DR025D0117	2.02	DR012L0202
VFD037ED21S	17	34	0.574	DR049DP574	1.17	DR018L0117

Table 6-8

200V–230V / 50–60 Hz (Three-phase power)

Model	Rated Current (Arms)	Saturation Current (Arms)	3% AC Input / Output Reactors (mH)	3% AC Input / Output Reactors (Delta Part #)	4% DC Reactors (mH)	4% DC Reactors (Delta Part #)
VFD040ED23	20	40	0.507	DR025AP507 DR025LP507	NA*	NA*
VFD055ED23	24	48	0.507	DR025AP507 DR025LP507	1.17	DR025D0117
VFD075ED23	30	60	0.32	DR033AP320 DR033LP320	0.851	DR033DP851
VFD110ED23	45	90	0.215	DR049AP215 DR049LP215	0.574	DR049DP574

Model	Rated Current (Arms)	Saturation Current (Arms)	3% AC Input / Output Reactors (mH)	3% AC Input / Output Reactors (Delta Part #)	4% DC Reactors (mH)	4% DC Reactors (Delta Part #)
VFD150ED23	58	116	0.162	DR065AP162 DR065LP162	0.432	DR065DP432
VFD185ED23	77	154	0.141	DR090AP141 DR090LP141	0.325	DR090DP325
VFD220ED23	87	174	0.141	DR090AP141 DR090LP141	0.325	DR090DP325
VFD300ED23	132	264	0.087	DR146AP087 DR146LP087	NA**	NA**
VFD370ED23	161	322	0.07	DR180AP070 DR180LP070	NA**	NA**

NOTE: NA* stands for not being able to install this accessory; NA** stands for built-in accessory. Table 6-9

380V–460V / 50–60 Hz (Three-phase power)

Model	Rated Current (Arms)	Saturation Current (Arms)	3% AC Input / Output Reactors (mH)	3% AC Input / Output Reactors (Delta Part #)	4% DC Reactors (mH)	4% DC Reactors (Delta Part #)
VFD040ED43S	11.5	23	2.31	DR010A0231 DR010L0231	NA*	NA*
VFD055ED43S	13	26	2.02	DR012A0202 DR012L0202	4.67	DR012D0467
VFD075ED43S	17	34	1.17	DR018A0117 DR018L0117	3.11	DR018D0311
VFD110ED43S	23	46	0.881	DR024AP881 DR024LP881	2.33	DR024D0233
VFD150ED43S	30	60	0.66	DR032AP660 DR032LP660	1.75	DR032D0175
VFD185ED43S	38	76	0.639	DR038AP639 DR038LP639	1.47	DR038D0147
VFD220ED43S	45	90	0.541	DR045AP541 DR045LP541	1.24	DR045D0124
VFD300ED43S	58	116	0.405	DR060AP405 DR060LP405	0.935	DR060DP935
VFD370ED43S	80	160	0.267	DR091AP267 DR091LP267	NA**	NA**
VFD450ED43S	100	200	0.221	DR110AP221 DR110LP221	NA**	NA**
VFD550ED43S	128	256	0.162	DR150AP162 DR150LP162	NA**	NA**
VFD750ED43S	165	330	0.135	DR180AP135 DR180LP135	NA**	NA**

NOTE: NA* stands for not being able to install this accessory; NA** stands for built-in accessory. Table 6-10

NOTE: Because Delta's three-phase power drive models fulfill the requirement for EN12015:2014 Section 6.6.3 condition a), and in accordance with EN12015:2014 Section 6.7.2 Table 4, use THD <48% to comply with EN12015:2014.

Reactor Dimension

AC input reactor dimension and specifications:

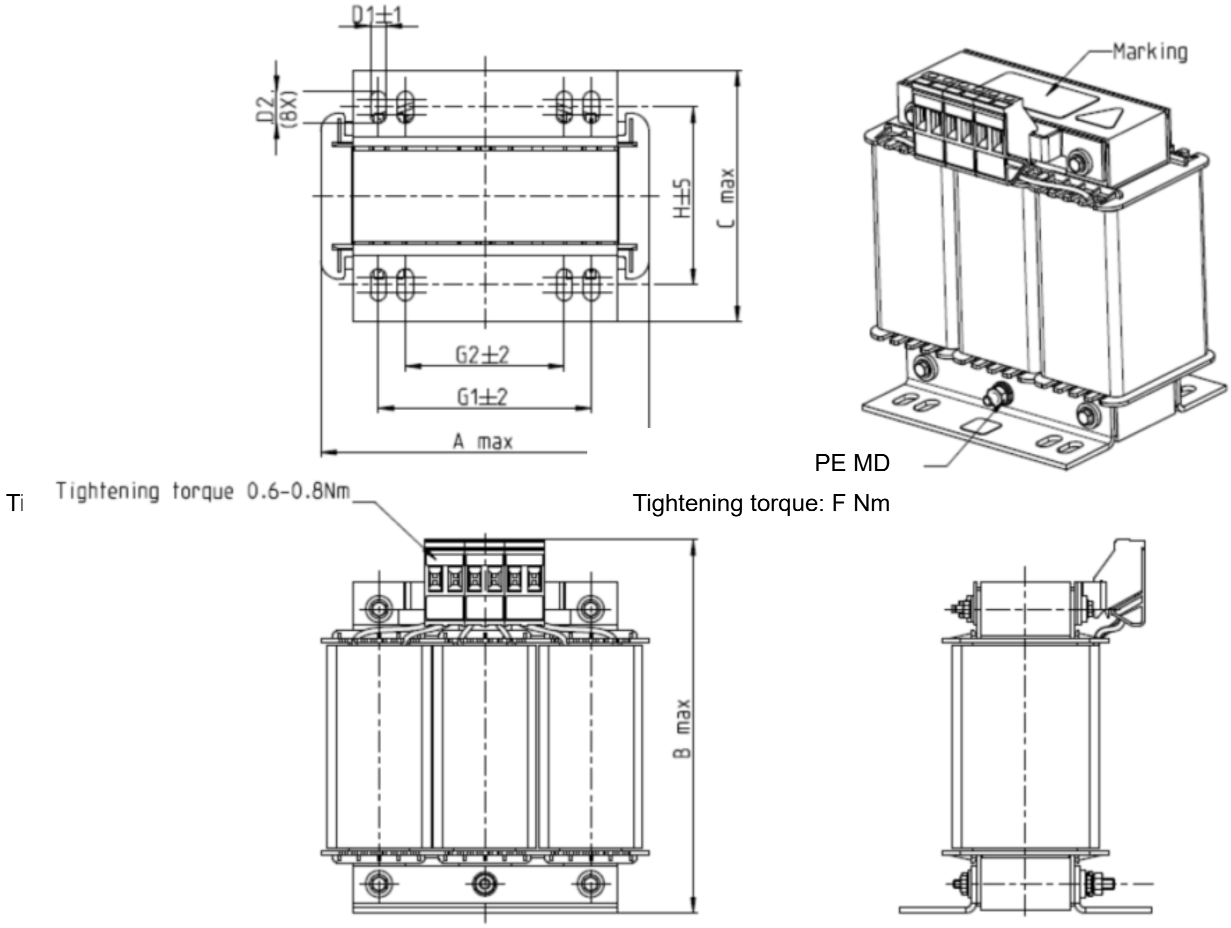


Figure 6-7

Unit: mm

Input Reactors Delta Part #	A	B	C	D1*D2	E	G1	G2	PE D
DR005A0254	100	115	65	6*9	45	60	40	M4
DR008A0159	100	115	65	6*9	45	60	40	M4
DR011A0115	130	135	95	6*12	60	80.5	60	M4
DR017AP746	130	135	100	6*12	65	80.5	60	M4

Table 6-11

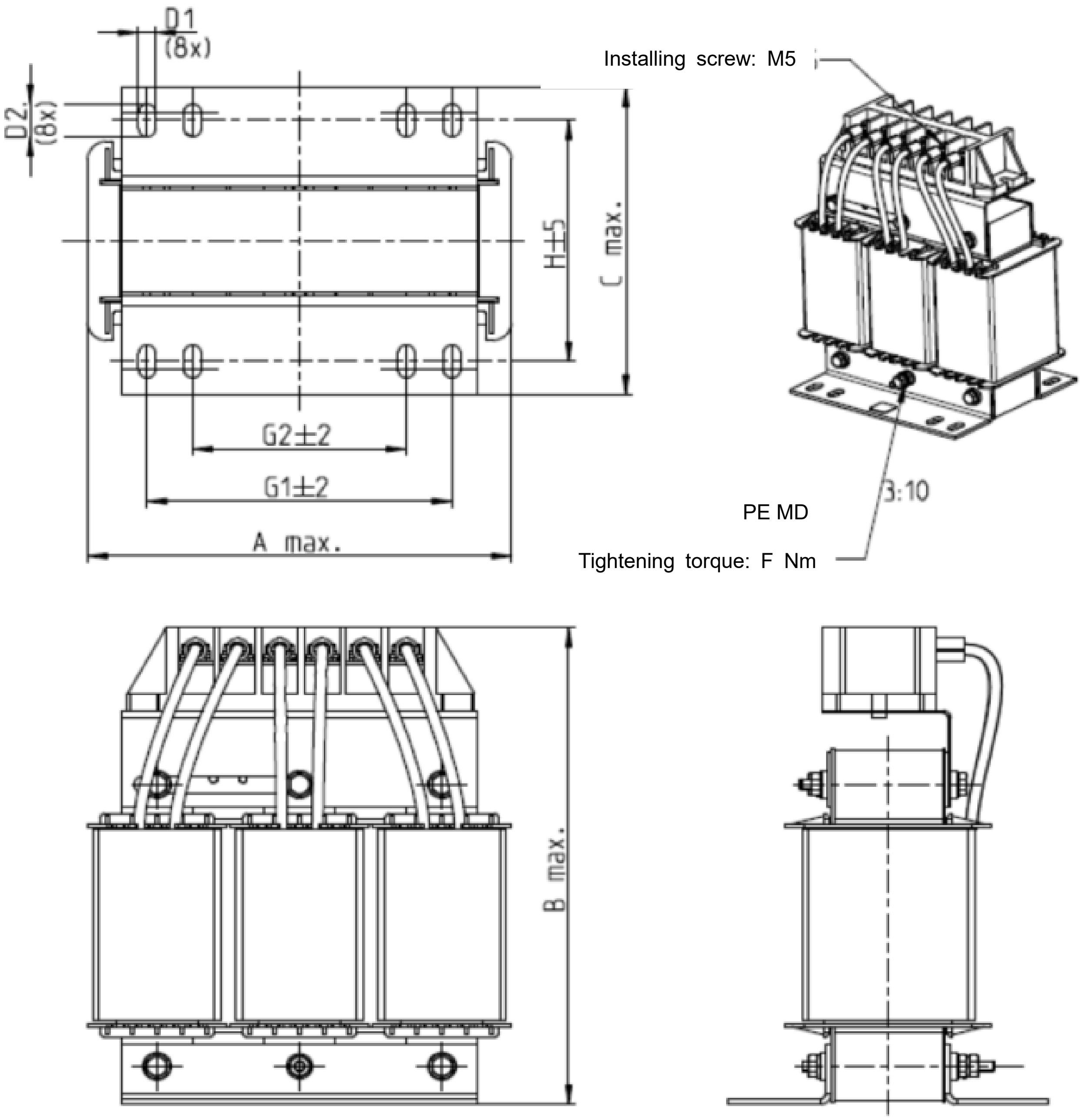


Figure 6-8

Unit: mm

Input Reactors Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR025AP215	130	195	100	6*12	65	80.5	60	M4
DR033AP163	130	195	100	6*12	65	80.5	60	M4
DR049AP163	160	200	125	6*12	90	107	75	M4

Table 6-12

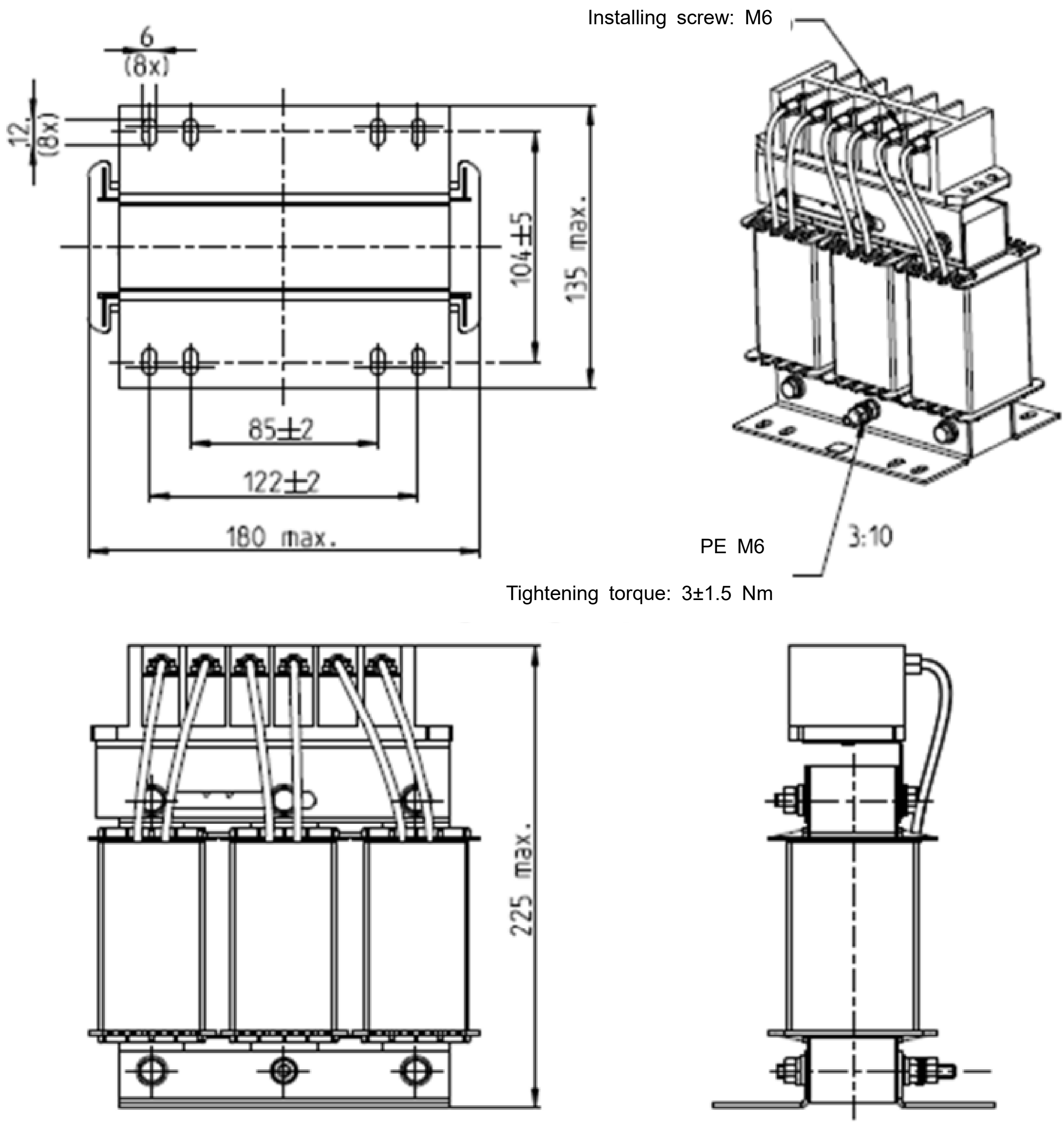


Figure 6-9

Unit: mm

Input Reactors Delta Part #	
DR065AP162	See above.

Table 6-13

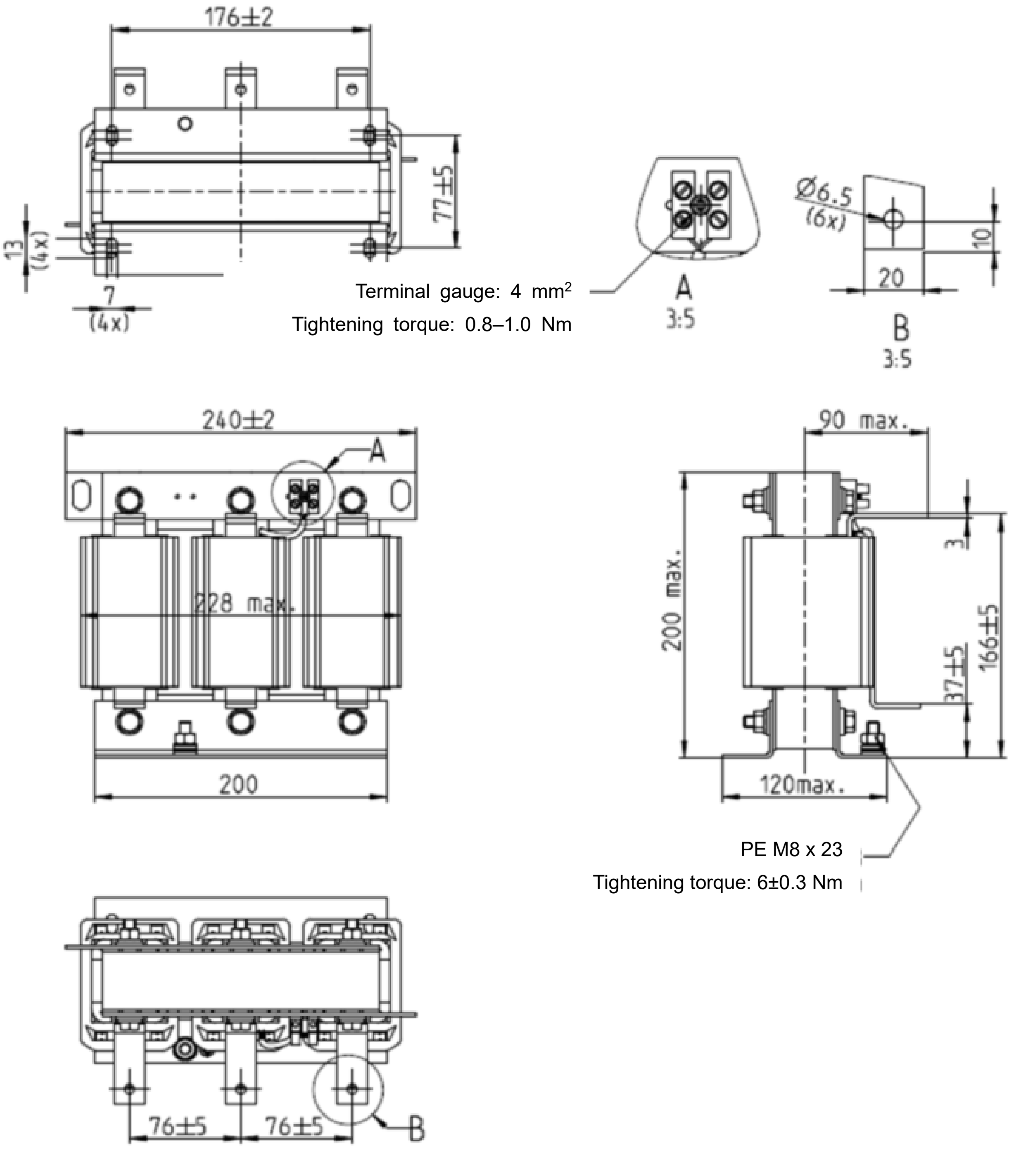


Figure 6-10

Unit: mm

Input Reactors Delta Part #	
DR075AP170	See above.

Table 6-14

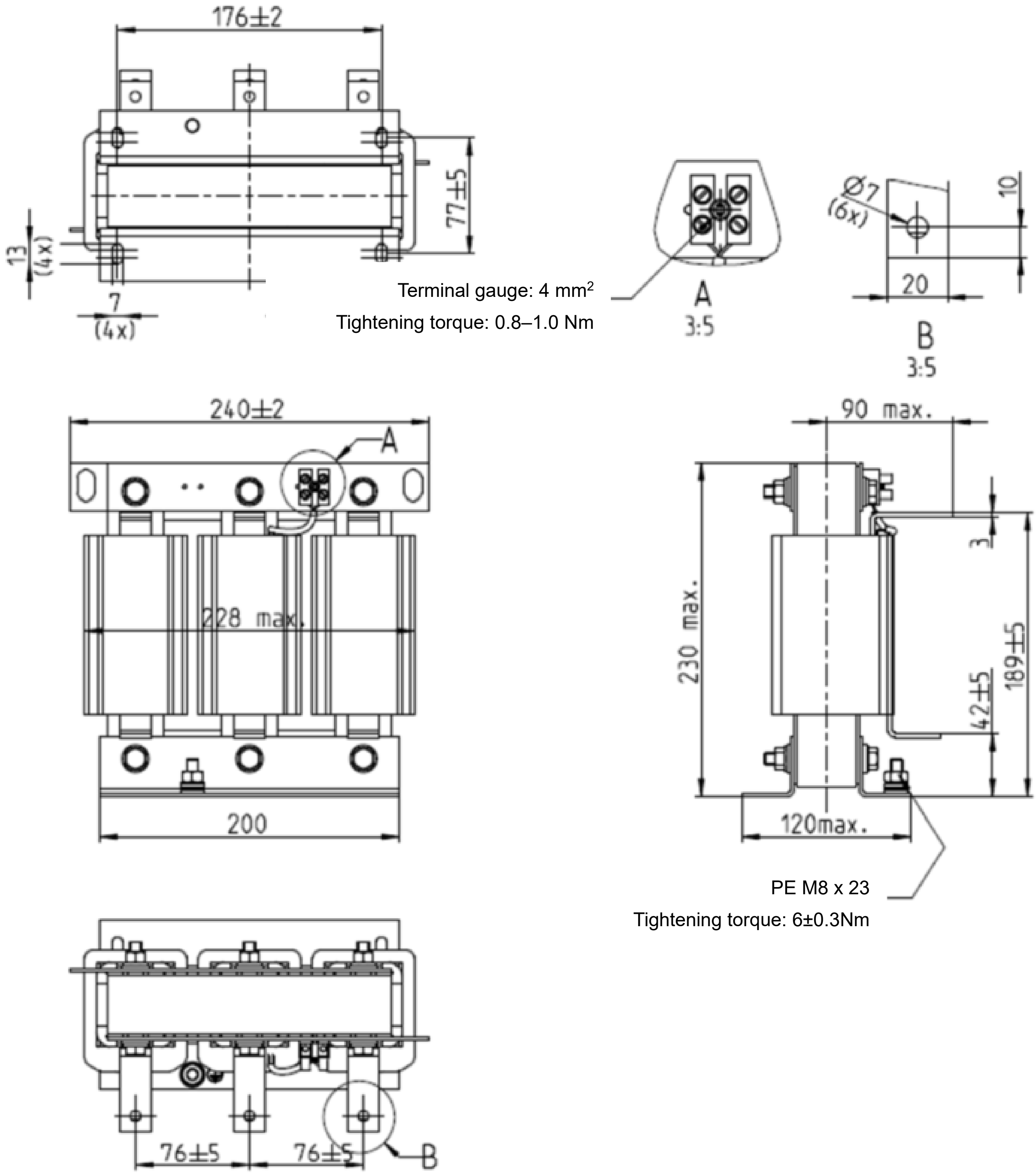


Figure 6-11

Unit: mm

Input Reactors Delta Part #	
DR090AP141	See above.

Table 6-15

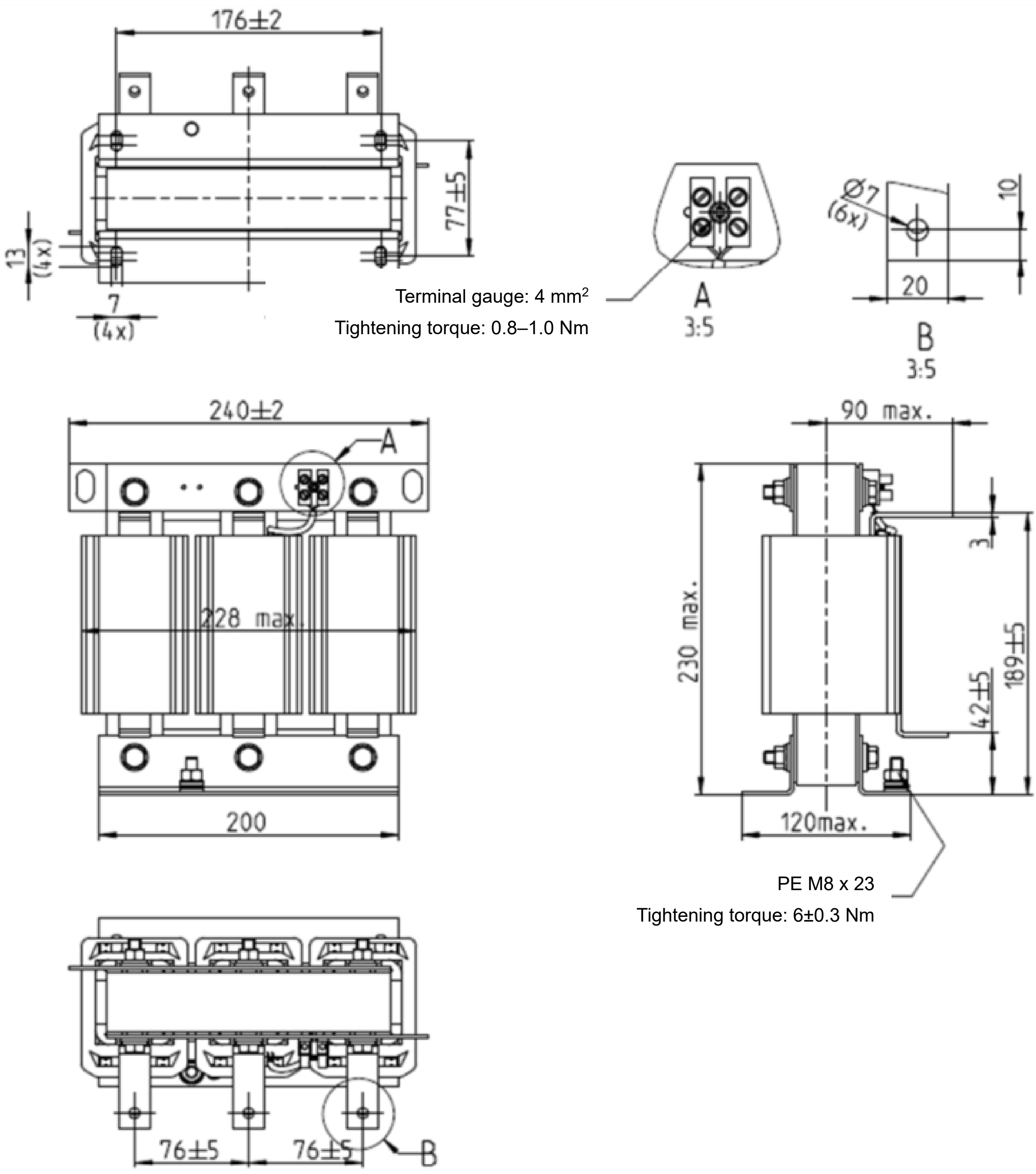


Figure 6-12

Unit: mm

Input Reactors Delta Part #	
DR105AP106	See above.

Table 6-16

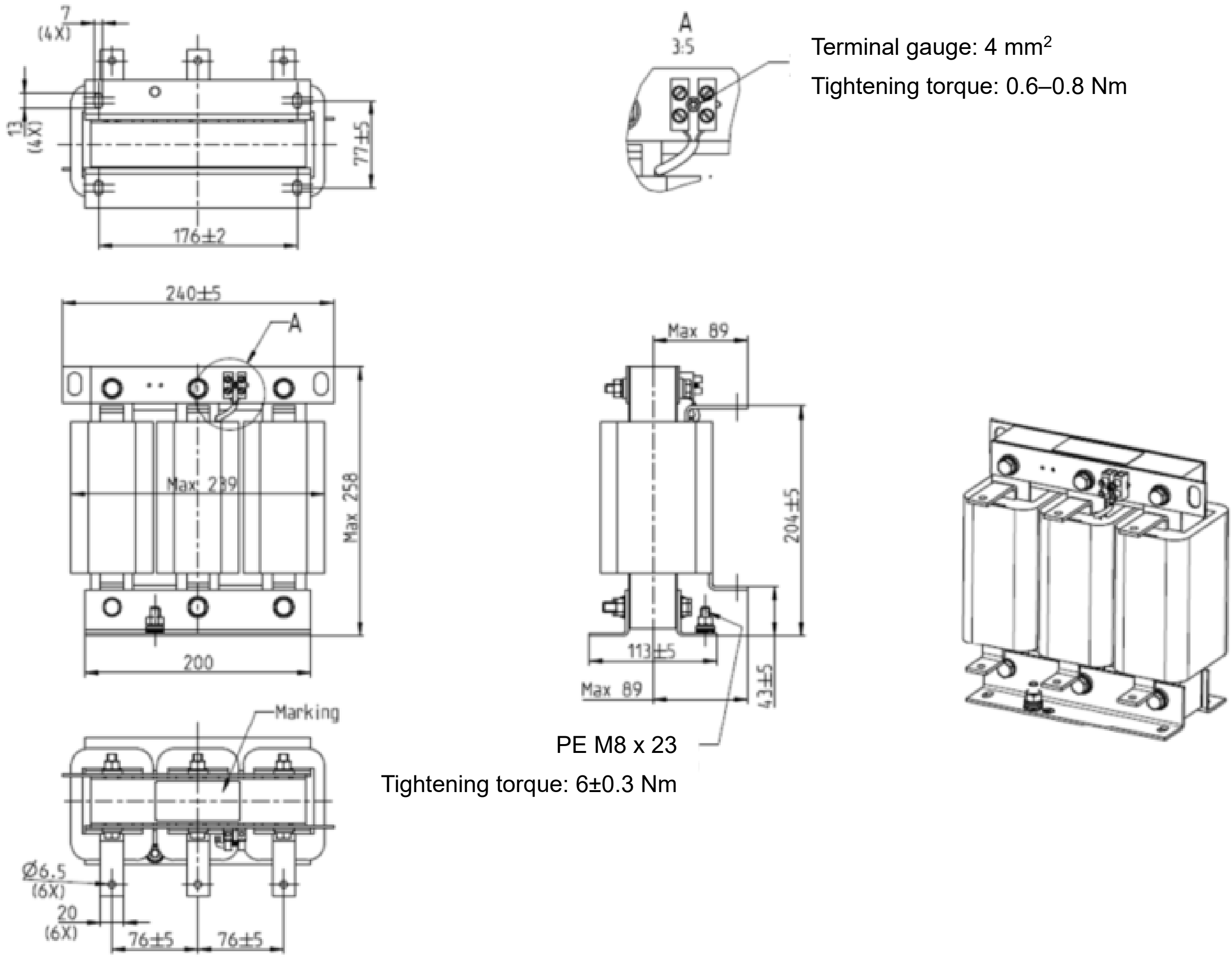


Figure 6-13

Unit: mm

Input Reactors Delta Part #	
DR146AP087	See above.

Table 6-17

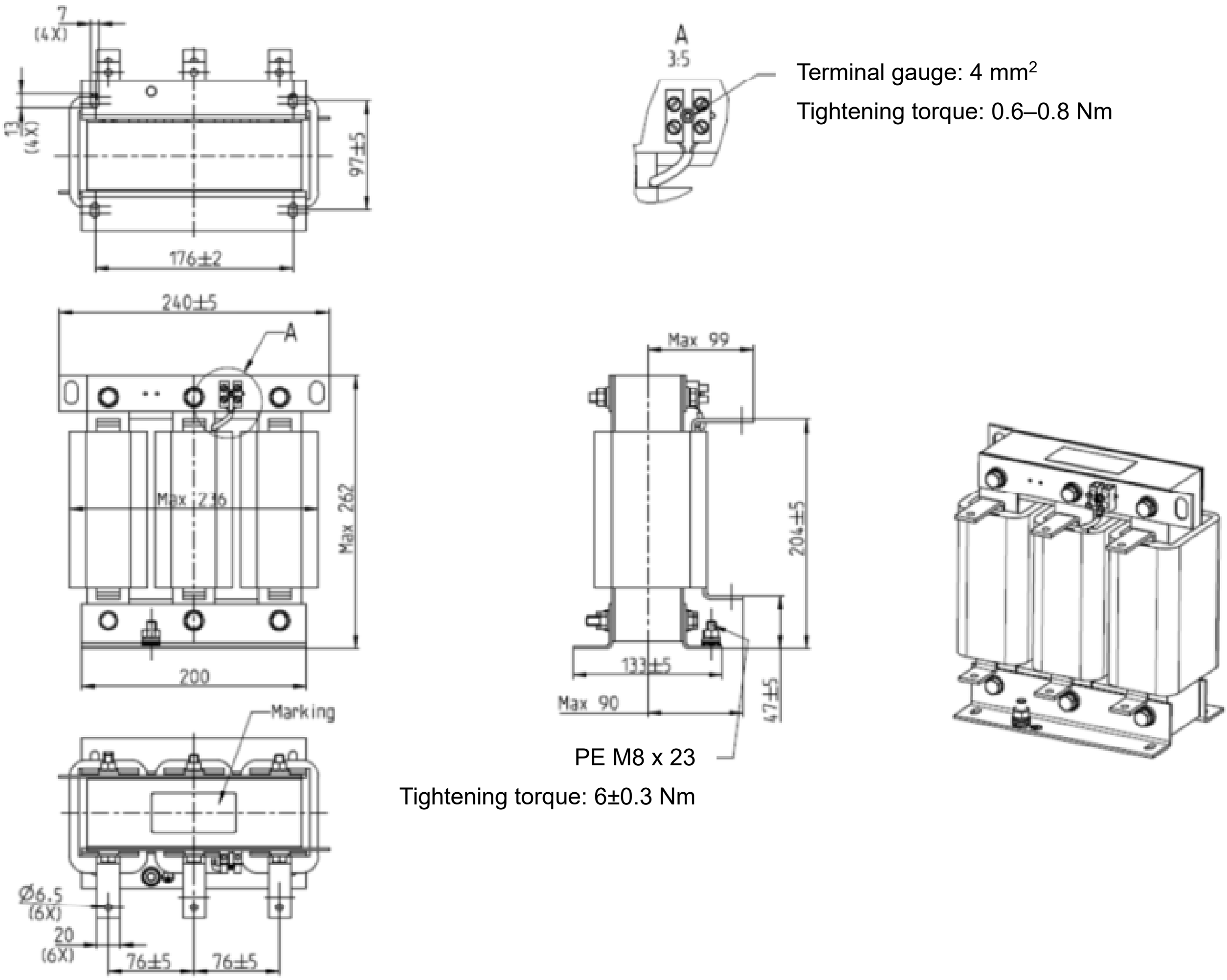


Figure 6-14

Unit: mm

Input Reactors Delta Part #	
DR180AP070	See above.

Table 6-18

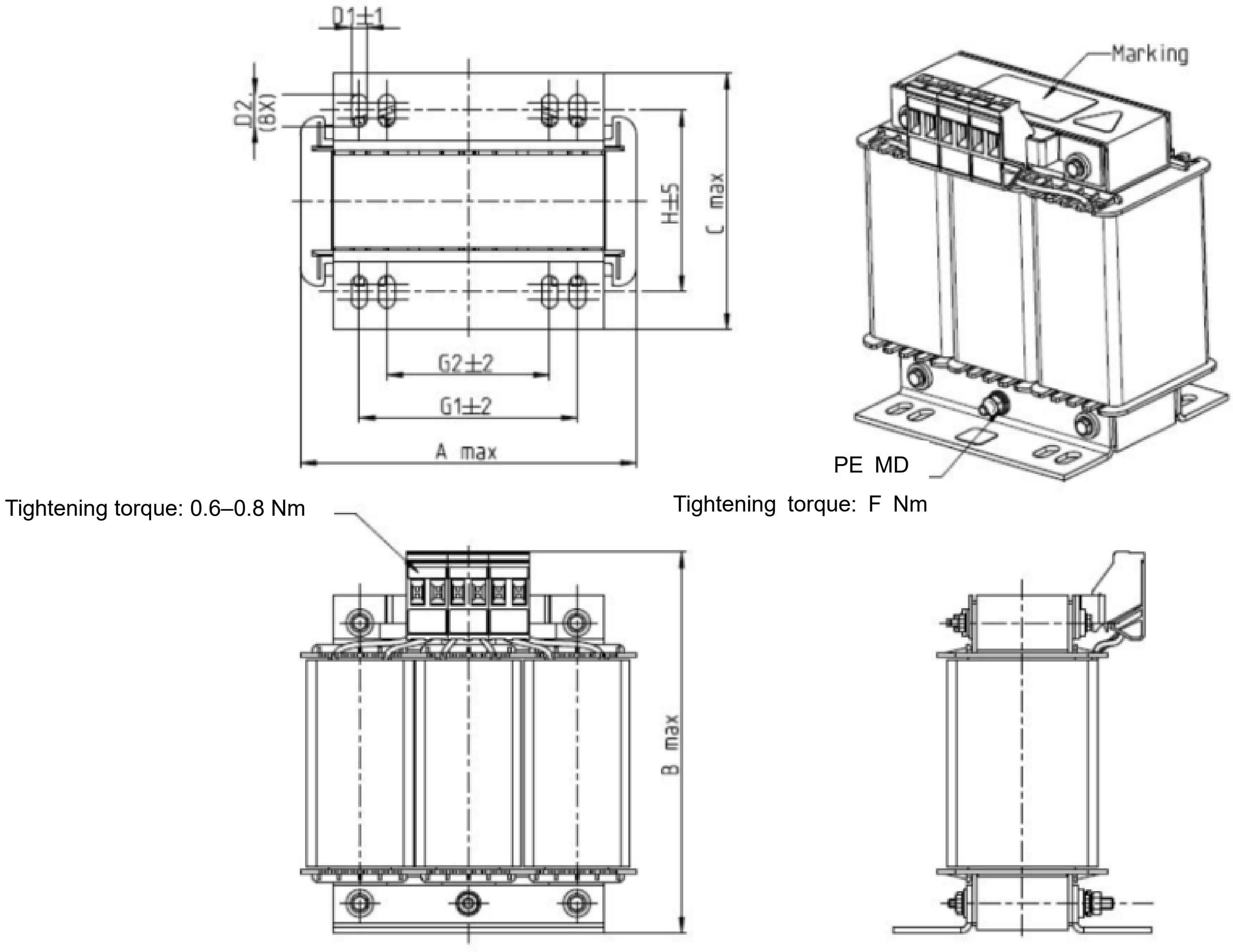


Figure 6-15

Unit: mm

Input Reactors Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR003A0810	100	125	65	6*9	43	60	40	M4
DR004A0607	100	125	65	6*9	43	60	40	M4
DR006A0405	130	15	95	6*12	60	80.5	60	M4
DR009A0270	160	160	105	6*12	75	107	75	M4
DR010A0231	160	160	115	6*12	90	107	75	M4
DR012A0202	160	160	115	6*12	90	107	75	M4
DR018A0117	160	160	115	6*12	90	107	75	M4

Table 6-19

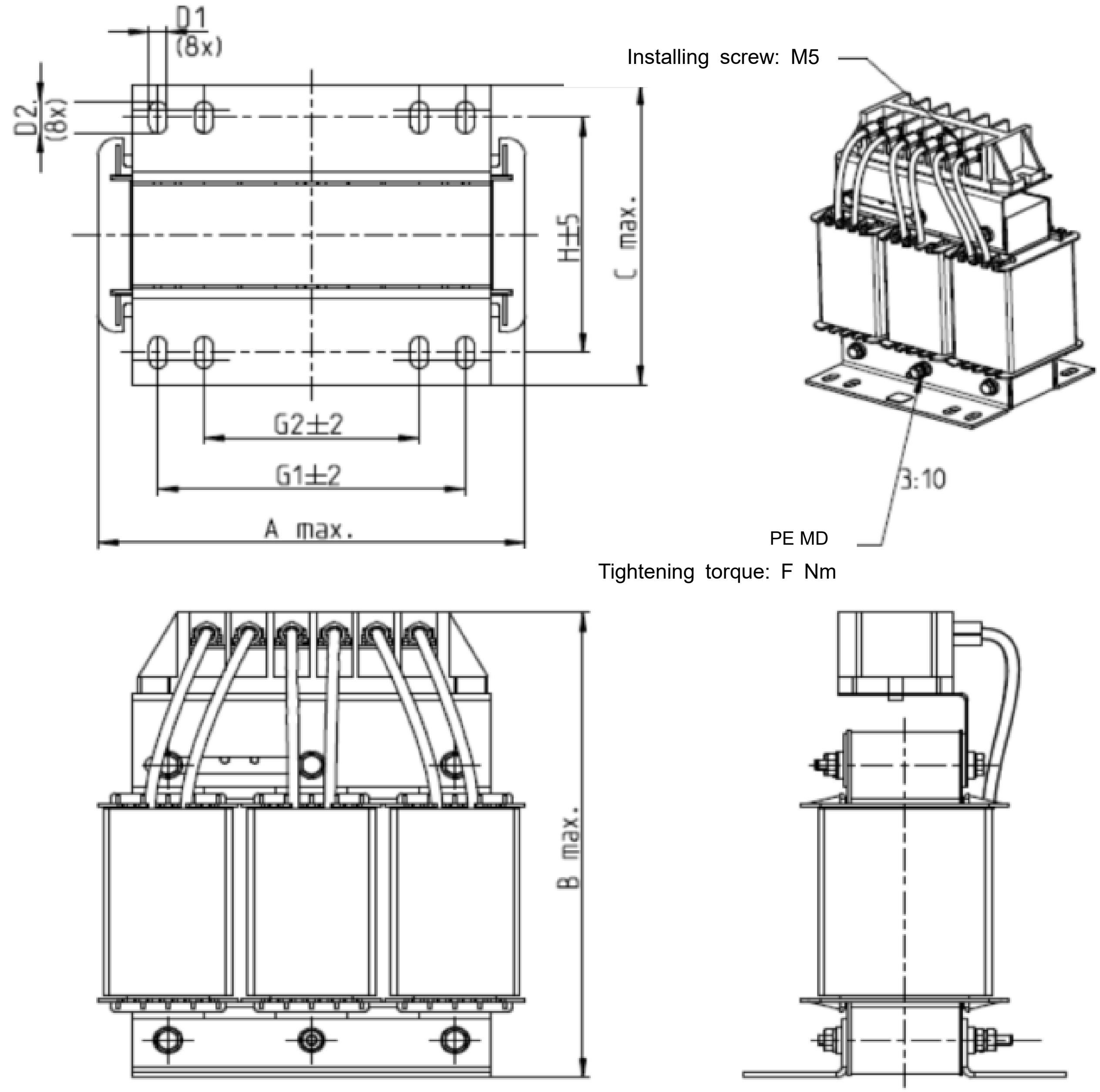


Figure 6-16

Unit: mm

Input Reactors Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR024AP881	160	175	115	6*12	90	107	75	M4
DR032AP660	195	200	145	6*12	115	122	85	M6
DR038AP639	190	200	145	6*12	115	122	85	M6
DR045AP541	190	200	145	6*12	115	122	85	M6

Table 6-20

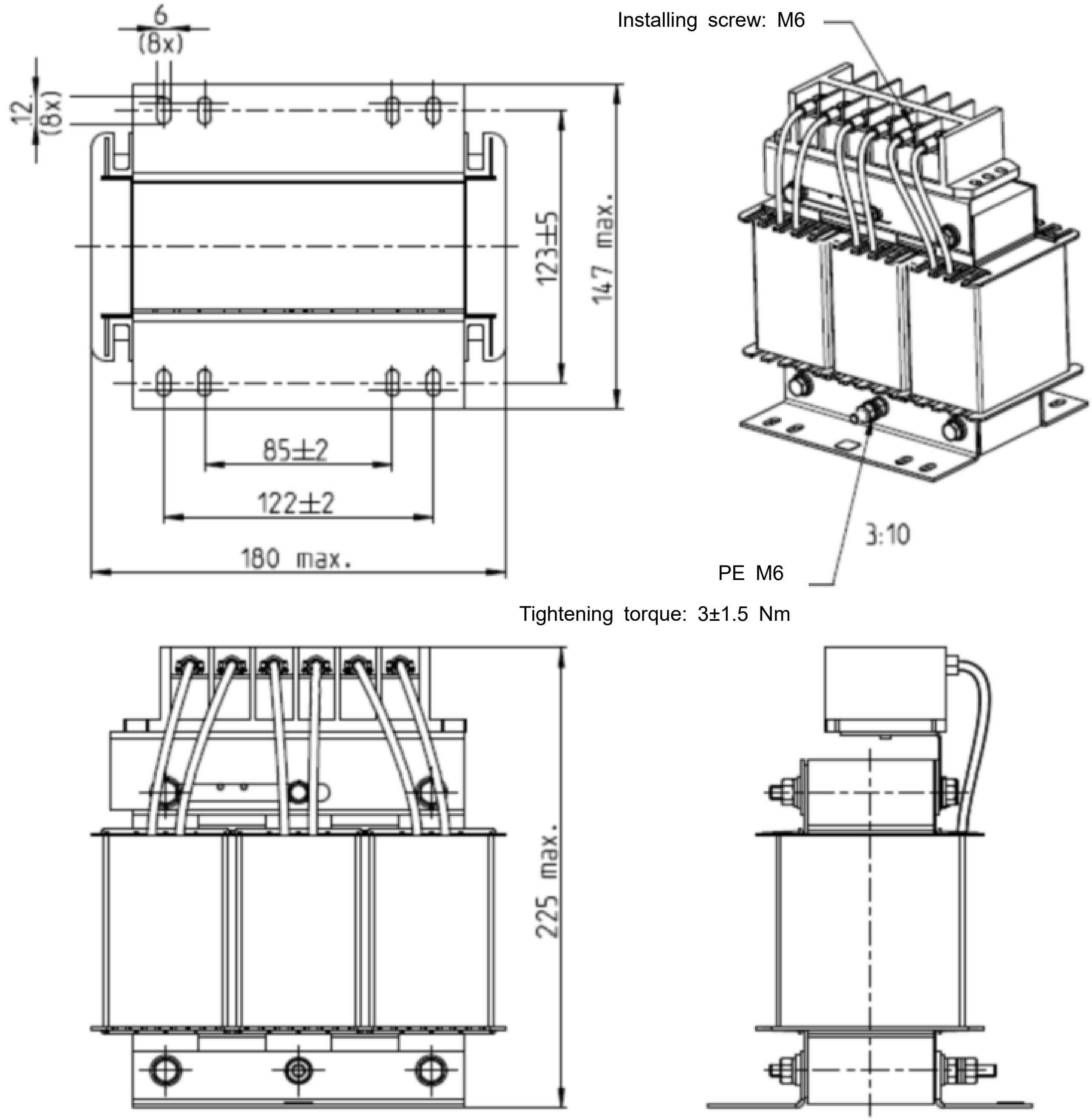


Figure 6-17

Unit: mm

Input Reactors Delta Part #	
DR060AP405	See above.

Table 6-21

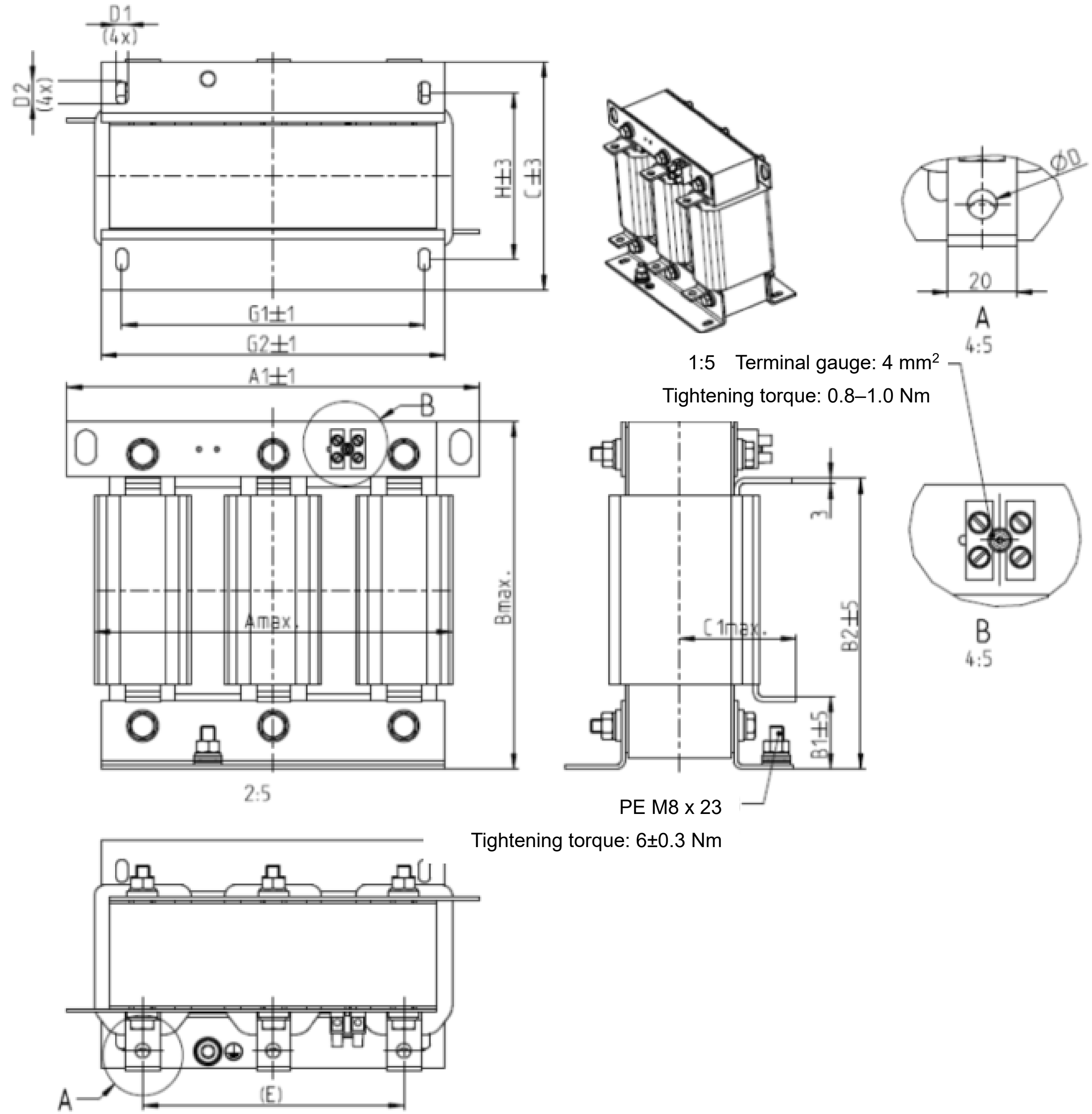


Figure 6-18

Unit: mm

Input Reactors Delta Part #	A	A1	B	B1	B2	C	D	D1*D2	E	C1	G1	G2	H
DR073AP334	228	240	215	40	170	133	8.5	7*13	152	75	176	200	97
DR091AP267	228	240	245	40	195	133	8.8	7*13	152	90	176	200	97
DR110AP221	228	240	245	40	195	138	8.5	7*13	152	75	176	200	102

Table 6-22

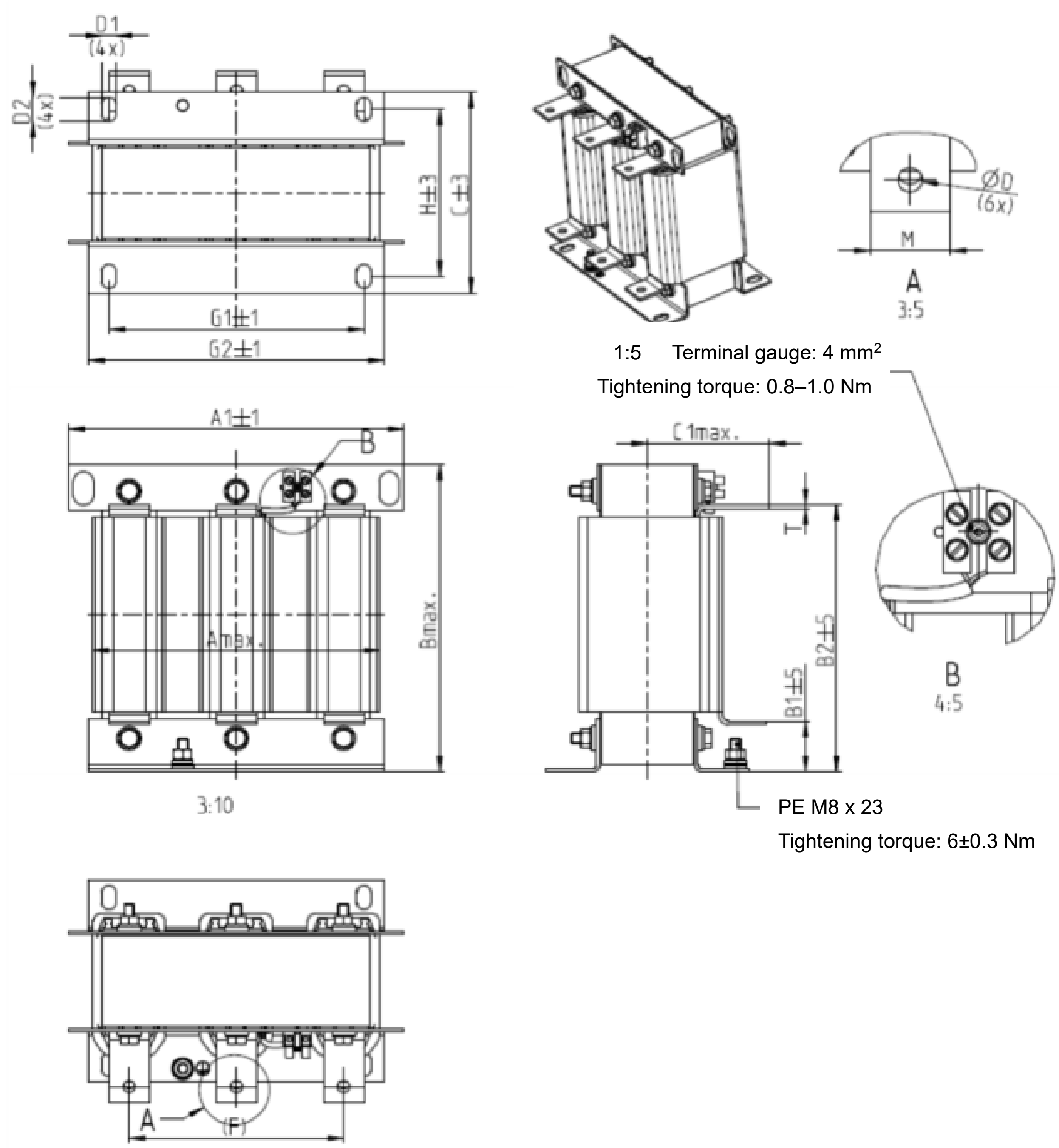


Figure 6-19

Unit: mm

Input Reactors Delta Part #	A	A1	B	B1	B2	C	C1	D	D1*D2	F	G1	G2	H	M*T
DR150AP162	240	250	245	40	200	151	105	9	11*18	160	190	220	125	20*3
DR180AP135	240	250	245	40	200	151	105	9	11*18	160	190	220	125	20*3
DR220AP110	264	270	275	50	230	151	105	9	10*18	176	200	230	106	30*3
DR260AP098	264	270	285	50	240	151	105	9	10*18	176	200	230	106	30*3
DR310AP078	300	300	345	55	295	153	105	9	10*18	200	224	260	113	30*3
DR370AP066	300	300	345	55	295	158	120	9	10*18	200	224	260	118	50*4

Table 6-23

DC reactor dimension and specifications:

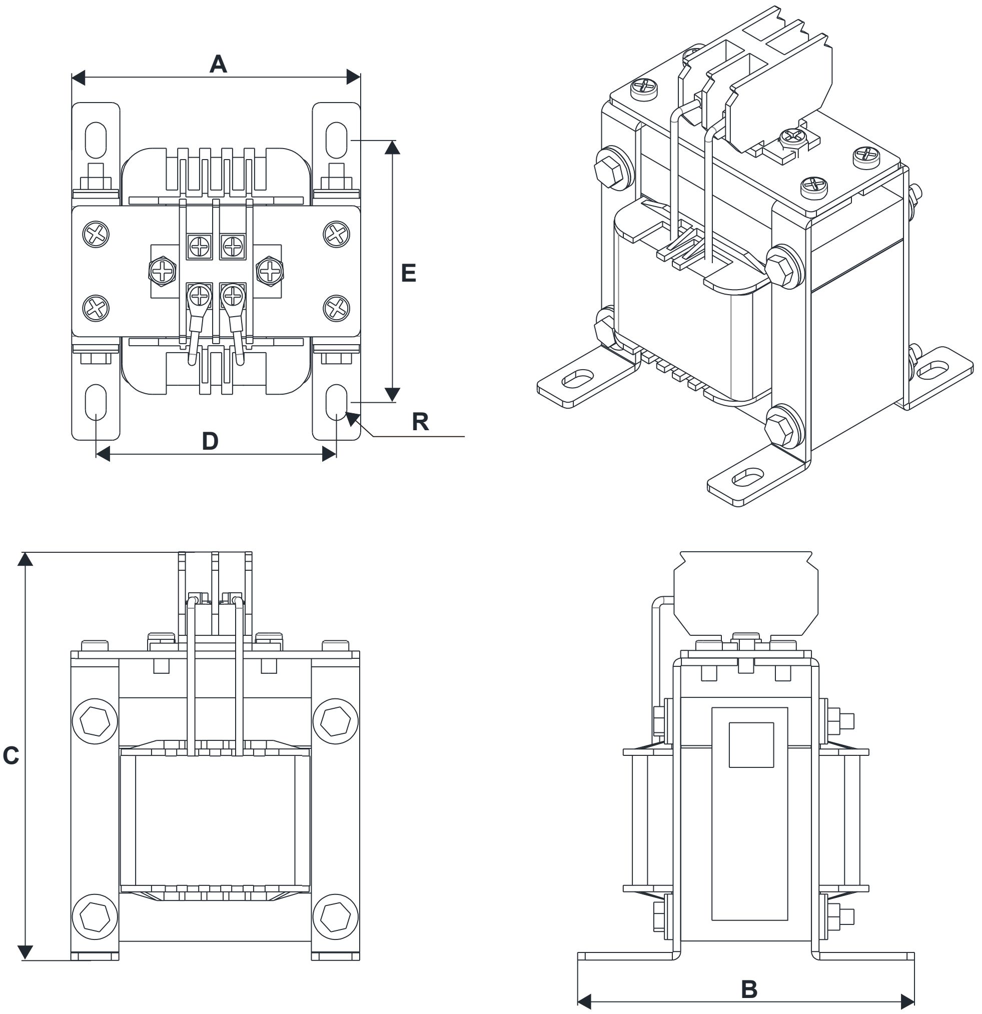


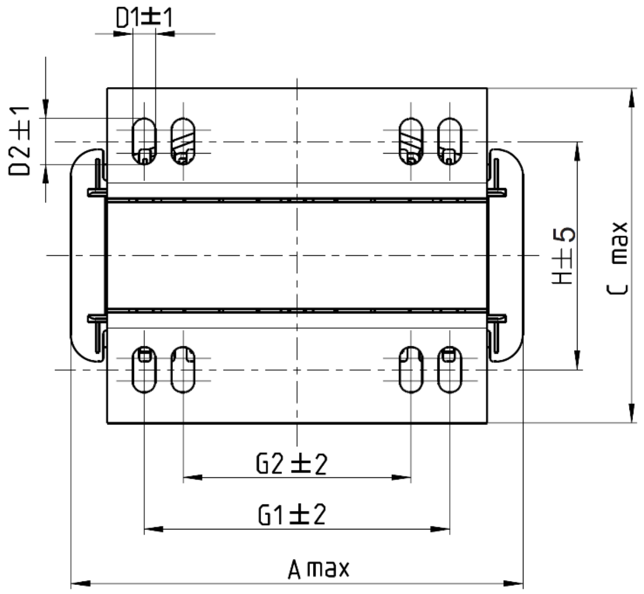
Figure 6-20

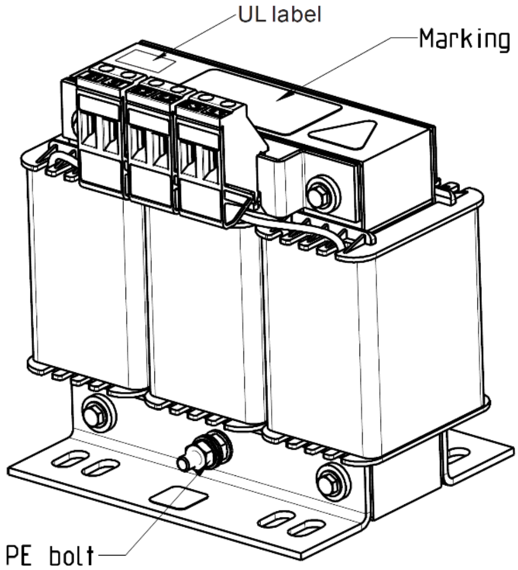
Unit: mm

DC Reactors Delta Part #	A	B	C	D	E	R
DR005D0585	79	78	112	64±2	56±2	9.5*5.5
DR008D0366	79	78	112	64±2	56±2	9.5*5.5
DR011D0266	79	92	112	64±2	69.5±2	9.5*5.5
DR017D0172	79	112	112	64±2	89.5±2	9.5*5.5
DR025D0117	99	105	128	79±2	82.5±2	9.5*5.5
DR033DP851	117	110	156	95±2	87±2	10*6.5
DR049DP574	117	120	157	95±2	97±2	10*6.5
DR065DP432	117	140	157	95±2	116.5±2	10*6.5
DR075DP391	136	135	178	111±2	112±2	10*6.5
DR090DP325	136	135	179	111±2	112±2	10*6.5
DR003D1870	79	78	112	64±2	56±2	9.5*5.5
DR004D1403	79	92	112	64±2	69.5±2	9.5*5.5
DR006D0935	79	92	112	64±2	69.5±2	9.5*5.5
DR009D0623	79	112	112	64±2	89.5±2	9.5*5.5
DR010D0534	99	93	128	79±2	70±2	9.5*5.5
DR012D0467	99	105	128	79±2	82.5±2	9.5*5.5
DR018D0311	117	110	144	95±2	87±2	10*6.5
DR024D0233	117	120	144	95±2	97±2	10*6.5
DR032D0175	117	140	157	95±2	116.5±2	10*6.5
DR038D0147	136	135	172	111±2	112±2	10*6.5
DR045D0124	136	135	173	111±2	112±2	10*6.5
DR060DP935	136	150	173	111±2	127±2	10*6.5

Table 6-24

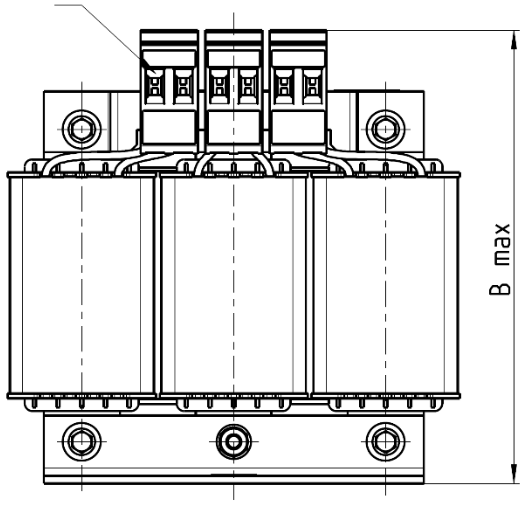
AC output reactor dimension and specifications:

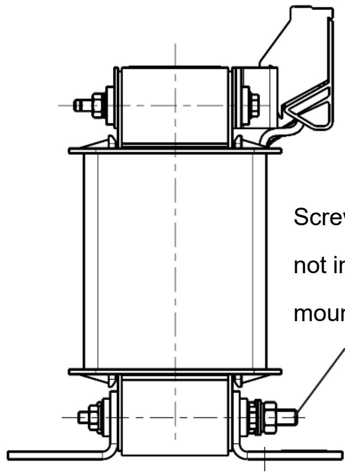




Tightening torque: 0.6–0.8 Nm

Tightening torque: 1.0–1.2 Nm





Screw length must not interfere with the mounting holes.

Figure 6-21

Unit: mm

Output Reactors Delta Part #	A	B	C	D1*D2	E	G1	G2	PE D
DR005L0254	96	110	70	6*9	42	60	40	M4
DR008L0159	120	135	96	6*12	60	80.5	60	M4
DR011L0115	120	135	96	6*12	60	80.5	60	M4
DR017LP746	120	135	105	6*12	65	80.5	60	M4
DR025LP507	150	160	120	6*12	88	107	75	M4
DR033LP320	150	160	120	6*12	88	107	75	M4

Table 6-25

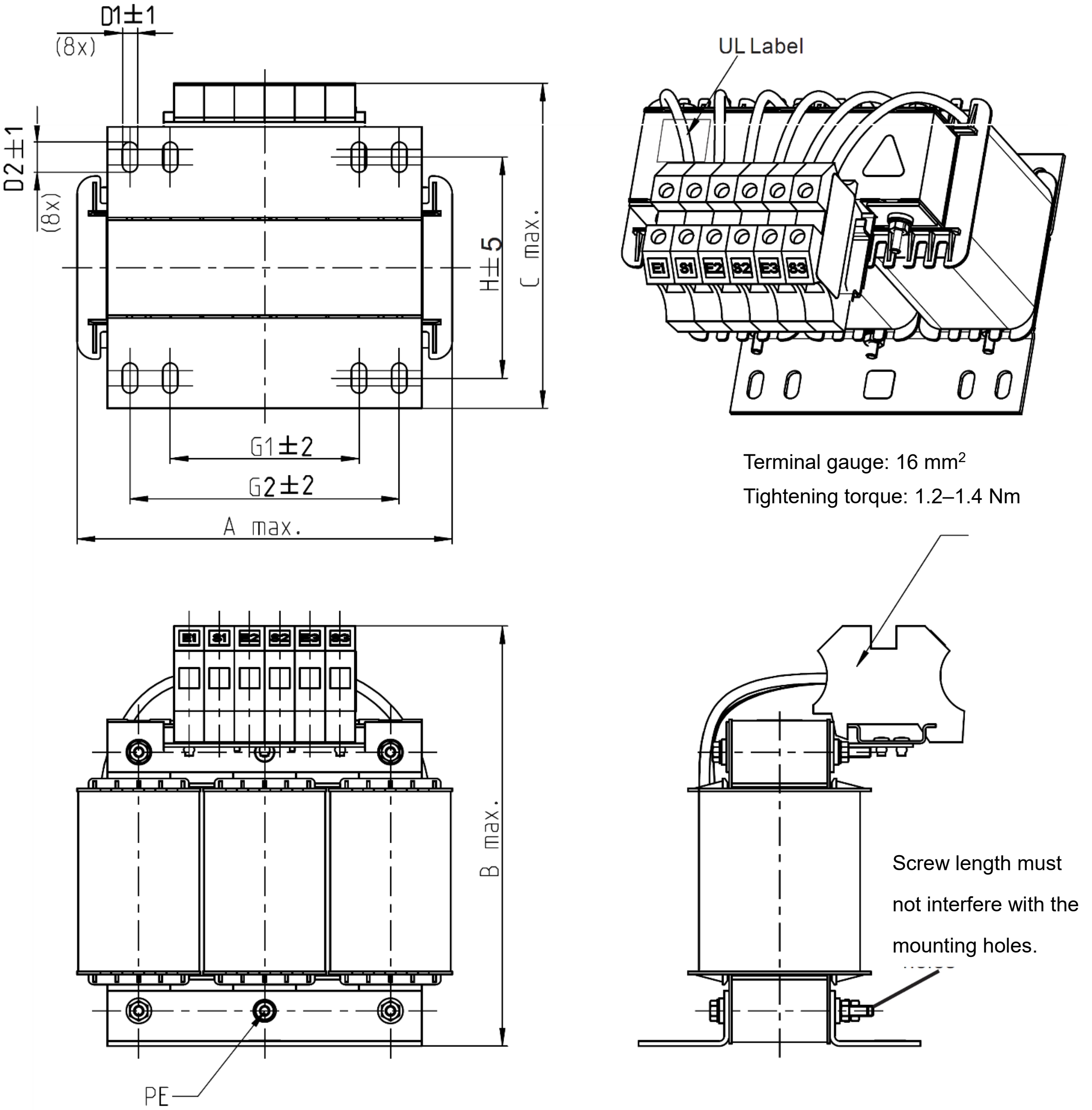


Figure 6-22

Unit: mm

Output Reactors Delta Part #	A	B	C	D1*D2	H	G	G1	Q	M	PE D
DR049LP215	180	205	175	6*12	115	85	122	16	1.2-1.4	M4
DR065LP162	180	215	185	6*12	115	85	122	35	2.5-3.0	M4

Table 6-26

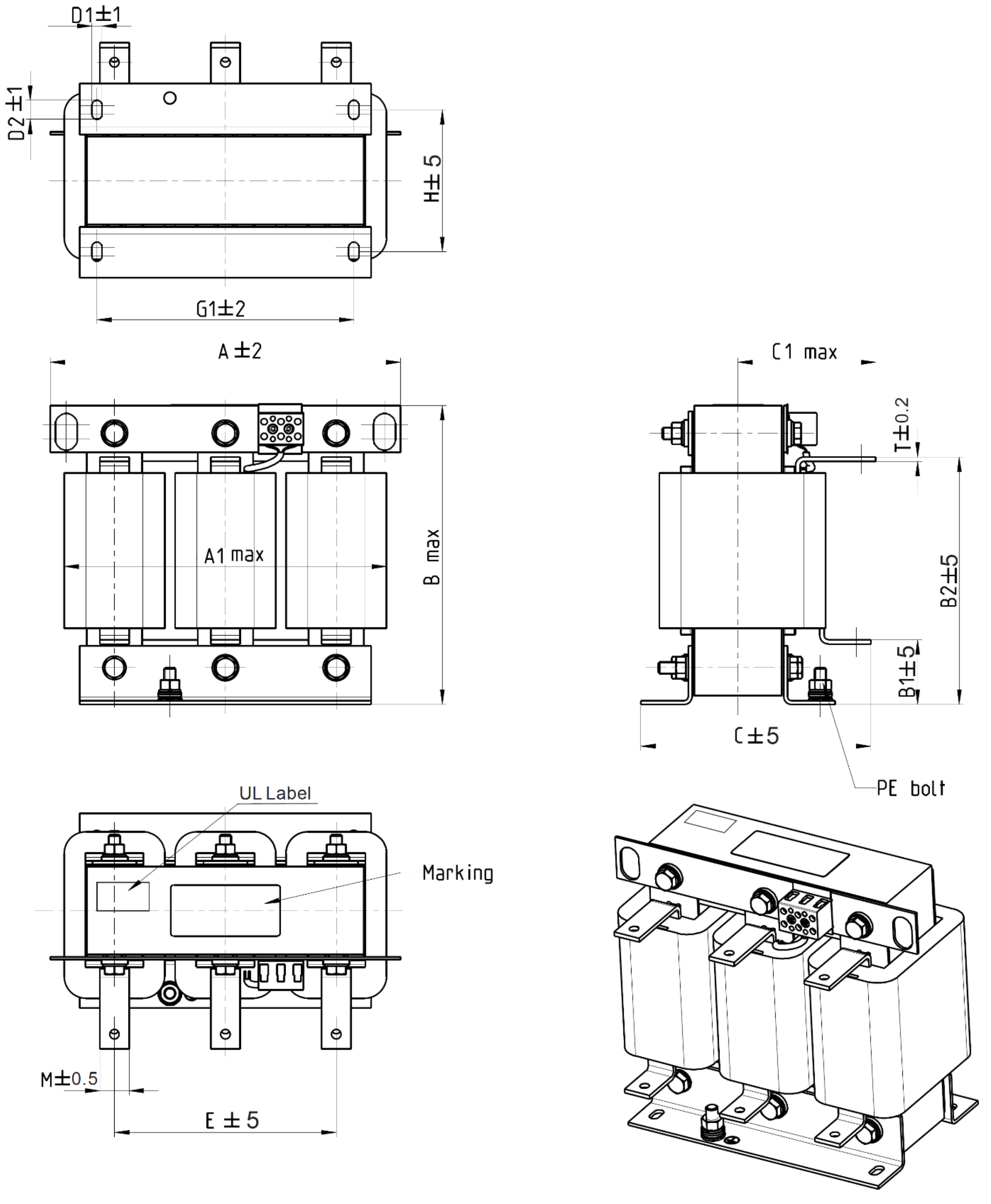


Figure 6-23

Unit: mm

Output Reactors Delta Part #	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	H	M*T
DR075LP170	240	228	215	44	170	151	100	7*13	152	176	85	20*3
DR090LP141	240	228	215	44	170	151	100	7*13	152	176	85	20*3
DR105LP106	240	228	215	44	170	165	110	7*13	152	176	97	20*3
DR146LP087	240	228	240	45	202	165	110	7*13	152	176	97	30*3
DR180LP070	250	240	250	46	205	175	110	11*18	160	190	124	30*5

Table 6-27

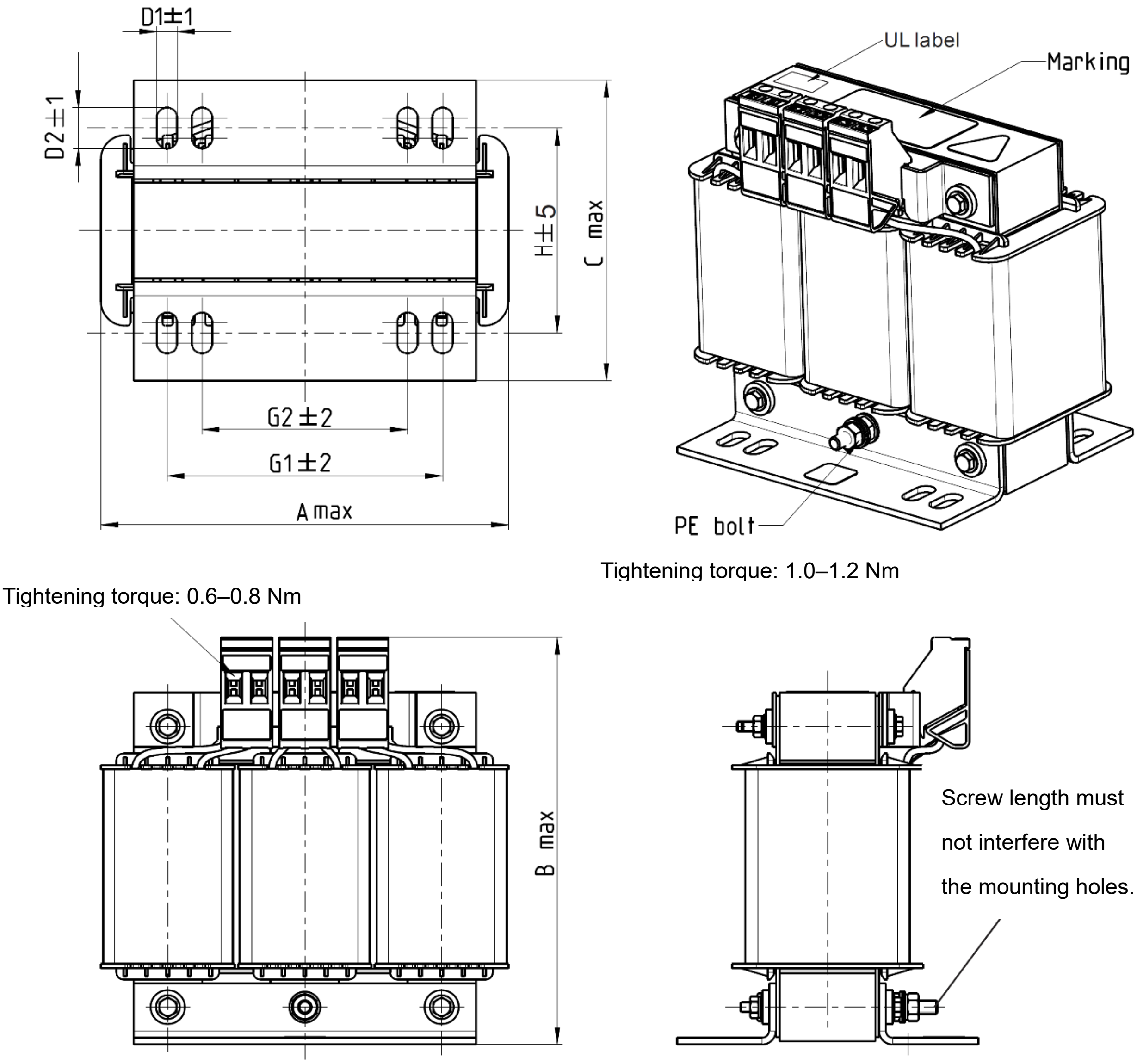


Figure 6-24

Unit: mm

Output Reactors Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR003L0810	96	115	65	6*9	42	60	40	M4
DR004L0607	120	135	95	6*12	60	80.5	60	M4
DR006L0405	120	135	95	6*12	60	80.5	60	M4
DR009L0270	150	160	100	6*12	74	107	75	M4
DR010L0231	150	160	115	6*12	88	107	75	M4
DR012L0202	150	160	115	6*12	88	107	75	M4
DR018L0117	150	160	115	6*12	88	107	75	M4
DR024LP881	150	160	115	6*12	88	107	75	M4
DR032LP660	180	190	145	6*12	114	122	85	M6

Table 6-28

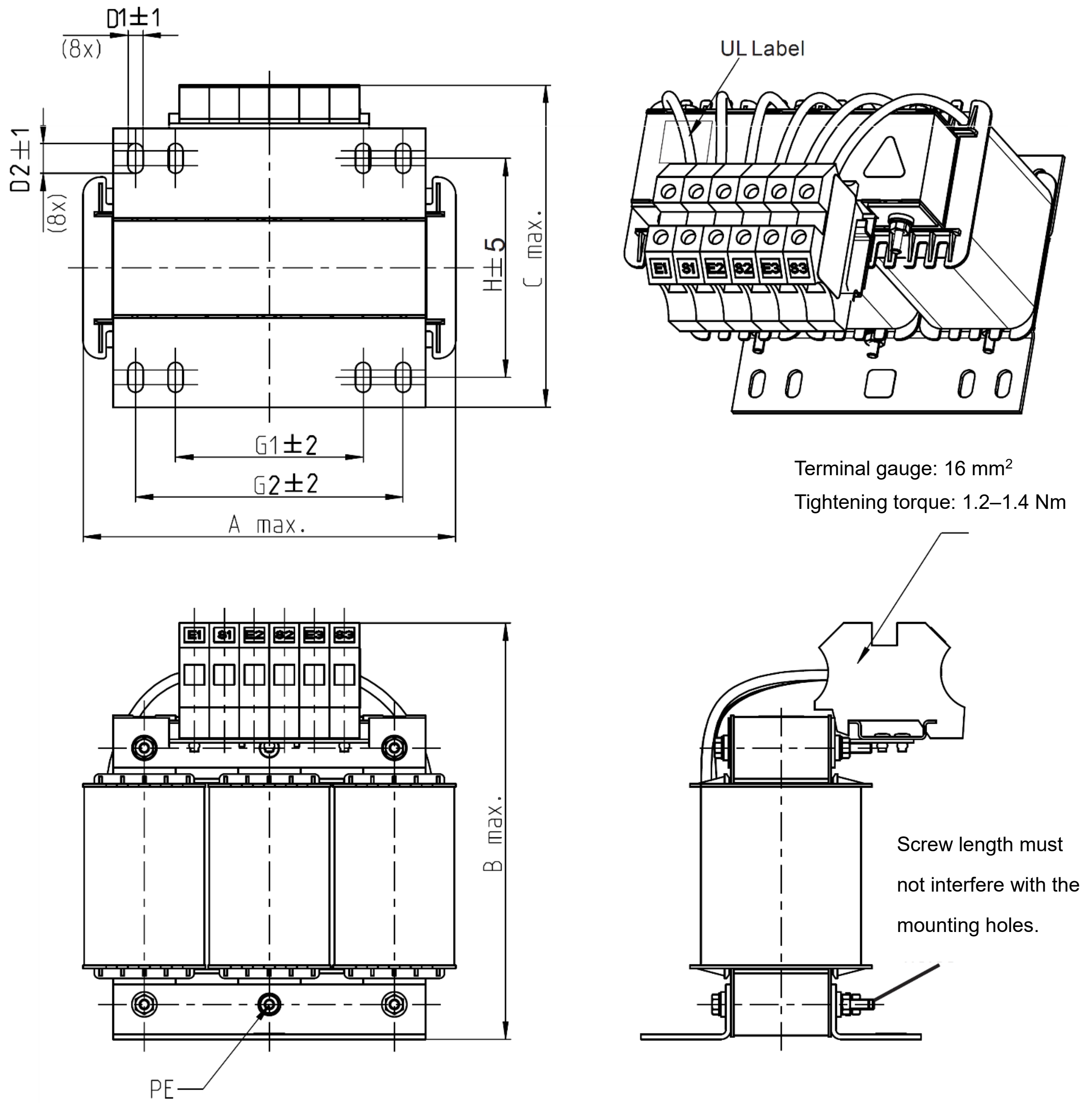


Figure 6-25

Unit: mm

Output Reactors Delta Part #	A	B	C	D1*D2	H	G1	G2	PE D
DR038LP639	180	205	170	6*12	115	85	122	M4
DR045LP541	235	245	155	7*13	85	/	176	M6

Table 6-29

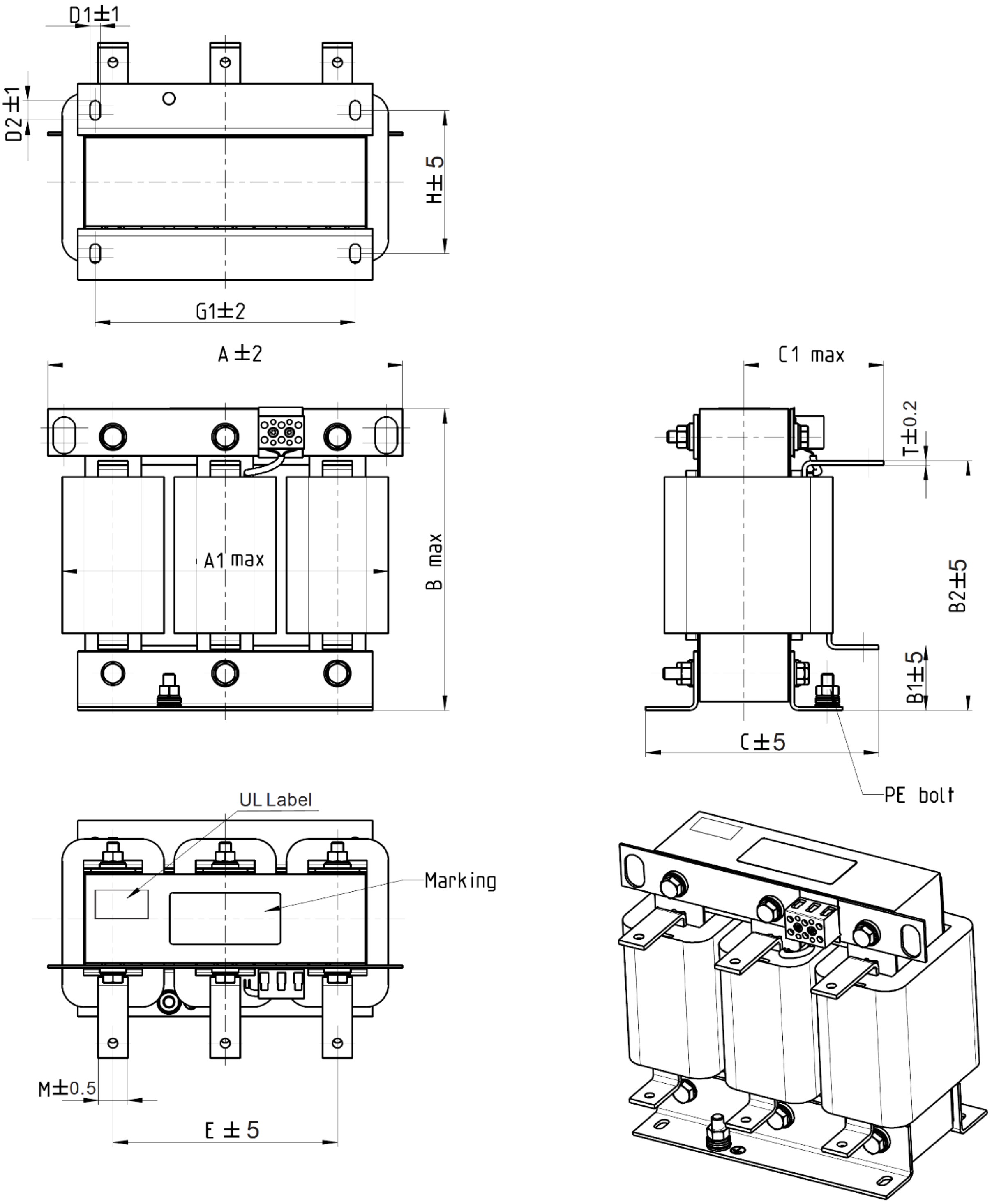


Figure 6-26

Unit: mm

Output Reactors Delta Part #	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	H	M*T
DR060LP405	240	228	215	44	170	163	110	7*13	152	176	97	20*3
DR073LP334	250	235	235	44	186	174	115	11*18	160	190	124	20*3
DR091LP267	250	240	235	44	186	174	115	11*18	160	190	124	20*3
DR110LP221	270	260	245	50	192	175	115	10*18	176	200	106	20*3

Table 6-30

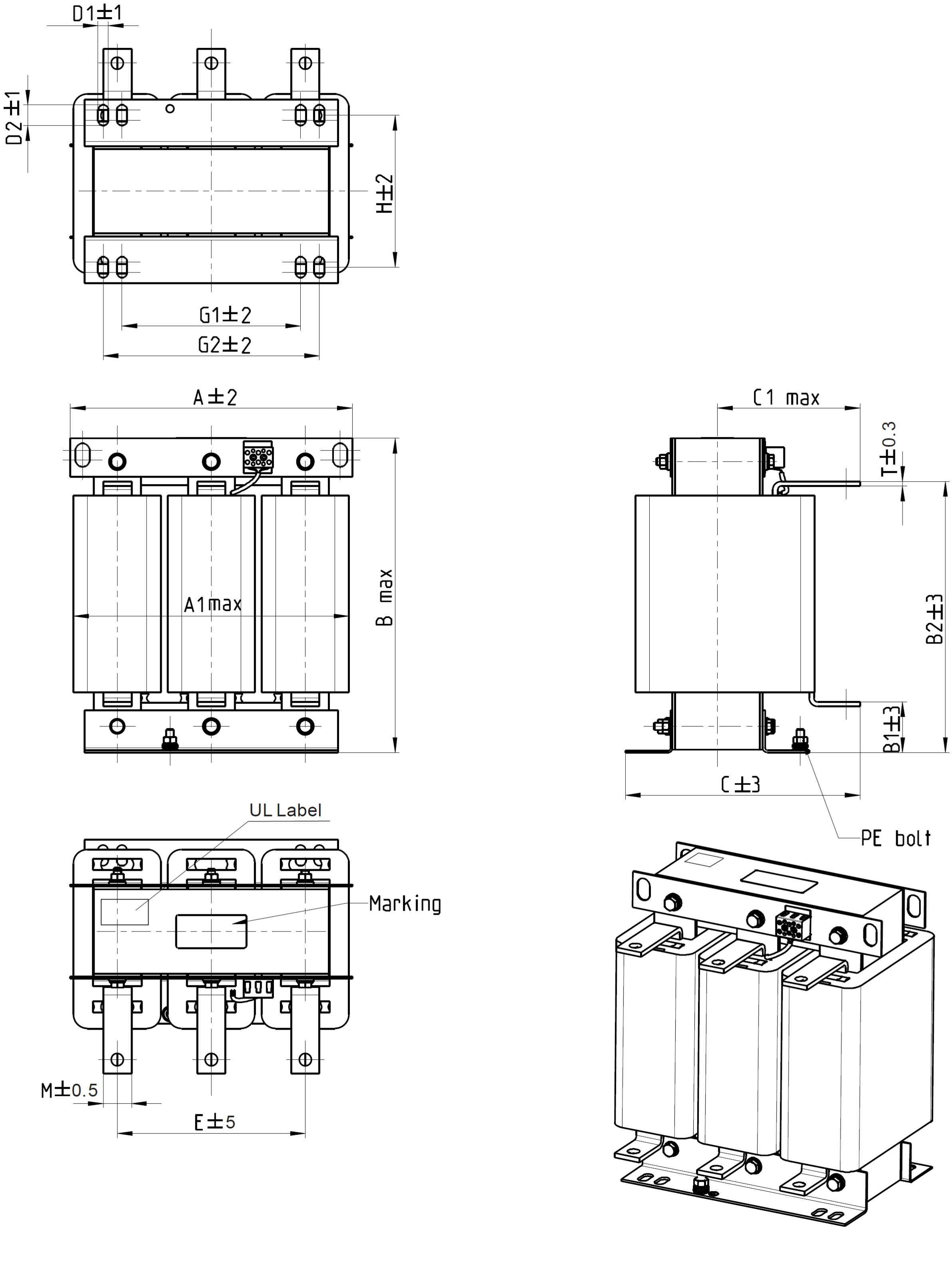


Figure 6-27

Unit: mm

Output Reactors Delta Part #	A	A1	B	B1	B2	C	C1	D1*D2	E	G1	G2	H	M*T
DR150LP162	270	264	265	51	208	192	125	10*18	176	200	/	118	30*3
DR180LP135	300	295	310	55	246	195	125	11*22	200	230	190	142	30*3

Table 6-31

6-5 Zero Phase Reactor

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. Due to the large current passed through the main input/motor output side, pay attention to core saturation issue. Delta provides two types of zero phase reactors to solve interference problems.

A. Casing with mechanical fixed part

The ideal material for withstanding large current loaded for the zero phase reactor at the main input/motor output is composite core. Core has strong saturation, and its strong resistance are many times of simple metal magnetic materials. Thus, it can be used for high frequencies and you can get higher impedance by increasing the number of turns.

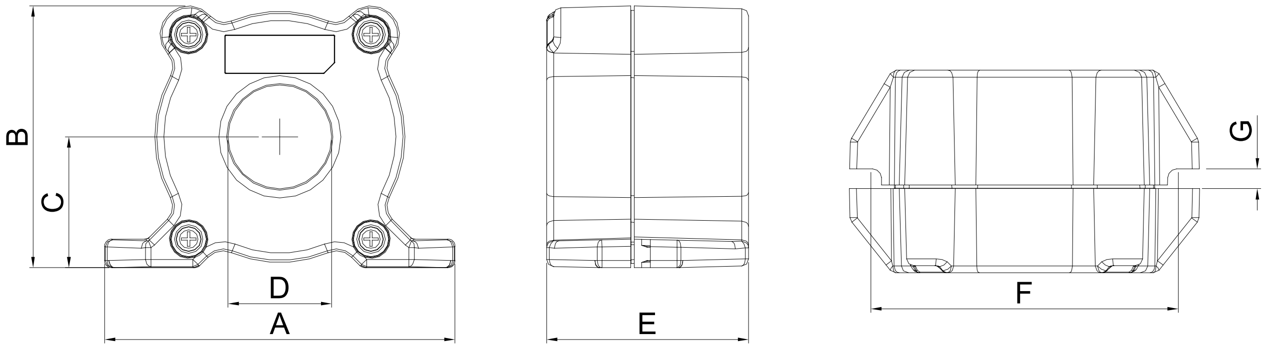


Figure 6-28

Unit: mm (inch)

Model	A	B	C	D	E	F	G(Ø)	Torque
RF008X00A	98 [3.858)	73 (2.874)	36.5 (1.437)	29 (1.142)	56.5 (2.224)	86 (3.386)	5.5 (0.217)	8–10 kgf/cm
RF004X00A	110 (4.331)	87.5 (3.445)	43.5 (1.713)	36 (1.417)	53 (2.087)	96 (3.780)	5.5 (0.217)	8–10 kgf/cm

Table 6-32

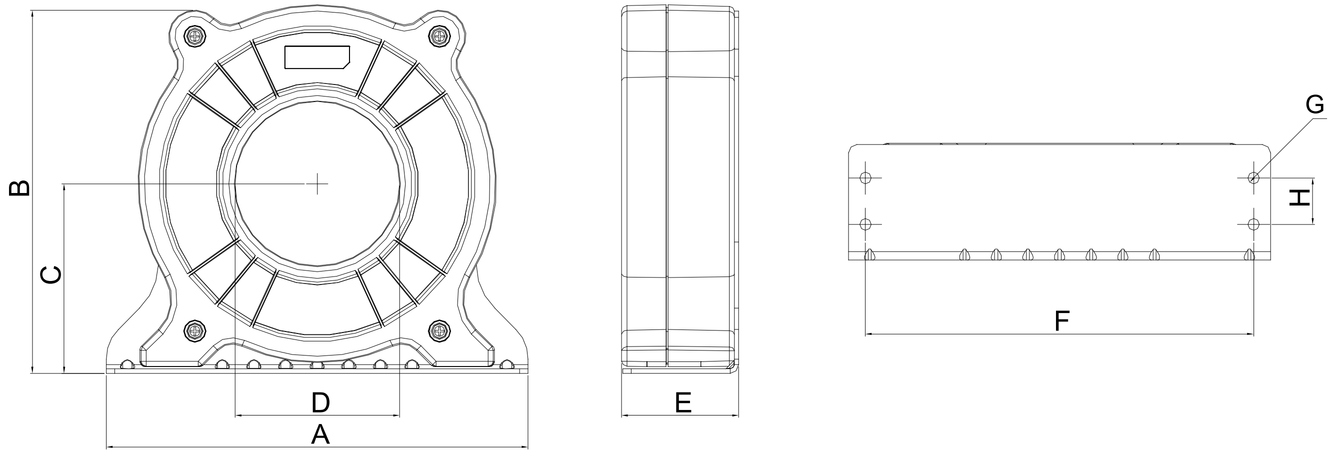


Figure 6-29

Unit: mm (inch)

Model	A	B	C	D	E	F	G(Ø)	H	Torque
RF002X00A	200 (7.874)	172.5 (6.791)	90 (3.543)	78 (3.071)	55.5 (2.185)	184 (7.244)	5.5 (0.217)	22 (0.866)	40–45 kgf/cm

Table 6-33

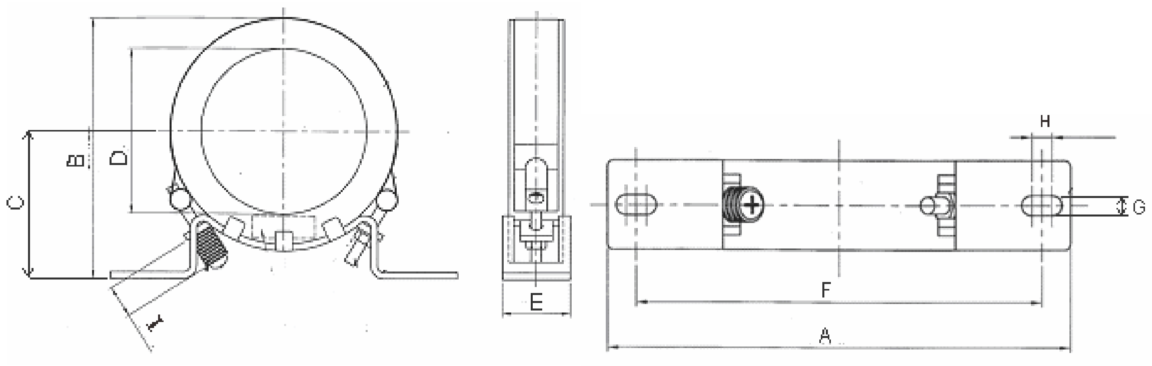


Figure 6-30

Unit: mm (inch)

Model	A	B	C	D	E	F	G(Ø)	H	I
RF300X00A	241 (9.488)	217 (8.543)	114 (4.488)	155 (6.102)	42 (1.654)	220 (8.661)	6.5 (0.256)	7.0 (0.276)	20 (0.787)
								Torque:40–45 kgf/cm	

Table 6-34

B. Casing without mechanical fixed part

Adopts nanocrystalline core developed by VAC®, and has 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.

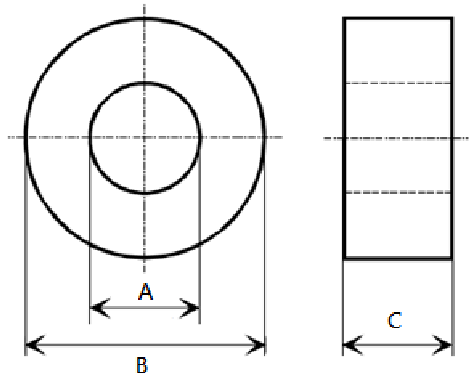


Figure 6-31

Unit: mm

Model	A	B	C	Function
T60006L2040W453	22.5	43.1	18.5	Motor wire
T60006L2050W565	36.3	53.5	23.4	Motor wire
T60006L2160V066	123.9	166.9	30.5	Motor wire
T60004L2016W620	10.7	17.8	8.0	Signal line
T60004L2025W622	17.5	27.3	12.3	Signal line

Table 6-35

Reactor Model *1	Recommended Wire Size		Wiring Method	Qty	Applicable Motor Drives
RF008X00A T60006L2040W453	≤ 8 AWG	≤ 8.37 mm^2	Fig. 6-32 Fig. 6-33	1	VFD022ED21S VFD037ED21S VFD040ED23S VFD040ED43S
RF004X00A T60006L2050W565	≤ 4 AWG	≤ 21.15 mm^2	Fig. 6-32 Fig. 6-33	1	VFD055ED23S VFD075ED23S VFD110ED23S VFD055ED43S VFD075ED43S VFD110ED43S VFD150ED43S VFD185ED43S
RF002X00A T60006L2160V066	≤ 2 AWG	≤ 33.62 mm^2	Fig. 6-32 Fig. 6-33	1	VFD150ED23S VFD185ED23S VFD220ED23S VFD220ED43S VFD300ED43S
RF300X00A T60006L2160V066	≤ 300 MCM	≤ 152 mm^2	Fig. 6-32 Fig. 6-33	1	VFD300ED23S VFD370ED23S VFD370ED43S VFD450ED43S VFD550ED43S VFD750ED43S

*1: 600V insulated cable wire

Table 6-36

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. Diagram A shows the installation diagram for a single turn zero phase reactor. If the wire diameter allows several turns, Diagram B shows the installation of a multi-turn zero phase reactor. The more turns, the better the noise suppression effect.

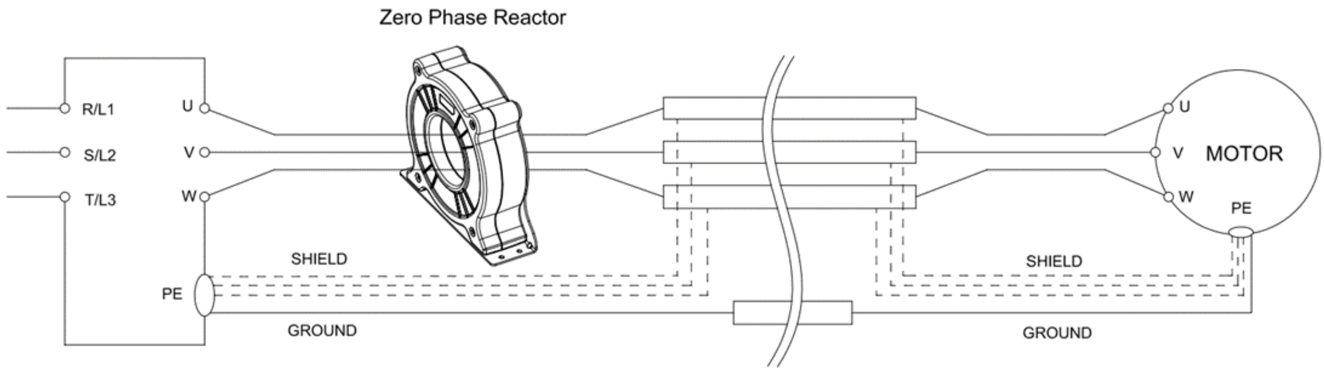


Figure 6-32 Single turn wiring diagram for shielding wire with a zero phase reactor

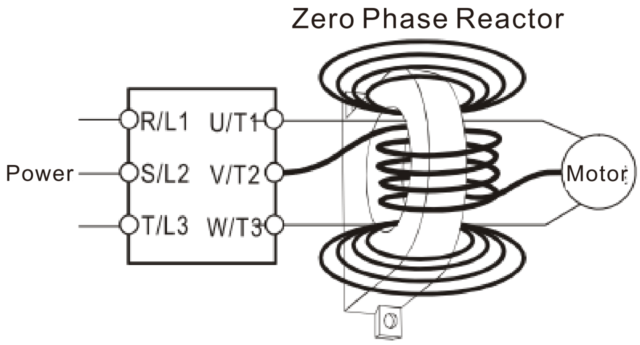


Figure 6-33 Multi-turn zero phase reactor

Installation Precaution

Install the zero phase reactor at the drive's output terminal (U/T1, V/T2, W/T3). 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 maximum wiring gauge when installing zero phase reactor:

Zero Phase Reactor Model No.	Max. Wire Gauge or LUG width	Max. Wire Gauge AWG (1 C*3)		Max. Wire Gauge AWG (4 C*1)	
		75°C	90°C	75°C	90°C
RF008X00A	13 MM	3 AWG	1 AWG	3 AWG	1 AWG
RF004X00A	16 MM	1 AWG	2/0 AWG	1 AWG	1/0 AWG
RF002X00A	36 MM	600 MCM	600 MCM	1 AWG	1/0 AWG
RF300X00A	73 MM	650 MCM	650 MCM	300 MCM	300 MCM
T60006L2040W453	11 MM	9 AWG	4 AWG	6 AWG	6 AWG
T60006L2050W565	16 MM	1 AWG	2/0 AWG	1 AWG	1/0 AWG
T60006L2160V066	57 MM	600 MCM	600 MCM	300 MCM	300 MCM

Table 6-37

6-6 EMC Filter

The table below shows external EMC filter models for each ED-S series motor drive. Choose corresponding zero phase reactors and applicable shielding cables according to the required noise emission and electromagnetic interference rating for the best configuration and anti-interference performance. If radiation emission (RE) is not a concern on site and you only need conducted emission (CE) to reach EN55011 Class A, you do not need to install a zero phase reactor on the input side to reach the EMC standard.

220V Models

VFD-ED			EMC Filter Model #	Zero Phase Reactor	Carrier Frequency	EN12015	
Frame	Motor Drive Model #	Rated Input Current (A)		Input Side (R/S/T)		Conducted Emission Length of Output Shielded Cable 50 m	Radiation Emission
B	VFD022ED21S	24	B84142A0042R122	RF008X00A or T60006L2040W453	Carrier frequency by default	CLASS A	CLASS A
	VFD037ED21S	34	B84142A0042R122	RF008X00A or T60006L2040W453		CLASSA	CLASSA
	VFD040ED23S	20	EMF035A23A	RF008X00A or T60006L2040W453		CLASS A	CLASS A
C	VFD055ED23S	23	EMF056A23A	RF004X00A or T60006L2050W565		CLASS A	CLASS A
	VFD075ED23S	30	EMF056A23A	RF004X00A or T60006L2050W565		CLASS A	CLASS A
	VFD110ED23S	47	EMF056A23A	RF004X00A or T60006L2050W565		CLASS A	CLASS A
D	VFD150ED23S	56	B84143D0150R127	RF002X00A or T60006L2160V066		CLASS A	CLASS A
	VFD185ED23S	73	B84143D0150R127	RF002X00A or T60006L2160V066		CLASS A	CLASS A
	VFD220ED23S	90	B84143D0150R127	RF002X00A or T60006L2160V066		CLASS A	CLASS A
E	VFD300ED23S	132	B84143D0150R127	RF002X00A or T60006L2160V066		CLASS A	CLASS A
	VFD370ED23S	161	B84143D0200R127	RF300X00A or T60006L2160V066		CLASS A	CLASS A

Table 6-38

460V Models

VFD-ED			EMC Filter Model #	Zero Phase Reactor	Carrier Frequency	EN12015	
Frame	Motor Drive Model #	Rated Input Current (A)		Input Side (R/S/T)		Conducted Emission Length of Output Shielded Cable 50 m	Radiation Emission
B	VFD040ED43S	11.5	EMF018A43A	RF008X00A or T60006L2040W453	Carrier frequency by default	CLASS A	CLASS A
C	VFD055ED43S	14	EMF018A43A	RF004X00A or T60006L2050W565		CLASSA	CLASS A
	VFD075ED43S	17	EMF018A43A	RF004X00A or T60006L2050W565		CLASS A	CLASS A
	VFD110ED43S	24	EMF033A43A	RF004X00A or T60006L2050W565		CLASS A	CLASS A
	VFD150ED43S	30	EMF033A43A	RF004X00A or T60006L2050W565		CLASS A	CLASS A
	VFD185ED43S	37	B84143D0075R127	RF004X00A or T60006L2050W565		CLASS A	CLASS A
D	VFD220ED43S	47	B84143D0090R127	RF002X00A or T60006L2160V066		CLASS A	CLASS A
	VFD300ED43S	58	B84143D0090R127	RF002X00A or T60006L2160V066		CLASS A	CLASS A
E	VFD370ED43S	80	B84143D0200R127	RF300X00A or T60006L2160V066		CLASS A	CLASS A
	VFD450ED43S	100	B84143D0200R127	RF300X00A or T60006L2160V066		CLASS A	CLASS A
	VFD550ED43S	128	B84143D0200R127	RF300X00A or T60006L2160V066		CLASS A	CLASS A
	VFD750ED43S	165	B84143D0200R127	RF300X00A or T60006L2160V066		CLASS A	CLASS A

Table 6-39

EMC Filter Dimension

EMC Filter Model #: EMF018A43A Unit: mm [inch]

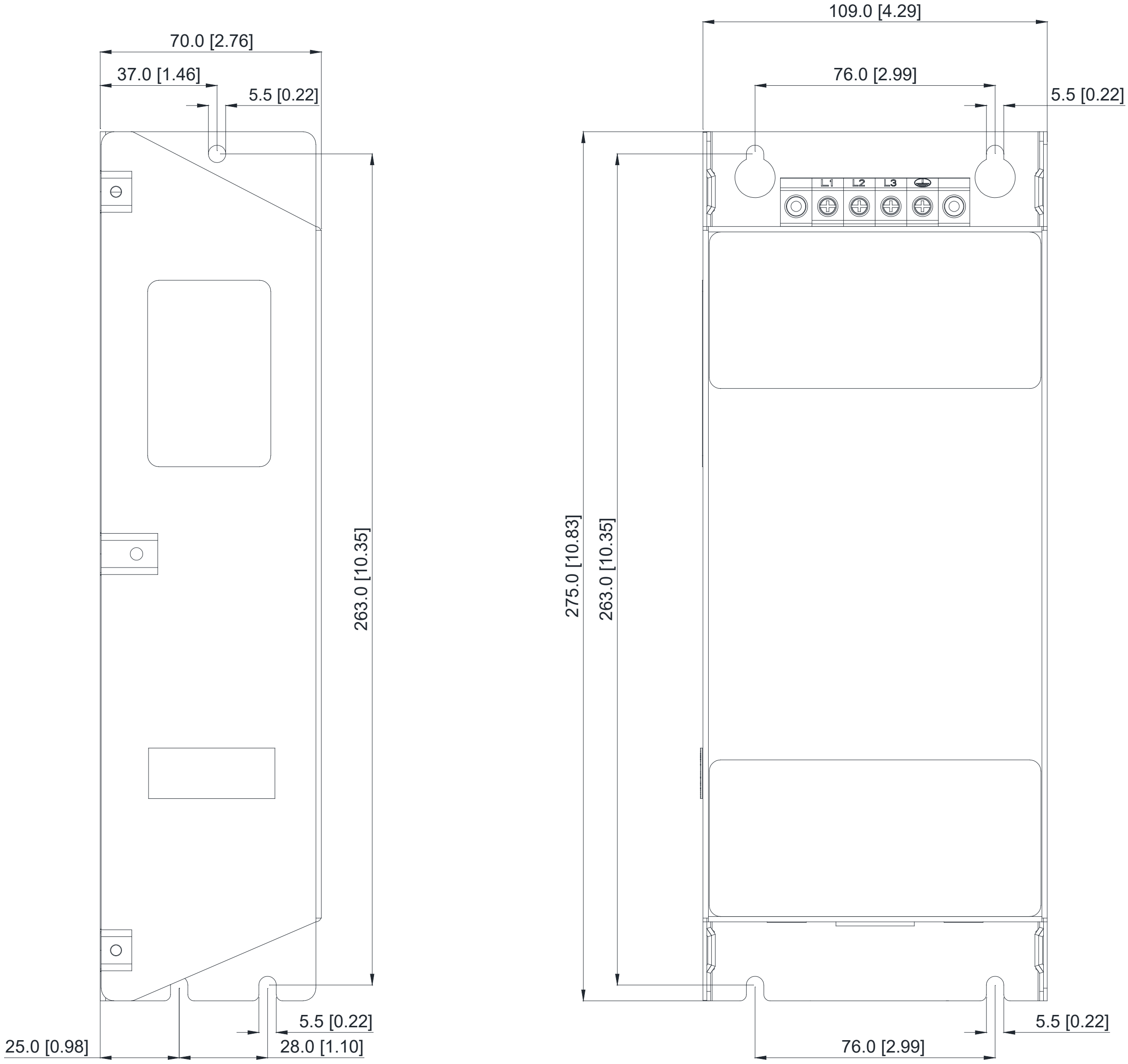


Figure 6-34

EMC Filter Model #: EMF035A23A, EMF033A43A

Unit: mm [inch]

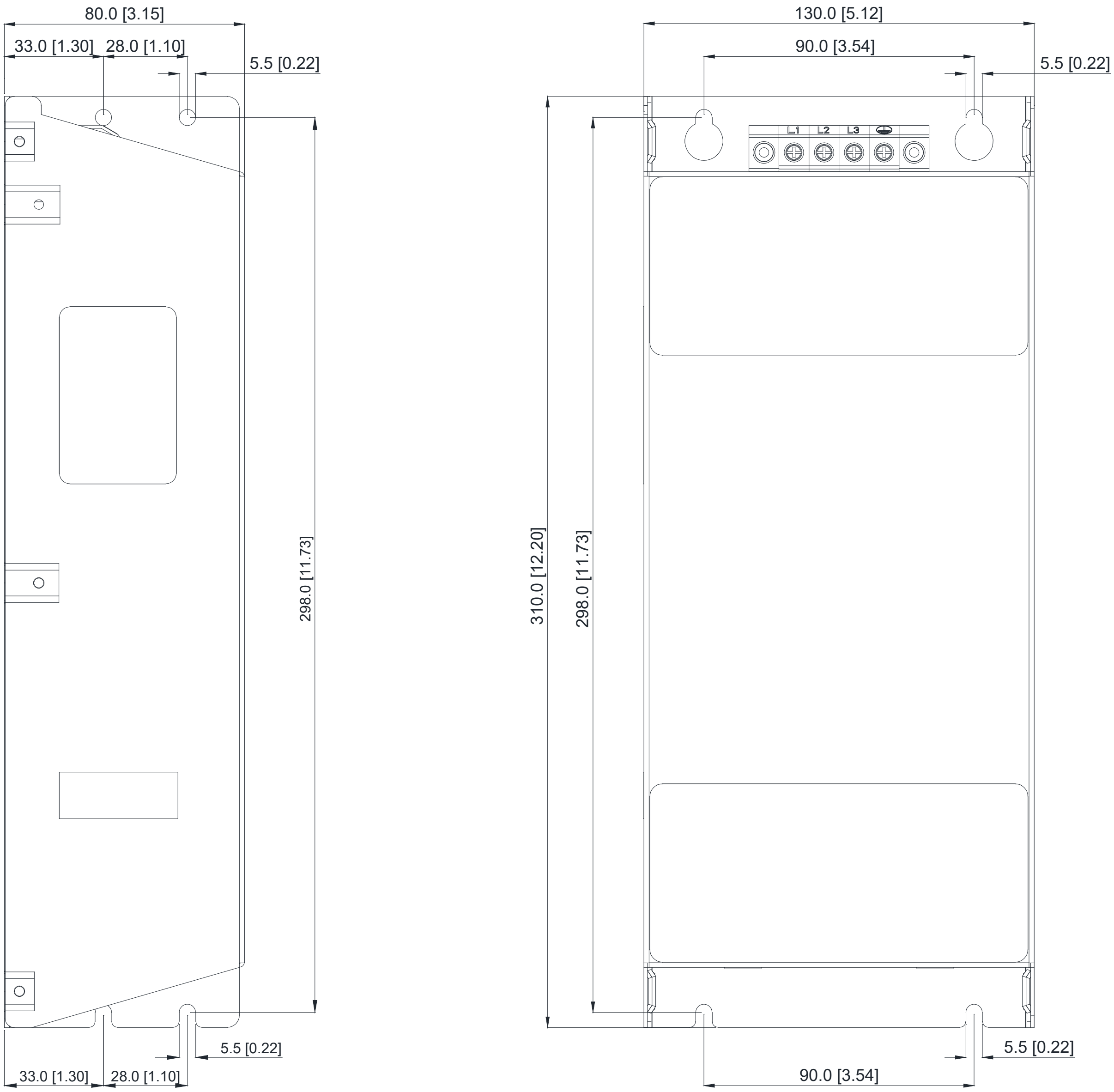


Figure 6-35

EMC Filter Model #: EMF056A23A

Unit: mm [inch]

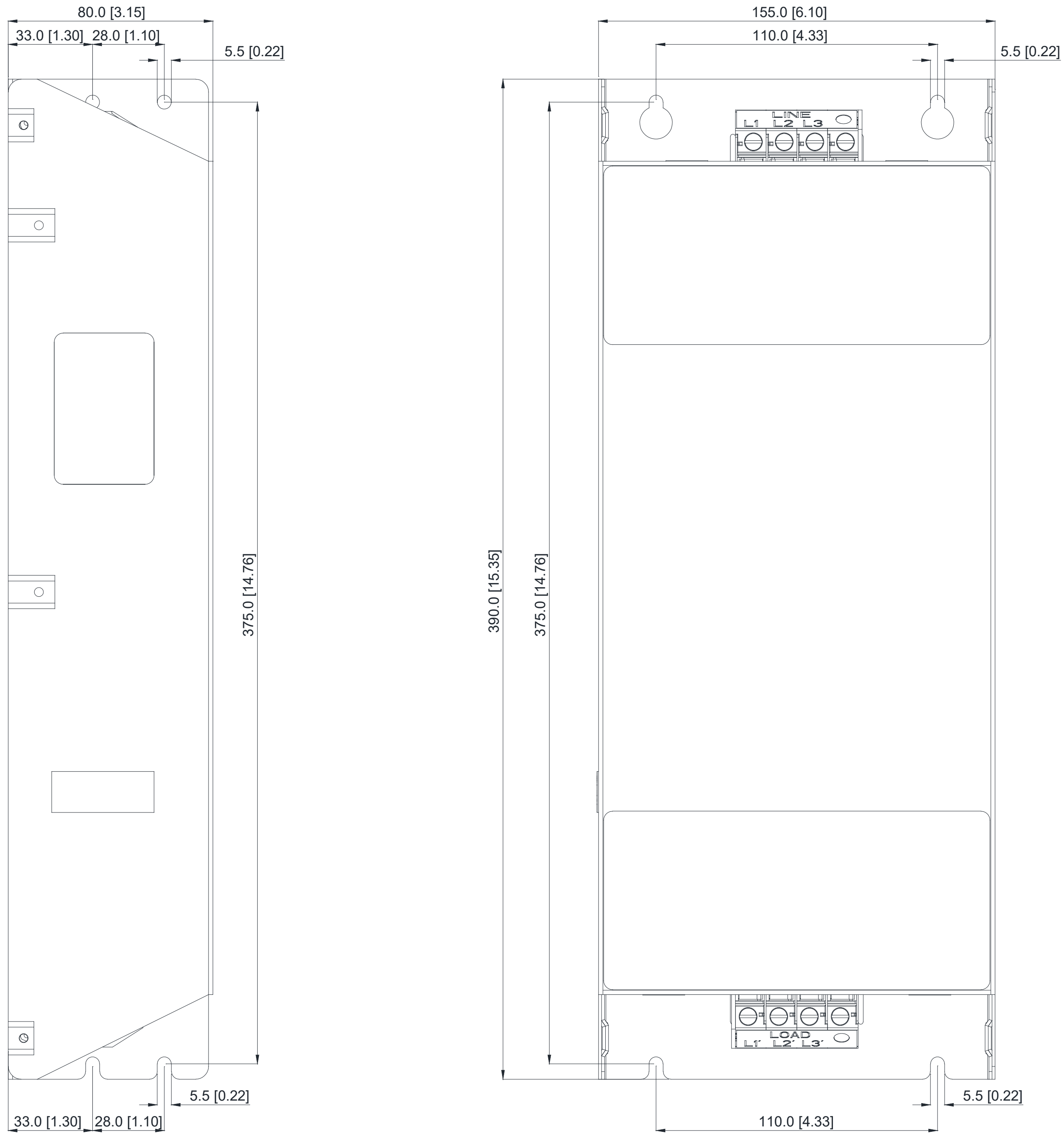


Figure 6-36

EMC Filter Model #: B84143D0075R127, B84143D0090R127

Unit: mm [inch]

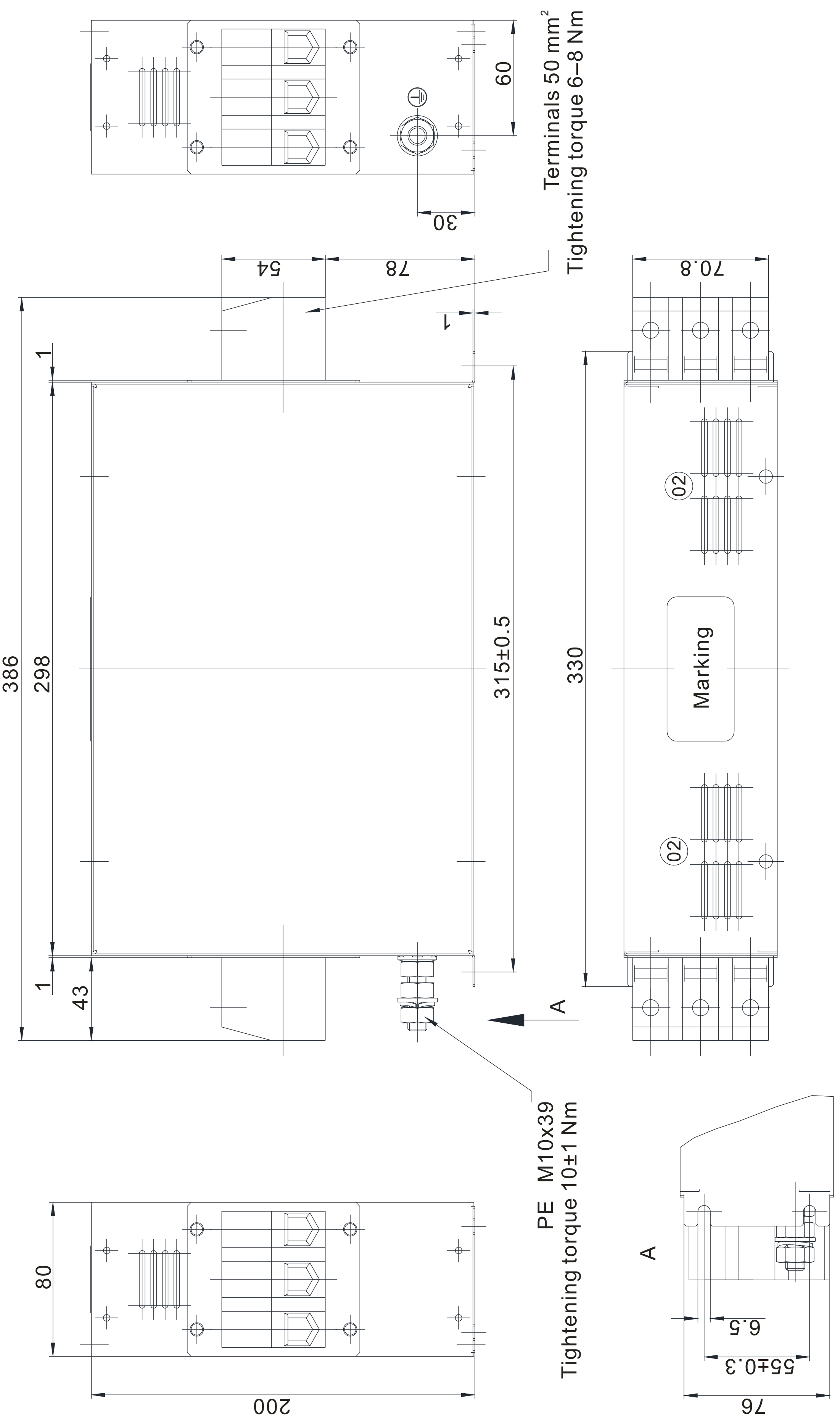


Figure 6-37

EMC Filter Model #: B84143D0150R127 Unit: mm [inch]

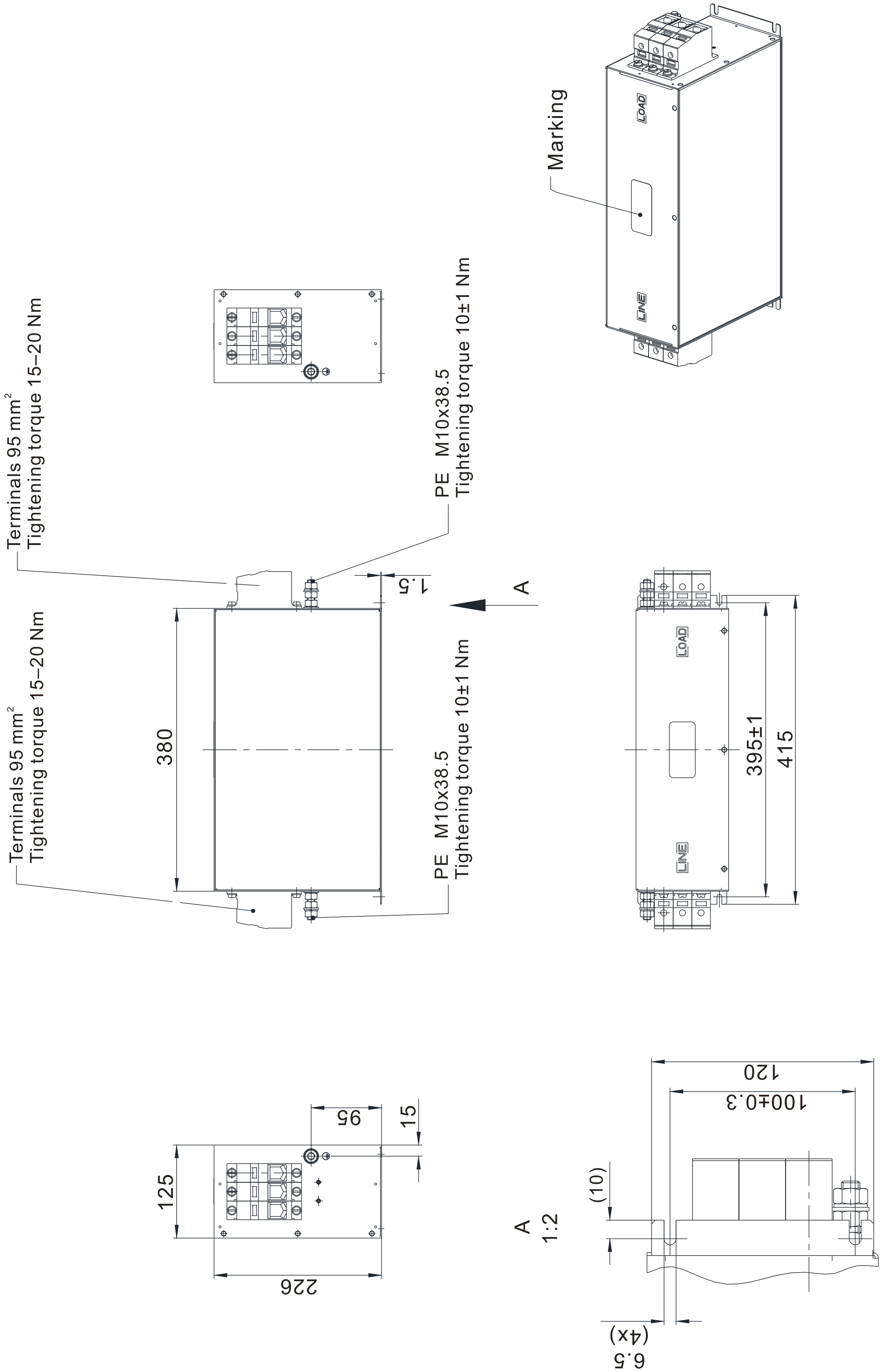


Figure 6-38

EMC Filter Model #: B84143D0200R127 Unit: mm [inch]

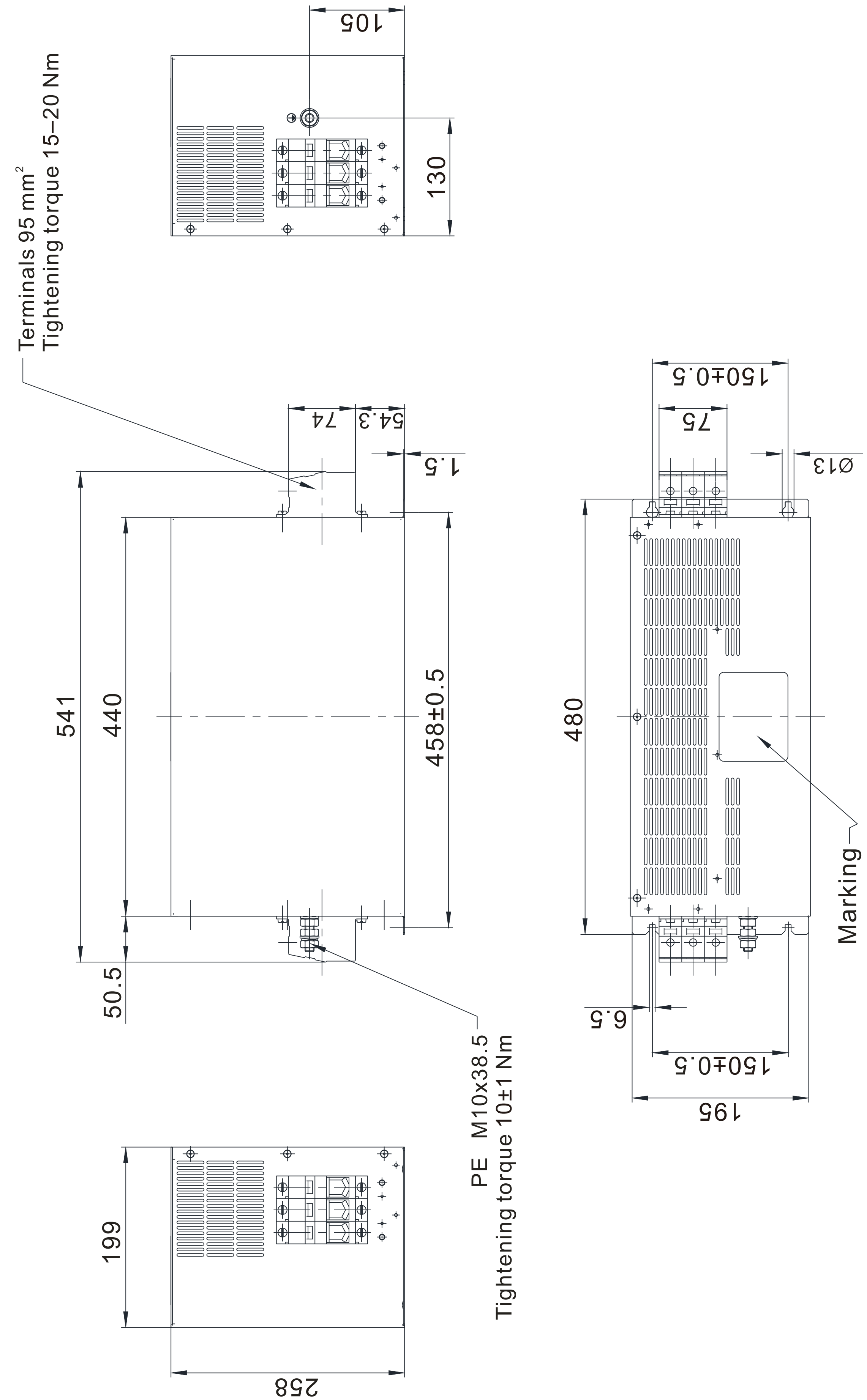


Figure 6-39

EMC Filter Model #: B84142A0042R122 Unit: mm [inch]

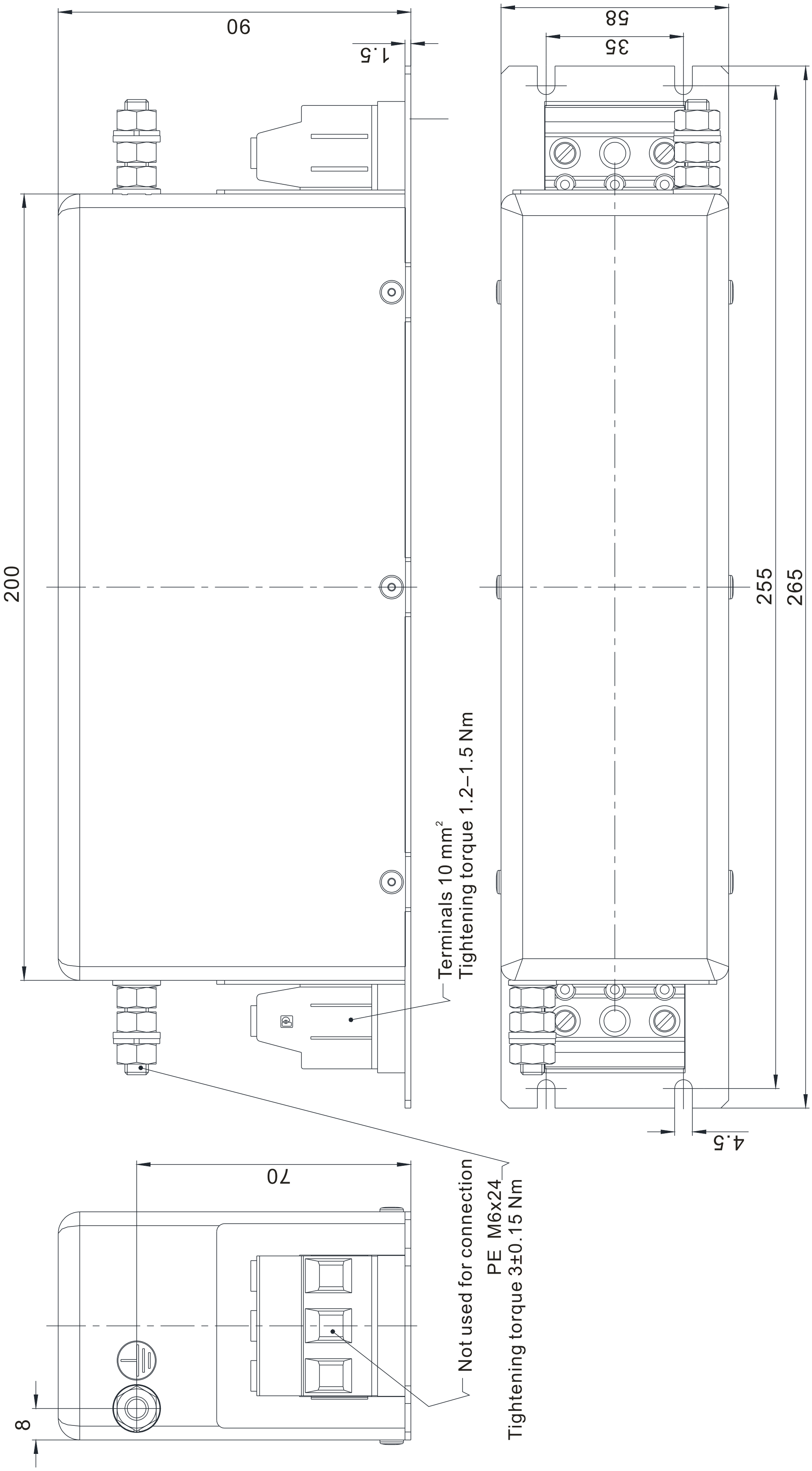


Figure 6-40

EMC Filter Installation

All electrical equipment in operation, including AC motor drives, generates high-frequency and low-frequency noise that interfere with peripheral equipment by radiation or conduction. By correctly installing an EMC filter, you can eliminate much of the interference. Use DELTA EMC filters for the best interference elimination.

The following standards are met when the AC motor drive and EMC filter are installed and wired according to the user manual:

- EN61000-6-4
- EN61800-3: 1996
- EN55011: (1991) Class A Group 1 (1st Environment, restricted distribution)
- European Standards: EN12015 & EN12016

General precaution

To ensure the best anti-interference performance for EMC filter, observe the following precautions in addition to the installation and wiring in the user manual:

☑ Install the EMC filter and AC motor drive on the same metal plate. Install the AC motor drive on the EMC filter footprint or install the EMC filter as close as possible to the AC motor drive.

☑ Use the shortest wire possible. Ground the metal plate. Fix the EMC filter cover and AC motor drive or grounding to the metal plate and make the contact area as large as possible.

Choose suitable motor cable and precautions

Improper installation and choice of motor cable affect the performance of EMC filters. Be sure to observe the following precautions when selecting motor cable.

☑ Use shielded cable (double shielding is best). Ground the shielding on both ends of the motor cable with the minimum length and maximum contact area.

☑ Remove any paint on the metal saddle for good ground contact with the plate and shielding (see Figure 6-41).

☑ The connections between the motor's shielded cable and metal plate must be correct. Use a U-shape metal saddle to fix both ends of the motor cable. See Figure 6-42 for correct connections.

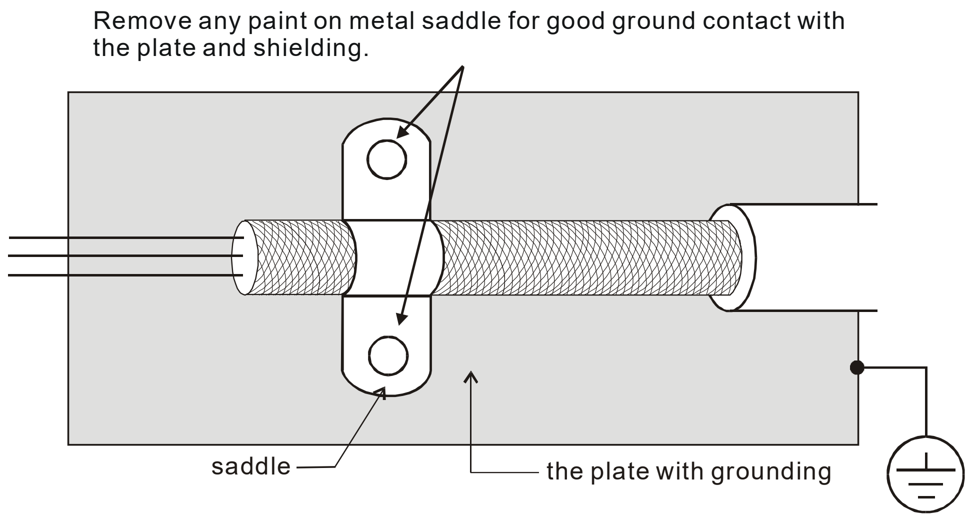


Figure 6-41

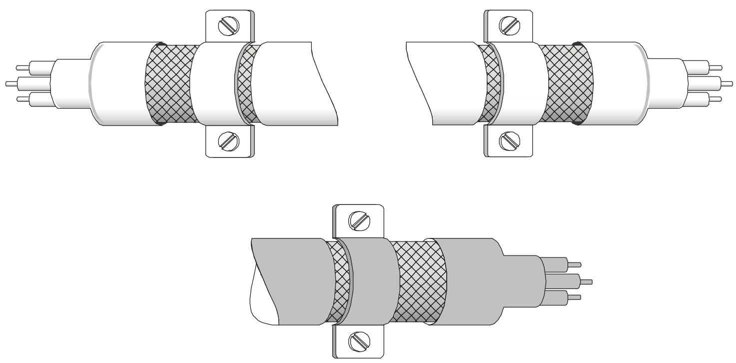


Figure 6-42

The motor cable length

- Required cable length when the motor drive is at full load.
  1. Non-shielded cable: For 5.5 kW (7.5 HP) and below models, the maximum cable length is 100 m (328 ft). For 7.5 kW (10 HP) and above models, the maximum cable length is 200 m (656 ft)
  2. Shielded cable: For 5.5 kW (7.5 HP) and below models, the maximum cable length is 50 m (165 ft). For 7.5 kW (10 HP) models, the maximum cable length is 100 m (328 ft).
  3. To be compatible with the European Standards EN12015 & EN12016, follow one of the following in addition to the precautions on page 6-45:
     (1) Use shielded cables
     (2) The motor cable must be shorter than 2 m (6 ft).

  If the cable length is longer than the recommended lengths above, install an output reactor.

  NOTE:
  1. If the cable length is too long, the stray capacitance between cables increases and may cause leakage current. In this case, It activates the over-current protection, increases leakage current, or may affect the current display. The worst case is that it may damage the AC motor drive.
  2. If more than one motor is connected to the AC motor drive, the total wiring length is the sum of the wiring length from AC motor drive to each motor.
  3. For the 460V series AC motor drive, when you install an overload thermal relay between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50 m; however, an overload thermal relay malfunction may still occur. To prevent the malfunction, install an output reactor (optional) to the drive or lower the carrier frequency setting (Pr.00-12).

- Consequence of the surge voltages on the motor
  When a motor is driven by a PWM-type AC motor drive, the motor terminals experience surge voltages due to component conversion of AC motor drive and cable capacitance. When the motor cable is very long (especially for the 460V series), surge voltages may damage the insulation. To prevent this, follow these rules:
  1. Use a motor with enhanced insulation (refer to the tables below).
  2. Reduce the cable length between the AC motor drive and motor to suggested values.
  3. Connect an output reactor (optional) to the output terminals of the AC motor drive.

For 7.5 kW (10 HP) and higher models:

Insulation level of motor	1000V	1300V	1600V
460 V_{AC} input voltage	20 m (66 ft)	100 m (328 ft)	400 m (1312 ft)
230 V_{AC} input voltage	400 m (1312 ft)	400 m (1312 ft)	400 m (1312 ft)

Table 6-40

For 5.5 kW (7.5 HP) and lower models:

Insulation level of motor	1000V	1300V	1600V
460 V_{AC} input voltage	20 m (66 ft)	50 m (165 ft)	50 m (165 ft)
230 V_{AC} input voltage	100 m (328 ft)	100 m (328 ft)	100 m (328 ft)

Table 6-41

6-7 Digital Keypad

KPC-CC01

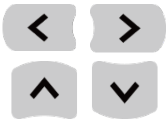
Communication Interface
RJ45 (socket), RS-485 interface

Communication protocol:
RTU19200, 8, N, 2

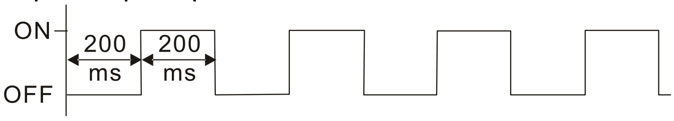
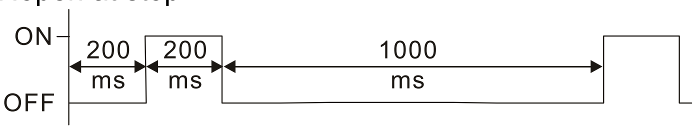
Installation Method
1. Embedded type and can be put flat on the surface of the control box. The front cover is water proof.
2. Buy a MKC-KPPK model to do wall mounting or embedded mounting. Its protection level is IP66.
3. The maximum RJ45 extension lead is 5 m (16ft)
4. This keypad can only be used on Delta's motor drive C2000, CH2000, CP2000, and ED series.

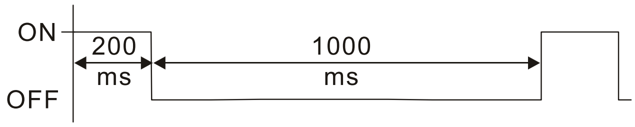
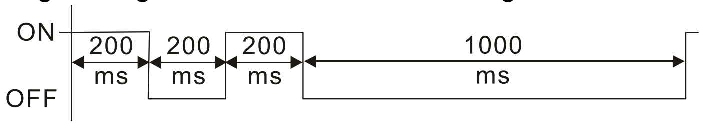
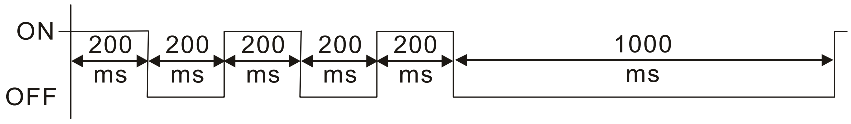
Descriptions of Keypad Functions

Key	Descriptions
	Start Operation Key 1. Only valid when the source of operation command is the keypad. 2. Operates the AC motor drive by the function setting. The RUN LED will be ON. 3. Can be pressed repeatedly at the stop process.
	Stop Command Key. 1. This key has the highest priority when the command is from the keypad. 2. When it receives the STOP command, regardless of whether the AC motor drive is in operation or stop status, the AC motor drive needs to execute the "STOP" command. 3. Use the RESET key to reset the drive after a fault occurs. 4. If you cannot reset after the fault: (1) The condition which triggers the fault is not cleared. After you clear the condition, you can then reset the fault. (2) The drive is in the fault status when powered on. After you clear the condition, restart and then you can reset the fault.
	Operation Direction Key 1. Only controls the operation direction, NOT the drive activation. FWD: forward, REV: reverse. 2. Refer to the Descriptions of LED Functions on p.9-6 for more details.
	ENTER Key Goes to the next menu level. If at the last level, press ENTER to execute the command.
	ESC Key Leaves the current menu and returns to the previous menu; also functions as a return key or cancel key in a sub-menu.

Key	Descriptions
	MENU key. Returns to the main menu. Menu items: 1. Parameter Setup 8. Time Setup 14. Main Page 5. Copy Parameter 9. Keypad Locked 15. PC Link 6. Fault Record 12. Display Setup 7. Language Setup 13. Start-up **NOTE:** Menu items that are not listed above are not supported in VFD-ED.
	Direction: Left / Right / Up / Down 1. In the numeric value setting mode, moves the cursor and changes the numeric value. 2. In the menu / text selection mode, selects an item.
	Function Key The functions keys have defaults and can also be user-defined. The defaults for F1 and F4 work with the function list below. For example, F1 is the JOG function, and F4 is a quick setting key for adding / deleting user-defined parameters.

Descriptions of LED Functions

<table>
<tr><th>LED</th><th>Descriptions</th></tr>
<tr><td></td><td>Steady ON: STOP indicator for the AC motor drive.
Blinking: the drive is in standby.
Steady OFF: the drive does not execute the “STOP” command.</td></tr>
<tr><td></td><td>Operation Direction LED
1. Green light: the drive is running forward.
2. Red light: the drive is running backward.
3. Flashing light: the drive is changing direction.</td></tr>
<tr><td>CANopen–
“RUN”</td><td>RUN LED:
<table>
<tr><th>LED status</th><th>Condition / State</th></tr>
<tr><td>OFF</td><td>CANopen at initial
No LED</td></tr>
<tr><td>Blinking</td><td>CANopen at pre-operation
</td></tr>
<tr><td>Single flash</td><td>CANopen at stop
</td></tr>
<tr><td>ON</td><td>CANopen at operation status
</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>LED</th><th>Descriptions</th></tr>
<tr><td>CANopen–
“ERR”</td><td>ERR LED:
<table>
<tr><th>LED status</th><th>Condition / State</th></tr>
<tr><td>OFF</td><td>No Error</td></tr>
<tr><td>Single flash</td><td>One message fail

</td></tr>
<tr><td>Double flash</td><td>Node guarding failure or heartbeat message failure

</td></tr>
<tr><td>Triple flash</td><td>Synchronization failure

</td></tr>
<tr><td>ON</td><td>Bus off

</td></tr>
</table>
</td></tr>
</table>

Dimension

Unit: mm [inch]

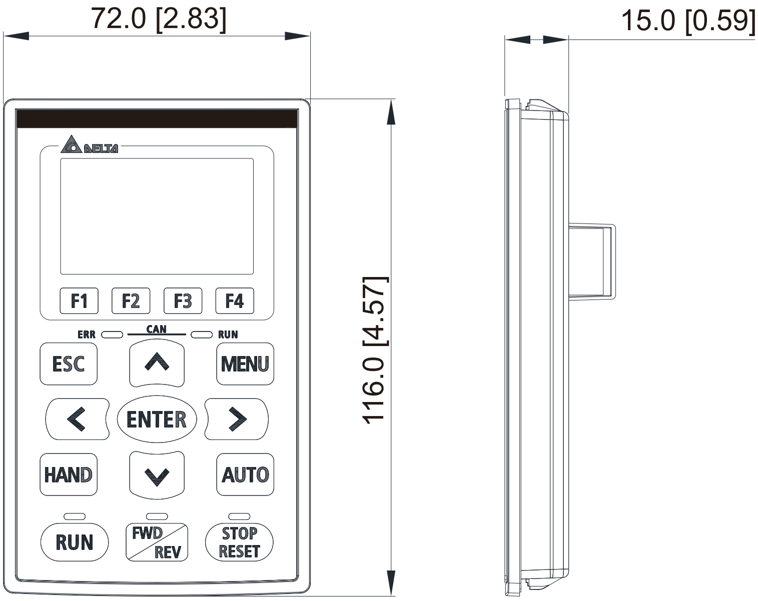


Figure 6-43

RJ45 Extension Cables for the Digital Keypad

Part #	Description
CBC-K3FT	3 feet RJ45 extension lead (approximately 0.9 m)
CBC-K5FT	5 feet RJ45 extension lead (approximately 1.5 m)
CBC-K7FT	7 feet RJ45 extension lead (approximately 2.1 m)
CBC-K10FT	10 feet RJ45 extension lead (approximately 3 m)
CBC-K16FT	16 feet RJ45 extension lead (approximately 4.9 m)

Table 6-42

NOTE: If communication cables are required, buy non-shielded, 24 AWG, four-wire twisted pair, 100 ohms communication cables.

6-8 USB/RS-485 Communication Interface IFD6530

⚠ Warning

✓ Thoroughly *read this instruction sheet before installation and putting it into use.*

✓ *The content of this instruction sheet and the driver file may be revised without prior notice. Consult our distributors or download the most updated instruction/driver version.*

Introduction

IFD6530 is a convenient RS-485-to-USB converter that does not require an external power supply and a complex setting process. It supports baud rates from 75 to 115.2 kbps and auto-switching of the data transmission direction. In addition, it adopts the RJ45 in RS-485 connector for convenient wiring. Its small size, use of plug-and-play and hot-swappable provide more conveniences for connecting all DELTA IABG products to your PC.

Applicable Models: All DELTA IABG products.

■ Application & Dimension:

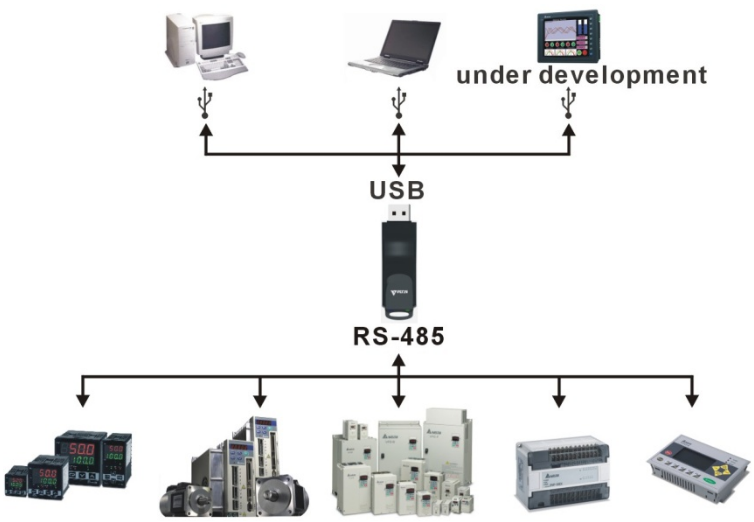


Figure 6-44

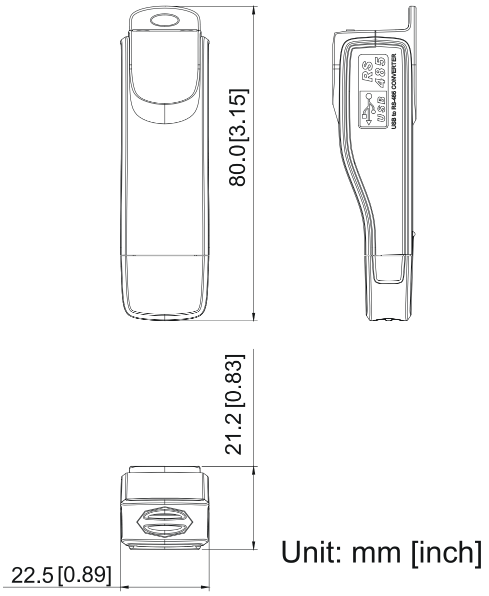


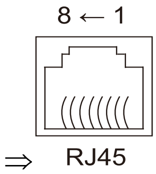
Figure 6-45

Specifications

Power supply	No external power is required.
Power consumption	1.5 W
Isolated voltage	2,500 V_{DC}
Baud rate	75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
RS-485 connector	RJ45
USB connector	A type (plug)
Compatibility	Full compliance with USB V2.0 specification
Maximum cable length	RS-485 communication port: 100 m
Supports RS-485 half-duplex transmission	

Table 6-43

RJ45



PIN	Description
1	Reserved
2	Reserved
3	GND
4	SG-

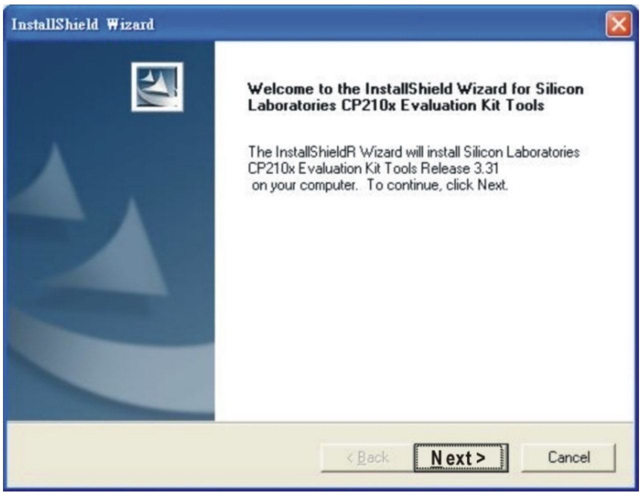
PIN	Description
5	SG+
6	GND
7	Reserved
8	+9V

Preparation before Installing Driver

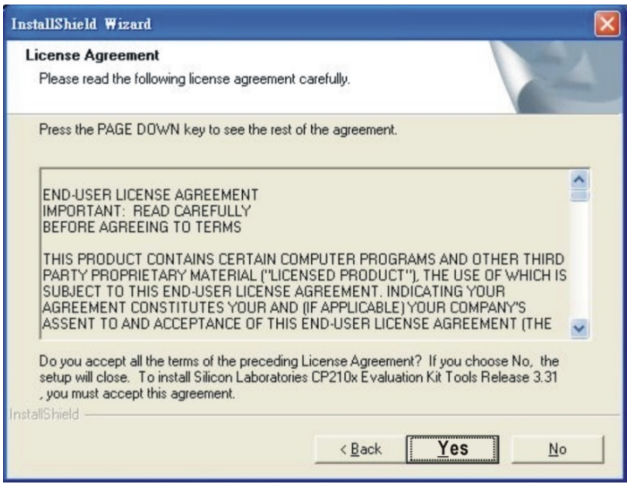
Extract the driver file (IFD6530_Drivers.exe) by following steps. Download the driver file (IFD6530_Drivers.exe) at Delta's website.

NOTE: DO NOT connect the IFD6530 to PC before extracting the driver file.

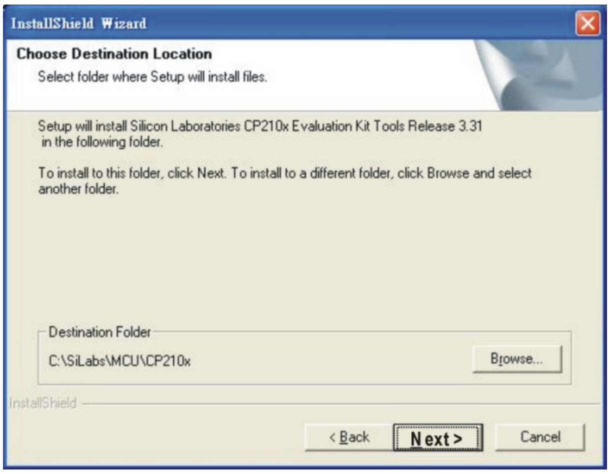
STEP 1



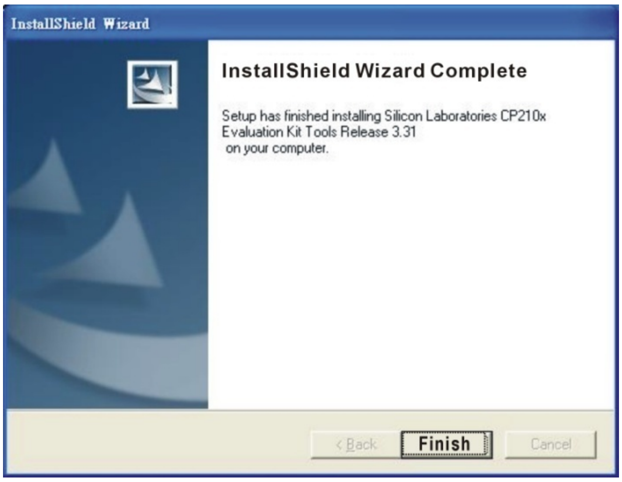
STEP 2



STEP 3



STEP 4



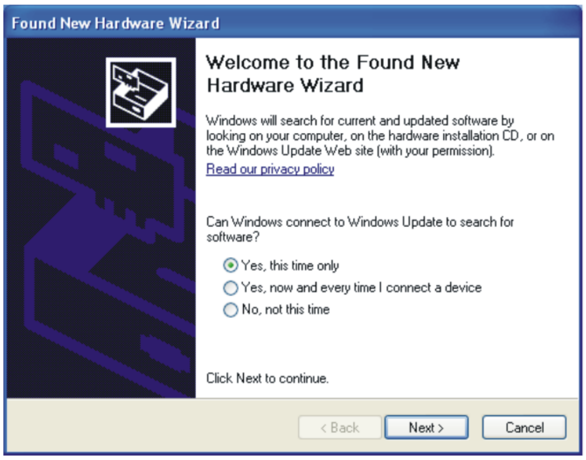
STEP 5

At the end of this process, you should have a folder named SiLabs under drive c:\ SiLabs.

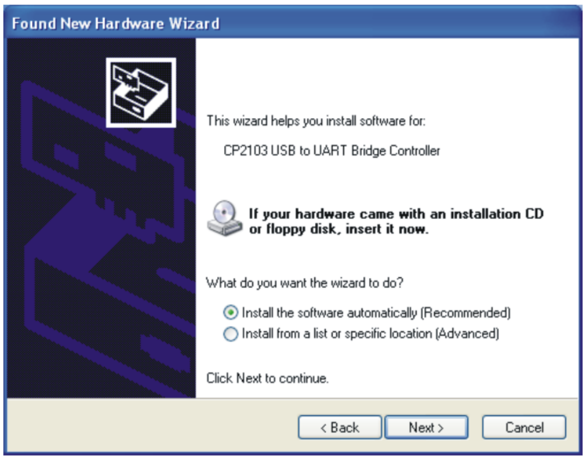
Installing the Driver

After connecting the IFD6530 to your PC, install the driver using the following steps.

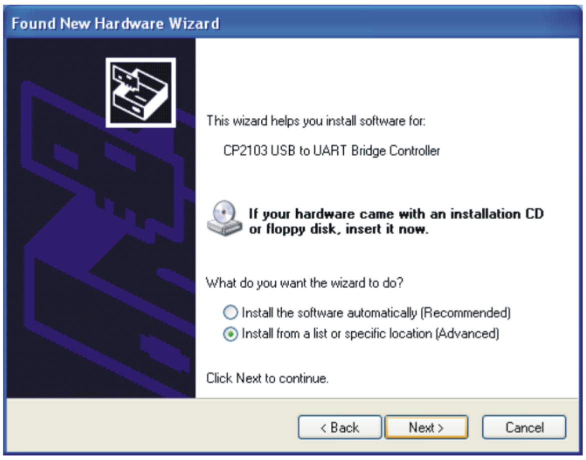
STEP 1

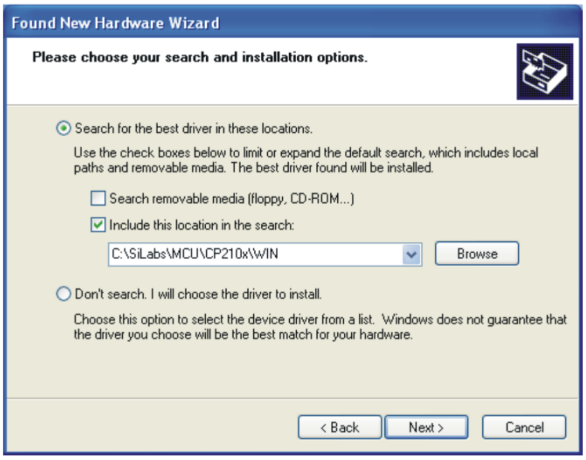


STEP 2



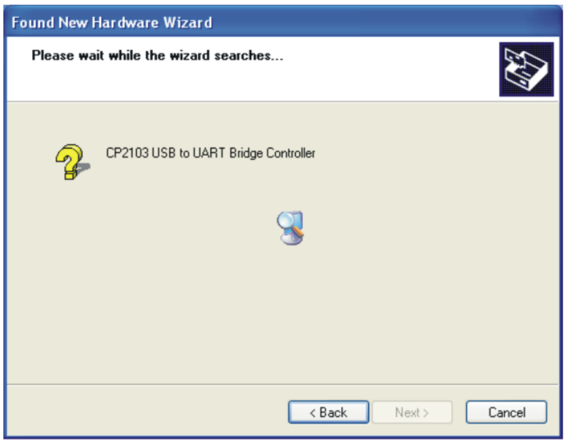
OR



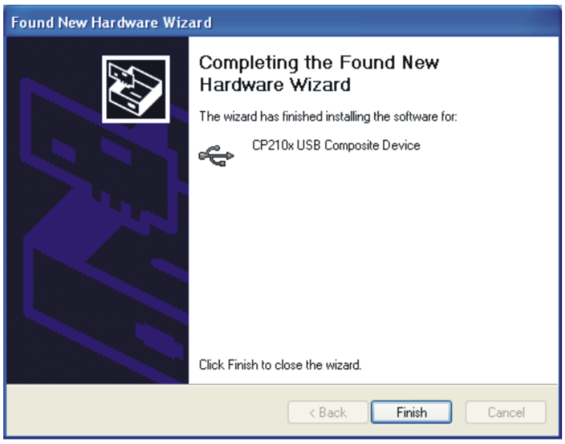


Browse and select directory, or enter C:\SiLabs\MCU\CP210x\WIN

STEP 3



STEP 4



STEP 5
Repeat Step 1 to Step 4 to complete COM PORT setting.

LED Display

1. Steady green LED ON: power is ON.
2. Blinking orange LED: data is transmitting.

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Chapter 7 Option Cards

- Select the applicable option cards for your drive or contact your local distributor for suggestions.
- To prevent damage to the motor drive during installation, remove the digital keypad and the cover before wiring. Refer to the following instructions.
- Note that the option cards do not support hot swapping. Turn off the drive power before installing or removing the option cards.

7-1 Option Card Installation

7-1-1 Detach and Attach the Top Cover

Frame B, C and D

Step 1: Loosen the four screws

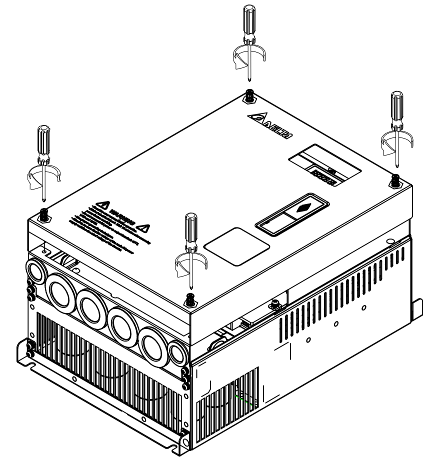


Figure 7-1

Step 2: Remove the top cover

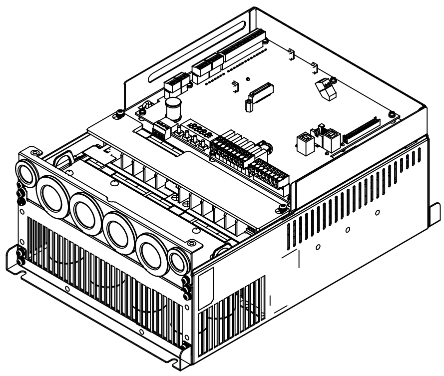


Figure 7-2

Step 3: Attach the top cover, and then tighten the four screws using torque force 15 kgf-cm.

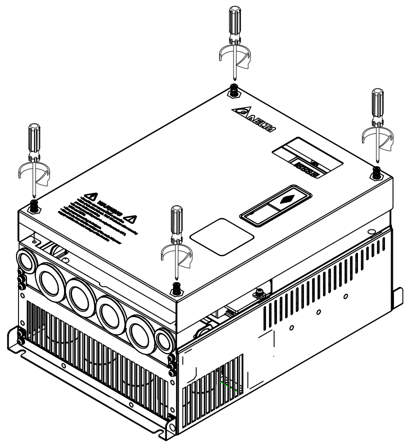
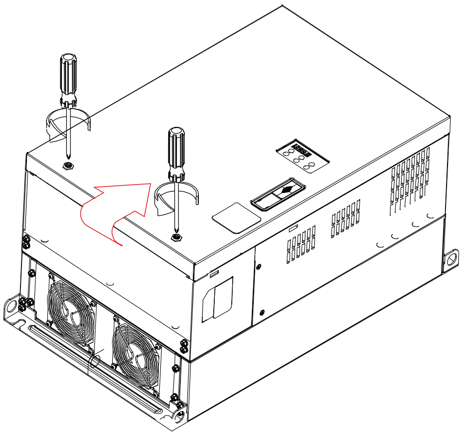
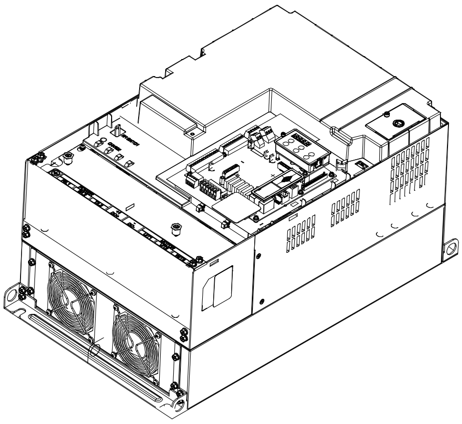
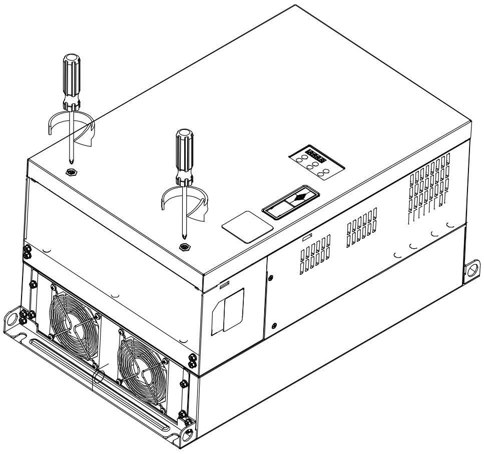
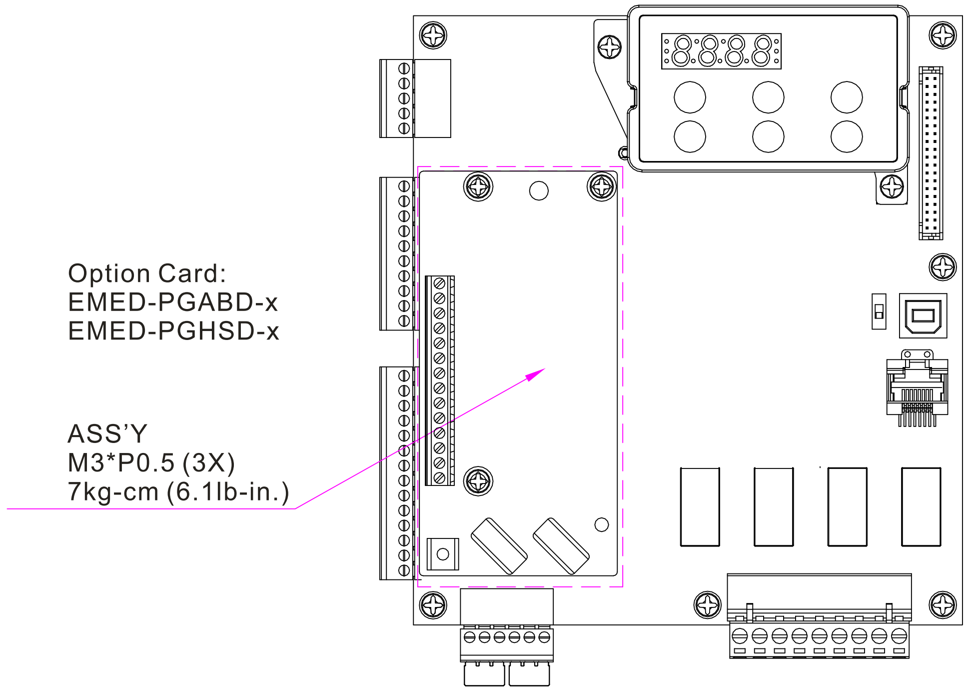


Figure 7-3

Frame E

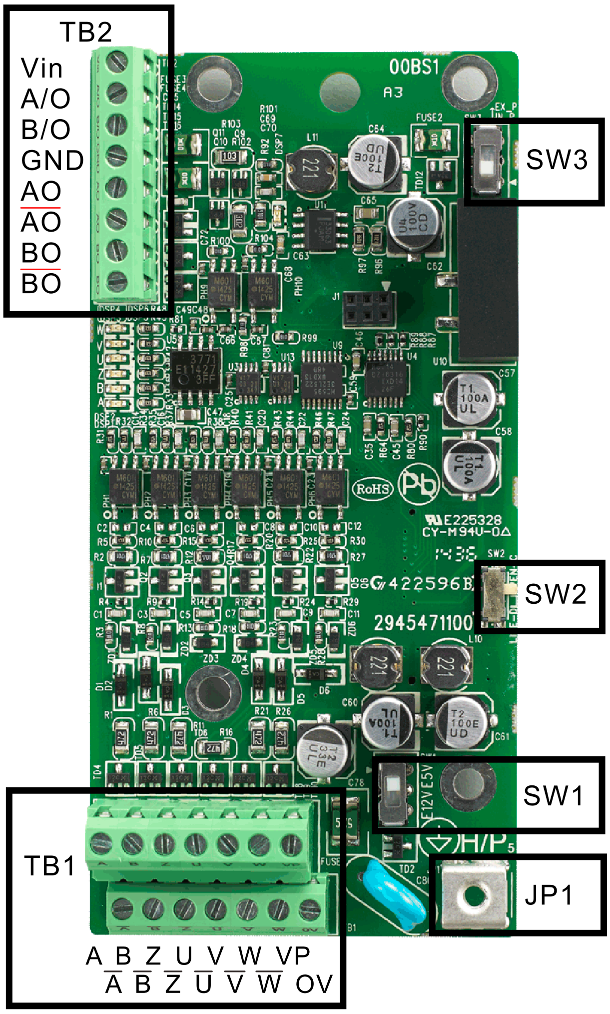
Step 1: Loosen the two screws in the direction as the arrow shows	 Figure 7-4
Step 2: Remove the top cover	 Figure 7-5
Step 3: Attach the top cover, and then tighten the two screws using torque force 15 kgf-cm.	 Figure 7- 6

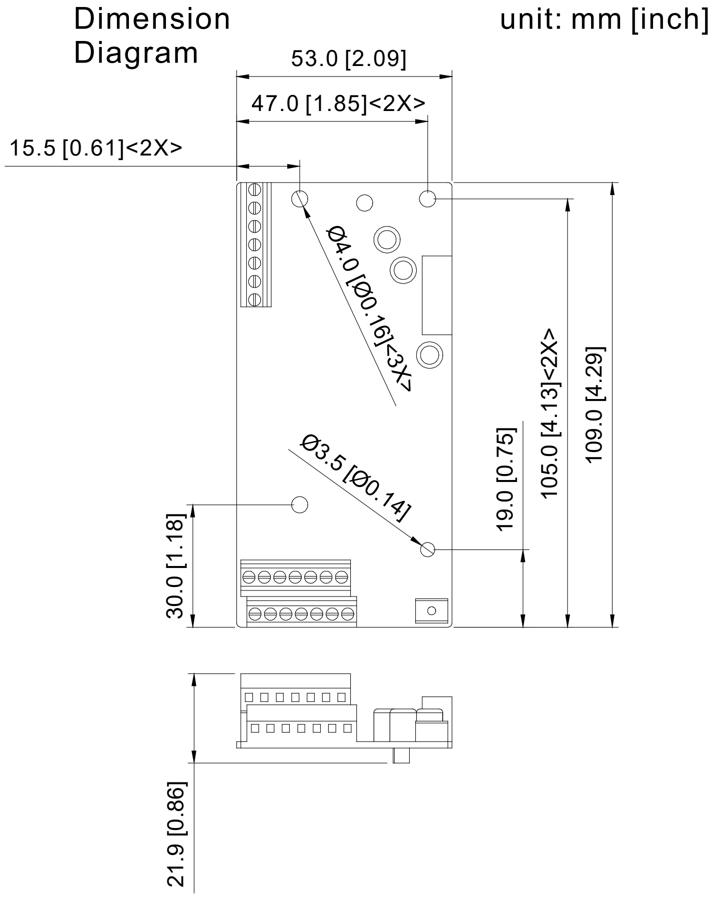
7-1-2 Vertical View of the Motor Drive & Screw Specifications



7-2 EMED-PGABD-2

7-2-1 Product Profile





NOTE:

1. Applicable encoder: A/B/Z and U/V/W Absolute Encoders
2. Screw specification

Wire Gauge	0.2–1.5 mm^2 (30–16 AWG)
Torque	1.6 kg-cm (1.4 lb-in.)

7-2-2 Terminal Function

Terminals		Descriptions
TB2	Vin	Voltage input, to adjust the amplitude of output voltage at terminal A/O and terminal B/O. It also provides a 5 V voltage to support line driver's signal. Vin voltage range: 8–24 V, Max: 24 V.
	A/O, B/O	Output signal for the push-pull voltage frequency division. Default: Output amplitude is about +24 V. Use SW3 to disable the internal default power. Required input power through Vin-GND port (i.e. output voltage's amplitude) Vin voltage range: 8–24 V, Max: 24 V. Push-Pull Voltage Output Max. output frequency: 100 kHz Supports frequency division output, the frequency division range: 1–31.
	GND	Common ground terminal connecting to the host controller and the motor drive.
	AO, $\overline{AO}$, BO, $\overline{BO}$	Output signal for the line driver frequency division. Line Driver RS422 Max. output frequency: 150 kHz Supports frequency division output, the frequency division range: 1–31.
TB1	VP	Power output for encoder **NOTE:** Use SW1 to set output voltage amplitude Voltage: +5 ± 0.5 V or +12 ± 1 V Current: 200 mA max.
	0 V	Common power terminal for encoder
	A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$	Incremental-type encoder signal input terminal Types of input signal: line driver, voltage, push-pull, open collector **NOTE:** Different input signals need different wiring methods. See the user manual for wiring diagrams. Max. input frequency: 150 kHz
	U, $\overline{U}$, V, $\overline{V}$, W, $\overline{W}$	Absolute-type encoder signal input terminal Types of input signal: line driver, voltage, push-pull, open collector **NOTE:** Different input signals need different wiring methods. See the user manual for wiring diagrams. Max. input frequency: 150 kHz
JP1	⏚	Ground Terminal Connect the motor drive power supply to ground. Supports PG shielding.
SW1		Switch between power for the encoder (5V / 12V).
SW2		Offline Detection Switch. Switch to the Line-D side to enable offline detection for the Line-D input signal. Switch to OPEN-C side to disable offline detection function for the OPEN-C input signal.
SW3		Power supply switch for frequency division. Switch to INP side to provide 24 V power for internal use. Switch to EXP side to provide 24 V power for external use (client).

7-2-3 Applicable encoders:

1. Open collector output encoder application: Use one pull-up resistor for each set of input current 5–15 mA. If open collector input voltage uses 5V or 12V external power, connect the encoder power externally. See the PG wiring Figure 7-8 below.

5V	Suggested pull-up resistor: above 150–520ohm, 1/2 W
12V	Suggested pull-up resistor: above 600–2Kohm, 1/2 W

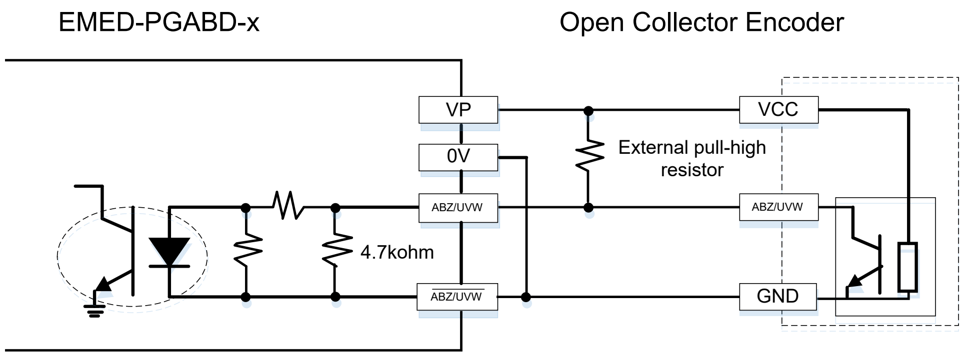


Figure 7-7

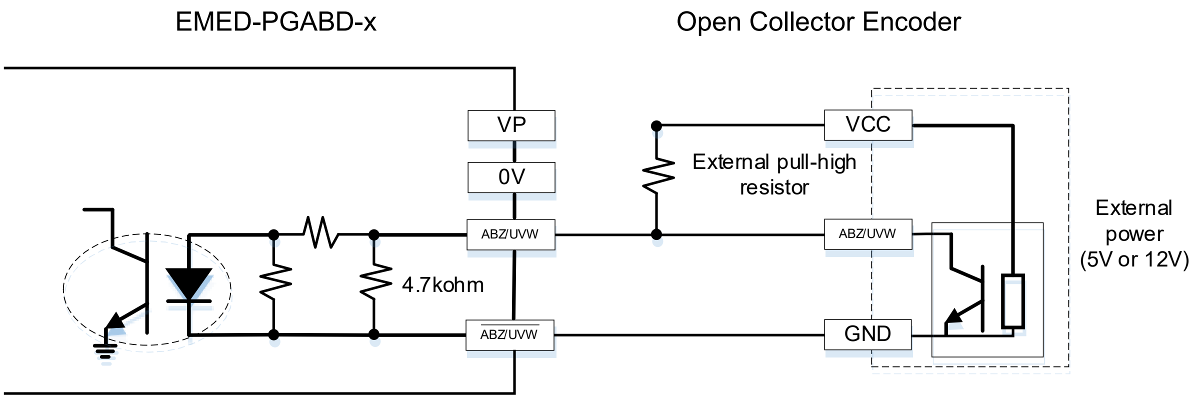


Figure 7-8

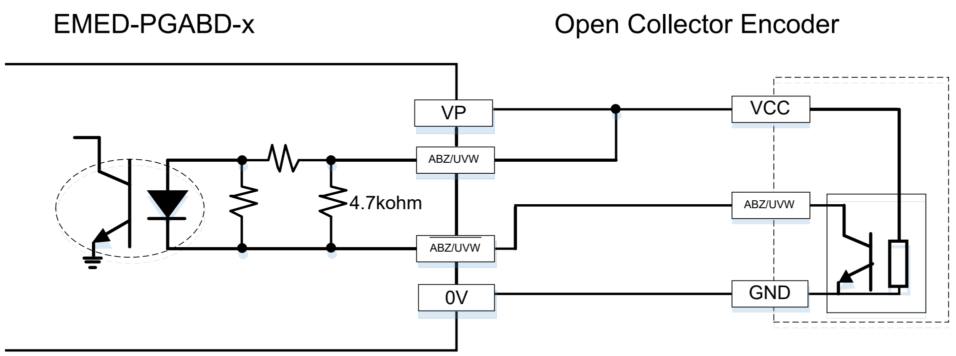


Figure 7-9

2. Voltage output encoder application: Each set of input current is 5–15 mA. If input voltage uses 5V or 12V external power, connect the encoder power externally. See the PG wiring Figure 7-11 below.

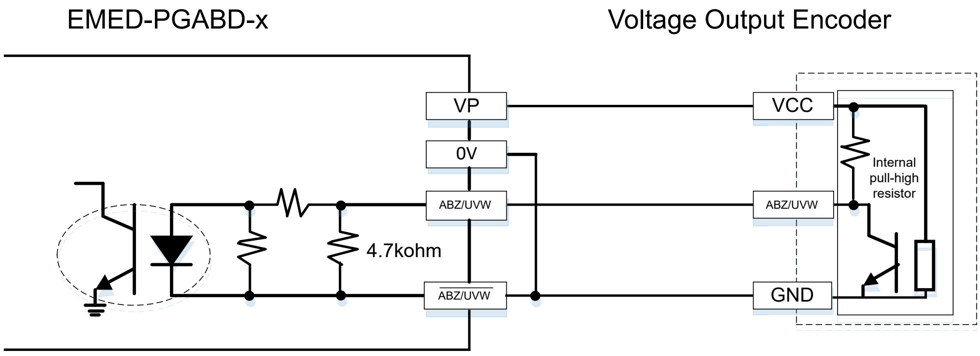


Figure 7-10

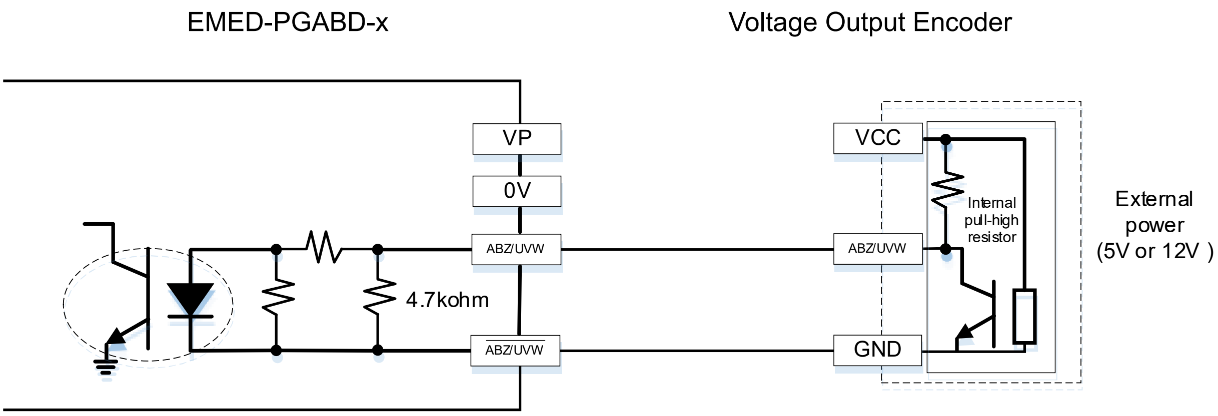


Figure 7-11

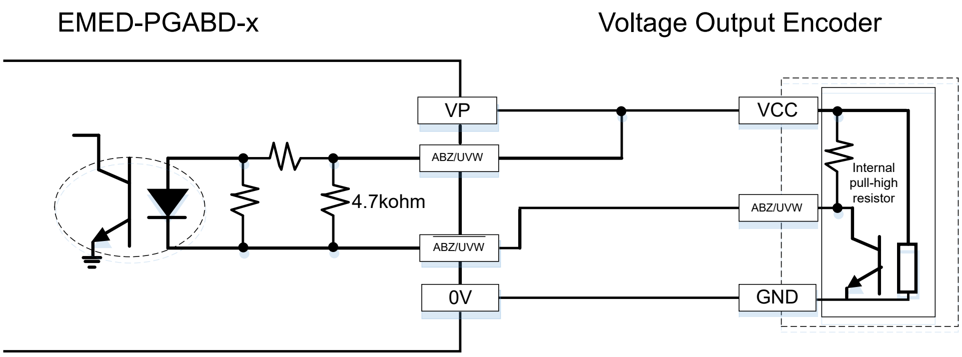


Figure 7-12

3. Push-pull output encoder application: Each set of input current is 5–15 mA. If input If input voltage uses 5V or 12V external power, connect the encoder power externally. See the PG wiring Figure 7-14 below.

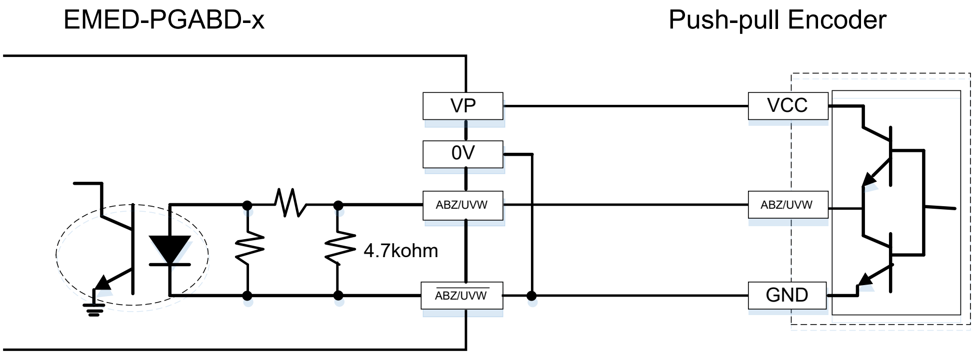


Figure 7-13

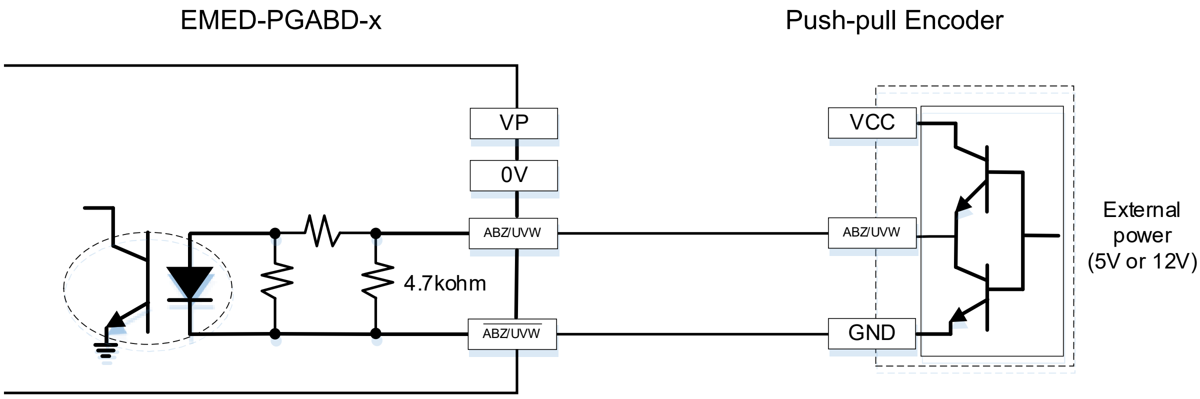


Figure 7-14

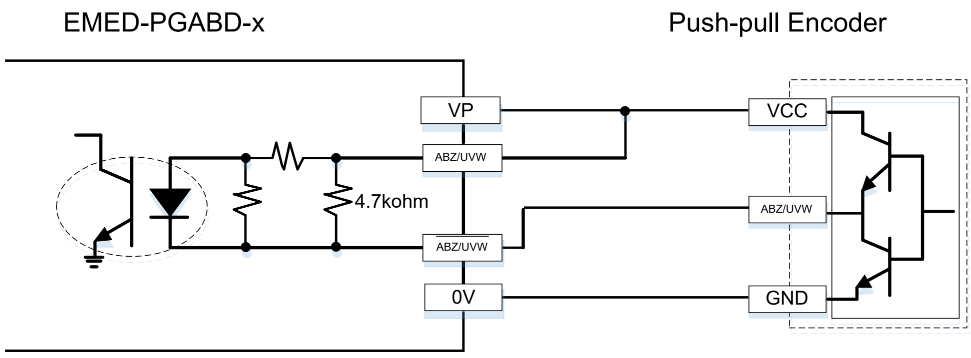


Figure 7-15

4. Line driver output encoder application: Each set of input current is 5–15 mA. If input voltage uses 5V or 12V external power, connect the encoder power externally. See the PG wiring Figure 7-17 below.

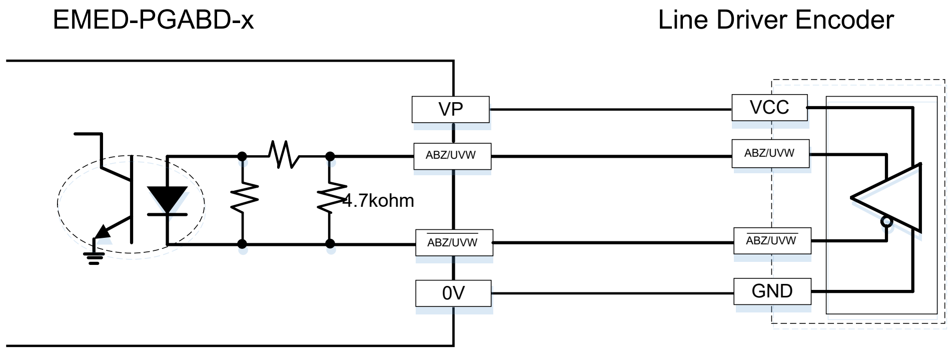


Figure 7-16

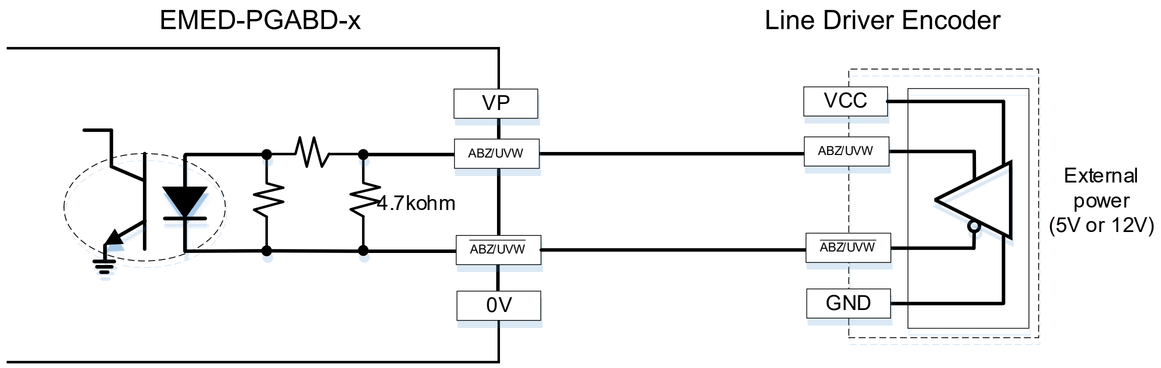


Figure 7-17

NOTE:

- Verify that the SW1 is set to the correct output voltage before powering ON.
- Keep the motor drive wiring away from any high voltage lines to avoid interference.
- When using push-pull output and voltage output, short-circuit $\overline{A}$, $\overline{B}$, $\overline{Z}$ to 0V.
- When using open collector output, short-circuit A, B, Z to VP.

7-2-4 Wiring Diagram

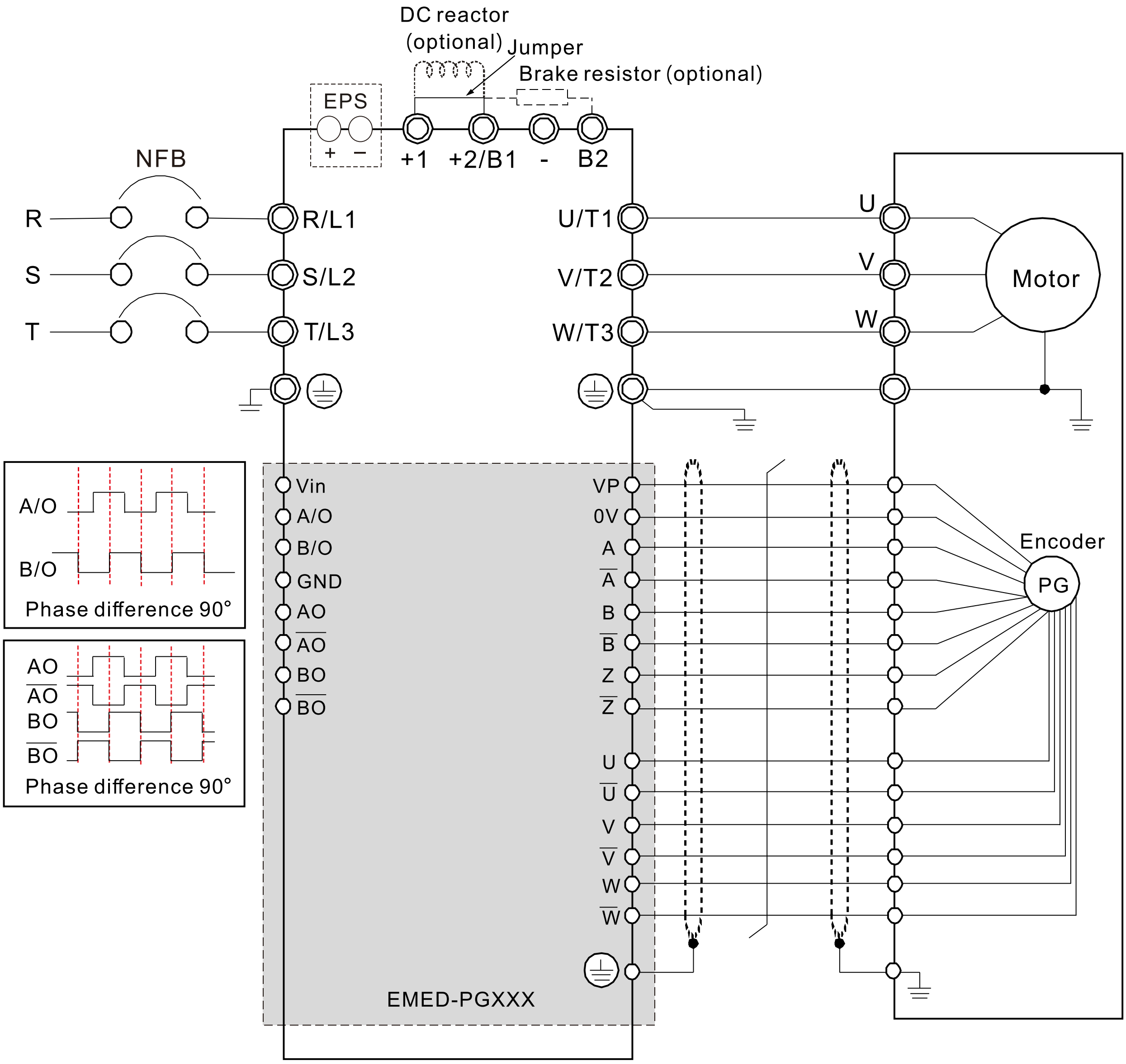


Figure 7-18

7-2-5 Frequency Division Signal Setting

1. After the encoder inputs a PULSE signal, there is an output signal by the division factor “n” Set the value in Pr.10-29 (PG card’s frequency division output).
2. Set Pr.10-29 (PG card’s frequency division output): The decimal frequency division output setting; range of the division factor “n”: 1–31.
3. Pr.10-30 (PG card’s frequency division output mode)

Bit3	Bit2	Bit1	Bit0
X	X	**OUT/M**	**IN/M**

OUT/M: Pulse output mode for frequency division;
IN/M: Pulse input mode for frequency division;
“X” is for backup while “0” is a value to write.

The following table lists the Input Mode (IN/M) & Output Mode (OUT/M) setting and description:

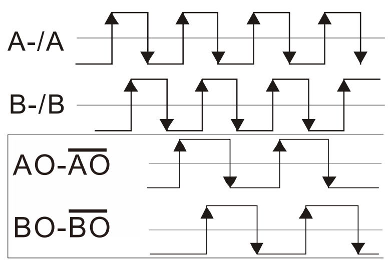
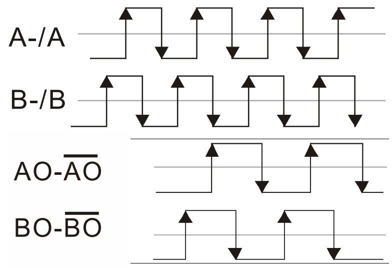
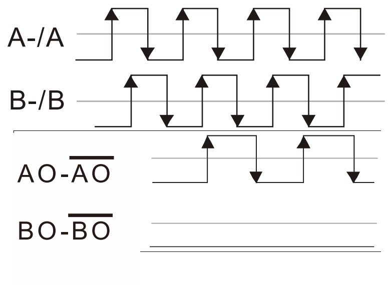
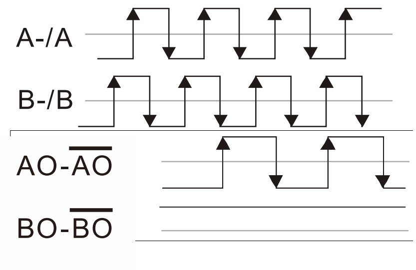
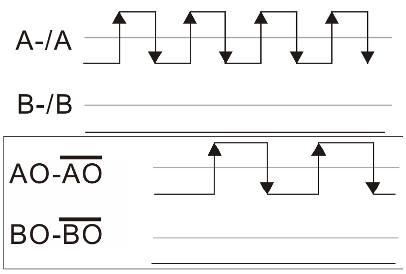
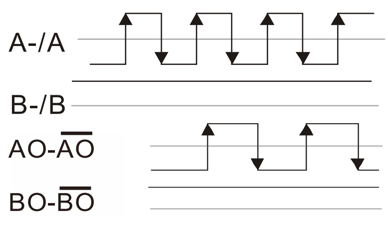
<table>
<tr><th rowspan="2">OUT/M</th><th rowspan="2">IN/M</th><th colspan="2">Division Factor</th></tr>
<tr><th>A is ahead of B</th><th>B is ahead of A</th></tr>
<tr><td>0</td><td>0</td><td></td><td></td></tr>
<tr><td>1</td><td>0</td><td></td><td></td></tr>
<tr><td>X</td><td>1</td><td></td><td></td></tr>
</table>

Table 7-1

NOTE:

- In the waveform, A-/A, B-/B are the PG card input signals; AO-$\overline{AO}$, BO-$\overline{BO}$ are the differential output frequency division signals. Use a differential probe to measure.
- In the waveform, A-/A, B-/B are the PG card input signals; AO-$\overline{AO}$, BO-$\overline{BO}$ are the differential output frequency division signals. Use a differential probe to measure.
- Division factor “n”: Set 15 to divide the input signal by 15.

- When **OUT/M, IN/M** set to 0 and 0, the PG card input signal A-/A, B-/B are square waves while AO-$\overline{AO}$, BO-$\overline{BO}$ are frequency division output.
- When **OUT/M, IN/M** are set to 1 and 0, the PG card input signal A-/A, B-/B are square waves while the BO-$\overline{BO}$ is the A and B phase indicator (for example, when BO-$\overline{BO}$ is LOW, it means A is ahead of B: when BO-$\overline{BO}$ is HIGH, it means B is ahead of A). AO-$\overline{AO}$ is frequency division output.
- When **OUT/M, IN/M** are set to X and 1, B-/B phase has to be the direction indication input signal (for example, when B-/B is LOW, it means A is ahead of B; when B-/B is HIGH, it means B is ahead of A). A-/A is a square wave input, BO-$\overline{BO}$ and B-/B phase are input into synchronous action; AO-$\overline{AO}$ is frequency division output.
- Take Pr.10-29 and Pr.10-30 as examples: When the frequency division value is 15, **OUT/M** =1, **IN/M** = 0. Set Pr.10-29 = 15 and Pr.10-30 = 0002h.

  Set Pr.10-29 =15

  Set Pr.10-30 =0002h

Bit3	Bit2	Bit1	Bit0
X	X	**1**	**0**

7-2-6 Wiring of Frequency Division Output

Push-pull Frequency Division (internal power supply)

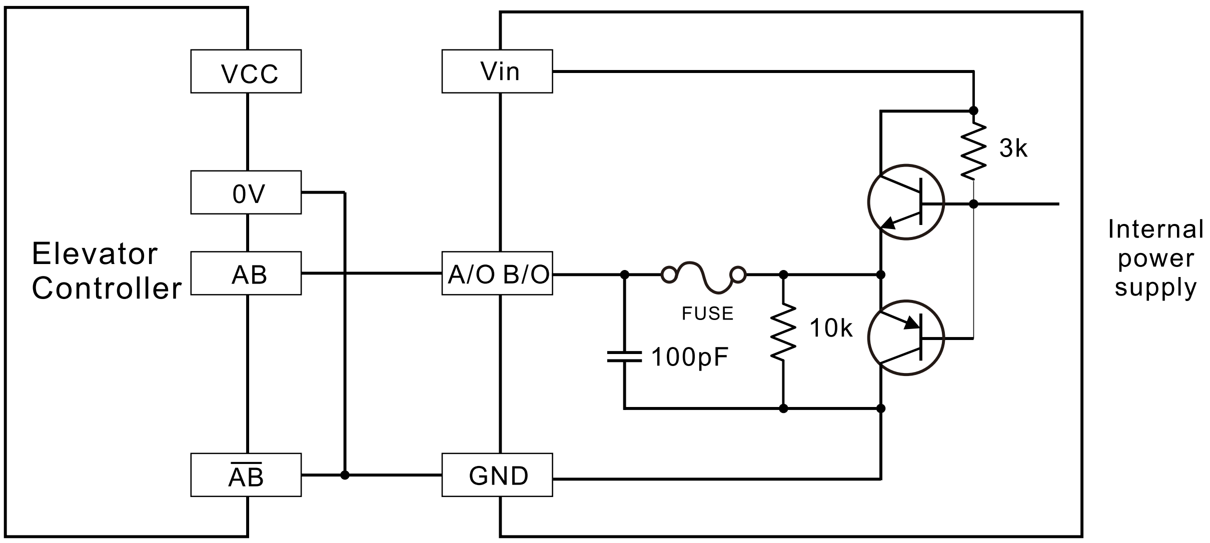


Figure 7-19

Push-pull Frequency Division (external power supply)

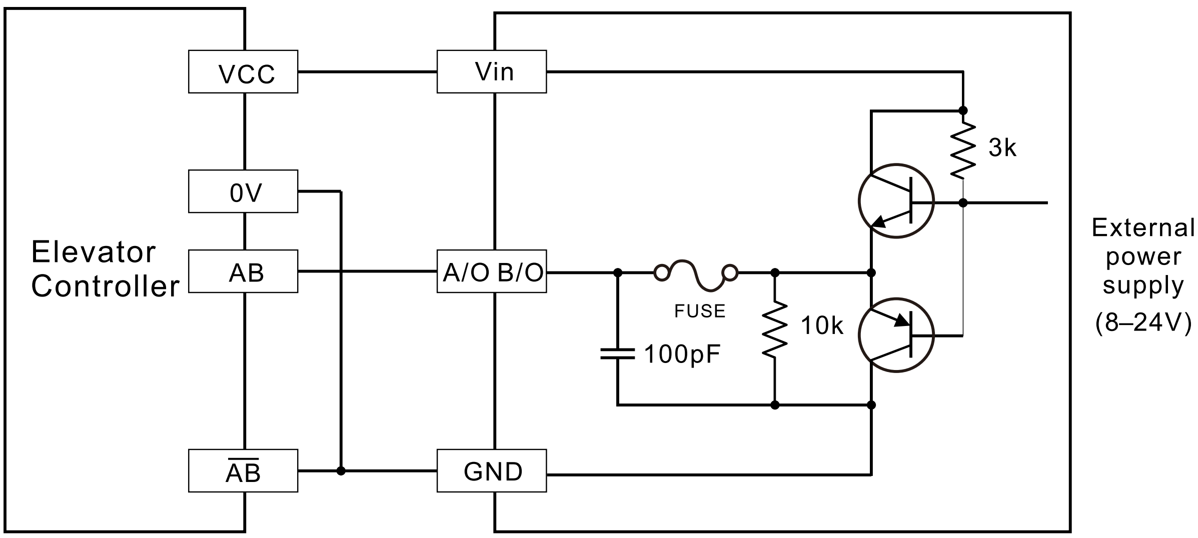


Figure 7-20

Line Driver Frequency Division (internal power supply)

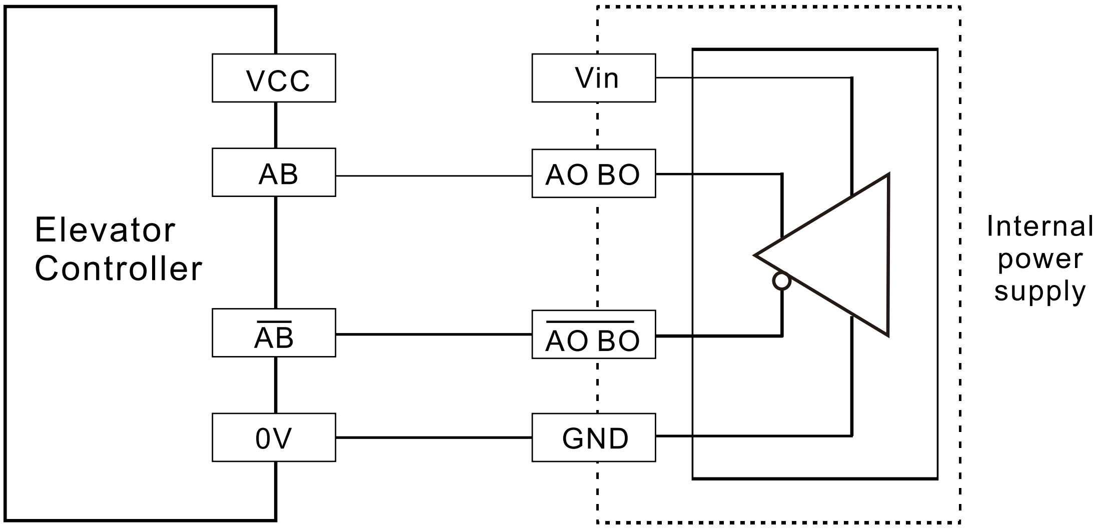


Figure 7-21

Line Driver Frequency Division (external power supply)

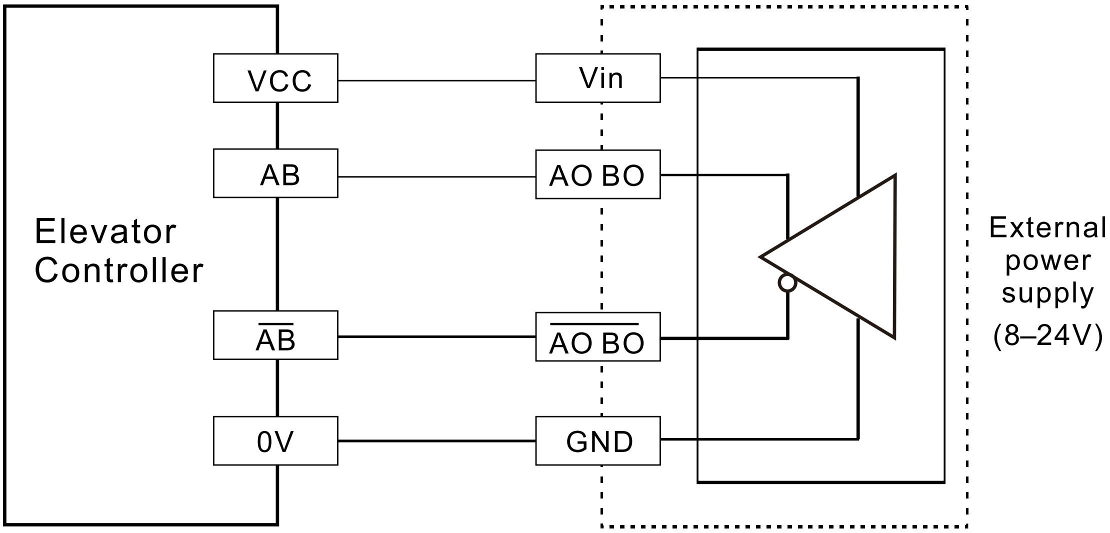
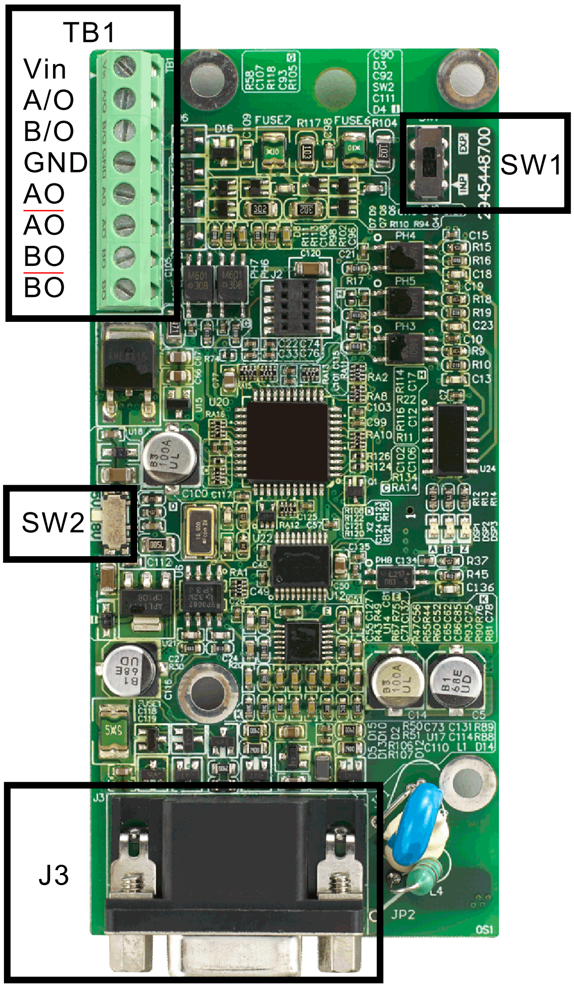


Figure 7-22

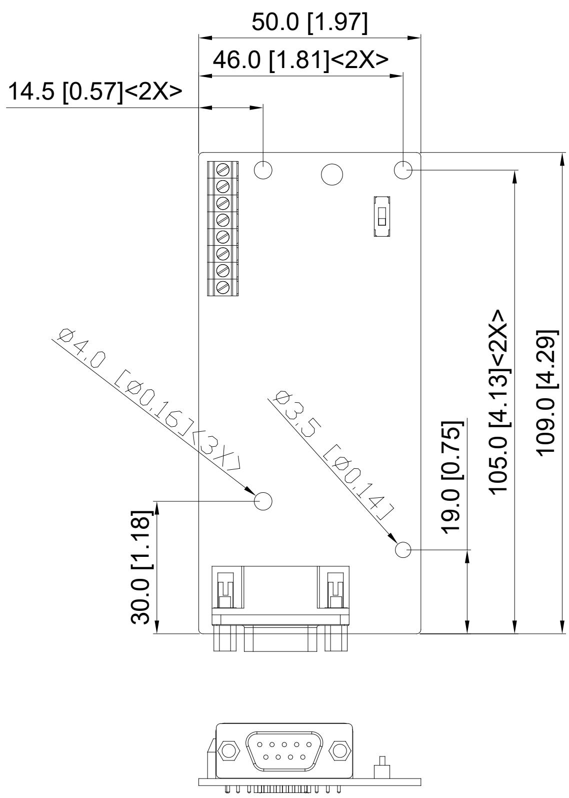
7-3 EMED-PGHSD-3

7-3-1 Product Profile



Dimension

Unit: mm [inch]



NOTE:

1. Applicable encoder:

   SIN/COS; Heidenhain ERN1387

   EnDat2.1/01: Heidenhain ECN413、ECN1313

   SICK HIPERFACE: SRS50/60

2. Screw specification:

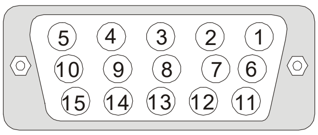
Wire Gauge	0.2–1.5 mm^2 (30–16 AWG)
Torque	1.6 kg-cm (1.4 lb-in.)

3. Supports Heidenhain ERN1387, EnDat2.1, HIPERFACE

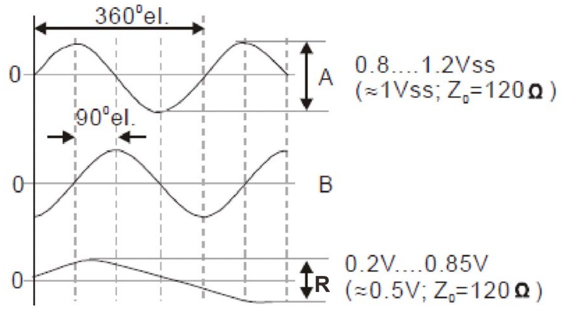
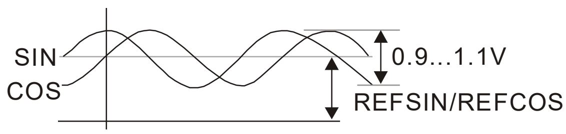
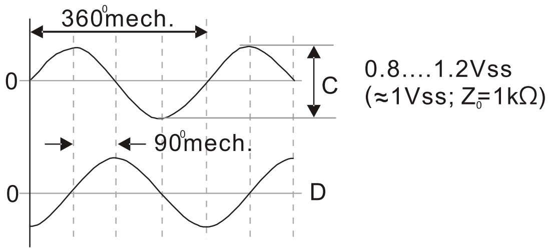
7-3-2 Terminal Function

Terminals		Descriptions
TB1	Vin	Voltage input: (to adjust the output voltage amplitude of the push-pull pulse) Max. input voltage: 24 V_{DC} Max. input current: 30 mA
	A/O, B/O	Push-pull pulse output signal Max. output frequency: 50 kHz
	GND	Common power input/signal output terminal
	AO, /AO, BO, /BO	Output signal for the line driver frequency division. Line driver RS422 Max. input frequency: 100 kHz
J3	(D-SUB female connector)	Encoder signal input terminal
SW1		Frequency division output power terminal selection INP: Power supplied by PG card EXP: Power from an external source
SW2		Encoder's voltage output terminal (Up) **NOTE:** Modify the terminal output voltage by switching the direction of the SW2 DIP switch on the PG card. 5V: 5 V_{DC} 8V: 8 V_{DC}

EMED-PGHSD-3 (Terminal J3) pin definitions depend on the encoder type

Terminal		Applicable Encoder		
J3	No.	Heidenhain ERN1387	Heidenhain ECN1313	HIPERFACE®
	①	B-	B-	REFSIN
	②	-	-	-
	③	R+	DATA	DATA+
	④	R-	/DATA	DATA-
	⑤	A+	A+	+COS
	⑥	A-	A-	REFCOS
	⑦	0V	0V	GND
	⑧	B+	B+	+SIN
	⑨	Up	Up	Up
	⑩	C-	-	-
	⑪	C+	-	-
	⑫	D+	-	-
	⑬	D-	-	-
	⑭	-	/CLOCK	-
	⑮	-	CLOCK	-

Terminal Function

Terminals		Descriptions	Specifications
J3	Up (VP)	The output voltage for the encoder. Use the SW2 DIP switch to change the output voltage to +5 V or +8 V.	Voltage: +5.1 V_{DC} ± 0.3 V; +8.4 V_{DC} ± 1.5 V Current: 200 mA max.
	0 V	Encoder common power terminal	Reference level for the encoder's power.
	A+, A-, B+, B-, R+, R-	Encoder sine wave differential signal input (incremental signal)	Input frequency: 40 kHz max. 
	+SIN, +COS, REFSIN, REFCOS	Encoder sine wave differential signal input (incremental signal)	Input frequency: 20 kHz max. 
	C+, C-, D+, D-	Encoder sine wave differential signal input (absolute signal)	
	DATA+(DATA), DATA-(/DATA)	RS-485 communication interface	Terminal resistance is about 130 Ω
	CLOCK+, CLOCK-	CLOCK differential output for ENDAT.	Line Driver RS422 level output

NOTE:

- Verify that the SW2 switch is set to the correct output voltage before powering on.
- Keep the motor drive wiring away from any high voltage lines to avoid interference.

7-3-3 Wiring Diagram

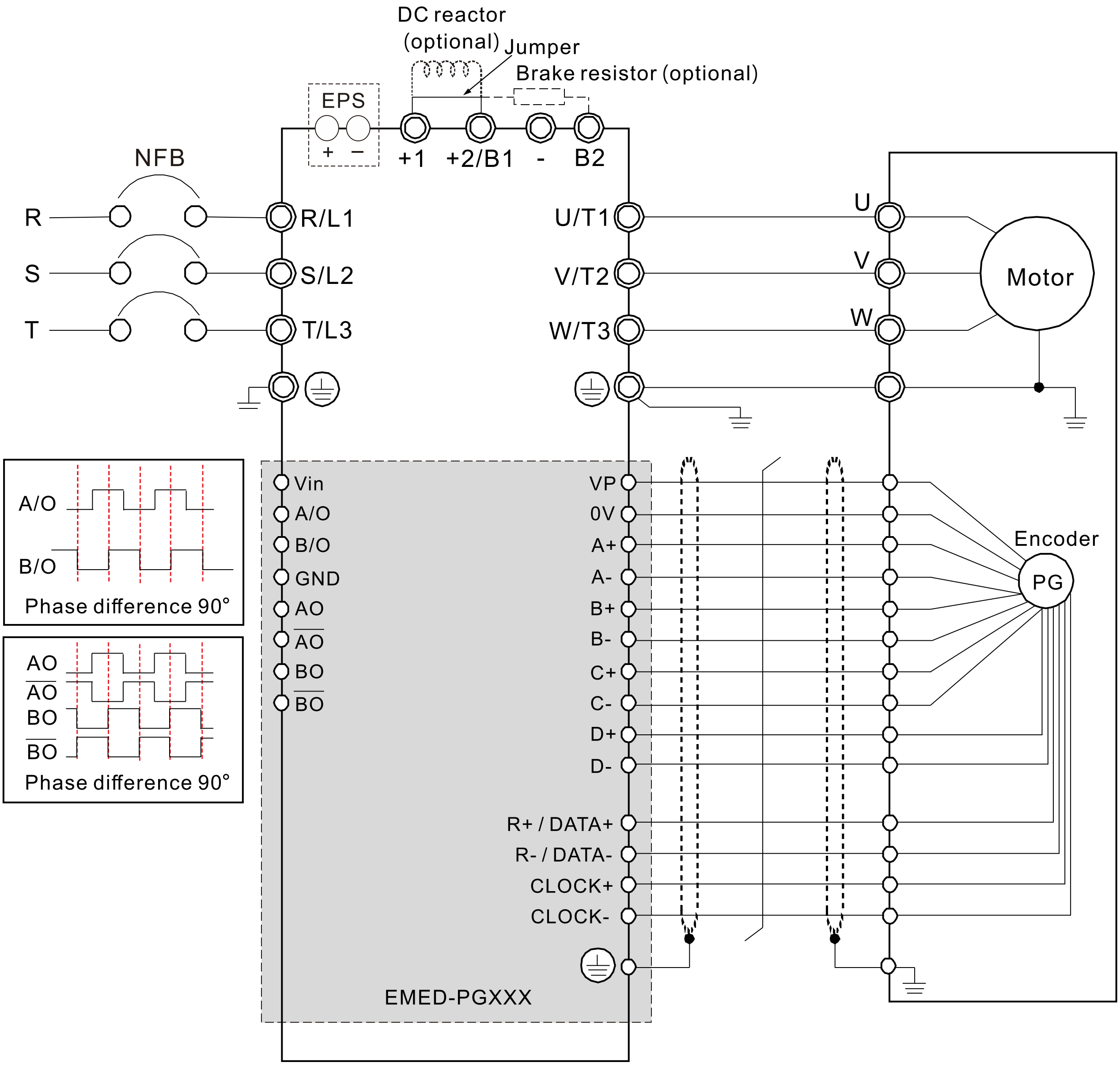


Figure 7-23

7-3-4 Frequency Division Signal Setting

1. After the encoder inputs a PULSE signal, there is an output signal by the division factor "n." Set the value in Pr.10-29 (PG card's frequency division output).
2. Set Pr.10-29 (PG card's frequency division output): The decimal frequency division output setting; range of the division factor "n": 1–31.
3. Pr.10-30 (PG card's frequency division output mode)

Bit3	Bit2	Bit1	Bit0
X	X	**OUT/M**	**IN/M**

OUT/M: Pulse output mode for frequency division;
IN/M: Pulse input mode for frequency division;
"X" is for backup while "0" is a value to write.

The following table lists the Input Mode (IN/M) & Output Mode (OUT/M) setting and description:

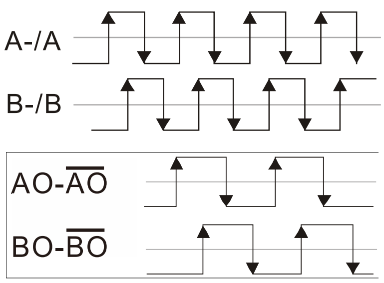
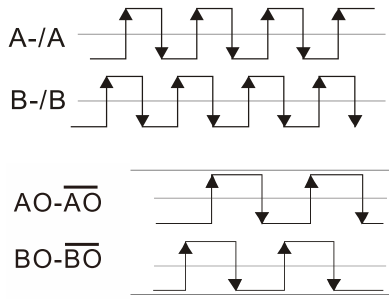
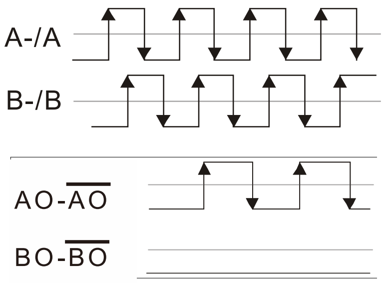
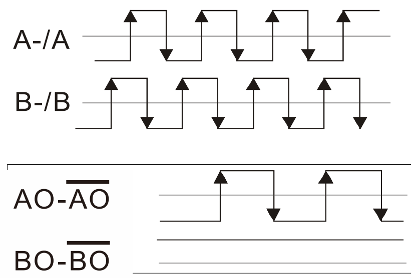
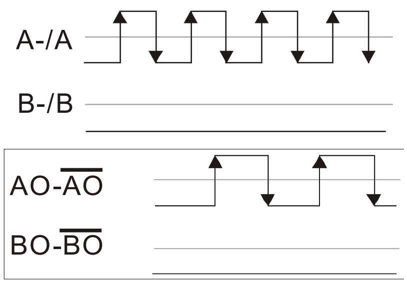
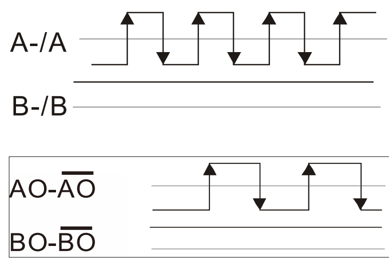
OUT/M	IN/M	Division Factor	
		A is ahead of B	B is ahead of A
0	0		
1	0		
X	1		

Table 7-2

NOTE:

- In the waveform, A-/A, B-/B are the PG card input signals; AO-$\overline{AO}$, BO-$\overline{BO}$ are the differential output frequency division signals. Use a differential probe to measure.
- Division factor "n": Set 15 to divide the input signal by 15.

- When **OUT/M, IN/M** set to 0 and 0, the PG card input signal A-/A, B-/B are square waves while AO-$\overline{\text{AO}}$, BO-$\overline{\text{BO}}$ are frequency division output.
- When **OUT/M, IN/M** are set to 1 and 0, the PG card input signal A-/A, B-/B are square waves while the BO-$\overline{\text{BO}}$ is the A and B phase indicator (for example, when BO-$\overline{\text{BO}}$ is LOW, it means A is ahead of B: when BO-$\overline{\text{BO}}$ is HIGH, it means B is ahead of A). AO-$\overline{\text{AO}}$ is frequency division output.
- When **OUT/M,** IN/**M** are set to X and 1, B-/B phase has to be the direction indication input signal (for example, when B-/B is LOW, it means A is ahead of B; when B-/B is HIGH, it means B is ahead of A). A-/A is a square wave input, BO-$\overline{\text{BO}}$ and B-/B phase are input into synchronous action; AO-$\overline{\text{AO}}$ is frequency division output.
- Take Pr.10-29 and Pr.10-30 as examples: When the frequency division value is 15, **OUT/M** =1, **IN/M** = 0. Set Pr.10-29 = 15 and Pr.10-30 = 0002h.

  Set Pr.10-29 =15

  Set Pr.10-30 =0002h

Bit3	Bit2	Bit1	Bit0
X	X	**1**	**0**

7-3-5 Wiring of Frequency Division Output

Push-pull Frequency Division (internal power supply)

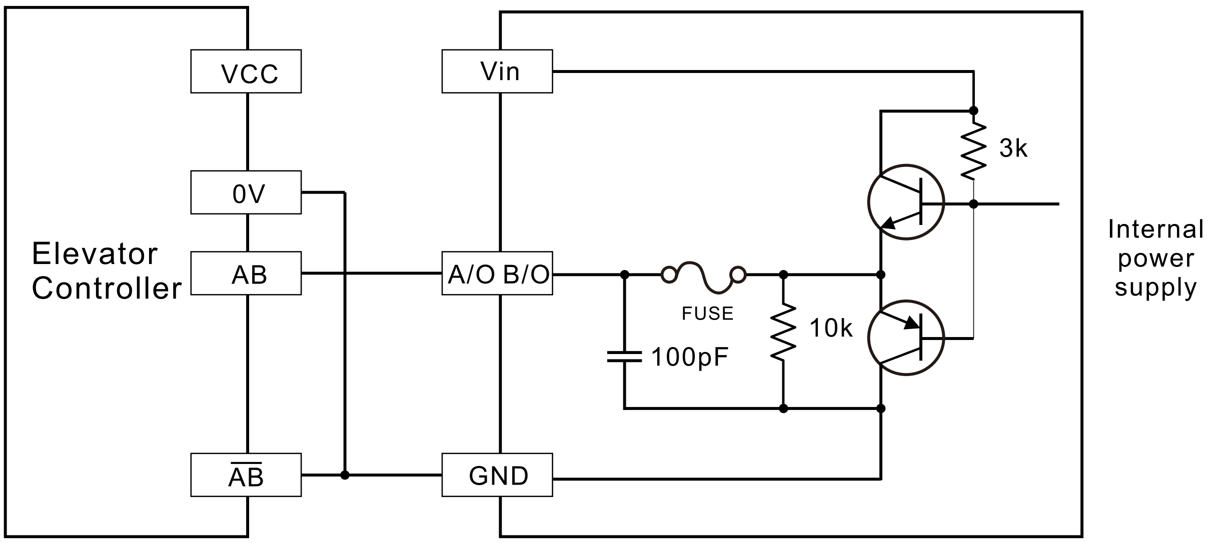


Figure 7-24

Push-pull Frequency Division (external power supply)

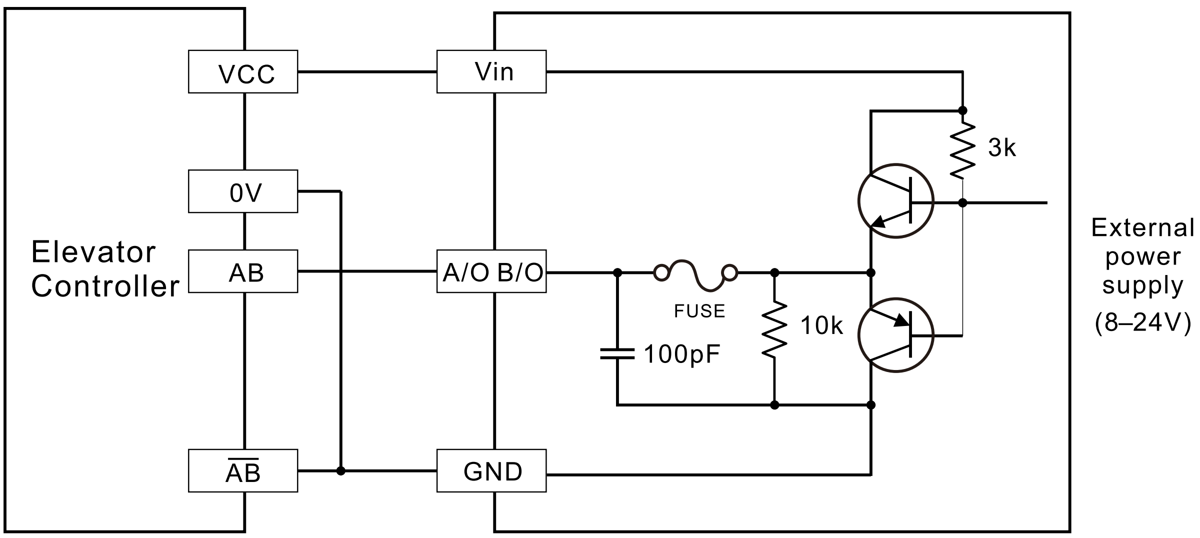


Figure 7-25

Line Driver Frequency Division (internal power supply)

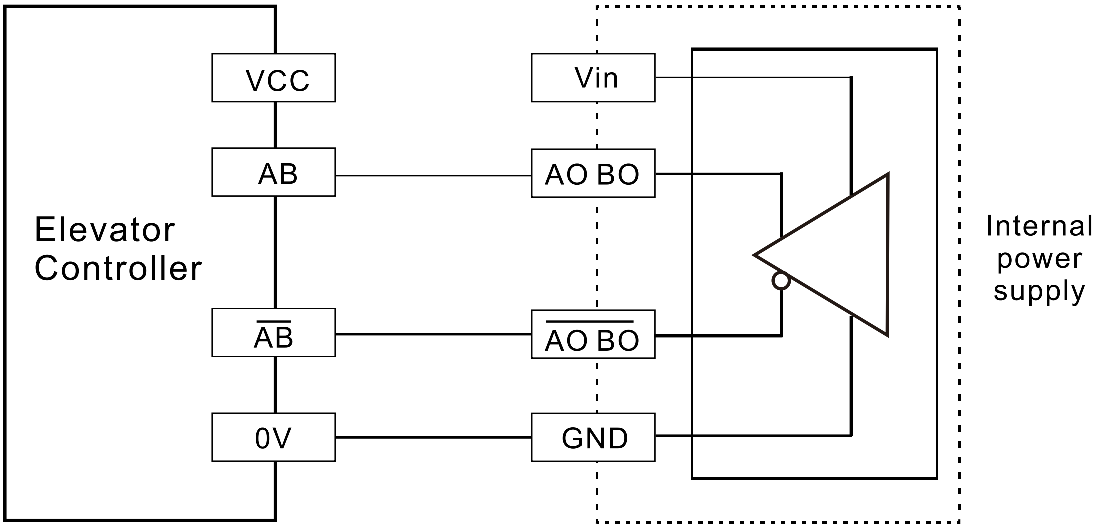


Figure 7-26

Line Driver Frequency Division (external power supply)

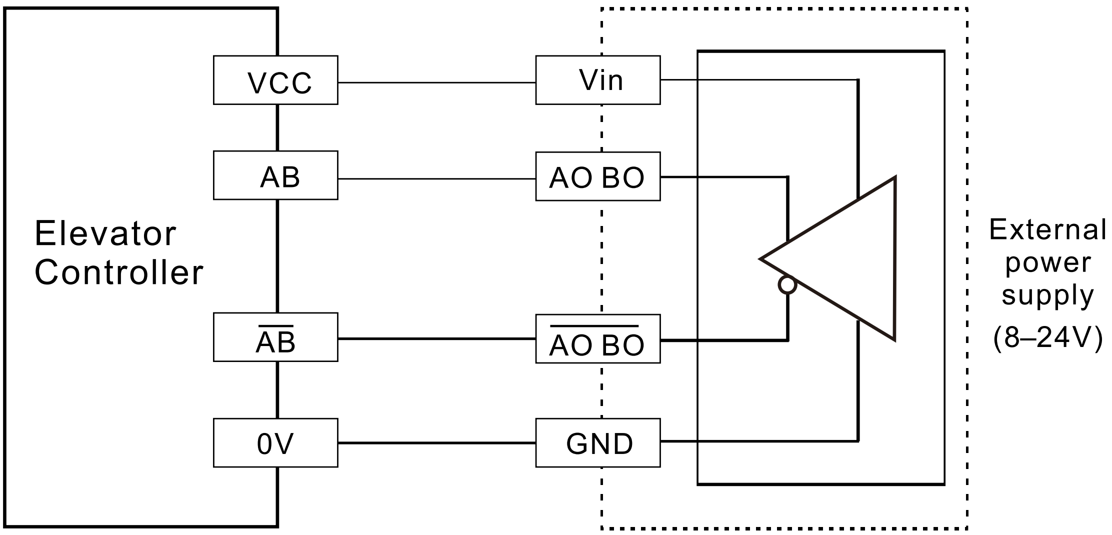
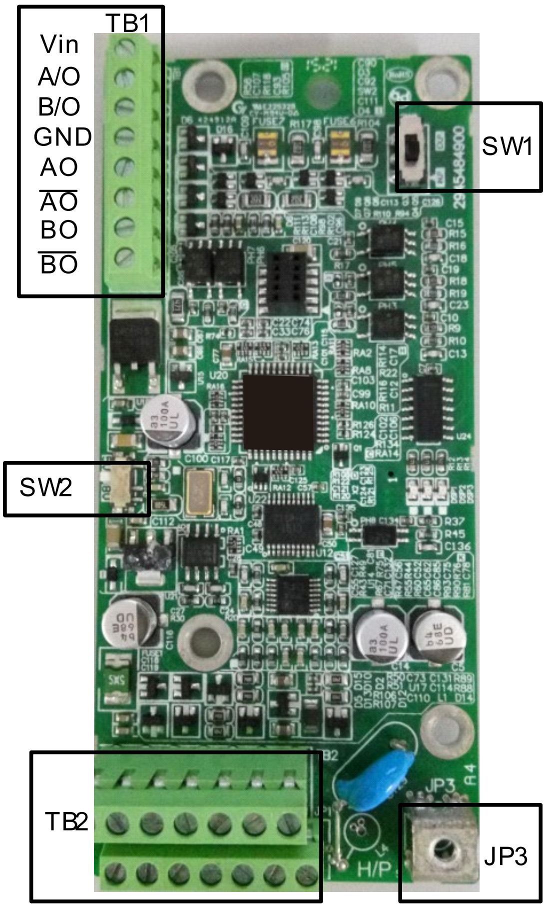


Figure 7-27

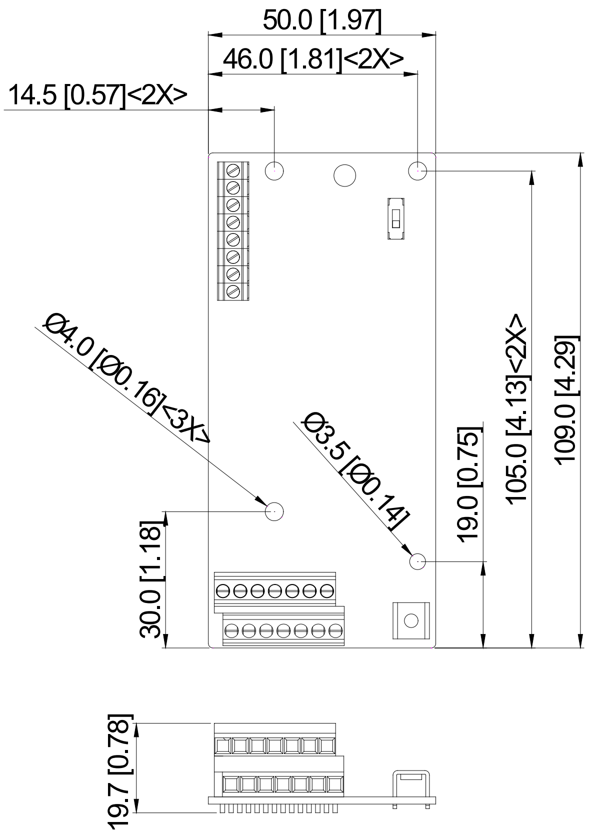
7-4 EMED-PGHSD-4

7-4-1 Product Profile



Dimension

Unit: mm [inch]



NOTE:

1. Applicable encoder:

   SIN/COS: Heidenhain ERN1387

   EnDat2.1/01: Heidenhain ECN413、ECN1313

   SICK HIPERFACE: SRS50/60

2. Screw specification:

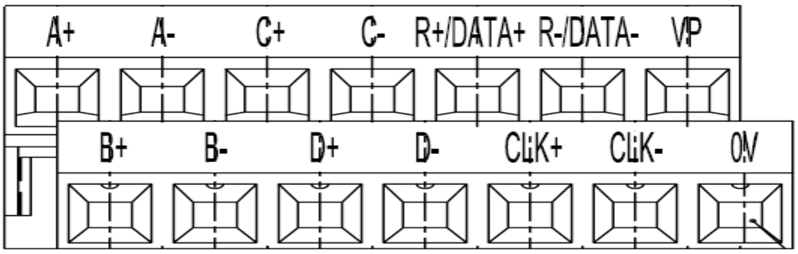
Wire Gauge	0.2–1.5 mm^2 (30–16 AWG)
Torque	1.6 kg-cm (1.4 Ib-in.)

3. Supports Heidenhain ERN1387, EnDat2.1, HIPERFACE

7-4-2 Terminal Function

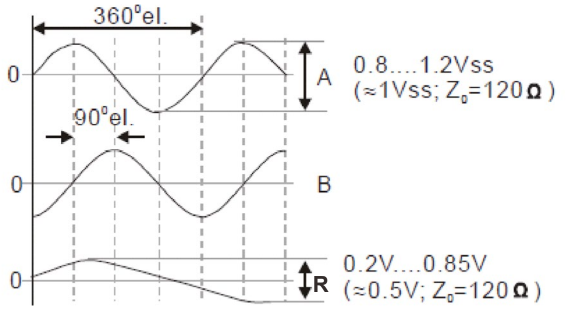
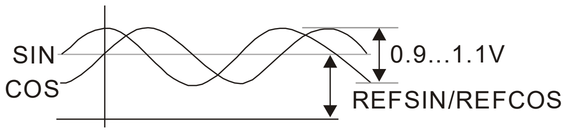
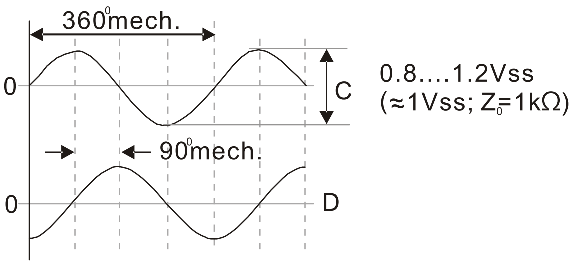
Terminals		Descriptions
TB1	Vin	Voltage input: (to adjust the output voltage amplitude of the push-pull pulse) Max. input voltage: 24 V_{DC} Max. input current: 30 mA
	A/O, B/O	Push-pull pulse output signal Max. output frequency: 50 kHz
	GND	Common power input/signal output terminal
	AO, /AO, BO, /BO	Output signal for the line driver frequency division. Line driver RS422 Max. input frequency: 100 kHz
TB2		Encoder signal input terminal
JP3	⏚	Ground Terminal Connect the motor drive power supply to ground. Supports PG shielding.
SW1		Frequency division output power terminal selection INP: Power supplied by PG card EXP: Power from an external source
SW2		Encoder's voltage output terminal (Up) **NOTE:** Modify the terminal output voltage by switching the direction of the SW2 DIP switch on the PG card. 5V: 5 V_{DC} 8V: 8 V_{DC}

EMED-PGHSD-4 (Terminal TB2) pin definitions depend on the encoder type



Terminals	Heidenhain ERN1387		Heidenhain ECN1313	HIPERFACE®
A+	A+		A+	+COS
A-	A-		A-	REFCOS
C+	C+	Must set Pr.10-31=1	-	-
C-	C-		-	-
R+/DATA+	R+		DATA	DATA+
R-/DATA-	R-		/DATA	DATA-
VP	Up		Up	Up
B+	B+		B+	+SIN
B-	B-		B-	REFSIN
D+	D+		-	-
D-	D-		-	-
CLK+	-		CLOCK	-
CLK-	-		/CLOCK	-
0V	0V		0V	GND

Terminal Function

<table>
<tr><th colspan="2">Terminals</th><th>Descriptions</th><th>Specifications</th></tr>
<tr><td rowspan="7">TB2</td><td>Up (VP)</td><td>The output voltage for the encoder. Use the SW2 DIP switch to change the output voltage to +5 V or +8 V.</td><td>Voltage: +5.1 V_{DC} ± 0.3 V; +8.4 V_{DC} ± 1.5 V
Current: 200 mA max.</td></tr>
<tr><td>0 V</td><td>Encoder common power terminal</td><td>Reference level for the encoder’s power.</td></tr>
<tr><td>A+, A-, B+, B-, R+, R-</td><td>Encoder sine wave differential signal input (incremental signal)</td><td>Input frequency: 40 kHz max.

</td></tr>
<tr><td>+SIN, +COS, REFSIN, REFCOS</td><td>Encoder sine wave differential signal input (incremental signal)</td><td>Input frequency: 20 kHz max.

</td></tr>
<tr><td>C+, C-, D+, D-</td><td>Encoder sine wave differential signal input (absolute signal)</td><td>
</td></tr>
<tr><td>DATA+(DATA), DATA-(/DATA)</td><td>RS-485 communication interface</td><td>Terminal resistance is about 130 Ω.</td></tr>
<tr><td>CLOCK+, CLOCK-</td><td>CLOCK differential output for ENDAT</td><td>Line driver RS422 level output</td></tr>
</table>

NOTE:

- Verify that the SW2 switch is set to the correct output voltage before powering on.
- Keep the motor drive wiring away from any high voltage lines to avoid interference.

7-4-3 Wiring Diagram

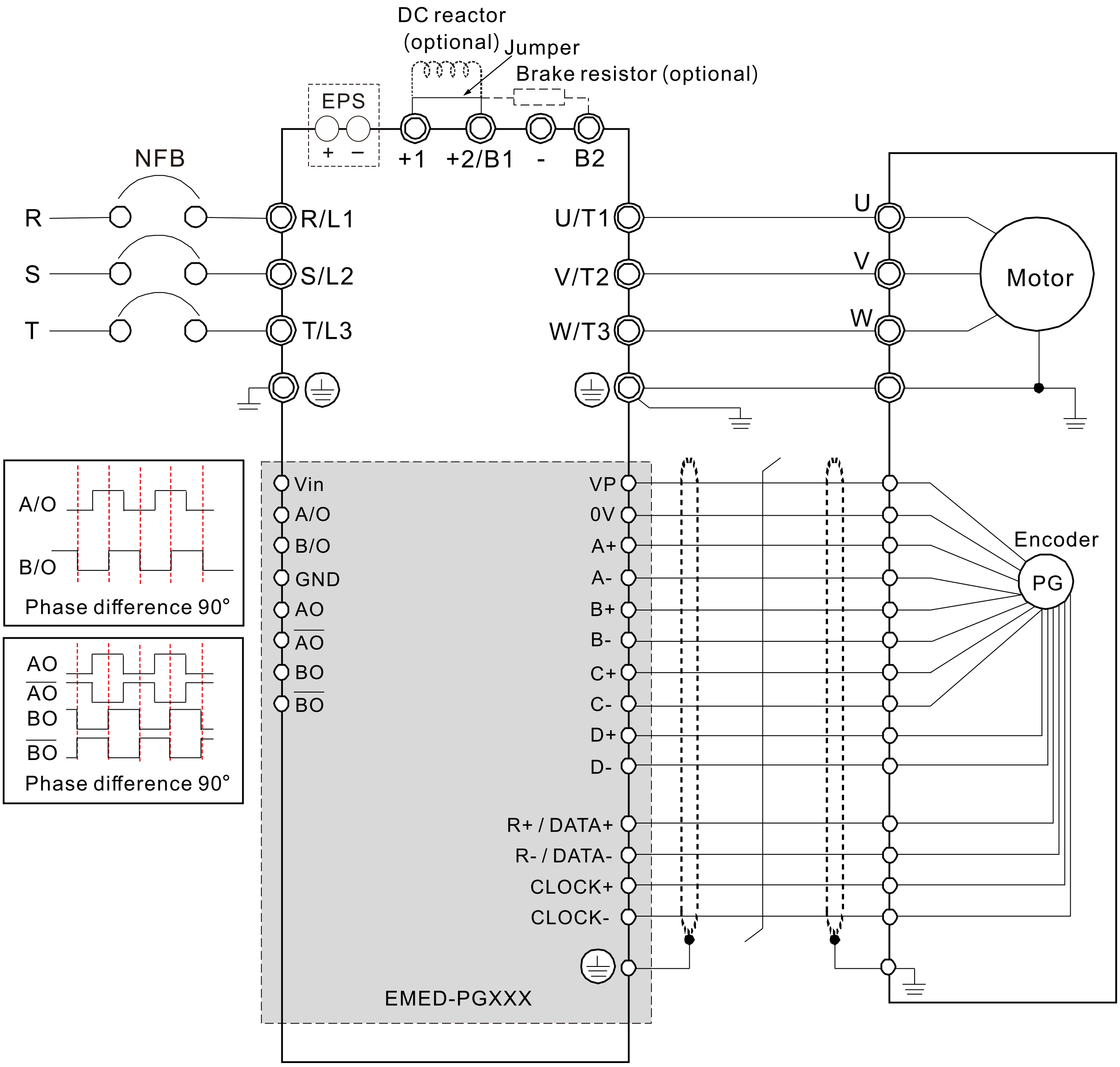


Figure 7-28

7-4-4 Frequency Division Signal Setting

1. After the encoder inputs a PULSE signal, there is an output signal by the division factor "n." Set the value in Pr.10-29 (PG card's frequency division output).
2. Set Pr.10-29 (PG card's frequency division output): The decimal frequency division output setting; range of the division factor "n": 1–31.
3. Pr.10-30 (PG card's frequency division output mode)

Bit3	Bit2	Bit1	Bit0
X	X	**OUT/M**	**IN/M**

OUT/M: Pulse output mode for frequency division;
IN/M: Pulse input mode for frequency division;
"X" is for backup while "0" is a value to write.

The following table lists the Input Mode (IN/M) & Output Mode (OUT/M) setting and description:

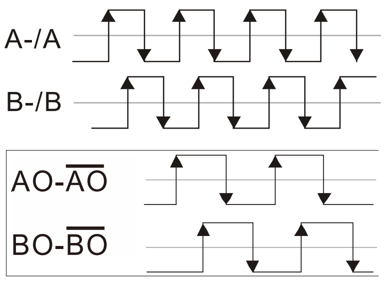
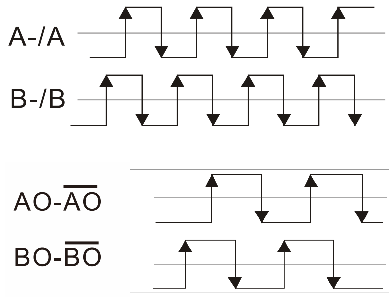
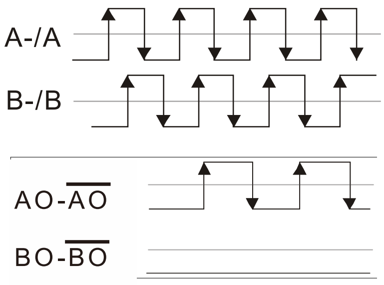
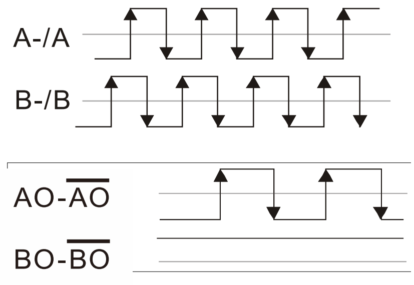
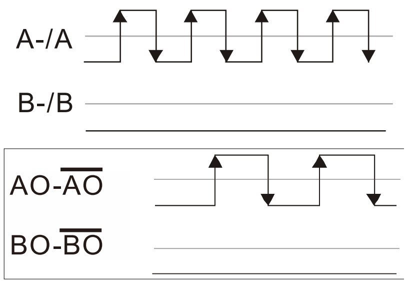
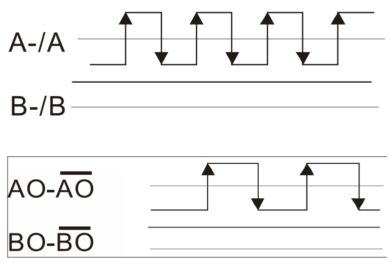
<table>
<tr><th rowspan="2">OUT/M</th><th rowspan="2">IN/M</th><th colspan="2">Division Factor</th></tr>
<tr><th>A is ahead of B</th><th>B is ahead of A</th></tr>
<tr><td>0</td><td>0</td><td>
</td><td>
</td></tr>
<tr><td>1</td><td>0</td><td>
</td><td>
</td></tr>
<tr><td>X</td><td>1</td><td>
</td><td>
</td></tr>
</table>

Table 7-3

NOTE:

- In the waveform, A-/A, B-/B are the PG card input signals; AO-$\overline{AO}$, BO-$\overline{BO}$ are the differential output frequency division signals. Use a differential probe to measure.
- Division factor "n": Set 15 to divide the input signal by 15.

- When **OUT/M, IN/M** set to 0 and 0, the PG card input signal A-/A, B-/B are square waves while AO-$\overline{AO}$, BO-$\overline{BO}$ are frequency division output.
- When **OUT/M, IN/M** are set to 1 and 0, the PG card input signal A-/A, B-/B are square waves while the BO-$\overline{BO}$ is the A and B phase indicator (for example, when BO-$\overline{BO}$ is LOW, it means A is ahead of B: when BO-$\overline{BO}$ is HIGH, it means B is ahead of A). AO-$\overline{AO}$ is frequency division output.
- When **OUT/M, IN/M** are set to X and 1, B-/B phase has to be the direction indication input signal (for example, when B-/B is LOW, it means A is ahead of B; when B-/B is HIGH, it means B is ahead of A). A-/A is a square wave input, BO-$\overline{BO}$ and B-/B phase are input into synchronous action; AO-$\overline{AO}$ is frequency division output.
- Take Pr.10-29 and Pr.10-30 as examples: When the frequency division value is 15, **OUT/M** =1, **IN/M** = 0. Set Pr.10-29 = 15 and Pr.10-30 = 0002h.

  Set Pr.10-29 =15

  Set Pr.10-30 =0002h

Bit3	Bit2	Bit1	Bit0
X	X	**1**	**0**

7-4-5 Wiring of Frequency Division Output

Push-pull Frequency Division (internal power supply)

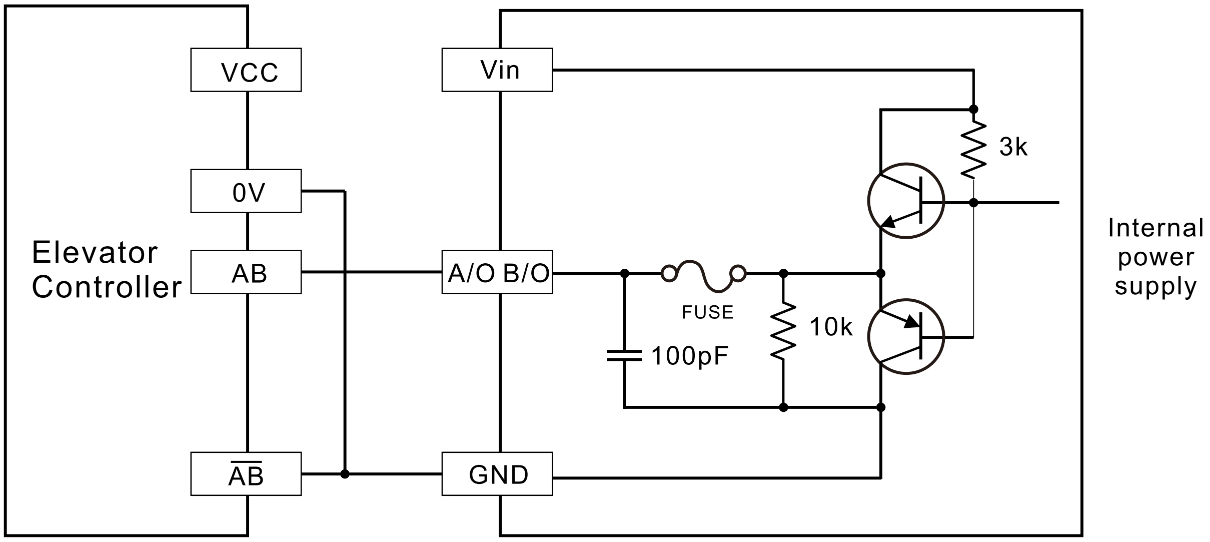


Figure 7-29

Push-pull Frequency Division (external power supply)

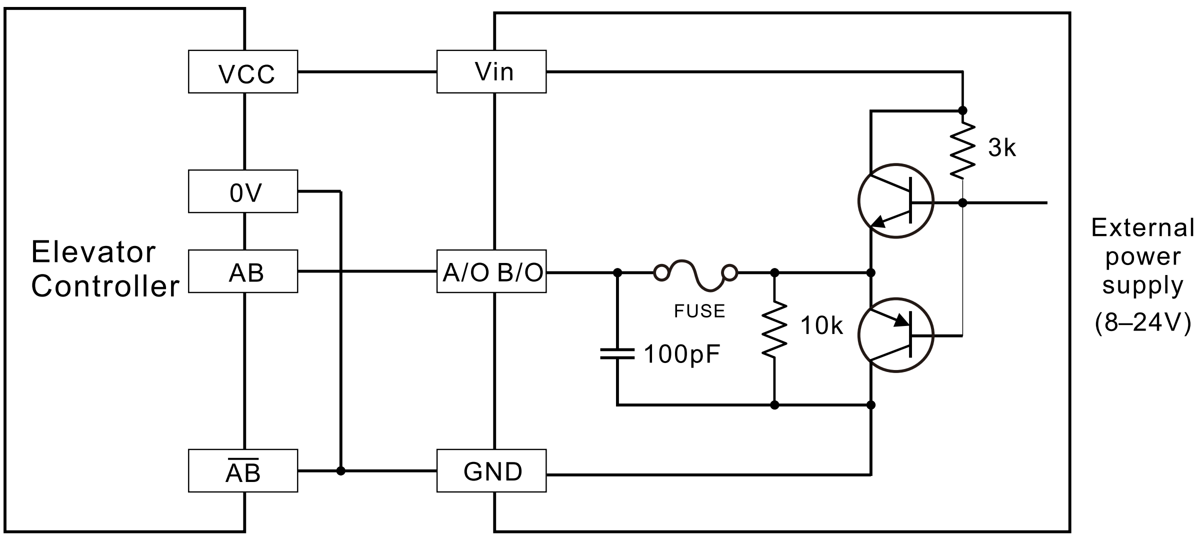


Figure 7-30

Line Driver Frequency Division (internal power supply)

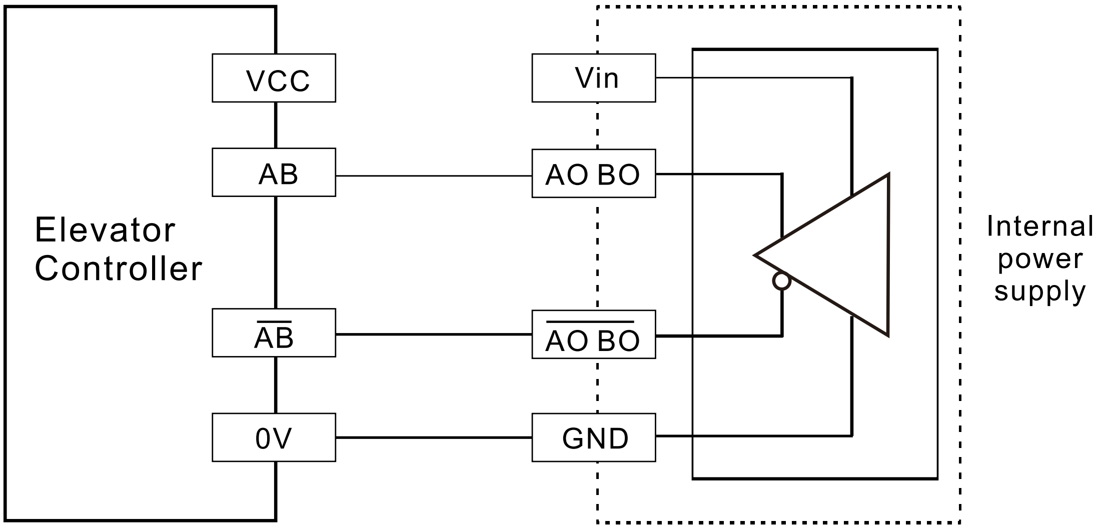


Figure 7-31

Line Driver Frequency Division (external power supply)

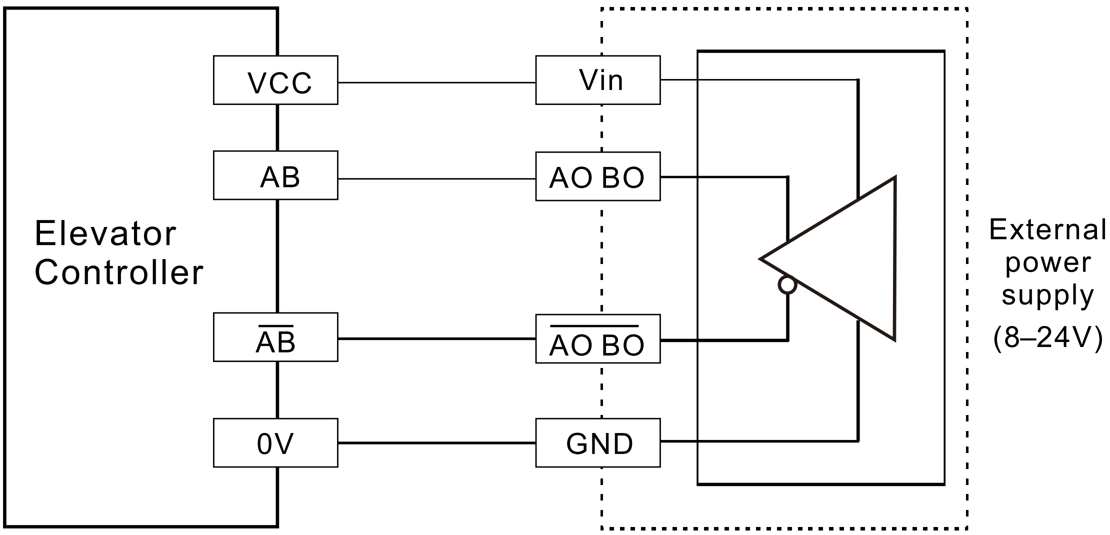


Figure 7-32

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Chapter 8 Specifications

8-1 230V Models

Frame Size		B			C			D			E	
Model VFD-_ _ _ED23/21S		022*	037*	040	055	075	110	150	185	220	300	370
Applicable Motor Output (kW)		2.2	3.7	4	5.5	7.5	11	15	18.5	22	30	37
Applicable Motor Output (HP)		3	5	5	7.5	10	15	20	25	30	40	50
Output Rating	Rated Output Capacity (kVA)	4.8	6.8	7.9	9.5	12.5	19	25	29	34	46	55
	Rated Output Current (A)	12	17	20	24	30	45	58	77	87	132	161
	Maximum Output Voltage (V)	Proportional to input voltage										
	Output Frequency Range (Hz)	0.00–299										
	Carrier Frequency Range (kHz)	2–15									2–9	
	Rated Output Maximum Carrier Frequency	8 kHz			10 kHz			8 kHz			6 kHz	
Input Rating	Input Current (A)	24	34	20	23	30	47	56	73	90	132	161
	Rated Voltage (V)	Single-phase		Three-phase								
		200–240										
	Rated Frequency (Hz)	50/60										
	Voltage Tolerance (V)	180–264										
	Frequency Tolerance (Hz)	47–63										
Cooling Method		Fan cooling										
Weight (kg)		6	6	6	8	10	10	13	13	13	36	36

NOTE: *VFD022ED21S & VFD037ED21S are single-phase input models.

Table 8-1

8-2 460V Models

Frame Size		B	C					D		E			
Model VFD-_ _ _ED43S		040	055	075	110	150	185	220	300	370	450	550	750
Applicable Motor Output (kW)		4	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Applicable Motor Output (HP)		5	7.5	10	15	20	25	30	40	50	60	75	100
Output Rating	Rated Output Capacity (kVA)	9.2	10.4	13.5	18.3	24	30.3	36	46.2	63.7	80	96.4	116.3
	Rated Output Current (A)	11.5	13	17	23	30	38	45	58	80	100	128	165
	Maximum Output Voltage (V)	Proportional to input voltage											
	Output Frequency Range (Hz)	0.00–299											
	Carrier Frequency Range (kHz)	2–15							2–9			2–6	
	Rated Output Maximum Carrier Frequency	8 kHz	10 kHz			8 kHz			6 kHz				
Input Rating	Input Current (A)	11.5	14	17	24	30	37	47	58	80	100	128	165
	Rated Voltage (V)	Three-phase 380–480											
	Rated Frequency (Hz)	50/60											
	Voltage Tolerance (V)	342–528											
	Frequency Tolerance (Hz)	47–63											
Cooling Method		Fan cooling											
Weight (kg)		6	8	10	10	10	10	13	14.5	36	36	50	50

NOTE: *Assumes operation at the rated output current. Input current rating varies depending on the input reactor, transformer, wiring connections and power supply impedance.

Table 8- 2

8-3 General Specifications

Item		Specifications
Control Characteristics	Control Method	V/F, VF+PG, SVC, FOC+PG, FOC+PM
	Starting Torque	In V/F mode: 150% at 0.5 Hz. In FOC+PG or FOC+PM mode: 150% at 0 Hz.
	Speed Control Range	1:50 (up to 1:1000 when using PG card)
	Speed Control Accuracy	±0.5% (up to ±0.02% when using PG card)
	Speed Response Ability	5 Hz (Up to 30 Hz for vector control)
	Max. Output Frequency	0.00–299.00 Hz
	Output Frequency Accuracy	Digital command 0.005%; analog command 0.5%.
	Frequency Setting Resolution	Digital command: 0.01 Hz; analog command: 1/4096 (12 bit) of the maximum output frequency.
	Torque Limit	Max. is 200% of the torque current
	Torque Accuracy	±5%
	Accel. / Decel. Time	0.00–600.00 seconds
	V/F Curve	Adjustable V/F curve using four independent points.
	Frequency Setting Signal	±10 V
	Brake Torque	About 125% while ED is 30% (use optional brake resistor) Note: ED is "Executive Duty"
Protection Characteristics	Motor Protection	Electronic thermal relay protection
	Over-current Protection	The current is limited by 190% of the drive's rated current and the limit for over-current protection is 250% of the drive's rated current.
	Ground Leakage Current Protection	More than 50% of the drive's rated current
	Overload Ability	Constant torque: 150% for 60 seconds; variable torque: 180% for 10 seconds.
	Voltage Protection	Over-voltage level: [230V models] V_{DC} > 400 V [460V models] V_{DC} > 800 V Low-voltage level: [230V models] V_{DC} < 200 V [460V models] V_{DC} < 400 V
	Over-voltage Protection for the Input Power	Varistor (MOV)
	Overheating Protection	Built-in temperature sensor
Certifications	EMC Directive	EN IEC 61800-3:2018
	Production Compliance	EN 61800-5-1:2007 + A1:2017 + A11:2021
	Production Certifications *1	CE, UL, EAC, RCM, KC, RoHS
	Safety Certification *1	TUV (STO SIL2)

Table 8-3

NOTE:

*1: For information on Certifications and Declaration of Conformity (Doc), visit Delta | Download Center (deltaww.com)

8-4 Operation, Storage and Transportation Environments

<table>
<tr><td colspan="5">DO NOT expose the AC motor drive to a poor environment, such as one with dust, direct sunlight, corrosive or inflammable gases, humidity, liquids or excessive vibration. The salt in the air must be less than 0.01 mg/cm^2 every year.</td></tr>
<tr><td rowspan="12">Environment</td><td>Installation Location</td><td colspan="3">IEC60364-1/IEC60664-1 pollution degree 2. Indoor use only.</td></tr>
<tr><td rowspan="6">Surrounding Temperature</td><td rowspan="4">Operation</td><td colspan="2">Between -10–40°C, up to 50°C with derating for the operation temperature.</td></tr>
<tr><td rowspan="3">Between 40–50°C with Derating</td><td>2.2–4 kW: for every 1°C increase in temperature, decrease the drive's rated current by 2.2%</td></tr>
<tr><td>5.5–30 kW: for every 1°C increase in temperature, decrease the drive's rated current by 2.5%</td></tr>
<tr><td>37–75 kW: for every 1°C increase in temperature, decrease the drive's rated current by 2.0%</td></tr>
<tr><td>Storage/ Transportation</td><td colspan="2">-20–60ºC</td></tr>
<tr><td colspan="3">Non-condensing, non-freezing.</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. 90%</td></tr>
<tr><td colspan="3">No water condensation</td></tr>
<tr><td>Altitude</td><td>Operation</td><td colspan="2">If the AC motor drive is installed at an altitude of 0–1000 m, follow normal operation restrictions. For altitudes of 1000–3000 m, decrease the drive's rated current by 1% or lower the temperature by 0.5°C for every 100 m increase in altitude. The maximum altitude for corner grounding is 3000 m. If installing at an altitude higher than 3000 m is required, contact Delta for more information.</td></tr>
<tr><td>Power System</td><td colspan="3">TN system[*1*2]</td></tr>
<tr><td rowspan="2">Package Drop</td><td>Storage</td><td colspan="3" rowspan="2">ISTA procedure 1A (according to weight) IEC60068-2-31</td></tr>
<tr><td>Transportation</td></tr>
<tr><td>Vibration</td><td colspan="4">● 1.0 mm, peak to peak value range from 2–13.2 Hz;
● 0.7–1.0 G range from 13.2–55 Hz;
● 1.0 G range from 55–512 Hz.
Compliance with IEC 60068-2-27.</td></tr>
<tr><td>Impact</td><td colspan="4">Compliance with IEC/EN 60068-2-27</td></tr>
<tr><td>Protection Level</td><td colspan="4">NEMA 1/IP20</td></tr>
<tr><td>EMC Level</td><td colspan="4">IEC 61800-3 and IEC 61000-4</td></tr>
</table>

NOTE:

Table 8-4

*[1]: TN system: The neutral point of the power system connects directly to the ground. The exposed metal components connect to the ground through the protective grounding conductor.

*[2]: Single-phase models use a single-phase three-wire power system.

8-5 Derating Curve

- To choose the right model for your applications, consider derating factors such as ambient temperature, altitude, carrier frequency, and so on.

Ambient Temperature Derating Curve

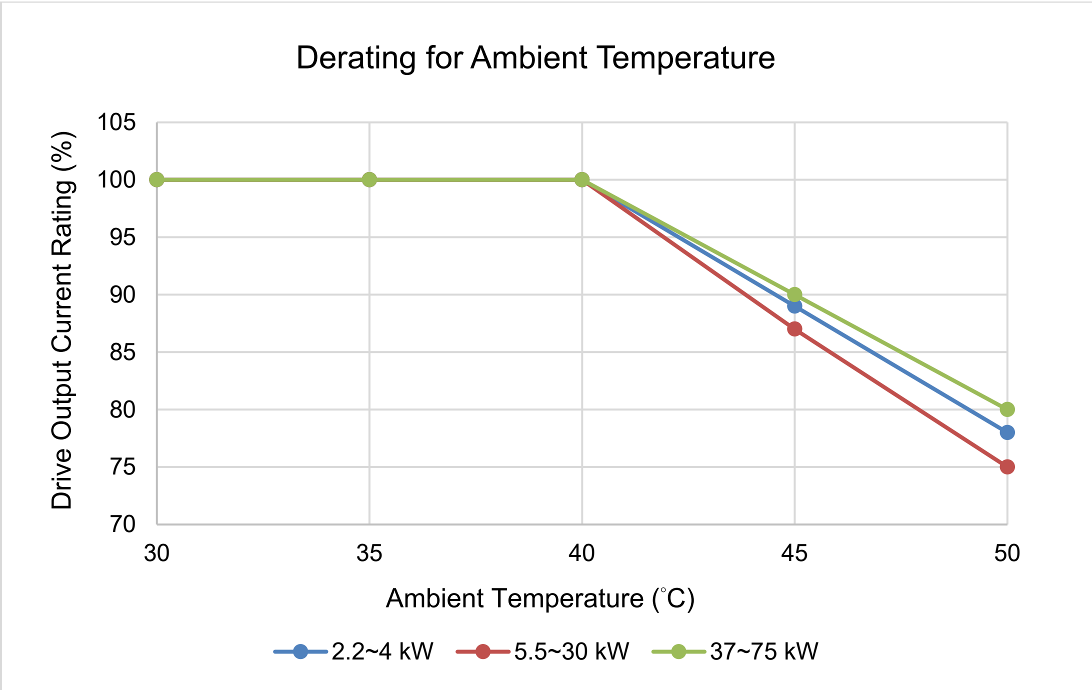

Figure 8-1

The rated output current derating (%) for different ambient temperature:

Model \ Ambient Temp.(°C)	30	35	40	45	50
2.2~4 kW	100	100	100	89	78
5.5~30 kW	100	100	100	87	75
37~75 kW	100	100	100	90	80

Table 8-5

Altitude Derating Curve

Condition	Operating Environment
High Altitude	If the AC motor drive is installed at an altitude of 0–1000 m, follow normal operation restrictions. For altitudes of 1000–3000 m, decrease the drive's rated current by 1% or lower the temperature by 0.5°C for every 100 m increase in altitude. The maximum altitude for corner grounding is 3000 m. If installing at an altitude higher than 3000 m is required, contact Delta for more information.

Table 8-6

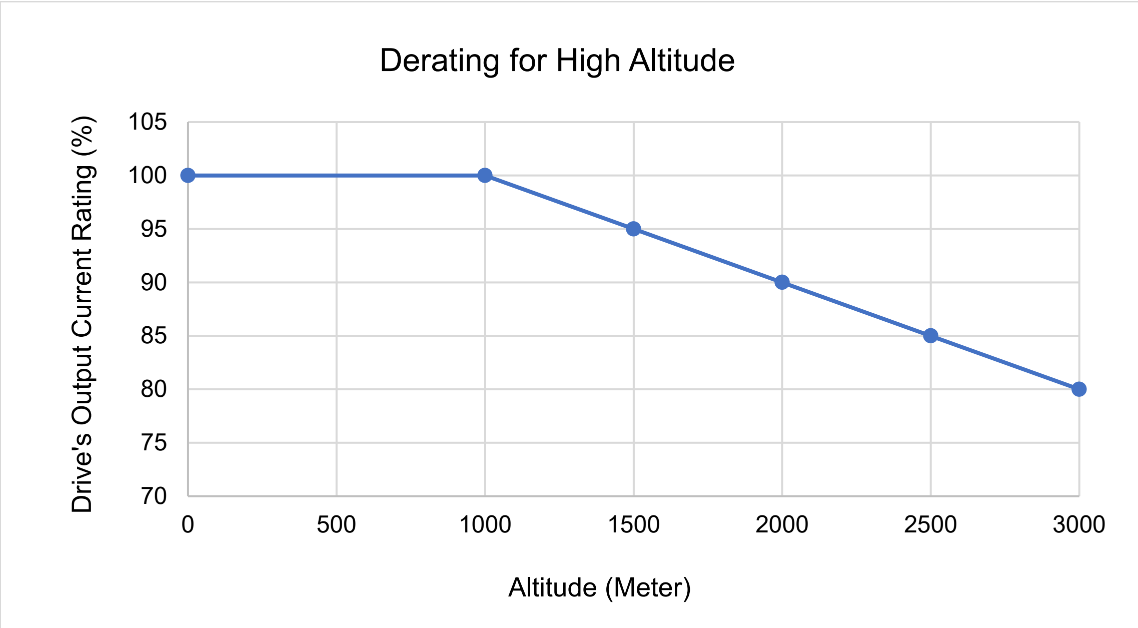

Figure 8-2

The rated output current derating (%) for different altitudes above sea level:

Altitude above Sea Level (Meter)	0	1000	1500	2000	2500	3000
Output Current / Rated Current (%)	100	100	95	90	85	80

Table 8-7

Carrier Frequency Derating Curve

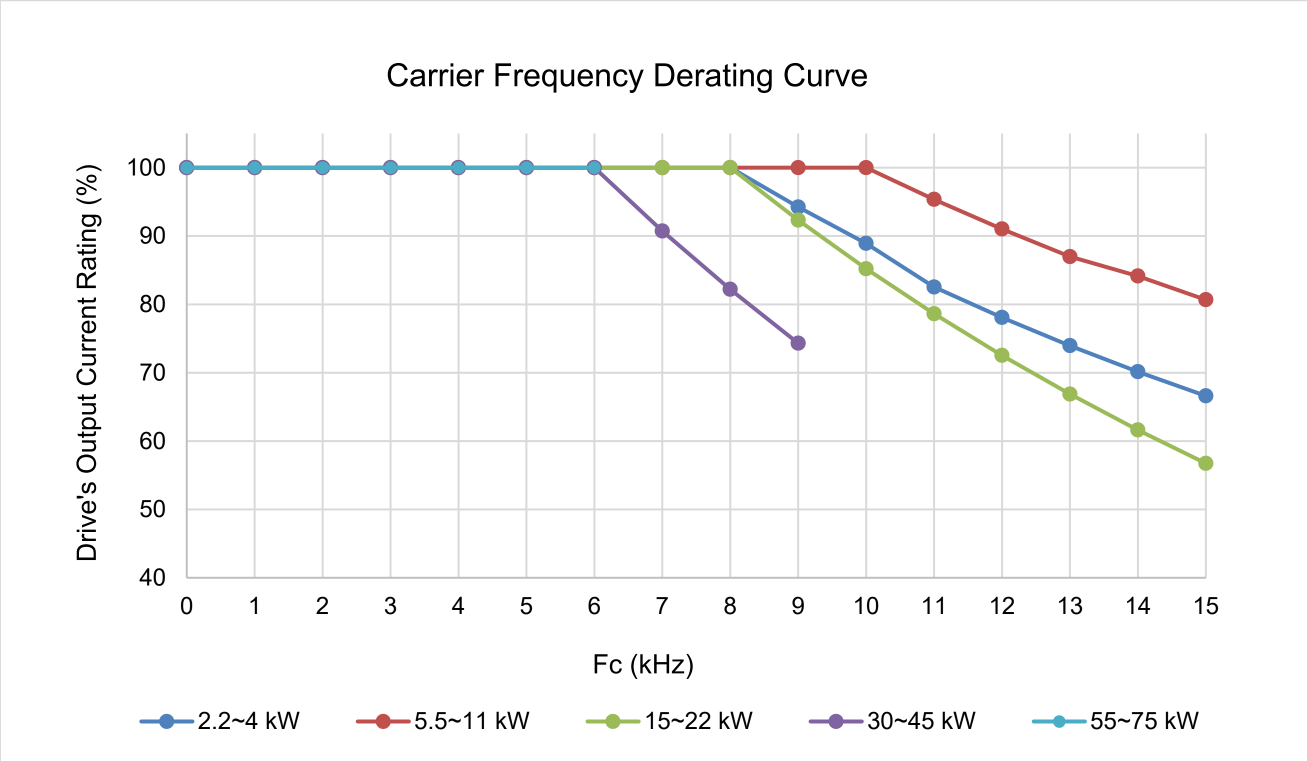

Figure 8-3

The rated output current derating (%) for different carrier frequencies:

Frame/Model \ Fc (kHz)		2	4	6	7	8	9	10	11	12	13	14	15
B	2.2~4 kW	100	100	100	100	100	94.24	88.92	82.54	78.08	73.95	70.14	66.61
C	5.5~11 kW	100	100	100	100	100	100	100	95.35	91.02	86.98	84.14	80.67
D	15~22 kW	100	100	100	100	100	92.32	85.21	78.63	72.53	66.87	61.62	56.74
E	30~45 kW	100	100	100	90.73	82.20	74.31	-	-	-	-	-	-
E	55~75 kW	100	100	100	-	-	-	-	-	-	-	-	-

Table 8-8

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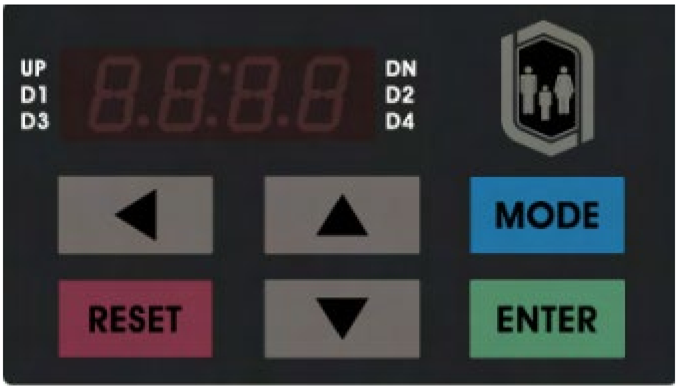
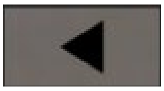
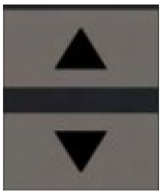
Chapter 9 Digital Keypad

9-1 Description of Keyboard Panel

Keyboard Panel KPED-LE01



Keypad Functions

Keys	Description
	**Shift key** Moves the cursor so you can adjust the selected value.
	**RESET key** Resets the motor drive after a fault.
	**MODE key** Changes among the different display modes.
	**ENTER key** Allows you to read or modify the current parameter settings.
	**Up and Down keys** These buttons have two functions: 1. Press the Up or Down button to increase or decrease the selected value. 2. Press the Up or Down button to select items in a menu and languages.

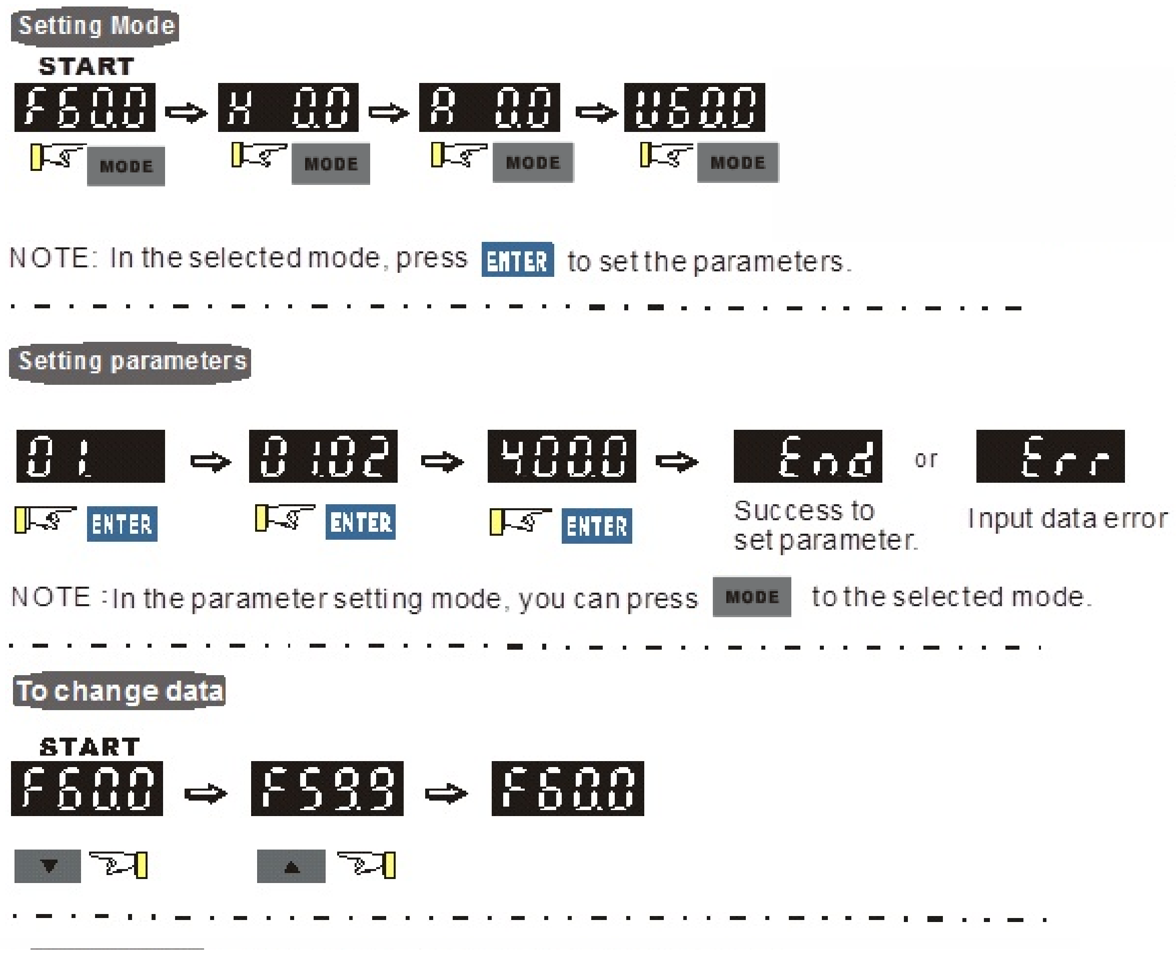
LED Function Description

LED	Description
	**Status Display** UP: Moving up. DN: Moving down D1: MI1 status D2: MI2 status D3: MI3 status D4: MI4 status
	**Main Display Area** Displays frequency, current, voltage, rotation direction, user-defined units, errors and warnings.

Description of Displayed Functions

Displayed Function	Description
	Displays the VFD-ED frequency setting.
	Displays the actual frequency output from the VFD-ED to the motor.
	Displays the user-defined value in Pr.00-04.
	Displays the current (amperes).
	Displays the selected parameter.
	Displays the value in a parameter.
	Displays the external fault.
	Displays “End” for approximately one second (as shown in the left figure) if the data has been accepted and automatically stored in the register.
	Displays if the setting data is not accepted or data value exceeds the allowed range.

9-2 Keypad Operation Process



9-3 Description of Digital Keypad KPC-CC01

KPC-CC01

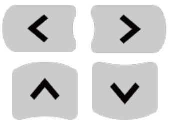
Communication Interface
RJ45 (socket), RS-485 interface

Communication protocol:
RTU19200, 8, N, 2

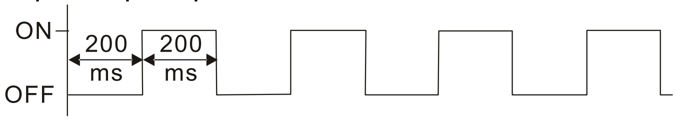
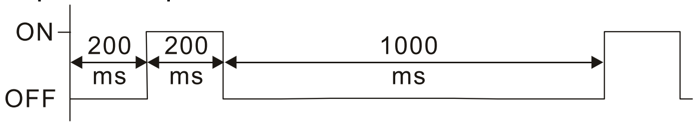
Installation Method
1. Embedded type and can be put flat on the surface of the control box. The front cover is water proof.
2. Buy a MKC-KPPK model to do wall mounting or embedded mounting. Its protection level is IP66.
3. The maximum RJ45 extension lead is 5 m (16ft)
4. This keypad can only be used on Delta's motor drive C2000, CH2000, CP2000, and ED series.

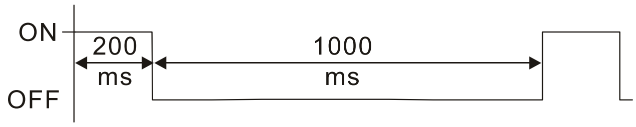
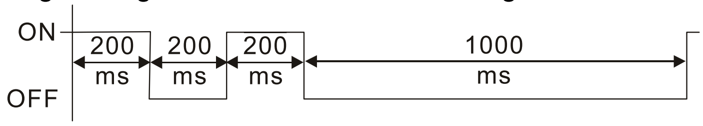
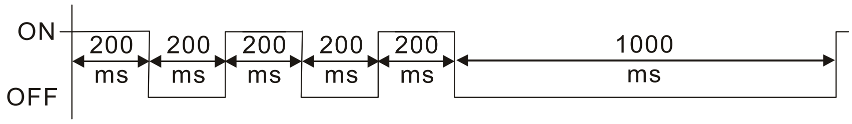
Descriptions of Keypad Functions

Key	Descriptions
	Start Operation Key 1. Only valid when the source of operation command is the keypad. 2. Operates the AC motor drive by the function setting. The RUN LED will be ON. 3. Can be pressed repeatedly at the stop process.
	Stop Command Key. 1. This key has the highest priority when the command is from the keypad. 2. When it receives the STOP command, regardless of whether the AC motor drive is in operation or stop status, the AC motor drive needs to execute the "STOP" command. 3. Use the RESET key to reset the drive after a fault occurs. 4. If you cannot reset after the fault: (1) The condition which triggers the fault is not cleared. After you clear the condition, you can then reset the fault. (2) The drive is in the fault status when powered on. After you clear the condition, restart and then you can reset the fault.
	Operation Direction Key 1. Only controls the operation direction, NOT the drive activation. FWD: forward, REV: reverse. 2. Refer to the Descriptions of LED Functions on p.9-6 for more details.
	ENTER Key Goes to the next menu level. If at the last level, press ENTER to execute the command.
	ESC Key Leaves the current menu and returns to the previous menu; also functions as a return key or cancel key in a sub-menu.

<table>
<tr><th>Key</th><th>Descriptions</th></tr>
<tr><td></td><td>MENU key. Returns to the main menu. Menu items:
1. Parameter Setup 8. Time Setup 14. Main Page
5. Copy Parameter 9. Keypad Locked 15. PC Link
6. Fault Record 12. Display Setup
7. Language Setup 13. Start-up
NOTE: Menu items that are not listed above are not supported in VFD-ED.</td></tr>
<tr><td></td><td>Direction: Left / Right / Up / Down
1. In the numeric value setting mode, moves the cursor and changes the numeric value.
2. In the menu / text selection mode, selects an item.</td></tr>
<tr><td></td><td>Function Key
The functions keys have defaults and can also be user-defined. The defaults for F1 and F4 work with the function list below. For example, F1 is the JOG function, and F4 is a quick setting key for adding / deleting user-defined parameters.</td></tr>
</table>

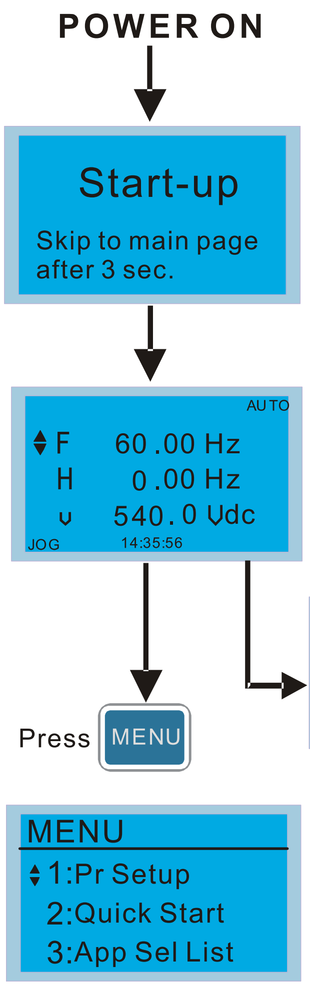
Descriptions of LED Functions

<table>
<tr><th>LED</th><th>Descriptions</th></tr>
<tr><td></td><td>Steady ON: STOP indicator for the AC motor drive.
Blinking: the drive is in standby.
Steady OFF: the drive does not execute the “STOP” command.</td></tr>
<tr><td></td><td>Operation Direction LED
1. Green light: the drive is running forward.
2. Red light: the drive is running backward.
3. Flashing light: the drive is changing direction.</td></tr>
<tr><td>CANopen–
“RUN”</td><td>RUN LED:
<table>
<tr><th>LED status</th><th>Condition / State</th></tr>
<tr><td>OFF</td><td>CANopen at initial
No LED</td></tr>
<tr><td>Blinking</td><td>CANopen at pre-operation
</td></tr>
<tr><td>Single flash</td><td>CANopen at stop
</td></tr>
<tr><td>ON</td><td>CANopen at operation status
</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>LED</th><th>Descriptions</th></tr>
<tr><td>CANopen–
“ERR”</td><td>ERR LED:
<table>
<tr><th>LED status</th><th>Condition / State</th></tr>
<tr><td>OFF</td><td>No Error</td></tr>
<tr><td>Single flash</td><td>One message fail

</td></tr>
<tr><td>Double flash</td><td>Node guarding failure or heartbeat message failure

</td></tr>
<tr><td>Triple flash</td><td>Synchronization failure

</td></tr>
<tr><td>ON</td><td>Bus off

</td></tr>
</table>
</td></tr>
</table>

9-4 Digital Keypad KPC-CC01 Functions

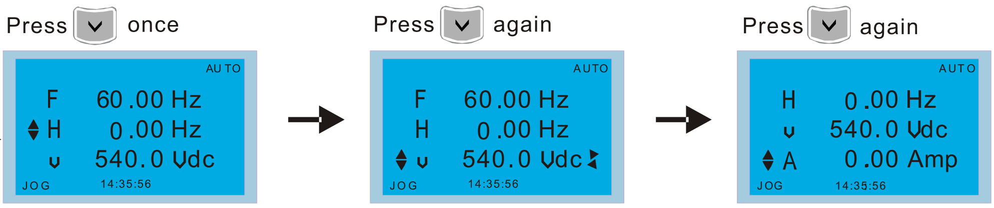


1) The default Start-up page is Delta Logo. (Default 1 and 2)
2) User can customize their start-up page through the edited function. (Need to purchase the optional accessories.)

→ The top line of LCD displays the status of drive.

After you select the main menu, the start-up screen displays in the user-defined format. The page on the left shows the Delta default setting.

→ The bottom line of LCD displays time and JOG.



MENU

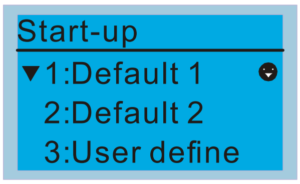
1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Start-up Menu
14: Main Page
15: PC Link
16: Start Wizard

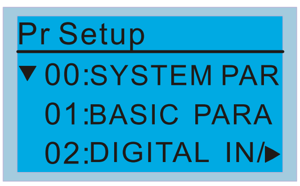
NOTE:

1. Start-up screen can only display pictures, not animation.
2. When powered ON, it displays the start-up screen then the main screen. The main screen displays Delta's default setting F/H/A/U. You can set the display order with Pr.00-03 (Start-up Display). When you selected the U screen, use the left / right keys to switch between the items, and set the display order for the U screen with Pr.00-04 (Content of Multi-function Display).
3. VFD-ED only supports the following menu items:

1. Parameter Setup	6. Fault Record	8. Time Setup	12. Display Setup	14. Main Page
5. Copy Parameter	7. Language Setup	9. Keypad Locked	13. Start-up	15. PC Link

Display Icon





● : present setting

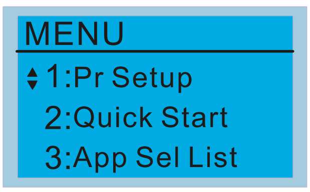
▼ : Scroll down the page for more options

Press ⋀ ⋁ for more options

▶ : show complete sentence

Press < > for complete information

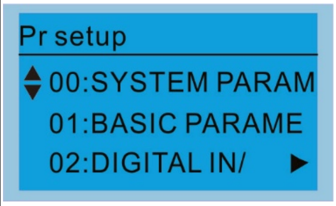
Display item



MENU

1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Start-up Menu
14: Main Page
15: PC Link
16: Start Wizard

1. Parameter Setup

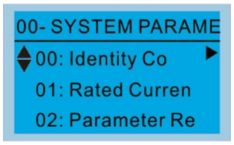


Press ENTER to select.

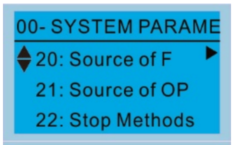
Press ^ v to select the parameter group.

Once you select a parameter group, press ENTER to go into that group.

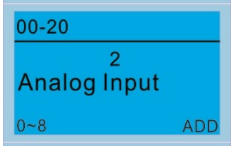
For example: Setup source for the master frequency command.



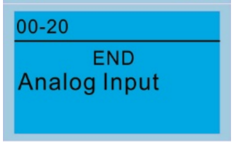
In Parameter Group 00 Basic Parameters, use Up/Down keys to select parameter 20: Auto Frequency Command.



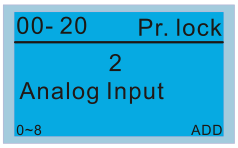
Press ENTER to go to this parameter's setting menu.



Use Up/Down keys to choose a setting.
For example: choose "2 Analog Input", and then press ENTER.

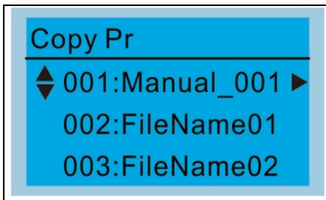


After you press ENTER, END is displayed which means the parameter setting is done.



NOTE: When parameter lock / password protection function is enabled, it displays "Pr. lock" on the upper right corner of the keypad. The parameter cannot be written or is protected by the password under this circumstance.

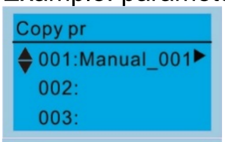
5. Copy Parameter



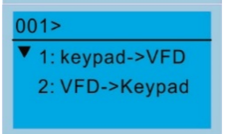
Press ENTER to go to 001–004: content storage

Four groups of parameters are available to copy.
The steps are shown in the example below.

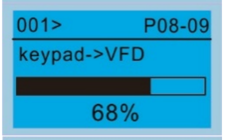
Example: parameter saved in the motor drive.



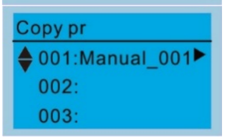
1. Go to "Copy Parameter"
2. Select the parameter group to copy and press ENTER key.



1. Select 1: keypad → VFD
2. Press ENTER key to go to "keypad → VFD" screen.

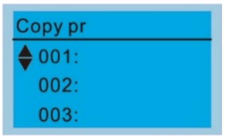


Begin copying parameters until it is done.

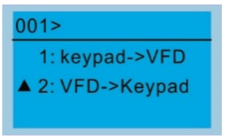


After copying parameters is done, the keypad automatically returns to this screen.

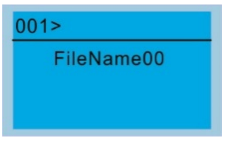
Example: parameter saved in the keypad.



1. Go to Copy parameter
2. Select the parameter group to copy and press ENTER.

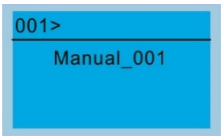


1. Select 2: VFD→ Keypad
2. Press ENTER to go to "Save in the keypad drive" screen.

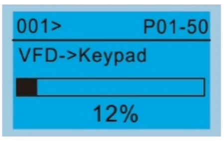


Press Up / Down keys to select a symbol.
Press Left / Right keys to move the cursor to select a file name.

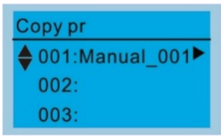
String & Symbol Table:
! ” # $ % & ’ ( ) ＊ + , − . ／ 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [＼] ︿ _ ‘ a b c d f g h i j k l m n o p q r s t u v w x y z { | } ~



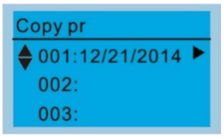
After you confirm the file name, press ENTER key.



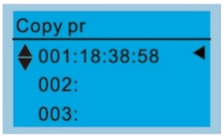
To begin copying parameters until it is done.



After copying parameters is done, the keypad automatically returns to this screen.

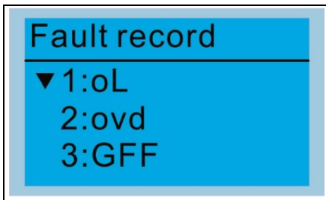


Press Right key to see the date of the parameters copied.



Press Right key to see the time of the parameters copied.

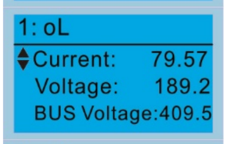
6. Fault Record



Press ENTER to see a fault record’s details.

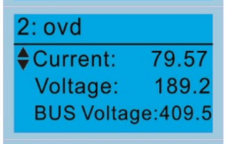
Able to store 6 fault codes (Keypad V1.02 and previous versions)
Able to store 30 fault codes (Keypad V1.20 and later version)
The most recent fault record shows as the first record. Choose a fault record to see its details such as date, time, frequency, current, voltage, and DC bus voltage)

Press Up / Down keys to select a fault record.
After selecting a fault code, press ENTER to see that fault record’s details.



Press Up / Down keys to scroll through a fault record’s details such as date, time, frequency, current, voltage, and DC bus voltage.

Press ESC key to go back to fault record page.
Press Up / Down keys to select the next fault code.
After selecting a fault code, press ENTER to see that fault record’s details.



Press Up / Down keys to see a fault record’s detail such as date, time, frequency, current, voltage, and DC bus voltage.

NOTE:

The AC motor drive actions are recorded and saved to the KPC-CC01. When you remove the KPC-CC01 and connect it to another AC motor

	drive, the previous fault records are not deleted. The new fault records of the new AC motor drive continue to be added to the KPC-CC01.

7. Language Setup

Use Up / Down keys to select the language, and then press ENTER.

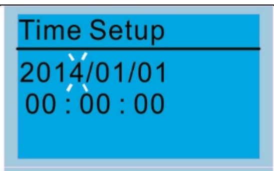
The language setting option is displayed in the language of your choice.
Language setting options:

1. English
2. 繁體中文
3. Türkçe
4. Русский

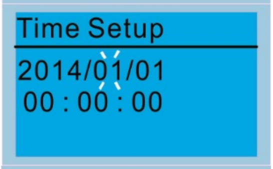
NOTE: VFD-ED only supports these four languages currently.

8. Time Setup

Use Left / Right keys to select Year, Month, Day, Hour, Minute or Second to change.



Press Up / Down keys to set the Year



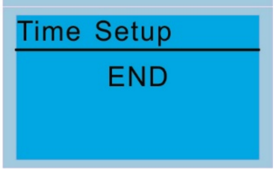
Press Up / Down keys to set the Month

Press Up / Down keys to set the Day

Press Up / Down keys to set the Hour

Press Up / Down keys to set the Minute

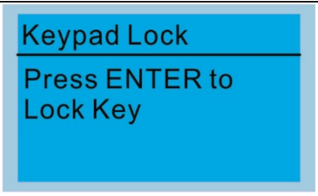
Press Up / Down keys to set the Second



Press ENTER to confirm the Time Setup.

NOTE:
Limitation: The charging process for the keypad super capacitor finishes in about 6 minutes. **When the digital keypad is removed, the time setting is saved for 7 days**. After 7 days, you must reset the time.

9. Keypad Locked

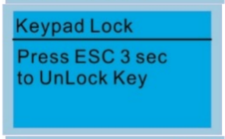


Press ENTER to lock

Lock the keypad

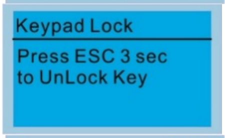
Use this function to lock the keypad. The main screen does not display "keypad locked" when the keypad is locked; however, it displays the message "Press ESC 3 sec to UnLock Key" when you press any key.

When the keypad is locked, the main screen does not indicate the lock status.



Press any key on the keypad; a message displays as shown on the left.

If you do not press ESC, the keypad automatically returns to this screen.



Press any key on the keypad, a message displays as shown on the left.

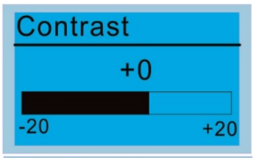
Press ESC for 3 seconds to unlock the keypad; the keypad returns to this screen. All keys on the keypad is functional.

All keys on the keypad is functional. Turning the power off and on does not lock the keypad.

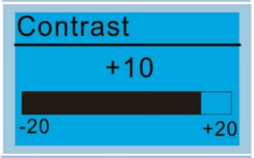
12. Display Setup

Press ENTER to go to the setting screen.

1. Contrast

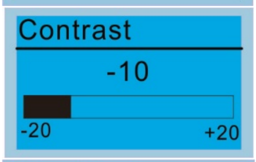


Press Up / Down keys to adjust the setting value.



For example, increase Contrast to +10.

After you set the value, press ENTER to see the screen display after contrast is adjusted to +10.

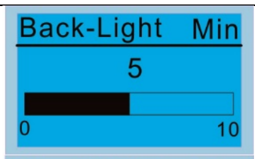
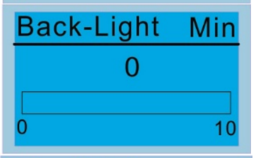


Then press ENTER and decrease the Contrast to -10.

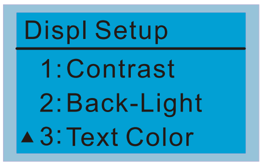
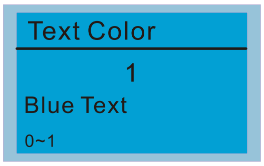
Press ENTER to see screen display after contrast is adjusted to -10.

2. Back-light

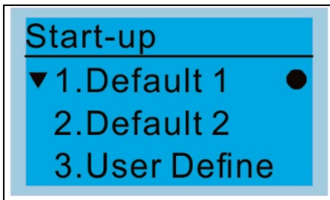
Press ENTER to go to the Back-Light Time Setting screen.

	Press Up / Down keys to adjust the setting value.
	When the setting value is 0 Min, the backlight remains on.
	When the setting value is 10 Min, the backlight turns off in 10 minutes.

3. Text Color

	Press ENTER to go to Text Color Setting screen.
	The default value is White Text.
	Press Up / Down keys to adjust the setting value, and then press ENTER.
	The setting value changes to Blue Text.

13. Start-up



1. Default 1 DELTA LOGO

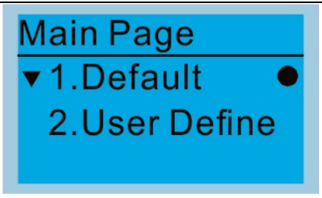
2. Default 2 DELTA Text

3. User Defined: an optional accessory is required (TPEditor & USB / RS-485 Communication Interface-IFD6530) to design your own start-up screen. If the editor accessory is not installed, the User Define option displays a blank screen.

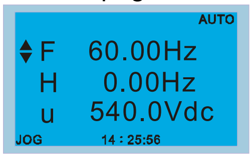
<table>
<tr><td></td><td>
<u>USB/RS-485 Communication Interface-IFD6530</u>
Refer to Chapter 6 Optional Accessories for more details.

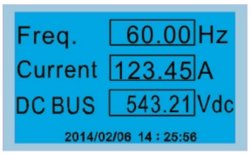
<u>TPEditor</u>
<u>Download</u> TPEditor software at Delta website. Select TPEditor version 1.60 or above. Refer to the instructions for TPEditor in <15. PC Link> in this section.
</td></tr>
</table>

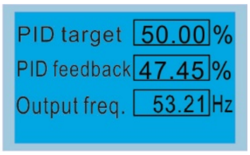
14. Main Page

<table>
<tr><td>


Default screen and editable screen are available upon selection.

Press ENTER to select.
</td><td>
1. Default page


F 60.00Hz >>> H >>> A >>> U (options rotate)
2. User Define: an optional accessory is required (TPEditor & USB / RS-485 Communication Interface-IFD6530) to design your own main screen.
If the editor accessory is not installed, the User Define option displays a blank screen.


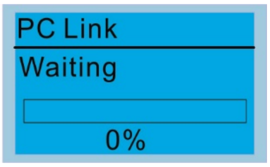


<u>USB/RS-485 Communication Interface-IFD6530</u>
Refer to Chapter 6 Optional Accessories for more details.

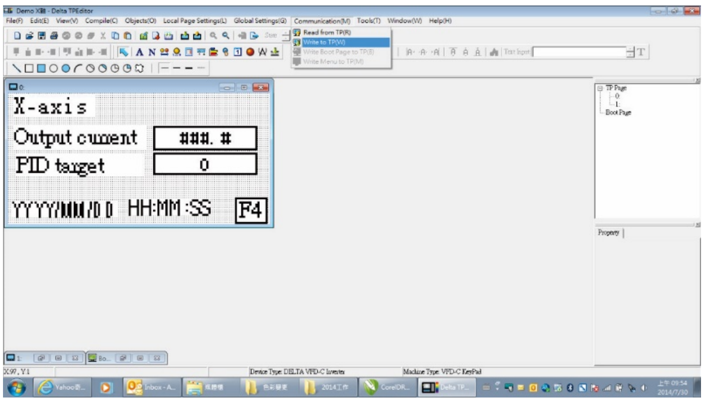
<u>TPEditor</u>
<u>Download</u> TPEditor software at Delta website. Select TPEditor version 1.60 or above. Refer to the instructions for TPEditor in <15. PC Link> in this section.
</td></tr>
</table>

15. PC Link

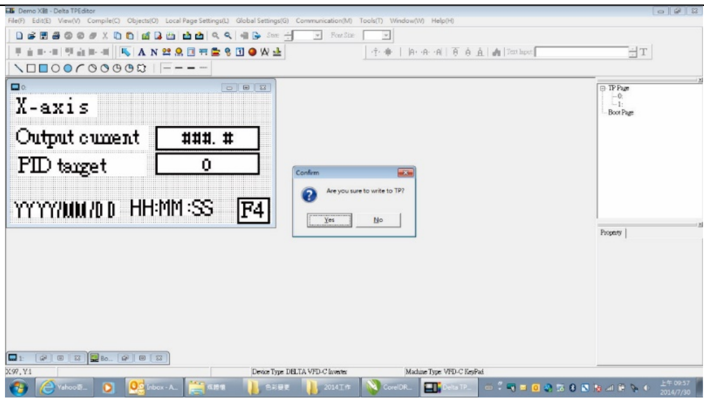
<table>
<tr><td>

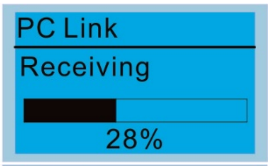

</td><td>
1. TPEditor: This function enables you to connect the keypad to a computer then to download and edit user-defined screens.


Click ENTER to go to <Waiting to connect to PC>

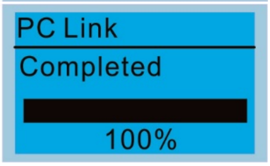
In TPEditor, from the Communication menu, then choose “Write to HMI”


In the Confirm message box, click YES.
</td></tr>
</table>





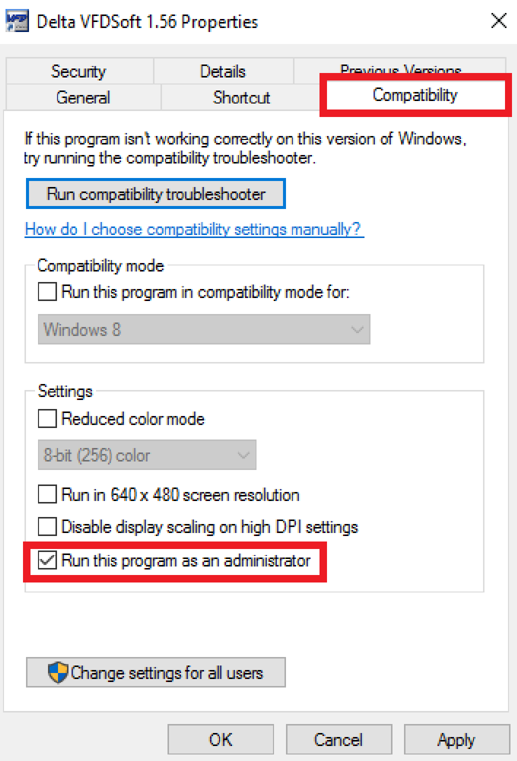
The software starts downloading screens to edit to the KPC-CC01.



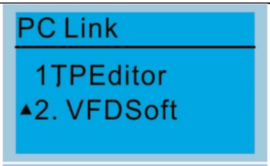
Download completed

2. VFDSoft: this function enables you to link to the VFDSoft then upload the parameters 1–4 you have saved in KPC-CC01.

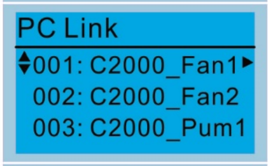
NOTE:
If the Operation System (OS) of your computer is Windows 10, right-click on the VFDSoft icon to enter the **Property**. Then, click the **Compatibility** tab and select the **Run this program as an administrator** checkbox. (as shown in the red frames in the figure below)



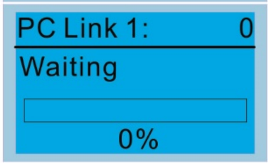
Connecting KPC-CCO1 to a computer



Select 2: VFDSoft, and then press ENTER.

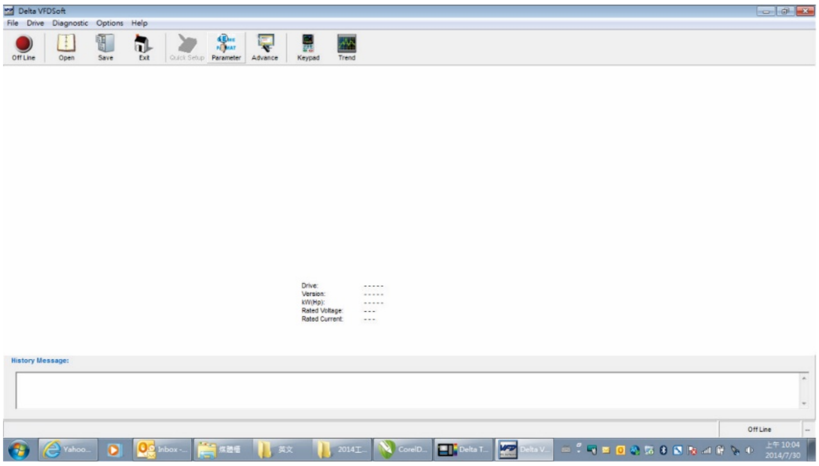


Press the Up / Down keys to select a parameter group to upload to VFDSoft.

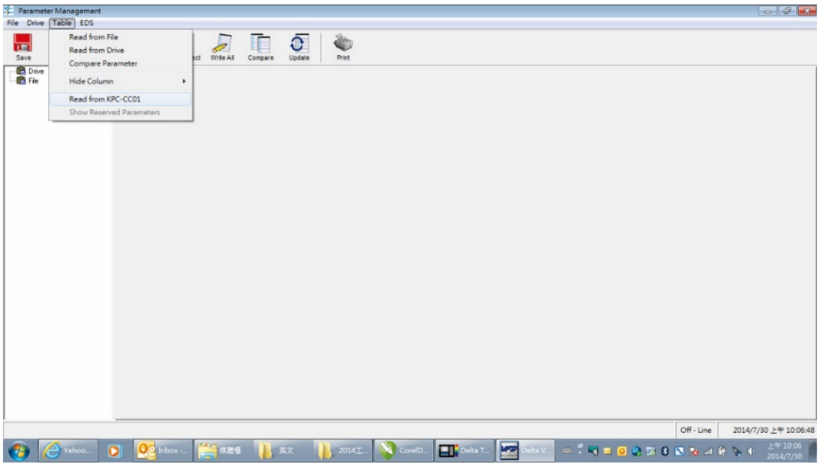


Press ENTER to go to Waiting to connect to PC screen.

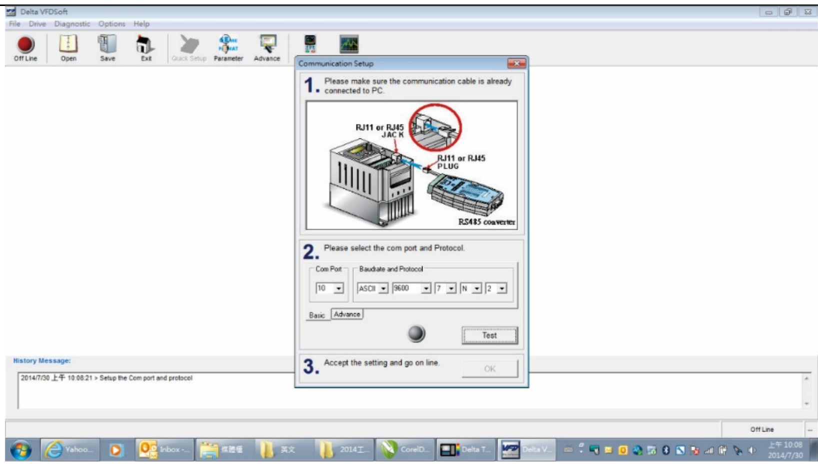
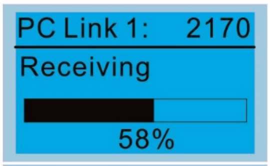
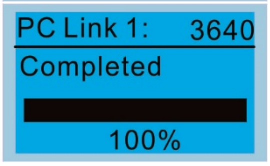
Open VFDSoft and click **Parameter** on the toolbar.



In Parameter Manager, from the **Table** menu, choose **Read from KPC-CC01**.

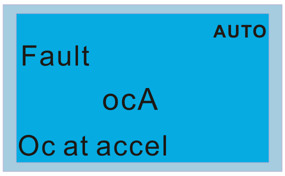


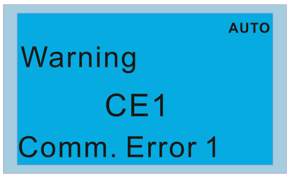
Choose the correct communication port and click OK

	  Start to upload parameters to VFDSoft  Uploading parameter is completed Before using the user-defined start-up screen and user-defined main screen, you must preset the start-up screen and the main screen as user-defined. If you do not download the user-defined screen to the KPC-CC01, the start-up screen and the main screen are blank.

Other displays

When a fault occurs, the screen shows a fault or warning:





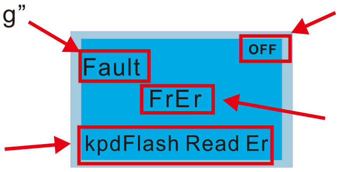
1. Press RESET key to reset the fault code. If there is no response, contact your local distributor or return the unit to the factory. To view the fault DC bus voltage, output current and output voltage, press MENU and then choose 6: Fault Record.
2. After resetting, if the screen returns to the main screen and shows no fault after you press ESC, the fault is cleared.
3. When the fault or warning message appears, the LED backlight blinks until the fault or warning is cleared.

Optional accessory: RJ45 Extension Lead for Digital Keypad

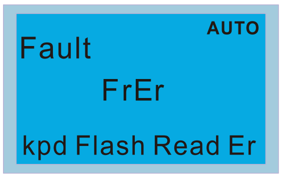
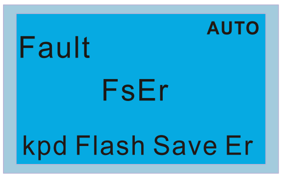
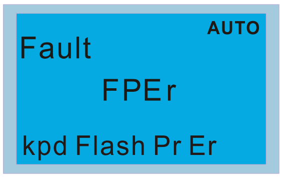
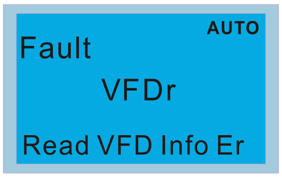
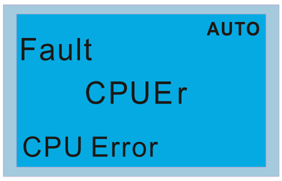
Part No.	Description
CBC-K3FT	RJ45 extension lead, 3 feet (approximately 0.9 m)
CBC-K5FT	RJ45 extension lead, 5 feet (approximately 1.5 m)
CBC-K7FT	RJ45 extension lead, 7 feet (approximately 2.1 m)
CBC-K10FT	RJ45 extension lead, 10 feet (approximately 3 m)
CBC-K16FT	RJ45 extension lead, 16 feet (approximately 4.9 m)

NOTE: If communication cables are required, buy non-shielded, 24 AWG, four-wire twisted pair, 100 ohms communication cables.

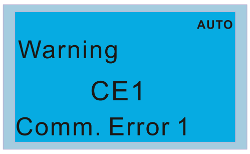
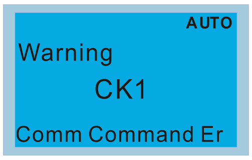
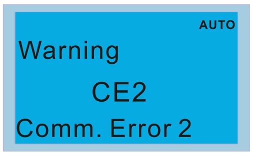
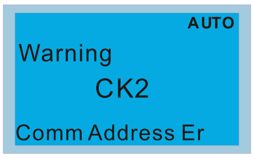
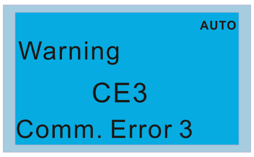
9-5 Digital Keypad KPC-CC01 Fault Codes and Descriptions

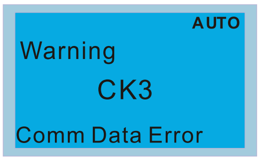
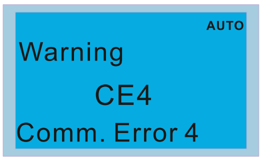
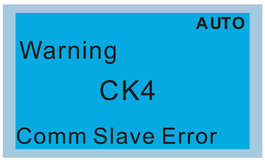
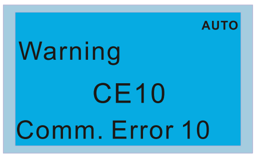
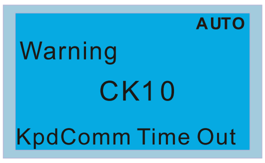


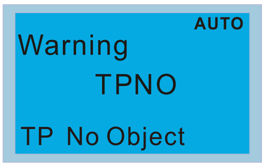
Fault Codes

LCD Display	Fault Name	Description	Corrective Actions
	Flash memory read error (FrEr)	Keypad flash memory read error	Error in the keypad's flash memory. 1. Press RESET to clear the errors. 2. Check for any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
	Flash memory save error (FsEr)	Keypad flash memory save error	Error in the keypad's flash memory. 1. Press RESET to clear the errors. 2. Check for any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
	Flash memory parameter error (FPEr)	Keypad flash memory parameter error	Error in the default parameters. It might be caused by a firmware update. 1. Press RESET to clear the errors. 2. Check for any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
	Reading AC motor drive data error (VFDr)	Keypad error when reading AC motor drive data	Keypad cannot read any data sent from the VFD. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.
	CPU error (CPUEr)	Keypad CPU error	A serious error in the keypad's CPU. 1. Check for any problem on CPU clock. 2. Check for any problem on Flash IC. 3. Check for any problem on RTC IC. 4. Verify that the communication quality of the RS-485 cable is good. 5. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your authorized local dealer for assistance.

Warning Codes

LCD Display	Warning Name	Description	Corrective Actions
	Communication error 1 (CE1)	RS-485 Modbus illegal function code	Motor drive does not accept the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication command error 1 (CK1)	Keypad communication data, illegal function code (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solutions works, contact your local authorized dealer.
	Communication error 2 (CE2)	RS-485 Modbus illegal data address	Motor drive does not accept the keypad's communication address. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication address error (CK2)	Keypad communication data, illegal data address (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solutions works, contact your local authorized dealer.
	Communication error 3 (CE3)	RS-485 Modbus illegal data value	Motor drive does not accept the communication data sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. If none of the above solutions works, contact your local authorized dealer for assistance.

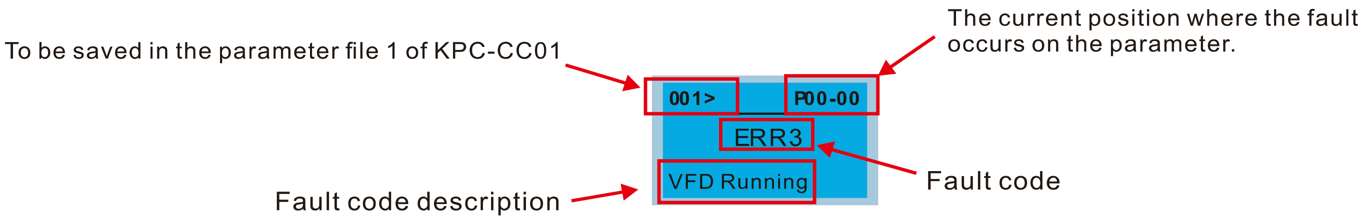
LCD Display	Warning Name	Description	Corrective Actions
	Communication data error (CK3)	Keypad communication data, illegal data value (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solutions works, contact your local authorized dealer.
	Communication error 4 (CE4)	RS-485 Modbus data is written to read-only address	Motor drive cannot process the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
	Communication slave error (CK4)	Keypad communication data is written to read-only address (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solutions works, contact your local authorized dealer.
	Communication error 10 (CE10)	Modbus transmission time-Out	Motor drive does not respond to the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
	Keypad communication time out (CK10)	Digital keypad transmission time-out (The keypad automatically detects and shown this warning)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solutions works, contact your local authorized dealer.

LCD Display	Warning Name	Description	Corrective Actions
	TP object is not defined (TPNO)	Object not supported by TPEditor	Keypad's TPEditor uses an unsupported object. 1. Verify that the TPEditor is not using an unsupported object or setting. Delete unsupported objects and unsupported settings. 2. Re-edit the object in the TPEditor, and then download it to the keypad. 3. Verify that the motor drive supports the TP functions. If the drive does not support TP function, the main page displays Default. If none of the above solutions works, contact your local authorized dealer for assistance.

NOTE: The warning code CExx only occurs when the communication problem is between the drive and the keypad. It has nothing to do with the drive and other devices. Note the warning code description to find the cause of the error if CExx appears.

File Copy Setting Fault Description

These faults occur when KPC-CC01 cannot perform the command after pressing the ENTER key in the copy function.



LCD Display	Fault Name	Description	Corrective Actions
001> P00-00 ERR1 Read Only	Read only (ERR1)	Parameter and file are read-only	The parameter / file is read-only and cannot be written to. 1. Verify the specification in the user manual. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR2 Write Fail	Write in error (ERR2)	Fail to write parameter and file	An error occurred while writing to a parameter / file. 1. Check for any problem on the Flash IC. 2. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
001> P00-00 ERR3 VFD Running	Drive operating (ERR3)	AC motor drive is in operating status	A setting cannot be changed while the motor drive is in operation. 1. Verify that the drive is not in operation. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR4 Pr Lock	Parameter locked (ERR4)	AC motor drive parameter is locked	A setting cannot be changed because a parameter is locked. 1. Check if the parameter is locked. If it is locked, unlock it and try to set the parameter again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR5 Pr Changing	Parameter changing (ERR5)	AC motor drive parameter is changing	A setting cannot be changed because a parameter is being modified. 1. Check if the parameter is being modified. If it is not being modified, try to change that parameter again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR6 Fault Code	Fault code (ERR6)	Fault code is not cleared	A setting cannot be changed because an error has occurred in the motor drive. 1. Check if any error occurred in the motor drive. If there is no error, try to change the setting again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR7 Warning Code	Warning code (ERR7)	Warning code is not cleared	A setting cannot be changed because of a warning message given to the motor drive. 1. Check if there is a warning message given to the motor drive. If this solution does not work, contact your local authorized dealer for assistance.

LCD Display	Fault Name	Description	Corrective Actions
001> P00-00 ERR8 Type Mismatch	File type mismatch (ERR8)	File type mismatch	Data to be copied are not the correct type, so the setting cannot be changed. 1. Check if the products' serial numbers to be copied are in the same category. If they are in the same category, try to copy the setting again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR9 Password Lock	Password locked (ERR9)	File is locked with password	A setting cannot be changed because some data are locked. 1. Check if the data are unlocked or able to be unlocked. If the data are unlocked, try to change the setting again. 2. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
001> P00-00 ERR10 Password Fail	Password fail (ERR10)	File password mismatch	A setting cannot be changed because the password is incorrect. 1. Check if the password is correct. If the password is correct, try to change the setting again. 2. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
001> P00-00 ERR11 Version Fail	Version fail (ERR11)	File version mismatch	A setting cannot be changed because the version of the data is incorrect. 1. Check if the version of the data matches the motor drive. If it matches, try to change the setting again. If none of the above solutions works, contact your local authorized dealer for assistance.
001> P00-00 ERR12 VFD Time Out	VFD Time out (ERR12)	AC motor drive copy function time-out	A setting cannot be changed because the data copying time-out expired. 1. Try copying the data again. 2. Check if copying data is authorized. If it is authorized, try to copy the data again. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.

NOTE: The content in this section only applies to KPC-CC01 keypad V1.01 and later versions.

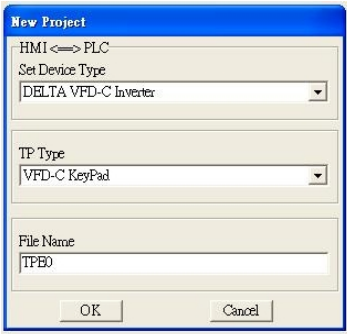
9-6 TPEditor Installation

TPEditor can edit up to 256 HMI (Human-Machine Interface) pages with a total storage capacity of 256 KB. Each page can include 50 normal objects and 10 communication objects.

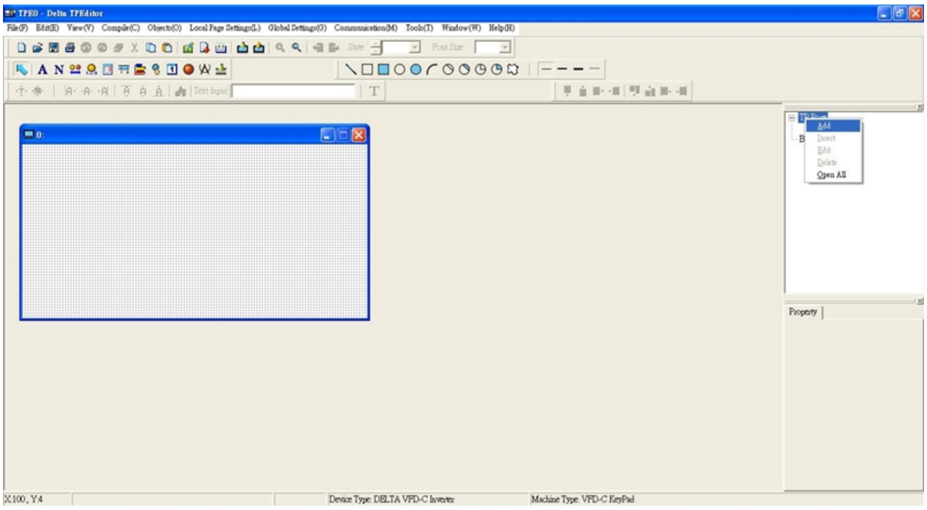
1. TPEditor: Setup & Basic Functions

    (1) Run TPEditor version 1.60 or later by double-clicking the program icon.

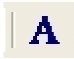
    (2) On the **File** menu, click **New**. In the New project dialog box, for **Set Device Type**, select **DELTA VFD-C Inverter**. For **TP Type**, select **VFD-C KeyPad**. For **File Name**, enter TPE0 and then click **OK**.

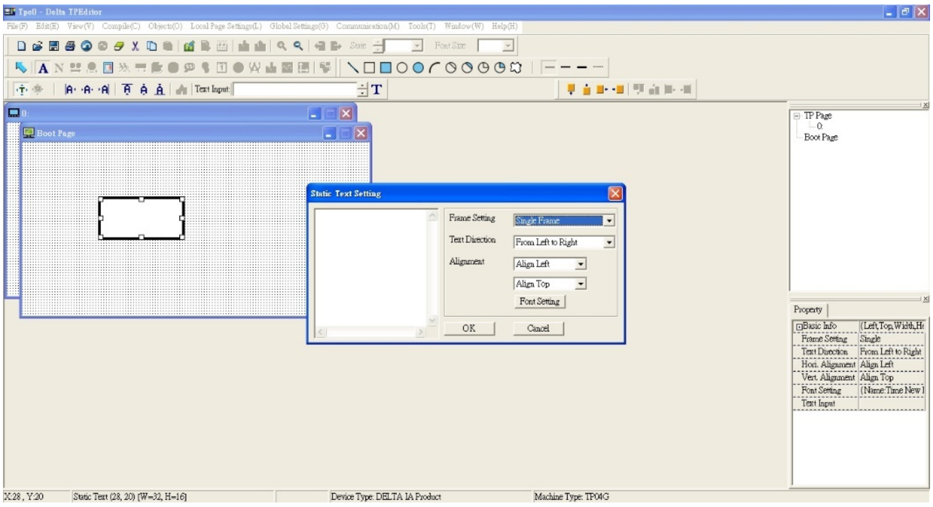


    (3) The editor displays the Design window. On the **Edit** menu, click **Add a New Page**. You can also right-click on the TP page in the upper right corner of the Design window and click **Add** to add one more page(s) to edit.

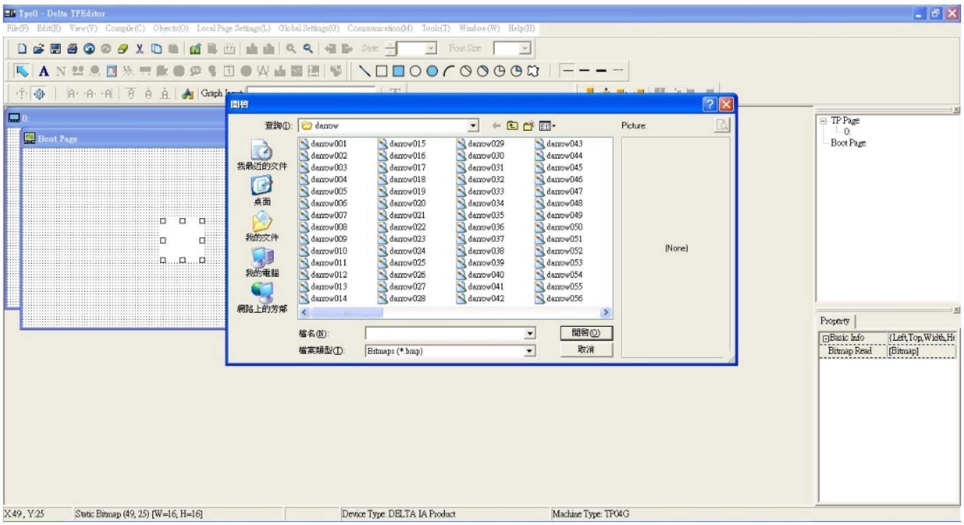


    (4) Edit the start-up screen.

(5) Add static text. Open a blank page (step 3), then on the toolbar click . Double-click the blank page to display the **Static Text Setting** dialog box, and then enter the static text.



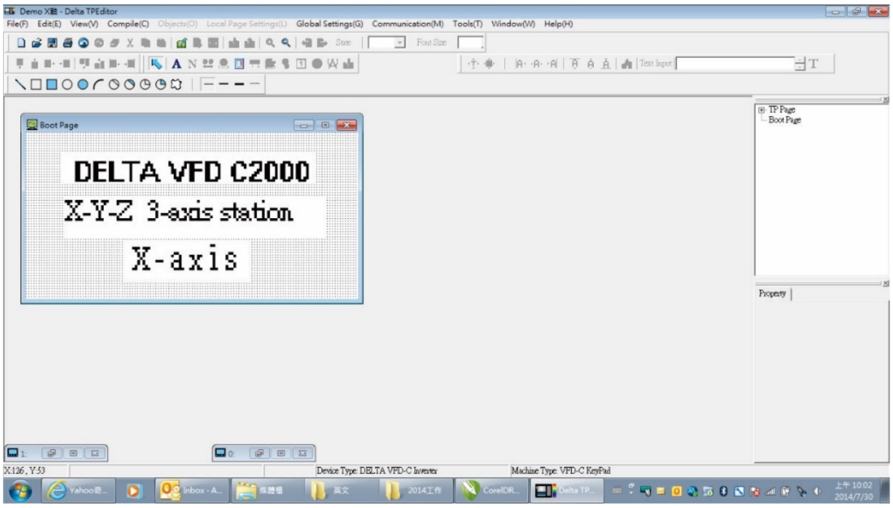
(6) Add a static bitmap. Open a blank page (step 3), then on the toolbar, click . Double-click the blank page to display the **Static Bitmap Setting** dialog box where you can choose the bitmap.



You can only use images in the BMP format. Click the image and then click Open to show the image in the page.

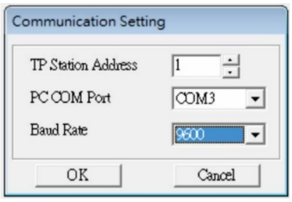
(7) Add a geometric bitmap. There are 11 kinds of geometric bitmaps to choose. Open a new blank page (step 3), then on the toolbar click the geometric bitmap icon that you need . In the page, drag the geometric bitmap and enlarge it to the size that you need.

(8) When you finish editing the start-up screen, on the **Communication** menu, click **Input User Defined Keypad Starting Screen.**

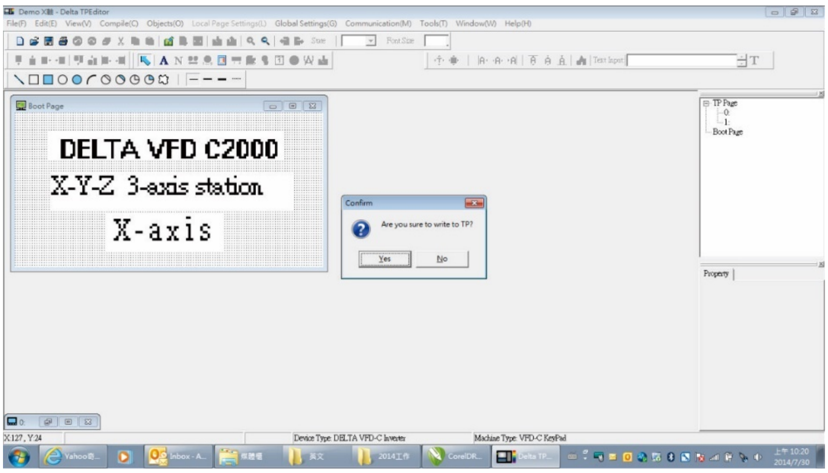


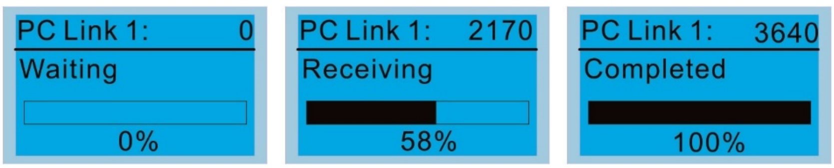
(9) Download the new setting: On the **Tool** menu, click **Communication**. Set up the communication port and speed for the IFD6530. There are three speeds available: 9600 bps, 19200 bps, and 38400 bps.

(10) On the **Communication** menu, click **Input User Defined Keypad Starting Screen**.



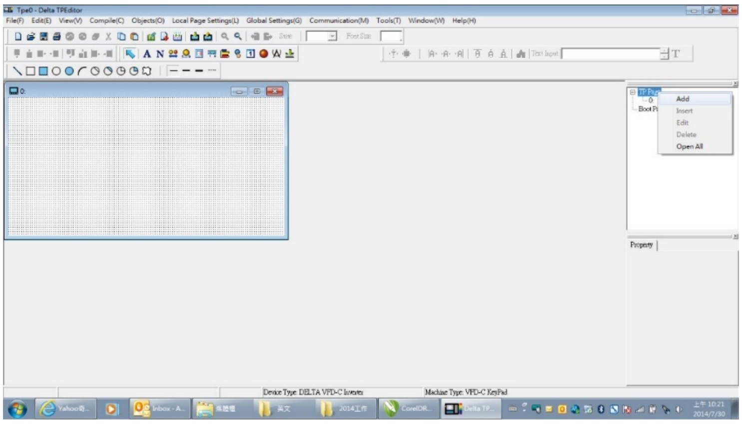
(11) The Editor displays a message asking you to confirm the new setting. Before you click **OK**, on the keypad, go to MENU, select PC LINK, press ENTER and then wait for few seconds. Then click **YES** in the confirmation dialog box to start downloading.



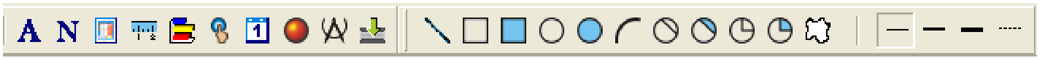


2. Edit the Main Page and Download to the Keypad

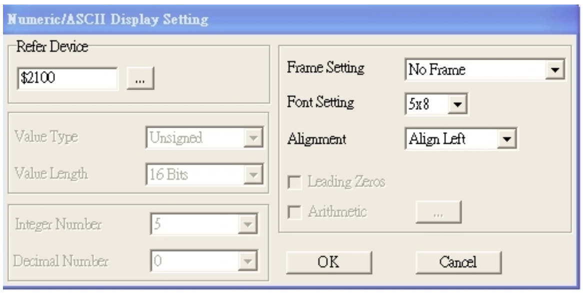
(1) In the Editor, add a page to edit. On the **Edit** menu, click **Add a New Page**. You can also right-click on the TP page in the upper right corner of the Design window and click **Add** to add one more page to edit. This keypad currently supports up to 256 pages.



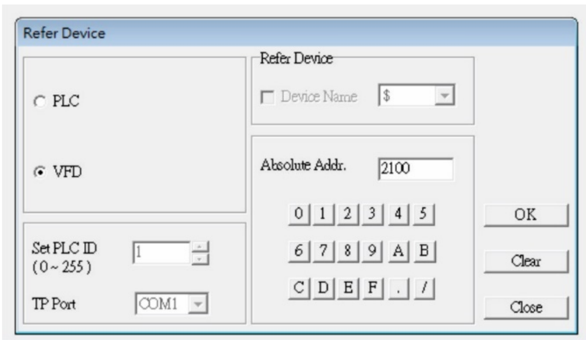
(2) In the bottom right-hand corner of the Editor, click the page number to edit, or on the **View** menu, click **HMI Page** to start editing the main page. As shown in the picture above, the following objects are available. From left to right they are: Static Text, ASCII Display, Static Bitmap, Scale, Bar Graph, Button, Clock Display, Multi-state bit map, Units, Numeric Input, the 11 geometric bitmaps, and lines of different widths. Use the same steps to add Static Text, Static Bitmap, and geometric bitmaps as for the start-up page.



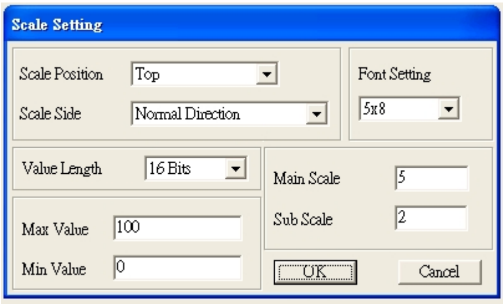
(3) Add a numeric/ASCII display. On the toolbar, click the **Numeric/ASCII** button. In the page, double-click the object to specify the **Refer Device**, **Frame Setting**, **Font Setting** and **Alignment**.



Click **[…]**. In the **Refer Device** dialog box, choose the VFD communication port that you need. If you want to read the output frequency (H), set the **Absolute Addr.** to 2202. For other values, refer to Appendix B-4 ACMD Modbus Comm Address List in this user manual.

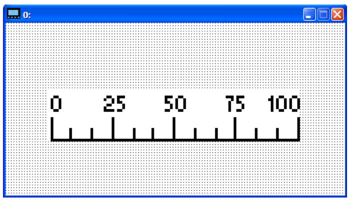


(4) Scale Setting. On the toolbar, click  to add a scale. You can also edit the Scale Setting in the Property Window on the right-hand side of your computer screen.

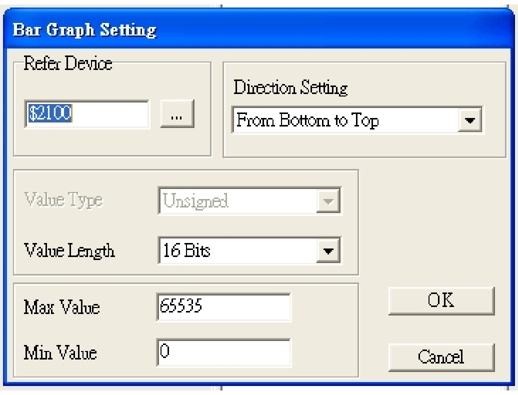


A. **Scale Position**: specifies where to place the scale.
B. **Scale Side**: specifies whether the scale is numbered from smaller numbers to larger numbers or from larger to smaller.
C. **Font Setting**: specifies the font.
D. **Value Length**: specifies 16 bits or 32 bits.
E. **Main Scale &** Sub-**Scale**: divides the whole scale into equal parts; enter the numbers for the main scale and sub-scale.
F. **Max Value &** Min **Value**: specifies the numbers on the two ends of the scale. They can be negative numbers, but the maximum and minimum values are limited by the **Value Length** setting. For example, when **Value Length** is **hexadecimal** (**16 bits**), the maximum and the minimum value cannot be entered as -40000.

Clicking **OK** creates a scale as in the picture below.



(5) Bar Graph setting. On the toolbar, click  to add a bar graph.



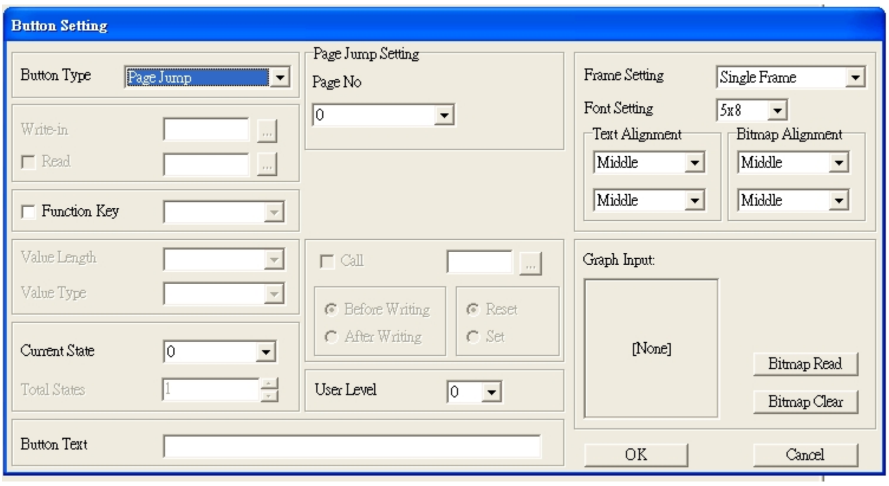
A. **Refer Device**: specifies the VFD communication port.

B. **Direction Setting**: specifies the direction: **From Bottom to Top**, **From Top to Bottom**, **From Left to Right** or **From Right to Left**.

C. **Value Length**: determines the range of the maximum value and minimum value.

D. **Max Value** and **Min Value**: specifies the maximum value and minimum value. A value smaller than or equal to the minimum value causes the bar graph to be blank (0). A value is bigger or equal to the maximum value causes the bar graph is full (100%). A value between the minimum and maximum values causes the bar graph to be filled proportionally.

(6) Button : on the toolbar, click . Currently this function only allows the keypad to switch pages; other functions are not yet available (including text input and insert image). In the blank page, double-click  to open the Button Setting dialog box.



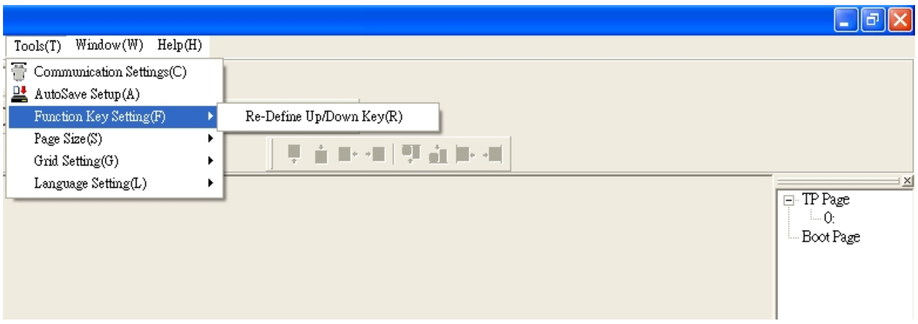
Button Type: specifies the button's functions.

Page Jump and **Constant Setting** are the only functions currently supported.

A. Page Jump Setting

a. **Page Jump Setting**: in the **Button Type** list, choose **Page Jump** to show the **Page Jump Setting**.

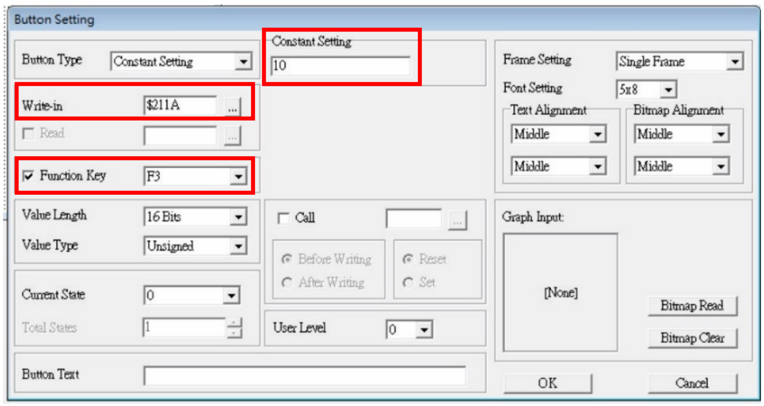
b. **Function Key**: specifies the functions for the following keys on the KPC-CC01 keypad: F1, F2, F3, F4, Up, Down, Left and Right. Note that the Up and Down keys are locked by TPEditor. You cannot program these two keys. If you want to program Up and Down keys, on the **Tool** menu, click **Function Key Setting**, and then click **Re-Define Up/Down Key**.



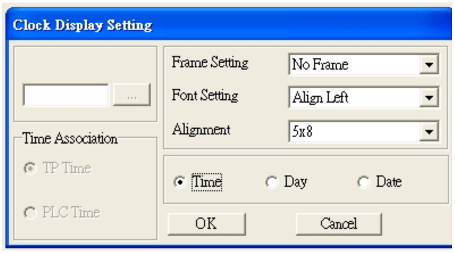
c. **Button Text**: specifies the text that appears on a button. For example, when you enter Next Page for the button text, that text appears on the button.

B. Constant Setting

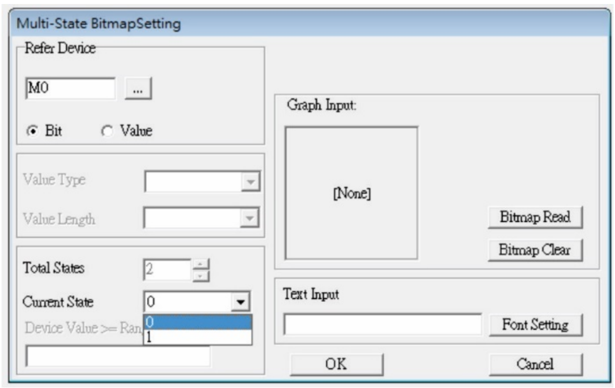
This function specifies the memory address' values for the VFD or PLC. When you press the **Function Key**, it writes a value to the memory address specified by the value for **Constant Setting**. You can use this function to initialize a variable.



(7) Clock Display Setting: on the toolbar, click . You can display the time, day, or date on the keypad. Open a new page and click once in that window to add a clock display.
Choose to display **Time**, **Day**, or **Date** on the keypad. To adjust time, go to Time Setup on the keypad's menu. You can also specify the **Frame Setting**, **Font Setting**, and **Alignment**.

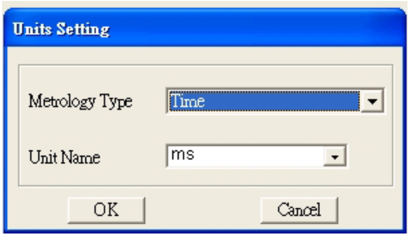


(8) Multi-state bitmap: on the toolbar, click . Open a new page and click once in that window to add a Multi-state bitmap. This object reads a bit's property value from the PLC. It defines the image or text that appears when this bit is 0 or 1. Set the initial status (**Current State**) to be 0 or 1 to define the displayed image or text.



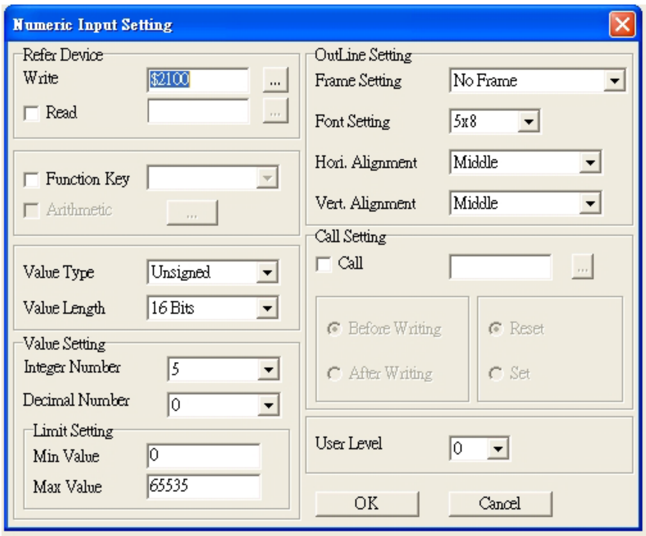
(9) Unit Measurement: on the toolbar, click .

Open a new blank page, and double-click on that window to display the **Units Setting** dialog box. Choose the Metrology Type and the Unit Name. For Metrology, the choices are Length, Square Measure, Volume/Solid Measure, Weight, Speed, Time, and Temperature. The unit name changes automatically when you change metrology type.



(10) Numeric Input Setting: on the toolbar, click 

This object enables you to provide parameters or communication ports (0x22xx) and to input numbers. Open a new file and double click on that window to display the **Numeric Input Setting** dialog box.



A. **Refer Device**: **specifies** the **Write** and the **Read** values. Enter the numbers to display and the **corresponding** parameter and communication port numbers. For example, enter 012C to Read and Write Parameter Pr.01-44.

B. **OutLine Setting**: **specifies** the **Frame Setting**, **Font Setting**, **Hori. Alignment**, and **Vert. Alignment** for the outline.

C. **Function Key**: **specifies** the function key to program on the keypad in the **Function Key** box. The corresponding key on the keypad starts to blink. Press ENTER to confirm the setting.

D. **Value Type** and **Value Length**: specify the range of the **Min Value** and **Max Value** for the **Limit Setting**. Note that the corresponding supporting values for VFD-ED must be 16 bits. 32-bit values are not supported.

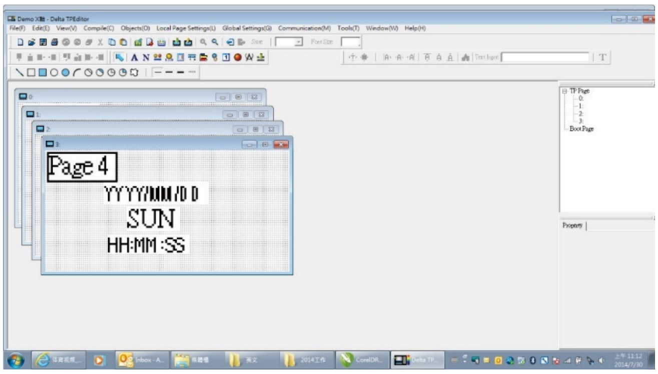
E. **Value Setting**: automatically set by **the** keypad itself.

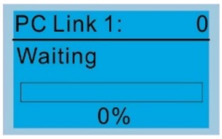
F. **Limit Setting**: specifies the range **for** the numeric input here.

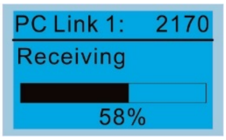
For example, if you set **Function Key** to **F1**, **Min Value** to 0 and **Max Value** to 4, when you press F1 on the keypad, then you can press Up/Down on the keypad to increase or decrease the value. Press

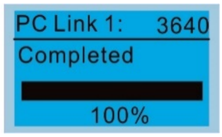
ENTER on the keypad to confirm your setting. You can also view the parameter table 01-44 to verify if you correctly entered the value.

(11) Download TP Page: Press Up / Down on the keypad to select PC Link menu item. Then press ENTER on the keypad. The screen displays “Waiting”. In TPEditor, choose a page that you have created, and then on the **Communication** menu click **Write to TP** to start downloading the page to the keypad. Then, the keypad displays “Receiving”. When you see “Completed” on the keypad screen, the download is finished. You can then press ESC on the keypad to go back to the menu screen.









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Chapter 10 Auto-tuning Process

10-1 Tuning in Easy Steps for IM

1. **Basic Parameter Settings**
   Pr.00-02 Parameter Reset
   Pr.00-14 Master Frequency Command Source
   Pr.00-15 Operation Command Source
   Pr.02-01–Pr.02-08 Multi-function Input Settings
   Pr.02-11–Pr.02-16 Multi-function Output Settings
2. **Encoder Settings**
   Pr.10-00 Selection of Encoder
   Pr.10-01 Encoder PPR
   Pr.10-02 Encoder Input Type Setting
3. **Motor Auto-tuning**
   (1) Motor Settings
   Pr.00-09 Control Mode
   Pr.01-00 Maximum Output Frequency
   Pr.01-01 Motor's Rated Frequency
   Pr.01-02 Motor's Rated Voltage
   (2) Settings for Induction Motor (IM)
   Pr.05-01 Motor Rated Current
   Pr.05-02 Motor Rated Power
   Pr.05-03 Motor Rated Speed
   Pr.05-04 Number of Motor Poles
   Pr.05-00 Motor Auto-tuning
4. **Multi-step Speed Settings**
   Pr.04-00–Pr.04-15 Multi-step Speed Setting
   Pr.01-12–Pr.01-19 Acceleration / Deceleration Time Setting
   Pr.01-24–Pr.01-27. Pr.01-29, Pr.01-30 S-curve for Acceleration and Deceleration Time Settings
5. **Elevator Related Parameters**
   Pr.11-01 Elevator Speed
   Pr.11-02 Traction Sheave Diameter
   Pr.11-03 Gear Ratio
   Pr.11-04 Suspension Ratio
   Pr.11-14 Motor Current at Acceleration
   Pr.11-05 Mechanical Inertial Ratio
6. **Trial Run**
7. **Elevator Performance Fine-tuning**

10-2 Tuning in Easy Steps for PM

1. **Basic Parameter Settings**
   Pr.00-02 Parameter Reset
   Pr.00-14 Master Frequency Command Source
   Pr.00-15 Operation Command Source
   Pr.02-01–Pr.02-08 Multi-function Input Settings
   Pr.02-11–Pr.02-16 Multi-function Output Settings
2. **Encoder Settings**
   Pr.10-00 Selection of Encoder
   Pr.10-01 Encoder PPR
   Pr.10-02 Encoder Input Type Setting
3. **Motor Auto-tuning**
   (1) Motor Settings
      Pr.00-09 Control Mode
      Pr.01-00 Maximum Output Frequency
      Pr.01-01 Motor's Rated Frequency
      Pr.01-02 Motor's Rated Voltage
   (2) Settings for Permanent Magnet Synchronous Motor (PM)
      Pr.08-01 Motor Rated Current
      Pr.08-02 Motor Rated Power
      Pr.08-03 Motor Rated Speed
      Pr.08-04 Number of Motor Poles
      Pr.11-00 System Control
      Pr.08-00 Motor Auto-tuning
4. **Multi-step Speed Settings**
   Pr.04-00–Pr.04-15 Multi-step Speed Setting
   Pr.01-12–Pr.01-19 Acceleration / Deceleration Time Setting
   Pr.01-24–Pr.01-27. Pr.01-29, Pr.01-30 S-curve for Acceleration and Deceleration Time Settings
5. **Elevator Related Parameters**
   Pr.11-01 Elevator Speed
   Pr.11-02 Traction Sheave Diameter
   Pr.11-03 Gear Ratio
   Pr.11-04 Suspension Ratio
   Pr.11-14 Motor Current at Acceleration
   Pr.11-05 Mechanical Inertial Ratio
6. **Trial Run**
7. **Elevator Performance Fine-tuning**

10-3 Descriptions of Tuning Steps

10-3-1 Basic Parameter Settings

Pr.00-02 Parameter Reset

Pr Setup 00: System Parame 01: Basic Parameter 02: Digital IN/OUT	Press ENTER	00-System Parameter 02: Parameter Reset 03: Start up Display 04: User Display
	Press ENTER	00-02 10 Parameter Reset 0–10 ADD

📖 Set Pr.00-02=9 or 10: Reset all parameters to the default. If the keypad is locked by a password, enter the password to reset to the default. The password is also erased.

Pr.00-14 Master Frequency Command Source

Pr Setup 00: System Parame 01: Basic Parameter 02: Digital IN/OUT	Press ENTER	00-System Parameter 14: Souce of Freq. 15: Source of Oper. 00: Identity Code
	Press ENTER	00-14 1 Source of Freq. 1–5 ADD

📖 Setting values:

1: RS-485 serial communication or digital keypad (KPC-CC01)

2: External analog input (See Pr.03-00)

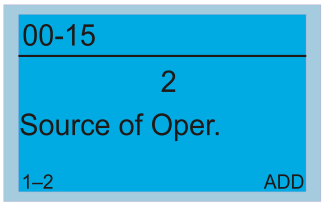
3: Digital terminal inputs

4: Direct docking mode only, contact Delta for more information.

📖 Determines the drive's master frequency source.

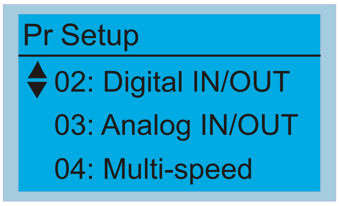
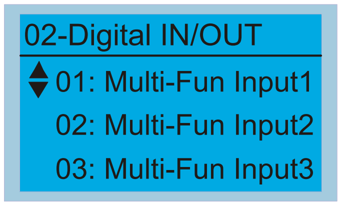
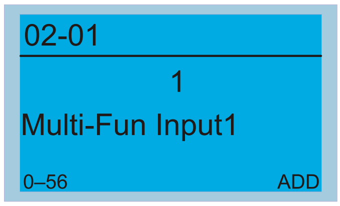
Pr.00-15 Operation Command Source

Pr Setup 00: System Parame 01: Basic Parameter 02: Digital IN/OUT	Press ENTER	00-System Parameter 15: Souce of Oper. 00: Identity Code 01: Rated Current

	Press ENTER	

Setting values:
1: External terminals (work with controller)
2: RS-485 serial communication or digital keypad (KPC-CC01) (does not work with controller)

Pr.02-01–Pr.02-08 Multi-function Input Settings

	Press ENTER	
	Press ENTER	

The default value of Pr.02-08 is 40 (Enable Drive). If you do not need this function (does not work with controller), set the setting value to 0.

Setting value:
0: No function
1: Multi-step speed command 1
2: Multi-step speed command 2
3: Multi-step speed command 3
4: Multi-step speed command 4
5: Reset
6: JOG command
7: Acceleration/deceleration speed inhibit
8: First, second acceleration/deceleration time
9: Third, fourth acceleration/deceleration time
10: EF input (Pr.07-28)
11: Reserved
12: Stop output
13–14: Reserved
15: AUI1 operation speed command
16: Reserved
17: AUI2 operation speed command
18: Emergency Stop (Pr.07-28)
19–23: Reserved
24: FWD JOG Command
25: REV JOG Command

26: Reserved
27: ASR1/ASR2 selection
28: Emergency stop (EF1) (motor coasts to stop)
29–30: Reserved
31: High torque bias (according to Pr.07-21)
32: Middle torque bias (according to Pr.07-22)
33: Low torque bias (according to Pr.07-23)
34–37: Reserved
38: Disable writing to EEPROM
39: Torque command direction (0 is positive direction)
40: Enable drive function
41: Magnetic contactor detection
42: Mechanical brake 1
43: EPS function (Emergency Power System)
44: Mechanical brake 2
45–51: Direct docking mode only
53: Terminal leveling signal for direct docking
54: Power failure signal
55: Manual emergency deceleration
56: Automatic emergency deceleration
57: Brake torque test action signal
59: AFE fault

Pr.02-11–Pr.02-16 Multi-function Output Settings

Pr Setup 02: Digital IN/OUT 03: Analog IN/OUT 04: Multi-speed	Press ENTER	02-Digital IN/OUT 11: Multi-Fun RLY1 12: Multi-Fun RLY2 13: Multi-Fun RLY3
	Press ENTER	02-11 0 Multi-Fun RLY1 0–49 ADD

Setting value:
0: No function
1: Indication during operation
2: Operation speed reached
3: Desired frequency 1 reached (Pr.02-25, Pr.02-26)
4: Desired frequency 2 reached (Pr.02-27, Pr.02-28)
5: Zero Speed (Frequency command)
6: Zero speed with stop (Frequency command)
7: Over-torque (OT1) (Pr.06-05–Pr.06-07)
8: Over-torque (OT2) (Pr.06-08–Pr.06-10)
9: Drive is ready

10: User-defined low-voltage detection (LV)
11: Malfunction indication
12: Mechanical brake release (Pr.02-29, Pr.02-30, Pr.02-37)
13: Overheat (Pr.06-14)
14: Brake transistor signal
15: Motor-controlled magnetic contactor output
16: Slip error (oSL)
17: Malfunction indication 1
18: Reserved
19: Brake transistor output error
20: Warning output
21: Over-voltage warning
22: Over-current stall prevention warning
23: Over-voltage stall prevention warning
24: Operation mode indication (Pr.00-15=1)
25: Forward command
26: Reverse command
27: Output when current ≥ Pr.02-33
28: Output when current < Pr.02-33
29: Output when frequency ≥ Pr.02-34
30: Output when frequency < Pr.02-34
31: Power generation direction and status verification
32: Power generation direction
33: Zero speed (actual output frequency)
34: Zero speed with Stop (actual output frequency)
35: Fault output option 1 (Pr.06-22)
36: Fault output option 2 (Pr.06-23)
37: Fault output option 3 (Pr.06-24)
38: Fault output option 4 (Pr.06-25)
39: Reserved
40: Speed reached (including zero speed)
41: Reserved
42: STO Output Error
43–44: Direct Docking Mode only
45: Reserved
46: Retrying after a fault has occurred indication
47: Direct Docking Mode only
48: Control output of MPSCC (Motor Phase Short Circuit Contactor)
49: Emergency power mode action
50: Speed reached Pr.02-34
51: Brake torque test finished
52: AFE reset

10-3-2 Encoder Settings

Speed feedback card selections: See Chapter 7 Speed Feedback Card Selection. Delta provides three types of PG cards, including EMED-PGABD-2, EMED-PGHSD-3, and EMED-PGHSD-4.

Pr.10-00 Selection of Encoder

Pr Setup 10: Speed Feedback 11: Advance Set 12: Access Paramet	Press ENTER	10-Speed Feedback 00: Encoder Types 01: Encoder pulses 02: PG input setting
	Press ENTER	10-00 0 Encoder Types 0–6 ADD

- When you set Pr.10-02 to 3, 4 or 5, you can set Pr.10-00 only to 0, 1 or 2, and you cannot use 3, 4, 5 and 6.
- When you set Pr.10-00 to 3, the encoder has one sine and one cosine signal for each revolution. The signal must be: 0.75–1.2 Vpp for the amplitude with phase angle 90°±5 elec. (E.g. ERN 1185 ERN 1387)
- When you set Pr.10-00 to 4 or 6, wait for two seconds after applying the power before executing the RUN command.
- When you set Pr.10-00 to 5, you must set Pr.08-09 to 360.
- Detection of the magnetic pole:
  (1) 1 or 5: The AC motor drive outputs a short circuit to detect the position of the magnetic pole. At this moment, the motor generates a little noise.
  (2) 2: The AC motor drive detects the position of the magnetic pole with the UVW encoder signal.
  (3) 3: The AC motor drive detects the position of the magnetic pole with the sine encoder signal.
  (4) 4 or 6: The AC motor drive detects the position of the magnetic pole with the communication encoder signal.
- The table below shows the correspondence among encoder, PG card and auto-tuning

PG Signal Type Setting	PG Signal Type	Applicable PG Card x=2, 3,…	Pr.08-00=1	Pr.08-00=3
Pr.10-00=1	A, B, Z	EMED-PGAB/ABD-x	N/A	N/A
Pr.10-00=2	A, B, Z+U, V, W	EMED-PGABD- x	Rolling test*1	Rolling test*1
Pr.10-00=3	SIN/COS + Sinusoidal (e.g. ERN1185, ERN1387)	EMED-PGHSD-x	Rolling test*1	Pr.11-00 Bit9=0: Rolling test*1 Pr.11-00 Bit9=1: Static test*1
Pr.10-00=4	SIN/COS + Endat 2.1 (e.g. ECN1313, ECN413)	EMED-PGSD-x	Dynamic test*1	Static test*1
Pr.10-00=5	SIN/COS	EMED-PGHSD-x	N/A	N/A
Pr.10-00=6	SIN/COS + Hiperface (e.g. SRS50/60)	EMED-PGHSD-x	Dynamic test*1	Static test*1

*1 Static: Brake engaged, no motor running. Dynamic: Brake released, motor rotates less than one revolution.
Rolling: Brake released, motor rotates more than one revolution.

Pr.10-01 Encoder PPR

Pr Setup 10: Speed Feedback 11: Advance Set 12: Access Paramet	Press ENTER	10-Speed Feedback 01: Encoder pulses 02: PG input setting 03: PG Err Treat
	Press ENTER	10-01 ppr 2048 Encoder pulses 0–25000 ADD

Sets the encoder pulses per revolution (PPR).

Pr.10-02 Encoder Input Type Setting

Pr Setup 10: Speed Feedback 11: Advance Set 12: Access Paramet	Press ENTER	10-Speed Feedback 02: PG input setting 03: PG Err Treat 04: PG Err Det. Time
	Press ENTER	10-02 0 PG input setting 0–5 ADD

When you set Pr.10-00 to 3, 4, 5 or 6, you can set Pr.10-02 only to 0, 1 or 2, and you cannot use 3, 4 and 5.

You must enter the correct pulse type for stable control.

It is suggested that you set Pr.10-02 to 1 first. When fault code PGF1 occurs or the motor does not run, set it to 2.

10-3-3 Motor Auto-tuning

10-3-3-1 Motor Settings

Pr.00-09 Control Mode

Pr Setup 00: System Parame 01: Basic Parameter 02: Digital IN/OUT	Press ENTER	00-System Parameter 09: Control Method 10: Speed Unit Sel. 11: CHG. Output DIR
	Press ENTER	00-09 0 Control Method 0–8 ADD

Mode selection:

Settings	Control Mode	Applicable Motor Type	Speed Feedback	Energy-savings	Tuning Difficulty	Ride Comfort	Speed Control Range	Motor Parameter Tuning	Basic Control	Speed Control
0	V/F	IM		Low	Low	Normal	1:50		V/F control	Voltage control
1	VFPG	IM	✓	Medium	Medium	Normal	1:50	✓	Frequency control	Frequency control
2	SVC	IM		Medium	Medium	Normal	1:50	✓	Voltage control	Voltage control
3	FOCPG	IM	✓	High	High	Good	1:1000	✓	Vector control	Frequency control
8	FOCPM	PM	✓	High	High	Good	1:1000	✓	Vector control	Frequency control

Determines the AC motor drive control method.

0: You can set the V/F ratio as required and control multiple motors simultaneously.

1: You can use a PG card with an Encoder for close-loop speed control.

2: Use auto-tuning for optimal settings of the control parameters.

3: To increase torque and the accuracy of the speed control (1:1000).

8: To increase torque and the accuracy of the speed control (1:1000). This setting is for use only with permanent magnet motors. The other settings are for use with induction motors.

Pr.01-00 Maximum Output Frequency

Pr Setup 01: Basic Parameter 02: Digital IN/OUT 03: Analog IN/OUT	Press ENTER	01-Basic Parameter 00: Max Output Freq. 01: Motor1 Fbase 02: Max Out-Volt 1
	Press ENTER	01-00 Hz 60.00 Max Output Freq. 5.00–299.00 ADD

Determines the AC motor drive maximum output frequency, ranging from 5–299 Hz.

Pr.01-01 Motor's Rated Frequency

Pr Setup 01: Basic Parameter 02: Digital IN/OUT 03: Analog IN/OUT	Press ENTER	01-Basic Parameter 01: Motor1 Fbase 02: Max Out-Volt 1 03: Mid Out-Freq.1-1
	Press ENTER	01-01 Hz 60.00 Motor1 Fbase 0.00–299.00 ADD

Set this parameter according to the rated frequency on the motor nameplate. If the motor is 60 Hz, set this parameter to 60. If the motor is 50 Hz, set it to 50.

Pr.01-02 Motor's Rated Voltage

Pr Setup 01: Basic Parameter 02: Digital IN/OUT 03: Analog IN/OUT	Press ENTER	01-Basic Parameter 02: Max Out-Volt 1 03: Mid Out-Freq.1-1 04: Mid Out-Volt 1-1
	Press ENTER	01-02 V 220.0 Max Out-Volt 1 0.0–255.0 ADD

Set this parameter according to the rated voltage on the motor nameplate. If the motor is 220 V, set this parameter to 220.0. If the motor is 200 V, set this parameter to 200.0.

10-3-3-2 Settings for Induction Motor (IM)

Pr.05-01 Motor Rated Current

Pr Setup 05: IM Parameter 06: Protection 07: Special	Press ENTER	05-IM Parameter 01: IM Motor Rated A 02: IM Motor Rated P 03: IM Motor Rated
	Press ENTER	05-01 Amps 16.36 IM Motor Rated A 0.00–27.27 ADD

📖 Set this value according to the rated motor frequency from the motor nameplate.

Pr.05-02 Motor Rated Power

Pr Setup 05: IM Parameter 06: Protection 07: Special	Press ENTER	05-IM Parameter 02: IM Motor Rated P 03: IM Motor Rated 04: IM Motor Poles
	Press ENTER	05-02 Kw 3.75 IM Motor Rated P 0.00–655.35 ADD

📖 Set the rated power of the motor. The default is the power of the drive.

Pr.05-03 Motor Rated Speed

Pr Setup 05: IM Parameter 06: Protection 07: Special	Press ENTER	05-IM Parameter 03: IM Motor Rated 04: IM Motor Poles 05: IM Motor No-Load
	Press ENTER	05-03 RPM 1710 IM Motor Rated 0–65535 ADD

📖 Sets the motor rated speed from the value on the motor nameplate.

Pr.05-04 Number of Motor Poles

Pr Setup 05: IM Parameter 06: Protection 07: Special	Press ENTER	05-IM Parameter 04: IM Motor Poles 05: IM Motor No-Load 06: IM Motor Rs
	Press ENTER	05-04 4 IM Motor Poles 2–48 ADD

📖 Sets the number of motor poles (must be an even number).

Pr.05-00 Motor Auto-tuning

Pr Setup 05: IM Parameter 06: Protection 07: Special	Press ENTER	05-IM Parameter 00: IM Auto-Tuning 01: IM Motor Rated A 02: IM Motor Rated P
	Press ENTER	05-00 0 IM Auto-Tuning 0–2 ADD

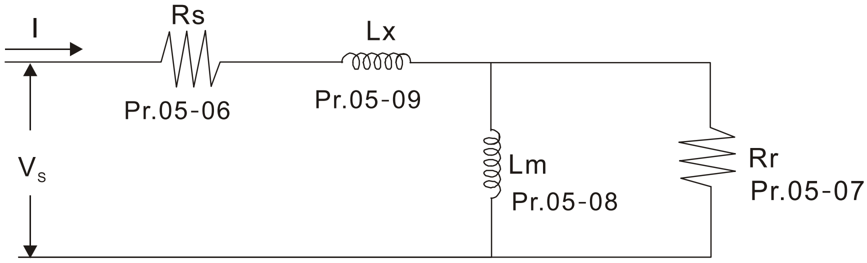
📖 Position the elevator near the middle floors before auto-tuning.

📖 Motor auto-tuning:

Set Pr.05-00 to 1 or 2, and then press the RUN key on the digital keypad KPC-CC01 (Pr.00-15=2) to start auto-tuning. Or when the drive is in manual mode (inspection), run the upward operation or downward operation (Pr.00-15=1) to start auto-tuning immediately. In the process of auto-tuning, an "Auto tuning" warning continuously displays on the digital keypad until it is finished.

📖 Pay attention to the following notes when Pr.05-00=1 (dynamic test):

1. Make sure that all the drive parameters are set to defaults and the motor wiring is correct.
2. Make sure the motor is not loaded before auto-tuning, and that the shaft is not connected to any belt or gear motor. Set this parameter to 2 if you cannot separate the motor from the load.
3. Enter the correct values for Pr.01-01, Pr.01-02, Pr.05-01, Pr.05-02, Pr.05-03 and Pr.05-04. Refer to motor capacity to set the acceleration/deceleration time.
4. After auto-tuning is finished, check if Pr.05-05–Pr.05-09 all have values.
5. Equivalent circuit diagram:



Equivalent circuit for VFD-ED Series

NOTE:

- In torque/vector control mode, do not run motors in parallel.
- Do not use torque/vector control mode if the motor rated power exceeds the rated power for the AC motor drive.
- The no-load current is usually 20–50% of the rated current.
- The rated speed cannot be larger or equal to 120 f/p (f: output frequency Pr.01-01, p: Number of Motor Poles Pr.05-04).
- After auto-tuning is finished, activate the drive again to make it operate when the auto-tuning command source is the external terminal.

10-3-3-3 Settings for Permanent Magnet Synchronous Motor (PM)

Pr.08-01 Motor Rated Current

Pr Setup 08: PM Parameter 09: Communication 10: Speed Feedback	Press ENTER	08-PM Parameter 01: PM Motor Rated A 02: PM Motor Rated P 03: PM Motor Rated
	Press ENTER	08-01 Amps 16.36 PM Motor Rated A 0.00~27.27 ADD
📖 Sets according to the motor rated current as indicated on the motor nameplate.		

Pr.08-02 Motor Rated Power

Pr Setup 08: PM Parameter 09: Communication 10: Speed Feedback	Press ENTER	08-PM Parameter 02: PM Motor Rated P 03: PM Motor Rated 04: PM Motor Poles
	Press ENTER	08-02 Kw 0.00 PM Motor Rated P 0.00~655.35 ADD
📖 Sets the motor rated power. The default is the power of the drive.		

Pr.08-03 Motor Rated Speed

Pr Setup 08: PM Parameter 09: Communication 10: Speed Feedback	Press ENTER	08-PM Parameter 03: PM Motor Rated 04: PM Motor Poles 05: PM Motor Rs
	Press ENTER	08-03 RPM 1710 PM Motor Rated 0~65535 ADD
📖 Sets the motor rated speed according to the motor nameplate.		

Pr.08-04 Number of Motor Poles

Pr Setup 08: PM Parameter 09: Communication 10: Speed Feedback	Press ENTER	08-PM Parameter 04: PM Motor Poles 05: PM Motor Rs 06: PM Motor Ld
	Press ENTER	08-04 4 PM Motor Poles 2–96 ADD

📖 Sets the number of motor poles (must be an even number).

Pr.11-00 System Control

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 00: System Control 01: Fmax to Lift Spd 02: Traction Sheave
	Press ENTER	11-00 Hex 0000h F E D C B A 9 8 7 6 5 4 3 2 1 0 □□□□□□□□□□□□□□□□ 0000h–FFFFh ADD

📖 When Bit 9=1, PGHSD-x with load static PG origin auto-tuning function is enabled. This function is valid only when the mechanical brake is in engaged status.

Pr.08-00 Motor Auto-tuning

Pr Setup 08: PM Parameter 09: Communication 10: Speed Feedback	Press ENTER	08-PM Parameter 00: PM Auto-Tuning 01: PM Motor Rated A 02: PM Motor Rated P
	Press ENTER	08-00 0 PM Auto-Tuning 0–3 ADD

📖 Position the elevator near the middle floors before auto-tuning.

📖 Auto-tuning process: 2, and then 1 or 3.

📖 Motor auto-tuning:

Set Pr.08-00 to 1 to 3, and then press the RUN key on the digital keypad KPC-CC01 (Pr.00-15=2) to start auto-tuning. Or when the drive is in manual mode (inspection), run the upward operation or downward operation (Pr.00-15=1) to start auto-tuning immediately. In the process of auto-tuning, an “Auto tuning” warning continuously displays on the digital keypad until it is finished.

📖 Pr.08-00=2: Motor auto-tuning is static test:

1. Make sure that all the drive parameters are set to defaults and the motor wiring is correct.
2. Enter the correct values for Pr.01-01, Pr.01-02, Pr.08-01, Pr.08-02, Pr.08-03 and Pr.08-04. Refer to motor capacity to set the acceleration/deceleration time.
3. Note that the motor will run! The shaft needs to be locked by an external force.
4. After auto-tuning is finished, check if Pr.08-05, Pr.08-07, and Pr.08-08 all have values.

📖 Pr.08-00=1: Auto-measures the angle between the magnetic pole and the PG origin. Pay attention to the following notes when measuring: (dynamic test)

1. Unload before auto-tuning.
2. If the drive controls the brake, the drive can auto-tune according to the normal sequence after you complete the wiring and set the brake control parameters.
3. If the host controller controls the brake, make sure that the brake is in release status before auto-tuning.

📖 Pr.08-00=3: Auto-measures the angle between the magnetic pole and the PG origin. Pay attention to the following notes when measuring: (static test)

1. The motor can be loaded or unloaded before auto-tuning.
2. See the reference table for auto-tuning for Pr.10-00 (PG Signal Type).
3. If the drive controls the brake, the drive can auto-tune according to the normal sequence after you complete the wiring and set the brake control parameters.
4. If the host controller controls the brake, make sure that the brake is in release status before auto-tuning.
5. Make sure the setting for Pr.10-02 is correct. Incorrectly setting Pr.10-02 causes incorrect positioning of the magnetic pole and results in the wrong angle between the magnetic pole and PG origin.

NOTE:

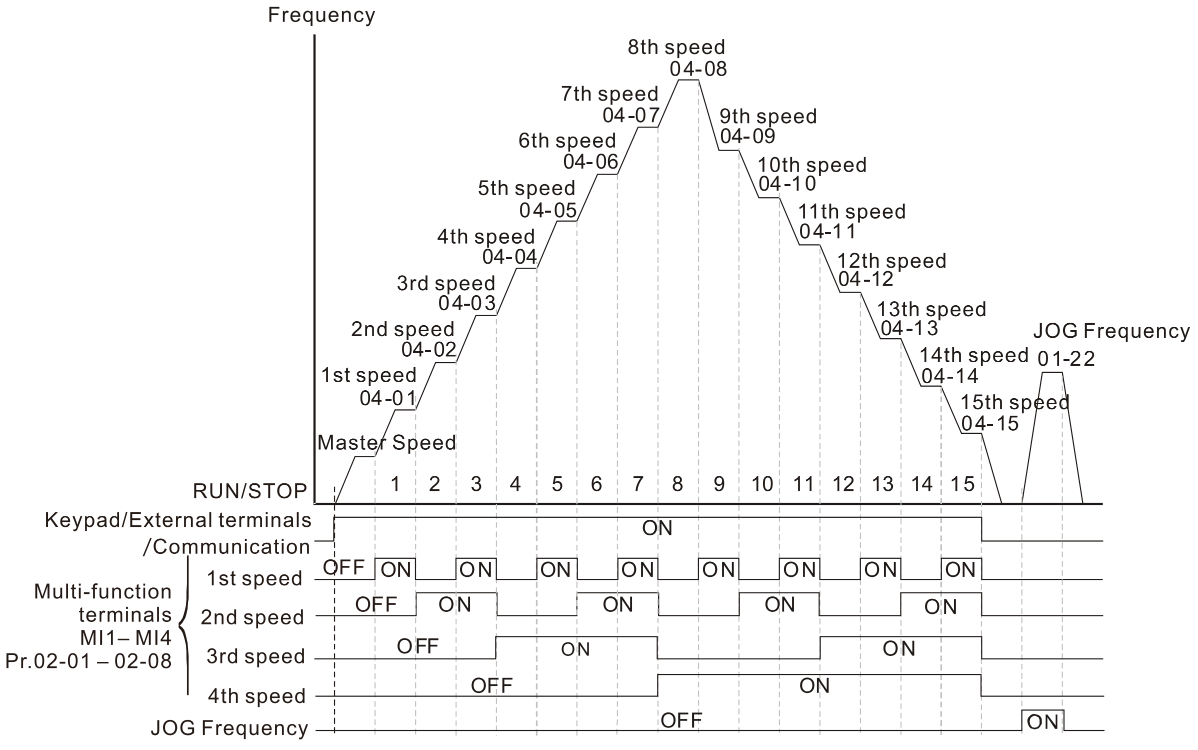
- The entered rated speed cannot be larger than or equal to 120 f/p.
- Note that if the contactor and brake are not controlled by the AC motor drive, release it manually.
- Set Pr.08-00 to 1 (unloaded motor) for accurate calculation. If you need to execute this function with a loaded motor, balance the carriage before execution.
- If you do not balance the carriage in a measured environment, you can execute this function with a loaded motor by setting Pr.08-00= 3. It will have a difference of 15–30o for different encoder types.
- “Auto Tuning Err” displays on the digital keypad when stopping due to an AC motor drive fault or human error, which means the detection fails. Check the wiring connections of the AC motor drive If “PG Fbk Error” displays on the digital keypad, change the setting of Pr.10-02 (if set to 1, change it to 2). If “PG Fbk Loss” displays on the digital keypad, check the feedback of Z-phase pulse.

10-3-4 Multi-step Speed Settings

Pr.04-00–Pr.04-15 Multi-step Speed Setting

Pr Setup 04: Multi-Speed 05: IM Parameter 06: Protection	Press ENTER	04-Multi-Speed 00: Multi-Speed 0 01: Multi-Speed 1 02: Multi-Speed 2
	Press ENTER	04-00 Hz 0.00 Multi-Speed 0 0.00–299.00 ADD

- The multi-function input terminals (refer to Pr.02-01–Pr.02-08) select one of the AC motor drive multi-step speeds (including the master frequency, in total 16 speeds). Pr.04-00–Pr.04-15 determine the speeds (frequencies) as shown above.
- When Pr.00-14 = 1, the master frequency is Pr.01-00.
- When Pr.00-14 = 3, the master frequency is Pr.04-00.

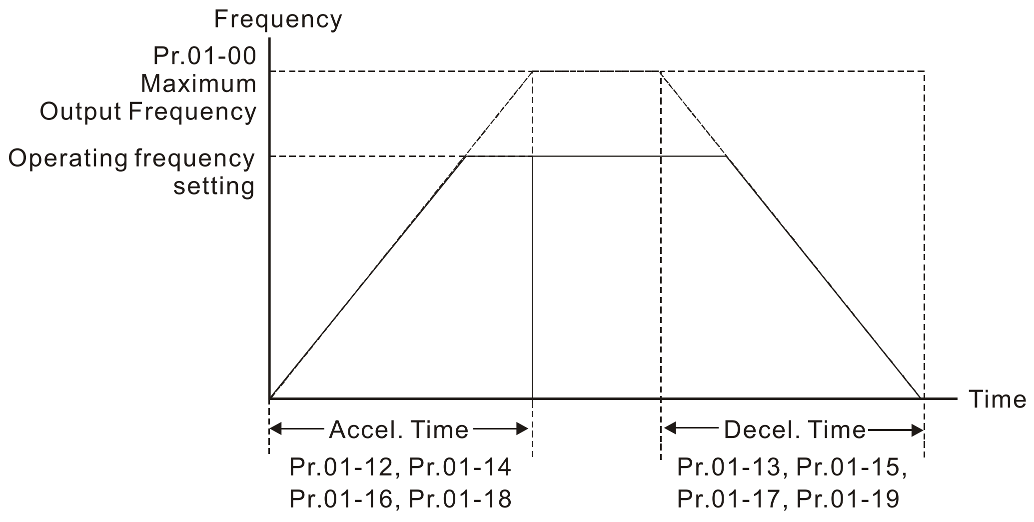


Multi-speed via External Terminals

Pr.01-12–Pr.01-19 Acceleration / Deceleration Time Setting

Pr Setup 01: Basic Parameter 02: Digital IN/OUT 03: Analog IN/OUT	Press ENTER	01-Basic Parameter 12: 1st Accel Time 13: 1st Decel Time 14: 2nd Accel Time
	Press ENTER	01-12 sec 3.00 1st Accel Time 0.00–600.00 ADD

- The Acceleration Time determines the time required for the AC motor drive to ramp from 0.00 Hz to the Maximum Output Frequency (Pr.01-00). The Deceleration Time determines the time required for the AC motor drive to decelerate from the Maximum Output Frequency (Pr.01-00) down to 0.00 Hz.
- Select the Acceleration/Deceleration Time 1, 2, 3, 4 with the multi-function input terminal settings. The defaults are Acceleration Time 1 and Deceleration Time 1.
- When there is a large opposing torque and inertial torque for the load, and the acceleration and deceleration time settings are less than the necessary value, then they enable the torque limit and stall prevention functions. When this happens, the actual acceleration and deceleration time are longer than the settings.

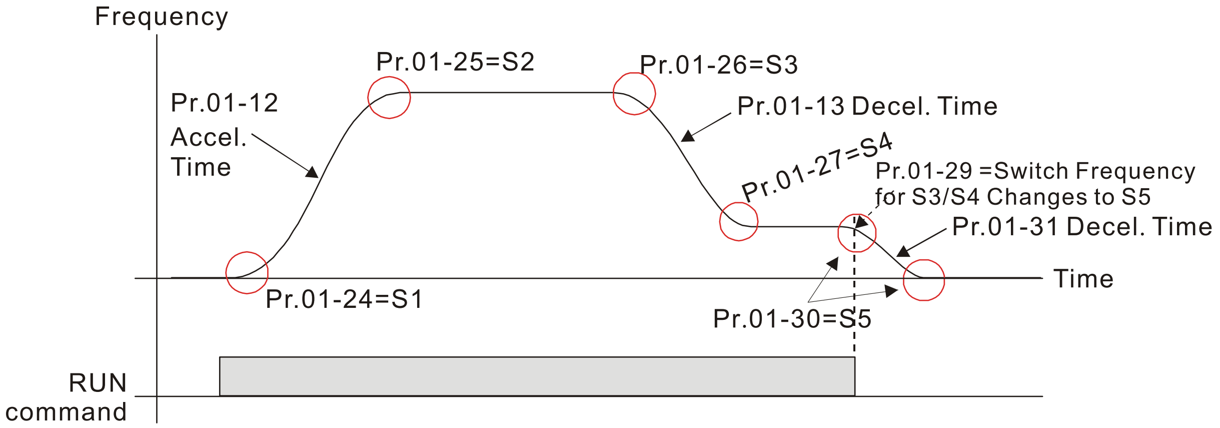


Acceleration & Decelertion Time Setting

Pr.01-24–Pr.01-27. Pr.01-29, Pr.01-30 S-curve for Acceleration and Deceleration Time Settings

Pr Setup 01: Basic Parameter 02: Digital IN/OUT 03: Analog IN/OUT	Press ENTER	01-Basic Parameter 24: S Curve Time 1 25: S Curve Time 2 26: S Curve Time 3
	Press ENTER	01-24 sec 1.00 S Curve Time 1 0.00–25.00 ADD

- Using an S-curve gives the smoothest transition between speed changes. The acceleration and deceleration curve adjusts the acceleration and deceleration S-curve. When enabled, the motor drive produces a different acceleration and deceleration curve according to the acceleration and deceleration time.
- The Actual Acceleration Time = selected acceleration Time + (Pr.01-24 + Pr.01-25) ÷ 2. The Actual Deceleration Time = selected deceleration Time + (Pr.01-26 + Pr.01-27 + Pr.01-30 x 2) ÷ 2.
- Use Pr.01-29 to set the switch frequency between S4 and S5 for smooth stopping.
- Set Pr.01-29 to the leveling speed of the elevator.



10-3-5 Elevator Related Parameters

Pr.11-01 Elevator Speed

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 01: Fmax to Lift Spd 02: Traction Sheave 03: Gear Ratio
	Press ENTER	11-01 m/s 1.00 Fmax to Lift Spd 0.10–4.00 ADD
Elevator speed (m/sec. = m/min. / 60)		

Pr.11-02 Traction Sheave Diameter

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 02: Traction Sheave 03: Gear Ratio 04: Suspension Ratio
	Press ENTER	11-02 mm 400 Traction Sheave Diam 100–2000 ADD

Pr.11-03 Gear Ratio

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 03: Gear Ratio 04: Suspension Ratio 05: Mech Inertia Ratio
	Press ENTER	11-03 1.00 Gear Ratio 1.00–100.00 ADD

Pr.11-04 Suspension Ratio

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 04: Suspension Ratio 05: Mech Inertia Ratio 06: Zero SP Loop BW
	Press ENTER	11-04 1 Suspension Ratio 0–3 ADD

Setting value:

0 = 1: 1

1 = 2: 1

2 = 4: 1

3 = 8: 1

Pr.11-14 Motor Current at Acceleration

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 14: Max. ACC Current 15: Max Meter per S 16: Disp address
	Press ENTER	11-14 % 150 Max. ACC Current 50–200 ADD

The maximum motor current measured when the elevator is tuning in automatic mode.

Pr.11-05 Mechanical Inertial Ratio

Pr Setup 11: Advance Set 12: Access Paramet 13: Display User-Set	Press ENTER	11-Advance Set 05: Mech Inertia Ratio 06: Zero SP Loop BW 07: Low SP Loop BW
	Press ENTER	11-05 % 40 Mech Inertia Ratio 1–300 ADD

You can calculate the load inertia according to the settings of motor parameters, Pr.11-01 to Pr.11-04 and Pr.11-14 Motor Current at Acceleration and Pr.11-15 Carriage Acceleration. You can use this parameter to adjust the mechanical inertia ratio.

📖 Mechanical inertia reference value (%):

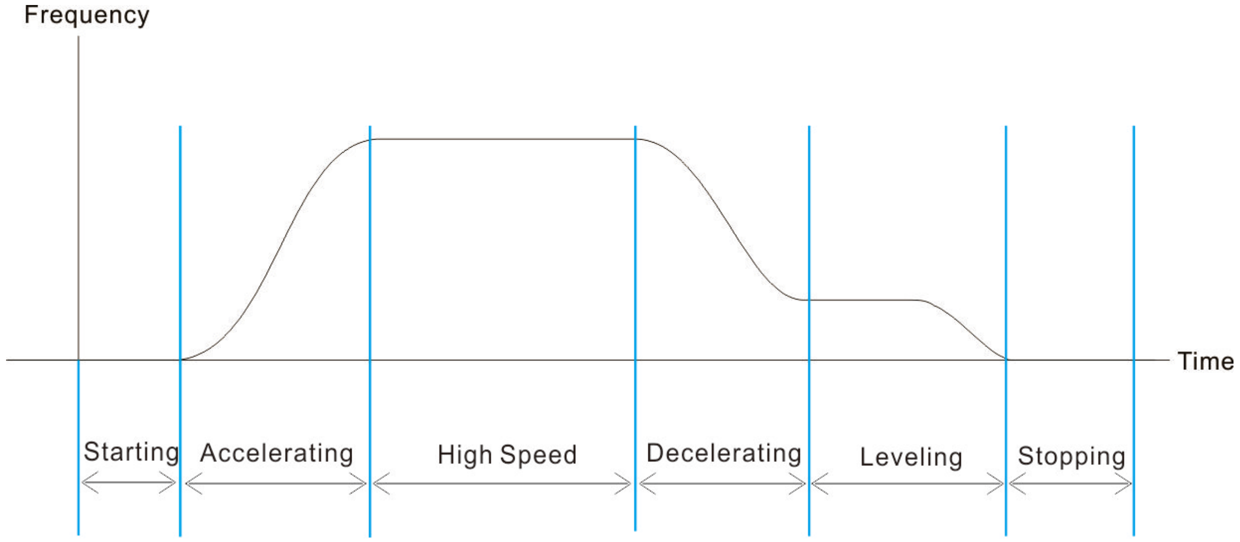
Load / Motor	IM	PM
Without load	40	10
With load	80–120	40

10-3-6 Trial Run

Test method:

1. Position the elevator near the middle floors.
2. Enter the correct values for Pr.00-14 and Pr.00-15.
3. Use the upward / downward operation of the inspection mode to execute the trial run.

10-4 Elevator Performance Fine-tuning



Stage	Function	Pr.	Control Mode	Description	Settings	Default
All	Slip Compen-sation	05-13	SVC	Slip Compensation Gain	0.00–10.00	1.00
		05-23	VF, SVC	Slip Compensation Gain % (Power Generation Mode)	0.0–100.0%	0.0
		05-24	VF, SVC	Slip Compensation Gain % (Electricity Mode)	0.0–100.0%	0.0
	System Control	11-00	FOCPG, FOCPM	System Control	Bit 0=1: ASR auto-tuning; PDFF enabled (Pr.11-06–11-08, Pr.11-19) Bit 7=1: Zero speed position control is enabled (Pr.10-19, Pr.10-22–10-24)	0000h
	Comfort	11-05	FOCPG, FOCPM	Mechanical Inertial Ratio	1–300%	40
Starting	Delay Time	02-31	VF, VFPG, SVC, FOCPG, FOCPM	Magnetic Contactor Contracting Delay Time between Drive and Motor	0.010–65.000 sec.	0.200
		02-29	VF, VFPG, SVC, FOCPG, FOCPM	Brake Release Delay Time when Elevator Starts	0.000–65.000 sec.	0.250
	Start-up Adjustment	01-08	VF, VFPG, SVC	Fourth Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0

Stage	Function	Pr.	Control Mode	Description	Settings	Default
	Comfort	11-06	FOCPG, FOCPM	Zero Speed Bandwidth	1–40 Hz	10
	Torque Check	02-33	VF, VFPG, SVC, FOCPG, FOCPM	External Terminal Output Current Level	0–100% (motor drive rated current)	0
		02-37	VF, VFPG, SVC, FOCPG, FOCPM	Torque Check	0: Disable 1: Enable	0
	Rollback	07-02	VF, VFPG, SVC	DC Brake Current Level at Start-up	0–100% (motor drive rated current)	0
		07-03	VF, VFPG, SVC, FOCPG, FOCPM	DC Brake Activation Time	0.0–60.0 sec.	0.7
		10-19	FOCPM	Zero Speed Position Control Gain (P)	0.00–655.00%	80.00
		10-22	FOCPM	Zero Speed Position Control Holding Time	0.001–65.535 sec.	0.250
		10-24	FOCPM	Zero Speed Position Control Activation Mode Selection	0: After the brake release set in Pr.02-29 1: After the brake signal input (Pr.02-01–Pr.02-08 is set to 42)	0
Accelerating	Multi-step Speed	01-12	VF, VFPG, SVC, FOCPG, FOCPM	Accel. Time 1	0.00–600.00 sec.	3.00
		01-24	VF, VFPG, SVC, FOCPG, FOCPM	S-curve for Acceleration Begin Time S1	0.00–25.00 sec.	1.00
		01-25	VF, VFPG, SVC, FOCPG, FOCPM	S-curve for Acceleration Arrival Time S2	0.00–25.00 sec.	1.00
	Comfort	01-04	VF, VFPG	Second Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0
		01-06	VF, VFPG	Third Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0
		11-07	FOCPG, FOCPM	Low Speed Bandwidth	1–40 Hz	10
		11-08	FOCPG, FOCPM	High Speed Bandwidth	1–40 Hz	10
High Speed	Comfort	11-08	FOCPG, FOCPM	High Speed Bandwidth	1–40 Hz	10
		11-09	FOCPG, FOCPM	PDFF Gain Value	0–200%	30

Stage	Function	Pr.	Control Mode	Description	Settings	Default
Decelerating	Multi-step Speed	01-13	VF, VFPG, SVC, FOCPG, FOCPM	Decel. Time 1	0.00–600.00 sec.	2.00
		01-26	VF, VFPG, SVC, FOCPG, FOCPM	S-curve for Deceleration Begin Time S3	0.00–25.00 sec.	1.00
		01-27	VF, VFPG, SVC, FOCPG, FOCPM	S-curve for Deceleration Arrival Time S4	0.00–25.00 sec.	1.00
	Comfort	01-04	VF, VFPG	Second Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0
		01-06	VF, VFPG	Third Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0
		11-07	FOCPG, FOCPM	Low Speed Bandwidth	1–40 Hz	10
		11-08	FOCPG, FOCPM	High Speed Bandwidth	1–40 Hz	10
Leveling	Comfort	11-07	FOCPG, FOCPM	Low Speed Bandwidth	1–40 Hz	10
Stopping	Delay Time	02-30	VF, VFPG, SVC, FOCPG, FOCPM	Brake Engage Delay Time when Elevator Stops	0.000–65.000 sec.	0.250
		02-32	VF, VFPG, SVC, FOCPG, FOCPM	Magnetic Contactor Release Delay Time between Drive and Motor	0.010–65.000 sec.	0.200
	Elevator Parking	01-29	VF, VFPG, SVC, FOCPG, FOCPM	Switch Frequency for S3/S4 Changes to S5	0.00–299.00Hz	0.00
		01-30	VF, VFPG, SVC, FOCPG, FOCPM	S-curve for Deceleration Arrival Time S5	0.00–25.00 sec.	1.00
		01-31	VF, VFPG, SVC, FOCPG, FOCPM	Deceleration Time when Operating without RUN Command	0.00–600.00 sec.	2.00
	Comfort	07-29	FOCPG, FOCPM	Time for Decreasing Torque at Stop	0.000–5.000 sec.	0.000
		11-19	FOCPG, FOCPM	Zero Speed Parking Bandwidth	1–40 Hz	10
	Torque Check	02-33	VF, VFPG, SVC, FOCPG, FOCPM	External Terminal Output Current Level	0–100% (motor drive rated current)	0

Stage	Function	Pr.	Control Mode	Description	Settings	Default
		02-37	VF, VFPG, SVC, FOCPG, FOCPM	Torque Check	0: Disable 1: Enable	0
	DC Brake	07-30	VF, VFPG, SVC	DC Brake Current Level at Stop	0–100% (motor drive rated current)	0
		07-04	VF, VFPG, SVC, FOCPG, FOCPM	DC Brake Stopping Time	0.0–60.0 sec.	0.7

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Chapter 11 Summary of Parameter Settings

This chapter provides a summary of parameter settings including the ranges and defaults that help you set the parameters. You can set, change, and reset the parameters using the digital keypad.

NOTE:

1. ✔: Indicates a parameter that you can set during operation.
2. For details on parameters, refer to Chapter 12 Descriptions of Parameter Settings.
3. ◆ indicates that the parameters or the setting values only apply on the Direct Docking Mode. The actual functions of each elevator controller vary from one to another. For more information, please contact Delta.
4. The parameters described in this user manual are designed for multi-step speed mode. The defaults for direct docking mode are different from the defaults described in this user manual. If you need to use the direct docking mode, contact Delta for more information.
5. The following are abbreviations of different types of motors:
   - IM: Induction motor
   - PM: Permanent magnet synchronous AC motor

00 Drive Parameters

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
00-00	AC Motor Drive Identity Code	108: 220 V, 2.2 kW, 3 HP (single-phase) 110: 220 V, 3.7 kW, 5 HP (single-phase) 10: 230V, 4.0 kW, 5 HP 11: 460V, 4.0 kW, 5 HP 12: 230V, 5.5 kW, 7.5 HP 13: 460V, 5.5 kW, 7.5 HP 14: 230V, 7.5 kW, 10 HP 15: 460V, 7.5 kW, 10 HP 16: 230V, 11 kW, 15 HP 17: 460V, 11 kW, 15 HP 18: 230V, 15 kW, 20 HP 19: 460V, 15 kW, 20 HP 20: 230V, 18.5 kW, 25 HP 21: 460V, 18.5 kW, 25 HP 22: 230V, 22 kW, 30 HP 23: 460V, 22 kW, 30 HP 24: 230V, 30 kW, 40 HP 25: 460V, 30 kW, 40 HP 26: 230V, 37 kW, 50 HP 27: 460V, 37 kW, 50 HP 29: 460V, 45 kW, 60 HP 31: 460V, 55 kW, 75 HP 33: 460V, 75 kW, 100 HP	Read Only	○	○	○	○	○
00-01	AC Motor Drive Rated Current Display	Display by model	Read only	○	○	○	○	○
00-02	Parameter Reset	0: No function	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			1: Read only 5: Direct docking mode only ◆ 8: Keypad locked 9: Reset all parameters to defaults (base frequency is 50 Hz) 10: Reset all parameters to defaults (base frequency is 60 Hz)						
〃	00-03	Start-up Display	0: Frequency command value 1: The actual output frequency 2: DC bus voltage 3: Output current 4: Output voltage 5: User-defined (Pr.00-04)	0	○	○	○	○	○
〃	00-04	Content of Multi-function Display	0: Display the output current supplied to the motor from the drive (A) (Unit: Amp) 1: Reserved 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 terminals U, V, and W output voltage of the drive (E) (Unit: V_{AC}) 5: Display the terminals U, V, and W output power factor angle to the motor (n) (Unit: deg) 6: Display the terminals U, V, and W output power to the motor (P) (Unit: kW) 7: Display the actual motor speed in rpm (r) (Unit: rpm) 8: Display the drive's estimated output torque in %; the motor's rated torque is 100% (t) (Unit: %) 9: Display the PG feedback (G) (See Pr.10-00 and Pr.10-01) 10: Display the electrical angle of drive output (d) (Unit: deg) 11: Display the AUI1 analog input terminal signal (1.) (Unit: %) 12: Reserved 13: Display the AUI2 analog input terminal signal (Unit: %) 14: Display the drive's heat sink temperature (t) (Unit: °C) 15: Display the IGBT temperature (T) (Unit: °C) 16: Display digital input status ON/OFF (i) 17: Display digital output status ON/OFF (o)	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			18: Display the step speed of multi-step speed that is executing (S) 19: The corresponding CPU digital input pin status (i.) 20: The corresponding CPU digital output pin status (o.) 21–23: Reserved 24: Output AC voltage when malfunction occurred (E) (Unit: V_{AC}) 25: Output DC voltage when malfunction occurred (v) (Unit: V_{DC}) 26: Motor frequency when malfunction occurred (H) (Unit: Hz) 27: Output current when malfunction occurred (A) (Unit: Amp) 28: Output frequency when malfunction occurred (F) (Unit: Hz) 29: Frequency command when malfunction occurred (F) (Unit: Hz) 30: Output power when malfunction occurred (P) (Unit: kW) 31: Output torque when malfunction occurred (t) (Unit: %) 32: Input terminal status when malfunction occurred (i) 33: Output terminal status when malfunction occurred (o) 34: Drive status when malfunction occurred (s) 35: Display MI and MO status on digital keypad 36: CAN communication interference index (c) (Unit: %) 37: Multi-function display selection (q) (Unit: %) 40: Elevator actual speed (Unit: m/s)						
〆	00-05	User-Defined Coefficient K	Digit 4: number of decimal points (0–3) Digit 3–0: 40–9999	0	○	○	○	○	○
	00-06	Software Version	READ ONLY	##.##	○	○	○	○	○
〆	00-07	Password Input	1–9998, 10000–65535 0–2: number of wrong password attempts	0	○	○	○	○	○
〆	00-08	Password Set	1–9998, 10000–65535 0: No password set or successful input in Pr.00-07 1: Password has been set	0	○	○	○	○	○
	00-09	Control Method	0: V/F control (V/F) 1: V/F control + Encoder (VFPG) 2: Sensorless Vector Control (SVC) 3: FOC vector control + Encoder (FOCPG)	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			8: FOC Permanent Motor control (FOCPM)						
✐	00-10	Speed Unit	0: Hz 1: m/s 2: ft/s 3: Direct docking mode only ◆	0	○	○	○	○	○
	00-11	Output Direction Selection	0: FWD: counterclockwise, REV: clockwise 1: FWD: clockwise, REV: counterclockwise	0	○	○	○	○	○
✐	00-12	Carrier Frequency	2–15 kHz	12	○	○	○	○	○
✐	00-13	Automatic Voltage Regulation (AVR) Function	0: Enable AVR 1: Disable AVR 2: Disable AVR when deceleration stop	0	○	○	○	○	○
✐	00-14	Master Frequency Command Source	1: RS-485 serial communication or digital keypad (KPC-CC01) 2: External analog input (Pr.03-00) 3: Digital terminal inputs (Pr.04-00–Pr.04-15) 4: Direct docking mode only ◆	1	○	○	○	○	○
✐	00-15	Operation Command Source	1: External terminals 2: RS-485 serial communication or digital keypad (KPC-CC01)	1	○	○	○	○	○

01 Basic Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
	01-00	Maximum Output Frequency	5.00–299.00 Hz	60.00/ 50.00	○	○	○	○	○
	01-01	First Output Frequency Setting (base frequency / motor's rated frequency)	0.00–299.00 Hz	60.00/ 50.00	○	○	○	○	○
	01-02	First Output Voltage Setting (base voltage/ motor's rated voltage)	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	220.0 440.0	○	○	○	○	○
	01-03	Second Output Frequency Setting	0.00–299.00 Hz	0.50	○	○			
✔	01-04	Second Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0	○	○			
	01-05	Third Output Frequency Setting	0.00–299.00 Hz	0.50	○	○			
✔	01-06	Third Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0	○	○			
	01-07	Fourth Output Frequency Setting	0.00–299.00 Hz	0.00	○	○	○	○	
✔	01-08	Fourth Output Voltage Setting	230V models: 0.1–255.0 V 460V models: 0.1–510.0 V	5.0 10.0	○	○	○		
	01-09	Starting 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	Accel. Time 1	0.00–600.00 sec.	3.00	○	○	○	○	○
✔	01-13	Decel. Time 1	0.00–600.00 sec.	2.00	○	○	○	○	○
✔	01-14	Accel. Time 2	0.00–600.00 sec.	3.00	○	○	○	○	○
✔	01-15	Decel. Time 2	0.00–600.00 sec.	2.00	○	○	○	○	○
✔	01-16	Accel. Time 3	0.00–600.00 sec.	3.00	○	○	○	○	○
✔	01-17	Decel. Time 3	0.00–600.00 sec.	2.00	○	○	○	○	○
✔	01-18	Accel. Time 4	0.00–600.00 sec.	3.00	○	○	○	○	○
✔	01-19	Decel. Time 4	0.00–600.00 sec.	2.00	○	○	○	○	○
✔	01-20	JOG Acceleration Time	0.00–600.00 sec.	1.00	○	○	○	○	○
✔	01-21	JOG Deceleration Time	0.00–600.00 sec.	1.00	○	○	○	○	○
✔	01-22	JOG Frequency	0.00–299.00 Hz	6.00	○	○	○	○	○
✔	01-23	Switch Frequency between First and Fourth Accel./ Decel.	0.00–299.00 Hz	0.00	○	○	○	○	○
✔	01-24	S-curve for Acceleration Begin Time S1	0.00–25.00 sec.	1.00	○	○	○	○	○
✔	01-25	S-curve for Acceleration Arrival Time S2	0.00–25.00 sec.	1.00	○	○	○	○	○
✔	01-26	S-curve for Deceleration	0.00–25.00 sec.	1.00	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
		Begin Time S3							
〆	01-27	S-curve for Deceleration Arrival Time S4	0.00–25.00 sec.	1.00	○	○	○	○	○
	01-28	Mode Selection when Frequency < Fmin	0: Output waiting 1: Zero-speed operation 2: Fmin (fourth output frequency setting)	1	○	○	○		
〆	01-29	Switch Frequency for S3/S4 Changes to S5	0.00–299.00 Hz	0.00	○	○	○	○	○
〆	01-30	S-curve for Deceleration Arrival Time S5	0.00–25.00 sec.	1.00	○	○	○	○	○
〆	01-31	Deceleration Time when Operating without RUN Command	0.00–600.00 sec.	2.00	○	○	○	○	○
	01-32	Direct docking mode only ◆							
	01-33	High Speed Time for Short Floor	0.00–60.00 sec.	3.00	○	○	○	○	○
	01-34	Leveling Time for Short Floor	0.00–60.00 sec.	3.00	○	○	○	○	○
	01-35	Limit for Direct Docking Terminal	0.00–10.00	2.00	○	○	○	○	○
	01-36	Deceleration Distance for Direct Docking Terminal	0.00–100.00 cm	30.00	○	○	○	○	○
	01-37	Deceleration Distance Reference for Short Floor	0.00–655.35 m	Read only	○	○	○	○	○
	01-38	Short Floor/Direct Docking Terminal Enabled	0000h: Disabled 0001h: Short floor enabled 0002h: Direct docking terminal enabled 0003h: Short floor + direct docking terminal enabled	0000h	○	○	○	○	○
	01-39	Automatic Emergency Deceleration Level	5.00–299.00 Hz	60.00		○		○	○
〆	01-40	Deceleration Time for Emergency Deceleration	0.00–600.00 sec.	2.00		○		○	○

02 Digital Input / Output Parameters

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
02-00	Two-wire/three-wire Operation Control	0: FWD/STOP, REV/STOP 1: FWD/STOP, REV/STOP (Line Start Lockout) 2: RUN/STOP, REV/FWD 3: RUN/STOP, REV/FWD (Line Start Lockout) 4: Three-wire 5: Three-wire (Line Start Lockout)	0	○	○	○	○	○
02-01	Multi-Function Input Command 1 (MI1)	0: no function	1	○	○	○	○	○
	(The Stop terminal for three-wire operation)	1: multi-step speed command 1		○	○	○	○	○
02-02	Multi-Function Input Command 2 (MI2)	2: multi-step speed command 2	2	○	○	○	○	○
02-03	Multi-Function Input Command 3 (MI3)	3: multi-step speed command 3	3	○	○	○	○	○
02-04	Multi-Function Input Command 4 (MI4)	4: multi-step speed command 4	4	○	○	○	○	○
02-05	Multi-Function Input Command 5 (MI5)	5: Reset	0	○	○	○	○	○
02-06	Multi-Function Input Command 6 (MI6)	6: JOG command	0	○	○	○	○	○
02-07	Multi-Function Input Command 7 (MI7)	7: Acceleration/ deceleration speed inhibit	0	○	○	○	○	○
02-08	Multi-Function Input Command 8 (MI8) (Enable Drive terminal)	8: First, second acceleration/deceleration time	40	○	○	○	○	○
		9: Third, fourth acceleration/deceleration time		○	○	○	○	○
		10: EF input (Pr.07-28)		○	○	○	○	○
		11: Reserved						
		12: Stop output		○	○	○	○	○
		13–14: Reserved						
		15: AUI1 operation speed command		○	○	○	○	○
		16: Reserved						
		17: AUI2 operation speed command		○	○	○	○	○
		18: Emergency Stop (Pr.07-28)		○	○	○	○	○
		19–23: Reserved						
		24: FWD JOG command		○	○	○	○	○
		25: REV JOG command		○	○	○	○	○
		26: Reserved						
		27: ASR1/ASR2 selection		○	○	○	○	○
		28: Emergency stop (EF1) (Motor coasts to stop)		○	○	○	○	○
		29–30: Reserved						

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			31: High torque bias (according to Pr.07-21)		○	○	○	○	○
			32: Middle torque bias (according to Pr.07-22)		○	○	○	○	○
			33: Low torque bias (according to Pr.07-23)		○	○	○	○	○
			34–37: Reserved						
			38: Disable writing to EEPROM function		○	○	○	○	○
			39: Torque command direction (0 is positive direction)						
			40: Enable drive function		○	○	○	○	○
			41: Magnetic contactor detection		○	○	○	○	○
			42: Mechanical brake 1		○	○	○	○	○
			43: EPS function (Emergency Power System)		○	○	○	○	○
			44: Mechanical brake 2						
			45–51: Direct docking mode only ◆						
			53: Terminal leveling signal for direct docking			○		○	○
			54: Power failure signal		○	○	○	○	○
			55: Manual emergency deceleration			○		○	○
			56: Automatic emergency deceleration			○		○	○
			57: Brake torque test action signal		○	○	○	○	○
			59: AFE fault		○	○	○	○	○
ϟ	02-09	Digital Input Response Time	0.001–30.000 sec.	0.005	○	○	○	○	○
ϟ	02-10	Digital Input Operation Direction	0–65535	0	○	○	○	○	○
ϟ	02-11	Multi-function Output 1: RA, RB, RC (Relay1)	0: No function	0	○	○	○	○	○
			1: Operation indication		○	○	○	○	○
ϟ	02-12	Multi-function Output 2: MRA, MRB, MRC (Relay2)	2: Operation speed reached	0	○	○	○	○	○
			3: Desired frequency reached 1 (Pr.02-25, Pr.02-26)		○	○	○	○	○
ϟ	02-13	Multi-function Output 3: R1A, R12C (Relay3)	4: Desired frequency reached 2 (Pr.02-27, Pr.02-28)	0	○	○	○	○	○
ϟ	02-14	Multi-function Output 4: R2A, R12C (Relay4)	5: Zero speed (Frequency command)	0	○	○	○	○	○
ϟ	02-15	Multi-function Output 5: (MO1)	6: Zero speed with stop (Frequency command)	0	○	○	○	○	○
ϟ	02-16	Multi-function Output 6: (MO2)	7: Over-torque (OT1) (Pr.06-05–06-07)	0	○	○	○	○	○
ϟ	02-17	Multi-function Output 7: (MO3)	8: Over-torque (OT2) (Pr.06-08–06-10)	0	○	○	○	○	○
ϟ	02-18	Multi-function Output 8: (MO4)	9: Drive ready	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
𝑵	02-19	Multi-function Output 9: (MO5)	10: User-defined low-voltage detection (LV)	0	○	○	○	○	○
𝑵	02-20	Multi-function Output 10: (MO6)	11: Malfunction indication	0	○	○	○	○	○
			12: Mechanical brake release (Pr.02-29, Pr.02-30, Pr.02-37)	0	○	○	○	○	○
			13: Overheat (Pr.06-14)	0	○	○	○	○	○
			14: Brake transistor signal		○	○	○	○	○
			15: Motor-controlled magnetic contactor output		○	○	○	○	○
			16: Slip error (oSL)		○	○	○	○	○
			17: Malfunction indication 1		○	○	○	○	○
			18: Reserved						
			19: Brake transistor output error		○	○	○	○	○
			20: Warning output		○	○	○	○	○
			21: Over-voltage warning		○	○	○	○	○
			22: Over-current stall prevention warning		○	○	○		
			23: Over-voltage stall prevention warning		○	○	○	○	○
			24: Operation mode indication (Pr.00-15=1)		○	○	○	○	○
			25: Forward command		○	○	○	○	○
			26: Reverse command		○	○	○	○	○
			27: Output when current ≥ Pr.02-33		○	○	○	○	○
			28: Output when current < Pr.02-33		○	○	○	○	○
			29: Output when frequency ≥ Pr.02-34		○	○	○	○	○
			30: Output when frequency < Pr.02-34		○	○	○	○	○
			31: Power generation direction and status verification		○	○	○	○	○
			32: Power generation direction		○	○	○	○	○
			33: Zero speed (actual output frequency)		○	○	○	○	○
			34: Zero speed with Stop (actual output frequency)		○	○	○	○	○
			35: Fault output option 1 (Pr.06-22)		○	○	○	○	○
			36: Fault output option 2 (Pr.06-23)		○	○	○	○	○
			37: Fault output option 3 (Pr.06-24)		○	○	○	○	○
			38: Fault output option 4 (Pr.06-25)		○	○	○	○	○
			39: Reserved						
			40: Speed reached (including zero speed)		○	○	○	○	○
			41: Reserved						
			42: STO output error		○	○	○	○	○
			43–44: Direct docking mode only ◆						

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			45: Reserved						
			46: Retrying after a fault has occurred indication		○	○	○	○	○
			47: Direct docking mode only ◆						
			48: Control output of MPSCC (Motor Phase Short Circuit Contactor)		○	○	○	○	○
			49: Emergency power mode action		○	○	○	○	○
			50: Speed reached Pr.02-34		○	○	○	○	○
			51: Brake torque test finished		○	○	○	○	○
			52: AFE reset		○	○	○	○	○
	02-21–02-22		Reserved						
〃	02-23	Multi-output Direction	0–65535	0	○	○	○	○	○
	02-24	Serial Start Signal Selection	0: According to FWD/REV signal 1: According to Enable drive function signal	0	○	○	○	○	○
〃	02-25	Desired Frequency Reached 1	0.00–299.00 Hz	60.00/ 50.00	○	○	○	○	○
〃	02-26	Desired Frequency Reached Width 1	0.00–299.00 Hz	2.00	○	○	○	○	○
〃	02-27	Desired Frequency Reached 2	0.00–299.00 Hz	60.00/ 50.00	○	○	○	○	○
〃	02-28	Desired Frequency Reached Width 2	0.00–299.00 Hz	2.00	○	○	○	○	○
	02-29	Brake Release Delay Time when Elevator Starts	0.000–65.000 sec.	0.250	○	○	○	○	○
	02-30	Brake Engage Delay Time when Elevator Stops	0.000–65.000 sec.	0.250	○	○	○	○	○
〃	02-31	Magnetic Contactor Contracting Delay Time between Drive and Motor	0.010–65.000 sec.	0.200	○	○	○	○	○
〃	02-32	Magnetic Contactor Release Delay Time between Drive and Motor	0.010–65.000 sec.	0.200	○	○	○	○	○
〃	02-33	External Terminal Output Current Level	0–100% (motor drive rated current)	0	○	○	○	○	○
〃	02-34	External Terminal Output Speed Limit	0.00–299.00 Hz (this is motor speed when using with PG) **NOTE:** The setting range and unit of Pr.02-34 varies with Pr.00-10 settings. See Chapter 12 for details.	0.00	○	○	○	○	○
〃	02-35	Mechanical Brake Detection Time	0.00–10.00 sec.	0.00	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
〴	02-36	Magnetic Contactor Detection Time	0.00–10.00 sec.	0.00	○	○	○	○	○
	02-37	Torque Check	0: Disable 1: Enable	0	○	○	○	○	○
〴	02-38	MPSCC (Motor Phase Short Circuit Contactor) Release Delay Time between Drive and Motor	0.010~65.000 sec.	0.200	○	○	○	○	○
〴	02-39	MPSCC (Motor Phase Short Circuit Contactor) Contracting Delay Time between Drive and Motor	0.010~65.000 sec.	0.200	○	○	○	○	○
	02-40 – 02-42	Direct docking mode only ◆		-		○		○	○
〴	02-43	Speed Reached Bandwidth	0.00–299.00 Hz	2.00	○	○	○	○	○

03 Analog Input / Output Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
✎	03-00	Analog Input 1 (AUI1)	0: No function	1	○	○	○	○	○
	03-01	Reserved	1: Frequency command (speed limit under torque control mode)						
✎	03-02	Analog Input 2 (AUI2)	2: Torque command (torque limit under speed mode)	0					
			3: Load compensation		○	○	○	○	○
			4–5: Reserved						
			6: P.T.C. thermistor input value		○	○	○	○	○
			7: Positive torque limit					○	○
			8: Negative torque limit					○	○
			9: Regenerative torque limit					○	○
			10: Positive/negative torque limit					○	○
✎	03-03	Analog Input Bias 1 (AUI1)	-100.0–100.0%	0.0	○	○	○	○	○
	03-04	Reserved							
✎	03-05	Analog Input Bias 1 (AUI2)	-100.0–100.0%	0.0	○	○	○	○	○
✎	03-06	AUI1 Positive/negative Bias Mode	0: Zero bias 1: Lower than or equal to bias 2: Higher than or equal to bias 3: Using bias as the base to get the absolute value of bias voltage (unipolar) 4: Using bias as the base (unipolar)	0	○	○	○	○	○
	03-07	Reserved							
✎	03-08	AUI2 Positive/negative Bias Mode		0	○	○	○	○	○
✎	03-09	Analog Input Gain 1 (AUI1)	0.0–500.0%	100.0	○	○	○	○	○
	03-10	Reserved							
✎	03-11	Analog Input Gain 1 (AUI2)	0.0–500.0%	100.0	○	○	○	○	○
✎	03-12	Analog Input Filter Time (AUI1)	0.00–2.00 sec.	0.01	○	○	○	○	○
	03-13	Reserved							
✎	03-14	Analog Input Filter Time (AUI2)	0.00–2.00 sec.	0.01	○	○	○	○	○
	03-15	Load Compensation Auto-tuning	0: No function 1: Auto-tunes with running without load 2: Auto-tunes with running with load	0	○	○	○	○	○
	03-15	Reserved							
	03-16	Reserved							
✎	03-17	Analog Output Selection 1	0: Output frequency (Hz)	0	○	○	○	○	○
			1: Frequency command (Hz)		○	○	○	○	○
			2: Motor speed (RPM)		○	○	○	○	○
			3: Output current (rms)		○	○	○	○	○
			4: Output voltage		○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			5: DC bus voltage		○	○	○	○	○
			6: Power factor angle		○	○	○	○	○
			7: Power factor		○	○	○	○	○
			8: Output torque		○	○	○	○	○
			9: AUI1		○	○	○	○	○
			10: Reserved						
			11: AUI2		○	○	○	○	○
			12: q-axis current		○	○	○	○	○
			13: q-axis feedback value		○	○	○	○	○
			14: d-axis current		○	○	○	○	○
			15: d-axis feedback value		○	○	○	○	○
			16: q-axis voltage		○	○	○	○	○
			17: d-axis voltage		○	○	○	○	○
			18: Torque command		○	○	○	○	○
			19–20: Reserved						
			21: Power Output		○	○	○	○	○
✎	03-18	Analog Output Gain 1	0–200.0%	100.0	○	○	○	○	○
✎	03-19	Analog Output Value in REV Direction 1	0: Absolute value in output voltage 1: Output 0 V in REV direction 2: Enable output voltage in REV direction	0	○	○	○	○	○
✎	03-20	Analog Output Selection 2	0: Output frequency (Hz)	0	○	○	○	○	○
			1: Frequency command (Hz)		○	○	○	○	○
			2: Motor speed (RPM)		○	○	○	○	○
			3: Output current (rms)		○	○	○	○	○
			4: Output voltage		○	○	○	○	○
			5: DC bus voltage		○	○	○	○	○
			6: Power factor angle		○	○	○	○	○
			7: Power factor		○	○	○	○	○
			8: Output torque		○	○	○	○	○
			9: AUI1		○	○	○	○	○
			10: Reserved						
			11: AUI2		○	○	○	○	○
			12: q-axis current		○	○	○	○	○
			13: q-axis feedback value		○	○	○	○	○
			14: d-axis current		○	○	○	○	○
			15: d-axis feedback value		○	○	○	○	○
			16: q-axis voltage		○	○	○	○	○
			17: d-axis voltage		○	○	○	○	○
			18: Torque command		○	○	○	○	○
			19–20: Reserved						
			21: Power Output		○	○	○	○	○
✎	03-21	Analog Output Gain 2	0–200.0%	100.0	○	○	○	○	○
✎	03-22	Analog Output Value in REV Direction 2	0: Absolute value in output voltage 1: Output 0 V in REV direction 2: Enable output voltage in REV direction	0	○	○	○	○	○

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
03-23	Analog Input Type (AUI1)	0: Bipolar (±10 V) 1: Unipolar (0–10 V)	0	○	○	○	○	○
03-24	Analog Input Type (AUI2)	0: Bipolar (±10 V) 1: Unipolar (0–10 V)	0	○	○	○	○	○

04 Multi-step Speed Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
⌁	04-00	Zero Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-01	1st Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-02	2nd Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-03	3rd Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-04	4th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-05	5th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-06	6th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-07	7th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-08	8th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-09	9th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-10	10th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-11	11th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-12	12th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-13	13th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-14	14th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
⌁	04-15	15th Step Speed Frequency	0.00–299.00 Hz	0.00	○	○	○	○	○
	04-16 – 04-99	Direct docking mode only ◆							

05 IM Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
	05-00	Motor Auto-tuning	0: No function 1: Dynamic test (Rs, Rr, Lm, Lx, no-load current) (Motor runs) 2: Static test (Motor does not run)	0	○				
	05-01	Motor Rated Current	(40–120%) * Pr.00-01 Amps	#.##	○	○	○	○	
	05-02	Motor Rated Power	0.00–655.35 kW	#.##			○	○	
	05-03	Motor Rated Speed (rpm)	0–65535	1710		○	○	○	
	05-04	Number of Motor Poles	2–48	4	○	○	○	○	
	05-05	Motor No-load Current	0–Pr.05-01 <default>	#.##		○	○	○	
	05-06	Motor Rs	0.000–65.535 Ω	0.000			○	○	
	05-07	Motor Rr	0.000–65.535 Ω	0.000			○	○	
	05-08	Motor Lm	0.0–6553.5 mH	0.0			○	○	
	05-09	Motor Lx	0.0–6553.5 mH	0.0			○	○	
↯	05-10	Torque Compensation Low Pass Filter Time	0.001–10.000 sec.	0.020			○		
↯	05-11	Slip Compensation Low Pass Filter Time	0.001–10.000 sec.	0.100			○		
↯	05-12	Torque Compensation Gain	0–10	0	○	○			
↯	05-13	Slip Compensation Gain	0.00–10.00	1.00			○		
↯	05-14	Slip Deviation Level	0–1000% (0: disable)	0		○	○	○	
↯	05-15	Slip Deviation Detection Time	0.0–10.0 sec.	1.0		○	○	○	
↯	05-16	Over-slip Action	0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop	0		○	○	○	
↯	05-17	Hunting Gain	0–10000 (0: disable)	2000	○	○	○		
	05-18	Accumulated Motor Operation Time (Min.)	0–1439	0	○	○	○	○	○
	05-19	Accumulated Motor Operation Time (day)	0–65535	0	○	○	○	○	○
↯	05-20	Core Loss Compensation	0–250%	10			○		
	05-21	Accumulated Motor Power-on Time (Min.)	0–1439	0	○	○	○	○	○
	05-22	Accumulated Motor Power-on Time (day)	0–65535	0	○	○	○	○	○
↯	05-23	Slip Compensation Gain % (Power Generation Mode)	0.0–100.0%	0.0	○		○		
↯	05-24	Slip Compensation Gain % (Electricity Mode)	0.0–100.0%	0.0	○		○		

06 Protection Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
⚡	06-00	Low Voltage Level	230V models: 160.0–220.0 V 460V models: 320.0–440.0 V	180.0 360.0	○	○	○	○	○
⚡	06-01	Input Phase-loss Protection during Operation	0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop	2	○	○	○	○	○
⚡	06-02	Over-current Stall Prevention during Acceleration	0: Disable 0–250% (rated current of the motor drive)	0	○	○	○		
⚡	06-03	Over-current Stall Prevention during Operation	0: Disable 0–250% (rated current of the motor drive)	0	○	○	○		
⚡	06-04	Acceleration/Deceleration Time for Stall Prevention at Constant Speed	0: Use the current acceleration/deceleration time 1: Use the first acceleration/deceleration time 2: Use the second acceleration/deceleration time 3: Use the third acceleration/deceleration time 4: Use the fourth acceleration/deceleration time 5: Use the auto-acceleration/ auto-deceleration time	0	○	○	○		
⚡	06-05	Over-torque Detection (OT1)	0: Disable 1: Over-torque detection during constant speed operation, continue to operate after detection 2: Over-torque detection during constant speed operation, stop operating after detection 3: Over-torque detection during operation, continue to operate after detection 4: Over-torque detection during operation, stop operating after detection	0	○	○	○	○	○
⚡	06-06	Over-torque Detection Level (OT1)	10–250% (rated current of the motor drive)	150	○	○	○	○	○
⚡	06-07	Over-torque Detection Time (OT1)	0.1–60.0 sec.	0.1	○	○	○	○	○
⚡	06-08	Over-torque Detection (OT2)	0: Disable 1: Over-torque detection during constant speed operation, continue to operate after detection	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			2: Over-torque detection during constant speed operation, stop operating after detection 3: Over-torque detection during operation, continue to operate after detection 4: Over-torque detection during operation, stop operating after detection						
✔	06-09	Over-torque Detection Level (OT2)	10–250% (rated current of the motor drive)	150	○	○	○	○	○
✔	06-10	Over-torque Detection Time (OT2)	0.1–60.0 sec.	0.1	○	○	○	○	○
✔	06-11	Current Limit	0–250% (rated current of the motor drive)	200				○	○
	06-12	Electronic Thermal Relay	0: Standard motor 1: Inverter motor 2: Disabled	2	○	○	○	○	○
✔	06-13	Electronic Thermal Characteristic	30.0–600.0 sec.	60.0	○	○	○	○	○
✔	06-14	IGBT Overheat Warning (oH1)	0.0–110.0°C	90.0	○	○	○	○	○
✔	06-15	Stall Prevention Limit Level	0–100% (refer to Pr.06-02, Pr.06-03)	50	○	○	○		
	06-16	Present Fault Record	0: No fault	0	○	○	○	○	○
	06-17	Second Most Recent Fault Record	1: Over-current during acceleration (ocA)	0	○	○	○	○	○
	06-18	Third Most Recent Fault Record	2: Over-current during deceleration (ocd)	0	○	○	○	○	○
	06-19	Fourth Most Recent Fault Record	3: Over-current during constant speed (ocn)	0	○	○	○	○	○
	06-20	Fifth Most Recent Fault Record	4: Ground fault (GFF)	0	○	○	○	○	○
	06-21	Sixth Most Recent Fault Record	5: IGBT short-circuit (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)	0	○	○	○	○	○

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
		14: Low voltage at stop (LvS) 15: Input phase loss (PHL) 16: IGBT overheat (oH1) 17: Bulk capacitors overheat (oH2) 18: Abnormal IGBT temperature detected (tH1o) 19: Abnormal bulk capacitor temperature detected (tH2o) 20: Unusual cooling fan operation (FAn) 21: Overload (oL) (150%; 1 minute, motor drive overloaded) 22: Motor overloaded (EoL1) 23: Reserved 24: Motor PTC overheat (oH3) 25: Reserved 26: Over-torque 1 (ot1) 27: Over-torque 2 (ot2) 28: Reserved 29: Reserved 30: Memory writing error (cF1) 31: Memory reading error (cF2) 32: Isum current detection error (cd0) 33: U-phase current detection error (cd1) 34: V-phase current detection error (cd2) 35: W-phase current detection error (cd3) 36: CC current clamp hardware error (Hd0) 37: OC (over-current) hardware error (Hd1) 38: ov (over-voltage hardware error (Hd2) 39: GFF (ground fault) hardware error (Hd3) 40: Auto-tuning error on motor’s parameter (AUE) 41: Reserved 42: PG feedback error (PGF1) 43: PG feedback loss (PGF2) 44: PG feedback stall (PGF3) 45: PG slip error (PGF4) 46: Reserved 47: Reserved 48: Reserved 49: External fault input (EF) 50: Emergency stop from external						

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			terminals (EF1) 51: Reserved 52: Password error after three attempts (Pcod) 53: Reserved 54: Illegal communication command (cE01) 55: Illegal communication address (cE02) 56: Communication data length error (cE03) 57: Communication attempts to write to a read-only address (cE04) 58: Modbus transmission time-out (cE10) 59: Keypad transmission time-out (cP10) 60: Brake transistor error (BF) 61–63: Reserved 64: Mechanical brake feedback error (MBF) 65: PG hardware error (PG5) 66: Magnetic contactor error (MCF) 67: Output phase loss (MPHL) 68: CAN BUS disconnected (CANF) 69–71: Reserved 72: Safe torque loss (STL1) 73: PG cd hardware error (PGcd) 74: PG absolute signal error (PGHL) 75: PG Z phase signal loss (PGAF) 76: Safe torque output stops (STO) 77: Safe torque loss 2 (STL2) 78: Safe torque loss 3 (STL3) 82: U-phase output phase loss (OPHL) 83: V-phase output phase loss (OPHL) 84: W-phase output phase loss (OPHL) 86: Leveling switch short-circuited (LSS) 87: Leveling switch open-circuited (LSo) 94: BTTx Fail (btt) 95: BTTx Error (bttE)						
〆	06-22	Fault Output Option 1	0–65535 (refer to bit table for fault code in Chapter 12)	0	○	○	○	○	○
〆	06-23	Fault Output Option 2	0–65535 (refer to bit table for fault code in Chapter 12)	0	○	○	○	○	○
〆	06-24	Fault Output Option 3	0–65535 (refer to bit table for fault code in Chapter 12)	0	○	○	○	○	○
〆	06-25	Fault Output Option 4	0–65535 (refer to bit table for fault code in Chapter 12)	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
⌿	06-26	PTC (Positive Temperature Coefficient) Detection Action	0: Warn and keep operation 1: Fault and ramp to stop	0	○	○	○	○	○
⌿	06-27	PTC Level	0.0–100.0%	50.0	○	○	○	○	○
⌿	06-28	PTC Detection Filter Time	0.00–10.00 sec.	0.20	○	○	○	○	○
	06-29	Voltage of Emergency Power	24.0–375.0 V_{DC} 48.0–750.0 V_{DC}	24.0 48.0	○	○	○	○	○
⌿	06-30	Fault Output Setting Method	0: According to Pr.06-22–Pr.06-25 (four sets) 1: According to the binary setting (fifteen sets)	0	○	○	○	○	○
	06-31	Phase Loss Detection of Drive Output at Start-up (MPHL)	0: Disable 1: Enable	1	○	○	○	○	○
	06-32	Accumulated Drive Power-on Time at the First Fault (min.)	0–65535	Read only	○	○	○	○	
	06-33	Accumulated Drive Power-on Time at the First Fault (day)	0–65535	Read only	○	○	○	○	
	06-34	Accumulated Drive Power-on Time at the Second Fault (min.)	0–65535	Read only	○	○	○	○	
	06-35	Accumulated Drive Power-on Time at the Second Fault (day)	0–65535	Read only	○	○	○	○	
	06-36	Accumulated Drive Power-on Time at the Third Fault (min.)	0–65535	Read only	○	○	○	○	
	06-37	Accumulated Drive Power-on Time at the Third Fault (day)	0–65535	Read only	○	○	○	○	
	06-38	Accumulated Drive Power-on Time at the Fourth Fault (min.)	0–65535	Read only	○	○	○	○	
	06-39	Accumulated Drive Power-on Time at the Fourth Fault (day)	0–65535	Read only	○	○	○	○	
	06-40	Accumulated Drive Power-on Time at the Fifth Fault (min.)	0–65535	Read only	○	○	○	○	
	06-41	Accumulated Drive Power-on Time at the Fifth Fault (day)	0–65535	Read only	○	○	○	○	
	06-42	Accumulated Drive	0–65535	Read	○	○	○	○	

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
		Power-on Time at the Sixth Fault (min.)		only					
	06-43	Accumulated Drive Power-on Time at the Sixth Fault (day)	0–65535	Read only	○	○	○	○	
	06-44	(EPS) Emergency Power Mode Operation Speed	0.00–299.00 Hz	Read only	○	○	○	○	○
〆	06-45	Fault and Warning Actions	Bit0 = 0: Display Lv fault and coast to stop Bit0 = 1: Display Lv warn and coast to stop Bit1 = 0: Fan lock, fault and coast to stop Bit1 = 1: Fan lock, warn and continue operation Bit2 = 0: software GFF protection enabled Bit2 = 1: software GFF protection disabled	0	○	○	○	○	○
〆	06-46	(EPS) Emergency Power ON Operation Direction	0: Run according to the current command 1: Run according to the operation direction of power generation mode, and execute the power generation direction detection when 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 = 32) confirms and the direction of power generation mode does not remain.) Execute the power generation direction detection every time. 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 =32) confirms and the direction of power generation mode remains.) Execute the power generation direction detection one time. 4. Run according to the operation direction of power generation mode, and execute the power generation	0	○	○	○	○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
			direction detection when in normal mode.						
〆	06-47	Power Generation Direction Search Time	0.0–5.0 sec.	1.0	○	○	○	○	○
	06-48	Power Capacity of Emergency Power (EPS)	0.0–100.0 kVA	0.0	○	○	○	○	○
〆	06-49	STO Latch Selection	0000h: STO fault latched, resending RUN command is required 0001h: STO warning latched, resending RUN command is required 0002h: STO fault latched 0003h: STO warning unlatched	0000h	○	○	○	○	○
〆	06-50	MO's Action when Retrying after Fault	0: Output 1: No output	0	○	○	○	○	○
〆	06-51	Number of Times to Retry after Fault	0–10	0	○	○	○	○	○
〆	06-52	Time Interval between Retries	0.5–600.0 sec.	10.0	○	○	○	○	○
	06-53	Frequency Command when the Most Recent Fault Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
	06-54	Output Frequency when the Most Recent Fault Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
	06-55	Output Current when the Most Recent Fault Occurred	0.00–655.35 Amps	Read only	○	○	○	○	○
	06-56	Motor Frequency when the Most Recent Fault Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
	06-57	Output Voltage when the Most Recent Fault Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
	06-58	DC Bus Voltage when the Most Recent Fault Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
	06-59	Output Power when the Most Recent Fault Occurred	0.0–6553.5 kW	Read only	○	○	○	○	○
	06-60	Output Torque when the Most Recent Fault Occurred	0.00–655.35%	Read only	○	○	○	○	○
	06-61	IGBT Temperature when the Most Recent Fault Occurred	-3276.8–3276.7ºC	Read only	○	○	○	○	○
	06-62	Multi-input Terminals	0000h–FFFFh	Read	○	○	○	○	○

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
	Status when the Most Recent Fault Occurred		only					
06-63	Multi-output Terminals status when the Most Recent Fault Occurred	0000h–FFFFh	Read only	○	○	○	○	○
06-64	Motor Drive Status when the Most Recent Fault Occurred	0000h–FFFFh	Read only	○	○	○	○	○
✎ 06-68	Power Factor Angle Level for Power Generation Direction	0.0–150.0°	70.0	○	○	○	○	○
06-69	Reference Level for Power Factor Angle during Operation	-200.0–200.0°	Read only	○	○	○	○	○
06-70	Power Generation Direction	0: FWD 1: REV	Read only	○	○	○	○	○
✎ 06-71	UPS Output Delay Time	0.0–10.0 sec.	1.0	○	○	○	○	○
06-72	UPS Stops Output Delay Time	0.0–60.0 sec.	3.0	○	○	○	○	○
06-73	Permanent Operation Direction Count (H)	0–60000	Read only	○	○	○	○	○
06-74	Permanent Operation Direction Count (L)	0–9999	Read only	○	○	○	○	○
06-75	Single Operation Direction Count (H)	0–20	Read only	○	○	○	○	○
06-76	Single Operation Direction Count (L)	0–9999	Read only	○	○	○	○	○
06-77	Number of Times for Single Operation Reset	0–100	Read only	○	○	○	○	○
06-78	Number of Times for Operation Direction	0.00–200.00 k	2.00	○	○	○	○	○
06-79	Function Selection for Operation Times	0–2	0	○	○	○	○	○
06-80	Output Frequency when Fault 2 Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
06-81	DC Bus Voltage when Fault 2 Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
06-82	Output Current when Fault 2 Occurred	0.00–655.35 Amps	Read only	○	○	○	○	○
06-83	IGBT Temperature when Fault 2 Occurred	-3276.8–3276.7ºC	Read only	○	○	○	○	○
06-84	Output Frequency when Fault 3 Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
06-85	DC Bus Voltage when Fault 3 Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
06-86	Output Current when	0.00–655.35 Amps	Read	○	○	○	○	○

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
	Fault 3 Occurred		only					
06-87	IGBT Temperature when Fault 3 Occurred	-3276.8–3276.7ºC	Read only	○	○	○	○	○
06-88	Output Frequency when Fault 4 Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
06-89	DC Bus Voltage when Fault 4 Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
06-90	Output Current when Fault 4 Occurred	0.00–655.35 Amps	Read only	○	○	○	○	○
06-91	IGBT Temperature when Fault 4 Occurred	-3276.8–3276.7ºC	Read only	○	○	○	○	○
06-92	Output Frequency when Fault 5 Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
06-93	DC Bus Voltage when Fault 5 Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
06-94	Output Current when Fault 5 Occurred	0.00–655.35 Amps	Read only	○	○	○	○	○
06-95	IGBT Temperature when Fault 5 Occurred	-3276.8–3276.7ºC	Read only	○	○	○	○	○
06-96	Output Frequency when Fault 6 Occurred	0.00–655.35 Hz	Read only	○	○	○	○	○
06-97	DC Bus Voltage when Fault 6 Occurred	0.0–6553.5 V	Read only	○	○	○	○	○
06-98	Output Current when Fault 6 Occurred	0.00–655.35 Amps	Read only	○	○	○	○	○
06-99	IGBT Temperature when Fault 6 Occurred	-3276.8–3276.7ºC	Read only	○	○	○	○	○

07 Special Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
✓	07-00	Brake Transistor Level	230V models: 350.0–450.0 V_{DC} 460V models: 700.0–900.0 V_{DC}	380.0 760.0	○	○	○	○	○
	07-01	Brake Transistor Hysteresis Voltage	0.0–100.0 V	0.0	○	○	○	○	○
✓	07-02	DC Brake Current Level at Start-up	0–100% (motor drive rated current)	0	○	○	○		
✓	07-03	DC Brake Activation Time	0.0–60.0 sec.	0.7	○	○	○	○	○
✓	07-04	DC Brake Stopping Time	0.0–60.0 sec.	0.7	○	○	○	○	○
✓	07-05	Start-point for DC Brake	0.00–299.00 Hz	0.00	○	○	○	○	
✓	07-06	DC Brake Proportional Gain	1–500	50	○	○	○		
✓	07-07	Dwell Time at Acceleration	0.00–600.00 sec.	0.00	○	○	○	○	○
✓	07-08	Dwell Frequency at Acceleration.	0.00–299.00 Hz	0.00	○	○	○	○	○
✓	07-09	Dwell Time at Deceleration.	0.00–600.00 sec.	0.00	○	○	○	○	○
✓	07-10	Dwell Frequency at Deceleration.	0.00–299.00 Hz	0.00	○	○	○	○	○
✓	07-11	Cooling Fan Control	0: Cooling fan always ON. 1: One minute after AC motor drive stops, cooling fan is OFF. 2: AC motor drive runs and cooling fan is ON; AC motor drive stops and cooling fan is OFF. 3: Cooling fan is ON to run when preliminary IGBT temperature (ºC) reached. 4: Cooling fan is always OFF.	2	○	○	○	○	○
✓	07-12	Torque command	-150.0–150.0% (Pr.07-14 setting = 100%)	0.0					
✓	07-13	Torque Command Source	0: Digital keypad (KPC-CC01) 1: RS-485 serial communication 2: Analog signal (Pr.03-00)	2					
✓	07-14	Maximum Torque Command	0–300% (motor drive rated torque)	100	○	○	○	○	○
✓	07-15	Torque Command Filter Time	0.000–1.000 sec.	0.000					
	07-16	Speed Limit	0: Settings in Pr.07-17 and Pr.07-18 1: Frequency command source (Pr.00-14)	0					
✓	07-17	Torque Mode + Speed Limit	0–120%	10					
✓	07-18	Torque Mode - Speed Limit	0–120%	10					
✓	07-19	Torque Offset Source	0: Disable 1: Analog input (Pr.03-00) 2: Torque offset setting (Pr.07-20) 3: Control through external terminals (by Pr.07-21–Pr.07-23)	0			○	○	○

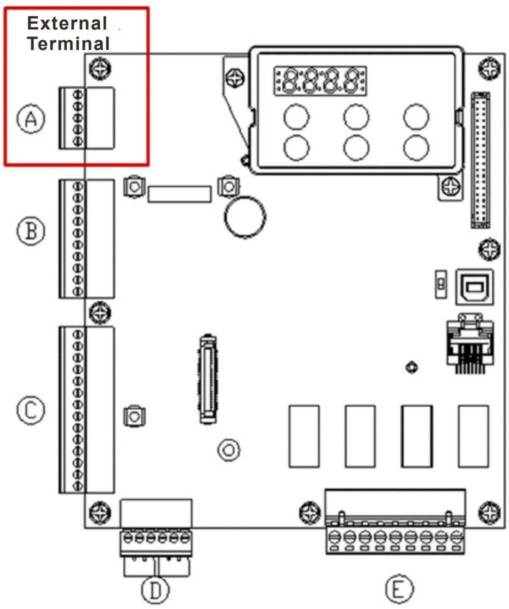
	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
✓	07-20	Torque Offset Setting	0.0–100.0% (motor drive rated torque)	0.0			○	○	○
✓	07-21	High Torque Offset	0.0–100.0% (motor drive rated torque)	30.0			○	○	○
✓	07-22	Middle Torque Offset	0.0–100.0% (motor drive rated torque)	20.0			○	○	○
✓	07-23	Low Torque Offset	0.0–100.0% (motor drive rated torque)	10.0			○	○	○
✓	07-24	Forward Motor Torque Limit	0–300% (motor drive rated torque)	200				○	○
✓	07-25	Forward Regenerative Torque Limit	0–300% (motor drive rated torque)	200				○	○
✓	07-26	Reverse Motor Torque Limit	0–300% (motor drive rated torque)	200				○	○
✓	07-27	Reverse Regenerative Torque Limit	0–300% (motor drive rated torque)	200				○	○
✓	07-28	Emergency Stop (EF) & Forced Stop	0: Coast to stop 1: According to deceleration time 1 2: According to deceleration time 2 3: According to deceleration time 3 4: According to deceleration time 4 5: According to Pr.01-31	0	○	○	○	○	○
✓	07-29	Time for Decreasing Torque at Stop	0.000–5.000 sec.	0.000				○	○
✓	07-30	DC Brake Current Level at Stop	0–100% (motor drive rated current)	0	○	○	○		
✓	07-31	Drive Output Torque	0.0–300.0%	0.0	○	○	○	○	○
	07-32	Brake Torque Test Function	0: No function 1: Brake torque test	0	○	○	○	○	○
	07-33	Brake Torque Test Distance	0–65535 ppr	0	○	○	○	○	○
	07-34	Brake Torque Test Time	0.0–5.0 sec.	5.0	○	○	○	○	○
	07-35	Most Recent Output Torque Ratio before Brake Torque Test Failure	0.00–3.00	Read only	○	○	○	○	○
✓	07-36	Minimum Output Torque Ratio Allowed during Brake Torque Test	0.00–2.00	0.00	○	○	○	○	○
✓	07-37	Maximum Output Torque Ratio Allowed during Brake Torque Test	0.00–2.00	0.00	○	○	○	○	○

08 PM Parameters

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
08-00	Motor Auto-tuning	0: No function 1: Only for an unloaded motor, auto-measures the angle between magnetic pole and PG origin (Pr.08-09) 2: For PM parameters (suggested to lock the brake) 3: Auto-measures the angle between magnetic pole and PG origin (Pr.08-09)	0					○
08-01	Motor Rated Current	(40–120%) * Pr.00-01 Amps	#.##					○
08-02	Motor Rated Power	0.00–655.35 kW	#.##					○
08-03	Motor Rated Speed (rpm)	0–65535 rpm	1710					○
08-04	Number of Motor Poles	2–96	4					○
08-05	Motor Rs	0.000–65.535 Ω	0.000					○
08-06	Motor Ld	0.0–6553.5 mH	0.0					○
08-07	Motor Lq	0.0–6553.5 mH	0.0					○
08-08	Back Electromotive Force	0.0–6553.5 V rms	0.0					○
08-09	Angle between Magnetic Pole and PG Origin	0.0–360.0°	360.0					○
08-10	Magnetic Pole Reorientation	0: Disable 1: Enable	0					○

09 Communication Parameters

Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
09-00	Communication Address	1–254	1					
09-01	Transmission Speed	4.8–115.2 kbps	19.2	○	○	○	○	○
09-02	Transmission Fault Treatment	0: Warn and keep operation 1: Fault and ramp to stop 2: Reserved 3: No action and no display	3	○	○	○	○	○
09-03	Time-out Detection	0.0–100.0 sec. 0.0: Disable	0.0	○	○	○	○	○
09-04	Communication Protocol	0: 7N1 (ASCII) 1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII) 10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	13	○	○	○	○	○
09-05	Response Delay Time	0.0–200.0 ms	2.0	○	○	○	○	○
09-06 – 09-13	Direct docking mode only ◆		-		○		○	○
09-14	PDO Transmission Interval	0–65535 ms	0	○	○	○	○	○



10 Feedback Control Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
	10-00	Selection of Encoder	0: Disable 1: ABZ 2: ABZ+Hall 3: SIN/COS+Sinusoidal 4: SIN/COS+Endat 5: SIN/COS 6: SIN/COS+Hiperface	0		○		○	○
	10-01	Encoder PPR	1–25000	2048		○		○	○
	10-02	Encoder Input Type Setting	0: Disable 1: Phase A leads in a forward run command and phase B leads in a reverse run command 2: Phase B leads in a forward run command and phase A leads in a reverse run command 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	0		○		○	○
✎	10-03	Encoder Feedback Signal Fault Action (PGF1, PGF2)	0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and stop operation	2		○		○	○
✎	10-04	Encoder Feedback Signal Fault Detection Time	0.0–10.0 sec.	1.0		○		○	○
✎	10-05	Encoder Stall Level (PGF3)	0–120% (0: Disable)	115		○	○	○	○
✎	10-06	Encoder Stall Detection Time	0.0–2.0 sec.	0.1		○	○	○	○
✎	10-07	Encoder Slip Range (PGF4)	0–50% (0: Disable)	50		○	○	○	○
✎	10-08	Encoder Slip Detection Time	0.0–10.0 sec.	0.5		○	○	○	○
✎	10-09	Encoder Stall and Slip Error Action	0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and stop operation	2		○	○	○	○
	10-10	Mode Selection for UVW Input	0: Z signal is at the falling edge of U-phase 1: Z signal is at the rising edge of U-phase	0		○		○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
〆	10-11	ASR (Auto Speed Regulation) Control (P) of Zero Speed	0.0–1000.0%	100.0	○	○	○	○	○
〆	10-12	ASR (Auto Speed Regulation) Control (I) of Zero Speed	0.000–10.000 sec.	0.100	○	○	○	○	○
〆	10-13	ASR (Auto Speed Regulation) Control (P) 1	0.0–1000.0%	100.0	○	○	○	○	○
〆	10-14	ASR (Auto Speed Regulation) Control (I) 1	0.000–10.000 sec.	0.100	○	○	○	○	○
〆	10-15	ASR (Auto Speed Regulation) Control (P) 2	0.0–1000.0%	100.0	○	○	○	○	○
〆	10-16	ASR (Auto Speed Regulation) Control (I) 2	0.000–10.000 sec.	0.100	○	○	○	○	○
〆	10-17	ASR 1/ ASR2 Switch Frequency	0.00–299.00 Hz (0: Disable)	7.00	○	○	○	○	○
〆	10-18	ASR Primary Low Pass Filter Gain	0.001–0.350 sec.	0.008	○	○	○	○	○
〆	10-19	Zero Speed Position Control Gain (P)	0.00–655.00%	80.00					○
〆	10-20	Low Speed ASR Width Adjustment	0.00–299.00 Hz	5.00		○		○	○
〆	10-21	High Speed ASR Width Adjustment	0.00–299.00 Hz	5.00		○		○	○
〆	10-22	Zero Speed Position Control Holding Time	0.001–65.535 sec.	0.250					○
〆	10-23	Zero Speed Position Control Low Pass Filter Time	0.001–65.535 sec.	0.004					○
〆	10-24	Zero Speed Position Control Activation Mode Selection	0: After the brake release set in Pr.02-29 1: After the brake signal input (Pr.02-01–Pr.02-08 is set to 42)	0					○
〆	10-25	Elevator Leveling (Zero Speed Gain P)	0.0–1000.0%	100.0	○	○	○	○	○
〆	10-26	Elevator Leveling (Zero Speed Integral I)	0.000–10.000 sec.	0.100	○	○	○	○	○
〆	10-27	Elevator Starting (Zero Speed Gain P)	0.0–1000.0%	100.0	○	○	○	○	○
〆	10-28	Elevator Starting (Zero Speed Integral I)	0.000–10.000 sec.	0.100	○	○	○	○	○
〆	10-29	PG Card Frequency Division Output	0–31	0		○		○	○
〆	10-30	PG Card Frequency Division Output Type	0000h–0008h	0000h		○		○	○
	10-31	PG Card C+/C-	0000h–0001h	0000h					

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
✎	10-32	Over-acceleration Level	0.0–20.0 m/s^2	0.0	○	○	○	○	○
	10-33	Over-acceleration Detection Time	0.01–5.00 sec.	0.05	○	○	○	○	○
	10-34	Over-acceleration Detection Selection	0: Always detect 1: Detect during operation	0	○	○	○	○	○

11 Advanced Parameters

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
	11-00	System Control	Bit 0 = 0: No function Bit 0 = 1: ASR auto-tuning; PDFF enabled Bit 7 = 0: No function Bit 7 = 1: Zero speed position control is enabled Bit 9 = 0: Dynamic PG origin auto-tuning with load (support by PGHSD-1) Bit 9 = 1: Static PG origin auto-tuning with load by enabling PGHSD-1 Bit 15 = 0: Detect the position of magnetic pole again when power is applied Bit 15 = 1: Start from the magnetic pole position of the previous power failure when power is applied	0				○	○
✓	11-01	Elevator Speed	0.10–4.00 m/s	1.00				○	○
✓	11-02	Traction Sheave Diameter	100–2000 mm	400				○	○
✓	11-03	Gear Ratio	1.00–100.00	1.00				○	○
✓	11-04	Suspension Ratio	0 = 1:1 1 = 2:1 2 = 4:1 3 = 8:1	1				○	○
✓	11-05	Mechanical Inertial Ratio	1–300%	40				○	○
✓	11-06	Zero speed Bandwidth	1–40 Hz	10				○	○
✓	11-07	Low speed Bandwidth	1–40 Hz	10				○	○
✓	11-08	High speed Bandwidth	1–40 Hz	10				○	○
✓	11-09	PDFF Gain Value	0–200%	30				○	○
✓	11-10	Speed Feed Forward Gain	0–500	0				○	○
✓	11-11	Notch Filter Depth	0–20 db	0				○	○
✓	11-12	Notch Filter Frequency	0.00–200.00 Hz	0.00				○	○
✓	11-13	Keypad Display for Low Pass Filter Time	0.001–65.535 sec.	0.500	○	○	○	○	○
✓	11-14	Motor Current at Acceleration	50–200%	150					○
✓	11-15	Carriage Acceleration	0.20–2.00 m/s^2	0.75					○
	11-16	Reserved							
	11-17	Reserved							
	11-18	Reserved							
✓	11-19	Zero Speed Parking Bandwidth	1–40 Hz	10				○	○

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
𝓝	11-20	PWM Mode	0: DPWM mode (Digital Pulse-Width Modulation Mode) 1: SVPWM mode (Space-Vector Pulse Width Modulation Mode)	0					
𝓝	11-21	Filter Time Display on KPED-LE01	0.001–65.535 sec.	0.500	○	○	○	○	○

12 User-defined Parameters

User-defined Parameters include parameters from Group 00–11.

	Pr.	Parameter Name	Setting Range	Default	VF	VFPG	SVC	FOCPG	FOCPM
〆	12-00	User-defined Parameter 1	0–9999	0616	○	○	○	○	○
〆	12-01	User-defined Parameter 2	0–9999	0632	○	○	○	○	○
〆	12-02	User-defined Parameter 3	0–9999	0633	○	○	○	○	○
〆	12-03	User-defined Parameter 4	0–9999	0653	○	○	○	○	○
〆	12-04	User-defined Parameter 5	0–9999	0654	○	○	○	○	○
〆	12-05	User-defined Parameter 6	0–9999	0655	○	○	○	○	○
〆	12-06	User-defined Parameter 7	0–9999	0656	○	○	○	○	○
〆	12-07	User-defined Parameter 8	0–9999	0657	○	○	○	○	○
〆	12-08	User-defined Parameter 9	0–9999	0658	○	○	○	○	○
〆	12-09	User-defined Parameter 10	0–9999	0659	○	○	○	○	○
〆	12-10	User-defined Parameter 11	0–9999	0660	○	○	○	○	○
〆	12-11	User-defined Parameter 12	0–9999	0661	○	○	○	○	○
〆	12-12	User-defined Parameter 13	0–9999	0662	○	○	○	○	○
〆	12-13	User-defined Parameter 14	0–9999	0663	○	○	○	○	○
〆	12-14	User-defined Parameter 15	0–9999	0664	○	○	○	○	○
〆	12-15	User-defined Parameter 16	0–9999	0617	○	○	○	○	○
〆	12-16	User-defined Parameter 17	0–9999	0634	○	○	○	○	○
〆	12-17	User-defined Parameter 18	0–9999	0635	○	○	○	○	○
〆	12-18	User-defined Parameter 19	0–9999	0618	○	○	○	○	○
〆	12-19	User-defined Parameter 20	0–9999	0636	○	○	○	○	○
〆	12-20	User-defined Parameter 21	0–9999	0637	○	○	○	○	○
〆	12-21	User-defined Parameter 22	0–9999	0619	○	○	○	○	○
〆	12-22	User-defined Parameter 23	0–9999	0638	○	○	○	○	○
〆	12-23	User-defined Parameter 24	0–9999	0639	○	○	○	○	○
〆	12-24	User-defined Parameter 25	0–9999	0620	○	○	○	○	○
〆	12-25	User-defined Parameter 26	0–9999	0640	○	○	○	○	○
〆	12-26	User-defined Parameter 27	0–9999	0641	○	○	○	○	○
〆	12-27	User-defined Parameter 28	0–9999	0621	○	○	○	○	○
〆	12-28	User-defined Parameter 29	0–9999	0642	○	○	○	○	○
〆	12-29	User-defined Parameter 30	0–9999	0643	○	○	○	○	○
〆	12-30	User-defined Parameter 31	0–9999	0	○	○	○	○	○
〆	12-31	User-defined Parameter 32	0–9999	1561	○	○	○	○	○

13 View User-defined Parameters

Pr.	Parameter Name Parameter Group 12 Setting Values	Display Address Pr.00-00–Pr.11-20	Default	VF	VFPG	SVC	FOCPG	FOCPM
13-00	Present Fault Record	0616	-	○	○	○	○	○
13-01	Motor Operation at Present Fault Time (min.)	0632	-	○	○	○	○	○
13-02	Motor Operation at Present Fault Time (day)	0633	-	○	○	○	○	○
13-03	Frequency Command at Present Fault	0653	-	○	○	○	○	○
13-04	Output Frequency at Preset Fault	0654	-	○	○	○	○	○
13-05	Output Current at Present Fault	0655	-	○	○	○	○	○
13-06	Motor Frequency at Present Fault	0656	-	○	○	○	○	○
13-07	Output Voltage at Present Fault	0657	-	○	○	○	○	○
13-08	DC Bus Voltage at Present Fault	0658	-	○	○	○	○	○
13-09	Output Power at Present Fault	0659	-	○	○	○	○	○
13-10	Output Torque at Present Fault	0660	-	○	○	○	○	○
13-11	Power Module IGBT Temperature at Present Fault	0661	-	○	○	○	○	○
13-12	Multi-function Terminal Input Status at Present Fault	0662	-	○	○	○	○	○
13-13	Multi-function Terminal Output Status at Present Fault	0663	-	○	○	○	○	○
13-14	Drive Status at Present Fault	0664	-	○	○	○	○	○
13-15	Second Most Recent Fault Record	0617	-	○	○	○	○	○
13-16	Motor Operation at Second Most Recent Fault Time (min.)	0634	-	○	○	○	○	○
13-17	Motor Operation at Second Most Recent Fault Time (day)	0635	-	○	○	○	○	○
13-18	Third Most Recent Fault Record	0618	-	○	○	○	○	○
13-19	Motor Operation at Third Most Recent Fault Time (min.)	0636	-	○	○	○	○	○
13-20	Motor Operation at Third Most Recent Fault Time (day)	0637	-	○	○	○	○	○
13-21	Fourth Most Recent Fault Record	0619	-	○	○	○	○	○
13-22	Motor Operation at Fourth Most Recent Fault Time (min.)	0638	-	○	○	○	○	○
13-23	Motor Operation at Fourth Most Recent Fault Time (day)	0639	-	○	○	○	○	○
13-24	Fifth Most Recent Fault Record	0620	-	○	○	○	○	○
13-25	Motor Operation at Fifth Most Recent Fault Time (min.)	0640	-	○	○	○	○	○
13-26	Motor Operation at Fifth Most Recent Fault Time (day)	0641	-	○	○	○	○	○
13-27	Sixth Most Recent Fault Record	0621	-	○	○	○	○	○
13-28	Motor Operation at Sixth Most Recent Fault Time (min.)	0642	-	○	○	○	○	○

Pr.	Parameter Name Parameter Group 12 Setting Values	Display Address Pr.00-00–Pr.11-20	Default	VF	VFPG	SVC	FOCPG	FOCPM
13-29	Motor Operation at Sixth Most Recent Fault Time (day)	0643	-	○	○	○	○	○
13-30	AC Motor Drive Identity Code	0	-	○	○	○	○	○
13-31	Date Code Y.WKD	1561	Read only	○	○	○	○	○

Chapter 12 Descriptions of Parameter Settings

00 Drive Parameters

✎: You can set this parameter during operation

00-00 AC Motor Drive Identity Code

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: ##

Settings Read Only

00-01 AC Motor Drive Rated Current Display

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: ##

Settings Read Only (Display by model)

- Pr.00-00 displays the AC motor drive identity code. The capacity, rated current, rated voltage and the maximum carrier frequency relate to the identity code. Use the following table to check how the AC motor drive rated current, rated voltage, and maximum carrier frequency correspond to the identity code.
- Pr.00-01 displays the AC motor drive rated current. By reading this parameter, you can check if the AC motor drive is correct.

230V models											
Power (kW)	2.2*	3.7*	4.0	5.5	7.5	11	15	18.5	22	30	37
Horsepower (HP)	3	5	5	7.5	10	15	20	25	30	40	50
Motor Drive ID Code (Pr.00-00)	108	110	10	12	14	16	18	20	22	24	26
Rated Output Current for General Purposes (A)	12.0	17.0	20	24	30	45	58	77	87	132	161
Range of the Carrier Frequency	2–15 kHz									2–9 kHz	
Rated Max. Output Carrier Frequency	8 kHz			10 kHz			8 kHz			6 kHz	

*VFD022ED21S and VFD037ED21S are single-phase models.

460V models												
Power (kW)	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Horsepower (HP)	5	7.5	10	15	20	25	30	40	50	60	75	100
Motor Drive ID Code (Pr.00-00)	11	13	15	17	19	21	23	25	27	29	31	33
Rated Output Current for General Purposes (A)	11.5	13	17	23	30	38	45	58	80	100	128	165
Range of the Carrier Frequency	2–15 kHz							2–9 kHz			2–6 kHz	
Rated Max. Output Carrier Frequency	8 kHz	10 kHz			8 kHz			6 kHz				

00-02 Parameter Reset

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
0: No Function
1: Read Only
5: Direct docking mode only, contact Delta for more information.
8: Keypad Locked
9: Reset all parameters to defaults (50 Hz)
10: Reset all parameters to defaults (60 Hz)

- 1: Set all parameters to read-only except Pr.00-00–Pr.00-07, and you can use this setting with the password setting for password protection.
- 9 or 10: Reset all parameters to the default. If the keypad is locked by a password, enter the password to reset to the default. The password is also erased.
- 8: Lock the keypad and only Pr.00-02 and Pr.00-07 can be changed.

00-03 Start-up Display

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
0: Display the Frequency command value (LED F)
1: Display the actual output frequency (LED H)
2: DC bus voltage (V)
3: Display the output current (A)
4: Output voltage (E)
5: User-defined (see Pr.00-04)

- Determines the start-up display page after power is applied to the drive.

00-04 Content of Multi-function Display

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
0: Display the output current supplied to the motor from the drive (A) (Unit: Amp)
1: Reserved
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 terminals U, V, and W output voltage of the drive (E) (Unit: V_{AC})
5: Display the terminals U, V, and W output power factor angle to the motor (n) (Unit: deg)
6: Display the terminals U, V, and W output power to the motor (P) (Unit: kW)
7: Display the actual motor speed in rpm (r) (Unit: rpm)
8: Display the drive's estimated output torque in %; the motor's rated torque is 100% (t) (Unit: %)
9: Display the PG feedback (G) (See Pr.10-00 and Pr.10-01)
10: Display the electrical angle of drive output (d) (Unit: deg)
11: Display the AUI1 analog input terminal signal (1.) (Unit: %)
12: Reserved

13: Display the AUI2 analog input terminal signal (Unit: %)

14: Display the drive's heat sink temperature (t) (Unit: °C)

15: Display the IGBT temperature (T) (Unit: °C)

16: Display digital input status ON/OFF (i)

17: Display digital output status ON/OFF (o)

18: Display the step speed of multi-step speed that is executing (S)

19: The corresponding CPU digital input pin status (i.)

20: The corresponding CPU digital output pin status (o.)

21–23: Reserved

24: Output AC voltage when malfunction occurred (E) (Unit: V_{AC})

25: Output DC voltage when malfunction occurred (v) (Unit: V_{DC})

26: Motor frequency when malfunction occurred (H) (Unit: Hz)

27: Output current when malfunction occurred (A) (Unit: Amp)

28: Output frequency when malfunction occurred (F) (Unit: Hz)

29: Frequency command when malfunction occurred (F) (Unit: Hz)

30: Output power when malfunction occurred (P) (Unit: kW)

31: Output torque when malfunction occurred (t) (Unit: %)

32: Input terminal status when malfunction occurred (i)

33: Output terminal status when malfunction occurred (o)

34: Drive status when malfunction occurred (s)

35: Display MI and MO status on digital keypad

36: CAN communication interference index (c) (Unit: %)

37: Multi-function display selection (q) (Unit: %)

40: Elevator actual speed (Unit: m/s)

📖 This parameter displays the content on the digital keypad KPC-CC01 on page U. Use this parameter to get the AC motor drive's status.

Example 01

Terminal	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD
Status	0	0	1	0	0	0	0	1	1	0

0: OFF, 1: ON

MI1: Set Pr.02-01 to 1 (multi-step speed command 1).

MI8: Set Pr.02-08 to 8 (the 1st, 2nd acceleration/deceleration time selection).

If REV, MI1 and MI8 are ON, the value is 0000 0000 1000 01102 in binary and 0086H in HEX. Meanwhile, if you set Pr.00-04 to 16 or 19, the keypad KPC-CC01 displays "0086" and LED U is ON. Pr.00-04=16 is the status of the digital input and Pr.00-04=19 is the corresponding CPU digital input pin status. Set the parameter to 16 to monitor the digital input status and then set to 19 to check if the wire is normal.

Example 02

Terminal	MO8	MO7	MO6	MO5	MO4	MO3	MO2	MO1	R2A	R1A	MRA	RA
Status	0	0	0	0	1	0	0	0	0	1	1	0

RA: Set Pr.02-11 to 9 (Drive ready)

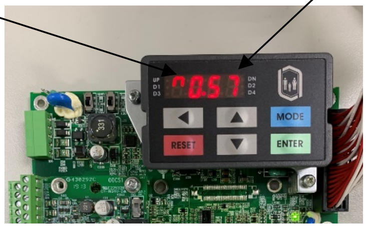
After applying the power to the AC motor drive, if there is no other error, the contact is ON. If you set Pr.00-04 to 17 or 20, the keypad displays 0001 and LED U is ON. Pr.00-04=17 is the status of digital output and Pr.00-04=20 is the corresponding CPU digital output pin status. Set the parameter to 17 to monitor the digital output status and then set to 20 to check if the wire is normal.

📖 Setting value 40 (elevator actual speed) displays as below on keyboard panel KPED-LE01:

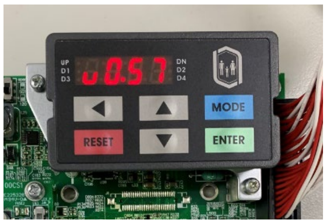
Direction: Upward (UP) / Downward (DN)

Elevator speed (m/s)

Elevator runs upward:



Elevator runs downward:



〆 00-05 User-defined Coefficient K

Control Mode	**VF**	**VFPG**	**SVC**	**FOCPG**	**FOCPM**	Default: 0

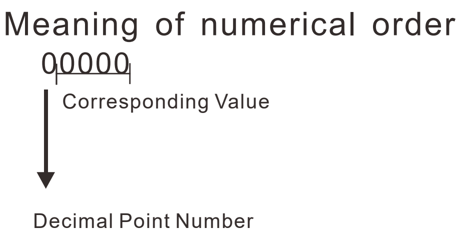
Settings Digit 4: number of decimal points (0–3)

Digit 0–3: 40–9999

📖 Digital setting method

📖 Digital 4: number of decimal points (0: no decimal points, 1: one decimal point and so on.)

Digit 0–3: 40–9999 (the corresponding value for the maximum frequency).



📖 For example, if you use rpm to display the motor speed, and the corresponding value for the four-pole motor, 60 Hz is 1800. You can set this parameter to 1800 to indicate that the corresponding value for 60 Hz is 1800 rpm. If the unit is rps, set to 10300 to indicate that the corresponding value for 60 Hz is 30.0 (one decimal point).

📖 The frequency setting only displays as the rpm value. For example, 60 Hz is displayed as 1800 rpm.

📖 After you set Pr.00-05, the keypad does not display the frequency unit “Hz” after returning to the Main menu.

00-06 Software Version

Control Mode	**VF**	**VFPG**	**SVC**	**FOCPG**	**FOCPM**	Default: ##.##

Settings Read Only

〆 00-07 Password Input

Control Mode	**VF**	**VFPG**	**SVC**	**FOCPG**	**FOCPM**	Default: 0

Settings 1–9998, 10000–65535

Display 0–2 (number of wrong password attempts)

- Inputs the password that is set in Pr.00-08. Enter the correct password here to enable changing parameters. You are limited to a maximum of three attempts. After three consecutive failed attempts, “Password Error” is displayed, and you must restart the AC motor drive before you can try again to enter the correct password.
- If you forget the password, you can decode by setting this parameter to 9999 and press the PROG/DATA button (PROG DATA) twice. Note that this resets the settings to the default.

00-08 Password Set

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0

Settings 1–9998, 10000–65535

Display 0: No password set or successful input in Pr. 00-07

1: Password has been set

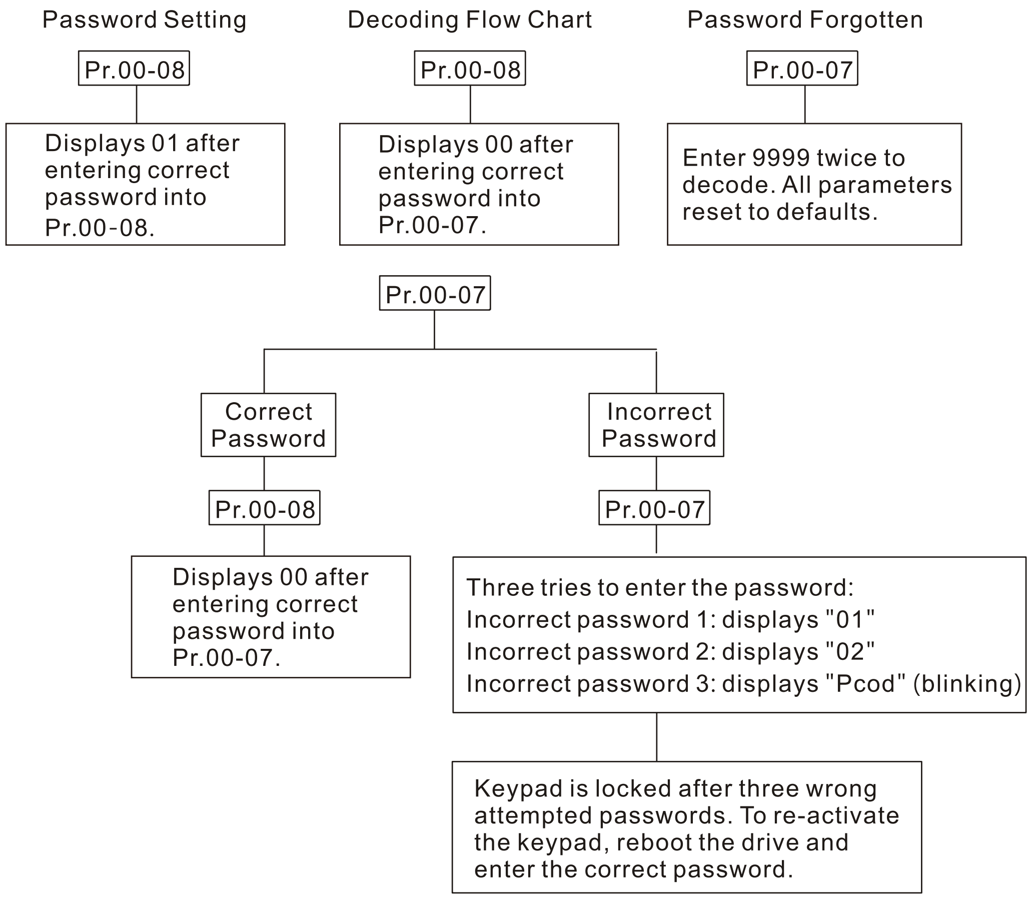
- This parameter is for setting the password protection. Password can be set directly the first time. After you set the password, the value of Pr.00-08 is 01, which means password protection is activated. However, if the value of Pr.00-08 is 00, the password protection is deactivated, which means you can change any of the parameter settings (including resetting the parameter protection password for Pr.00-08). When Pr.00-08 is 01 and if you want to change any of the parameter settings, you must enter the correct password in Pr.00-07 to deactivate the password, and this would make Pr.00-08 become 00. Note that if you set this parameter to 00 again, the password protection function is permanently deactivated. Otherwise, password protection is always reactivated after you reboot the motor drive. If you want to change any of the parameter settings after rebooting the motor drive, enter the correct password in Pr.00-07 to deactivate the password.
- How to make the password valid again after decoding by Pr.00-07:

Method 1: Re-enter the original password into Pr.00-08 (or you can enter a new password if you want to use a changed or new one).

Method 2: After rebooting, the password function is restored.

Method 3: Entering a non-password value into Pr.00-07.

Password Decode Flow Chart



00-09 Control Mode

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: V/F control (V/F)

1: V/F control + Encoder (VFPG)

2: Sensorless Vector Control (SVC)

3: FOC vector control + Encoder (FOCPG)

8: FOC Permanent Motor control (FOCPM)

📖 Mode selection:

Settings	Control Mode	Applicable Motor Type	Speed Feedback	Energy-savings	Tuning Difficulty	Ride Comfort	Speed Control Range	Motor Parameter Tuning	Basic Control	Speed Control
0	V/F	IM		Low	Low	Normal	1:50		V/F control	Voltage control
1	VFPG	IM	✓	Medium	Medium	Normal	1:50	✓	Frequency control	Frequency control
2	SVC	IM		Medium	Medium	Normal	1:50	✓	Voltage control	Voltage control
3	FOCPG	IM	✓	High	High	Good	1:1000	✓	Vector control	Frequency control
8	FOCPM	PM	✓	High	High	Good	1:1000	✓	Vector control	Frequency control

📖 Determines the AC motor drive control method.

0: You can set the V/F ratio as required and control multiple motors simultaneously.

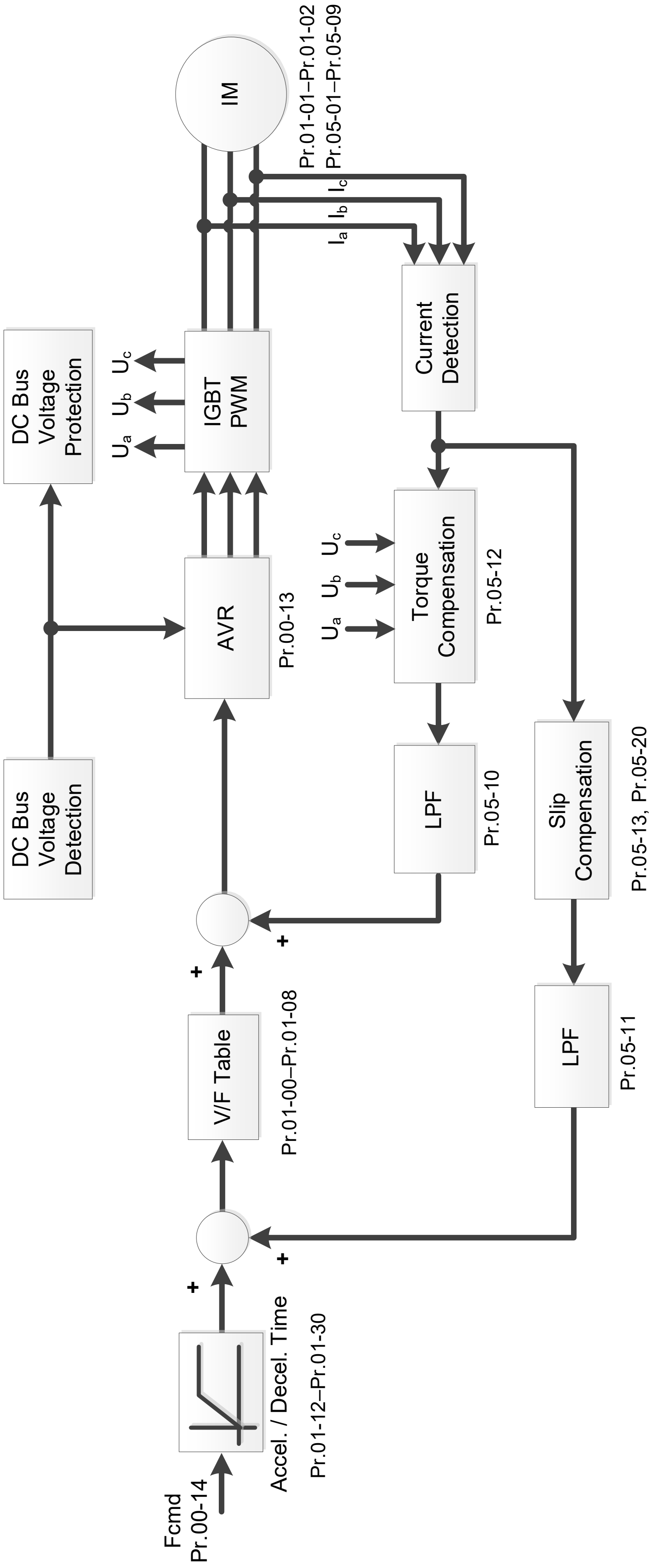
1: You can use a PG card with an encoder for closed-loop speed control.

2: Use auto-tuning for optimal settings of the control parameters.

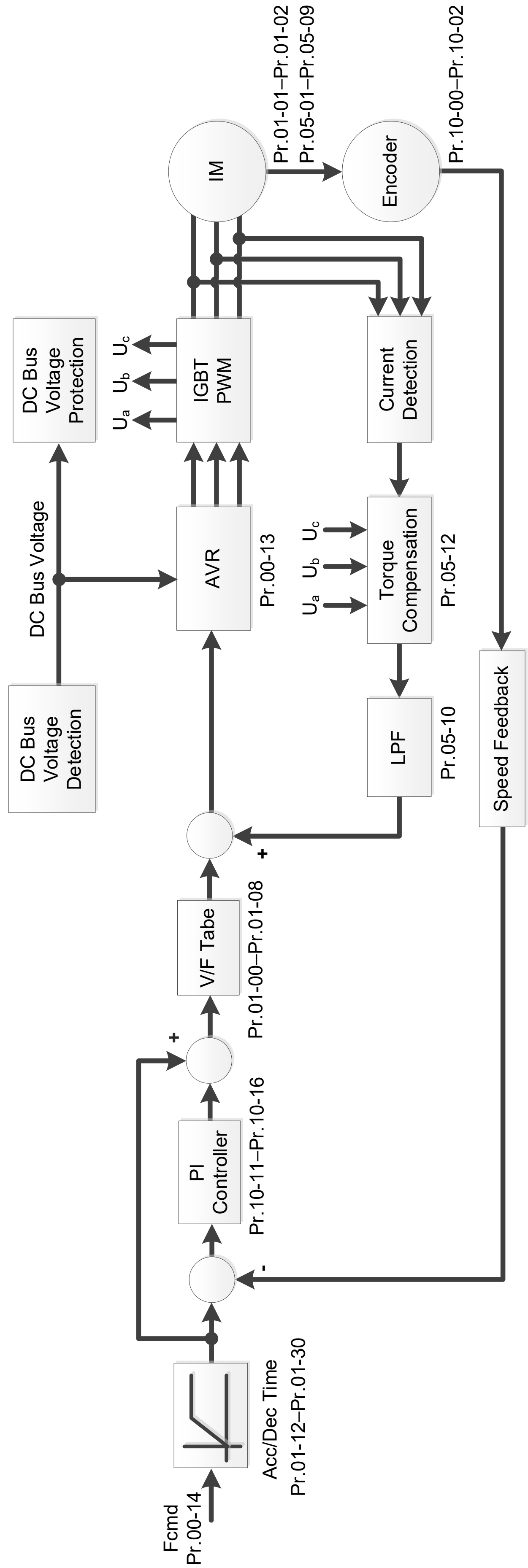
3: To increase torque and the accuracy of the speed control (1:1000).

8: To increase torque and the accuracy of the speed control (1:1000). This setting is for use only with permanent magnet motors. The other settings are for use with induction motors.

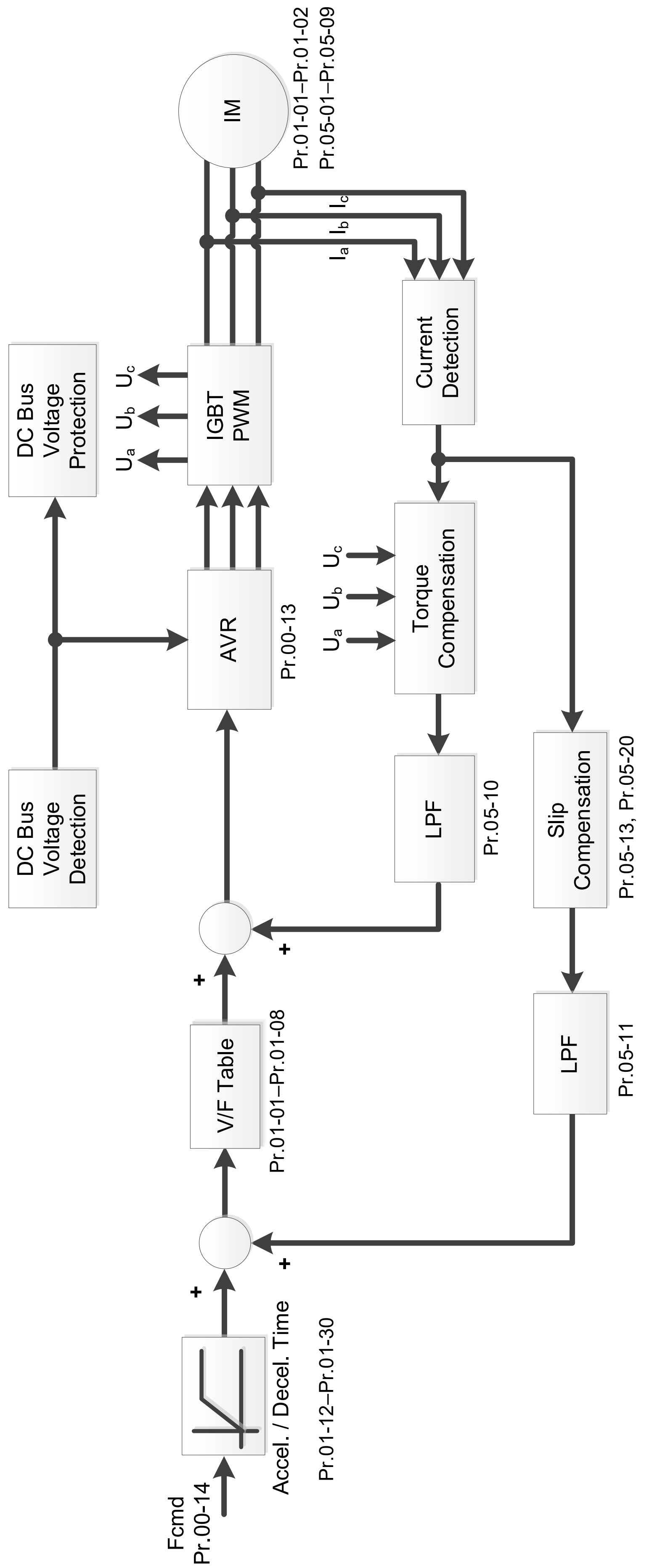
📖 When Pr.00-09=0, V/F control (V/F) control diagram is as follows:



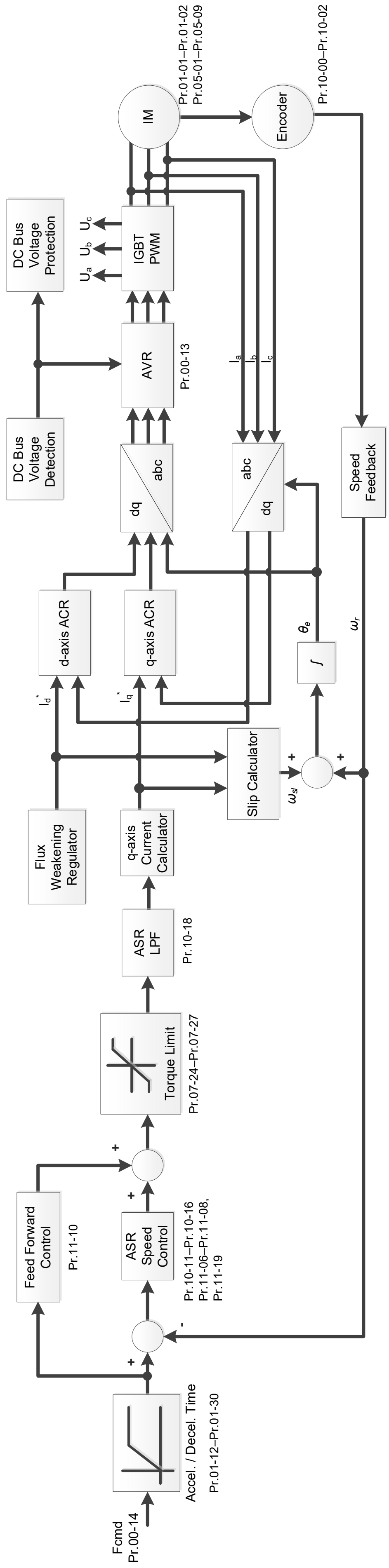
📖 When Pr.00-09=1, V/F control + Encoder (VFPG) control diagram is as follows:



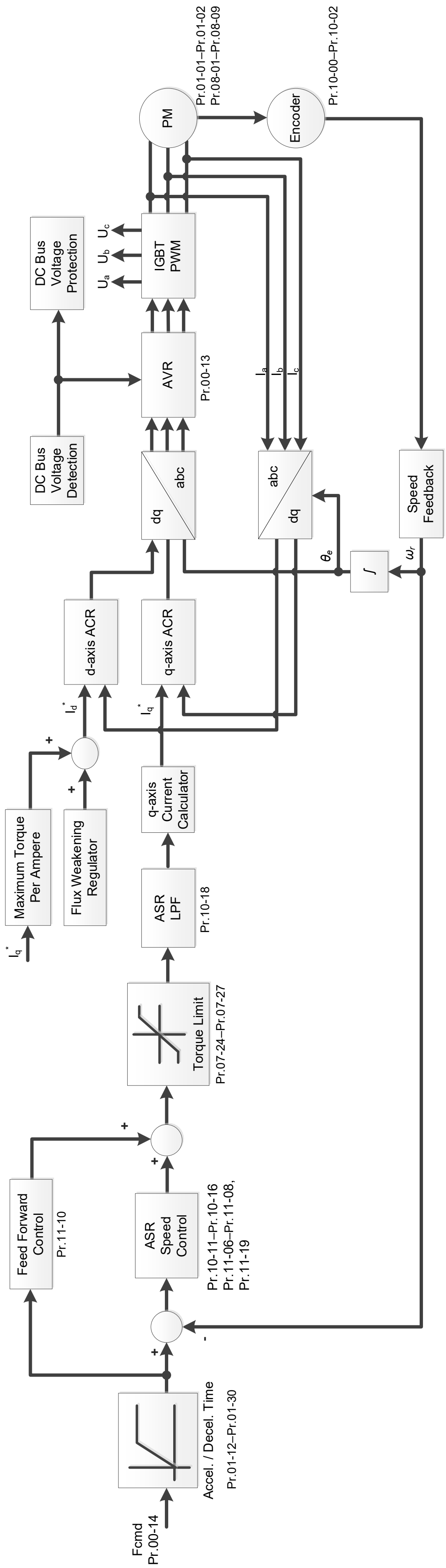
📖 When Pr.00-09=2, Sensorless Vector Control (SVC) control diagram is as follows:



📖 When Pr.00-09=3, FOC vector control + Encoder (FOCPG) control diagram is as follows:



📖 When Pr.00-09=8, FOC Permanent Motor control (FOCPM) control diagram is as follows:



00-10 Speed Unit

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Hz
1: m/s
2: ft/s
3: Direct docking mode only, contact Delta for more information.

00-11 Output Direction Selection

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: FWD: counterclockwise, REV: clockwise
1: FWD: clockwise, REV: counterclockwise

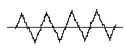
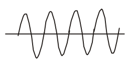
00-12 Carrier Frequency

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default:12

Settings 2–15 kHz

- Determines the PWM carrier frequency for the AC motor drive.

Models	3–5 HP	7.5–15 HP	20–30 HP	40–60 HP	75–100 HP
Settings	2–15 kHz	2–15 kHz	2–15 kHz	2–9 kHz	2–6 kHz
Default	8 kHz	10 kHz	8 kHz	6 kHz	6 kHz

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 table, you see that the PWM carrier frequency has significant influences on the motor's 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.
- If you set the carrier frequency higher than the defaults in the table above, the motor drive derates the capacity. See Carrier Frequency Derating Capacity (Fc) in Chapter 08.

00-13 Automatic Voltage Regulation (AVR) Function

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Enable AVR
1: Disable AVR
2: Disable AVR when decelerating to stop

- The AVR function automatically regulates the AC motor drive output voltage to the motor's rated voltage when the input power is larger than the motor's rated voltages. For instance, if you set V/F curve to 200 V_{AC}/50 Hz and the input voltage is between 200–264 V_{AC}, then the output voltage to the motor is automatically regulated to 200 V_{AC}/50 Hz. If the input voltage is from 180 to 200 V_{AC}, the output voltage to the motor and the input voltage is in direct proportion to the input voltage.

- When the motor stops with deceleration, it shortens the deceleration time with AVR disabled. Setting this parameter to 1 with auto-acceleration/auto-deceleration results in quicker deceleration.

✓ 00-14 Master Frequency Command Source

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default:1

Settings
1: RS-485 serial communication or digital keypad (KPC-CC01)
2: External analog input (Pr.03-00)
3: Digital terminal inputs
4: Direct docking mode only, contact Delta for more information.

- Determines the drive's master frequency source.

✓ 00-15 Operation Command Source

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default:1

Settings
1: External terminals
2: RS-485 serial communication or digital keypad (KPC-CC01)

- The ED series motor drives are shipped without a digital keypad, but you can use the external terminals or RS-485 to control the operation command.
- When the LED PU is ON, you can control the operation command with the optional digital keypad. (Refer to Chapter 09 for more information about the digital keypad KPC-CC01).

01 Basic Parameters

✓: You can set this parameter during operation

01-00 Maximum Output Frequency

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 60.00/50.00

Settings 5.00–299.00 Hz

- Determines the AC motor drive's Maximum Output Frequency. All the AC motor drive frequency command sources (analog inputs -10–10 V) are scaled to correspond to the output frequency range.

01-01 1st Output Frequency Setting (base frequency/ motor's rated frequency)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 60.00/50.00

Settings 0.00–299.00 Hz

- Set this parameter according to the rated frequency on the motor nameplate. If the motor is 60 Hz, set this parameter to 60. If the motor is 50 Hz, set it to 50.

01-02 1st Output Voltage Setting (base voltage/ motor's rated voltage)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 220.0/440.0

Settings 230V models 0.1–255.0 V

460V models 0.1–510.0 V

- Set this parameter according to the rated voltage on the motor nameplate. If the motor is 220 V, set this parameter to 220.0. If the motor is 200 V, set this parameter to 200.0.
- There are many motor types in the market and the power system for each country is also different. The economical and convenient solution is to install an AC motor drive. Then there is no problem using the motor with different voltage and frequency inputs, and the motor drive can improve the original motor characteristics and useful life.

01-03 Second Output Frequency Setting

Control Mode **VF** **VFPG** Default: 0.50

Settings 0.00–299.00 Hz

✓ 01-04 Second Output Voltage Setting

Control Mode **VF** **VFPG** Default: 5.0/10.0

Settings 230V models 0.1–255.0 V

460V models 0.1–510.0 V

01-05 Third Output Frequency Setting

Control Mode **VF** **VFPG** Default: 0.50

Settings 0.00–299.00 Hz

✓ 01-06 Third Output Voltage Setting

Control Mode **VF** **VFPG** Default: 5.0/10.0

Settings 230V models 0.1–255.0 V

460V models 0.1–510.0 V

01-07 Fourth Output Frequency Setting

Control Mode **VF** **VFPG** **SVC** **FOCPG** Default: 0.00

Settings 0.00–299.00 Hz

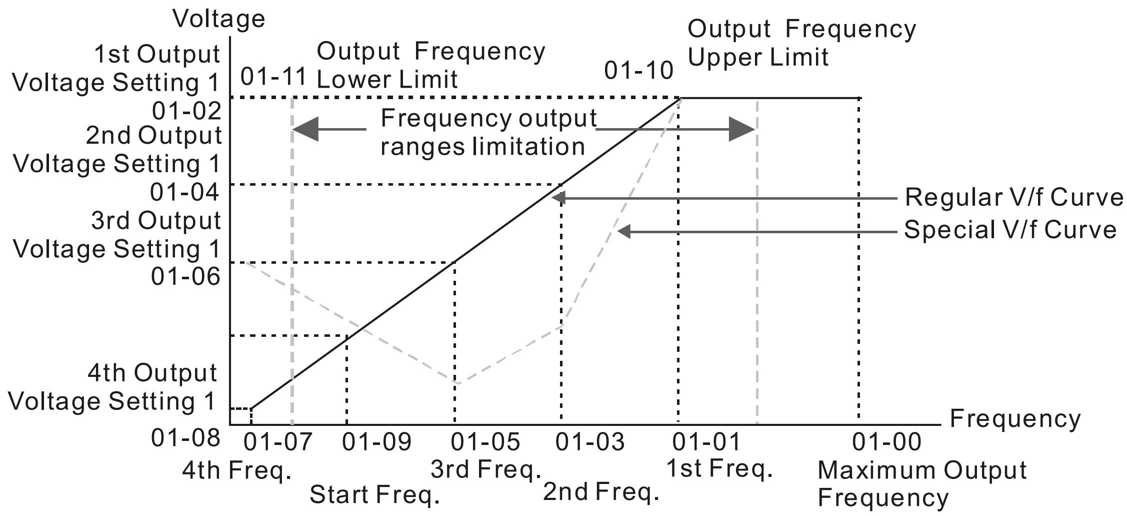
01-08 Fourth Output Voltage Setting

Control Mode **VF** **VFPG** **SVC** Default: 5.0/10.0

Settings 230V models 0.1–255.0 V

460V models 0.1–510.0 V

- You usually set the V/F curve according to the motor's allowable loading characteristics. Pay special attention to the motor's heat dissipation, dynamic balance, and bearing lubrication when the loading characteristics exceed the loading limit of the motor.
- The frequency setting of V/F curve must be set according to this rule: Pr.01-01 ≥ Pr.01-03 ≥ Pr.01-05 ≥ Pr.01-07. There is no limit for the voltage setting, but a high voltage at low frequency may cause motor burnout, overheating, and trigger stall prevention or over-current protection. Use l
- ow voltages at low frequencies to prevent motor damage or drive malfunction.



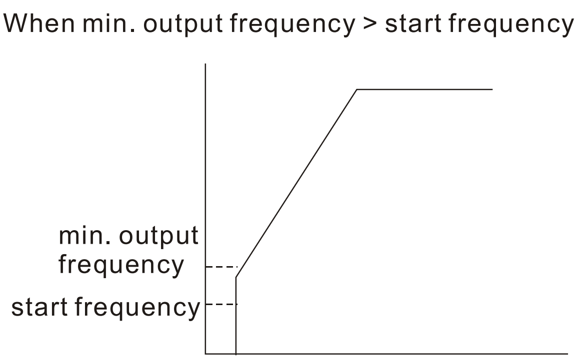
V/f Curve

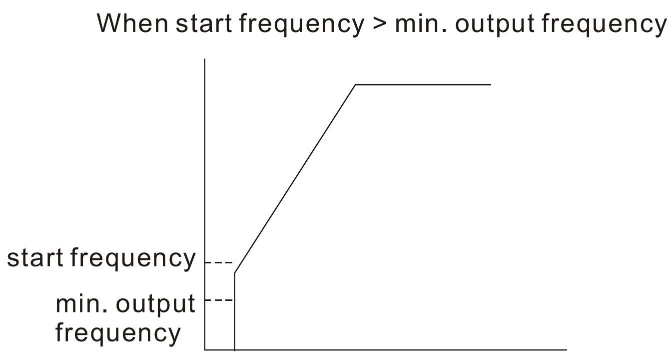
01-09 Starting Frequency

Control Mode **VF** **VFPG** **SVC** **FOCPG** Default: 0.50

Settings 0.00–299.00 Hz

- Determines the starting frequency. When the starting frequency (Pr.01-09) is larger than the output frequency (Pr.01-11), the frequency output starts when the starting frequency (Pr.01-09) reaches the F command.





01-10 Output Frequency Upper Limit

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 299.00
	Settings	0.00–299.00 Hz				

01-11 Output Frequency Lower Limit

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0.00
	Settings	0.00–299.00 Hz				

- Use the upper/lower output frequency settings to limit the actual output frequency. If the frequency setting is lower than the start-up frequency, it runs with zero speed. If the frequency setting is higher than the upper limit, it runs with the upper limit frequency. If the output frequency lower limit is larger than output frequency upper limit, this function is invalid.

01-12 Accel. Time 1

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 3.00
	Settings	0.00–600.00 sec.				

01-13 Decel. Time 1

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 2.00
	Settings	0.00–600.00 sec.				

01-14 Accel. Time 2

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 3.00
	Settings	0.00–600.00 sec.				

01-15 Decel. Time 2

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 2.00
	Settings	0.00–600.00 sec.				

01-16 Accel. Time 3

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 3.00
	Settings	0.00–600.00 sec.				

01-17 Decel. Time 3

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 2.00
	Settings	0.00–600.00 sec.				

01-18 Accel. Time 4

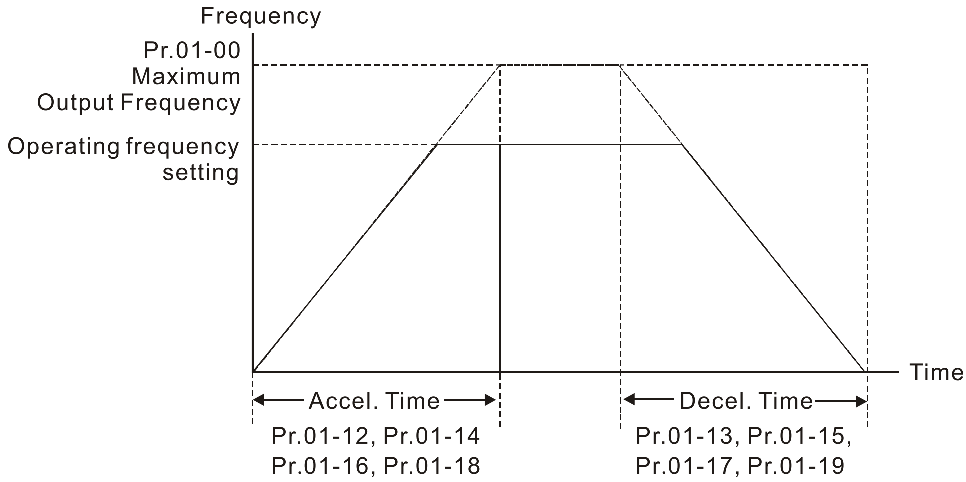
Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 3.00
	Settings	0.00–600.00 sec.				

01-19 Decel. Time 4

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 2.00
	Settings	0.00–600.00 sec.				

- The Acceleration Time determines the time required for the AC motor drive to ramp from 0.00 Hz to the Maximum Output Frequency (Pr.01-00). The Deceleration Time determines the time required for the AC motor drive to decelerate from the Maximum Output Frequency (Pr.01-00) down to 0.00 Hz.

- Select the Acceleration/Deceleration Time 1, 2, 3, 4 with the multi-function input terminal settings. The defaults are Acceleration Time 1 and Deceleration Time 1.
- When there is a large opposing torque and inertial torque for the load, and the acceleration and deceleration time settings are less than the necessary value, then they enable the torque limit and stall prevention functions. When this happens, the actual acceleration and deceleration time are longer than the settings.



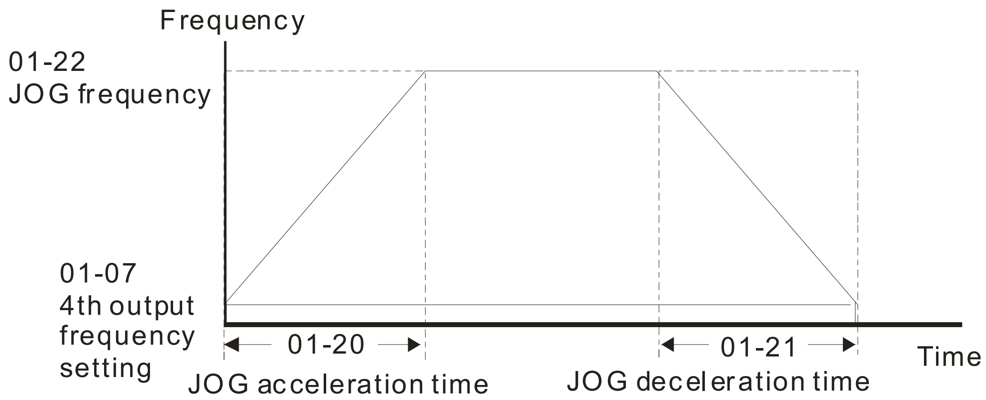
Acceleration & Decelertion Time Setting

01-20 JOG Acceleration Time
01-21 JOG Deceleration Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 1.00

Settings 0.00–600.00 sec.

- You can use both the external terminal JOG and the JOG key on the keypad. When the JOG command is ON, the AC motor drive accelerates from the fourth output voltage setting (Pr.01-07) to the JOG frequency (Pr.01-22). When the JOG command is OFF, the AC motor drive decelerates from the JOG frequency to zero. The Acceleration and Deceleration time are set by these parameters (Pr.01-20, Pr.01-21).
- You cannot execute the JOG command when the AC motor drive is running. When the JOG command is running, other operation commands are invalid except the Forward and Reverse commands.



JOG accel./decel. time

01-22 JOG Frequency

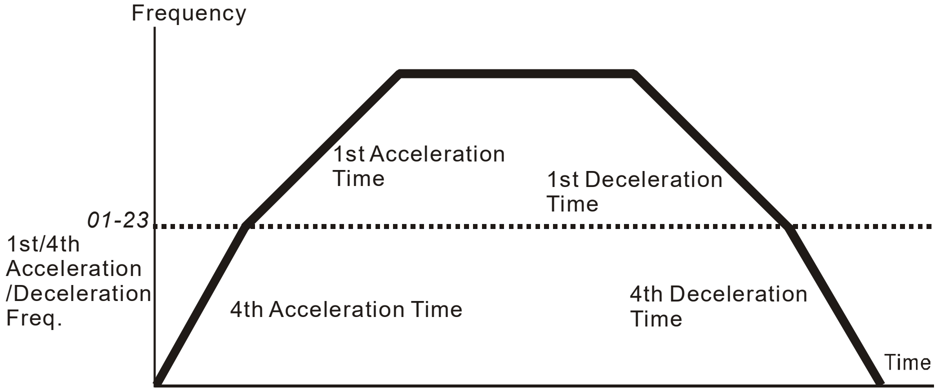
Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 6.00
	Settings	0.00–299.00 Hz				

- You can use both the external terminal JOG and the JOG key on PU. When the JOG terminal is disabled, the AC motor drive accelerates from 0 Hz to the JOG frequency (Pr.01-22). When the JOG terminal is enabled, the AC motor drive decelerates from the JOG frequency to zero. The Acceleration and Deceleration time are set by these parameters (Pr.01-20, Pr.01-21). You cannot execute the JOG command when the AC motor drive is running. When the JOG command is running, other operation commands are invalid except the Forward and Reverse commands and the STOP key on the digital keypad.

01-23 Switch Frequency between First and Fourth Accel./Decel.

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0.00
	Settings	0.00–299.00 Hz				

- Determines the frequency for the transition from acceleration and deceleration time 1 to acceleration and deceleration time 4. You can also enable the transition from acceleration or deceleration time 1 to acceleration and deceleration time 4 with the external terminals (Pr.02-01–Pr.02-08). The external terminal has priority over Pr.01-23.



1st/4th Acceleration/Deceleration Switching

01-24 S-curve for Acceleration Begin Time S1
01-25 S-curve for Acceleration Arrival Time S2
01-26 S-curve for Deceleration Begin Time S3
01-27 S-curve for Deceleration Arrival Time S4
01-30 S-curve for Deceleration Arrival Time S5

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 1.00
	Settings	0.00–25.00 sec.				

01-29 Switch Frequency for S3/S4 Changes to S5

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0.00
	Settings	0.00–299.00 Hz				

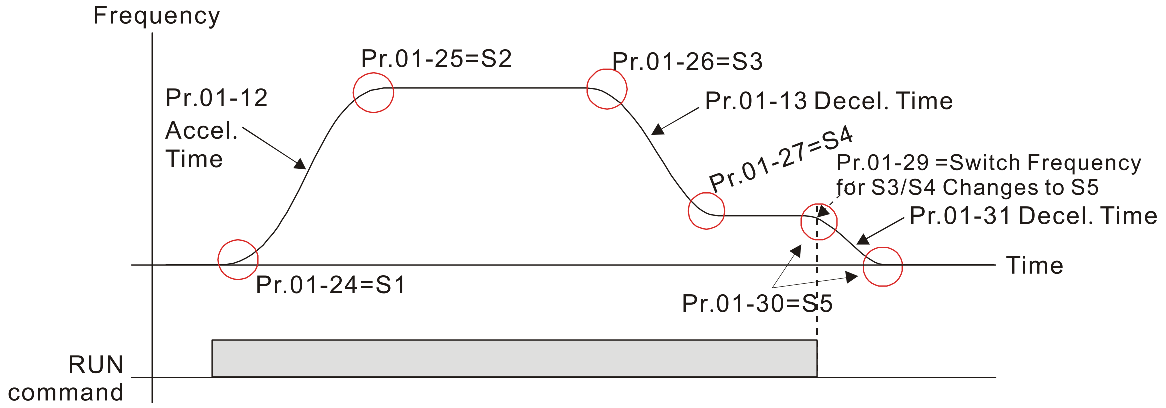
- Using an S-curve gives the smoothest transition between speed changes. The acceleration and deceleration curve adjusts the acceleration and deceleration S-curve. When enabled, the motor drive produces a different acceleration and deceleration curve according to the acceleration and deceleration time.

The Actual Acceleration Time = selected acceleration Time + (Pr.01-24 + Pr.01-25) ÷ 2.

The Actual Deceleration Time = selected deceleration Time + (Pr.01-26 + Pr.01-27 + Pr.01-30 x 2) ÷ 2.

Use Pr.01-29 to set the switch frequency between S4 and S5 for smooth stopping.

Set Pr.01-29 to the leveling speed of the elevator.



01-28 Mode Selection when Frequency < Fmin

Control Mode **VF** **VFPG** **SVC** Default: 1

Settings 0: Output Waiting

1: Zero-speed operation

2: Fmin (Fourth output frequency setting)

The AC motor drive uses this parameter when it is at 0 Hz.

1 or 2: The voltage outputs according to the output voltage command corresponding to Fmin (Pr.01-08).

01-31 Deceleration Time when Operating without RUN Command

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2.00

Settings 0.00–600.00 sec.

The AC motor drive stops according to this parameter when cancelling the RUN command. Refer to the figure in the description for Pr.01-29 for details.

01-32 Direct docking mode only

Control Mode Default: -

Settings Contact Delta for more information

01-33 High Speed Time for Short Floor

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 3.00

Settings 0.00–60.00 sec.

Sets the high speed duration during short floor operation.

01-34 Leveling Speed Time for Short Floor

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 3.00

Settings 0.00–60.00 sec.

Sets the leveling speed duration during short floor operation.

01-35 Limit for Direct Docking Terminal

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2.00

Settings 0.00–10.00

- Sets the limit for changing from leveling speed to acceleration when using terminals for direct docking.

01-36 Deceleration Distance for Direct Docking Terminal

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 30.00

Settings 0.00–10.00 cm

- Sets the distance between deceleration points.

01-37 Deceleration Distance Reference for Short Floor

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 m

- Sets the distance between deceleration points according to short floors (write inhibit).

01-38 Short Floor/Direct Docking Terminal Enabled

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0000h

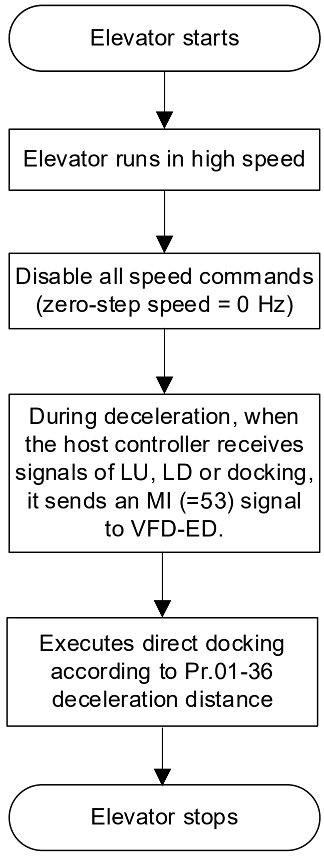
Settings
0000h: Disabled
0001h: Short floor enabled
0002h: Direct docking terminal enabled
0003h: Short floor + direct docking terminal enabled

- Related parameters: Pr.02-01–02-08 multi-function input terminal (53: terminal leveling signal for direct docking).
- Direct docking terminal function:
  When the elevator runs to the leveling area, controller sends a leveling signal to the drive to make the drive stop within effective distance (Pr.01-36). If deceleration distance is too short, the drive adjusts the speed according to the limit for acceleration change (Pr.01-35). Deceleration of direct docking terminal function is calculated through Pr.11-01.

There are two methods for sending leveling signals:

1. Using multi-function input terminals (MI=53)
2. Deactivate MI1 and MI2 (Multi-step speed command 1 and 2)

Method 1: Direct docking terminal function (using MI terminal to input leveling signals)

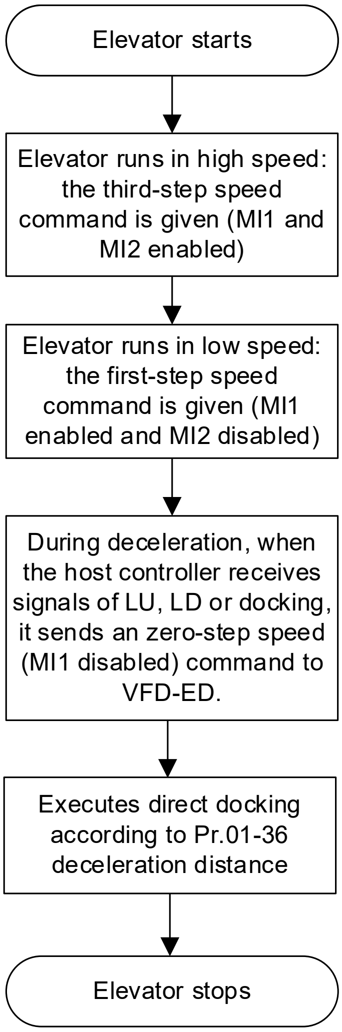


The steps to execute direct docking terminal function using multi-function input terminal (MI=53) are as follows:

1. The control mode should be in closed-loop. Set Pr.00-01 = 2 (FOCPG) or 3 (FOCPM).
2. Set Pr.00-14 = 3 (External digital input).
3. Set Pr.00-15 = 1 (External terminals).
4. Set Pr.04-00 = 0 (Zero-step speed frequency must be set to 0 Hz).
5. Increase Pr.01-13 appropriately in case the elevator stops while having not reached the leveling plate.
6. Set Pr.01-35 (Limit for Direct Docking Terminal Function). In normal condition, there is no need to adjust this parameter.
7. Set Pr.01-36 (Deceleration Distance for Direct Docking Terminal Function). Enter the length of leveling plate.
8. Set Pr.01-38 = 2 (Direct docking terminal function enabled).
9. Set multi-function input (MI) terminal to 53.
10. Set Pr.11-01 (Elevator speed). Deceleration speed for terminal function direct docking is calculated according to this parameter

NOTE: Before the terminal function direct docking is activated, all speed commands must be disabled (zero-step speed = 0 Hz).

Method 2: Direct docking terminal function (using multi-step speed change)



The steps to execute direct docking terminal function using deactivating multi-step speed command 1 and 2 (MI1 and MI2) are as follows:

1. The control mode should be in closed-loop. Set Pr.00-09 = 3 (FOCPG) or 8 (FOCPM).
2. Set Pr.00-14 = 3 (External digital input).
3. Set Pr.00-15 = 1 (External terminals).
4. Set Pr.04-00 = 0 (Zero-step speed frequency must be set to 0 Hz).
5. Set Pr.04-01 (First-step Speed Frequency).
6. Set Pr.04-03 (Third-step Speed Frequency).
7. Increase Pr.01-13 appropriately in case the elevator stops while having not reached the leveling plate.
8. Set Pr.01-35 (Limit for Direct Docking Terminal Function). In normal condition, there is no need to adjust this parameter.
9. Set Pr.01-36 (Deceleration Distance for Direct Docking Terminal Function). Enter the length of leveling plate.
10. Set Pr.01-38 = 2 (Direct docking terminal function enabled).
11. Set Pr.11-01 (Elevator speed). Deceleration speed for terminal function direct docking is calculated according to this parameter.

NOTE: Do NOT set multi-function (MI) terminal to 53.

01-39 Automatic Emergency Deceleration Level

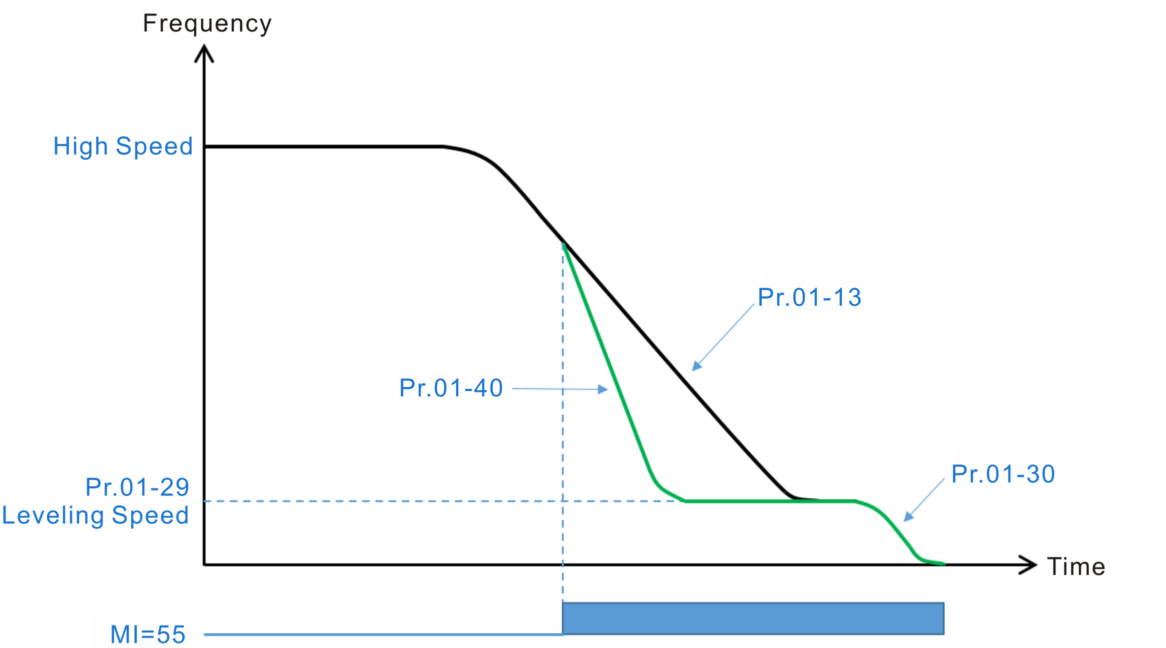
Control Mode	VFPG	FOCPG	FOCPM	Default: 60.00
	Settings	5.00–299.00 Hz		

- When MI is set to 56, the system monitors the current speed. If the speed is higher than Pr.01-39, the drive decelerates to Pr.01-29 speed according to Pr.01-40 deceleration time.

01-40 Deceleration Time for Emergency Deceleration

Control Mode	VFPG	FOCPG	FOCPM	Default: 2.00
	Settings	0.00–600.00 sec.		

- When MI=55 function is triggered, the drive decelerates to Pr.01-29 speed according to Pr.01-40 deceleration time, as shown in the figure below.



02 Digital Input / Output Parameters

✔: You can set this parameter during operation

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

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: FWD/STOP, REV/STOP

1: FWD/STOP, REV/STOP (Line Start Lockout)

2: RUN/STOP, REV/FWD

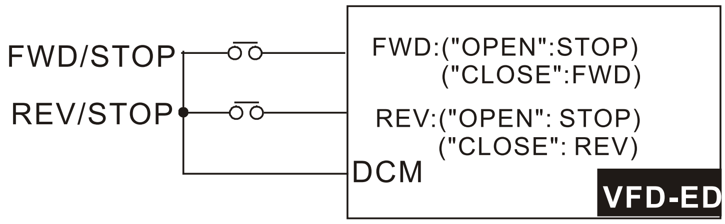
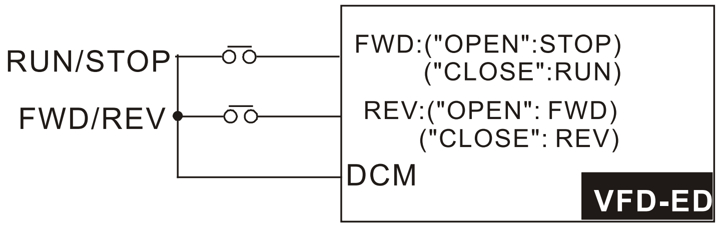
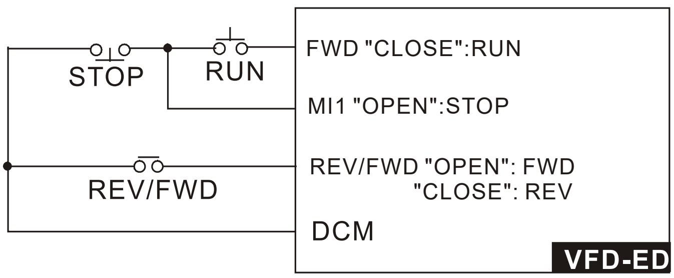
3: RUN/STOP, REV/FWD (Line Start Lockout)

4: Three-wire

5: Three-wire (Line Start Lockout)

📖 Three of the six modes include a “Line Start Lockout” feature. When line start lockout is enabled, the motor drive does not run when you apply power. The Line Start Lockout feature does not guarantee that the motor never starts under this condition. It is possible the motor may be set in motion by a mechanical vibration or malfunctioning switch.

This parameter controls operation from external terminals. There are three different control modes.

<table>
<tr><th>Pr.02-00</th><th>External Terminal Control Circuits</th></tr>
<tr><td>0, 1
Two-wire operation control (1)
FWD/STOP
REV/STOP</td><td>
</td></tr>
<tr><td>2, 3
Two-wire operation control (2)
RUN/STOP
REV/FWD</td><td>
</td></tr>
<tr><td>4, 5
Three-wire operation control</td><td>
</td></tr>
</table>

02-01 Multi-function Input Command 1 (MI1) (It is the Stop terminal for three-wire operation)

Default: 1

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

Default: 2

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

Default: 3

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

Default: 4

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

Default: 0

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

Default: 0

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

Default: 0

02-08 Multi-function Input Command 8 (MI8) (Enable Drive terminal)

Default:40

Settings	Control Mode	VF	VFPG	SVC	FOCPG	FOCPM
0: No function		O	O	O	O	O
1: Multi-step speed command 1		O	O	O	O	O
2: Multi-step speed command 2		O	O	O	O	O
3: Multi-step speed command 3		O	O	O	O	O
4: Multi-step speed command 4		O	O	O	O	O
5: Reset		O	O	O	O	O
6: JOG command		O	O	O	O	O
7: Acceleration/deceleration speed inhibit		O	O	O	O	O
8: First, second acceleration/deceleration time		O	O	O	O	O
9: Third, fourth acceleration/deceleration time		O	O	O	O	O
10: EF input (Pr.07-28)		O	O	O	O	O
11: Reserved						
12: Stop output		O	O	O	O	O
13–14: Reserved						
15: AUI1 operation speed command		O	O	O	O	O
16: Reserved		O	O	O	O	O
17: AUI2 operation speed command		O	O	O	O	O
18: Emergency Stop (Pr.07-28)		O	O	O	O	O
19–23: Reserved						
24: FWD JOG Command		O	O	O	O	O
25: REV JOG Command		O	O	O	O	O
26: Reserved						
27: ASR1/ASR2 selection		O	O	O	O	O
28: Emergency stop (EF1) (motor coasts to stop)		O	O	O	O	O
29–30: Reserved						
31: High torque bias (according to Pr.07-21)		O	O	O	O	O
32: Middle torque bias (according to Pr.07-22)		O	O	O	O	O
33: Low torque bias (according to Pr.07-23)		O	O	O	O	O
34–37: Reserved						
38: Disable writing to EEPROM		O	O	O	O	O
39: Torque command direction (0 is positive direction)						
40: Enable drive function		O	O	O	O	O

41: Magnetic contactor detection		○	○	○	○
42: Mechanical brake 1	○	○	○	○	○
43: EPS function (Emergency Power System)	○	○	○	○	○
44: Mechanical brake 2	○	○	○	○	○
45–51: Direct docking mode only					
53: Terminal leveling signal for direct docking		○		○	○
54: Power failure signal	○	○	○	○	○
55: Manual emergency deceleration		○		○	○
56: Automatic emergency deceleration		○		○	○
57: Brake torque test action signal	○	○	○	○	○
59: AFE fault	○	○	○	○	○

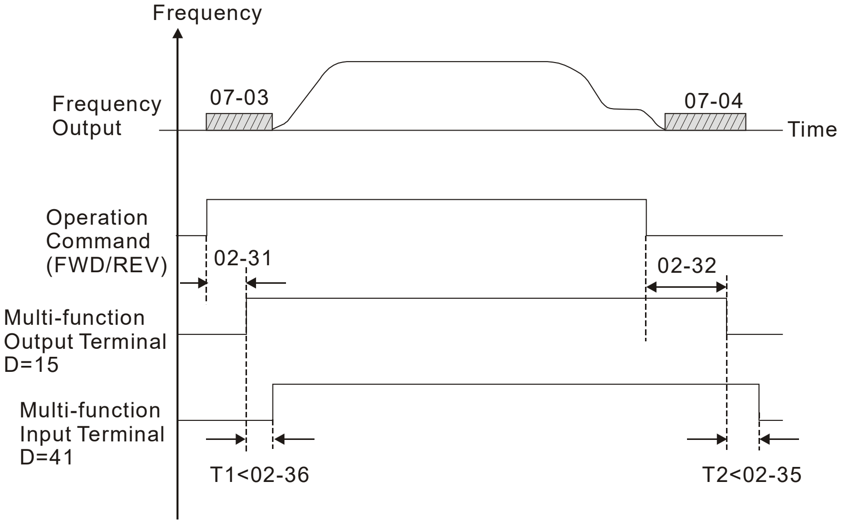
- Selects the functions for each multi-function input terminal.
- If you set Pr.02-00 to three-wire operation control, terminal MI1 is for STOP terminal, and MI1 is not available for any other operation.

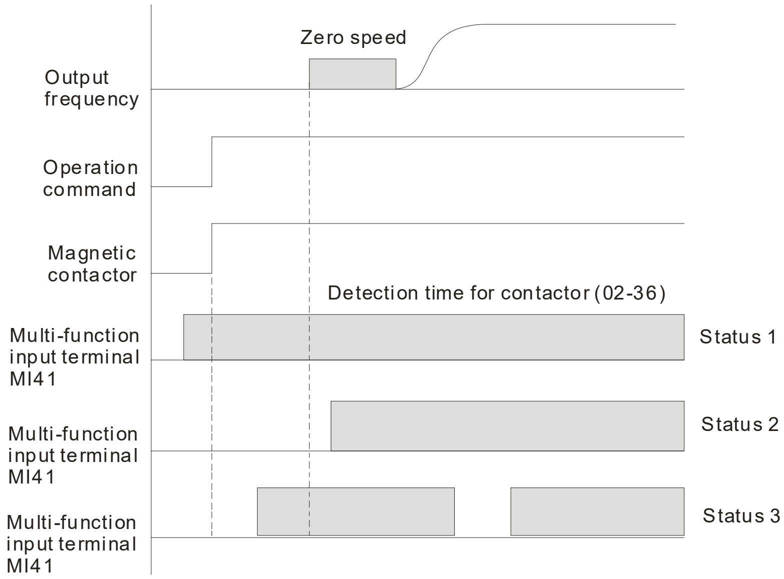
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>0</td><td>No Function</td><td></td></tr>
<tr><td>1</td><td>Multi-step speed command 1</td><td rowspan="4">15-step speeds controlled through the four terminals, and 17 in total including the master speed and JOG (refer to Pr. 04-00–Pr.04-14).
When using communication to control the multi-step speed, settings 1–4 are invalid.</td></tr>
<tr><td>2</td><td>Multi-step speed command 2</td></tr>
<tr><td>3</td><td>Multi-step speed command 3</td></tr>
<tr><td>4</td><td>Multi-step speed command 4</td></tr>
<tr><td>5</td><td>Reset</td><td>After you eliminate the drive error, use this terminal to reset the drive.</td></tr>
<tr><td>6</td><td>JOG Command</td><td>JOG operation</td></tr>
<tr><td>7</td><td>Acceleration/deceleration Speed Inhibit</td><td>When enabled, acceleration and deceleration are stopped and the AC motor drive starts to accelerate and decelerate from the inhibit point.</td></tr>
<tr><td>8</td><td>The first, second acceleration or deceleration time</td><td rowspan="2">You can select the motor drive's acceleration and deceleration time through the terminals; there are four acceleration and deceleration speeds in total.
<table>
<tr><th>Bit 0</th><th>Bit 1</th><th>Descriptions</th></tr>
<tr><td>0</td><td>0</td><td>First accel./decel. time
When output frequency is less than Pr.01-23 (Switch Frequency between First/Fourth Accel./Decel.), it outputs the fourth accel./decel. time.</td></tr>
<tr><td>0</td><td>1</td><td>Second accel./decel. time</td></tr>
<tr><td>1</td><td>0</td><td>Third accel./decel. time</td></tr>
<tr><td>1</td><td>1</td><td>Fourth accel./decel. time</td></tr>
</table>
If the drive receives STOP command, it decelerates to stop with Pr.01-31.</td></tr>
<tr><td>9</td><td>The third, fourth acceleration or deceleration time</td></tr>
<tr><td>10</td><td>EF Input</td><td>External fault input terminal, and decelerates according to Pr.07-28 (records EF fault).</td></tr>
<tr><td colspan="3">11: Reserved</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>12</td><td>Stop output</td><td>When enabled, the motor drive output stops immediately and the motor coasts. When disabled, the motor drive accelerates to the frequency setting.</td></tr>
<tr><td colspan="3">13–14: Reserved</td></tr>
<tr><td>15</td><td>AUI1 operation speed command</td><td>When the operation speed command source is AUI1 and AUI2, and two or more terminals are ON, the priority is AUI1 > AUI2.
When enabled, the frequency source is AUI1.</td></tr>
<tr><td colspan="3">16: Reserved</td></tr>
<tr><td>17</td><td>AUI2 operation speed command</td><td>When enabled, it forces the frequency source to AUI2.</td></tr>
<tr><td>18</td><td>Emergency Stop</td><td>When enabled, the motor drive ramps to stop according to Pr.07-28.</td></tr>
<tr><td colspan="3">19–23: Reserved</td></tr>
<tr><td>24</td><td>FWD JOG command</td><td>When enabled, the motor drive executes the forward Jog command.</td></tr>
<tr><td>25</td><td>REV JOG command</td><td>When enabled, the motor drive executes the reverse Jog command.</td></tr>
<tr><td colspan="3">26: Reserved</td></tr>
<tr><td>27</td><td>ASR1/ASR2 selection</td><td>ON: Speed is adjusted according to ASR 2.
OFF: Speed is adjusted according to ASR 1.</td></tr>
<tr><td>28</td><td>Emergency stop (EF1) (Motor coasts to stop)</td><td>ON: The motor drive executes emergency stop and records the fault code.</td></tr>
<tr><td colspan="3">29–30: Reserved</td></tr>
<tr><td>31</td><td>High torque bias</td><td rowspan="3">When Pr.07-19 is set to 3:
Set the high torque bias in Pr.07-21.
Set the middle torque bias in Pr.07-22.
Set the low torque bias in Pr.07-23.
<table>
<tr><th>31</th><th>32</th><th>33</th><th>Torque Bias</th></tr>
<tr><td>OFF</td><td>OFF</td><td>OFF</td><td>N/A</td></tr>
<tr><td>OFF</td><td>OFF</td><td>ON</td><td>Pr.07-23</td></tr>
<tr><td>OFF</td><td>ON</td><td>OFF</td><td>Pr.07-22</td></tr>
<tr><td>OFF</td><td>ON</td><td>ON</td><td>Pr.07-23+ Pr.07-22</td></tr>
<tr><td>ON</td><td>OFF</td><td>OFF</td><td>Pr.07-21</td></tr>
<tr><td>ON</td><td>OFF</td><td>ON</td><td>Pr.07-21+ Pr.07-23</td></tr>
<tr><td>ON</td><td>ON</td><td>OFF</td><td>Pr.07-21+ Pr.07-22</td></tr>
<tr><td>ON</td><td>ON</td><td>ON</td><td>Pr.07-21+ Pr.07-22+ Pr.07-23</td></tr>
</table></td></tr>
<tr><td>32</td><td>Middle torque bias</td></tr>
<tr><td>33</td><td>Low torque bias</td></tr>
<tr><td colspan="3">34–37: Reserved</td></tr>
<tr><td>38</td><td>Disable writing to EEPROM</td><td>When enabled, you cannot write to EEPROM.</td></tr>
<tr><td>39</td><td>Torque command direction</td><td>When the torque command is AUI, set this function to change the torque command direction. To work with Pr.07-13 = 2, set Pr.03-00 to 2.</td></tr>
</table>

Settings	Functions	Descriptions
40	Enable drive function	When enabled, it executes the motor drive function. This function can be used with multi-function output (setting Pr.02-11–Pr.02-14 to 15) and (Pr.02-31 and Pr.02-32).
41	Magnetic contactor detection	This terminal is for the magnetic contactor feedback signal ON/OFF. When the motor drive receives a RUN command, it enables the corresponding output terminal (setting 15) after Pr.02-31 time. It checks if this function is enabled in the detection time (Pr.02-36). If NOT, the magnetic contactor error occurs and error code “MCF” displays.
42	Mechanical brake 1	When the motor drive receives a RUN command, it enables the corresponding output terminal (setting 12) after Pr.02-29 time. It checks if this function is enabled in the detection time (Pr.02-35). If NOT, the mechanical brake error occurs and error code “MBF” displays.
43	EPS function (Emergency Power System)	If power is cut during running, the drive stops when the DC bus voltage is less than the low voltage level. After power is cut, the drive runs according to the EPS frequency when EPS is applied and this function is ON.
44	Mechanical brake 2	When the motor drive receives a RUN command, it enables the corresponding output terminal (setting 12) after Pr.02-29 time. It checks if this function is enabled in the detection time (Pr.02-35). If NOT, the mechanical brake error occurs and error code “MBF” displays.
45–51	Direct docking mode only	Contact Delta for more information.
53	Terminal leveling signal for direct docking	When the elevator runs to the leveling area, controller sends a signal to the drive to make the drive stop within effective distance (Pr.01-36).
54	Power failure signal	When power failure occurs, the host controller inputs this signal to inform the drive. When the motor drive receives this signal, MO = 49 is disabled after Pr.06-71 time
55	Manual emergency deceleration	When the motor drive receives this signal, it decelerates to Pr.01-29 speed according to Pr.01-40 deceleration time.
56	Automatic emergency deceleration	After setting this MI function, the system monitors the current speed. If the speed is higher than Pr.01-39, the drive decelerates to Pr.01-29 speed according to Pr.01-40 deceleration time.

Settings	Functions	Descriptions
57	Brake torque test action signal	Executes brake torque test when receiving signals.
59	AFE fault	Use with AFE series product





02-09 Digital Input Response Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.005

Settings 0.001–30.000 sec.

- Defines the digital input terminal signal delay and confirmation. The delay time prevents interference that can cause errors (except for the counter input) in the digital terminal input (FWD, REV and MI1–8). Increasing the setting for this parameter can reduce the errors, but it delays the response time.

02-10 Digital Input Operation Direction

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–65535

- Sets the input signal level and it is not affected by the SINK/SOURCE status.
- Bit 0 is for FWD terminal, bit 1 is for REV terminal and bits 2–9 are for MI1 to MI8.

📖 You can change the terminal status between ON and OFF through communications.
For example, set MI1=1 (multi-step speed command 1) and MI2=2 (multi-step speed command 2). Then the reverse + second step speed command = 1010 (binary) = A (hexadecimal). You only need to set Pr.02-10=A through communications and it can move reverse at the second step speed. In this case, you do not need to wire any multi-function terminals.

bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD

✓ 02-11 Multi-function Output 1: RA, RB, RC (Relay 1)

Default: 0

✓ 02-12 Multi-function Output 2: MRA, MRB, MRC (Relay 2)

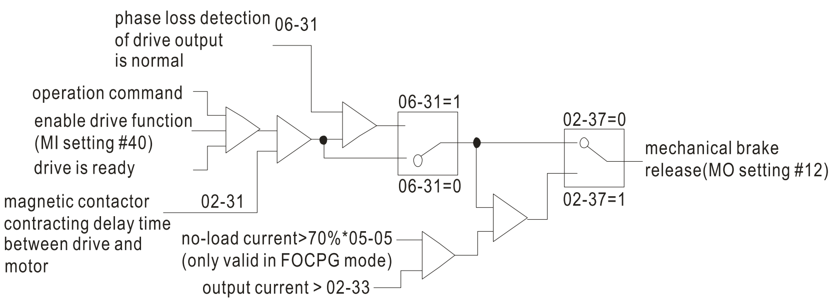
Default: 0

✓ 02-13 Multi-function Output 3: R1A, R12C (Relay 3)
✓ 02-14 Multi-function Output 4: R2A, R12C (Relay 4)
✓ 02-15 Multi-function Output 5: MO1
✓ 02-16 Multi-function Output 6: MO2
✓ 02-17 Multi-function Output 7: MO3
✓ 02-18 Multi-function Output 8: MO4
✓ 02-19 Multi-function Output 9: MO5
✓ 02-20 Multi-function Output 10: MO6
02-21 Reserved
02-22 Reserved

Default: 0

Settings / Control Mode	VF	VFPG	SVC	FOCPG	FOCPM
0: No function	○	○	○	○	○
1: Indication during operation	○	○	○	○	○
2: Operation speed reached	○	○	○	○	○
3: Desired frequency 1 reached (Pr.02-25, Pr.02-26)	○	○	○	○	○
4: Desired frequency 2 reached (Pr.02-27, Pr.02-28)	○	○	○	○	○
5: Zero Speed (Frequency command)	○	○	○	○	○
6: Zero speed with stop (Frequency command)	○	○	○	○	○
7: Over-torque (OT1) (Pr.06-05–06-07)	○	○	○	○	○
8: Over-torque (OT2) (Pr.06-08–06-10)	○	○	○	○	○
9: Drive is ready	○	○	○	○	○
10: User-defined low-voltage detection (LV)	○	○	○	○	○
11: Malfunction indication	○	○	○	○	○
12: Mechanical brake release (Pr.02-29, Pr.02-30, Pr.02-37)	○	○	○	○	○
13: Overheat (Pr.06-14)	○	○	○	○	○

14: Brake transistor signal	○	○	○	○	○
15: Motor-controlled magnetic contactor output	○	○	○	○	○
16: Slip error (oSL)	○	○	○	○	○
17: Malfunction indication 1	○	○	○	○	○
18: Reserved					
19: Brake transistor output error	○	○	○	○	○
20: Warning output	○	○	○	○	○
21: Over-voltage warning	○	○	○	○	○
22: Over-current stall prevention warning	○	○	○		
23: Over-voltage stall prevention warning	○	○	○	○	○
24: Operation mode indication (Pr.00-15=1)	○	○	○	○	○
25: Forward command	○	○	○	○	○
26: Reverse command	○	○	○	○	○
27: Output when current ≥ Pr.02-33	○	○	○	○	○
28: Output when current < Pr.02-33	○	○	○	○	○
29: Output when frequency ≥ Pr.02-34	○	○	○	○	○
30: Output when frequency < Pr.02-34	○	○	○	○	○
31: Power generation direction and status verification	○	○	○	○	○
32: Power generation direction	○	○	○	○	○
33: Zero speed (actual output frequency)	○	○	○	○	○
34: Zero speed with Stop (actual output frequency)	○	○	○	○	○
35: Fault output option 1 (Pr.06-22)	○	○	○	○	○
36: Fault output option 2 (Pr.06-23)	○	○	○	○	○
37: Fault output option 3 (Pr.06-24)	○	○	○	○	○
38: Fault output option 4 (Pr.06-25)	○	○	○	○	○
39: Reserved					
40: Speed reached (including zero speed)	○	○	○	○	○
41: Reserved					
42: STO Output Error	○	○	○	○	○
43–44: Direct Docking Mode only					
45: Reserved					
46: Retrying after a fault has occurred indication	○	○	○	○	○
47: Direct Docking Mode only					
48: Control output of MPSCC (Motor Phase Short Circuit Contactor)	○	○	○	○	○
49: Emergency power mode action	○	○	○	○	○
50: Speed reached Pr.02-34	○	○	○	○	○
51: Brake torque test finished	○	○	○	○	○
52: AFE reset	○	○	○	○	○

Settings	Functions	Descriptions
0	No function	MO has no function
1	Indication during operation	Active when there is an output from the drive or RUN command is ON.
2	Operation speed reached	Active when the AC motor drive reaches the output frequency setting.
3	Desired frequency 1 reached (Pr.02-25, 02-26)	Active when the desired frequency (Pr.02-25, 02-26) reached.
4	Desired frequency 2 reached (Pr.02-27, 02-28)	Active when the desired frequency (Pr.02-27, 02-28) reached.
5	Zero Speed (Frequency command)	Active when the Frequency command = 0. (the drive should be at RUN mode)
6	Zero Speed with stop (Frequency command)	Active when Frequency command = 0 or Stop.
7	Over-torque (OT1) (Pr.06-05–06-07)	Active when detecting over-torque. Refer to Pr.06-05 (over-torque detection-OT1), Pr.06-06 (over-torque detection level-OT1) and Pr.06-07 (over-torque detection time-OT1).
8	Over-torque (OT2) (Pr.06-08–06-10)	Active when detecting over-torque. Refer to Pr.06-08 (over-torque detection-OT2), Pr.06-09 (over-torque detection level-OT2) and Pr.06-10 (over-torque detection time-OT2).
9	Drive is ready	Active when the drive is ON and no error detected.
10	User-defined low-voltage detection	Active when the DC bus voltage is too low (see Pr.06-00 Low voltage level).
11	Malfunction indication	Active when a fault occurs (except Lv stop).
12	Mechanical brake release (Pr.02-29, Pr.02-30, Pr.02-37)	When the drive runs according to Pr.02-29, it is ON. Use this function with the DC brake. It is recommended to use contact “b” (N.C). 
13	Overheat (Pr.06-14)	Active when IGBT or heat sink overheats. To prevent OH, turn off the drive (refer to Pr.06-14).
14	Brake transistor signal	Activated when the drive needs help braking the load. This function helps achieve a smooth deceleration (refer to Pr.07-00).
15	Motor-controlled magnetic contactor output	Active when you set MI function to #40 (Enable drive function).
16	Slip error (oSL)	Active when the slip error is detected (according to Pr.05-14).
17	Malfunction indication 1	Activate after 10 ms when a fault occurs (except Lv stop).

18	Reserved	
19	Brake transistor output error	Active when a brake transistor error is detected
20	Warning output	Active when a warning is detected.
21	Over-voltage warning	Active when an over-voltage is detected.
22	Over-current stall prevention warning	Active when an over-current stall prevention is detected.
23	Over-voltage stall prevention warning	Active when an over-voltage stall prevention is detected.
24	Operation mode indication	Active when the operation command is controlled by an external terminal (Pr.00-15=1).
25	Forward command	Active when the operation direction is forward.
26	Reverse command	Active when the operation direction is reverse.
27	Output when current ≥ Pr.02-33	Active when current is ≥ Pr.02-33.
28	Output when current < Pr.02-33	Active when current is < Pr.02-33.
29	Output when frequency ≥ Pr.02-34	Active when frequency is ≥ Pr.02-34.
30	Output when frequency < Pr.02-34	Active when frequency is < Pr.02-34.
31	Power generation direction and status verification	Activate when the power generation direction is verified.
32	Power generation direction	Activate when the power generation direction runs forward.
33	Zero speed (actual output frequency)	Active when the actual output frequency is 0. The drive should be in RUN mode.
34	Zero speed with stop (actual output frequency)	Active when the actual output frequency is 0 or Stop. The drive should be in RUN mode.
35	Fault output option 1 (Pr.06-22)	Active when Pr.06-22 is ON.
36	Fault output option 2 (Pr.06-23)	Active when Pr.06-23 is ON.
37	Fault output option 3 (Pr.06-24)	Active when Pr.06-24 is ON.
38	Fault output option 4 (Pr.06-25)	Active when Pr.06-25 is ON.
39	Reserved	
40	Speed reached (including zero speed)	Active when the output frequency reaches the frequency setting. Can be used to work with Pr.02-43.
41	Reserved	

<table>
<tr><td>42</td><td>STO Output Error</td><td><table><tr><td rowspan="2">Status of drive</td><td>Status of safety output</td></tr><tr><td>Status A (MO=42)</td></tr><tr><td>Normal</td><td>Broken circuit (open)</td></tr><tr><td>STO</td><td>Short circuit (closed)</td></tr><tr><td>STL1–STL3</td><td>Short circuit (closed)</td></tr></table>*See Table 16-3 for settings of logic output B</td></tr>
<tr><td>43–44</td><td>Direct Docking Mode only</td><td>Contact Delta for more information</td></tr>
<tr><td>45</td><td>Reserved</td><td></td></tr>
<tr><td>46</td><td>Retrying after a fault has occurred indication</td><td>Retry multiple outputs after an error has occurred. When the retry period has finished, MO stops.</td></tr>
<tr><td>47</td><td>Direct Docking Mode only</td><td>Contact Delta for more information</td></tr>
<tr><td>48</td><td>Control output of MPSCC (Motor Phase Short Circuit Contactor)</td><td>Active when the drive receives a STOP command.</td></tr>
<tr><td>49</td><td>Emergency power mode action</td><td>Active when the drive receives a signal from the host controller (Pr.02-01–02-08=54) after Pr.06-71 time.</td></tr>
<tr><td>50</td><td>Speed reached Pr.02-34</td><td>Active when drive’s output frequency is > Pr.02-34, and PGF3 error will be triggered.</td></tr>
<tr><td>51</td><td>Brake torque test finished</td><td>Active when brake torque test is finished.</td></tr>
<tr><td>52</td><td>AFE reset</td><td>Use with AFE series product</td></tr>
</table>

02-23 Multi-function Output Terminal Direction

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–65535

This parameter uses bit setting. If the bit is 1, the multi-function output terminal acts in the opposite direction. For example, if you set Pr.02-11 to 1 and the forward bit is 0, Relay 1 is ON when the drive is running and OFF when the drive is stopped.

Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
-	-	MO6	MO5	MO4	MO3	MO2	MO1	**R2A**	**R1A**	**MRA**	**RA**

02-24 Serial Start Signal Selection

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

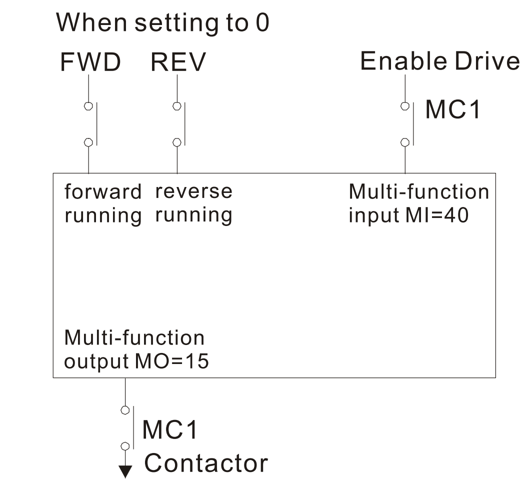
Settings 0: According to FWD/REV signal

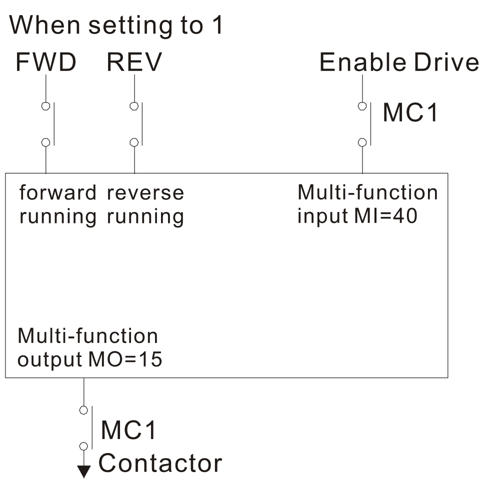
1: According to Enable drive function signal

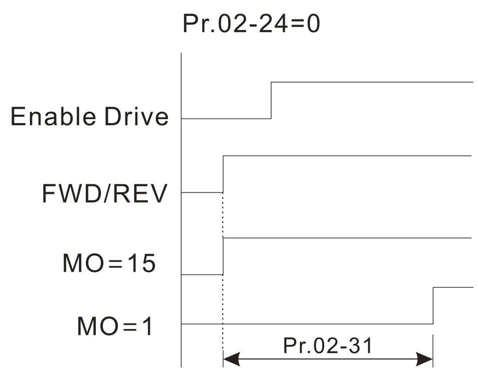
Selects the contactor serial start method.

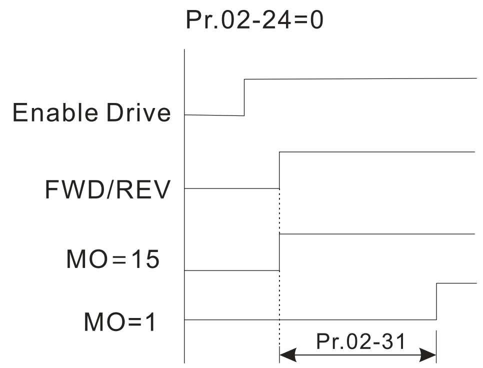
0: According to FWD/REV signal, the motor starts to run after the Enable signal MI = 40 is ON.

1: According to Enable signal, the contactor, mechanical brake and DC brake all follow parameters’ setting to run after FWD/REV and Enable are ON.





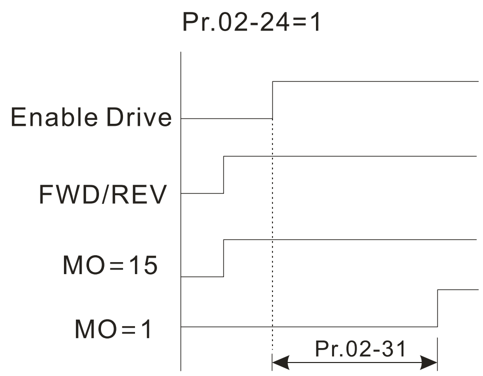


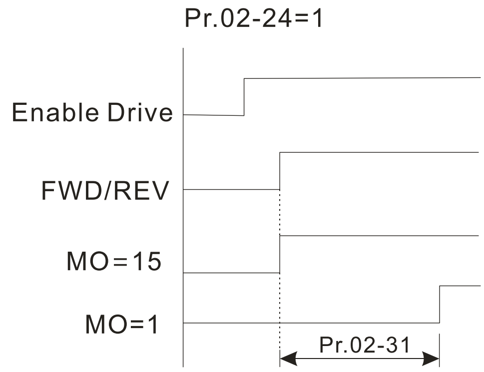


Pr.02-24=0		Enable Drive	
		0	1
Multi-function output MO= 15	0	False	False
	1	True	True

<u>**No matter** if the Enable Drive function signal outputs or not,</u>

<u>the drive starts to count Pr.02-31 after MO15 outputs.</u>





Pr.02-24=1		Enable Drive	
		0	1
Multi-function output MO= 15	0	False	False
	1	False	True

<u>**After both** Enable Drive function signal and MO15 output, the drive starts to count Pr.02-31.</u>

02-25 Desired Frequency Reached 1

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 60.00/50.00

Settings 0.00–299.00 Hz

02-26 Desired Frequency Reached Width 1

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2.00

Settings 0.00–299.00 Hz

02-27 Desired Frequency Reached 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 60.00/50.00

Settings 0.00–299.00 Hz

02-28 Desired Frequency Reached Width 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2.00

Settings 0.00–299.00 Hz

- Once the output frequency reaches the desired frequency and the corresponding multi-function output terminal is set to 3 or 4 (Pr.02-11–Pr.02-22), this multi-function output terminal is ON.

02-29 Brake Release Delay Time when Elevator Starts

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.250

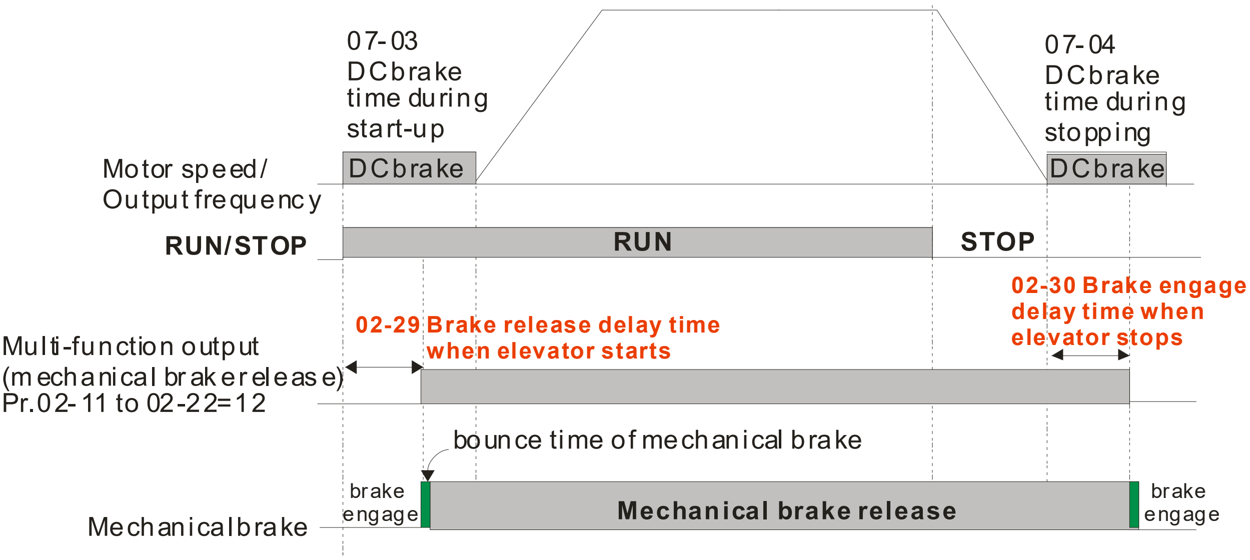
Settings 0.000–65.000 sec.

02-30 Brake Engage Delay Time when Elevator Stops

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.250

Settings 0.000–65.000 sec.

- When the AC motor drive runs and after the delay time in Pr.02-29, the corresponding multi-function output terminal (12: mechanical brake release) is ON.
- When the AC motor drive stops and after the delay time in Pr.02-30, the corresponding multi-function output terminal (12: mechanical brake release) is OFF.
- Use this function with the DC brake function.



02-31 Magnetic Contactor Contracting Delay Time between Drive and Motor
02-32 Magnetic Contactor Release Delay Time between Drive and Motor

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.200

Settings 0.010–65.000 sec.

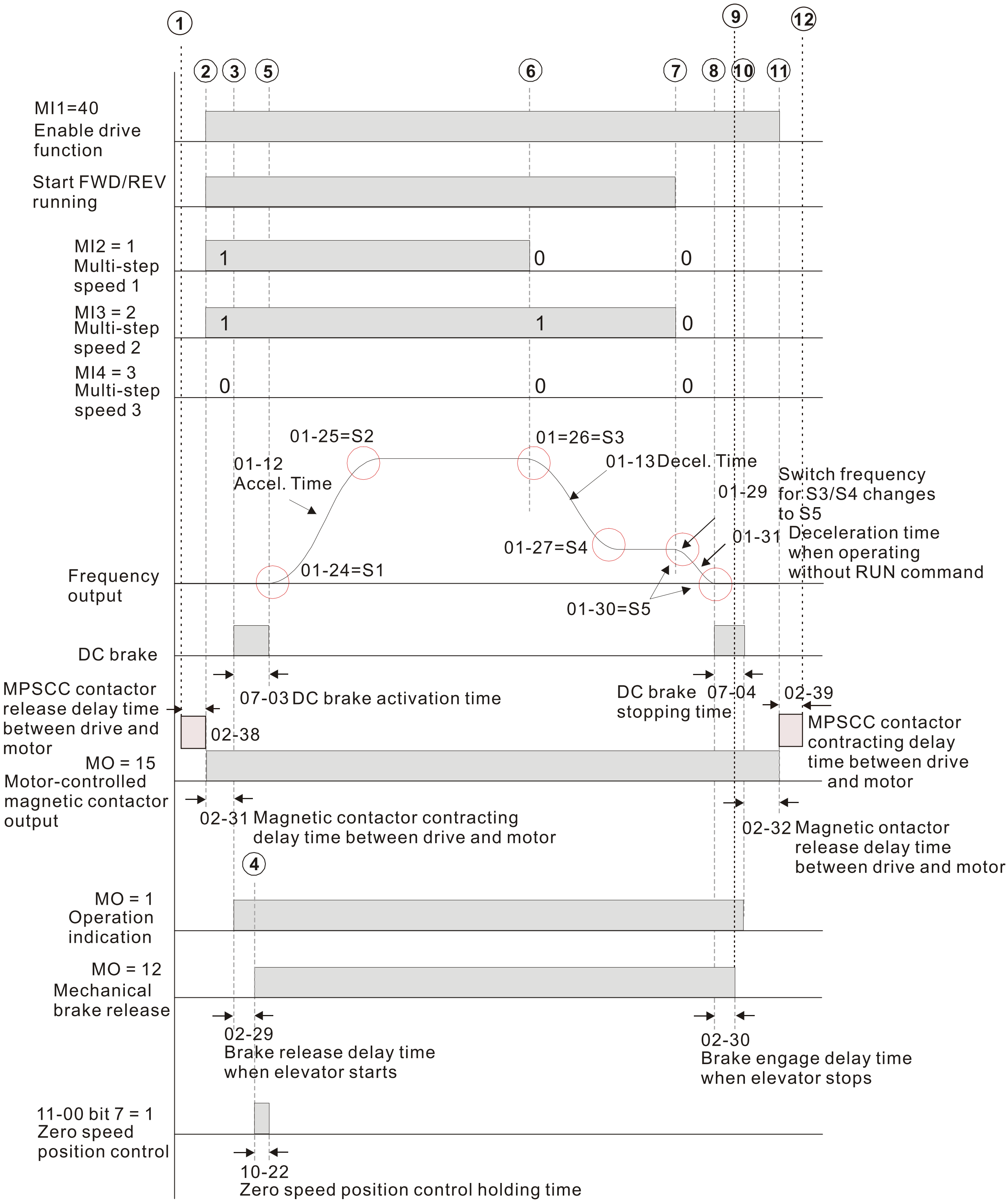
📖 After running, use these parameters with multifunction input terminal setting 40 (Enable drive function), and multifunction output terminal setting 15 (motor-controlled magnetic contactor output). When the multifunction output terminals are ON, the drive starts outputting after the delay time in Pr.02-31. When the drive stops outputting, multifunction output terminals release after the delay time in Pr.02-32.

✓ 02-38 MPSCC (Motor Phase Short Circuit Contactor) Release Delay Time between Drive and Motor

Control Mode	**VF**	**VFPG**	**SVC**	**FOCPG**	**FOCPM**	Default: 0.200
	Settings	0.010~65.000 sec.				

✓ 02-39 MPSCC (Motor Phase Short Circuit Contactor) Contracting Delay Time between Drive and Motor

Control Mode	**VF**	**VFPG**	**SVC**	**FOCPG**	**FOCPM**	Default: 0.200
	Settings	0.010~65.000 sec.				



1. Elevator starts running
2. Star-delta contactor release
3. Magnetic contactor is ON
4. Mechanical brake release
5. End of <DC brake at start-up>
6. Start of deceleration
7. End of creeping
8. Start of <DC brake at stop>
9. Brake release engage
10. End of <DC brake at stop>
11. Magnetic contactor release
12. MPSCC contracting (motor release)

Elevator Timing Diagram

02-33 External Terminal Output Current Level

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–100%

- When output current is ≥ Pr.02-33, it activates the multi-function output terminal (Pr.02-11–Pr.02-22 are set to 27).
- When output current is < Pr.02-33, it activates the multi-function output terminal (Pr.02-11–Pr.02-22 are set to 28).

02-34 External Terminal Output Speed Limit

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.00

Settings 0.00–299.00 Hz (this is motor speed when using with PG)

- When drive's output frequency is ≥ Pr.02-34, multi-function terminal 29 (Pr.02-11–Pr.02-22) will be activated.
- When drive's output frequency is < Pr.02-34, multi-function terminal 30 (Pr.02-11–Pr.02-22) will be activated.
- When drive's output frequency is > Pr.02-34, multi-function terminal 50 (Pr.02-11–Pr.02-22) will be activated, and PGF3 error will be triggered.
- The setting range and unit of Pr.02-34 varies with Pr.00-10 settings:
  When Pr.00-10=0, the setting range and unit of Pr.02-34 is 0.00–299.0 Hz.
  When Pr.00-10=1, the setting range and unit of Pr.02-34 is 0.00–93.93 m/s.
  When Pr.00-10=2, the setting range and unit of Pr.02-34 is 0.00–308.09 ft/s.

02-35 Mechanical Brake Detection Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.00

Settings 0.00–10.00 sec.

- When the mechanical brake function (Pr.02-01–Pr.02-08 are set to 42) is not enabled within this setting time, the drive displays error code 64 (MBF) mechanical brake error.

02-36 Magnetic Contactor Detection Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default:0.00

Settings 0.00–10.00 sec.

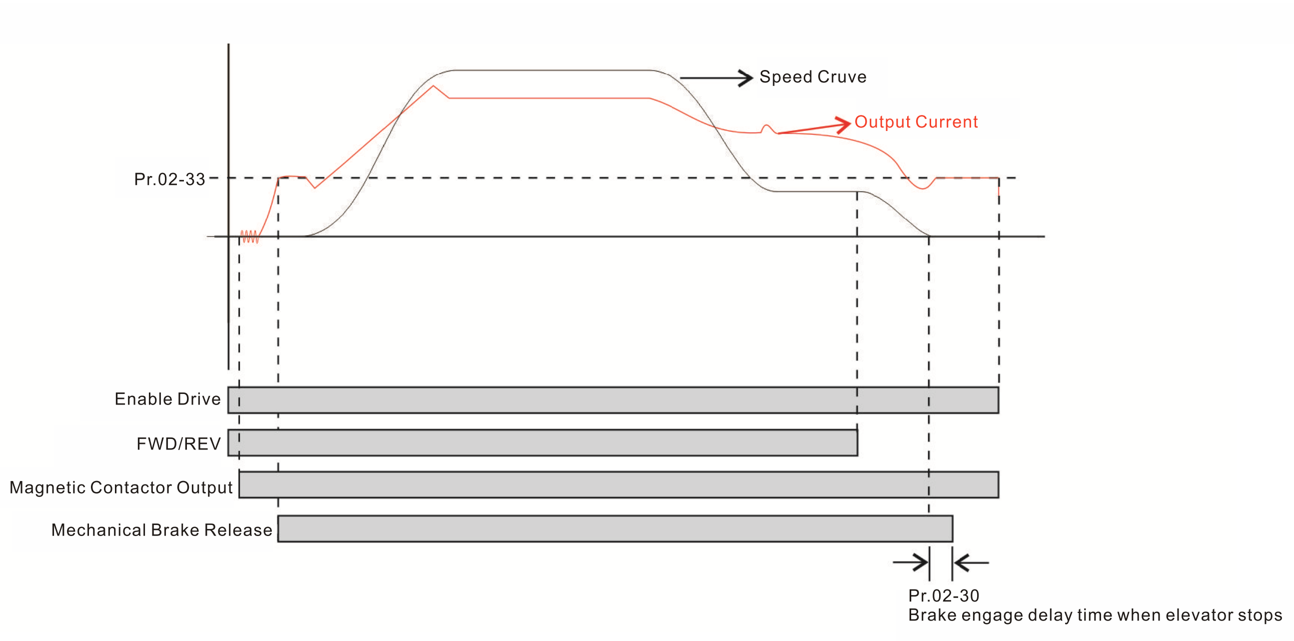
- When the magnetic contactor function (Pr.02-01–02-08 are set to 41) is not enabled within this setting time, the drive displays error code 66 (MCF) magnetic contactor error.

02-37 Torque Check

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Disable
1: Enable

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



02-40 – 02-42 Direct Docking Mode Only

Control Mode		VFPG		FOCPG	FOCPM	Default: -
	Settings	Contact Delta for more information				

02-43 Speed Reached Bandwidth

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 2.00
	Settings	0.00–299.00 Hz				

When drive's output frequency and target frequency is smaller than or equal to this bandwidth, multi-function output terminal MO=2 and MO=40 will be activated (ON). When drive's output frequency and target frequency is larger than this bandwidth, MO=2 and MO=40 will be deactivated (OFF).

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03 Analog Input / Output Parameters

✓: You can set this parameter during operation

✓ 03-00 Analog Input 1 (AUI1)

Default:1

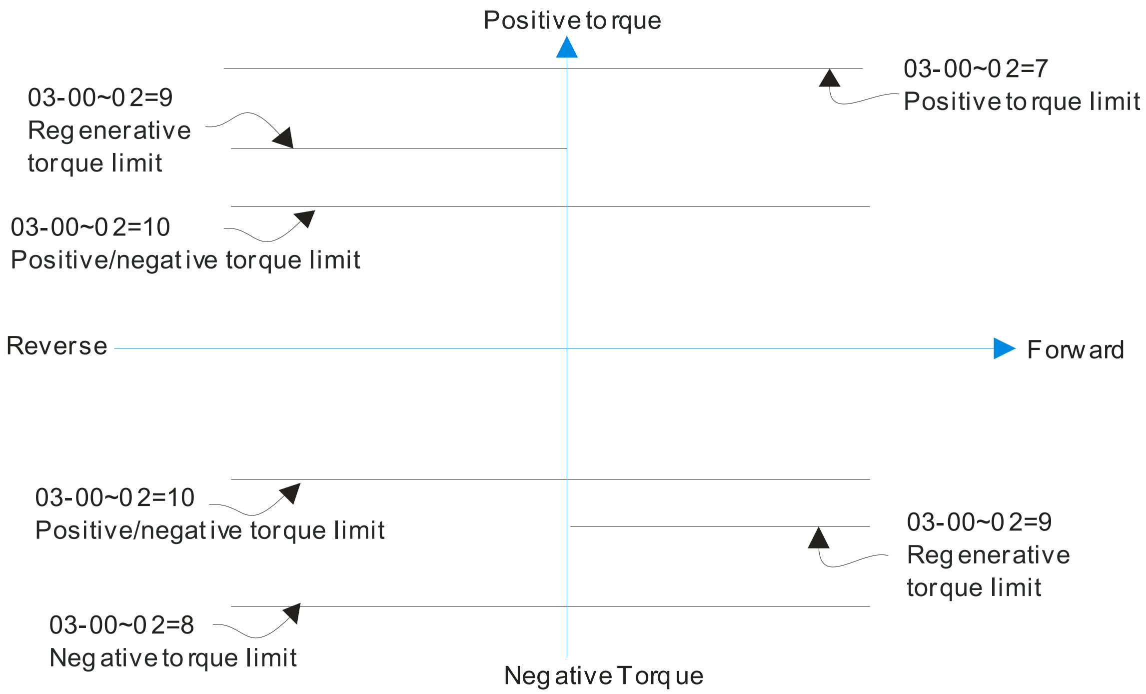
03-01 Reserved

✓ 03-02 Analog Input 2 (AUI2)

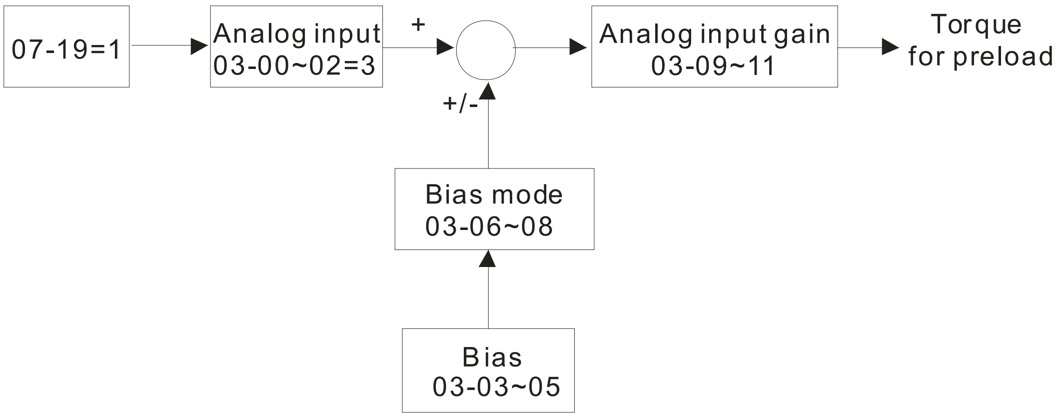
Default: 0

Settings	Control Mode	VF	VFPG	SVC	FOCPG	FOCPM
0: No function		○	○	○	○	○
1: Frequency command (speed limit under torque control mode)		○	○	○	○	○
2: Torque command (torque limit under speed mode)						
3: Load compensation		○	○	○	○	○
4–5: Reserved						
6: P.T.C. thermistor input value		○	○	○	○	○
7: Positive torque limit					○	○
8: Negative torque limit					○	○
9: Regenerative torque limit					○	○
10: Positive/negative torque limit					○	○

- 📖 When using the Frequency command or speed limit under torque control mode, the corresponding value for 0 to ±10 V or 4–20 mA is 0–maximum output frequency (Pr.01-00).
- 📖 When using the Torque command or torque limit, the corresponding value for 0 to ±10 V or 4–20 mA is 0–maximum output torque (Pr.07-14).
- 📖 When using torque compensation, the corresponding value for 0 to ±10 V or 4–20 mA is 0–moto's rated torque.



07-19: Source of torque offset
03-00~02: Analog input selections (AUI1/ACI/AUI2)
03-03~05: Analog input bias (AUI1/ACI/AUI2)
03-06~08: AUI1/ACI/AUI2 bias mode



✓ 03-03 Analog Input Bias 1 (AUI1)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding AUI1 voltage for the external analog input 0.

03-04 Reserved

✓ 03-05 Analog Input Bias 1 (AUI2)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default:0.0

Settings -100.0–100.0%

- Sets the corresponding AUI2 voltage for the external analog input 0.
- The relation between external input voltage/current and setting frequency is equal to -10–10 V (4–20 mA) corresponding to 0–60 Hz.

03-07 Reserved

✓ 03-06 AUI1 Positive/negative Bias Mode

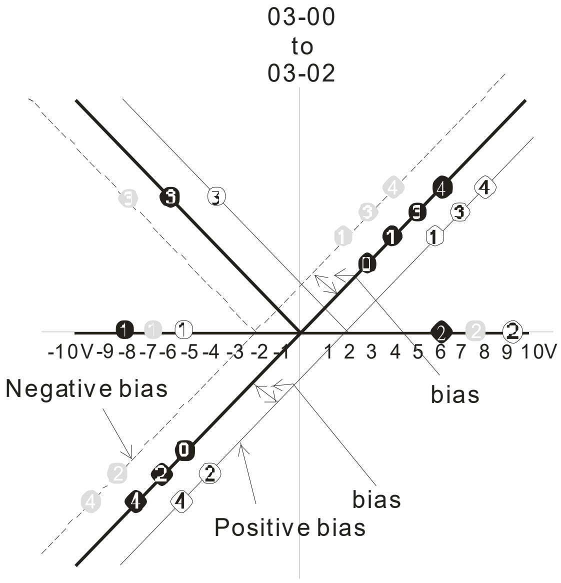
Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

✓ 03-08 AUI2 Positive/negative Bias Mode

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Zero bias
1: Lower than or equal to bias
2: Higher than or equal to bias
3: Use bias as the base to get the absolute value of bias voltage (unipolar)
4: Using bias as the base (unipolar)

- In a noisy environment, you can use a negative bias to provide a noise margin. It is recommended that you NOT use less than 1 V to set the operating frequency.



03-09~03-11 gain is positive
0 Zero bias
1 Serve bias as the center, lower than bias = bias
2 Serve bias as the center, greater than bias=bias
3 The absolute value of the bias voltage while serving as the center (unipolar)
4 Serve bias as the center (unipolar)

03-09 Analog Input Gain 1 (AUI1)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–500.0%

03-10 Reserved

03-11 Analog Input Gain 1 (AUI2)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–500.0%

- Pr.03-03–Pr.03-11 are used when the Frequency command source is the analog voltage/current signal.

03-12 Analog Input Filter Time (AUI1)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.01

Settings 0.00–2.00 sec.

03-13 Reserved

03-14 Analog Input Filter Time (AUI2)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.01

Settings 0.00–2.00 sec.

- Analog signals, such as those entering AUI1 and AUI2, are commonly affected by interference that affects the stability of the analog control. Use the Input Noise Filter to create a more stable system.
- If Pr.03-14 is large, the control is more stable, but the response to the input is slower. If Pr.03-14 is small, the control may be unstable, but the response to the input is faster.

03-15 Load Compensation Auto-tuning

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

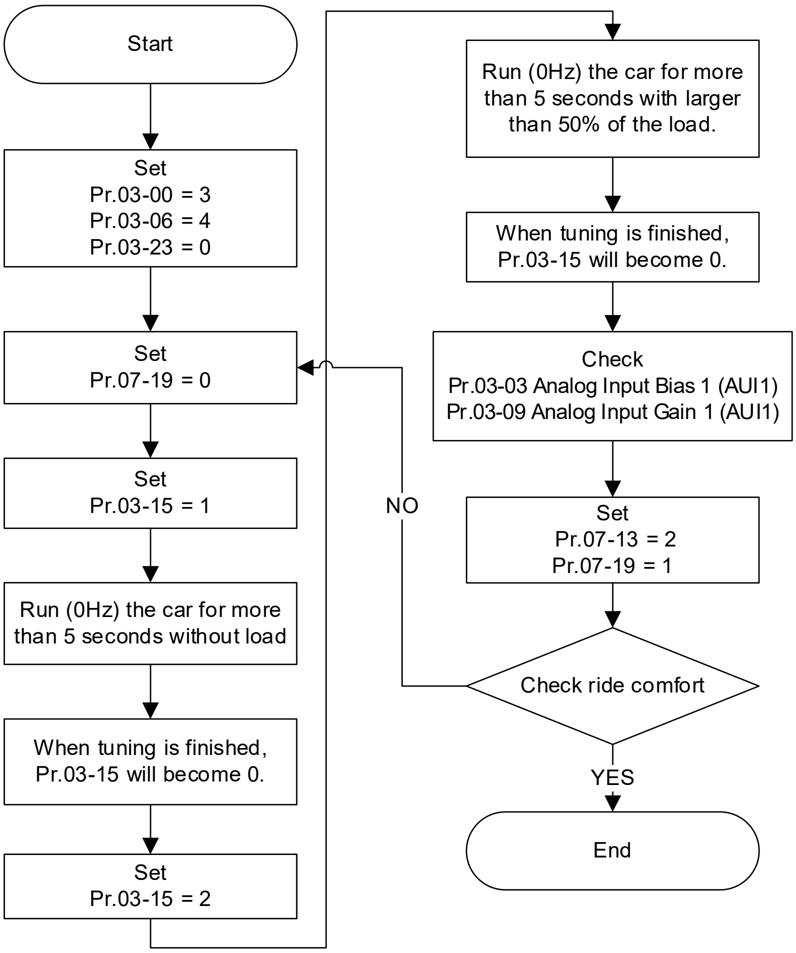
Settings 0: No function

1: Auto-tunes with running without load

2: Auto-tunes with running with load

- Use torque compensation function to avoid the roll-back generated by using IM to work with spiral gear.

- This function is only valid for AUI1.
- Auto-tuning process:



03-16 Reserved

03-17 Analog Output Selection 1
03-20 Analog Output Selection 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
0: Output frequency (Hz)
1: Frequency command (Hz)
2: Motor speed (RPM)
3: Output current (rms)
4: Output voltage
5: DC bus voltage
6: Power factor angle
7: Power factor
8: Output torque
9: AUI1
10: Reserved
11: AUI2
12: q-axis current
13: q-axis feedback value

14: d-axis current

15: d-axis feedback value

16: q-axis voltage

17: d-axis voltage

18: Torque command

19–20: Reserved

21: Power output

📖 When setting to 0, it is output frequency, not ASR output frequency.

✓ 03-18 Analog Output Gain 1
✓ 03-21 Analog Output Gain 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0–200.0%

📖 Sets the corresponding voltage for the analog output 0.

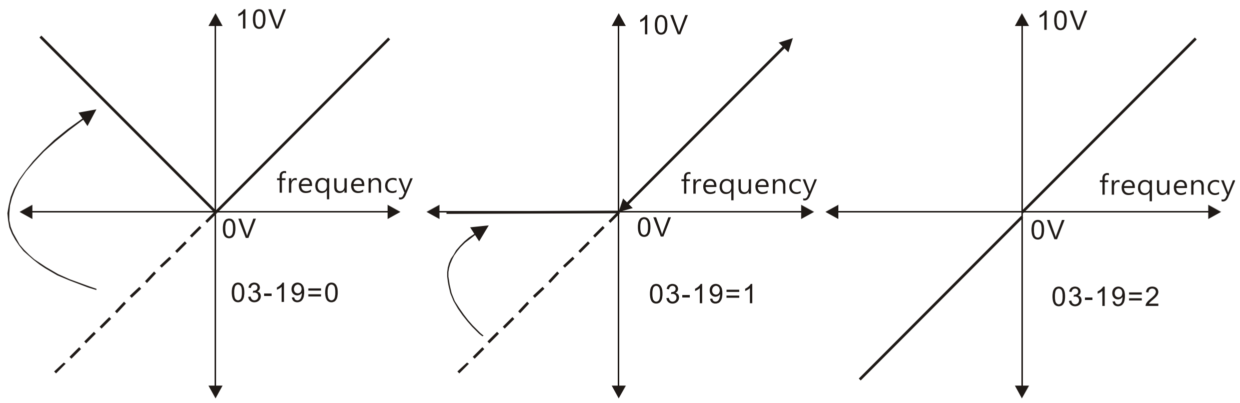
✓ 03-19 Analog Output Value in REV Direction 1
✓ 03-22 Analog Output Value in REV Direction 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Absolute value in output voltage

1: Output 0 V in REV direction

2: Enable output voltage in REV direction



Selection for the analog output direction

03-23 Analog Input Type (AUI1)
03-24 Analog Input Type (AUI2)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Bipolar (±10 V)

1: Unipolar (0–10 V)

📖 When this parameter is set to 0 (bipolar), the input function direction is determined by the input signal.

📖 0: And Pr.03-00=1 or 2, AUI decides the operation direction.

📖 1: And Pr.03-00=1, the FWD/REV terminal decides the operation direction.

📖 1: And Pr.03-00=2, setting Pr.02-01–Pr.02-08 to 39 decides the operation direction.

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04 Multi-step Speed Parameters

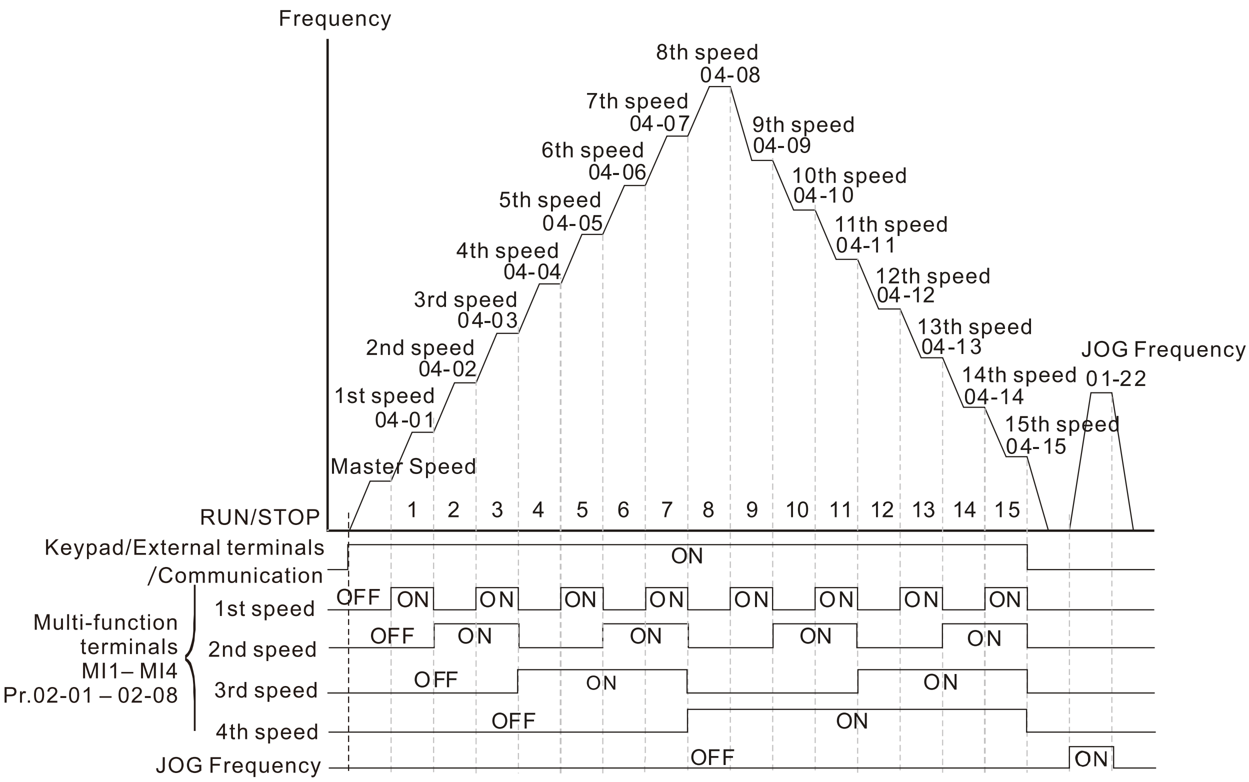
✎: You can set this parameter during operation

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

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0.00

Settings 0.00–299.00 Hz

- The multi-function input terminals (refer to Pr.02-01–Pr.02-08) select one of the AC motor drive multi-step speeds (including the master frequency, in total 16 speeds). Pr.04-00–Pr.04-15 determine the speeds (frequencies) as shown above.
- When Pr.00-14 = 1, the master frequency is Pr.01-00.
- When Pr.00-14 = 3, the master frequency is Pr.04-00.



Multi-speed via External Terminals

✔ 04-16 – 04-99	Direct docking mode only

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Settings	Contact Delta for more information

05 IM Parameters

✓: You can set this parameter during operation

05-00 Motor Auto-tuning

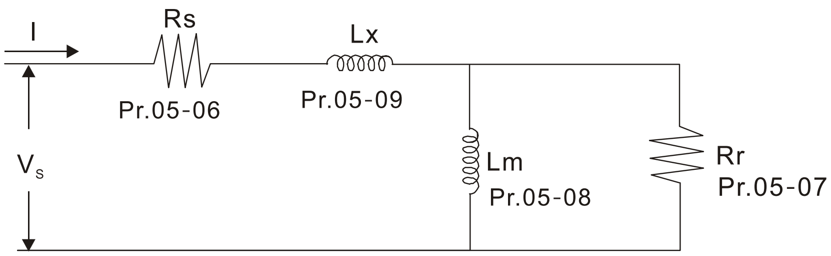
Control Mode **VF** Default: 0

Settings 0: No function

1: Dynamic test (Rs, Rr, Lm, Lx, no-load current) [motor runs]

2: Static Test [motor does not run]

- Position the elevator near the middle floors before auto-tuning.
- Motor auto-tuning:
  Set Pr.05-00 to 1 or 2, and then press the RUN key on the digital keypad KPC-CC01 (Pr.00-15=2) to start auto-tuning. Or when the drive is in manual mode (inspection), run the upward operation or downward operation (Pr.00-15=1) to start auto-tuning immediately. In the process of auto-tuning, an “Auto tuning” warning continuously displays on the digital keypad until it is finished.
- Pay attention to the following notes when Pr.05-00=1 (dynamic test):
  1. Make sure that all the drive parameters are set to defaults and the motor wiring is correct.
  2. Make sure the motor is not loaded before auto-tuning, and that the shaft is not connected to any belt or gear motor. Set this parameter to 2 if you cannot separate the motor from the load.
  3. Enter the correct values for Pr.01-01, Pr.01-02, Pr.05-01, Pr.05-02, Pr.05-03 and Pr.05-04. Refer to motor capacity to set the acceleration/deceleration time.
  4. After auto-tuning is finished, check if Pr.05-05–Pr.05-09 all have values.
  5. Equivalent circuit diagram:



Equivalent circuit for VFD-ED Series

NOTE:

- In torque/vector control mode, do not run motors in parallel.
- Do not use torque/vector control mode if the motor rated power exceeds the rated power for the AC motor drive.
- The no-load current is usually 20–50% of the rated current.
- The rated speed cannot be larger or equal to 120 f/p (f: output frequency Pr.01-01, p: Number of Motor Poles Pr.05-04).
- After auto-tuning is finished, activate the drive again to make it operate when the auto-tuning command source is the external terminal.

05-01 Motor Rated Current

Control Mode **VF** **VFPG** **SVC** **FOCPG** Unit: Amp

Default: #.##

Settings (40–120%) * Pr.00-01 Amps

📖 Set this value according to the rated motor frequency from the motor nameplate.

Example: Suppose the rated current for 7.5 HP (5.5 kW) models is 25 A and the default is 22.5 A. In this way, the current range is from 10 A (25 * 40%) to 30 A (25 * 120%).

📖 As the table below shows, the defaults vary according to the different motor drive outputs in HP and in kW.

	Motor Drive's Output (HP)	3*	5*	5	7.5	10	15	20	25	30	40	50	60	75	100
	Motor Drive's Output (kW)	2.2	3.7	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75
230V	Motor Rated Current (A) Default	9.82	13.91	16.36	19.64	24.54	36.82	47.46	63	71.18	108	131.72			
460V	Motor Rated Current (A) Default			9.41	10.64	13.91	18.82	24.54	31.1	36.82	47.46	65.46	81.82	104.72	135

*: single-phase models.

05-02 Motor Rated Power

Control Mode **SVC** **FOCPG** Default: #.##

Settings 0.00–655.35 kW

📖 Sets the rated power of the motor. The default is the power of the drive.

05-03 Motor Rated Speed (rpm)

Control Mode **VFPG** **SVC** **FOCPG** Default: 1710

Settings 0–65535

📖 Sets the motor rated speed from the value on the motor nameplate.

05-04 Number of Motor Poles

Control Mode **VF** **VFPG** **SVC** **FOCPG** Default: 4

Settings 2–48

📖 Sets the number of motor poles (must be an even number).

05-05 Motor No-load Current

Control Mode **VFPG** **SVC** **FOCPG** Unit: Amp

Default: #.##

Settings 0–Pr.05-01 default

📖 As the table below shows, the defaults vary according to the different motor drive output in HP and in kW.

	Motor Drive's Output (HP)	3*	5*	5	7.5	10	15	20	25	30	40	50	60	75	100
	Motor Drive's Output (kW)	2.2	3.7	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75
230V	Motor Current w/o Load (A) Default	3.44	4.87	5.73	6.85	8.5	12.56	15.97	20.78	23.22	33.51	39.52			
460V	Motor Current w/o Load (A) Default			3.29	3.71	4.81	6.43	8.26	10.28	11.99	15	19.64	24.55	31.42	40.5

*: single-phase models.

05-06 Rs of Motor
05-07 Rr of Motor

Control Mode **SVC** **FOCPG** Default: 0.000

Settings 0.000–65.535 Ω

05-08 Lm of Motor
05-09 Lx of Motor

Control Mode **SVC** **FOCPG** Default: 0.0

Settings 0.0–6553.5 mH

✎ 05-10 Torque Compensation Low Pass Filter Time

Control Mode **SVC** Default: 0.020

Settings 0.001–10.000 sec.

✎ 05-11 Slip Compensation Low Pass Filter Time

Control Mode **SVC** Default: 0.100

Settings 0.001–10.000 sec.

- Setting Pr.05-10 and Pr.05-11 changes the response time for the compensation.
- When you set Pr.05-10 and Pr.05-11 to 10 seconds, it maximizes the response time for the compensation. If the settings are too low, the system may become unstable.

✎ 05-12 Torque Compensation Gain

Control Mode **VF** **VFPG** Default: 0

Settings 0–10

- You can set this parameter so that the AC motor drive increases its voltage output for a higher torque.

✎ 05-13 Slip Compensation Gain

Control Mode **SVC** Default: 1.00

Settings 0.00–10.00

- When the motor drive controls an asynchronous motor, the load and slip increase. Use this parameter to correct the frequency and lower the slip to make the motor run near the synchronous speed under the rated current. When the output current is larger than the motor no-load current, the drive compensates the frequency according to the Pr.05-13 setting. If the actual speed is slower than the expected speed, increase the setting and vice versa.
- This is only valid in SVC mode.

✎ 05-14 Slip Deviation Level

Control Mode **VFPG** **SVC** **FOCPG** Default: 0

Settings 0–1000%

0: Disable

✎ 05-15 Slip Deviation Detection Time

Control Mode **VFPG** **SVC** **FOCPG** Default:1.0

Settings 0.0–10.0 sec.

✎ 05-16 Over-slip Action

Control Mode VFPG SVC FOCPG Default: 0

Settings 0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and coast to stop

Pr.05-14–Pr.05-16 set the allowable slip level and over-slip action when the drive is running.

When Pr.05-16 is set to 1 (Fault and ramp to stop), if brake or operation contactor is OFF under the circumstance that STO or MI40 (Enable drive function) is not deactivated during deceleration, elevator still runs even brake has engaged (brake wear), and electric arc occurs when operation contactor is OFF.

05-17 Hunting Gain

Control Mode VF VFPG SVC Default: 2000

Settings 0–10000
0: Disable

The motor has current wave motion under some specific conditions. You can improve this situation by setting this parameter. You can set it to 0 for current wave motion in the high frequency range or when running with PG. When the current wave motion happens in the low frequency range, increase Pr.05-17.

05-18 Accumulated Motor Operation Time (Min.)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0

Settings 0–1439 minutes

05-19 Accumulated Motor Operation Time (Day)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0

Settings 0–65535 days

Pr.05-18 and Pr.05-19 record the motor operation time. You can clear the records by setting the values to 0. Operating time that is less than 60 seconds is not recorded.

05-20 Core Loss Compensation

Control Mode SVC Default: 10

Settings 0–250%

05-21 Accumulated Motor Power-on Time (Min.)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0

Settings 0–1439 minutes

05-22 Accumulated Motor Power-on Time (day)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0

Settings 0–65535 days

05-23 Slip Compensation Gain % (power generation mode)

Control Mode VF SVC Default: 0.0

Settings 0.0–100.0%

✎ 05-24 Slip Compensation Gain % (electricity mode)

Control Mode **VF** **SVC** Default: 0.0

Settings 0.0–100.0%

- When in VF mode, you do NOT have to set Pr.05-13. To satisfy the demand for different compensation gains in power generation mode and electricity mode, set Pr.05-23 and Pr.05-24.
- When in SVC mode, set Pr.05-13 first. To satisfy the demand for different compensation gains in power generation mode and electricity mode, set Pr.05-23 and Pr.05-24.

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06 Protection Parameters

⌿: You can set this parameter during operation

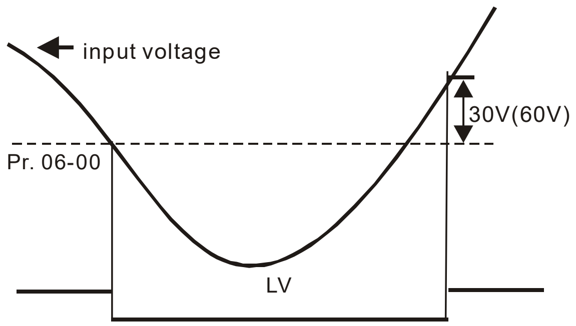
⌿ 06-00 Low Voltage Level

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 180.0/360.0

Settings 230V models: 160.0–220.0 V

460V models: 320.0–440.0 V

📖 Sets the Lv level.



⌿ 06-01 Input Phase-loss Protection during Operation

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2

Settings 0: Warn and keep operation

1: Fault and ramp to stop

2: Fault and coast to stop

📖 Sets the phase-loss protection action for power at input side. The phase-loss affects the drive's control characteristics and life.

📖 When Pr.06-01 is set to 1 (Fault and ramp to stop), if brake or operation contactor is OFF under the circumstance that STO or MI40 (Enable drive function) is not deactivated during deceleration, elevator still runs even brake has engaged (brake wear), and electric arc occurs when operation contactor is OFF.

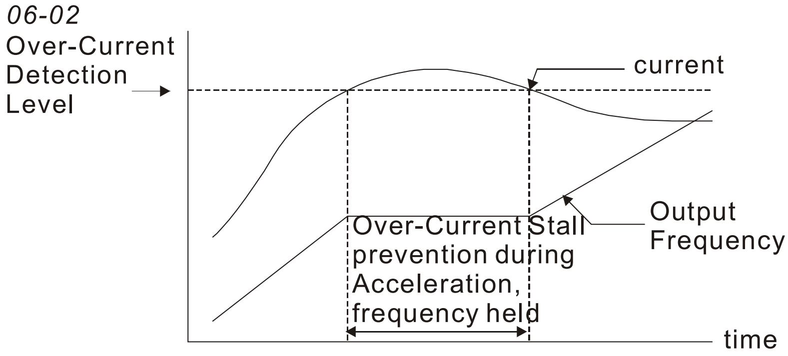
⌿ 06-02 Over-current Stall Prevention during Acceleration

Control Mode **VF** **VFPG** **SVC** Default: 0

Settings 0: Disable

0–250% (rated current of the motor drive)

📖 During acceleration, the AC motor drive output current may increase abruptly and exceed the value specified in Pr.06-02 due to rapid acceleration or excessive load on the motor. When you enable this function, the AC motor drive stops accelerating and keeps the output frequency constant until the current drops below the maximum value.



actual acceleration time when over-current stall prevention is enabled

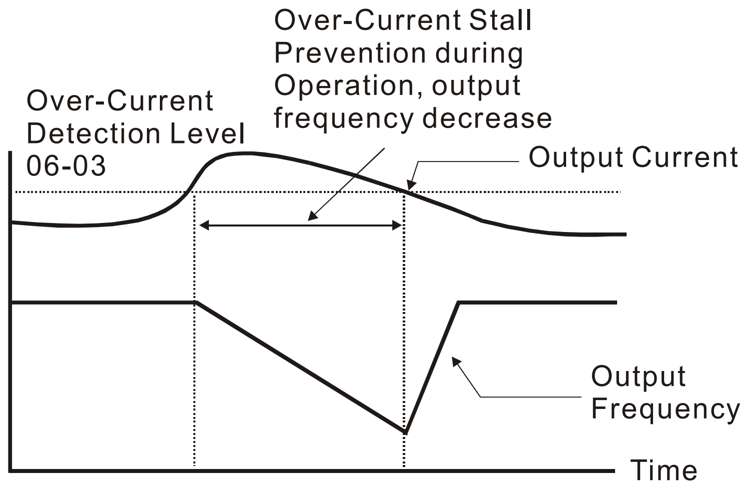
06-03 Over-current Stall Prevention during Operation

Control Mode **VF** **VFPG** **SVC** Default: 0

Settings 0: Disable

0–250% (rated current of the motor drive)

- If the output current exceeds the setting specified in Pr.06-03 when the drive is operating, the drive decreases its output frequency according to the Pr.06-04 setting to prevent motor stall. If the output current is lower than the setting in Pr.06-03, the drive accelerates (according to Pr.06-04) again to catch up with the Frequency command value.



over-current stall prevention during operation

06-04 Acceleration/Deceleration Time for Stall Prevention at Constant Speed

Control Mode **VF** **VFPG** **SVC** Default: 0

Settings 0: Use the current acceleration/deceleration time

1: Use the 1st acceleration/deceleration time

2: Use the 2nd acceleration/deceleration time

3: Use the 3rd acceleration/deceleration time

4: Use the 4th acceleration/deceleration time

5: Use the auto-acceleration/auto-deceleration time

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

06-05 Over-torque Detection (OT1)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Over-torque detection disabled

1: Over-torque detection during constant speed operation, continue to operate after detection

2: Over-torque detection during constant speed operation, stop operating after detection

3: Over-torque detection during operation, continue to operate after detection

4: Over-torque detection during operation, stop operating after detection

06-06 Over-torque Detection Level (OT1)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 150

Settings 10–250% (rated current of the motor drive)

06-07 Over-torque Detection Time (OT1)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.1

Settings 0.1–60.0 sec.

06-08 Over-torque Detection (OT2)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0

Settings 0: Over-torque detection disabled

1: Over-torque detection during constant speed operation, continue to operate after detection

2: Over-torque detection during constant speed operation, stop operating after detection

3: Over-torque detection during operation, continue to operate after detection

4: Over-torque detection during operation, stop operating after detection

06-09 Over-torque Detection Level (OT2)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 150

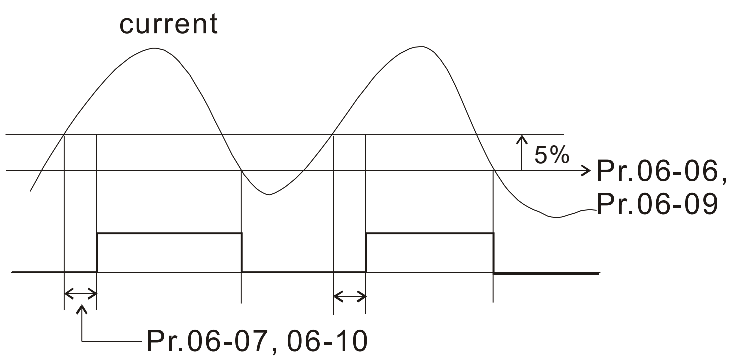
Settings 10–250% (rated current of the motor drive)

06-10 Over-torque Detection Time (OT2)

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.1

Settings 0.1–60.0 sec.

- Pr.06-05 and Pr.06-08 determine the drive's operating mode after over-torque is detected.
- Over-torque is detected according to the following method: if the output current exceeds the over-torque detection level (Pr.06-06, default is 150%) and also exceeds the over-torque detection time (Pr.06-07, default is 0.1 second), the keypad displays the fault code "OT1/OT2". If using a multi-function output terminal for over-torque detection, the output is ON. Refer to Pr.02-11–02-22 for details.



06-11 Current Limit

Control Mode FOCPG FOCPM Default: 200

Settings 0–250% (rated current of the motor drive)

- Sets the drive's maximum output current.

06-12 Electronic Thermal Relay

Control Mode VF **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2

Settings 0: Standard motor

1: Inverter motor

2: Disabled

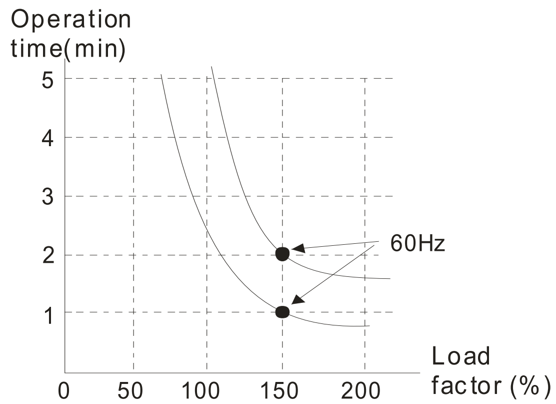
📖 Prevents self-cooled motor from overheating at low speeds. You can use an electrical thermal relay to limit the drive's output power.

✗ 06-13 Electronic Thermal Characteristic

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 60.0

Settings 30.0–600.0 sec.

📖 The parameter is set by the drive's output frequency, current and operation time for activating the I^2t electronic thermal protection function. The function is activated for 150% of the setting current in Pr.06-13.



✗ 06-14 IGBT Overheat Warning (oH1)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 90.0

Settings 0.0–110.0°C

✗ 06-15 Stall Prevention Limit Level

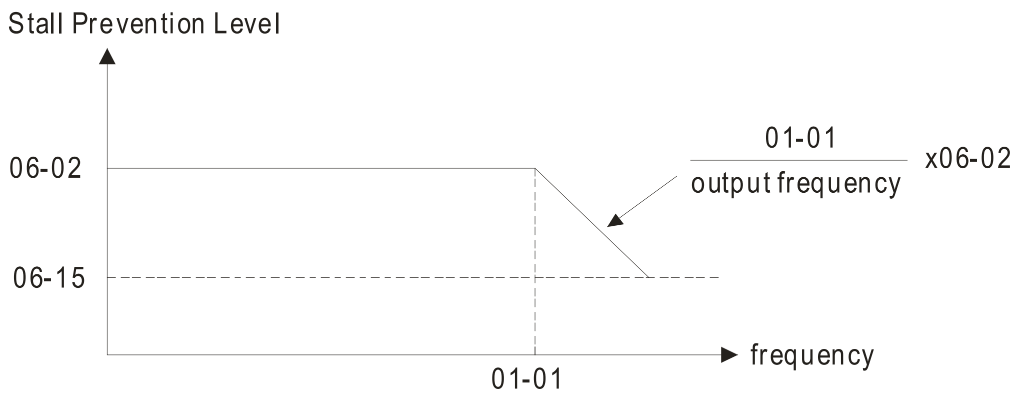
Control Mode **VF** **VFPG** **SVC** Default: 50

Settings 0–100% (Refer to Pr.06-02, Pr.06-03)

📖 When the operating frequency is larger than Pr.01-01, Pr.06-02 = 150%, Pr.06-03 = 100% and Pr.06-15 = 80%:

Stall Prevention Level during acceleration = Pr.06-02 x Pr.06-15 = 150% x 80% = 120%.

Stall Prevention Level at constant speed = Pr.06-03 x Pr.06-15 = 100% x 80% = 80%.



06-16 Present Fault Record
06-17 Second Most Recent Fault Record
06-18 Third Most Recent Fault Record
06-19 Fourth Recent Fault Record
06-20 Fifth Most Recent Fault Record
06-21 Sixth Most Recent Fault Record

Control mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0

Settings
0: No fault
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 (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: Input phase loss (PHL)
16: IGBT overheat (oH1)
17: Bulk capacitor overheat (oH2)
18: Abnormal IGBT temperature detected (tH1o)
19: Abnormal bulk capacitor temperature detected (tH2o)
20: Unusual cooling fan operation (FAn)
21: Overload (oL) (150%; 1 minute, motor drive overloaded)
22: Motor overload (EoL1)
23: Reserved
24: Motor PTC overheat (oH3)
25: Reserved
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Reserved
29: Reserved
30: Memory writing error (cF1)
31: Memory reading error (cF2)
32: Isum current detection error (cd0)
33: U-phase current detection error (cd1)
34: V-phase current detection error (cd2)
35: W-phase current detection error (cd3)
36: cc current clamp hardware error (Hd0)
37: oc (over-current) hardware error (Hd1)

38: ov (over-voltage) hardware error (Hd2)
39: GFF (ground fault) hardware error (Hd3)
40: Auto-tuning error on motor's parameter (AuE)
41: Reserved
42: PG feedback error (PGF1)
43: PG feedback loss (PGF2)
44: PG feedback stall (PGF3)
45: PG slip error (PGF4)
46: Reserved
47: Reserved
48: Reserved
49: External fault input (EF)
50: Emergency stop from external terminals (EF1)
51: Reserved
52: Password error after three attempts (Pcod)
53: Reserved
54: Illegal communication command (cE01)
55: Illegal communication address (cE02)
56: Communication data length error (cE03)
57: Communication attempts to write to a read-only address (cE04)
58: Modbus transmission time-out (cE10)
59: Keypad transmission time-out (cP10)
60: Brake transistor error (BF)
61–63: Reserved
64: Mechanical brake feedback error (MBF)
65: PG hardware error (PGF5)
66: Magnetic contactor error (MCF)
67: Motor output phase loss (MPHL)
68: CAN BUS disconnected (CANF)
69–71: Reserved
72: Safe torque loss (STL1)
73: PG cd hardware error (PGcd)
74: PG absolute signal error (PGHL)
75: PG Z phase signal loss (PGAF)
76: Safe torque output stops (STO)
77: Safe torque loss 2 (STL2)
78: Safe torque loss 3 (STL3)
82: U-phase output phase loss (OPHL)
83: V-phase output phase loss (OPHL)
84: W-phase output phase loss (OPHL)
86: Leveling switch short-circuited (LSS)
87: Leveling switch open-circuited (LSo)
94: BTTx Fail (btt)
95: BTTx Error (bttE)

📖 The parameters record when the fault occurs and forces a stop. For the Lv, it records when it is operating, or it warns without recording.

06-30 Fault Output Setting Method

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: According to settings in Pr.06-22–Pr.06-25 (four sets)

1: According to the binary setting (fifteen sets)

- This parameter is used with the settings 35–38 in Pr.02-11–Pr.02-22 (multi-function output). The fault output selections 1–4 correspond to Bit 0–3.
- This parameter provides two setting methods for the fault output.

  0: Set according to the settings in Pr.06-22–Pr.06-25.

  1: Set according to the binary setting. Refer to the following example for details.

  Example:

  Assume that:

  Pr.02-13 (Multi-function output 3 R1A (Relay 3)) is set to 35 Bit0 (Pr.06-22).

  Pr.02-14 (Multi-function output 4 R2A (Realy4)) is set to 36 Bit1 (Pr.06-23).

  Pr.02-15 (Multi-function output 5 (MO1)) is set to 37 Bit2 (Pr.06-24).

  Pr.02-16 (Multi-function output 6 (MO2)) is set to 38 Bit3 (Pr.06-25).

  Also assume that external fault (EF) outputs with the following signal: R1A = 1, R2A = 1, MO1 = 0 and MO2 = 1. The corresponding Bit 3–0 is 1011.

Bit 3	Bit 2	Bit 1	Bit 0	Fault Code
-	-	-	-	0: No fault
0	0	0	1	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 (occ)
				6: Over-current at stop (ocS)
0	0	1	0	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)
0	0	1	1	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: Input phase loss (PHL)
0	1	0	0	16: IGBT overheat (oH1)
				17: Bulk capacitor overheat (oH2)
				18: Abnormal IGBT temperature detected (tH1o)
				19: Abnormal bulk capacitor temperature detected (tH2o)
1	0	0	0	20: Unusual cooling fan operation (FAn)
0	1	0	1	21: Overload (oL) (150%; 1 minute, motor drive overloaded)
0	1	1	0	22: Motor overload (EoL1)
				24: Motor PTC overheat (oH3)
0	1	1	1	26: Over-torque 1 (ot1)
				27: Over-torque 2 (ot2)

Bit 3	Bit 2	Bit 1	Bit 0	Fault Code
1	0	0	0	30: Memory writing error (cF1)
				31: Memory reading error (cF2)
				32: Isum current detection error (cd0)
				33: U-phase current detection error (cd1)
				34: V-phase current detection error (cd2)
				35: W-phase current detection error (cd3)
				36: cc (current clamp) hardware error (Hd0)
				37: oc (over-current) hardware error (Hd1)
				38: ov (over-voltage) hardware error (Hd2)
				39: GFF (ground fault) hardware error (Hd3)
1	0	0	1	40: Auto-tuning error on motor’s parameter (AUE)
1	0	1	0	41: Reserved
				42: PG feedback error (PGF1)
				43: PG feedback loss (PGF2)
0	1	1	1	44: PG feedback stall (PGF3)
1	0	1	0	45: PG slip error (PGF4)
				46: Reserved
				47: Reserved
				48: Reserved
1	0	1	1	49: External fault input (EF)
				50: Emergency stop from external terminals (EF1)
1	0	0	1	52: Password error after three attempts (Pcod)
1	1	0	0	54: Illegal communication command (cE01)
				55: Illegal communication address (cE02)
				56: Communication data length error (cE03)
				57: Communication attempts to write to a read-only address (cE04)
				58: Modbus transmission time-out (cE10)
				59: Keypad transmission time-out (cP10)
1	0	0	0	60: Brake transistor error (BF)
1	0	1	1	61–63: Reserved
				64: Mechanical brake feedback error (MBF)
1	0	0	0	65: PG hardware error (PGF5)
1	0	1	1	66: Magnetic contactor error (MCF)
1	0	1	1	67: Output phase loss (MPHL)
1	1	0	1	68: CAN BUS disconnected (CANF)
1	1	1	0	72: Safe torque loss (STL1)
1	0	0	0	73: PG cd hardware error (PGcd)
1	0	0	0	74: PG absolute signal error (PGHL)
1	0	0	0	75: PG Z phase signal loss (PGAF)
1	1	1	0	76: Safe torque output stops (STO)
1	1	1	0	77: Safe torque loss 2 (STL2)
1	1	1	0	78: Safe torque loss 3 (STL3)
1	0	1	1	82: U-phase output phase loss (OPHL)
1	0	1	1	83: V-phase output phase loss (OPHL)
1	0	1	1	84: W-phase output phase loss (OPHL)

Bit 3	Bit 2	Bit 1	Bit 0	Fault Code
-	-	-	-	86: Leveling switch short-circuited (LSS)
-	-	-	-	87: Leveling switch open-circuited (LSo)
1	0	0	0	94: BTTx Fail (btt)
1	0	0	0	95: BTTx Error (bttE)

06-22 Fault Output Option 1
06-23 Fault Output Option 2
06-24 Fault Output Option 3
06-25 Fault Output Option 4

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

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

You can use these parameters with multi-function output (set Pr.02-11–Pr.02-22 to 35–38) for the specific requirement. When a fault occurs, the corresponding terminals are activated. You must convert binary value to decimal value when setting Pr.06-22–Pr.06-25.

Fault Code	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
0: No fault							
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 (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: Input phase loss (PHL)						●	
16: IGBT overheat (oH1)			●				
17: Bulk capacitor overheat (oH2)			●				
18: Abnormal IGBT temperature detected (tH1o)			●				
19: Abnormal bulk capacitor temperature detected (tH2o)			●				
20: Unusual cooling fan operation (FAn)						●	
21: Overload (oL) (150%; 1 minute, motor drive overloaded)			●				
22: Motor overload (EoL1)			●				
23: Reserved							
24: Motor PTC overheat (oH3)			●				

Fault Code	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
25: Reserved							
26: Over-torque 1 (ot1)			●				
27: Over-torque 2 (ot2)			●				
28: Reserved							
29: Reserved							
30: Memory writing error (cF1)				●			
31: Memory reading error (cF2)				●			
32: Isum current detection error (cd0)				●			
33: U-phase current detection error (cd1)				●			
34: V-phase current detection error (cd2)				●			
35: W-phase current detection error (cd3)				●			
36: cc (current clamp) hardware error (Hd0)				●			
37: oc (over-current) hardware error (Hd1)				●			
38: ov (over-voltage) hardware error (Hd2)				●			
39: GFF (ground fault) hardware error (Hd3)				●			
40: Auto-tuning error on motor’s parameter (AUE)				●			
41: Reserved					●		
42: PG feedback error (PGF1)					●		
43: PG feedback loss (PGF2)					●		
44: PG feedback stall (PGF3)					●		
45: PG slip error (PGF4)					●		
46: Reserved					●		
47: Reserved						●	
48: Reserved						●	
49: External fault input (EF)						●	
50: Emergency stop from external terminals (EF1)						●	
51: Reserved							
52: Password error after three attempts (Pcod)				●			
53: Reserved							
54: Illegal communication command (cE01)							●
55: Illegal communication address (cE02)							●
56: Communication data length error (cE03)							●
57: Communication attempts to write to a read-only address (cE04)							●
58: Modbus transmission time-out (cE10)							●
59: Keypad transmission time-out (cP10)							●
60: Brake transistor error (BF)						●	
61–62: Reserved							
63: Reserved				●			
64: Mechanical brake feedback error (MBF)						●	
65: PG hardware error (PGF5)				●			
66: Magnetic contactor error (MCF)						●	
67: Output phase loss (MPHL)						●	

Fault Code	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
68: CAN BUS disconnected (CANF)							●
72: Safe torque loss (STL1)				●			
73: PG cd hardware error (PGcd)				●			
74: PG absolute signal error (PGHL)				●			
75: PG Z phase signal loss (PGAF)				●			
76: Safe torque output stops (STO)				●			
77: Safe torque loss 2 (STL2)				●			
78: Safe torque loss 3 (STL3)				●			
82: U-phase output phase loss (OPHL)						●	
83: V-phase output phase loss (OPHL)						●	
84: W-phase output phase loss (OPHL)						●	
86: Leveling switch short-circuited (LSS)							
87: Leveling switch open-circuited (LSo)							
94: BTTx Fail (btt)				●			
95: BTTx Error (bttE)				●			

06-26 PTC (Positive Temperature Coefficient) Detection Action

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Warn and keep operation

1: Fault and ramp to stop

- Sets the action after detecting PTC.
- When Pr.06-26 is set to 1 (Fault and ramp to stop), if brake or operation contactor is OFF under the circumstance that STO or MI40 (Enable drive function) is not deactivated during deceleration, elevator still runs even brake has engaged (brake wear), and electric arc occurs when operation contactor is OFF.

06-27 PTC Level

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 50.0

Settings 0.0–100.0%

- Sets the PTC level. 100% PTC level corresponds to the maximum analog input value.

06-28 PTC Detection Filter Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.20

Settings 0.00–10.00 sec.

- See Parameter Group 03 Analog Input/ Output Parameters for details.

06-31 Phase Loss Detection of Drive Output at Start-up (MPHL)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 1

Settings 0: Disable

1: Enable

- 1: Auto-detect whether the connection between the drive and motor is normal whenever the drive runs. If an error occurs to the connection between the drive and the motor (broken or loose wiring) or there is no output for the drive’s any or all of the three phases, the drive displays fault code “67” to indicate motor output phase loss.

06-32 Accumulated Drive Power-on Time at the First Fault (min.)
06-34 Accumulated Drive Power-on Time at the Second Fault (min.)
06-36 Accumulated Drive Power-on Time at the Third Fault (min.)
06-38 Accumulated Drive Power-on Time at the Fourth Fault (min.)
06-40 Accumulated Drive Power-on Time at the Fifth Fault (min.)
06-42 Accumulated Drive Power-on Time at the Sixth Fault (min.)

Control Mode **VF** **VFPG** **SVC** **FOCPG** Default: Read only

Settings 0–65535 min.

06-33 Accumulated Drive Power-on Time at the First Fault (day)
06-35 Accumulated Drive Power-on Time at the Second Fault (day)
06-37 Accumulated Drive Power-on Time at the Third Fault (day)
06-39 Accumulated Drive Power-on Time at the Fourth Fault (day)
06-41 Accumulated Drive Power-on Time at the Fifth Fault (day)
06-43 Accumulated Drive Power-on Time at the Sixth Fault (day)

Control Mode **VF** **VFPG** **SVC** **FOCPG** Default: Read only

Settings 0–65535 day

✎ **06-45** Fault and Warning Action

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
Bit 0 = 0: Display Lv fault and coast to stop
Bit 0 = 1: Display Lv warn and coast to stop
Bit 1= 0: Fan lock, fault and coast to stop
Bit 1 = 1: Fan lock, warn and continue operation
Bit 2 = 0: Software GFF protection enabled
Bit 2 = 1: Software GFF protection disabled

06-29 Voltage of Emergency Power

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 24.0/48.0

Settings
24.0–375.0 V_{DC}
48.0–750.0 V_{DC}

📖 This parameter works with setting 43 (EPS function) for Pr.02-01–Pr.02-08 (multi-function input commands).

06-44 Emergency Power (EPS) Mode Operation Speed

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–299.00 Hz

✎ **06-46** Emergency Power (EPS) ON Operation Direction

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Run according to current command

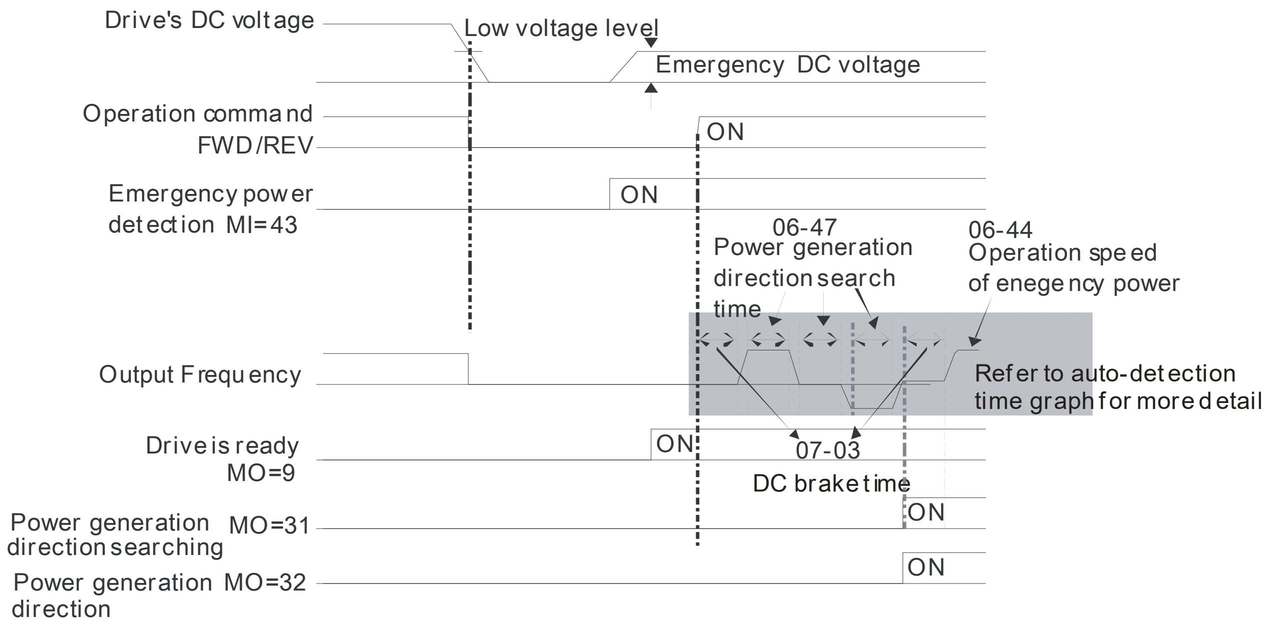
1: Run according to the operation direction of power generation mode, and execute the power generation direction detection when in power generation mode.

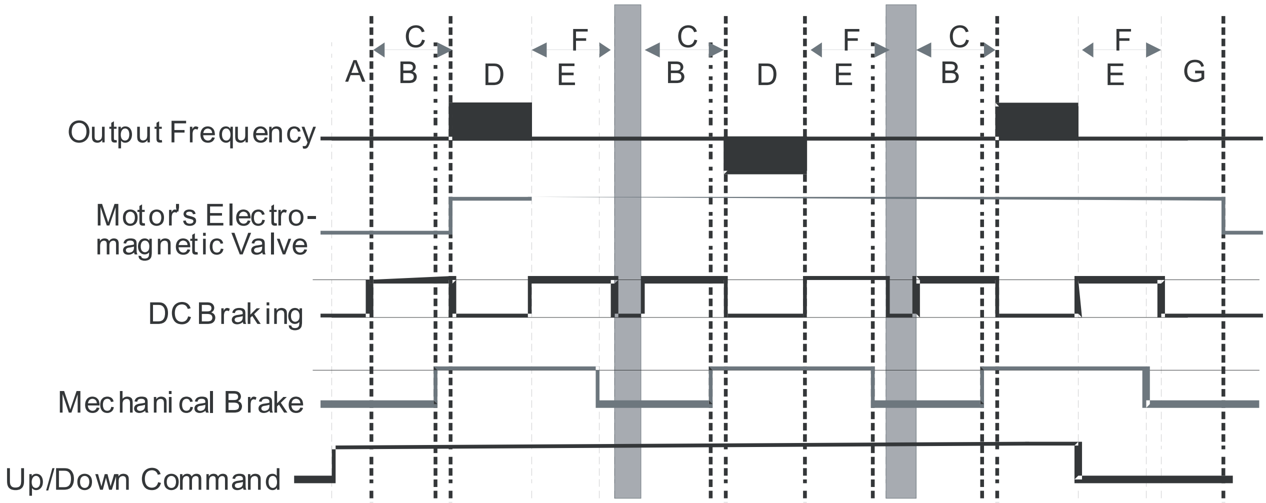
2: After determining the power generation direction, the host controller sends a running direction command. (When at STOP, the direction of power generation mode (MO = 32) confirms and the direction of power generation mode does not remain.) Execute the power generation direction detection every time.

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 =32) confirms and the direction of power generation mode remains.) Execute the power generation direction detection one time.

4: Run according to the operation direction of power generation mode, and execute the power generation direction detection when in normal mode.

- Pr.06-46 is enabled when the external terminal detects the emergency power signal EPS (MI=43).
- When you set Pr.06-46 to 1 and a forward/reverse run command is given, the drive checks for the elevator loading and operates in the power regeneration direction (the motor is in power generating status). The drive uses and operates in the direction that was detected as its power regeneration direction. For safety, the drive does not operate in user command direction to prevent emergency power voltage drop (EPS).
- When you set Pr.06-46 to 4 (motor with gear box, for IM):
  1. When the normal mode runs to the largest power factor angel, the results are saved in Pr.06-69.
  2. Compare the power factor angle detected by the power generation direction with Pr.06-68 setting value, if the value is larger than Pr.06-68, the current direction is saved in Pr.06-70.
  3. When in emergency power mode, the drive runs according to the Pr.06-70 operation direction.
- VF and SVC control modes: In the time setting in Pr.06-47, the drive detects the elevator loading status by performing forward/reverse run. Then the elevator operates in the power regeneration direction (the motor is in power generating status). Refer to the diagram below for the Auto-Detection Timing Graph.





A Pr.02-31: Magnetic Contactor Contracting Delay Time between Drive and Motor

B Pr.02-29: Brake Release Delay Time when Elevator Starts

C Pr.07-03: DC Brake Activation Time

D Pr.06-47: Power Generation Direction Search Time

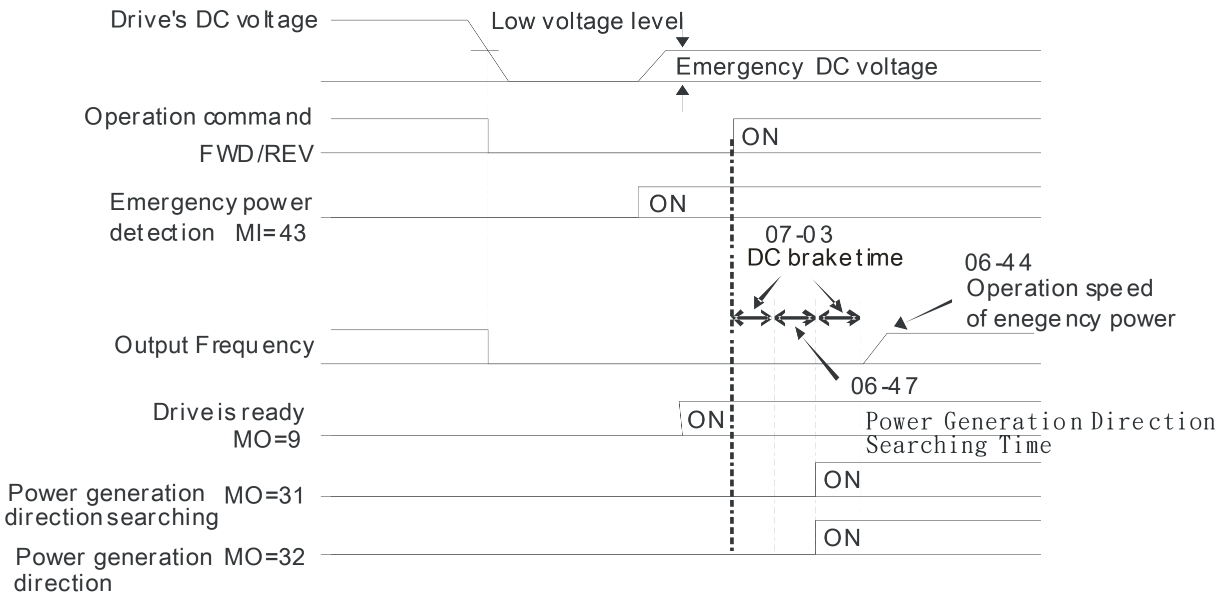
E Pr.02-30: Brake Engage Delay Time when Elevator Stops

F Pr.07-04: DC Brake Stopping Time

G Pr.02-32: Magnetic Contactor Release Delay Time between Drive and Motor

Auto-detection Timing Diagram

📖 FOCPG/PM Control Mode: In the time setting in Pr.06-47, the drive remains at zero-speed and it is able to determine the elevator loading without performing forward/reverse run. Then the elevator operates in the power regeneration direction (the motor is in power generating status). Refer to the diagram below for the Auto-Detection Timing Graph.



06-47 Power Generation Direction Search Time

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 1.0
Settings	0.0–5.0 sec.					

06-48 Power Capacity of Emergency Power (EPS)

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0.0
Settings	0.0–100.0 kVA					

- When using emergency power (EPS), you must set the parameter to the required power capacity for the emergency power, and then the AC motor drive calculates the acceptable elevator speed (Pr.06-44) with the following equation.
- $I_{motor\_rated} = 05-01$ (Induction Motor)/ $08-01$ (PM Motor)

$$V_{eps\_\max} = \frac{06-48 \times 0.5}{\sqrt{3} \times I_{motor\_rated}}$$

$$f_{eps\_\lim it} = \frac{V_{eps\_\max}}{01-02} \times 01-01$$

When the Frequency command > f_{EPS}, the operation speed of emergency power (EPS) is f_{EPS}.
When the Frequency command ≤ f_{EPS}, the operation speed of emergency power (EPS) is set according to the current Frequency command.

06-68 Power Factor Angle Level for Power Generation Direction

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 70.0
Settings	0.0–150.0°					

- During operation, if the largest power factor angle is larger than Pr.06-68 setting value, the power generation direction is the current operation direction.

06-69 Reference Level for Power Factor Angle during Operation

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: Read only
Settings	-200.0–200.0°					

- The largest power factor angle during operation.

06-70 Power Generation Direction

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: Read only
Settings	0: FWD					
	1: REV					

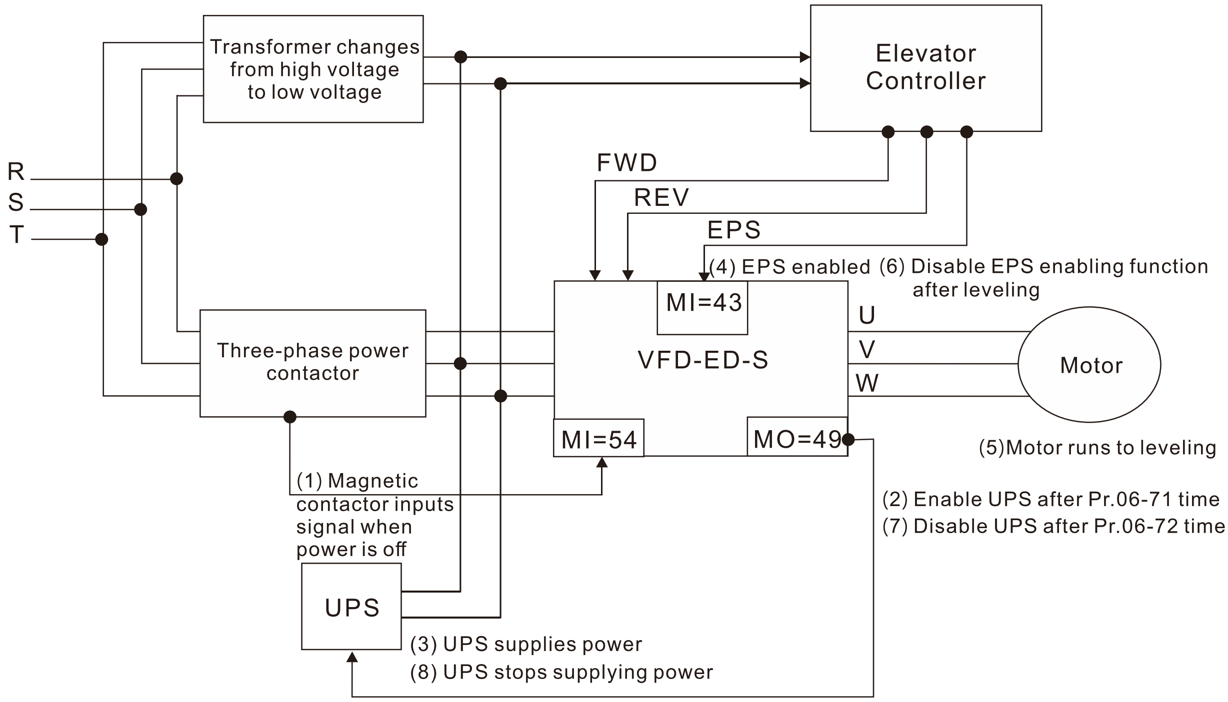
06-71 UPS Output Delay Time

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 1.0
Settings	0.0–10.0 sec.					

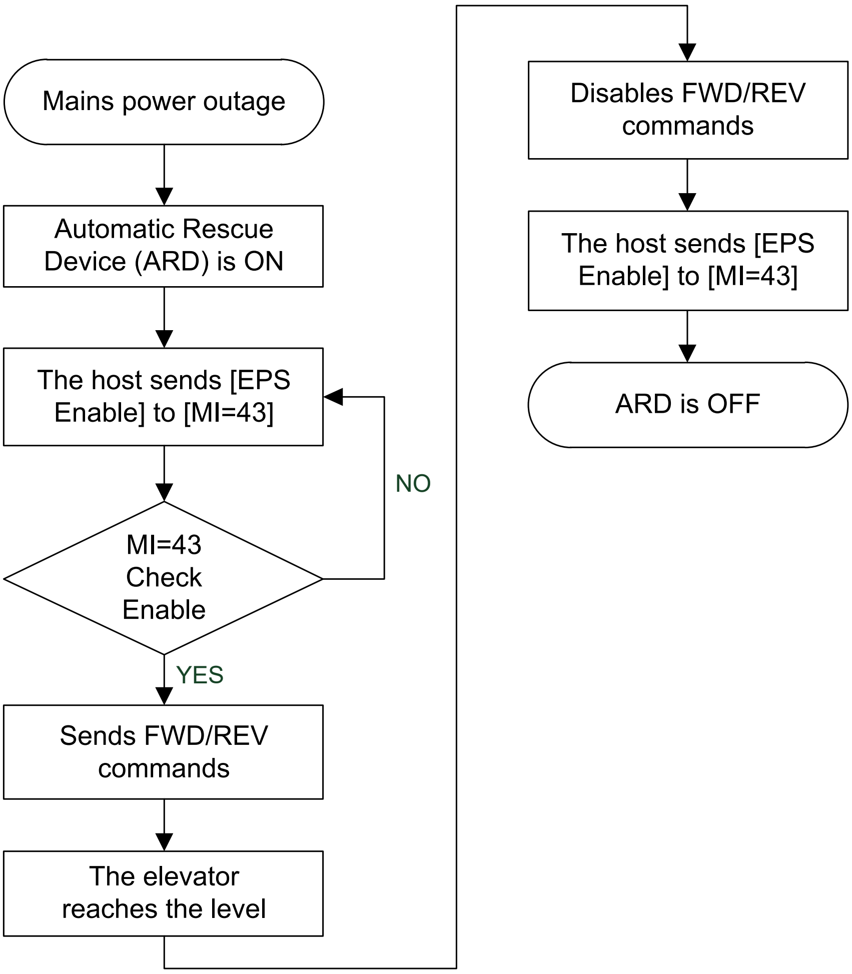
06-72 UPS Stops Output Delay Time

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 3.0
Settings	0.0–60.0 sec.					

- Pr.06-71: At power failure, the contactor sends a MI signal to inform the drive to activate UPS. Then, the drive sends a MO signal to activate the UPS contactor after Pr.06-71 delay time.
- Pr.06-72: After the controller deactivates the emergency power mode, it stops sending a MO signal to deactivate the UPS power after Pr.06-72 delay time.
- Related parameters: multi-function input commands Pr.02-01–Pr.02-08 function setting 54 (Power failure signal) and multi-function output terminals Pr.02-11–Pr.02-16 function setting 49 (Emergency power mode action).



EPS Flow Chart

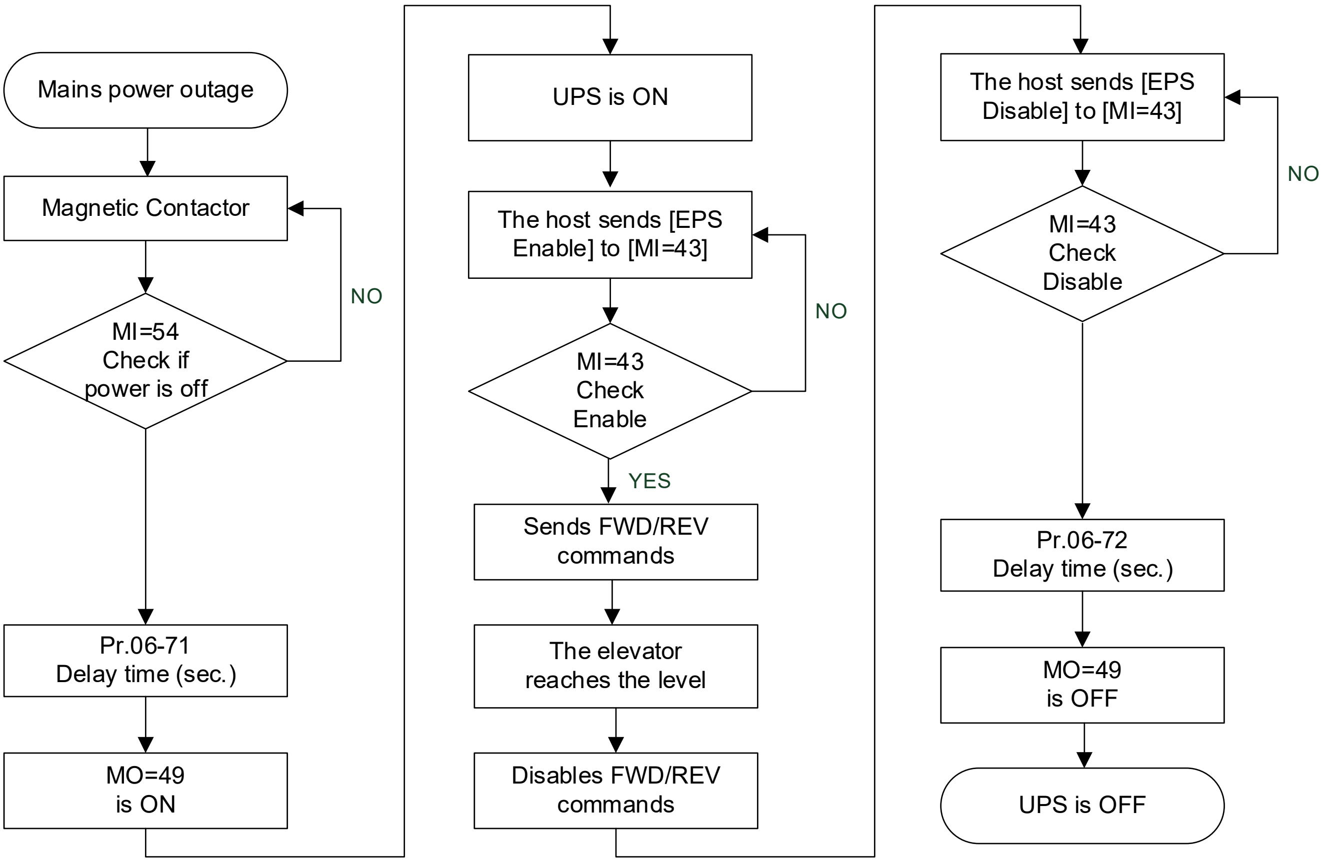


EPS Flow Chart (ARD or UPS)

The steps to set ARD/UPS as EPS are as follows:

1. Set MI = 43 (EPS function)
2. Set Pr.06-46 = EPS mode selection
3. Set Pr.06-29 = Emergency power voltage running
4. Set Pr.06-48 = Emergency power capacity running
5. Set Pr.06-47 = Power generation direction search time
6. Set Pr.06-68 = Detecting level of power factor at the direction of power generation

NOTE: ARD or UPS can automatically judge whether to cut off the power or not.



EPS Flow Chart (Battery)

The steps to set battery as EPS are as follows:

1. Set MI = 54 (Power failure signal)
2. Set MI = 43 (EPS function)
3. Set MO = 49 (Emergency power mode action)
4. Set Pr.06-46 = EPS mode selection
5. Set Pr.06-29 = Emergency power voltage running
6. Set Pr.06-48 = Emergency power capacity running
7. Set Pr.06-47 = Power generation direction search time
8. Set Pr.06-68 = Detecting level of power factor at the direction of power generation
9. Set Pr.06-71 = MO enables UPS delay time
10. Set Pr.06-72 = MO disables UPS delay time

NOTE: When using battery as EPS in an elevator system, auxiliary contact of the contactor should be used to judge whether to cut off the power and notify the drive.

06-49 STO Latch Selection

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0000h

Settings 0000h: STO fault latched, resending RUN command is required
0001h: STO warning latched, resending RUN command is required
0002h: STO fault latched
0003h: STO warning unlatched

- 0000h: STO fault latched, resending RUN command is required
  If STO is ON in any condition and a fault occurs, it does not reset until STO is back to normal and use a RESET command or power-on again after resending the RUN command.
- 0001h: STO warning latched, resending RUN command is required
  If STO is ON in any condition and a warning occurs, it does not reset until STO is back to normal and resend the RUN command.
- 0002h: STO fault latched
  If STO is ON in any condition and a fault occurs, it does not reset until STO is back to normal and use a RESET command or power-on again.
- 0003h: STO warning unlatched
  If STO is ON in any condition and a warning occurs, it automatically resets when STO is back to normal.
- For more information on the timing diagram, see Section 16-5.
- Make sure there is no risk, which is assessed by the elevator controller, before using the STO warning unlatched function.
- Fault codes STL1 to STL3 are regarded as fault latched (you cannot set Pr.06-49).

06-50 MO's Action when Retrying after Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Output
1: No output

- Determines whether to display the fault indication when the following faults occur:
  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: Input Phase loss (PHL)

📖 Two MO terminals are affected by this parameter and should be set up as:
MO = 10: Low voltage waning (LV)
MO = 11: Fault Indication

06-51 Number of Times to Retry after Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–10 times

📖 To determine the number of times to retry when the following faults occur:
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: Input Phase loss (PHL)

📖 After every retry attempt, the number of times to retry is automatically reduced by one as displayed on the keypad.

📖 The principles for the number of times to reset:
1. Reset the fault manually.
2. After running normally for 10 minutes, the motor drive returns to the prior setting.
3. The motor drive is powered on and powered off again.

06-52 Time Interval between Retries

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 10.0

Settings 0.5–600.0 sec.

📖 Determines the time interval between retries when the following faults occur:
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)

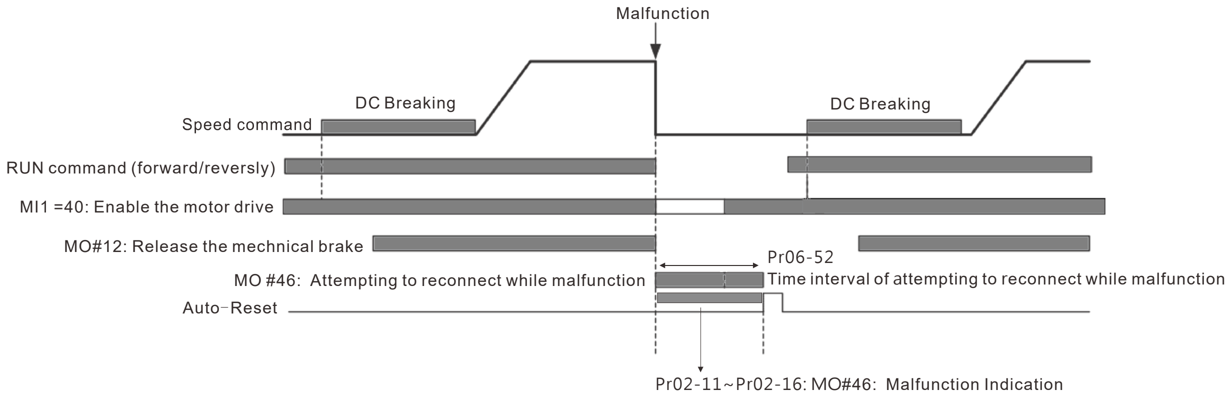
12: Low voltage during deceleration (Lvd)

13: Low voltage during constant speed (Lvn)

14: Low voltage at stop (LvS)

15: Input Phase loss (PHL)

📖 A minimum time interval between retries is 5.5 seconds when OCx/GFF faults are triggered.



06-53 Frequency Command when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-54 Output Frequency when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-55 Output Current when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Amps

06-56 Motor Frequency when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-57 Output Voltage when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-58 DC Bus Voltage when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-59 Output Power when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 kW

06-60 Output Torque when the Most Recent Fault Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35%

06-61 IGBT Temperature when the Most Recent Fault Occurred

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings -3276.8–3276.7℃

06-62 Multi-input Terminals Status when the Most Recent Fault Occurred

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0000h–FFFFh

06-63 Multi-output Terminals Status when the Most Recent Fault Occurred

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0000h–FFFFh

06-64 Motor Drive Status when the Most Recent Fault Occurred

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0000h–FFFFh

06-73 Permanent Operation Direction Count (H)

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0–60000

06-74 Permanent Operation Direction Count (L)

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0–9999

06-75 Single Operation Direction Count (H)

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0–20

06-76 Single Operation Direction Count (L)

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0–9999

06-77 Number of Times for Single Operation Reset

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: Read only

Settings 0–100

06-78 Number of Times for Operation Direction

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 2.00

Settings 0.00–200.00 k

06-79 Function Selection for Operation Times

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0

Settings 0–2

- When you set Pr.06-79 to 0:
  Disable the operation direction count function and clear parameters (Pr.06-75, 06-76, and 06-78), and add one time to the number of times for single operation reset (pr.06-77).
- When you set Pr.06-79 to 1:
  Enable the operation direction count function and add one time to the permanent operation direction count and single operation direction count whenever the operation direction changes. If the single operation direction count is larger than Pr.06-78, SERV warning code will be triggered and continues operation.
- When you set Pr.06-79 to 2:
  Enable the operation direction count function and add one time to the permanent operation direction count and single operation direction count whenever the operation direction changes. If the single operation direction count is larger than Pr.06-78, SERV fault code will be triggered before operation.

06-80 Output Frequency when Fault 2 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-81 DC Bus Voltage when Fault 2 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-82 Output Current when Fault 2 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Amps

06-83 IGBT Temperature when Fault 2 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings -3276.8–3276.7ºC

06-84 Output Frequency when Fault 3 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-85 DC Bus Voltage when Fault 3 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-86 Output Current when Fault 3 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Amps

06-87 IGBT Temperature when Fault 3 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings -3276.8–3276.7ºC

06-88 Output Frequency when Fault 4 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-89 DC Bus Voltage when Fault 4 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-90 Output Current when Fault 4 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Amps

06-91 IGBT Temperature when Fault 4 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings -3276.8–3276.7ºC

06-92 Output Frequency when Fault 5 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-93 DC Bus Voltage when Fault 5 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-94 Output Current when Fault 5 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Amps

06-95 IGBT Temperature when Fault 5 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings -3276.8–3276.7ºC

06-96 Output Frequency when Fault 6 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Hz

06-97 DC Bus Voltage when Fault 6 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.0–6553.5 V

06-98 Output Current when Fault 6 Occurred

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

Settings 0.00–655.35 Amps

06-99 IGBT Temperature when Fault 6 Occurred

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: Read only

Settings -3276.8–3276.7ºC

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07 Special Parameters

✓: You can set this parameter during operation

✓ 07-00 Brake Transistor Level

Control Mode VF VFPG SVC FOCPG FOCPM Default: 380.0/760.0

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

460V models: 700.0–900.0 V_{DC}

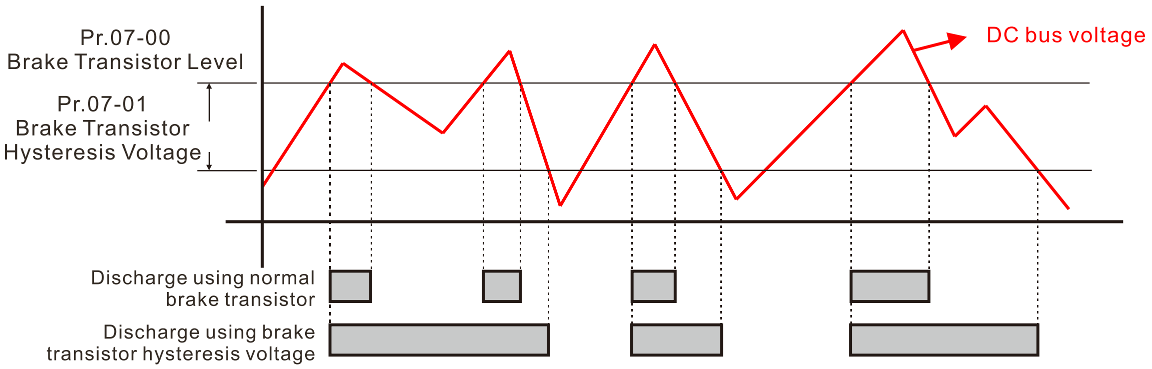
📖 Sets the DC bus voltage at which the brake transistor is activated.

07-01 Brake Transistor Hysteresis Voltage

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.0

Settings 0.0–100.0 V

📖 Used with Pr.07-00 to make the activated voltage level within range in order to prevent the brake resistor from overheating due to frequent ON/OFF of the brake transistor caused by fluctuated DC bus voltage.



✓ 07-02 DC Brake Current Level at Start-up

Control Mode VF VFPG SVC Default: 0

Settings 0–100% of the rated current of the motor drive

📖 Sets the level of the DC brake current output to the motor at start-up. When setting the DC brake current, the rated current (Pr.00-01) is 100%. It is recommended that you start with a low DC brake current level and then increase until you reach the proper holding torque. However, the DC brake current cannot exceed the motor's rated current to prevent the motor from burnout. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.

📖 When in FOCPG/FOCPM mode, you can enable the DC brake function without setting up this parameter.

✓ 07-03 DC Brake Activation Time

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.7

Settings 0.0–60.0 sec.

📖 Sets the length of time that the DC brake current is supplied to motor when activating the drive.

✓ 07-04 DC Brake Stopping Time

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.7

Settings 0.0–60.0 sec.

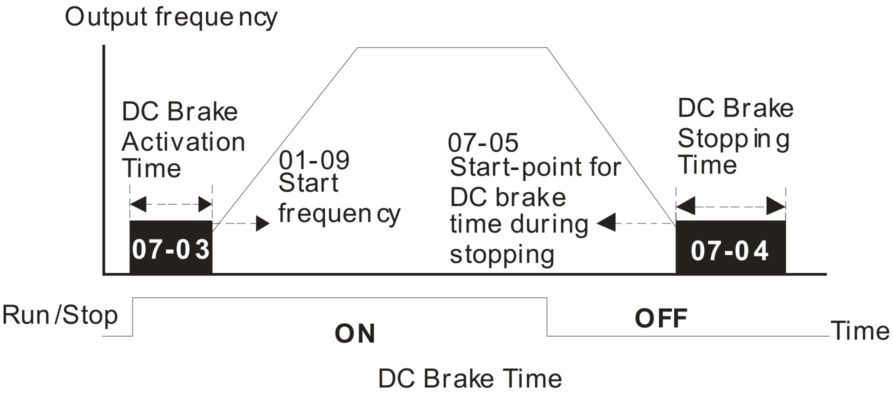
📖 Sets the length of time that the DC brake current is supplied to motor when stopping the drive.

07-05 Start-point for DC Brake

Control Mode **VF** **VFPG** **SVC** **FOCPG** Default: 0.00

Settings 0.00–299.00 Hz

- Determines the frequency at which the DC brake begins during deceleration. When the setting is less than the start frequency (Pr.01-09), the start-point for the DC brake begins at the minimum frequency.



07-06 DC Brake Proportional Gain

Control Mode **VF** **VFPG** **SVC** Default: 50

Settings 1–500

- Sets the output voltage gain when DC braking.

07-07 Dwell Time at Acceleration

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.00

Settings 0.00–600.00 sec.

07-09 Dwell Time at Deceleration

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.00

Settings 0.00–600.00 sec.

07-08 Dwell Frequency at Acceleration

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.00

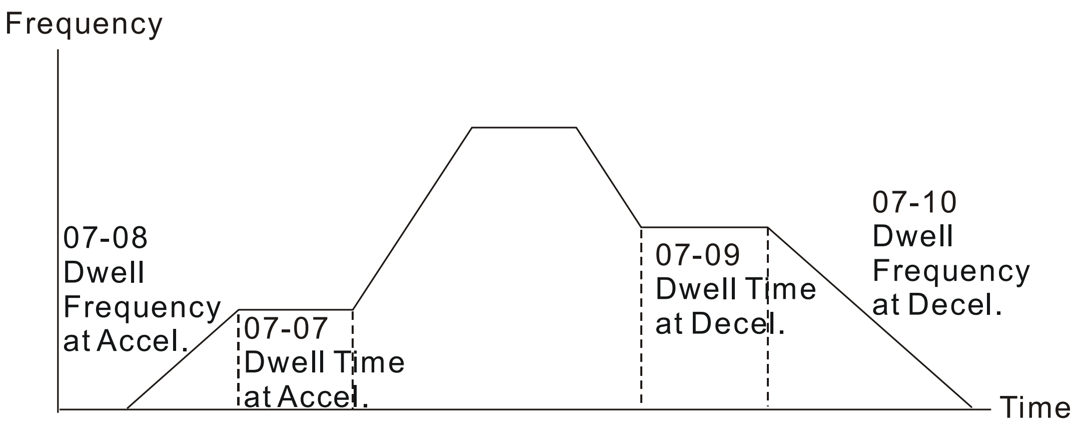
Settings 0.00–299.00 Hz

07-10 Dwell Frequency at Deceleration

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.00

Settings 0.00–299.00 Hz

- In a heavy load situation, dwelling can temporarily stabilize the output frequency.
- Use Pr.07-07–Pr.07-10 with heavy load to prevent over-voltage or over-current.



Dwell at accel./decel.

07-11 Cooling Fan Control

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 2

Settings
0: Cooling fan is always ON.
1: One minute after AC motor drive stops, cooling fan is OFF.
2: AC motor drive runs and cooling fan is ON; AC motor drive stops and cooling fan is OFF.
3: Cooling fan is ON to run when preliminary IGBT temperature (°C) reached.
4: Cooling fan is always OFF.

- Use this parameter for the fan control.
- When set to 3, the fan starts to run until the heat sink temperature is less than 40°C if temperature exceeds 40°C.

07-12 Torque Command

Control Mode Default: 0.0

Settings -150.0–150.0% (Pr.07-14 setting = 100%)

- This parameter sets the Torque command. When Pr.07-14 is 250% and Pr.07-12 is 100%, the actual Torque command = 250 x 100% = 250% of the motor rated torque.

07-13 Torque Command Source

Control Mode Default: 2

Settings
0: Use the KPC-CC01 digital keypad
1: Use the RS-485 serial communication
2: Use the analog signal (Pr.03-00)

- Specifies the Torque command source (Torque command is in Pr.07-12).

07-14 Maximum Torque Command

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 100

Settings 0–300% of the rated motor drive torque

- Sets the maximum Torque command value (the motor rated torque is 100%).

07-15 Torque Command Filter Time

Control Mode Default: 0.000

Settings 0.000–1.000 sec.

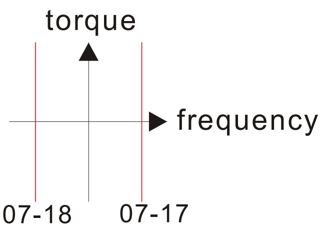
📖 When the setting is too long, the control is stable but the control response is delayed. When the setting is too short, the response is quick but the control may be unstable. Adjust the setting according to your control and response situation.

07-16 Speed Limit

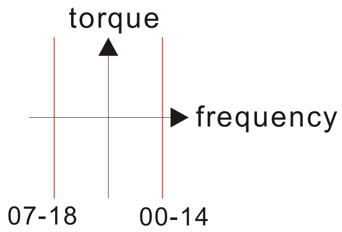
Control Mode Default: 0

Settings 0: Use the settings in Pr.07-17 and Pr.07-18

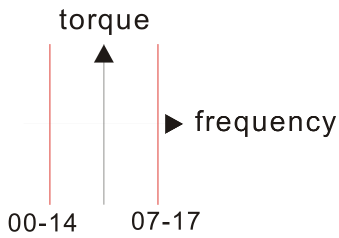
1: Use the Frequency command source (Pr.00-14)



Pr.07-16=0
Running/opposite running direction are limited by Pr.07-17 and Pr.07-18.



07-16=1
When it is forward running, running direction is limited by Pr.00-14 opposite running direction is limited by Pr.07-18.



07-16=1
When it is reverse running, running direction is limited by Pr.07-17 opposite running direction is limited by Pr.00-14.

✓ 07-17 Torque Mode + Speed Limit

Control Mode Default: 10

Settings 0–120%

✓ 07-18 Torque Mode - Speed Limit

Control Mode Default: 10

Settings 0–120%

📖 Limits the speed for forward and reverse running in torque mode (Pr.01-00 Maximum Output Frequency = 100%).

✓ 07-19 Torque Offset Source

Control Mode **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Disable

1: Use the analog input (Pr.03-00)

2: Use the torque offset setting (Pr.07-20)

3: Use the external terminals (by Pr.07-21–Pr.07-23)

📖 Specifies the torque offset source.

📖 When set to 3, the torque offset sources are Pr.07-21, Pr.07-22 and Pr.07-23 according to the multi-function input terminal settings (31, 32 or 33).

Pr.02-01–Pr.02-08 is set to 31	Pr.02-01–Pr.02-08 is set to 32	Pr.02-01–Pr.02-08 is set to 33	Torque offset
OFF	OFF	OFF	N/A
OFF	OFF	ON	07-23
OFF	ON	OFF	07-22
OFF	ON	ON	07-23+07-22
ON	OFF	OFF	07-21
ON	OFF	ON	07-21+07-23
ON	ON	OFF	07-21+07-22
ON	ON	ON	07-21+07-22+07-23

07-20 Torque Offset Setting

Control Mode SVC FOCPG FOCPM Default: 0.0

Settings	0.0–100.0% (motor drive rated torque)

Sets the torque offset. The motor rated torque is 100%.

07-21 High Torque Offset

Control Mode SVC FOCPG FOCPM Default: 30.0

Settings	0.0–100.0% (motor drive rated torque)

07-22 Middle Torque Offset

Control Mode SVC FOCPG FOCPM Default: 20.0

Settings	0.0–100.0% (motor drive rated torque)

07-23 Low Torque Offset

Control Mode SVC FOCPG FOCPM Default: 10.0

Settings	0.0–100.0% (motor drive rated torque)

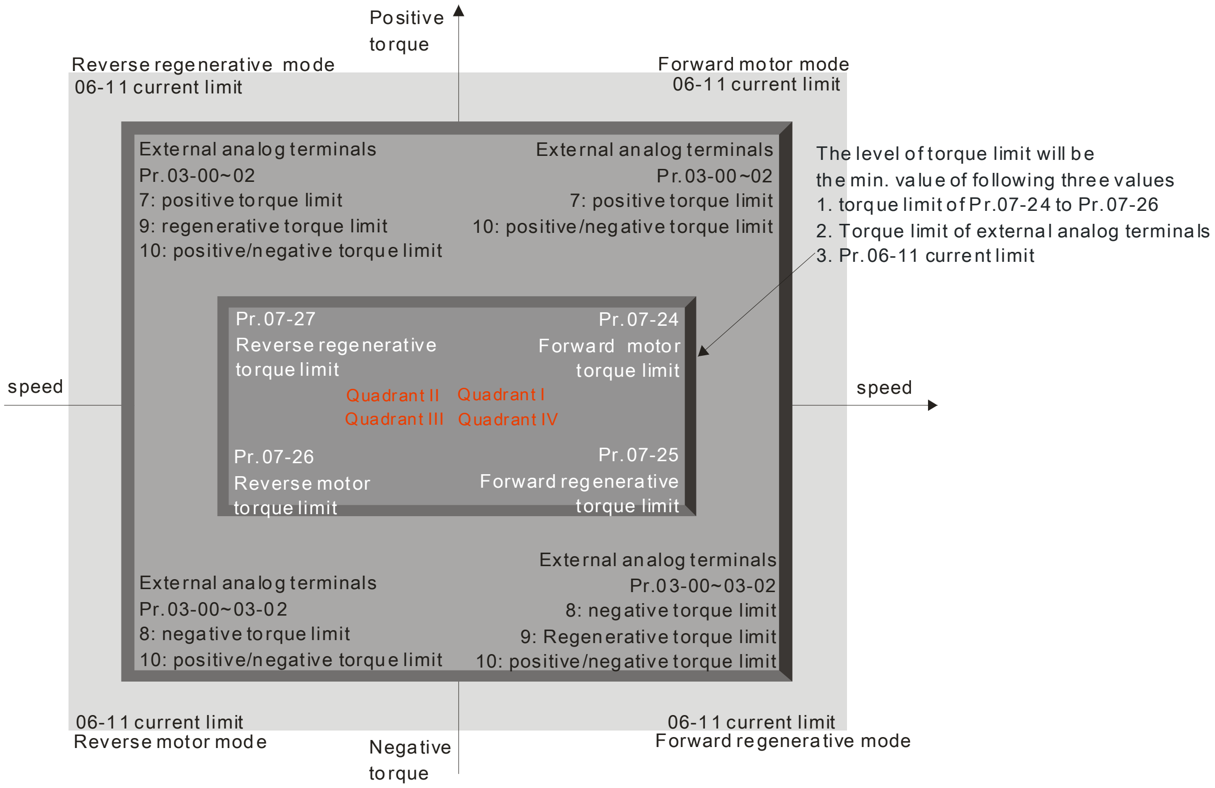
When set to 3, the torque offset sources are Pr.07-21, Pr.07-22 and Pr.07-23 according to the multi-function input terminal settings (31, 32 or 33). The motor rated torque is 100%.

07-24 Forward Motor Torque Limit
07-25 Forward Regenerative Torque Limit
07-26 Reverse Motor Torque Limit
07-27 Reverse Regenerative Torque Limit

Control Mode FOCPG FOCPM Default: 200

Settings	0–300% (rated torque of the motor drive)

The motor rated torque is 100%. The settings for Pr.07-24–Pr.07-27 compare with Pr.03-00=7, 8, 9, 10. The minimum of the comparison result is torque limit. The diagram below illustrates the torque limit.



07-28 Emergency Stop (EF) & Forced Stop

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
- 0: Coast to stop
- 1: According to deceleration Time 1
- 2: According to deceleration Time 2
- 3: According to deceleration Time 3
- 4: According to deceleration Time 4
- 5: According to Pr.01-31

When the multi-function input terminal is set to 10 or 18 and is ON, the drive operates according to this parameter setting.

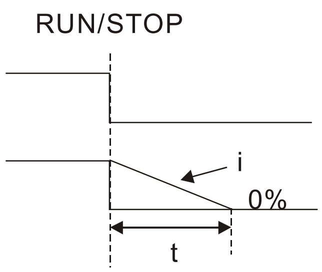
07-29 Time for Decreasing Torque at Stop

Control Mode **FOCPG** **FOCPM** Default: 0.000

Settings 0.000–5.000 sec.

When the elevator is stopped and the mechanical brake is engaged, the drive stops output. At the same time, it produces noise from the reacting force between the motor and the mechanical brake. Use this parameter to decrease this reacting force and lower the noise.

Sets the time when torque decreases from 300% to 0%.



$$\frac{i}{00\text{-}01} \times \frac{100\%}{300\%} \times (07\text{-}29) = t$$

07-30 DC Brake Current Level at Stop

Control Mode **VF** **VFPG** **SVC** Default: 0

Settings 0–100% of the rated current of the motor drive

- Sets the level of the DC brake current output to the motor at stop. When setting the DC brake current, the rated current (Pr.00-01) is 100%. It is recommended that you start with a low DC brake current level and then increase until you reach the proper holding torque. However, the DC brake current cannot exceed the motor's rated current to prevent the motor from burnout. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.
- When in FOCPG/FOCPM control mode, you can enable the DC brake without setting up Pr.07-30.

07-31 Drive Output Torque

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.0

Settings 0.0–300.0%

- Measurement: Make mechanical brake engage, and enable drive run 3 to 5 seconds. At this time, output torque value will be displayed on built-in keyboard panel (set Pr.00-04=8). Then, enter the value into Pr.07-31.
- If the value displays too fast to view, increase Pr.11-21 (Filter Time Display on KPED-LE01).

07-32 Brake Torque Test Function

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: No function
1: Brake torque test

- Brake torque test action:
  1. Make sure the drive's output torque value has been entered (as described in Pr.07-31).
  2. Enter Pr.07-36 and Pr.07-37 according to actual conditions
  3. Set Pr.07-32=1. Press RUN key on digital keypad KPC-CC01 or execute inspection upward operation or downward operation in manual mode (inspection) (set Pr.00-15=1) so that brake torque test can be run immediately.
  4. In the process of brake torque test, warning code bttA (BTTx Testing) will be triggered. Increase 10% of Pr.07-31 setting value for each time, and a maximum test is 10 times (BTT1 to BTT10). Once the test succeeds, warning code bttS (BTTx Success) will be displayed.
- Multi-function input terminal MI=57 can also be used to enable the brake torque test.

07-33 Brake Torque Test Distance

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–65535 ppr

07-34 Brake Torque Test Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 5.0

Settings 0.0–5.0 sec.

07-35 Most Recent Output Torque Ratio before Brake Torque Test Failure

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: Read only
	Settings	0.00–3.00				

- Records the most recent output torque ratio before brake torque test failure
- For example: When brake torque test fails in the fifth time, the output torque ratio of brake torque test failed in the fourth times, that is 0.40, will be displayed.

✎ 07-36 Minimum Output Torque Ratio Allowed during Brake Torque Test

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0.00
	Settings	0.00–2.00				

- For example: When brake torque test fails in the fifth times, and the output torque ratio of brake torque test failed in the fourth times Pr.07-35 is smaller than Pr.07-36, it means the brake torque test fails, and fault code btt (BTTx Fail) will be triggered on display.

✎ 07-37 Maximum Output Torque Ratio Allowed during Brake Torque Test

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: 0.00
	Settings	0.00–2.00				

- For example: When brake torque test fails in the fifth time,
  1. If the output torque ratio of brake torque test in the fifth time Pr.07-35 ≥ Pr.07-36, then brake torque test succeeds, warning code bttS (BTTx Success) will be displayed on keypad.
  2. If the output torque ratio of brake torque test in the fifth time Pr.07-35 < Pr.07-36, then brake torque test is valid, warning code bttn (BTTx Success) will be displayed on keypad. In this case, check if it is necessary to adjust Pr.07-37 and execute the brake torque test again.

08 PM Parameters

✓: You can set this parameter during operation

08-00 Motor Auto-tuning

Control Mode **FOCPM** Default: 0

Settings
0: No function
1: Only for an unloaded motor; auto-measures the angle between magnetic pole and PG origin (Pr.08-09)
2: Auto-tuning PM parameters (suggested to lock the brake)
3: Auto-measures the angle between magnetic pole and PG origin (Pr.08-09)

- Position the elevator near the middle floors before auto-tuning.
- Auto-tuning process: 2, and then 1 or 3.
- Motor auto-tuning:
  Set Pr.08-00 to 1 to 3, and then press the RUN key on the digital keypad KPC-CC01 (Pr.00-15=2) to start auto-tuning. Or when the drive is in manual mode (inspection), run the upward operation or downward operation (Pr.00-15=1) to start auto-tuning immediately. In the process of auto-tuning, an "Auto tuning" warning continuously displays on the digital keypad until it is finished.
- Pr.08-00=2: Motor auto-tuning is static test:
  1. Make sure that all the drive parameters are set to defaults and the motor wiring is correct.
  2. Enter the correct values for Pr.01-01, Pr.01-02, Pr.08-01, Pr.08-02, Pr.08-03 and Pr.08-04. Refer to motor capacity to set the acceleration/deceleration time.
  3. Note that the motor will run! The shaft needs to be locked by an external force.
  4. After auto-tuning is finished, check if Pr.08-05, Pr.08-07, and Pr.08-08 all have values.
- Pr.08-00=1: Auto-measures the angle between the magnetic pole and the PG origin. Pay attention to the following notes when measuring: (dynamic test)
  1. Unload before auto-tuning.
  2. If the drive controls the brake, the drive can auto-tune according to the normal sequence after you complete the wiring and set the brake control parameters.
  3. If the host controller controls the brake, make sure that the brake is in release status before auto-tuning.
- Pr.08-00=3: Auto-measures the angle between the magnetic pole and the PG origin. Pay attention to the following notes when measuring: (static test)
  1. The motor can be loaded or unloaded before auto-tuning.
  2. See the reference table for auto-tuning for Pr.10-00 (PG Signal Type).
  3. If the drive controls the brake, the drive can auto-tune according to the normal sequence after you complete the wiring and set the brake control parameters.
  4. If the host controller controls the brake, make sure that the brake is in release status before auto-tuning.
  5. Make sure the setting for Pr.10-02 is correct. Incorrectly setting Pr.10-02 causes incorrect positioning of the magnetic pole and results in the wrong angle between the magnetic pole and PG origin.

NOTE:

- The entered rated speed cannot be larger than or equal to 120 f/p.
- Note that if the contactor and brake are not controlled by the AC motor drive, release it manually.

- Set Pr.08-00 to 1 (unloaded motor) for accurate calculation. If you need to execute this function with a loaded motor, balance the carriage before execution.
- If you do not balance the carriage in a measured environment, you can execute this function with a loaded motor by setting Pr.08-00 = 3. It will have a difference of 15–30° for different encoder types.
- “Auto Tuning Err” displays on the digital keypad when stopping due to an AC motor drive fault or human error, which means the detection fails. Check the wiring connections of the AC motor drive If “PG Fbk Error” displays on the digital keypad, change the setting of Pr.10-02 (if set to 1, change it to 2). If “PG Fbk Loss” displays on the digital keypad, check the feedback of Z-phase pulse.

08-01 Motor Rated Current

Control Mode FOCPM Unit: Amp

Default: #.##

Settings (40–120%) * Pr.00-01 Amps

- Sets according to the motor rated current as indicated on the motor nameplate. The default is 90% of the rated current.
- Example: Suppose the rated current for 7.5 HP (5.5 kW) models is 25 A and the default is 22.5 A. In this case, the current range is from 10 A (25 * 40%) to 30 A (25 * 120%).

✓ 08-02 Motor Rated Power

Control Mode FOCPM Default: #.##

Settings 0.00–655.35 kW

- Sets the motor rated power. The default is the power of the drive.

✓ 08-03 Motor Rated Speed (rpm)

Control Mode FOCPM Default: 1710

Settings 0–65535 rpm

- Sets the motor rated speed according to the motor nameplate.

08-04 Number of Motor Poles

Control Mode FOCPM Default: 4

Settings 2–96

- Sets the number of motor poles (must be an even number).

08-05 Motor Rs

Control Mode FOCPM Default: 0.000

Settings 0.000–65.535 Ω

08-06 Motor Ld
08-07 Motor Lq

Control Mode FOCPM Default: 0.0

Settings 0.0–6553.5 mH

08-08 Back Electromotive Force

Control Mode **FOCPM** Default: 0.0

Settings 0.0–6553.5 Vrms

- Sets the back electromotive force (phase-phase RMS value) when the motor is operated at the rated speed.
- You can get the RMS value by setting Pr.08-00 = 2 (Motor Auto-tuning).

08-09 Offset Angle between Magnetic Pole and PG Origin

Control Mode **FOCPM** Default: 360.0

Settings 0.0–360.0°

- The offset angle between the magnetic pole and PG origin (measured by auto-tuning).

08-10 Magnetic Pole Re-orientation

Control Mode **FOCPM** Default: 0

Settings 0: Disable

1: Enable

- Use with Pr.11-00 bit15 = 1.
- Use this function to search for the magnetic pole position only for permanent magnet motors.
- When there is no origin-adjustment for the encoder (Pr.08-09 is 360.0), it only ensures that the motor operation efficiency can be up to 86% of the best efficiency. In this situation, if you need to improve the operation efficiency, cycle the power or set Pr.08-10 to 1 to measure the magnetic pole orientation again.

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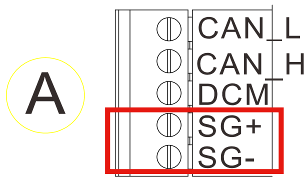
09 Communication Parameters

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. For details on Modbus communication protocol, see Appendix B. Modbus Protocol.



✔: You can set this parameter during operation

✔ 09-00 Communication Address

Default: 1

Settings 1–254

📖 Sets the communication address for the drive if the AC motor drive is controlled through RS-485 serial communication. The communication address for each AC motor drive must be unique.

✔ 09-01 Transmission Speed

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 19.2

Settings 4.8–115.2kbps

📖 Sets the transmission speed between the RS-485 master (PLC, PC, etc.) and the AC motor drive.

✔ 09-02 Transmission Fault Treatment

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 3

Settings 0: Warn and keep operation

1: Fault and ramp to stop

2: Reserved

3: No action and no display

📖 Determines the treatment if a transmission time-out error (such as disconnection) occurs during communication.

📖 When Pr.09-02 is set to 1 (Fault and ramp to stop), if brake or operation contactor is OFF under the circumstance that STO or MI40 (Enable drive function) is not deactivated during deceleration, elevator still runs even brake has engaged (brake wear), and electric arc occurs when operation contactor is OFF.

✔ 09-03 Time-out Detection

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.0

Settings 0.0–100.0 sec.

0.0: Disable

📖 Sets the communication time-out value.

✔ 09-04 Communication Protocol

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 13

Settings 0: 7, N, 1 for ASCII

1: 7, N, 2 for ASCII

2: 7, E, 1 for ASCII
3: 7, O, 1 for ASCII
4: 7, E, 2 for ASCII
5: 7, O, 2 for ASCII
6: 8, N, 1 for ASCII
7: 8, N, 2 for ASCII
8: 8, E, 1 for ASCII
9: 8, O, 1 for ASCII
10: 8, E, 2 for ASCII
11: 8, O, 2 for ASCII
12: 8, N, 1 for RTU
13: 8, N, 2 for RTU
14: 8, E, 1 for RTU
15: 8, O, 1 for RTU
16: 8, E, 2 for RTU
17: 8, O, 2 for RTU

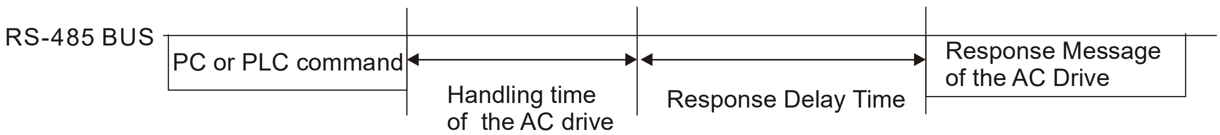
- Control by PC (Computer Link)
  When using the RS-485 serial communication interface, you must specify each drives communication address in Pr.09-00. The computer then implements control using the drive's individual addresses.
- Modbus ASCII (American Standard Code for Information Interchange): Each 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).

09-05 Response Delay Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2.0

Settings 0.0–200.0 ms

- If the host computer does not finish the transmitting/receiving process, you can use this parameter to set the response delay time after the AC motor drive receives communication command as shown in the following picture.



09-06 – 09-13 Direct Docking Mode Only

Control Mode **VFPG** **FOCPG** **FOCPM** Default: -

Settings Contact Delta for more information

09-14 PDO Transmission Interval

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–65535 ms

10 Feedback Control Parameters

In this parameter group, ASR is the abbreviation for Adjust Speed Regulator and PG is the abbreviation for Pulse Generator.

✓: You can set this parameter during operation

10-00 Selection of Encoder

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 0

Settings 0: No function
1: ABZ
2: ABZ+Hall
3: SIN/COS + Sinusoidal
4: SIN/COS + Endat
5: SIN/COS
6: SIN/COS + Hiperface

- When you set Pr.10-02 to 3, 4 or 5, you can set Pr.10-00 only to 0, 1 or 2, and you cannot use 3, 4, 5 and 6.
- When you set Pr.10-00 to 3, the encoder has one sine and one cosine signal for each revolution. The signal must be: 0.75–1.2 Vpp for the amplitude with phase angle 90°±5 elec. (E.g. ERN 1185 ERN 1387)
- When you set Pr.10-00 to 4 or 6, wait for two seconds after applying the power before executing the RUN command.
- When you set Pr.10-00 to 5, you must set Pr.08-09 to 360.
- Detection of the magnetic pole:
  (1) 1 or 5: The AC motor drive outputs a short circuit to detect the position of the magnetic pole. At this moment, the motor generates a little noise.
  (2) 2: The AC motor drive detects the position of the magnetic pole with the UVW encoder signal.
  (3) 3: The AC motor drive detects the position of the magnetic pole with the sine encoder signal.
  (4) 4 or 6: The AC motor drive detects the position of the magnetic pole with the communication encoder signal.
- The table below shows the correspondence among encoder, PG card and auto-tuning

PG Signal Type Setting	PG Signal Type	Applicable PG Card x=2, 3,…	Pr.08-00=1	Pr.08-00=3
Pr.10-00=1	A, B, Z	EMED-PGAB/ABD-x	N/A	N/A
Pr.10-00=2	A, B, Z+U, V, W	EMED-PGABD- x	Rolling test*[1]	Rolling test*[1]
Pr.10-00=3	SIN/COS + Sinusoidal (e.g. ERN1185, ERN1387)	EMED-PGHSD-x	Rolling test*[1]	Pr.11-00 Bit9=0: Rolling test*[1] Pr.11-00 Bit9=1: Static test*[1]
Pr.10-00=4	SIN/COS + Endat 2.1 (e.g. ECN1313, ECN413)	EMED-PGSD-x	Dynamic test*[1]	Static test*[1]
Pr.10-00=5	SIN/COS	EMED-PGHSD-x	N/A	N/A
Pr.10-00=6	SIN/COS + Hiperface (e.g. SRS50/60)	EMED-PGHSD-x	Dynamic test*[1]	Static test*[1]

*[1] Static: Brake engaged, no motor running. Dynamic: Brake released, motor rotates less than one revolution.
Rolling: Brake released, motor rotates more than one revolution.

10-01 Encoder PPR

Control Mode	VFPG	FOCPG	FOCPM	Default: 2048

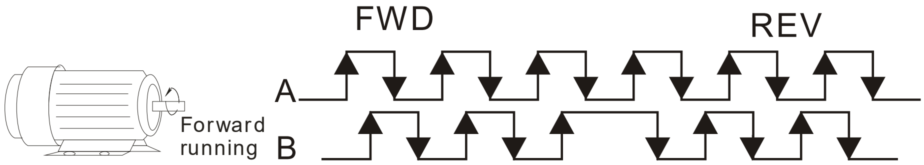
Settings 1–25000

- Sets the encoder pulses per revolution (PPR).

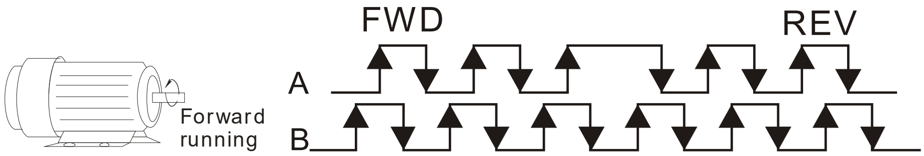
10-02 Encoder Input Type Setting

Control Mode	VFPG	FOCPG	FOCPM	Default: 0

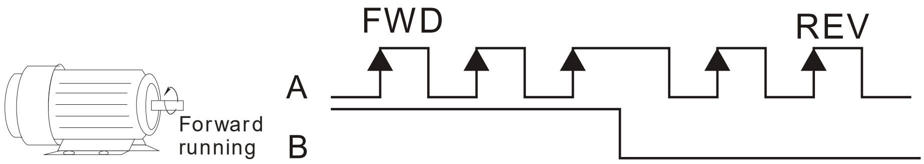
Settings
0: Disable
1: Phase A leads in a forward run command and phase B leads in a reverse run command



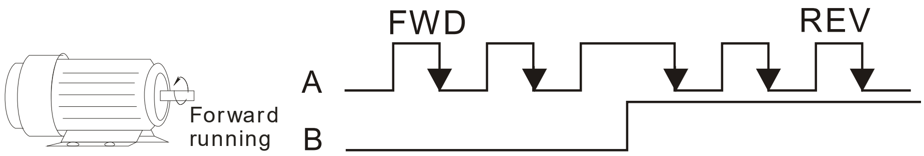
2: Phase B leads in a forward run command and phase A leads in a reverse run command



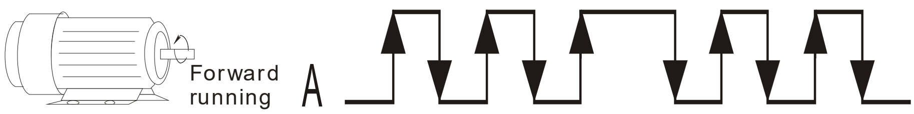
3: Phase A is a pulse input and phase B is a direction input. (low input=reverse direction, high input=forward direction)



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



- When Pr.10-00 is set to 3, 4, 5 or 6, Pr.10-02 can be only set to 0, 1 or 2, and you cannot use 3, 4 and 5.
- You must enter the correct pulse type for stable control.

10-03 Encoder Feedback Signal Fault Action (PGF1, PGF2)

Control Mode	VFPG	FOCPG	FOCPM	Default: 2

Settings
0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and stop operation

- When Pr.10-03 is set to 1 (Fault and ramp to stop), if brake or operation contactor is OFF under the circumstance that STO or MI40 (Enable drive function) is not deactivated during deceleration, elevator still runs even brake has engaged (brake wear), and electric arc occurs when operation contactor is OFF.

10-04 Encoder Feedback Signal Fault Detection Time

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 1.0

Settings 0.0–10.0 sec.

- When there is a PG loss, encoder signal error, pulse signal setting error or signal error, if time exceeds the setting for this parameter (Pr.10-04), the PG signal error occurs. Refer to Pr.10-03 for the encoder feedback signal fault action.

10-05 Encoder Stall Level (PGF3)

Control Mode **VFPG** **SVC** **FOCPG** **FOCPM** Default: 115

Settings 0–120%

0: Disable

- Determines the maximum encoder feedback signal allowed before a fault occurs. (The maximum output frequency Pr.01-00 = 100%.)

10-06 Encoder Stall Detection Time (maximum output frequency Pr.01-00 = 100%)

Control Mode **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.1

Settings 0.0–2.0 sec.

10-07 Encoder Slip Range (PGF4) (maximum output frequency Pr.01-00 = 100%)

Control Mode **VFPG** **SVC** **FOCPG** **FOCPM** Default: 50

Settings 0–50%

0: Disable

10-08 Encoder Slip Detection Time (maximum output frequency Pr.01-00=100%)

Control Mode **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.5

Settings 0.0–10.0 sec.

10-09 Encoder Stall and Slip Error Action (maximum output frequency Pr.01-00 = 100%)

Control Mode **VFPG** **SVC** **FOCPG** **FOCPM** Default: 2

Settings 0: Warn and keep operation

1: Fault and ramp to stop

2: Fault and stop operation

- When the difference of (rotation speed－motor frequency) exceeds the Pr.10-07 setting, and the detection time exceeds Pr.10-08 or the motor frequency exceeds Pr.10-05 setting, the drive starts to count time. If the detection time exceeds Pr.10-06, the encoder feedback signal error occurs. Refer to Pr.10-09 encoder stall and slip error action.
- When Pr.10-09 is set to 1 (Fault and ramp to stop), if brake or operation contactor is OFF under the circumstance that STO or MI40 (Enable drive function) is not deactivated during deceleration, elevator still runs even brake has engaged (brake wear), and electric arc occurs when operation contactor is OFF.

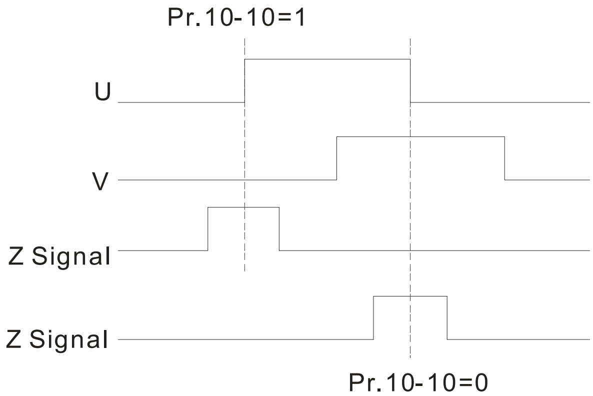
10-10 Mode Selection for UVW Input

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 0

Settings 0: Z signal is at the falling edge of U-phase

1: Z signal is at the rising edge of U-phase

- 0: The operation is U->V->W, Z signal is at the falling edge of U-phase.
- 1: The operation is U->V->W, Z signal is at the rising edge of U-phase.



10-11 ASR (Auto Speed Regulation) Control (P) of Zero Speed

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–1000.0%

10-12 ASR (Auto Speed Regulation) Control (I) of Zero Speed

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.100

Settings 0.000–10.000 sec.

10-13 ASR (Auto Speed Regulation) Control (P) 1

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–1000.0%

10-14 ASR (Auto Speed Regulation) Control (I) 1

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.100

Settings 0.000–10.000 sec.

10-15 ASR (Auto Speed Regulation) Control (P) 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–1000.0%

10-16 ASR (Auto Speed Regulation) Control (I) 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.100

Settings 0.000–10.000 sec.

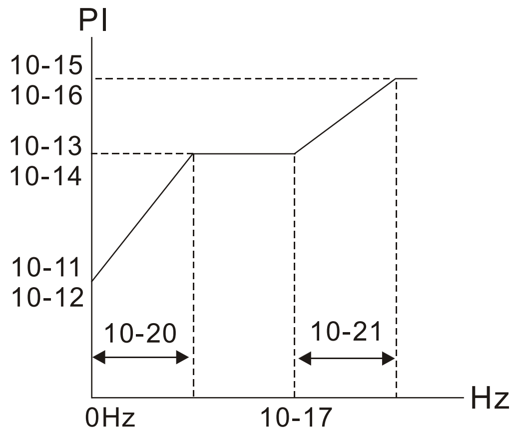
10-17 ASR 1/ASR2 Switch Frequency

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 7.00

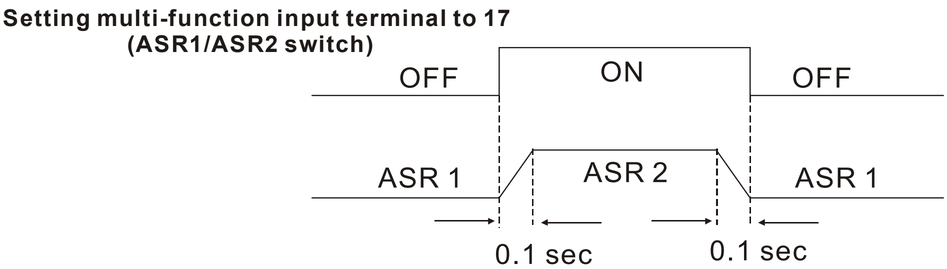
Settings 0.00–299.00 Hz

0: Disable

- ASR P determines the proportional control and associated gain (P). ASR I determines the integral control and associated gain (I).
- When you set the integral time to 0, it is disabled. Pr.10-17 defines the switch frequency for the ASR1 (Pr.10-13, Pr.10-14) and ASR2 (Pr.10-15, Pr.10-16).



When using multi-function input terminals to switch ASR1/ASR2, the following diagram shows the operation.



10 - 18 ASR Primary Low Pass Filter Gain

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.008

Settings 0.001–0.350 sec.

Defines the ASR command filter time.

When Pr.11-00 is set to 1 ASR auto-tuning, Pr.10-18 is invalid.

10 - 19 Zero Speed Position Control Gain (P)

Control Mode **FOCPM** Default: 80.00

Settings 0.00–655.00%

When Pr.11-00 is set to bit 7=1, Pr.10-19 is valid

10 - 20 Low Speed ASR Width Adjustment

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 5.00

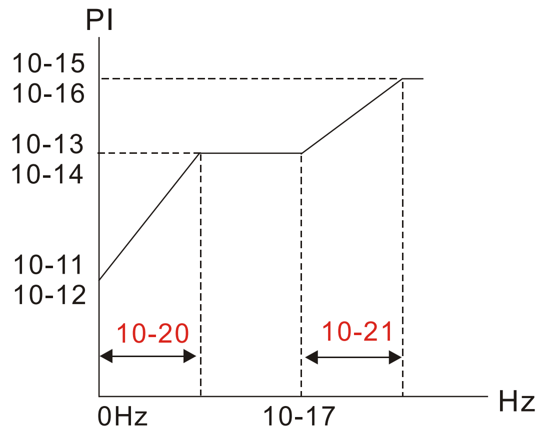
Settings 0.00–299.00 Hz

10 - 21 High Speed ASR Width Adjustment

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 5.00

Settings 0.00–299.00 Hz

These two parameters set the width of the slope of the ASR command during zero speed to low speed or Pr.10-17 to high speed.



10-22 Zero Speed Position Control Holding Time

Control Mode **FOCPM** Default: 0.250

Settings 0.001–65.535 sec.

📖 When Pr.11-00 is set to bit 7=1, Pr.10-22 is valid.

📖 Sets this parameter when elevator jerk at start-up or carriage inversion occurs. In principle, the holding time cannot exceed the time when frequency starts output.

10-23 Zero Speed Position Control Low Pass Filter Time

Control Mode **FOCPM** Default: 0.004

Settings 0.001–65.535 sec.

10-24 Zero Speed Position Control Activation Mode Selection

Control Mode **FOCPM** Default: 0

Settings 0: After the brake release set in Pr.02-29

1: After the brake signal input (Pr.02-01–02-08 is set to 42)

📖 When Pr.10-24 = 0, use the zero speed control with Pr.02-29 (refer to the explanations in Pr.02-32).

10-25 Elevator Leveling (Zero Speed Gain P)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–1000.0%

10-26 Elevator Leveling (Zero Speed Integral I)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.100

Settings 0.000–10.000 sec.

10-27 Elevator Starting (Zero Speed Gain P)

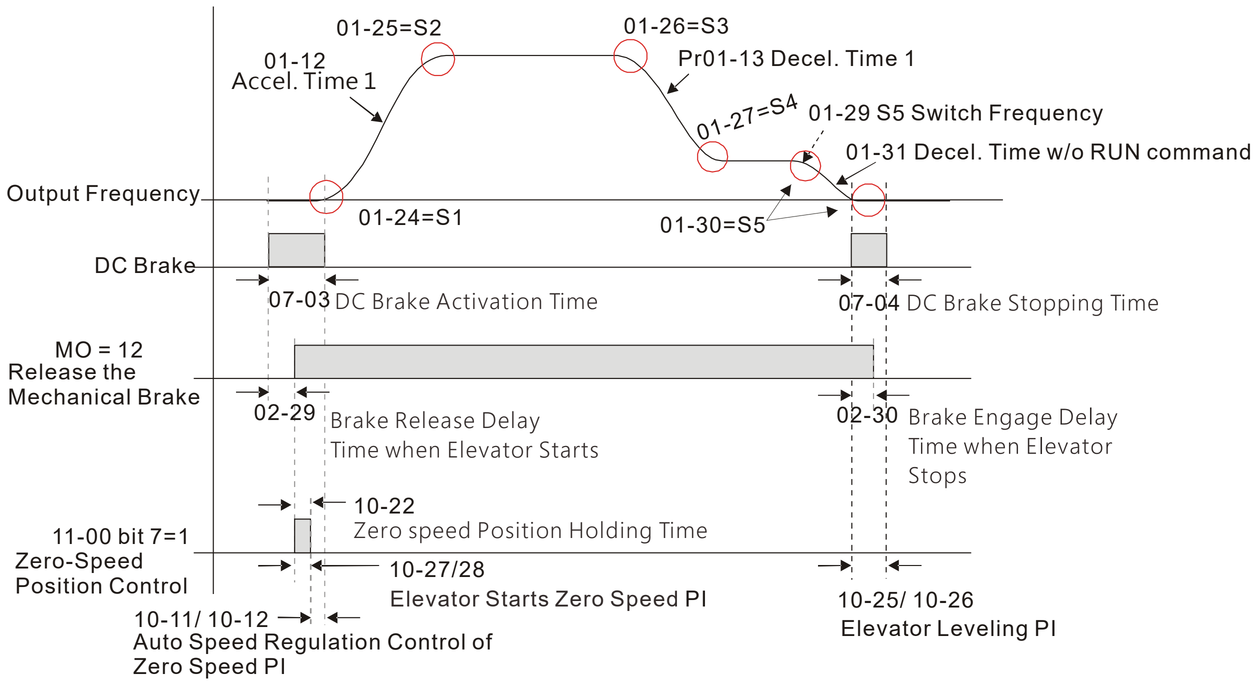
Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 100.0

Settings 0.0–1000.0%

10-28 Elevator Starting (Zero Speed Integral I)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.100

Settings 0.000–10.000 sec.



10-29 PG Card Frequency Division Output

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 0

Settings 0–31

Setting to 0 is the same as setting to 1:

0: No frequency division

1: Frequency division by 1 (remains the same as the original frequency)

10-30 PG Card Frequency Division Output Type

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 0000h

Settings 0000h–0008h

See Chapter 7 for more information about PG cards.

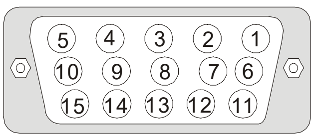
10-31 PG Card C+/C-

Control Mode **VFPG** **FOCPG** **FOCPM** Default: 0000h

Settings 0000h–0001h

When using a Heidenhain ERN1387 encoder, use Pr.10-31 to adjust the definition of the Delta PG card EMED-PGHSD-3's terminal 10 and terminal 11 (see the table below). Refer to p.7-17 for detailed terminal descriptions.

Delta PG card: EMED-PGHSD-3 (D-sub Terminal #)



	Heidenhain ERN1387	
Terminal #	**Pr.10-31=0000h**	**Pr.10-31=0001h**
10	C-	C+
11	C+	C-

After connecting Delta PG card EMED-PGHSD-4 according to the descriptions in Section 7-4, **you must set Pr.10-31=0001h**.

10-32 Over-acceleration Level

✓

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.0

Settings 0.0–20.0 m/s^2

10-33 Over-acceleration Detection Time

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0.05

Settings 0.01–5.00 sec.

10-34 Over-acceleration Detection Selection

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0: Always detect

1: Detect during operation

11 Advanced Parameters

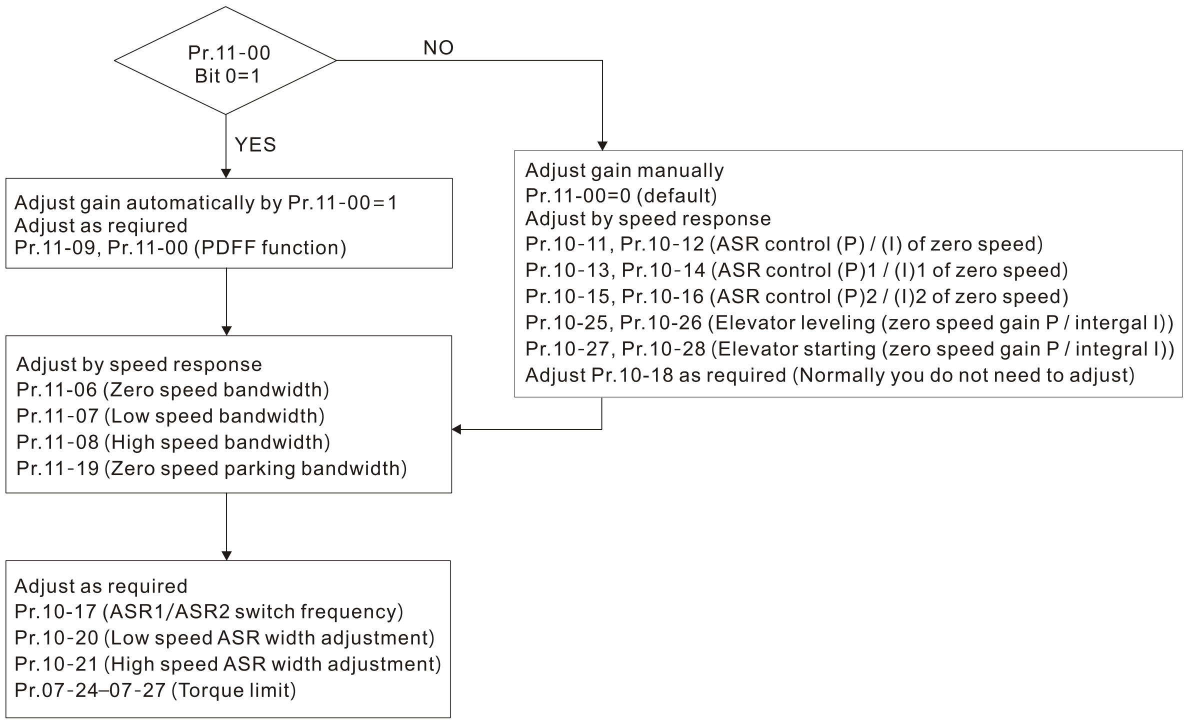
✗: You can set this parameter during operation

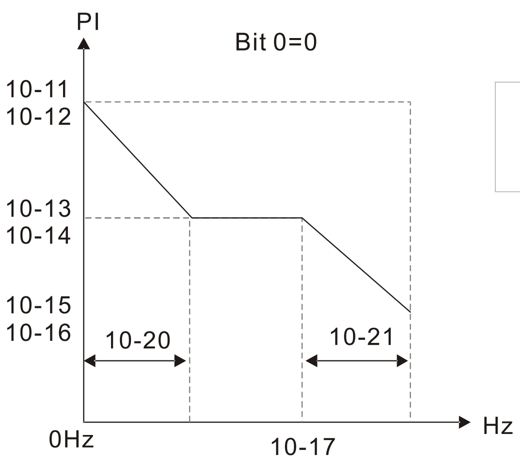
11-00 System Control

Control Mode FOCPG FOCPM Default: 0000h

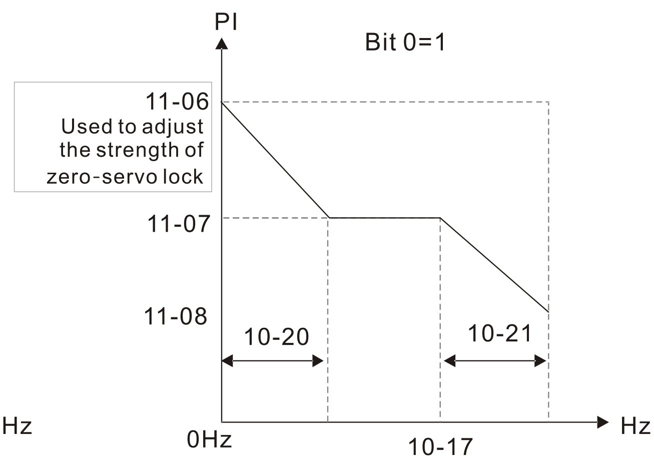
Settings
Bit 0 = 0: No function
Bit 0 = 1: ASR auto-tuning; PDFF enabled
Bit 7 = 0: No function
Bit 7 = 1: Zero speed position control is enabled
Bit 9 = 0: Dynamic PG origin auto-tuning with load (support by PGHSD-x)
Bit 9 = 1: Static PG origin auto-tuning with load by enabling PGHSD-x
Bit 15 = 0: When power is applied, detect the position of the magnetic pole again
Bit 15 = 1: When power is applied, start from the magnetic pole position of the previous power failure

- Bit 0 = 1: Enable the PDFF function and the system generates an ASR setting. At this time, Pr.10-11–Pr.10-16 are invalid and Pr.11-09–Pr.11-10 are valid.





PI adjustment-manual gain



PI adjustment-auto gain

- When Bit 7 = 1, zero speed position control is enabled (refer to Chapter 12 Parameter Group 02 Elevator Timing Diagram). Pr.10-22 is valid only when bit 7 is set to 1, and this function only supports PM motors.
- When Bit 9 = 1, valid only when Pr.10-00 is set to 3, and the mechanical brake must be in engaged status.

11-01 Elevator Speed

Control Mode **FOCPG** **FOCPM** Default: 1.00

Settings 0.10–4.00 m/s

11-02 Traction Sheave Diameter

Control Mode **FOCPG** **FOCPM** Default: 400

Settings 100–2000 mm

11-03 Gear Ratio

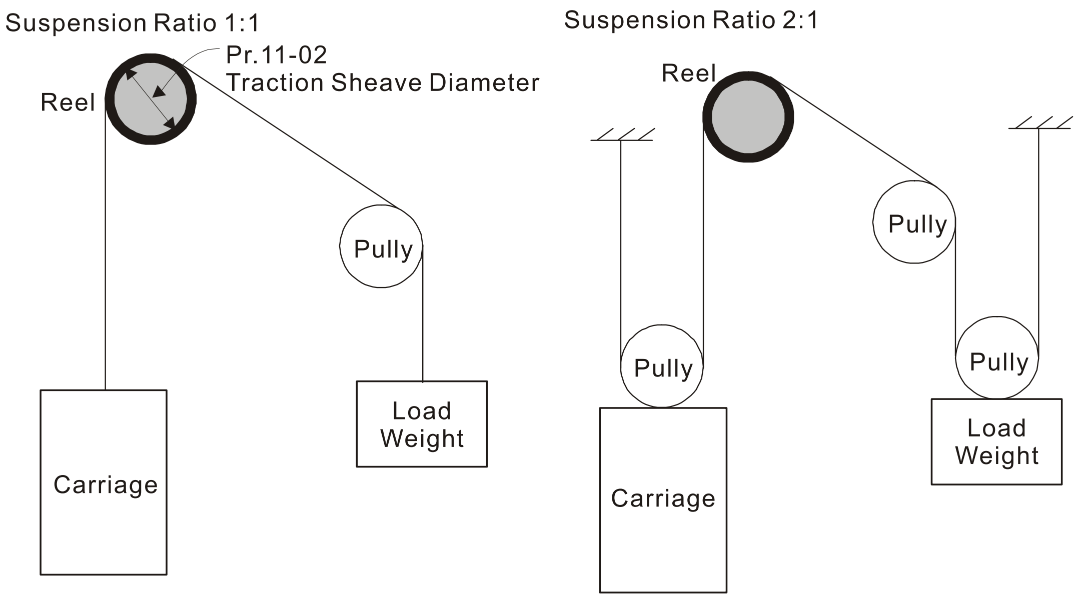
Control Mode **FOCPG** **FOCPM** Default: 1.00

Settings 1.00–100.00

11-04 Suspension Ratio

Control Mode **FOCPG** **FOCPM** Default: 1

Settings
0 = 1: 1
1 = 2: 1
2 = 4:1
3 = 8:1



11-05 Mechanical Inertial Ratio

Control Mode **FOCPG** **FOCPM** Default: 40

Settings 1–300%

- You can calculate the load inertia according to the settings of motor parameters, Pr.11-02 Traction Sheave Diameter, Pr.11-14 Motor Current at Acceleration and Pr.11-15 Carriage Acceleration. You can use this parameter to adjust the mechanical inertia ratio.
- Mechanical inertia reference value (%):

Load / Motor	IM	PM
Without load	40	10
With load	80–120	40

11-06 Zero speed Bandwidth

Control Mode FOCPG FOCPM Default: 10

Settings 1–40 Hz

11-07 Low speed Bandwidth

Control Mode FOCPG FOCPM Default: 10

Settings 1–40 Hz

11-08 High speed Bandwidth

Control Mode FOCPG FOCPM Default: 10

Settings 1–40 Hz

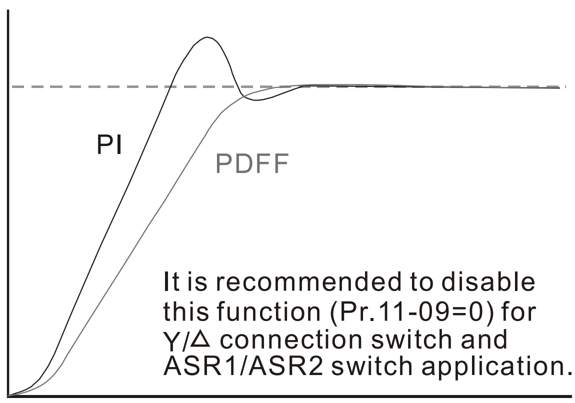
- After estimating the inertia and setting Pr.11-00 =1 (auto-tuning), you can adjust parameters Pr.11-06, Pr.11-07 and Pr.11-08 separately by speed response. The larger the value, the faster the response. Pr.10-17 is the switch frequency between the low speed and high speed bandwidth.

11-09 PDFF Gain Value

Control Mode FOCPG FOCPM Default: 30

Settings 0–200%

- After you estimate and set Pr.11-00=1 (auto-tuning), use Pr.11-09/11-10 to reduce overshoot. Adjust the PDFF gain value according to the actual situation.
- In addition to traditional PI control, it also provides the PDFF function to reduce overshoot for speed control.
  1. Get system inertia
  2. Set Pr.11-00 to 1
  3. Adjust Pr.11-09 and Pr.11-10 (a larger value suppresses overshoot better). Adjust according to the actual condition.



11-10 Speed Feed Forward Gain

Control Mode FOCPG FOCPM Default: 0

Settings 0–500

- Pr.11-09 and Pr.11-10 are enabled when Pr.11-00 is set to Bit 0 = 1.

11-11 Notch Filter Depth

Control Mode FOCPG FOCPM Default: 0

Settings 0–20 db

11-12 Notch Filter Frequency

Control Mode FOCPG FOCPM Default: 0.00

Settings 0.00–200.00 Hz

- Sets the resonance frequency of the mechanical system. Adjust it to a smaller value to suppress the mechanical system resonance.
- A larger value improves resonance suppression function.
- The notch filter frequency is the mechanical frequency resonance.

11-13 Keypad Display for Low Pass Filter Time

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.500

Settings 0.001–65.535 sec.

- Lowers the blinking frequency of the LCD display.

11-14 Motor Current at Acceleration

Control Mode FOCPM Default: 150

Settings 50–200%

11-15 Carriage Acceleration

Control Mode FOCPM Default: 0.75

Settings 0.20–2.00 m/s^2

11-16 Reserved
11-17 Reserved
11-18 Reserved

11-19 Zero Speed Parking Bandwidth

Control Mode FOCPG FOCPM Default: 10

Settings 1–40 Hz

11-20 PWM Mode (Pulse-Width Modulation Mode)

Control Mode Default: 0

Settings 0: DPWM Mode (Digital Pulse-Width Modulation Mode)

1: SVPWM mode (Space-Vector Pulse Width Modulation Mode)

11-21 Filter Time Display on KPED-LE01

Control Mode VF VFPG SVC FOCPG FOCPM Default: 0.500

Settings 0.001–65.535 sec.

- Adjusts filter time displayed on built-in keyboard panel.

12 User-defined Parameters

✎: You can set this parameter during operation

✎ **12-00** User-defined Parameter 1

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0616

Settings 0–9999

✎ **12-01** User-defined Parameter 2

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0632

Settings 0–9999

✎ **12-02** User-defined Parameter 3

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0633

Settings 0–9999

✎ **12-03** User-defined Parameter 4

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0653

Settings 0–9999

✎ **12-04** User-defined Parameter 5

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0654

Settings 0–9999

✎ **12-05** User-defined Parameter 6

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0655

Settings 0–9999

✎ **12-06** User-defined Parameter 7

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0656

Settings 0–9999

✎ **12-07** User-defined Parameter 8

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0657

Settings 0–9999

✎ **12-08** User-defined Parameter 9

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0658

Settings 0–9999

✎ **12-09** User-defined Parameter 10

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0659

Settings 0–9999

✎ **12-10** User-defined Parameter 11

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0660

Settings 0–9999

12-11 User-defined Parameter 12

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0661

Settings 0–9999

12-12 User-defined Parameter 13

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0662

Settings 0–9999

12-13 User-defined Parameter 14

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0663

Settings 0–9999

12-14 User-defined Parameter 15

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0664

Settings 0–9999

12-15 User-defined Parameter 16

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0617

Settings 0–9999

12-16 User-defined Parameter 17

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0634

Settings 0–9999

12-17 User-defined Parameter 18

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0635

Settings 0–9999

12-18 User-defined Parameter 19

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0618

Settings 0–9999

12-19 User-defined Parameter 20

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0636

Settings 0–9999

12-20 User-defined Parameter 21

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0637

Settings 0–9999

12-21 User-defined Parameter 22

Control Mode **VF VFPG SVC FOCPG FOCPM** Default: 0619

Settings 0–9999

⌁ 12-22 User-defined Parameter 23

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0638

Settings 0–9999

⌁ 12-23 User-defined Parameter 24

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0639

Settings 0–9999

⌁ 12-24 User-defined Parameter 25

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0620

Settings 0–9999

⌁ 12-25 User-defined Parameter 26

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0640

Settings 0–9999

⌁ 12-26 User-defined Parameter 27

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0641

Settings 0–9999

⌁ 12-27 User-defined Parameter 28

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0621

Settings 0–9999

⌁ 12-28 User-defined Parameter 29

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0642

Settings 0–9999

⌁ 12-29 User-defined Parameter 30

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0643

Settings 0–9999

⌁ 12-30 User-defined Parameter 31

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 0–9999

⌁ 12-31 User-defined Parameter 32

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 1561

Settings 0–9999

- Commonly used parameters can be defined in parameter group 12.
- Enter the parameters from group 00 to group 11 into group 12 (it saves up to 32 parameters).
- The saved values can also be the parameter addresses (but the hexadecimal value must be converted to a decimal value).
- Examples of user-defined parameters

Example 1:

If you need to enter Pr.08-03 into Pr.12-00, enter 0803 into Pr.12-00. Then, the keypad displays the setting for Pr.08-03 in Pr.13-00.

Example 2:

If you need to enter parameter addresses 2102H and 211BH with the digital keypad, convert 211BH to a decimal value before entering (see below for details).

The setting method for 211BH:

Convert 211BH (hexadecimal) to a decimal value:

$2\ 1\ \underline{1}\ \underline{B}$

$\underline{1}x16^{1}+\underline{11}x16^{0}=16+11=27$ input 2127

13 View User-defined Parameters

✔: You can set this parameter during operation

13-00 – 13-31 View User-defined Parameters

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Settings	Pr.00-00–Pr.11-20					

13-00 Present Fault Record

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0616 (Same as Pr.06-16)					

13-01 Motor Operation at Present Fault Time (min.)

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0632 (Same as Pr.06-32)					

13-02 Motor Operation at Present Fault Time (day)

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0633 (Same as Pr.06-33)					

13-03 Frequency Command at Present Fault

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0653 (Same as Pr.06-53)					

13-04 Output Frequency at Preset Fault

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0654 (Same as Pr.06-54)					

13-05 Output Current at Present Fault

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0655 (Same as Pr.06-55)					

13-06 Motor Frequency at Present Fault

Control Mode	VF	VFPG	SVC	FOCPG	FOCPM	Default: -
Display Address	0656 (Same as Pr.06-56)					

13-07 Output Voltage at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0657 (Same as Pr.06-57)

13-08 DC Bus Voltage at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0658 (Same as Pr.06-58)

13-09 Output Power at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0659 (Same as Pr.06-59)

13-10 Output Torque at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0660 (Same as Pr.06-60)

13-11 Power Module IGBT Temperature at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0661 (Same as Pr.06-61)

13-12 Multi-function Terminal Input Status at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0662 (Same as Pr.06-62)

13-13 Multi-function Terminal Output Status at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0663 (Same as Pr.06-63)

13-14 Drive Status at Present Fault

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0664 (Same as Pr.06-64)

13-15 Second Most Recent Fault Record

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0617 (Same as Pr.06-17)

13-16 Motor Operation at Second Most Recent Fault Time (min.)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0634 (Same as Pr.06-34)

13-17 Motor Operation at Second Most Recent Fault Time (day)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0635 (Same as Pr.06-35)

13-18 Third Most Recent Fault Record

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0618 (Same as Pr.06-18)

13-19 Motor Operation at Third Most Recent Fault Time (min.)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0636 (Same as Pr.06-36)

13-20 Motor Operation at Third Most Recent Fault Time (day)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0637 (Same as Pr.06-37)

13-21 Fourth Most Recent Fault Record

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0619 (Same as Pr.06-19)

13-22 Motor Operation at Fourth Most Recent Fault Time (min.)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0638 (Same as Pr.06-38)

13-23 Motor Operation at Fourth Most Recent Fault Time (day)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0639 (Same as Pr.06-39)

13-24 Fifth Most Recent Fault Record

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0620 (Same as Pr.06-20)

13-25 Motor Operation at Fifth Most Recent Fault Time (min.)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0640 (Same as Pr.06-40)

13-26 Motor Operation at Fifth Most Recent Fault Time (day)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0641 (Same as Pr.06-41)

13-27 Sixth Most Recent Fault Record

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0621 (Same as Pr.06-21)

13-28 Motor Operation at Sixth Most Recent Fault Time (min.)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0642 (Same as Pr.06-42)

13-29 Motor Operation at Sixth Most Recent Fault Time (day)

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0643 (Same as Pr.06-43)

13-30 AC Motor Drive Identity Code

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: -

Display Address 0 (Same as Pr.00-00)

13-31 Date Code Y.WKD

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: Read only

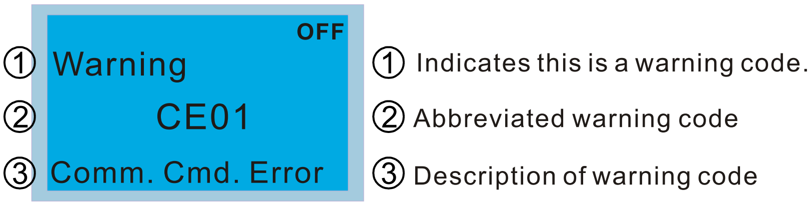
Display Address 1561 (Same as Pr.15-61)

📖 Displays the year / week / day that the program of this firmware version is completed. For example, 20.321 indicates that the program is completed on the first day of the 32th week in year 2020.

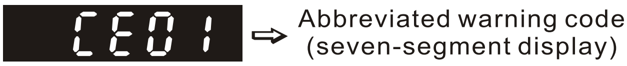
Chapter 13 Warning Codes

Warning code displays differently on digital keypad KPC-CC01 and built-in keyboard panel KPED-LE01. Examples of their different displays show as below.

- Example of warning code shows on digital keypad KPC-CC01:



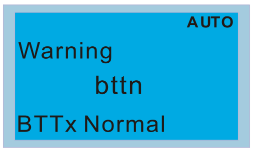
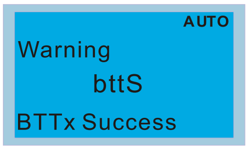
- Example of warning code shows on built-in keyboard panel KPED-LE01:



ID No.	Display on KPED-LE01	Display on KPC-CC01	Descriptions
1	CE01	CE01 HAND Warning CE01 Comm. Cmd. Err	Illegal communication command Cause Communication command error
2	CE02	CE02 HAND Warning CE02 Data Adrr. Err	Illegal data address Cause Data address error
3	CE03	CE03 HAND Warning CE03 Data Length Err	Communication data length error Cause Communication data length exceeds 1–20 characters
4	CE04	CE04 HAND Warning CE04 Wrong Writing	Attempt to write to a read-only address. Cause Communication error occurred when attempting to write values into 0x21xx, 0x22xx read-only address.
5	CE10	CE10 HAND Warning CE10 Comm. Time Out	Modbus transmission time-out Cause Communication cable error
6	CP10	CP10 HAND Warning CP10 Keypad time out	Digital keypad KPC-CC01 transmission time-out Cause Communication cable or digital keypad error
7	SE1	SE1 HAND Warning SE1 Keypad Copy Err	Keypad copy parameter error Cause Keypad copy errors, including communication delays, communication error (keypad received error FF86) and parameter value error.
8	SE2	SE2 HAND Warning SE2 Keypad Copy Fail	Keypad copy parameter failure Cause Keypad copy done but parameter writing error
9	oH1	oH1 HAND Warning oH1 IGBT Over Heat	IGBT overheat warning Cause IGBT temperature is over the default 90˚C (Pr.06-14).

ID No.	Display on KPED-LE01	Display on KPC-CC01	Descriptions
10	oH2	oH2 HAND Warning oH2 Capacitance oH	Capacitor overheat warning Cause The temperature of the capacitor is over 65˚C.
15	PGF1	PGF1 HAND Warning PGF1 PGFBK warn	PG feedback error Cause When Pr.10-03 = 0 (default = 2), a warning message displays instead of a fault message when an error occurs.
16	PGF2	PGF2 HAND Warning PGF2 PGFBK Loss	PG feedback loss warning Cause Pr.10-03 = 0 (default = 2), a warning message displays instead of a fault message when an error occurs.
17	PGF3	PGF3 HAND Warning PGF3 PGFBK Stall	PG feedback stall warning Cause Pr.10-09 = 0 (default = 2), a warning message displays instead of a fault message when an error occurs.
18	PGF4	PGF4 HAND Warning PGF4 PG Slip Err	PG slip error warning Cause Pr.10-09 = 0 (default = 2), a warning message displays instead of a fault message when an error occurs.
19	PHL	PHL HAND Warning PHL Phase Loss	Phase loss Cause When Pr.06-01 =0 (default = 2), a warning message displays instead of a fault message when a phase loss occurs.
20	ot1	ot1 HAND Warning ot1 Over Torque 1	Over-torque 1 Cause When Pr.06-05 =1 or 3 (default = 0), a warning message displays instead of a fault message when there is an over-torque detection.
21	ot2	ot2 HAND Warning ot2 Over Torque 2	Over-torque 2 Cause When Pr.06-05 =1 or 3 (default = 0), a warning message displays instead of a fault message when there is an over-torque detection.
22	oH3	oH3 HAND Warning oH3 Motor Over Heat (PTC)	Motor overheat (PTC) Cause When Pr.06-26 = 0 (default = 0), a warning message displays when there is a PTC detection.

ID No.	Display on KPED-LE01	Display on KPC-CC01	Descriptions
24	oSL	oSL HAND Warning oSL Over Slip Warn	Over-slip error Cause When Pr.05-16 = 0 (default = 0), a warning message displays when the slip deviation level is over the setting in Pr.05-14 and the slip deviation detection time is longer than the setting in Pr.05-15.
25	tUn	tUn HAND Warning tUn Auto tuning	Auto-tuning is in process
26	FAn	FAn HAND Warning Fan Fan Off	Fan error warning Cause When Pr.06-45 bit 1 = 1, a warning message displays when the cooling fan is locked (when bit1 = 1, there is an output error).
27	dCAn	dCAn HAND Warning CAN OFF CAN bus Off	CAN Bus off Cause CAN Bus disconnection or PDO communication time-out
28	StOA	STOA HAND Warning STOA STO Warning	Safe Torque Off alarm Cause Safe torque output function is off and Pr.06-49 = 0001h or 0003h.
43	LS	LS AUTO Warning LS Lv Sensor Warn	Leveling switch signal error When elevator runs downward, LU signal is still active. When elevator runs upward, LD signal is still active. Cause Leveling switch (LU/LD) action error Corrective Action Check if the action of leveling switch (LU/LD) is normal.
48	bttA	bttA AUTO Warning bttA BTTx Testing	BTTx Testing Brake torque test is running Cause When brake torque test is running, this warning code will be triggered. Corrective Action When brake torque test is finished, this warning will be automatically cleared.

ID No.	Display on KPED-LE01	Display on KPC-CC01	Descriptions
49	bttn	bttn 	BTTx Normal Brake torque test is valid Cause Maximum output torque ratio allowed during brake torque test (Pr.07-37) is too large Corrective Action Adjust Pr.07-37 Maximum Output Torque Ratio Allowed during Brake Torque Test
50	btt5	bttS 	BTTx Success Brake torque test is finished.

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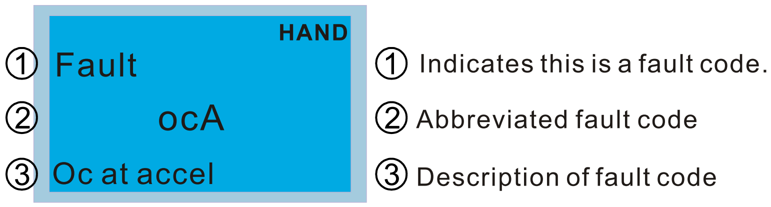
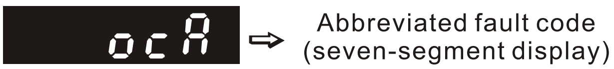
Chapter 14 Fault Codes

Fault code displays differently on digital keypad KPC-CC01 and built-in keyboard panel KPED-LE01. Examples of their different displays show as below.

- Example of fault code shows on digital keypad KPC-CC01:



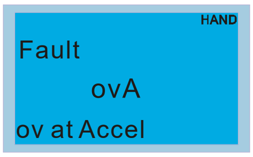
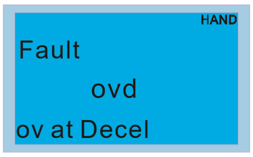
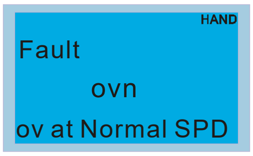
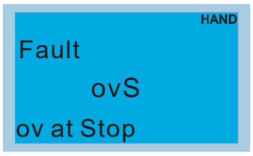
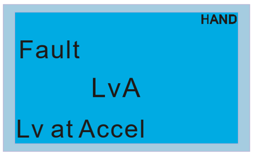
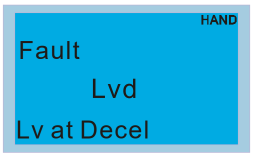
- Example of fault code shows on built-in keyboard panel KPED-LE01:



NOTE: Check Pr.06-16 to Pr.06-21 for the most recent fault records.

*: ID No. are in accordance with the settings of Pr.06-16 to Pr.06-21.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
1	ocA	HAND Fault ocA oc at Accel	Over-current during acceleration (output current exceeds three times the drive's rated current during acceleration). corrective action 1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Acceleration Time is too short: Increase the Acceleration Time. 3. AC motor drive output power is too small: Replace with a drive with larger capacity.
2	ocd	HAND Fault ocd oc at Decel	Over-current during deceleration (output current exceeds three times the drive's rated current during deceleration). corrective action 1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Deceleration Time is too short: Increase the Deceleration Time. 3. AC motor drive output power is too small: Replace with a drive with larger capacity.
3	ocn	HAND Fault ocn oc at Normal SPD	Over-current during steady operation (output current exceeds three times the drive's rated current during constant speed). corrective action 1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Sudden increase in motor load: Check for possible motor stall. 3. AC motor drive output power is too small: Replace with a drive with larger capacity.
4	GFF	HAND Fault GFF Ground Fault	Ground fault When one or more of the output terminals is (are) grounded, and the short circuit current is more than 60% of the AC motor drive rated current, the AC motor drive power module may be damaged. **NOTE:** The short circuit protection is to protect the AC motor drive, not to protect you. corrective action 1. Check the wiring connections between the AC motor drive and motor for possible short circuits, also check connection to ground. 2. Check whether the IGBT power module is damaged. 3. Check for possible poor insulation at the output.
5	occ	HAND Fault occ Short Circuit	Short circuit is detected between the IGBT module upper bridge and lower bridge. corrective action Contact the dealer or manufacturer to return the motor drive to the factory for repair.
6	ocS	HAND Fault ocS oc at Stop	Over-current at stop Hardware failure in over-current detection corrective action Contact the dealer or manufacturer to return the motor drive to the factory for repair.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
7	ouA		DC bus over-voltage during acceleration 230V: 405 V_{DC}; 460V: 810 V_{DC} corrective action 1. Check if the input voltage falls in the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC bus over-voltage is due to regenerative voltage, increase the Acceleration Time or add an optional brake resistor.
8	oud		DC bus over-voltage during deceleration 230V: 405 V_{DC}; 460V: 810 V_{DC} corrective action 1. Check if the input voltage falls in the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC bus over-voltage due to regenerative voltage, increase the Deceleration Time or add an optional brake resistor.
9	oun		DC bus over-voltage at constant speed 230V: 405 V_{DC}; 460V: 810 V_{DC} corrective action 1. Check if the input voltage falls in the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC bus over-voltage due to regenerative voltage, increase the Deceleration Time or add an optional brake resistor.
10	ouS		Over-voltage at stop Hardware failure in voltage detection. corrective action 1. Check if the input voltage falls in the rated AC motor drive input voltage range. 2. Check for possible voltage transients.
11	LuA		DC bus voltage during acceleration is less than the setting in Pr.06-00. corrective action 1. Check if the input voltage is normal. 2. Check for possible sudden load change.
12	Lud		DC bus voltage during deceleration is less than the setting in Pr.06-00. corrective action 1. Check if the input voltage is normal. 2. Check for possible sudden load change.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
13	Lun	HAND Fault Lvn Lv at Normal SPD	DC bus voltage at constant speed is less than the setting in Pr.06-00 corrective action 1. Check if the input voltage is normal. 2. Check for possible sudden load change.
14	LuS	HAND Fault LvS Lv at Stop	Low voltage at stop corrective action 1. Check if the input voltage is normal. 2. Check for possible sudden load change.
15	PHL	HAND Fault PHL Phase Loss	Phase Loss corrective action Check power source input to make sure all three input phases are connected correctly.
16	oH1	HAND Fault oH1 IGBT Over Heat	IGBT overheating IGBT temperature exceeds protection level 3–5 HP, 50–60 HP: 105ºC 7.5–30 HP: 95ºC 40–100 HP: 110ºC corrective action 1. Ensure that the ambient temperature falls in the specified temperature range. 2. Make sure heat sink is not obstructed. Check if the fan is operating 3. Check if there is enough ventilation clearance for the AC motor drive.
17	oH2	HAND Fault oH2 Capacitance oH	Capacitor overheating Capacitor's temperature exceeds the protection level. 3–100 HP: 65ºC corrective action 1. Ensure that the ambient temperature falls in the specified temperature range. 2. Make sure heat sink is not obstructed. Check if the fan is operating 3. Check if there is enough ventilation clearance for the AC motor drive.
18	tH1o	HAND Fault tH1o Thermo 1 Open	IGBT overheating protection fault corrective action Contact the dealer or manufacturer to return the motor drive to the factory for repair.

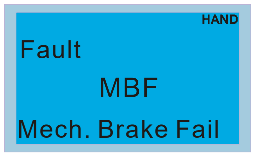
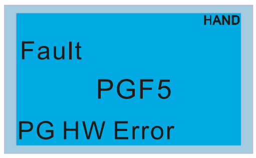
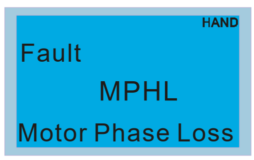
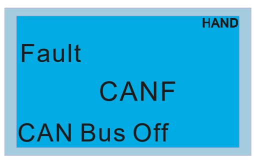
ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
19	tH2o	HAND Fault tH2o Thermo 2 Open	Capacitor module overheating fault corrective action Contact the dealer or manufacturer to return the motor drive to the factory for repair.
20	FAn	HAND Fault FAn Fan Locked	Cooling fan does not run properly. corrective action Check if the cooling fan is covered by dust and needs to be cleaned. Contact the dealer or manufacturer to return the motor drive to the factory for repair if necessary.
21	oL	HAND Fault oL Over Load	The output current causes the motor drive to be overload. If the output current is 150% higher than the drive's rated current, the motor drive can sustain the output for a maximum of 60 seconds. corrective action 1. Check if the motor is overloaded. 2. Increase the output capacity of the motor drive.
22	EoL1	HAND Fault EoL1 Thermal Relay 1	The output current causes the motor to be overload. If the output current is 150% higher than the drive's rated current, the motor can sustain the output for a maximum of 60 seconds. corrective action 1. Check the setting for motor full-load current (Pr.05-01). 2. Check if motor is overloaded and change to a higher power motor.
24	oH3	HAND Fault oH3 Motor Over Heat	Motor overheating The AC motor drive internal temperature exceeds the setting in Pr.06-27 (PTC level). corrective action 1. Make sure that the motor is not obstructed. 2. Ensure that the ambient temperature falls in the specified temperature range. 3. Change to a higher power motor.
26	ot1	HAND Fault ot1 Over Torque 1	The ot1 and ot2 fault codes appear when the following conditions occur: - The output current exceeds the setting in Pr.06-06 (Over-torque Detection Level (OT1)> and Pr.06-09 (Over-torque Protection Level (OT2).

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
27	ot2	Fault ot2 Over Torque 2	- The output current lasts longer than the time setting in Pr.06-07 and Pr.06-10. - You set Pr.06-05 or Pr.06-08 to 2 or 4. corrective action 1. Check if the motor is overloaded. 2. Check if the setting in Pr.05-01 IM (Motor Full-load Current) and Pr.08-01 PM (Motor Full-load Current) are appropriate. 3. If necessary, increase the motor output capacity.
30	cF1	Fault cF1 EEPROM Write Err	Cannot program internal EEPROM. corrective action 1. Press RESET key to reset to the default. 2. Contact the dealer or manufacturer to return the motor drive to the factory for repair.
31	cF2	Fault cF2 EEPROM Read Err	Cannot read internal EEPROM. corrective action 1. Press RESET key to reset to the default. 2. Contact the dealer or manufacturer to return the motor drive to the factory for repair.
32	cd0	Fault cd0 Isum Sensor Err	Hardware failure in current detection corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
33	cd1	Fault cd1 Ias Sensor Err	U-phase current detection error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
34	cd2	Fault cd2 Ibs Sensor Err	V-phase current detection error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
35	cd3	HAND Fault cd3 Ics Sensor Err	W-phase current detection error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
36	Hd0	HAND Fault Hd0 cc HW Error	CC (current clamp) hardware error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
37	Hd1	HAND Fault Hd1 oc HW Error	OC hardware error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
38	Hd2	HAND Fault Hd2 ov HW Error	OV hardware error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
39	Hd3	HAND Fault Hd3 GFF HW Error	GFF hardware error corrective action Reboot the motor drive. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
40	AUE	HAND Fault AUE Auto Tuning Err	Auto-tuning error corrective action 1. Check the cabling between drive and motor. 2. Check if the motor capacity and the parameter settings are appropriate and try again.
42	PGF1	HAND Fault PGF1 PG Fbk Error	PG feedback error (command direction is different from the feedback direction) corrective action When PG feedback control is enabled, check if Pr.10-01 (Encoder PPR) is set to 0.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
43	PGF2	HAND Fault PGF2 PG Fbk Loss	PG feedback loss corrective action Check the PG feedback wiring.
44	PGF3	HAND Fault PGF3 PG Fbk Over SPD	PG feedback stall corrective action 1. Check the PG feedback wiring. 2. Check if the settings for PI gain and acceleration/deceleration are appropriate (Pr.10-05, Pr.10-06). 3. Contact the dealer or manufacturer to return the motor drive to the factory for repair.
45	PGF4	HAND Fault PGF4 PG Fbk Deviate	PG slip error corrective action 1. Check the PG feedback wiring. 2. Check if the settings for PI gain and acceleration/deceleration are appropriate (Pr.10-07, Pr.10-08). 3. Contact the dealer or manufacturer to return the motor drive to the factory for repair.
49	EF	HAND Fault EF External Fault	External Fault When you set the Multi-Function Input command (MI1–MI8) to #10 EF input (Pr.07-28) and when multi-function input terminals are triggered to close, the motor drive stops running. corrective action Press RESET after you clear the fault.
50	EF1	HAND Fault EF1 Emergency Stop	Emergency Stop When you set the Multi-Function Input command (MI1–MI8) to #28 Emergency stop (EF1) (Motor coasts to stop), the motor drive stops running. corrective action Press RESET after you clear the fault.
52	Pcod	HAND Fault Pcod Password Error	Password error After entering the wrong password three consecutive times, the keypad is locked. corrective action Refer to Pr.00-07 and Pr.00-08 settings for more information. Cycle the power for the motor drive to clear the lock and enter the correct password.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
54	cE01	HAND Fault cE01 Comm Cmd Err	Illegal function code corrective action Check if the function code is correct (function code must be 03, 06, 10, 63).
55	cE02	HAND Fault cE02 Data Addr Err	Illegal data address (00H to 254H) The data address for 0X2XX is between 0X2000–0X2005. Any address out of this range is a fault. corrective action Check if the communication data address is correct.
56	cE03	HAND Fault cE03 Data length Err	Illegal data length The data length must be between 1 to 20 digits. Any length out of this range is a fault. corrective action Check if the data length is smaller than the minimum value or larger than the maximum value.
57	cE04	HAND Fault cE04 Wrong Writing	Attempt to write value to read-only communication address Communication addresses such as 0X21XX, 0X22XX are read-only. Any command sent to these addresses causes a fault. corrective action Check if the communication address is correct.
58	cE10	HAND Fault cE10 Comm Time Out	Modbus communication time-out (Pr.09-02–Pr.09-03) corrective action Check if the communication wiring is correct.
59	cP10	HAND Fault cP10 Keypad Time Out	Keypad KPC-CC01 transmission time-out corrective action 1. Check if the communication wiring is correct 2. Check if there is anything wrong with the keypad
60	bF	HAND Fault BF Braking Fault	Brake transistor fault corrective action If the fault code continues to display on the keypad after you press RESET key, contact the dealer or manufacturer to return the motor drive to the factory for repair.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
64			Mechanical brake failure The feedback signal and the release signal are not consistent. corrective action 1. Check if the mechanical brake signal is correct. 2. Check if the mechanical brake detection time setting (Pr.02-35) is correct.
65			PG card hardware error corrective action 1. Check if the PG feedback wiring is correct. 2. If fault code continues to display on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
66			Magnetic contactor error The feedback signal and the release signal are not consistent. corrective action 1. Check if the magnetic contactor signal is correct. 2. Check if the magnetic contactor detection time setting (Pr.02-36) is correct.
67			Motor output phase loss. corrective action 1. Unbalanced three-phase impedance of the motor. Replace the motor. 2. Check if the motor wiring is incorrect. 3. Check if a single-phase motor is used. 4. Check if the current sensor is broken. 5. Check if temporary power supply is used or any grounding fault. 6. Make sure the capacity of the drive matches the motor. 7. Any abnormal motor current spikes or drops may trigger MPHL.
68			CAN Bus off corrective action 1. Check that the CAN Bus is wired correctly. 2. Verify that there is no PDO communication time-out.
69	Reserved		
70	Reserved		
71	Reserved		

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
72	StL1	Fault STL1 STO Loss 1	STO1–SCM1 internal hardware error. corrective action 1. Check the STO1/SCM1 wiring. 2. Reset the emergency switch (ON) and reboot the motor drive. 3. Check the voltage at least > 11 V. 4. Check the wiring between STO1 and E24V, and the wiring between SCM1 and DCM. 5. After checking all the wiring, reboot the motor drive. If STL1 still appears, contact the local dealer or manufacturer.
73	PGcd	Fault PGcd PG cd Wrong Wire	PG card wiring error corrective action Incorrect wiring for pin C+, C-, D+, D-. Verify if the wiring matches the descriptions in Section 7-3 (EMED-PGHSD-3) and Section 7-4 (EMED-PGHSD-4).
74	PGHL	Fault PGHL PG Hall loss Err	PG absolute signal error corrective action 1. Check if the encoder absolute positions (C+/C- and D+/D-) and PG card are properly wired. 2. If the cables are properly wired but the fault code still displays on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
75	PGAF	Fault PGAF Z Sig. loss Err	PG Z-phase signal loss corrective action 1. Check if the encoder's Z-phase signal and PG card are properly wired. 2. If the cables are properly wired but the fault code still displays on the keypad, contact the dealer or manufacturer to return the motor drive to the factory for repair.
76	StO	Fault STO Safe Torque Off	Safe Torque Off function is enabled. corrective action 1. Check the wiring for STO1/SCM1 and STO2/SCM2. 2. Reset the emergency switch (ON) and reboot the motor drive. 3. Check the voltage at least > 11 V. 4. Check the wiring between STO1/STO2 and E24V, and the wiring between SCM1/SCM2 and DCM. 5. After checking all the wiring, reboot the motor drive. If STO still appears, contact the local dealer or manufacturer.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
77	StL2	HAND Fault STL2 STO Loss 2	STO2–SCM2 internal hardware error. corrective action 1. Check the STO2/SCM2 wiring. 2. Reset the emergency switch (ON) and reboot the motor drive. 3. Check the voltage at least > 11 V. 4. Check the wiring between STO2 and E24V, and the wiring between SCM2 and DCM. 5. After checking all the wiring, reboot the motor drive. If STL2 still appears, contact the local dealer or manufacturer.
78	StL3	HAND Fault STL3 STO Loss 3	Internal hardware error. corrective action After checking all the wiring, reboot the motor drive. If STL3 still appears, contact the local dealer or manufacturer.
82	OPHL	HAND Fault OPHL U Phase Loss	U-phase output phase loss corrective action 1. Unbalanced three-phase impedance of the motor. Replace the motor. 2. Check if the motor wiring is incorrect. 3. Check if a single-phase motor is used. 4. Check if the current sensor is broken. 5. Check if temporary power supply is used or any grounding fault. 6. Make sure the capacity of the drive matches the motor.
83	OPHL	HAND Fault OPHL V Phase Loss	V-phase output phase loss corrective action 1. Unbalanced three-phase impedance of the motor. Replace the motor. 2. Check if the motor wiring is incorrect. 3. Check if a single-phase motor is used. 4. Check if the current sensor is broken. 5. Check if temporary power supply is used or any grounding fault. 6. Make sure the capacity of the drive matches the motor.

ID No.*	Display on KPED-LE01	Display on KPC-CC01	Descriptions
84	OPHL	HAND Fault OPHL W Phase Loss	W-phase output phase loss corrective action 1. Unbalanced three-phase impedance of the motor. Replace the motor. 2. Check if the motor wiring is incorrect. 3. Check if a single-phase motor is used. 4. Check if the current sensor is broken. 5. Check if temporary power supply is used or any grounding fault. 6. Make sure the capacity of the drive matches the motor.
86	LSS	HAND Fault LSS Lv Sensor Short	Leveling switch short-circuited When elevator runs downward, LD signal will be inactive. When elevator runs upward, LU signal will be inactive. When elevator is running, there will be signal active for LU and LD whenever passing through each floor. If not so, this fault code will be triggered. corrective action Check if the action of leveling switch (LU/LD) is normal.
87	LSo	HAND Fault LSo Lv Sensor Open	Leveling switch open-circuited When elevator executes leveling, either LU or LD is open-circuited or both are open-circuited, this fault code will be triggered. corrective action Check if the action of leveling switch (LU/LD) is normal.
94	btt	HAND Fault btt BTTx Fail	BTTx Fail Brake torque test failed corrective action 1. Minimum output torque ratio allowed during brake torque test (Pr.07-36) is too large. Adjust Pr.07-36 Minimum Output Torque Ratio Allowed during Brake Torque Test 2. Mechanical brake clamping force is insufficient. Adjust or replace the mechanical brake.
95	bttE	HAND Fault bttE BTTx Error	BTTx Error Brake torque test action error corrective action Poor wiring connection. Check MI terminal wiring (FWD, REV, and MI=57).

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Chapter 15 Maintenance and Troubleshooting

The AC motor drive has various warnings and protections against errors such as over-voltage, low voltage, or over-current. Once an error occurs, the protections activate, the AC motor drive stops output, activates the error contacts, and the motor coasts to stop. Please refer to the warning/fault display from the AC motor drive and look up the corresponding causes / corrective actions in Chapter 13 Warning Codes and Chapter 14 Fault Codes. The fault record is stored in the AC motor drive internal memory and can store the six most recent error messages. You can read it from the digital keypad or through the communications by accessing the parameters.

The AC motor drive includes a large number of electronic components, including ICs, resistors, capacitors, transistors, cooling fans and relays. These components do not last forever. Even under normal circumstances, they will eventually become error-prone if used past their lifespans. Therefore, you must perform periodic preventive maintenance to identify defective and worn out parts, and eliminate the causes of malfunctions in the AC motor drive at an early stage. At the same time, parts that have exceeded their product life should be replaced whenever possible to ensure safe operation.

Visual checks should be done regularly to monitor the AC motor drives operation, and to make sure nothing unusual happens. Check the situations listed in the following table.

CAUTION	☑ Wait five seconds after a fault has been cleared before pressing RESET with the input terminal keypad. ☑ The drive must first be switched off for at least five minutes for ≤ 22 kW models, and 10 minutes for ≥ 30kW models until the charging indicator turns off, and the voltage between terminals ⊕ – ⊖ must be lower than 25 V_{DC} before it is safe to open the cover to begin maintenance operations. ☑ Only qualified personnel can work on maintenance or replace parts. (Remove metal items such as watch, rings, and other metal items before operation, and use only insulated tools.) ☑ Never modify internal components or wiring. ☑ The performance and the surrounding environment should meet the standard specifications. There should be no abnormal noise, vibration, or odor.

15-1 Maintenance and Inspections

For regular maintenance, first stop operation, then turn off the power, and then take off the outer cover. Even after turning off the power supply, charging voltages remaining in the filter capacitor require some time to discharge. To avoid danger, operation must not start until the charging indicator goes off, and you confirm the voltage with a voltmeter to be below the safety value (≤ 25 V_{DC}).

Ambient environment

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, and vibration and check for any dust, gas, oil or water drops.	Visual inspection and measurement with equipment with standard specification	○		
Check for any dangerous objects	Visual inspection	○		

Voltage

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check that the voltage of main circuit and control circuit are correct.	Measure with multimeter with standard specifications.	○		

Digital keypad display

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check that the display is clear for reading	Visual inspection	○		
Check for any missing characters	Visual inspection	○		

Mechanical parts

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any abnormal sound or vibration	Visual and audible inspection		○	
Check for any loose bolts	Securely tighten		○	
Check for any deformed or damaged parts	Visual inspection		○	
Check for any color change caused by overheating	Visual inspection		○	
Check for any dust or dirt	Visual inspection		○	

Main circuit

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any loose or missing bolts	Securely tighten	○		
Check for machine or insulator deformation, crack, damage or color change due to overheating or ageing	Visual inspection		○	
Check for any dust or dirt	Visual inspection		○	

Main circuit terminals and wiring

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check the terminal and copper plate for color change or deformation due to overheating	Visual inspection		○	
Check for damage to the wiring insulation or color change	Visual inspection		○	

Main circuit terminal block

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any damage	Visual inspection	○		

Main circuit filter capacitor

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any liquid leaks, color change, crack or buckling of the exterior cover	Visual inspection	○		
Check if the safety valve is not removed or if the valve is obviously expanded	Visual inspection	○		
Measure static capacity when required	-	○		

Main circuit resistor

Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any odors or insulation cracks due to overheating	Visual and audible inspection	○		
Check for any disconnections	Visual inspection	○		
Check for damaged connections	Measure with multimeter with standard specifications	○		

Main circuit transformer and reactor				
Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any abnormal vibration or odors	Visual and audible inspection	○		

Main circuit magnetic contactor and relay				
Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any sound of vibration while running	Audible inspection	○		
Check that the contact works correctly	Visual inspection	○		

Main circuit PCB and connector				
Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any loose screws and connectors	Tighten the screws and press the connectors firmly in place.		○	
Check for any odors and color change	Visual and smell inspection		○	
Check for any crack, damage, deformation or corrosion	Visual inspection		○	
Check for any liquid leaks or deformation in capacity	Visual inspection		○	

Cooling system cooling fan				
Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any abnormal sound or vibration	Visual, audible inspection, and turn the fan by hand (turn off the power before operation) to see if it rotates smoothly.		○	
Check for any loose bolts	Securely tighten		○	
Check for any color change due to overheating	Visual inspection		○	

Cooling system ventilation channel				
Items to Check	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check for any obstruction in the heat sink, air intake or air outlet	Visual inspection		○	

NOTE: Use a chemically neutral cloth to clean and use a dust cleaner to remove dust when necessary.

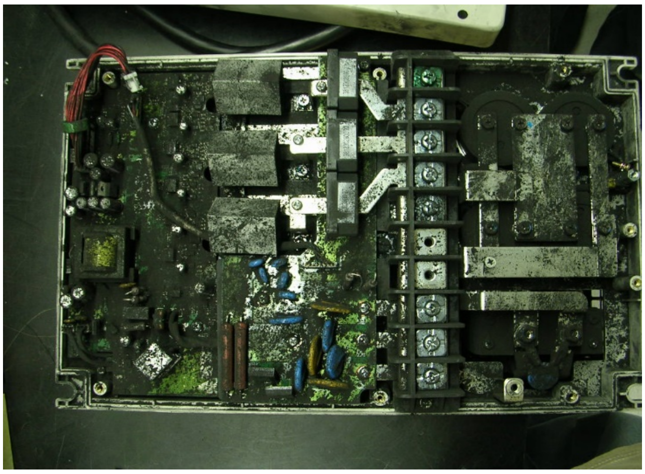
15-2 Greasy Dirt Problems

Serious greasy dirt problems generally occur in processing industries such as machine tools, punching machines and so on. Please be aware of the possible damages that greasy oil may cause to your drive.

1. Electronic components that silt up with greasy oil may cause the drive to burn out or even explode.
2. Most greasy dirt contains corrosive substances that may damage the drive.

Solution:

Install the AC motor drive in a standard cabinet to keep it away from greasy dirt. Clean and remove greasy dirt regularly to prevent damage to the drive.



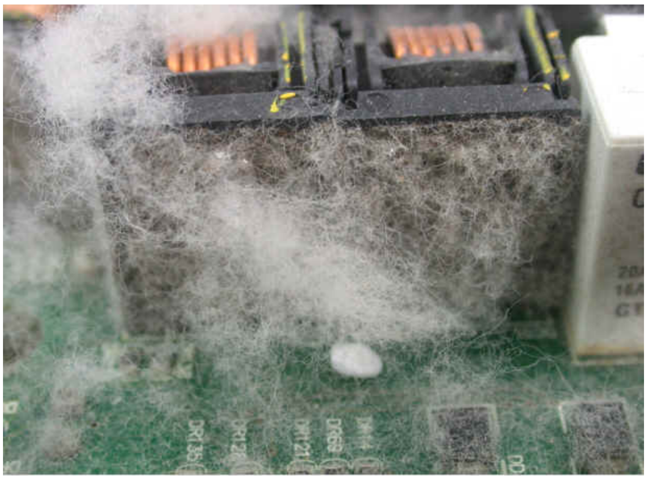
15-3 Fiber Dust Problems

Serious fiber dust problems generally occur in the textile industry. Please be aware of the possible damages that fiber may cause to your drives.

1. Fiber that accumulates or adheres to the fans leads to poor ventilation and causes overheating problems.
2. Plant environments in the textile industry have higher degrees of humidity that may cause the drive to burn out, become damaged or explode due to wet fiber dust adhering to the devices.

Solution:

Install the AC motor drive in a standard cabinet to keep it away from fiber dust. Clean and remove fiber dust regularly to prevent damage to the drive.



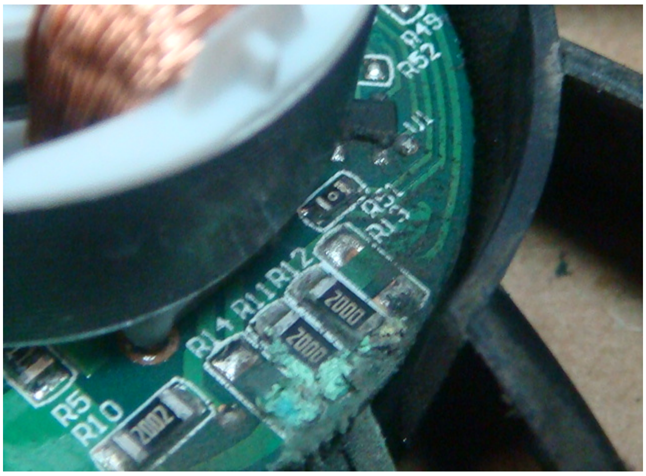
15-4 Corrosion Problems

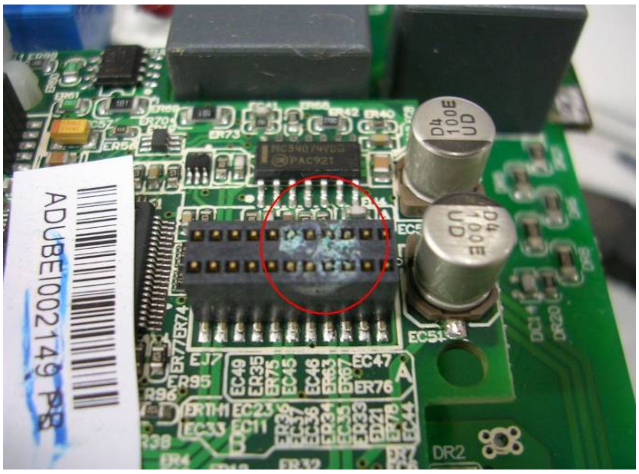
Corrosion problems may occur if any fluids flow into the drives. Please be aware of the possible damages that corrosion may cause to your drive.

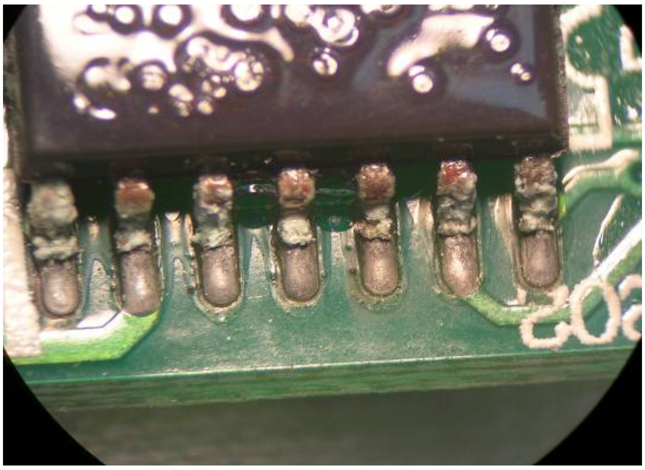
1. Corrosion of internal components may cause the drive to malfunction and possibility to explode.

Solution:

Install the AC motor drive in a standard cabinet to keep it away from fluids. Clean the drive regularly to prevent corrosion.







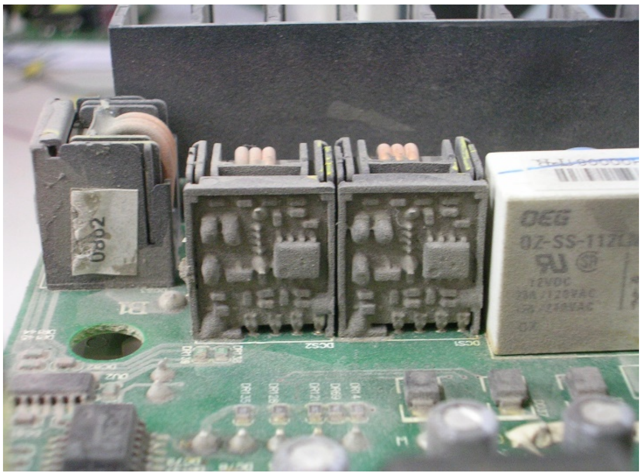
15-5 Industrial Dust Problems

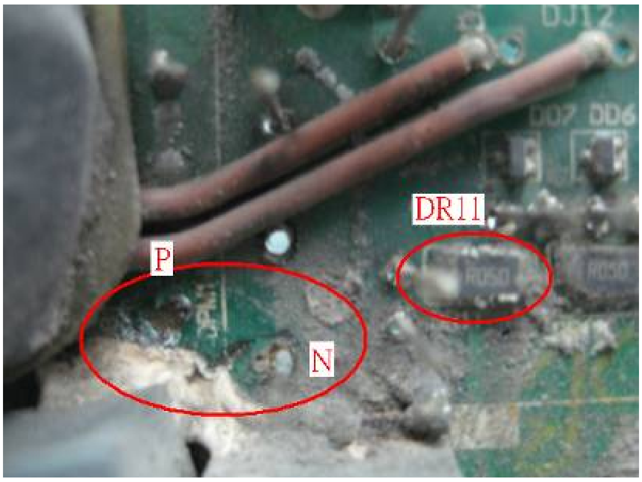
Serious industrial dust pollution frequently occurs in environments such as stone processing plants, flour mills, cement plants, and so on. Please be aware of the possible damages that industrial dust may cause to your drives.

1. Dust accumulating on electronic components may cause overheating problem and shorten the service life of the drive.
2. Conductive dust may damage the circuit board and may even cause the drive to explode.

Solution:

Install the AC motor drive in a standard cabinet and cover the drive with a dust cover. Clean the cabinet and ventilation holes regularly for good ventilation.





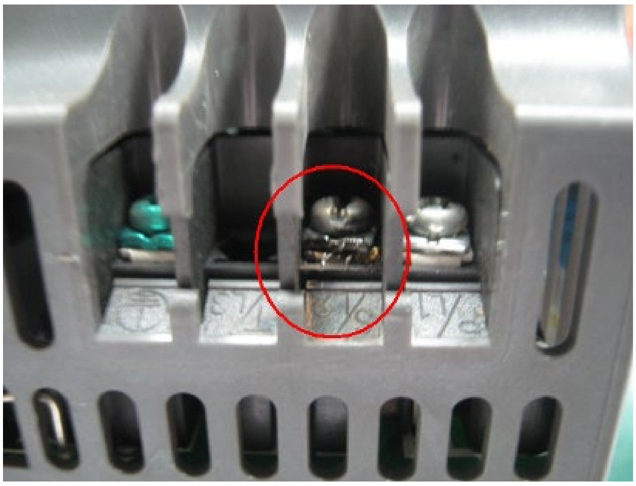
15-6 Installation and Wiring Problems

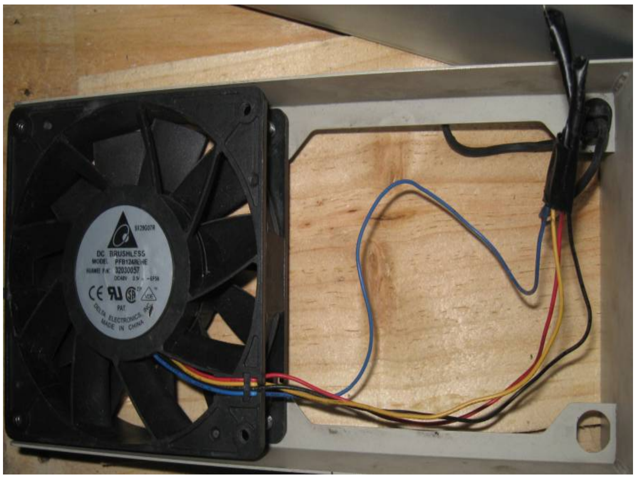
When wiring the drive, the most common problem is incorrect wire installation or poor wiring. Please be aware of the possible damages that poor wiring may cause to your drives.

1. If screws are not fully tightened, then sparking may occur as impedance increases.
2. If you have opened the drive and modified the internal circuit board, the internal components may have been damaged.

Solution:

Ensure that all screws are tightened when installing the AC motor drive. If the AC motor drive functions abnormally, send it back to Delta for repair. DO NOT try to modify or repair the internal components or wiring.





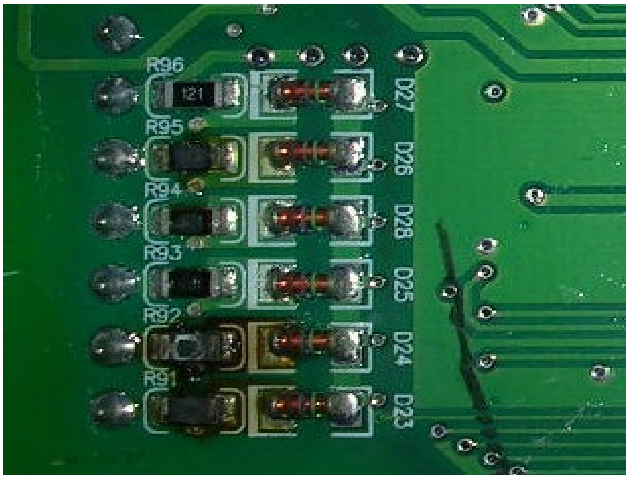
15-7 Multi-function Input / Output Terminal Application Problems

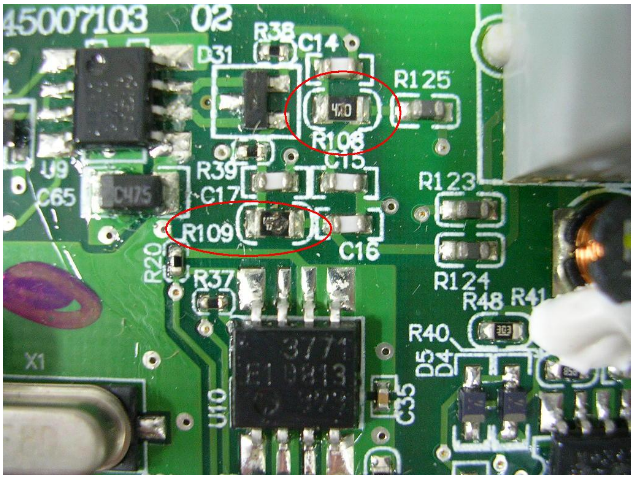
Multi-function input / output terminal errors are generally caused by over-usage of the terminals and not following the specifications. Please be aware of the possible damages that multi-function input / output terminal errors may cause to your drives.

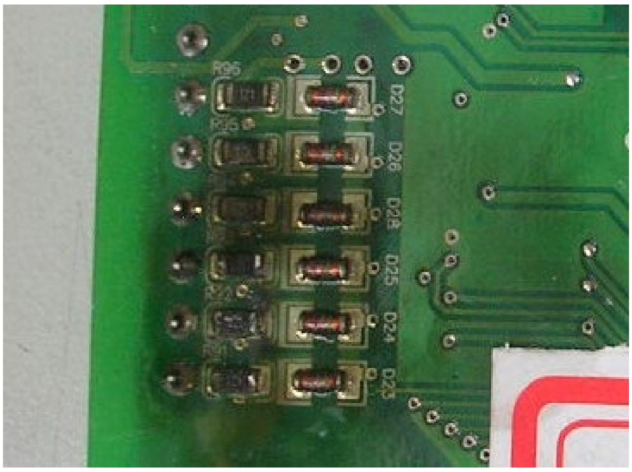
1. Input / output circuit may burn out when the terminal usage exceeds the specified limit.

Solution:

Refer to the user manual for multi-function input / output terminals usage and follow the specified voltage and current. DO NOT exceed the specification limits.







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Chapter 16 Safe Torque Off Function

16-1 Failure Rate of the Drive's Safety Function

Item	Definition	Standard	Performance
SFF	Safe Failure Fraction	IEC61508	Channel 1: 80.08% Channel 2: 68.91%
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	9.56×10^{-10}
PFD_{av}	Probability of Dangerous Failure on Demand	IEC61508	4.18×10^{-6}
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 16-1

16-2 Description of STO's Functions

The STO (Safe Torque Off) function is to cut off the motor's power supply to prevent the motor from producing torque force. The STO function is run by two independent hardware circuits to control the drive signals emitted by the motor's current, and then to cut off motor drive's power module output in order to safely stop the motor drive.

The following table describes the terminal functions.

Signal	Channel	Status of Photo Coupler			
STO Signal	STO1–SCM1	ON (High)	ON (High)	OFF (Low)	OFF (Low)
	STO2–SCM2	ON (High)	OFF (Low)	ON (High)	OFF (Low)
Drive Output Status		Ready	STL2 mode (Torque output off)	STL1 mode (Torque output off)	STO mode (Torque output Off)

Table 16-2

- 🕮 STO is Safe Torque Off
- 🕮 STL1–STL3 means an STO internal hardware error.
- 🕮 STL3 means STO1–SCM1 and STO2–SCM2 has an internal circuit error.
- 🕮 STO1–SCM1 ON (High): means STO1–SCM1 has connection to a +24 V_{DC} power supply.
- 🕮 STO2–SCM2 ON (High): means STO2–SCM2 has connection to a +24 V_{DC} power supply.
- 🕮 STO1–SCM1 OFF (Low): means STO1–SCM1 has no connection to a +24 V_{DC} power supply.
- 🕮 STO2–SCM2 OFF (Low): means STO2–SCM2 has no connection to a +24 V_{DC} power supply.

16-3 Wiring Diagram

16-3-1 Internal Safety Circuit

Drive's internal safety circuit shows as Figure 16-1 below.

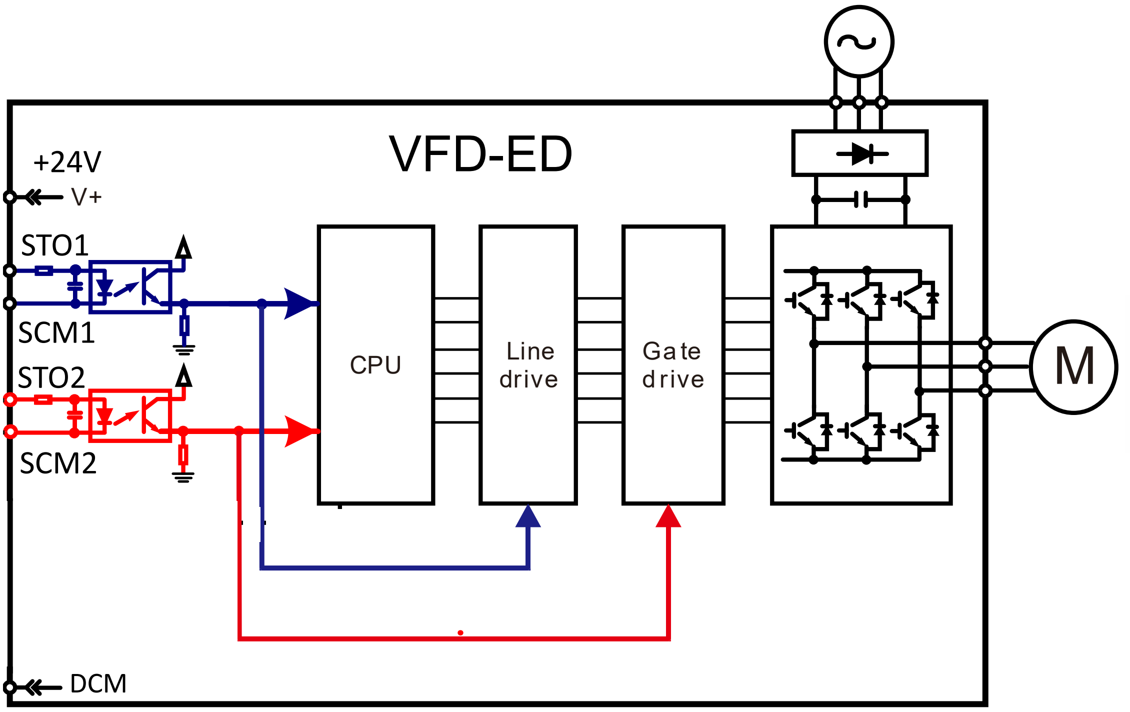

Figure 16-1

16-3-2 Internal Safety Circuit Terminals

The part D in Figure 16-2 below shows the default for terminals +24V-STO1-STO2 and terminals SCM1-SCM2-DCM in the drive's internal safety circuit, which are short-circuited when they are delivered from the factory.

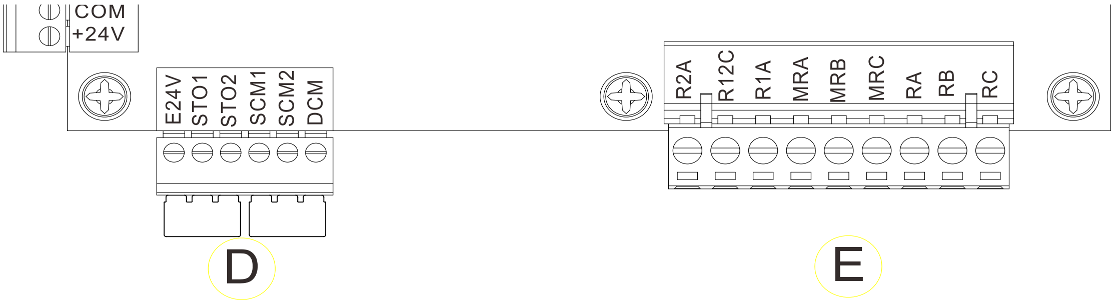

Figure 16-2

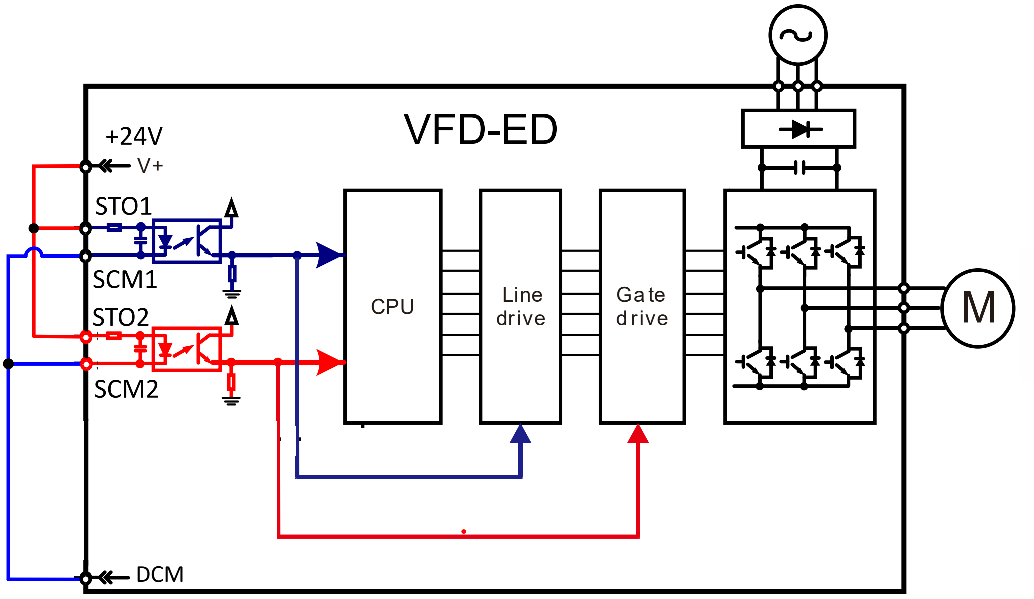

Figure 16-3

16-3-3 Drive's Control Circuit Wiring Diagram

1. Remove the E24V-STO1-STO2 short circuit.
2. Figure 16-4 below shows the wiring. The contract for safety interlock circuit must be closed during the normal situation so that the motor drive can run.
3. In STO mode, if you switch on the safety interlock circuit, the motor drive stops outputting and the keypad displays STO.
4. If the restart permission signal is OFF before the elevator controller issues the command to start the elevator, it means that the STO function is currently malfunctioned or M1 magnetic contactor error has occurred, and then the elevator is unable to start (R1 cannot be ON).

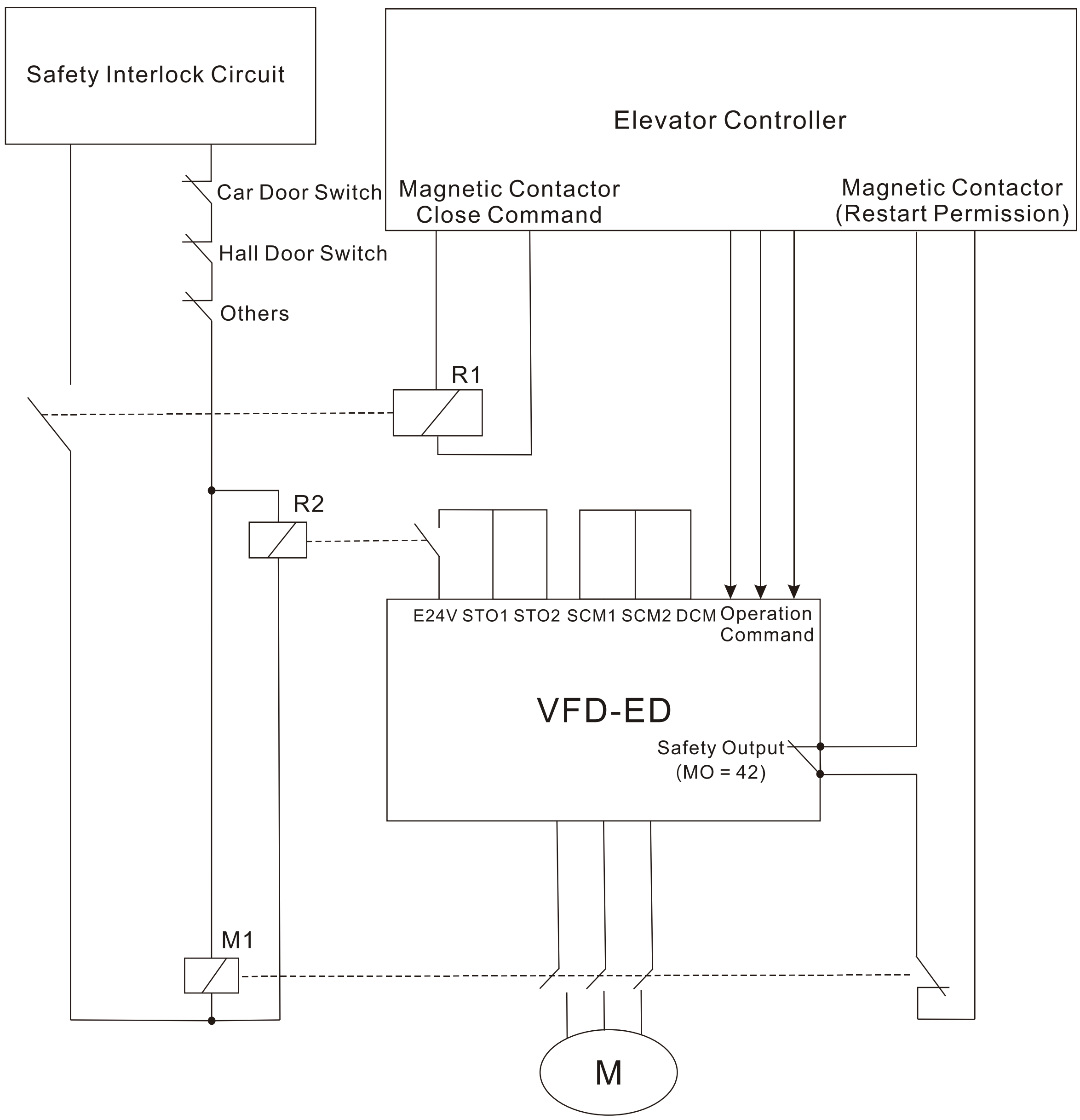

Figure 16-4

NOTE: R" in R1/R2 stands for Relay; "M" in M1 stands for MC (Magnetic Contactor)

16-4 Related Parameters

06-49 STO Latch Selection

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0000h

Settings
0000h: STO fault latched, resending RUN command is required
0001h: STO warning latched, resending RUN command is required
0002h: STO fault latched
0003h: STO warning unlatched

02-11 Multi-function Output 1: RA, RB, RC (Relay 1)

Default: 0

02-12 Multi-function Output 2: MRA, MRB, MRC (Relay 2)

Default: 0

02-13 Multi-function Output 3: R1A, R12C (Relay 3)
02-14 Multi-function Output 4: R2A, R12C (Relay 4)
02-15 Multi-function Output 5: MO
02-16 Multi-function Output 6: MO2
02-17 Multi-function Output 7: MO3
02-18 Multi-function Output 8: MO4
02-19 Multi-function Output 9: MO5
02-20 Multi-function Output 10: MO6

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings
0: No function
1: Operation indication
11: Malfunction indication
42: STO Output Error

02-23 Multi-function Output Terminal Direction

Default: 0

This parameter uses bit setting. If the bit is 1, the multi-function output terminal acts in the opposite direction.

Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
-	-	MO6	MO5	MO4	MO3	MO2	MO1	**R2A**	**R1A**	**MRA**	**RA**

📖 STO output default: Pr.02-15 (MO1 = 42 Logic Output A). You can also set Pr.02-23 (Multi-output direction) to choose Logic Output B.

Drive Status	Output Safety Status	
	Logic Output A (Pr.02-15=42)	Logic Output B (Pr.02-15=42) (Pr.02-23=16)
Normal	Broken circuit (Open)	Short circuit (Closed)
STO	Short circuit (Closed)	Broken circuit (Open)
STL1–STL3	Short circuit (Closed)	Broken circuit (Open)

Table 16-3

16-5 Timing Diagram Description

16-5-1 Normal Operation Status

As shown in Figure 16-5, when the STO1–SCM1 and STO2–SCM2 are ON (safety function is not required), the motor drive executes “Operating” or “Output Stop” according to the RUN/STOP command.

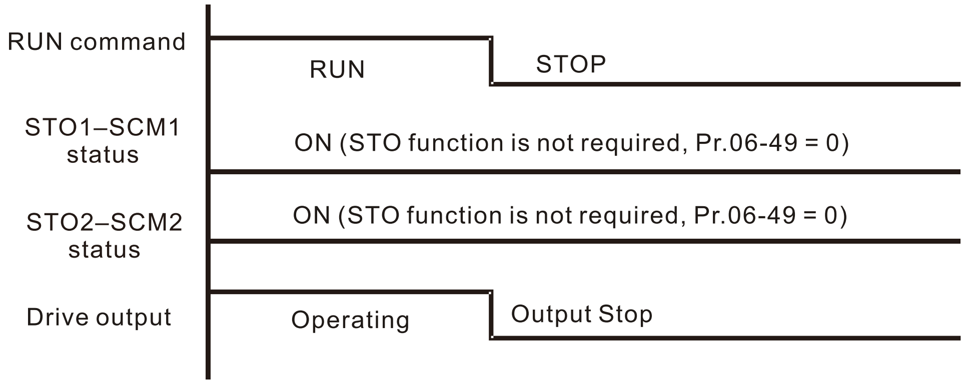

Figure 16-5

16-5-2 Pr.06-49 = 0000h, STO fault latched, resending RUN command is required

If STO is ON in any condition and a fault occurs, it does not reset until STO is back to normal and use a RESET command or power-on again after resending the RUN command.

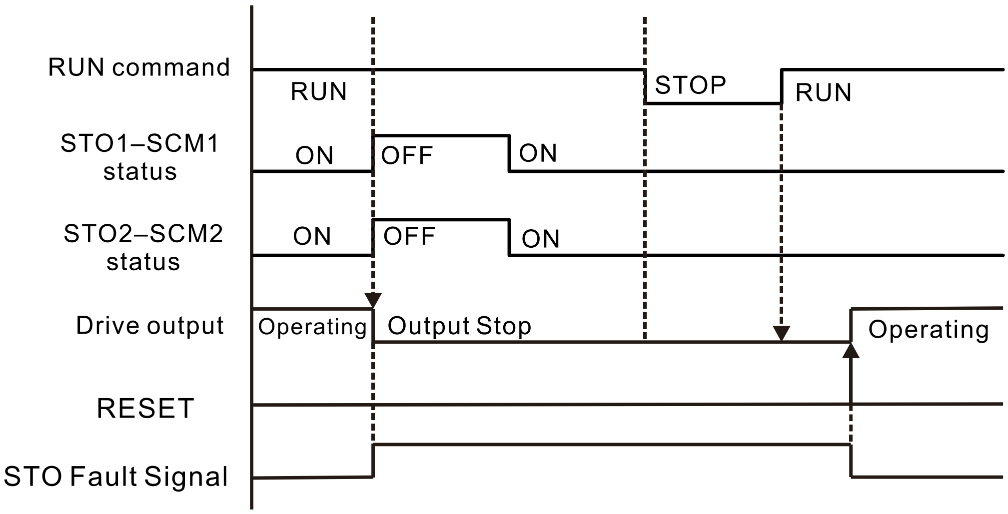

Figure 16-6

16-5-3 Pr.06-49 = 0001h, STO warning latched, resending RUN command is required

If STO is ON in any condition and a warning occurs, it does not reset until STO is back to normal and resend the RUN command.

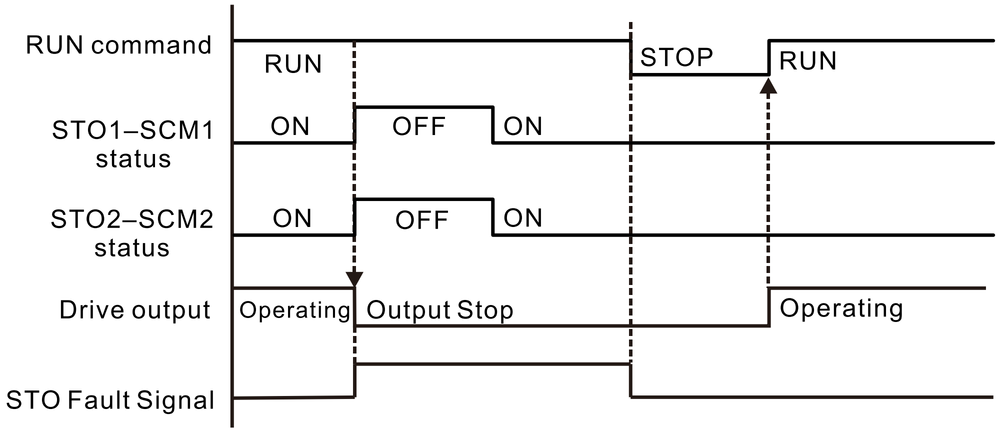

Figure 16-7

16-5-4 Pr.06-49 = 0002h, STO fault latched

If STO is ON in any condition and a fault occurs, it does not reset until STO is back to normal and use a RESET command or power-on again.

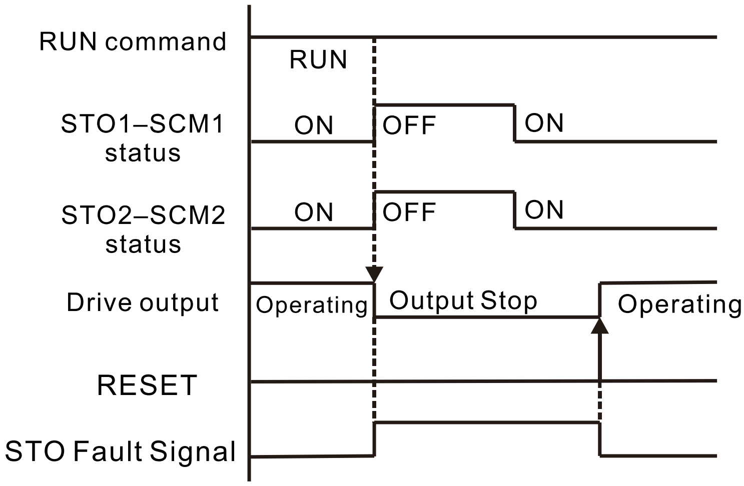

Figure 16-8

16-5-5 Pr.06-49 = 0003h, STO warning unlatched

If STO is ON in any condition and a warning occurs, it automatically resets when STO is back to normal.

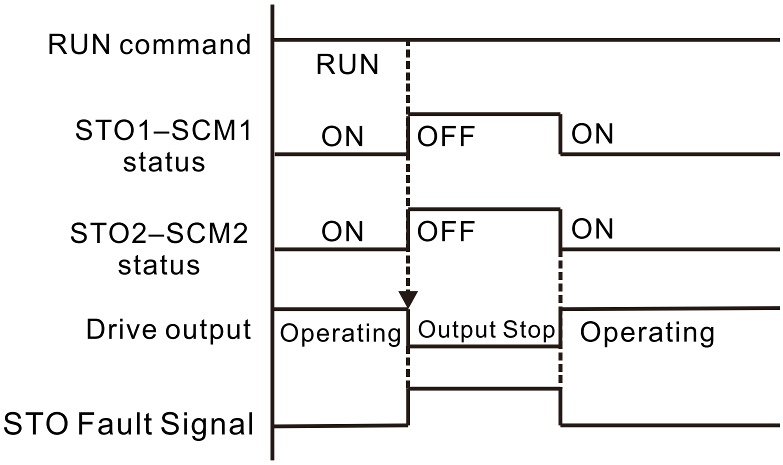

Figure 16-9

16-5-6 STL1

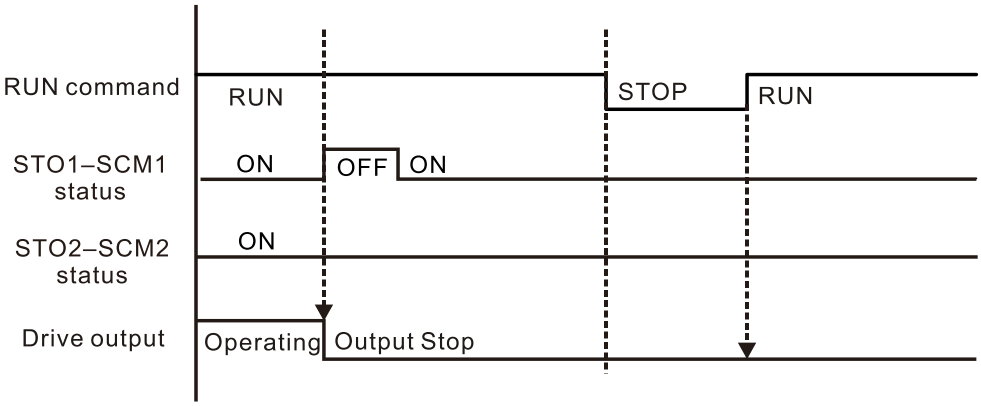

Figure 16-10

16-5-7 STL2

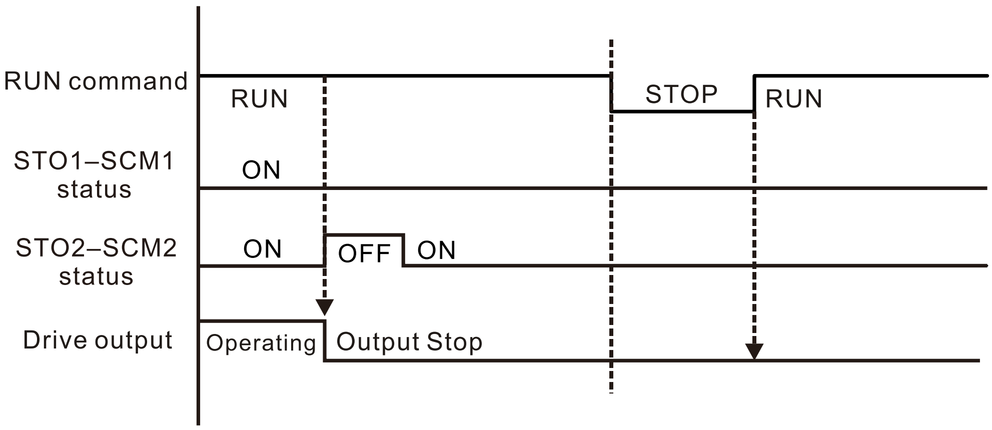

Figure 16-11

16-6 Fault Codes Related to STO

06-16	Present Fault Record
06-17	Second Most Recent Fault Record
06-18	Third Most Recent Fault Record
06-19	Fourth Recent Fault Record
06-20	Fifth Most Recent Fault Record
06-21	Sixth Most Recent Fault Record

Control Mode **VF** **VFPG** **SVC** **FOCPG** **FOCPM** Default: 0

Settings 72: Safe torque loss (STL1)

76: Safe torque output stops (STO)

77: Safe torque loss 2 (STL2)

78: Safe torque loss 3 (STL3)

Fault Code	Reading	Description
72 (STL1)	Safe torque loss (STL1)	STO1–SCM1 internal circuit error.
76 (STO)	Safe torque output stops (STO)	Safe Torque Off function is enabled while Pr.06-49 is set to 0000h or 0002h.
77 (STL2)	Safe torque loss 2 (STL2)	STO2–SCM2 internal circuit error.
78 (STL3)	Safe torque loss 3 (STL3)	STO1–SCM1 and STO2–SCM2 internal circuit error.

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Appendix A. AC Motor Drives EMC Standard Installation Guide

EMC Compliance Practice

Preface

When an AC motor drive is installed in a noisy environment, radiated and/or conducted noise via signal and power cables can interfere with the correct functioning, cause errors or even damage to the drive. To prevent this, some AC motor drives have an enhanced noise resistance but the results are limited and it is not economical. Therefore, an effective method would be finding the cause of the noise and use the right solution to achieve “no emission, no transmission and no reception of noise”. All three solutions should be applied.

Finding the Noise

- Ensure whether the error is caused by noise.
- Find the source of the noise and its transmission path.
- Confirm the signal and the source of noise

Solutions

- Ensure whether the error is caused by noise.
- Find the source of the noise and its transmission path.
- Confirm the signal and the source of noise

A-1 Introduction

A-1-1 What is EMC

Electromagnetic Compatibility (EMC) is the ability of an electrical device to function properly in electromagnetic environments. It does not emit electromagnetic noise to surrounding equipment and is immune to interference from surrounding equipment. The goal is to achieve high immunity and low emission; these two properties define the quality of EMC. In general, electrical devices react to high and low frequency phenomena. High frequency phenomena are electrostatic discharge (ESD); pulse interference; radiated electromagnetic field; and conducted high frequency electrical surge. Low frequency phenomena refer to mains power harmonics and imbalance.

The standard emission and immunity levels for compliance depend on the installation location of the drive. A Power Drive System (PDS) is installed in an industrial or domestic environment. A PDS in a domestic environment must have lower emission levels and is allowed to have lower immunity levels. A PDS in an industrial environment is allowed to have higher emission levels but must have more severe immunity levels.

A-1-2 EMC for AC Motor Drive

When an AC motor drive is put into operation, harmonic signal will occur at the AC drive's power input and output side. It creates a certain level of electromagnetic interference to the surrounding electrical devices and the mains power network. An AC motor dive is usually applied in industrial environments with a strong electromagnetic interference. Under such conditions, an AC drive could disturb or be disturbed.

Installing the AC motor drive accurately will decrease EMC influences and ensure long-term stability of the electricity system. It is strongly suggested to follow Delta's user manual for wiring and grounding. If any difficulties or problems arise, follow the instructions and measures as indicated in this EMC Standard Installation Guide.

A-2 How to Prevent EMC

A-2-1 Types of EMC: Common-mode and Differential Mode Noise

The electromagnetic noise of an AC motor drive can be distinguished into common-mode and differential-mode noise. Differential-mode noise is caused by the stray capacitance between the conducting wires and common-mode noise is caused by the common-mode coupling current path created by the stray capacitance between the conducting wires and ground.

Basically, differential-mode noise has a greater impact to the AC motor drive and common-mode noise has a greater impact to high-sensitivity electronic devices. An excessive amount of differential-mode noise may trigger the circuit protection system of the AC motor drive. Common-mode noise affects peripheral electronic devices via the common ground connection.

EMC problems can be more serious when the following conditions apply:

- When a large horsepower AC motor drive is connected to a large horsepower motor.
- The AC motor drive's operation voltage increases.
- Fast switching of the IGBTs.
- When a long cable is used to connect the motor to the AC motor drive.

A-2-2 How does EMC Transmit (Noise Transmission)

Noise disturbs peripheral high-sensitivity electrical devices/systems via conduction and radiation, their transmission paths are shown hereafter:

1. Noise current in the unshielded power cable is conducted to ground via stray capacitances into a common-mode voltage. Whether or not other modules are capable to resist this common-mode noise depends on their Common-Mode Rejection Ratio (CMRR), as shown in Figure A-1.

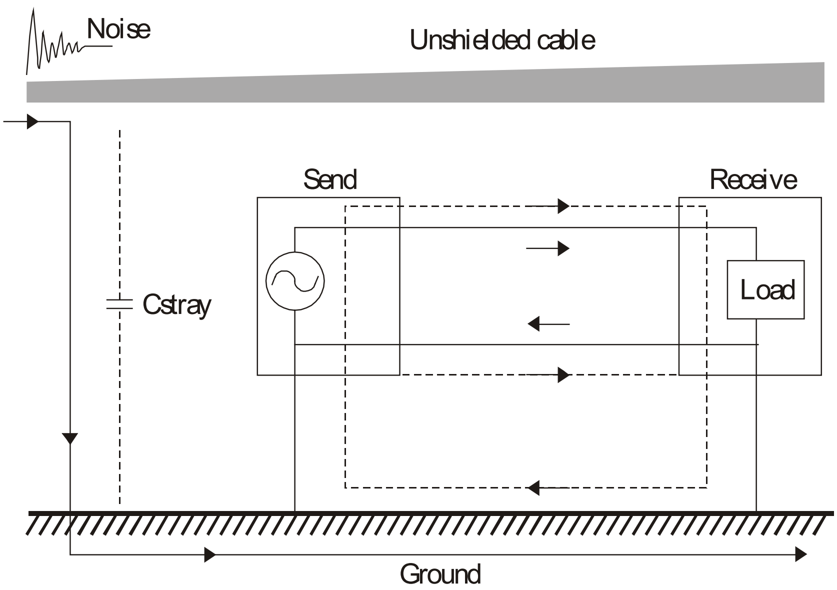

Figure A-1

2. Common-mode noise in the power cable is transmitted through the stray capacitance and coupled into the adjacent signal cable, as shown in Figure A-2. Several methods can be applied to reduce the effect of this common-mode noise; for example, shield the power cable and/or the signal cables, separate the power and signal cables, take the input and output side of the signal cable and twist them together to balance out the stray capacitance, let power cables and signal cables cross at 90°, etc.

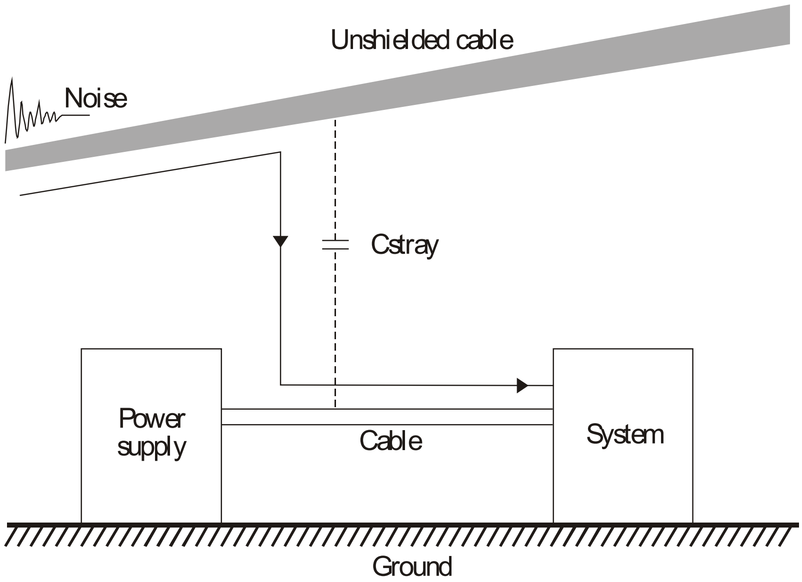

Figure A-2

3. Common-mode noise is coupled via the power cable to other power systems then the cable of such a power system is coupled to the transmission system, as shown in Figure A-3.

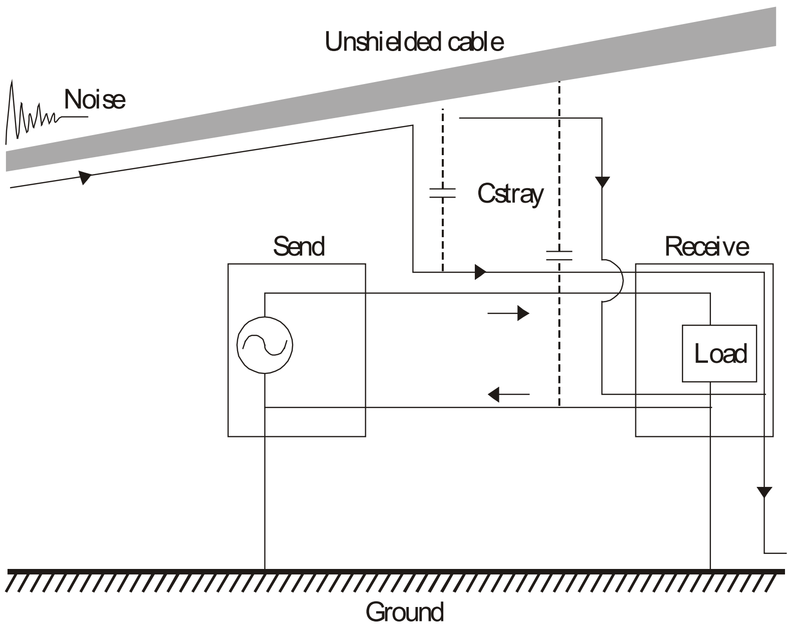

Figure A-3

4. The common-mode noise of an unshielded power cable is transmitted to the ground via the stray capacitance. Since both shielded wire and unshielded wire are connected to a common ground, other systems can be interfered with by the common-mode noise that is transmitted from the ground back to the system via the shield. See Figure A-4.

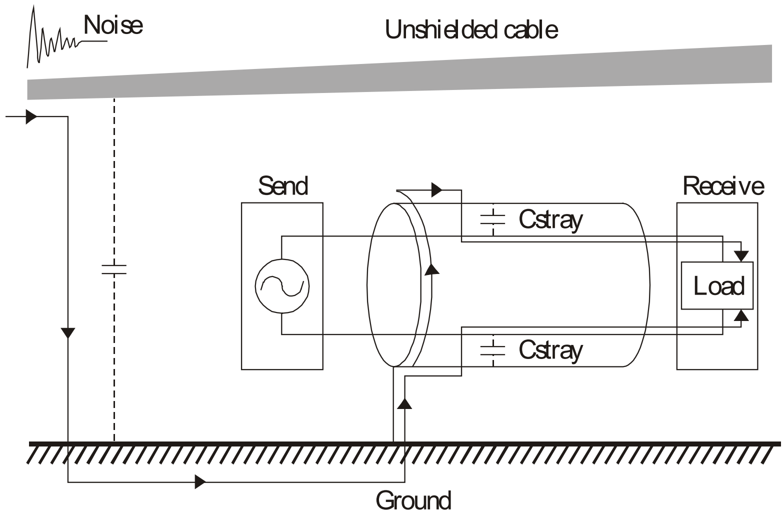

Figure A-4

5. When excessive pulse modulated currents pass through an un-grounded AC drive cable, it acts as an antenna and creates radiated interference.

A-3 Solution to EMC: Grounding

The leakage current of an electronic equipment is conducted to ground via the grounding wire and the ground electrode. According to Ohm's law, potential differences may arise when the electrode's ground and the ground's ground resistance are different.

According to Ohm's law, the earth resistance for electrode and the ground are different; in this case, potential differences may arise.

A-3-1 Protective Grounding & Functional Grounding

Please carefully read the following instructions if two types of grounding are applied at the same time.

Protective grounding is applied outside buildings and must have low resistance. On the other hand, functional grounding can be applied inside buildings and must have low impedance.

The goal of EMC is to avoid any interference effects. Grounding for EMC can be distinguished by frequency. For frequencies lower than 10 kHz, a **single point ground** *system* should be used and for frequencies higher than 10 kHz, a **multiple point ground** *system* should be used.

- **Single Point Grounding**: all signal grounds of all IT equipment are connected in series to form a single reference point. This point can be grounded directly to earth; to the designated grounding point or to the safety point that is already grounded.
- **Multiple Point Grounding***:* all signals of all IT equipment are grounded independently.
- **Hybrid Grounding***:* this type of grounding behaves differently for low and high frequencies. When two pieces of IT equipment (A and B) are connected via a shielded cable, one end is connected directly to ground while the other end is connected to ground via a capacitor. This type of grounding system fulfils the criteria for high and low frequency grounding.
- **Floating grounding***:* the signals of all IT equipment are isolated from each other and are not grounded.

DC current flows evenly throughout the conductor section. But AC current flows towards the conductor's surface as frequency increases; this is called the "skin effect". It causes the effective cross-section area to be reduced with increasing frequency. Therefore, it is suggested to increase the effective ground cross-section area for high frequencies by replacing pigtail grounding by braided conductors or strip conductors. Refer to the Figure A-5 below.

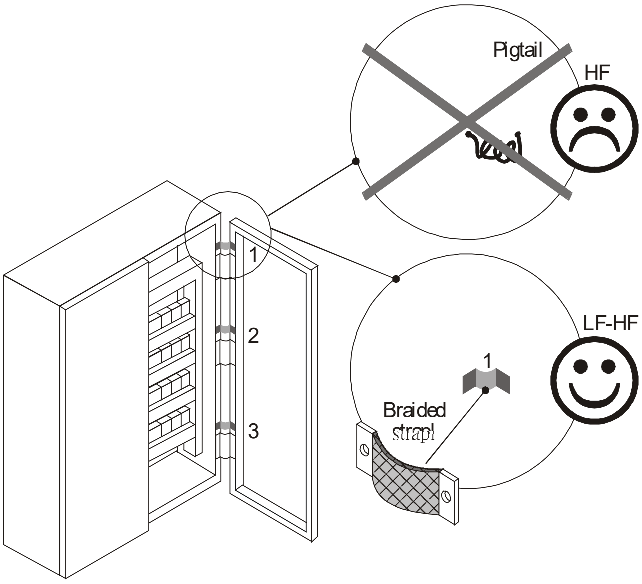

Figure A-5

This is why a thick short ground wire must be implemented for connecting to the common grounding path or the ground busbar. Especially when a controller (e.g. PLC) is connected to an AC motor drive, it must be grounded by a short and thick conducting wire. It is suggested to use a flat braided conductor (ex: metal mesh) with a lower impedance at high frequencies.

If the grounding wire is too long, its inductance may interfere structure of the building or the control cabinet and form mutual inductance and stray capacitance. As shown in the Figure A-6, a long grounding wire could become a vertical antenna and turn into a source of noise.

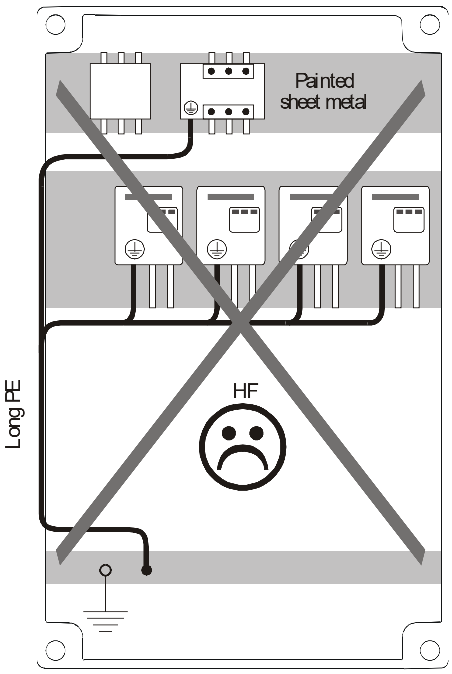

Figure A-6

A-3-2 Ground Loops

A **ground loop** occurs when the pieces of equipment are connected to more than one grounding path. In this case, the ground current may return to the grounding electrode via more than one path. There are three methods to prevent ground loops:

1. Use a common power circuit
2. Single point grounding
3. Isolate signals, e.g. by photocouplers

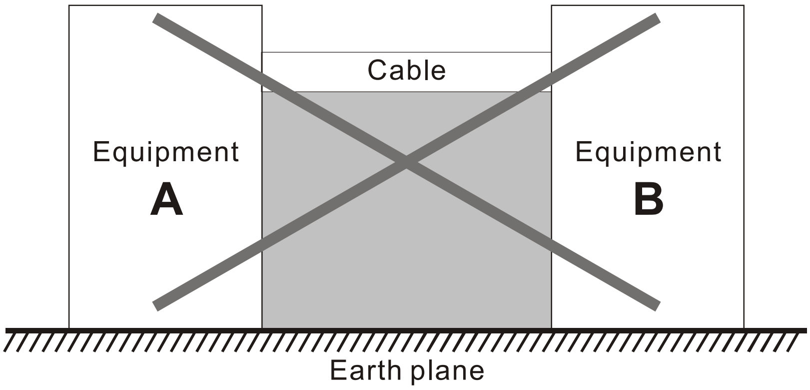

Figure A-7

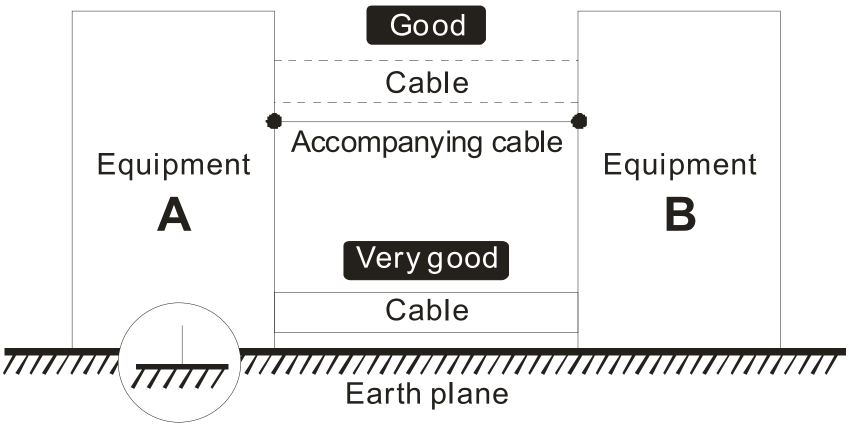

Figure A-8

In order to avoid "Common Mode Noise", use parallel wires or twisted pair wiring. Follow this rule and also avoid long wires, it is suggested to place the two wires as close to each other as possible.

A-3-3 Earthing Systems

The international standard IEC60364 distinguishes three different earthing system categories, using the two-letter codes **TN**, **TT**, **IT**.

- The **first letter** indicates the type of earthing for the power supply equipment (generator or transformer).
  T: One or more points of the power supply equipment are connected directly to the same earthing point.
  I: Either no point is connected to earth (isolated) or it is connected to earth via high impedance.

- The **second letter** indicates the connection between earth and the power supply equipment.
  T: Connected directly to earth (This earthing point is separate from other earthing points in the power supply system.)
- **N**: Connected to earth via the conductor that is provided by the power supply system

- The **third and fourth letter** indicate the location of the earth conductor.
  S: Neutral and earth conductors are separate
  C: Neutral and earth are combined into a single conductor

TN system

TN: The neutral point of the low voltage transformer or generator is earthed, usually the star point in a three-phase system. The body of the electrical device is connected to earth via this earth connection at the transformer.

Protective earth (PE): The conductor that connects the exposed metallic parts of the consumer.
Neutral (N): The conductor that connects to the start point in a three-phase system or that carries the return current in a single-phase system.

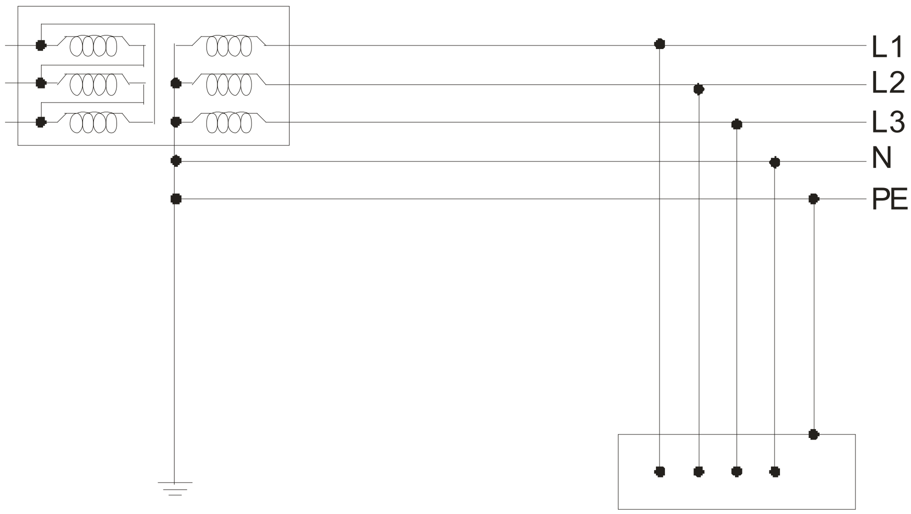

Figure A-9

TN-S system

TN-S: PE and N are two separate conductors that are combined together only near the power source (transformer or generator). It is the same as a three-phase five-wire system.

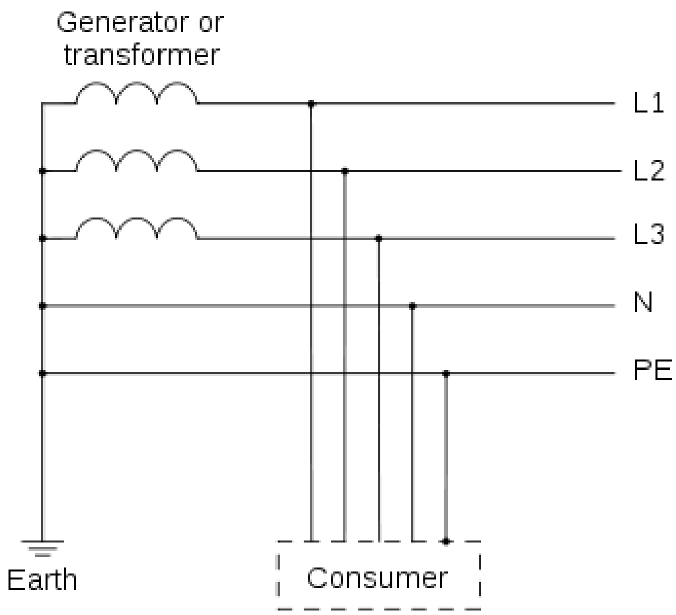

Figure A-10

TN-C system

TN-C: PE and N are two separate conductors in an electrical installation similar to a three-phase five-wire system, but near the power side, PE and N are combined into a PEN conductor similar to a three-phase four-wire system.

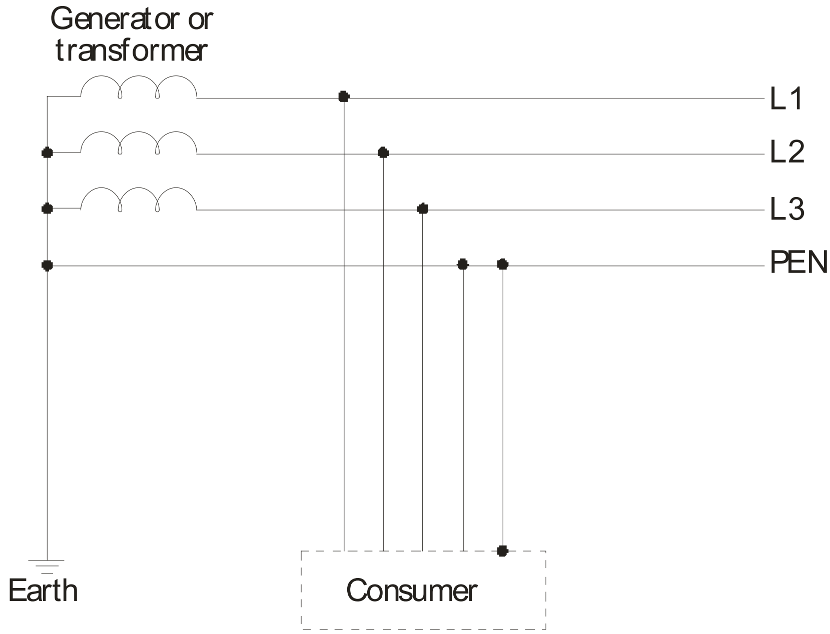

Figure A-11

TN-C-S system

TN-C-S: A combined earth and neutral system (PEN conductor) is used in certain systems but eventually split up into two separate conductors PE and N. A typical application of combined PEN conductor is from the substation to the building but within the building PEN is separated into the PE and N conductors. Direct connection of PE and N conductors to many earthing points at different locations in the field will reduce the risk of broken neutrals. Therefore, this application is also known as **protective multiple earthing (PME)** in the UK or as **multiple earthed neutral (MEN)** in Australia

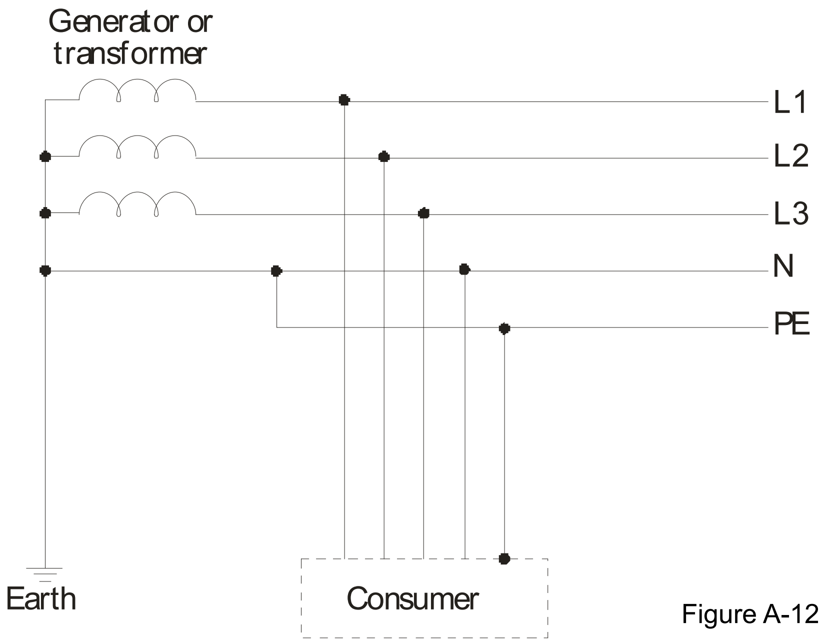

Figure A-12

TT system

TT: The neutral point (N) of the low voltage transformer and the equipment frames (PE) are connected to a separate earthing point. The Neutral (N) of the transformer and electrical equipment are connected.

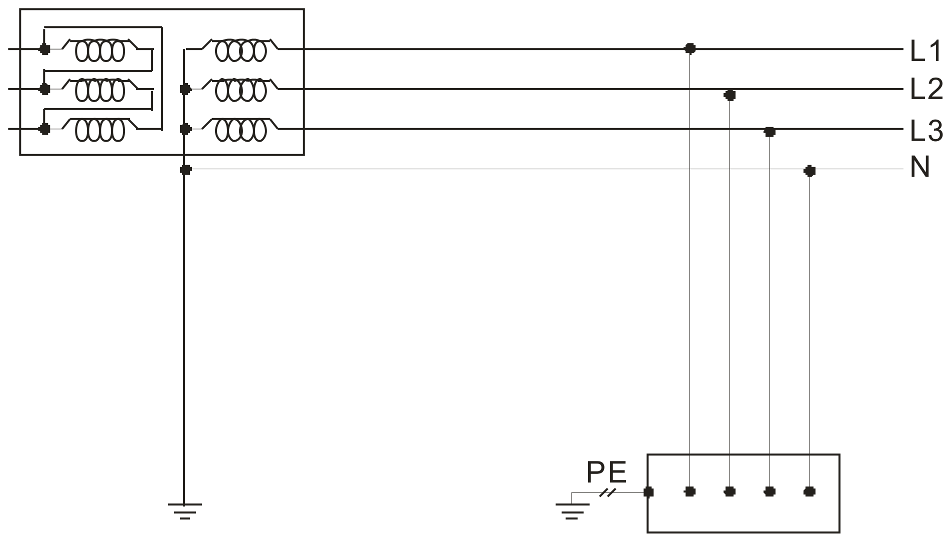

Figure A-13

IT system

IT: The neutral point of the transformer and electrical equipment are not earthed, only the equipment frames PE are earthed.

In the IT network, the power distribution system Neutral is either not connected to earth or is earthed via high impedance. In such a system, an insulated monitoring device is used for impedance monitoring.

A built-in filter should be disconnected by the RFI-jumper and an external filter should not be installed when the AC motor drive or the AC servo motor drive is connected to an IT system.

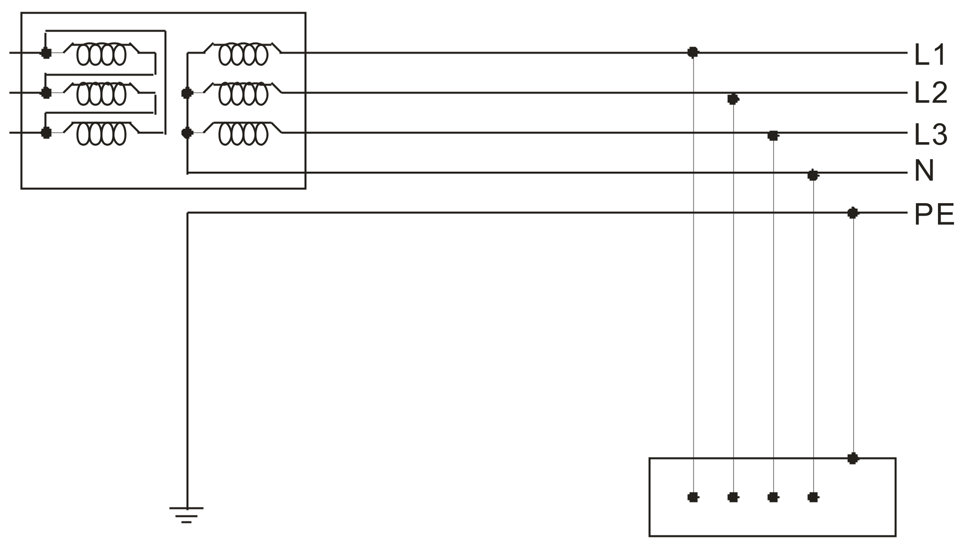

Figure A-14

Criteria for Earthing System and EMC

	TN-S	TN-C	TT	IT
Safety of Personnel	***Good***	***Good***	***Good***	***Good***
	Continuity of the PE conductor must be ensured throughout the installation	Continuity of the PE conductor must be ensured throughout the installation	RCD is mandatory	Continuity of the PE conductor must be ensured throughout the installation
Safety of Property	***Poor***	***Poor***	***Good***	***Good***
	High fault current (around 1kA)	High fault current (around 1kA)	Medium fault current (< a few dozen amperes)	Low current at the first fault (< a few dozen mA) but high current at the second fault
Availability of Energy	***Good***	***Good***	***Good***	***Excellent***
EMC Behavior	***Excellent***	***Poor (prohibited)***	***Good***	***Poor (should be avoided)***
	• Almost equipotential Problems: • Need to handle the high leaking currents problem of the device • High fault current (transient disturbances)	• Neutral and PE are the same • Circulation of disturbance currents in exposed conductive parts (high magnetic-field radiation) • High fault currents (transient disturbances)	• Over-voltage risk • Equipotential Problems: • Need to handle the high leaking currents problem of the device • RCD (Residual-current device)	• Over-voltage risk • Common–mode filters and surge arrestors must handle the phase-to-phase voltage. • RCDs subject to nuisance tripping when common-mode capacitors are present • Equivalent to TN system for second fault

A-4 Solution to EMC: Shielding

A-4-1 What is Shielding

Electrostatic shielding is used to isolate equipment so that it will not create electromagnetic field interference or be influenced by an external electromagnetic field. A conductive material is used for electrostatic shielding to achieve this isolation. A Faraday cage can be made from a mesh of metal or a conductive material.

One characteristic of metal is that it is highly conductive and not electrostatic, which offers shielding and prevents interference by external electrical fields. Metal with its high conductivity protects the internal devices from high voltages—no voltage will enter the cage even when the cage is experiencing a high current. In addition, electromagnetic fields can also pass through the Faraday cage without causing any disturbance.

Electromagnetic shielding is applied to some electrical devices and measurement equipment for the purpose of blocking interference. Examples of shielding include:

- Earth high-voltage indoor equipment using a metal frame or a high-density metal mesh
- Shielding a power transformer is achieved by wrapping a metal sheet between the primary and secondary windings or by adding an enamel wire to the winding wire which is then earthed.
- A shielding coating, which is made of metal mesh or conductive fibers to provide effective protection for the workers who work in a high-voltage environment.

In the picture below, the radio appears to be not fully covered by metal but if the conductivity of the metal is high, radio waves are completely blocked and the radio will not receive any signal.

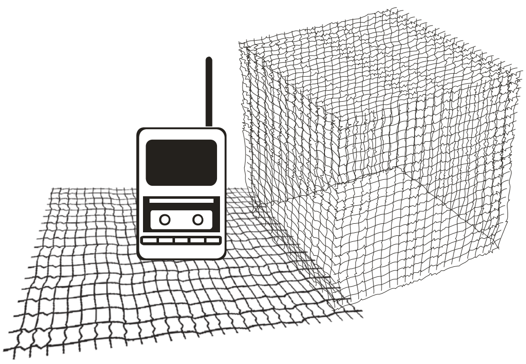

Figure A-15

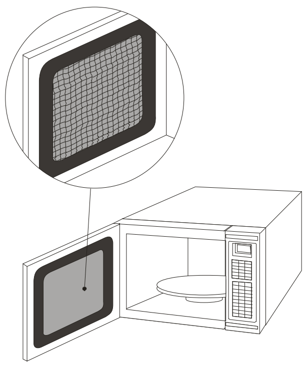

Figure A-16

Mobile phone connections are also established through the transmission of radio waves. This is why the mobile phone reception is often cut off when we walk into an elevator. The metal walls of the elevator create the same shielding effect just as if we had entered a metal cage. Another example is a microwave oven. The microwave door may seem transparent in visible light, but the density of the metal mesh in the microwave door blocks the electromagnetic waves. A higher density of the metal mesh offers better shielding.

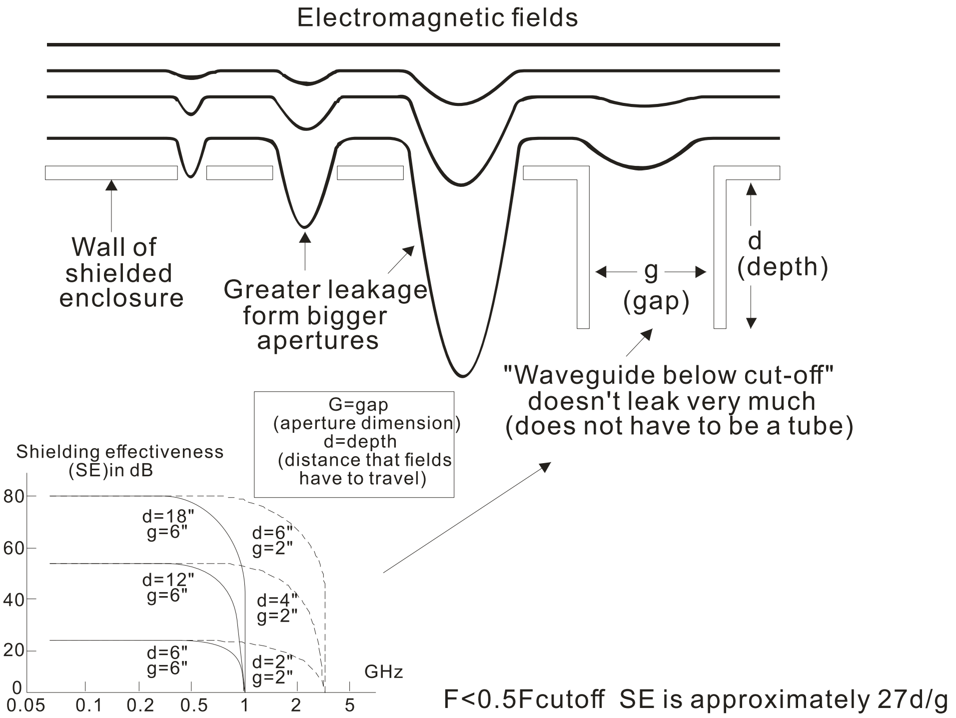

Figure A-17

A-4-2 How to Reduce EMC by Shielding

Iron and other metals are high conductivity materials that provide effective shielding at extremely low frequencies. But conductivity will decrease as:

1. High frequency signals are applied to the conductor
2. Equipment is located in a strong magnetic field
3. The shielding frame is forced into a specific form by machines

It is difficult to select a suitable high-conductivity material for shielding without the help from a shielding material supplier or a related EMC institution.

Metallic Shielding Effectiveness

Shielding Effectiveness (SE) is used to assess the applicability of the shielding shell. The formula is:

SEdB=A+R+B (Measures in dB)	where	A= Absorption loss (dB)
		R= Reflection loss (dB)
		B= Correction factor (dB) (for multiple reflections in thin shields)

The absorption loss refers to the amount of energy loss as the electromagnetic wave travels through the shield. The formula is:

AdB=1.314(fσμ) 1/2t	where	f= frequency (MHz)
		μ= permeability relative to copper
		σ= conductivity relative to copper
		t= thickness of the shield in centimeters

The reflection loss depends on the source of the electromagnetic wave and the distance from that source. For a rod or straight wire antenna, the wave impedance increases as it moves closer to the source and decreases as it moves away from the source until it reaches the plane wave impedance (377) and shows no change. If the wave source is a small wire loop, the magnetic field is dominant and the wave impedance decreases as it moves closer to the source and increases as it moves away from the source; but it levels out at 377 when the distance exceeds one-sixth of the wavelength.

Electrical Cabinet Design

In a high frequency electric field, shielding can be achieved by painting a thin layer of conductive metal on the enclosure or on the internal lining material. However, the coating must be thorough and all parts should be properly covered without any seams or gaps (just like a Faraday cage). That is only the ideal. Making a seamless shielding shell is practically impossible since the cage is composed of metal parts. In some conditions, it is necessary to drill holes in the shielding enclosure for installation of accessories (like optional cards and other devices).

1. If the metallic components are properly welded using sophisticated welding technology to form an electrical cabinet, deformation during usage is unlikely to occur. But if the electrical cabinet is assembled with screws, the protective insulating layer under the screw must be properly removed before assembly to achieve the greatest conductivity and best shielding.
2. Drilling holes for the installation of wires in the electrical cabinet lowers the shielding effectiveness and increases the chance of electric waves leaking through the openings and emitting interference. We recommend that the drilled holes are as narrow as possible. When the wiring holes are not used, properly cover the holes with metal plates or metal covers. The paint or the coating of the metal plate and metal cover should be thoroughly removed to ensure a metal-to-metal contact or a conductive gasket should be installed.
3. Install industrial conductive gaskets to completely seal the electrical cabinet and the cabinet door without gaps. If conductive gaskets are too costly, please screw the cabinet door to the electrical cabinet with a short distance between the screws.
4. Reserve a grounding terminal on the electrical cabinet door. This grounding terminal shall not be painted. If the paint already exists, please remove the paint before grounding.

Electrical Wires and Cables

Shielded Twisted Pair (STP) is a type of cable where two insulated copper wires are twisted together with a metal mesh surrounding the twisted pair that forms the electromagnetic shielding and can also be used for grounding.

The individual electrical wires and complete cable are surrounded by (synthetic) rubber that provides insulation and also protects against damage.

There are two types of electrical cables: high voltage and low voltage. The high voltage cable differs from the low voltage cable in that it has an additional insulation layer called the dielectric insulator within the plastic sleeve. The dielectric insulator is the most important component in insulation. The low voltage cable is usually only filled with a soft polymer material for keeping the internal copper wire in place. The shield has two functions:

1. To shield the electrical wire and cable.
   (1) Electric currents increase as power flows through the power cable and generate an electrical field. Such interference can be suppressed inside the cable by shielding the power cables or the electrical wires.
   (2) To form a protective earthing. When the cable core is damaged, the leakage current will flow via the shield to ground.
2. To protect the cable. A power cable used for the computer control purpose generates only relatively low amount of current inside the cable. Such power cable will not become the source of interferences but has great possibility to be interfered by the surrounding electrical devices.

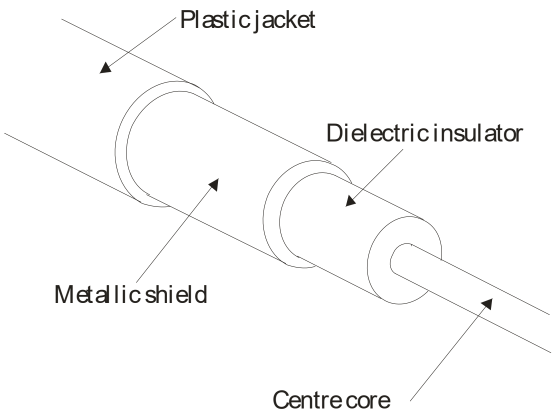

Figure A-18

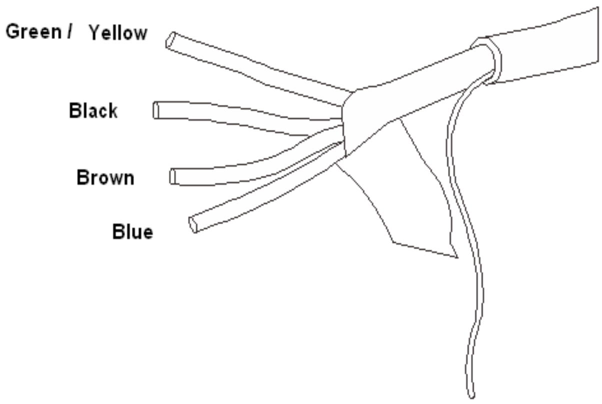

Figure A-19

A-5 Solution to EMC: Filter

A-5-1 Filter

Electromagnetic interference is transmitted in two ways, by radiation and by conduction. The most effective and economical method of reducing radiated interference is to use shielding and of reducing conducted interference is to use an electromagnetic filter.

Noise interference can be divided into two categories: high frequency (150 kHz–300 MHz) and low frequency (100–3000 Hz). High-frequency noise fades more over distance and has a shorter wave-length, while low-frequency noise fades less over distance and has a longer wave-length. Both types of interference are transmitted through power cables and power leads, affecting the power supply side.

High-frequency interference at the power side can be eliminated or attenuated by mounting a filter. The filter consists of coils and capacitors. Some drives do not have a built-in filter, in which case the installation of an external option filter is required. Figure A-20 below shows a standard filter diagram.

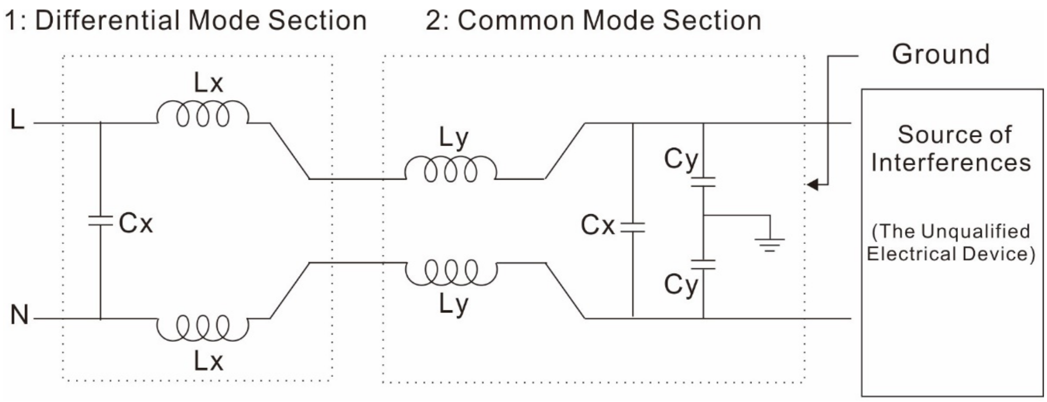

Figure A-20

A filter is composed of a Differential Mode section (to eliminate noise below 150 kHz) and a Common Mode section (to eliminate noise above 150 kHz). For high-frequency noise, the inductor acts as a high impedance to form an open circuit and the capacitor acts as a low impedance to form a short circuit. Proper design and dimensioning of inductors and capacitors give a resonant circuit to absorb harmonic currents. Capacitor Cy is earthed to lead the harmonic currents to the ground.

External Filter

The filter and the AC drive should be installed in the control cabinet or on the mounting plate that is earthed to ground. The motor cable must be shielded and as short as possible. Use the filters recommended by Delta to ensure compliance with EMC standards.

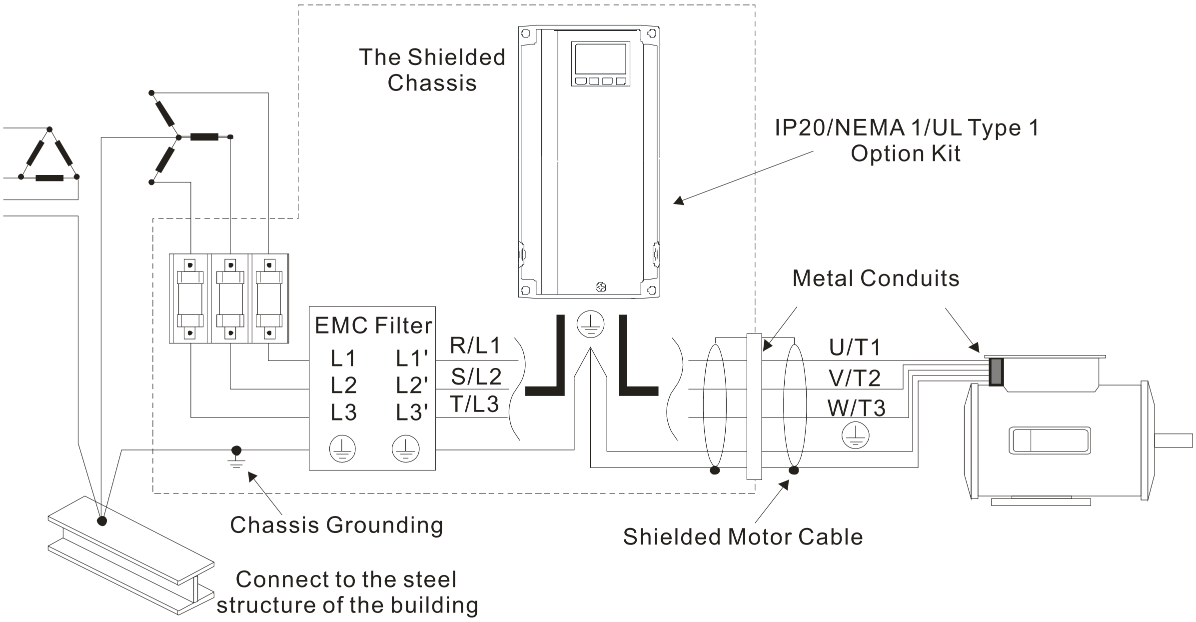

Figure A-21

AC Motor Drives with Built-in Filter

1. Since interferences are suppressed by installing an earthed capacitor in the filter, the amount of current to ground (leakage current) could result in electric shocks to personnel or the power system. Please be aware of this problem.
2. Since the leakage current to ground can be high, it is crucial to implement protective earthing to prevent electrical shocks.

Filter Installation (With and Without)

< 15 m @ 60 Hz with EMC Filter

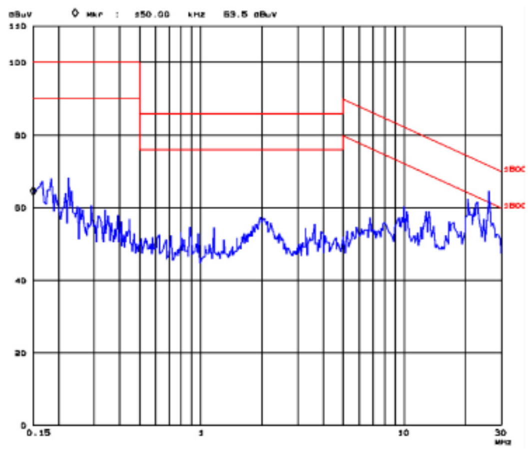

Figure A-22

< 15 m @ 60 Hz without EMC Filter

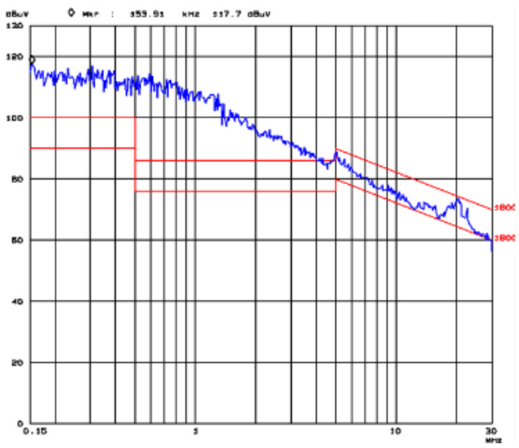

Figure A-23

Zero Phase Reactor (Choke)

Interferences can also be suppressed by installing a zero phase reactor at the power supply side and/or the AC Motor Drive's output, depending on where the interference is. Since currents are large at the power input and the AC Motor Drive's output, please carefully select the magnetic core with suitable current handling capability. An ideal magnetic material for large currents is compound magnetic powder. It has a higher current handling capability and higher impedance compared to pure metallic magnetic cores. It is therefore suitable to implement in a high frequency environment. The impedance can also be enhanced by increasing the turn ratio.

Zero Phase Reactor Installation

There are two installation methods, depending on the size of the zero phase reactor and the motor cable length.

1. Wind the motor cable through the middle of a zero-phase reactor four times. Place the reactor and the AC Motor Drive as close to each other as possible.

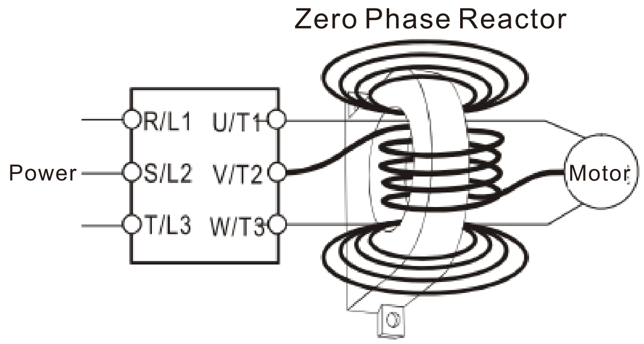

Figure A-24

2. Place all wires through the middle of four zero-phase reactors without winding.

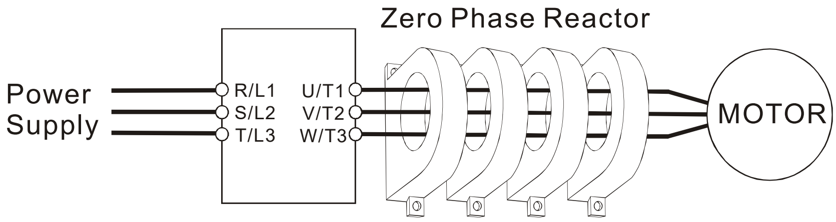

Figure A-25

Analog Input Signals

If the analog input signals are affected by noise from the AC motor drive, connect a capacitor and a ferrite core as indicated in Figure A-26 below. Wind the wires around the core in same direction for 3 times or more.

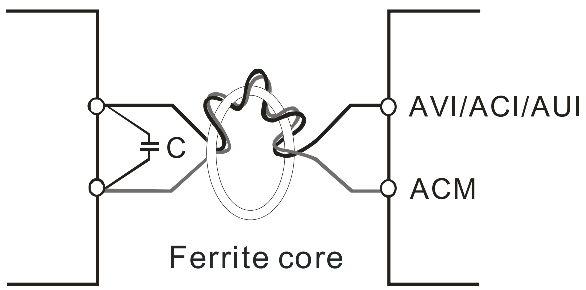

Figure A-26

A-5-2 Harmonic Interference

The AC motor drive's input current is non-linear, the input rectifier generates harmonics. Harmonics must be limited to within a certain range to avoid impact the mains power and to avoid current distortion to ensure surrounding devices are not influenced. An AC Motor Drive with built-in DC reactor suppresses harmonic currents (Total Harmonic Current Distortion THID) effectively and therefore reduces the harmonic voltage peaks (Total Harmonic Voltage Distortion).

Harmonic Current at the Power Supply Side

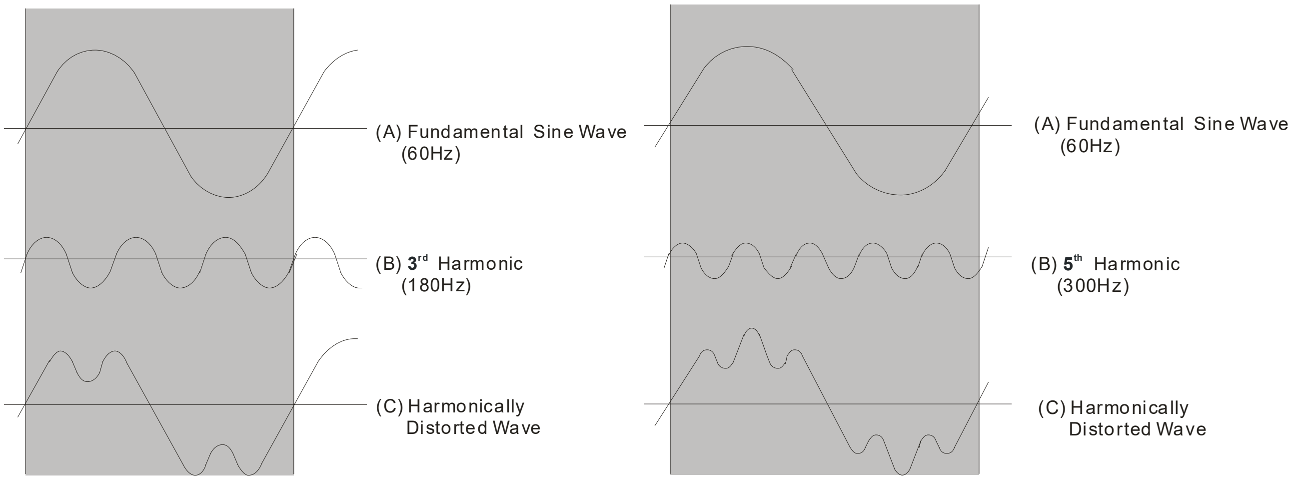

Figure A-27

Suppression of Harmonic Currents

Reactor

When a large portion of lower order harmonic currents (5th, 7th, 11th, etc.) occur at the power input, surrounding devices will be disturbed and the power factor will be low as a result of reactive power. Installing a reactor at the AC Motor Drive's input effectively suppresses lower order harmonic currents.

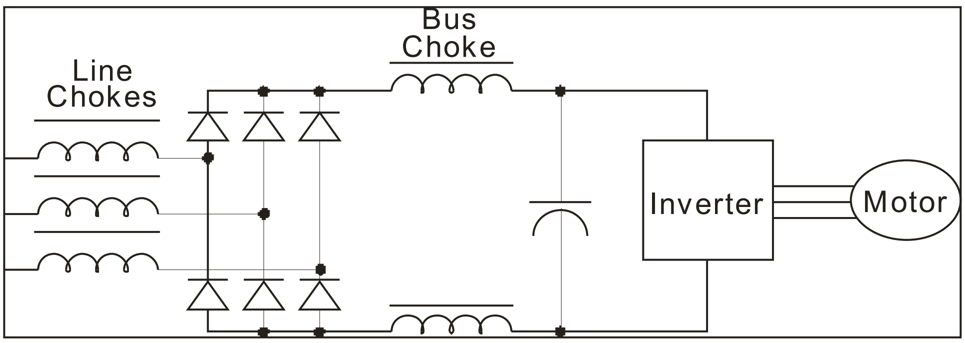

Figure A-28

AC Reactor

Installed in series with the power supply and is effective in reducing low order current harmonics. Features of an AC reactor include:

1. Reduces the harmonic currents to the AC Motor Drive and increases the impedance of the power supply.
2. Absorbs interferences generated by surrounding devices (such as surge voltages, currents, and mains surge voltages) and reduce their effect on the AC Motor Drive.
3. Increases the power factor.

DC Reactor

A DC-Reactor is installed between the rectifier and the DC-bus capacitor to suppress harmonic currents and to achieve a higher power factor.

Current Wave Diagrams

Without Reactor

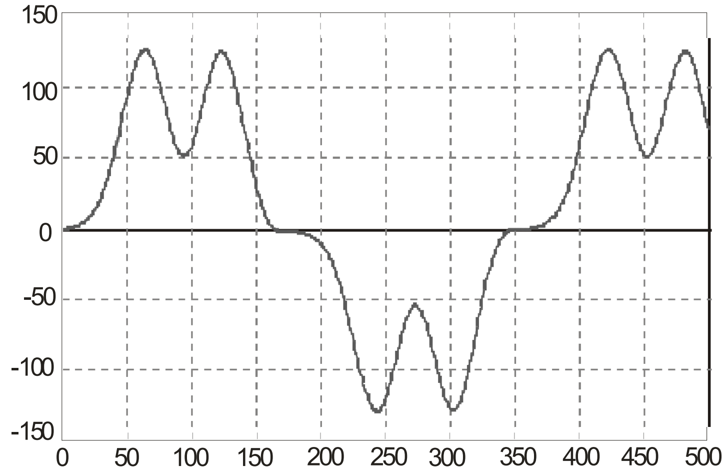

Figure A-29

With Reactor

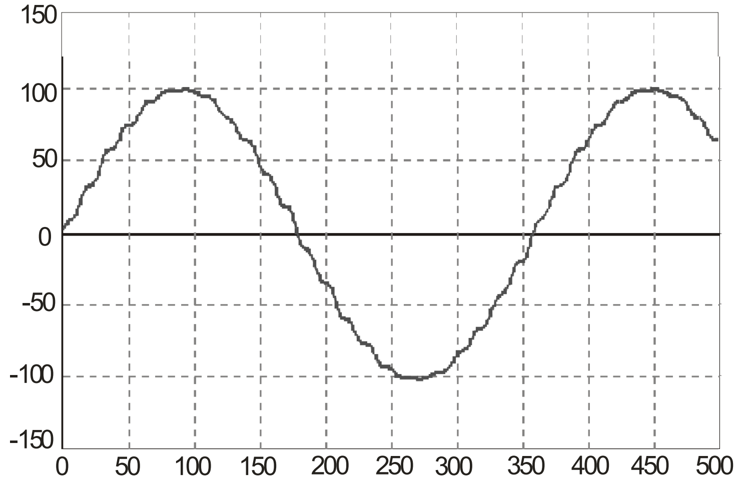

Figure A-30

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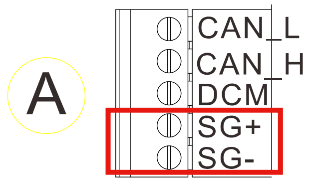
Appendix B. Modbus Protocol

- 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. For details on communication port as the right diagram shows, see the lower right corner in Figure 3-5 in Chapter 3 Wiring.



- 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 parity bit
  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)

B-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.

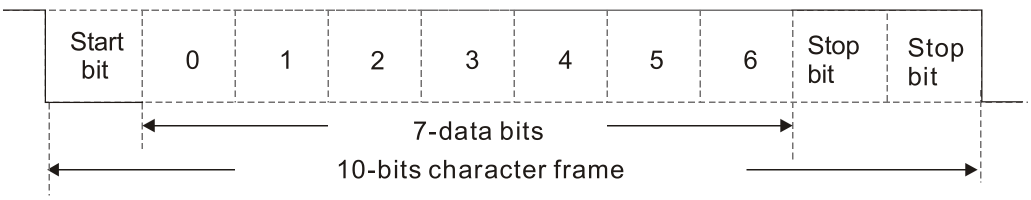
Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

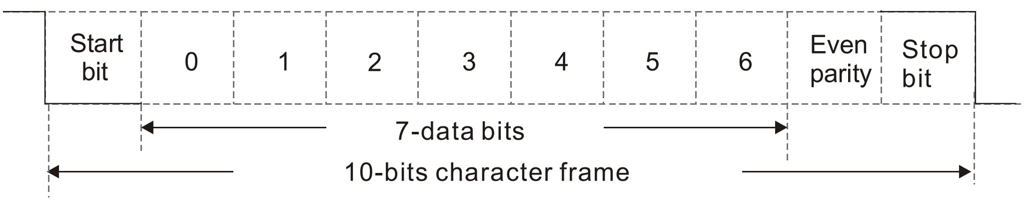
B-2 Data Format

1. 10-bit character frame (For ASCII)

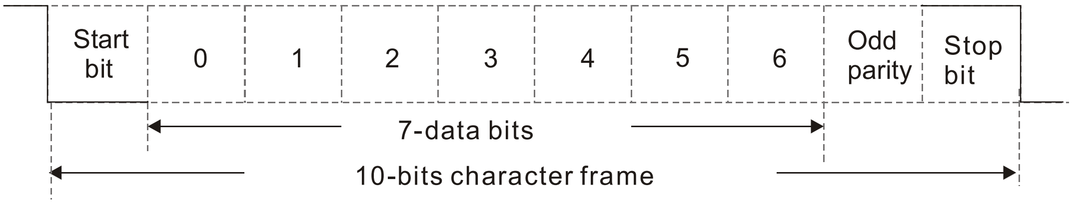
(7, N, 2)



(7, E, 1)

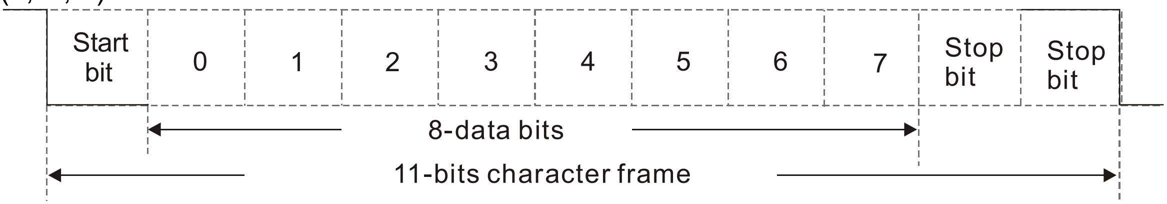


(7, O, 1)

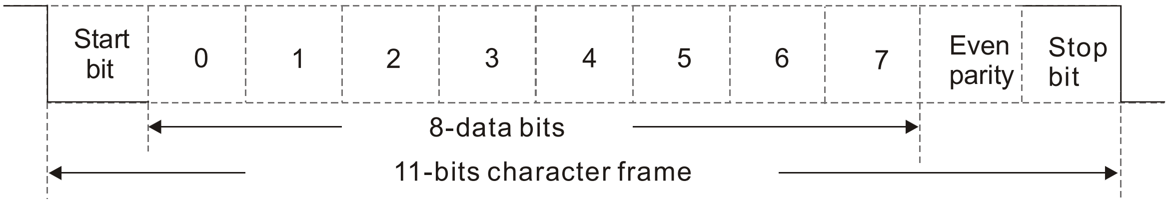


2. 11-bit character frame (For RTU)

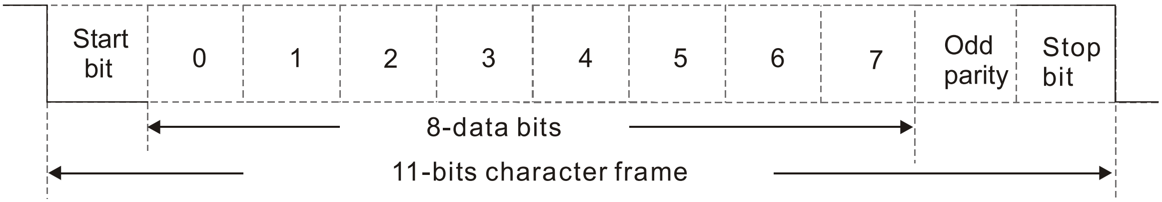
(8, N, 2)



(8, E, 1)



(8, O, 1)



B-3 Communication Protocol

1. Communication data frame

ASCII mode:

STX	Start character = ‘:’ (3AH)
Address High	Communication address:
Address Low	one 8-bit address consists of 2 ASCII codes
Function High	Command code:
Function Low	one 8-bit command consists of 2 ASCII codes
DATA (n-1)	Contents of data:
…….	n x 8-bit data consists of 2n ASCII codes
DATA 0	n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
LRC Check High	LRC checksum:
LRC Check Low	one 8-bit checksum consists of 2 ASCII codes
END High	End characters:
END Low	END1= CR (0DH), END0= LF(0AH)

RTU mode:

START	Defined by a silent interval of larger than / equal to 10 ms
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 10 ms

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

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

3. 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

4. 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 ADR 0	‘0’
	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘4’
	‘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 ADR 0	‘0’
	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘4’
	‘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	04H
	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	04H
	00H
Number of register (Count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

5. Checksum

(1) 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.

(2) 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.

6. 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
}
```

B-4 Address List

1. ASCII
   - 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
   - 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
   - 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) + 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
   - Reads one or more parameter values: 01h (station address 01) + 03h (function code 03h) + 00xxh–26xxh (Modbus address) + xxxxh (reading length) + CRC (checksum)
   - Writes one parameter value: 01h (station address 01) + 06h (function code 06h) + 00xxh–26xxh (Modbus address) + xxxxh (writing value) + CRC (checksum)
   - Writes 20 parameter values: 01h (station address 01) + 10h (function code 10h) + 00xxh–26xxh (Modbus address) + 0014h (data length, count by word) + 28h (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="13">Operation command</td><td rowspan="13">2000H</td><td rowspan="13">R (03H) / W (06H, 10H)</td><td rowspan="4">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.00-15=2).</td></tr>
<tr><td>01B: Stop</td></tr>
<tr><td>10B: Run</td></tr>
<tr><td>11B: JOG + Run</td></tr>
<tr><td rowspan="9">U16</td><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="4">1. Valid only when 2000h bit12 is set to 1.
2. Obtain the current running speed by</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>
</table>

Function Name	Modbus Address	Attribute (Function Code)	Size	Description		
				bit11–8	0000B: zero step speed	reading 2107h.
					0001B: 1st step speed	
					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
				bit15–2	Reserved	

5. Status monitor read only (21xx): communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description	
Fault status	2100H	R(03H)	U16	bit7–0: Fault code bit15–8: Warning code	
Drive operation status	2119H	R(03H)	U16	bit1–0	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

Function Name	Modbus Address	Attribute (Function Code)	Size	Description	
					(RUN indicator is ON / STOP indicator is OFF)
				bit2	1: JOG command
				bit4–3	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)
				bit7–5	Reserved
				bit8	1: Master frequency controlled by communication interface
				bit9	1: Master frequency controlled by analog / external terminal signal
				bit10	1: Operation command controlled by communication interface
				bit11	1: Parameter locked
				bit12	1: Enable copy parameter from keypad
				bit15–13	Reserved
Frequency command	2102H	R(03H)		Drive's frequency command (XXX.XX Hz)	
Output frequency	2103H	R(03H)		Drive's output frequency (XXX.XX Hz)	
Output current	2104H	R(03H)		Drive's output current (XX.XX A). Decimal places can be referred by the high byte of 211F	
DC bus voltage	2105H	R(03H)	U16	Drive's DC bus voltage (XXX.X V)	
Output voltage	2106H	R(03H)		Drive's output voltage (XXX.X V)	
Multi-step speed status	2107H	R(03H)		Drive's current running speed step given by multi-step speed command (0 is main speed)	
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.	

6. Status monitor read only (22xx): communication station address is Pr.09-00 setting value

Function Name	Modbus Address	Attribute (Function Code)	Size	Description
Maximum user-defined value	2201H	R(03H)	U16	Maximum Operation Frequency (Pr.01-00)
AUI1 analog input	2203H	R(03H)		Display signal of AUI analog input terminal, -10–10 V corresponds to -100.00–100.00%
AUI2 analog input	2204H	R(03H)		Display signal of AUI analog input terminal, -10–10 V corresponds to -100.00–100.00%
IGBT temperature	2206H	R(03H)		IGBT temperature of drive power module (XXX.XºC)
Heat sink temperature	2207H	R(03H)		Display temperature of heat sink (ºC) (only for model 40 HP and above)
Digital input status	2208H	R(03H)		The status of digital input (ON/OFF), refer to Pr.02-10 (see Example 01 in Pr.00-04)
Digital output status	2209H	R(03H)		The status of digital output (ON/OFF), refer to Pr.02-23 (see Example 02 in Pr.00-04)

B-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
10	Transmission time-out

Appendix C. Revision History

Firmware Version: V1.11

Issued Edition: 00

Issued Date: June, 2023

Added	
Descriptions	Chapters
• Added notes for airflow and heat dissipation for single and multiple drive installation	Section 2-2
• Added maximum and minimum wire gauge, screw size and tightening torque for ground terminal. • Added recommended wires when installing at an ambient 50°C or above environment	Section 4-2
• Added wiring diagram for frequency division output	Section 7-2-6 Section 7-3-5 Section 7-4-5
• Added links for Certifications and Declaration of Conformity (Doc)	Section 8-3
• Added data value in tables for derating curves	Section 8-5
• Added rollback function parameters in Starting stage. • Added Pr.07-29 for comfort function in Stopping stage.	Section 10-4
• Pr.00-04: Added setting value 40 (elevator actual speed m/s) and display illustration • Pr.00-09: Added block diagrams for each control mode	Pr. Group 00
• Pr.01-08: Added SVC control mode	Pr. Group 01
• MO40: Added descriptions regarding use with Pr.02-43 • Added multi-function input #MI57, MI59, and multi-function output #MO50, MO51, MO52 • Pr.02-34: Added related descriptions when actual output H > Pr.02-34, and descriptions regarding setting range and unit varying with Pr.00-10. • Added Pr.02-40 to Pr.02-42 (direct docking mode only), and Pr.02-43 (Speed Reached Bandwidth)	Pr. Group 02
• Pr.05-16, Pr.06-01, Pr.06-26, Pr.09-02, Pr.10-03, Pr.10-09: Added notes regarding setting value "fault and ramp to stop"	Pr. Group 05, 06, 09, 10
• Pr.06-50, Pr.06-51, Pr.06-52: Added cross-reference fault codes ocA, ocd, ocn, ocS, GFF • Pr.06-52: Added notes regarding minimum time interval • Pr.06-72: Added two methods 1. ARD or UPS 2. Battery used as EPS	Pr. Group 06
• Added Pr.07-31 to Pr.07-37 brake torque test functions	Pr. Group 07
• Added Pr.11-21 (filter time display settings on built-in keyboard panel)	Pr. Group 11
• Added warning codes: LS, bttA, bttn, bttS	Chapter 13
• Added fault codes: OPHL (U/V/W phase output phase loss), LSS, LSo, btt, bttE	Pr. Group 06 Chapter 14

Updated	
Descriptions	Chapters
• Updated Personal Repair Request service link	Section 1-4
• Updated data value for MI1 to MI8 Default (NPN Mode)	Section 5-3
Updated recommended filter selections for the following models: • VFD055ED43S: from EMF033A43A to EMF018A43A • VFD075ED43S: from EMF033A43A to EMF018A43A • VFD150ED43S: from B84143D0075R127 to EMF033A43A	Section 6-6
• Updated information on digital keypad from KPC-CE01 to KPC-CC01	Section 6-7 Section 9-4
• Updated IFD6530 driver download link	Section 6-8
• Deleted discontinued option cards: EMED-PGABD-1, EMED-PGHSD-1, EMED-PGHSD-2	Section 7-1-2 Section 7-2 to 7-4 Section 10-3 Pr. Group 10, 11 Section 14
• Updated terminal DGND to GND in wiring diagrams	Section 7-2 to 7-4
• Maximum external power is 12V, deleted 24V related information • Updated wiring diagrams in external power • Updated note item 3: from A, B, Z to /A, /B, /Z	Section 7-2-3
• Maximum output voltage: deleted “three-phase” • Output frequency range: updated output frequency upper limit to 299 Hz	Section 8-1 Section 8-2
• Updated speed control range: 1: 100 (up to 1:1000 when using PG card) to 1:50 (up to 1:1000 when using PG card) • Maximum output frequency: updated output frequency upper limit to 299.00 Hz • Categorized Certifications into EMC Directive, Production Compliance, Production Certifications, and Safety Certification.	Section 8-3
• Updated digital keypad KPC-CC01 to latest • Simplified Chinese language is not supported in this version.	Chapter 09
• Updated function parameters in All stage. • Updated parameters for comfort function in Starting stage.	Section 10-4
• Pr.01-38: Updated the process and steps for two methods of sending leveling signals • Updated drive’s output frequency upper limit: Pr.01-00, Pr.01-01, Pr.01-03, Pr.01-05, Pr.01-07, Pr.01-09, Pr.01-10, Pr.01-11, Pr.01-22, Pr.01-23, Pr.01-29, Pr.01-39	Chapter 10 Pr. Group 01
• Multi-function input MI#39: Updated cross-reference from Pr.03-01 to Pr.03-00 • Pr.02-34: Updated drive’s output frequency upper limit to 299.00 Hz, and deleted tolerance range plus–minus sign • Pr.02-38, Pr.02-39: Updated elevator timing diagram • Pr.02-25, Pr.02-26, Pr.02-27, Pr.02-28, Pr.02-34: Updated drive’s output frequency upper limit	Pr. Group 02
• Pr.03-15: Updated load compensation auto-tuning process	Pr. Group 03
• Pr.04-00 to Pr.04-15: Updated drive’s output frequency upper limit	Chapter 10 Pr. Group 04

Updated	
Descriptions	Chapters
• Pr.06-01: Updated parameter name • Pr.06-14: Updated parameter name • Pr.06-30: Updated parameter setting range and descriptions • Pr.06-44: Updated drive's output frequency upper limit • Pr.06-45: Updated setting value Bit1=1 to "Fan lock, warn and continue operation" • Pr.06-46: Updated descriptions • Pr.06-79: Updated cross-reference ERV/SERV warning/fault code descriptions	Pr. Group 06
• Pr.7-24 to Pr.07-27: Updated cross-reference from Pr.03-00=5, 6, 7, 8 to Pr.03-00=7, 8, 9, 10 • Pr.07-05, Pr.07-08, Pr.07-10: Updated drive's output frequency upper limit	Pr. Group 07
• Pr.09-02: Updated setting value 1 to "Fault and ramp to stop" • Pr.09-04: Moved partial contents in Parameter Group 09 to Appendix B. Modbus Protocol	Pr. Group 09 Appendix B
• Pr.10-17, Pr.10-20, Pr.10-21: Updated drive's output frequency upper limit	Pr. Group 10
• Pr.11-00: Delated "speed bandwidth control enabled" for setting value Bit 0=1, and updated text descriptions of "PI adjustment-auto gain" diagram	Pr. Group 11
• Fault code MPHL: Updated fault name and corrective actions	Pr. Group 06 Chapter 14

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