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*We reserve the right to change the information in this manual without prior notice.

DELTA_IA-MDS_CFP2000_UM_EN_20200116

Delta IP55 Fan and Pump Drive CFP2000 Series User Manual




Delta IP55 Fan and Pump Drive CFP2000 Series User Manual

www.deltaww.com

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Limitation of Liability

The contents of this user manual are only for the use of the AC motor drives manufactured by Delta. Except as defined in special mandatory laws, Delta provides this user manual “as is” and does not offer any kind of warranty through this user manual for using the product, either express or implied, including but not limited to the following: (i) this product will meet your needs or expectations; (ii) the information contained in the product is current and correct; (iii) the product does not infringe any rights of any other person. You shall bear your own risk to use this product.

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Delta reserves the right to make changes to the user manual and the products described in the user manual without prior notice and afterwards.

PLEASE 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 of power system to install motor drives is listed below. Ensure that the installation voltage is in the correct range when installing a motor drive.
  1. For 460V models, the range is between 323–528 V.
- ☑ Refer to the table below for short circuit rating:

Model (Power)	Short circuit rating
230V / 460V	100 kA

- ☑ Only qualified persons are allowed to install, wire and maintain the AC motor drives.
- ☑ Even if the three-phase AC motor is stopped, a charge with hazardous voltages may still remain in the main circuit terminals of the AC motor drive.
- ☑ The performance of electrolytic capacitor will degrade if it is not charged for a long time. It is recommended to charge the drive which is stored in no charge condition every 2 years for 3–4 hours to restore the performance of electrolytic capacitor in the motor drive. Note: When power up the motor drive, use adjustable AC power source (ex. 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. Please consult our distributors or download the latest version at http://www.deltaww.com/iadownload_acmotordrive

Table of Contents

Issued Edition: 02
Firmware Version: V1.06 (Refer to Parameter 00-06 on the product to get the firmware version.)
Issued Date: 2020/01

Chapter 1 Introduction

Receiving and Inspection

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

1. Please inspect the unit after unpacking to ensure 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 lies within the range as indicated on the nameplate. Please install the AC motor drive according to this manual.
3. Before applying the power, please make sure that all devices, including power, motor, control board and digital keypad, are connected correctly.
4. When wiring the AC motor drive, please make sure that the wiring of input terminals "R/L1, S/L2, T/L3" and output terminals "U/T1, V/T2, W/T3" is correct to prevent damage to the drive.
5. When power is applied, select the language and set parameter groups via the digital keypad (KPC-CC01). When executes trial run, please begin with a low speed and then gradually increase the speed until the desired speed is reached.

1-1 Nameplate Information

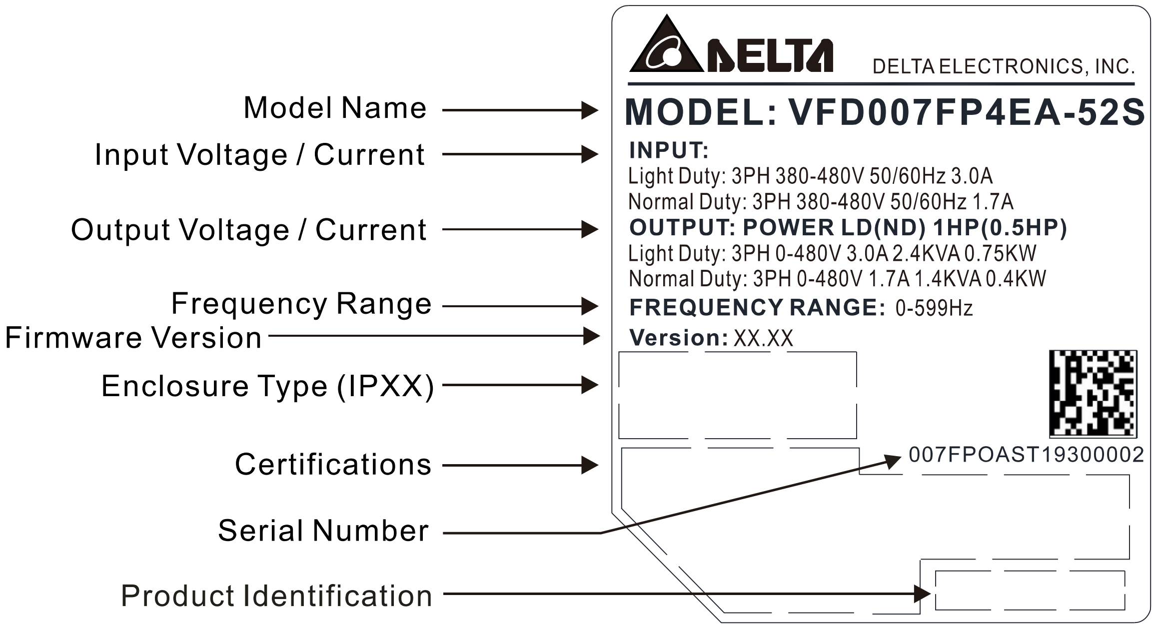
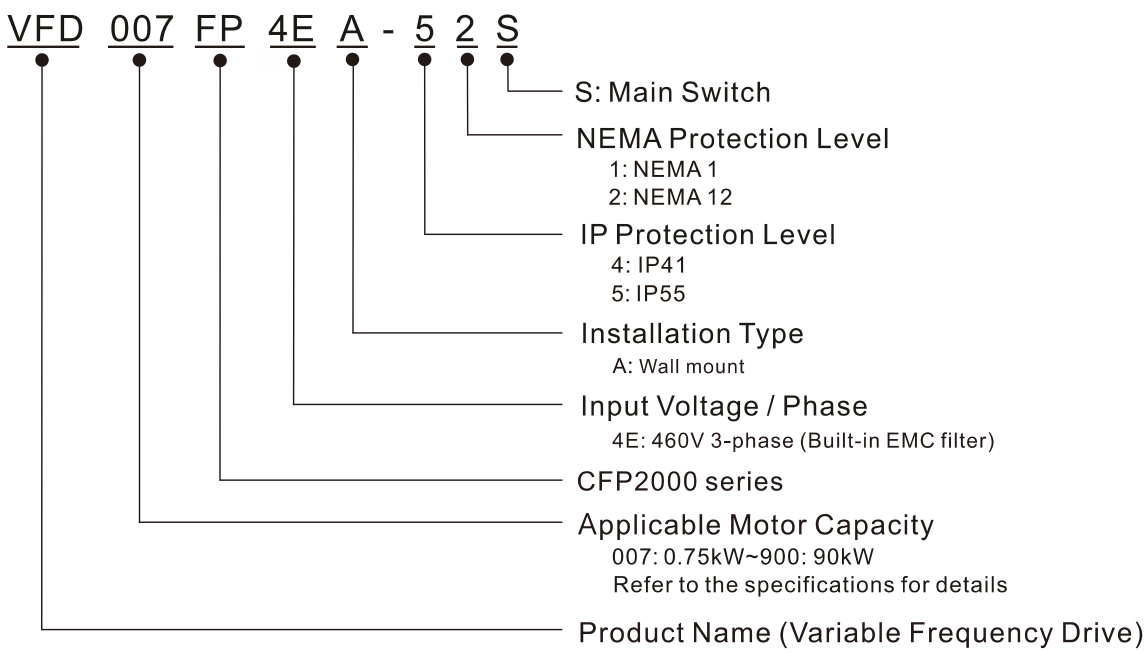
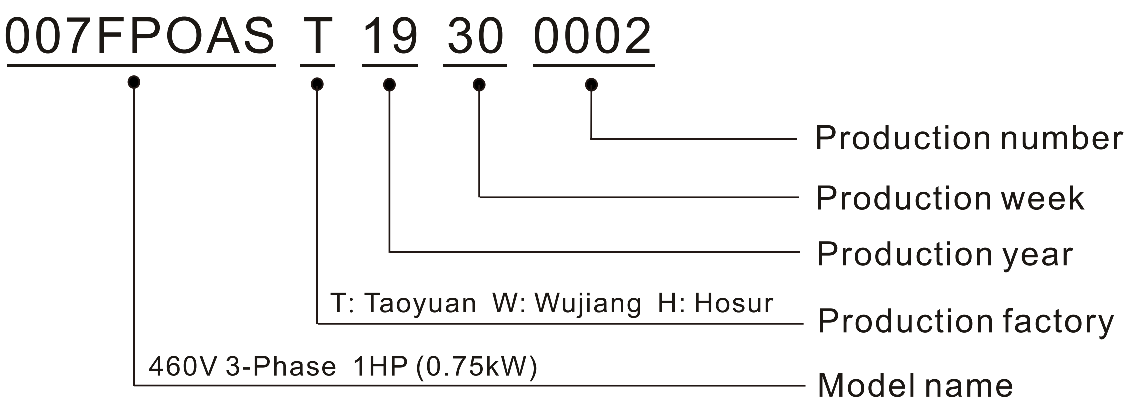


Figure 1-1

1-2 Model Name



1-3 Serial Number



1-4 Apply After Service by Mobile Device

1-4-1 Location of Service Link Label

Frame A–D

Service link label (Service Label) will be pasted on the lower-left corner of the side where keypad is installed on the case body, as below drawing shown:

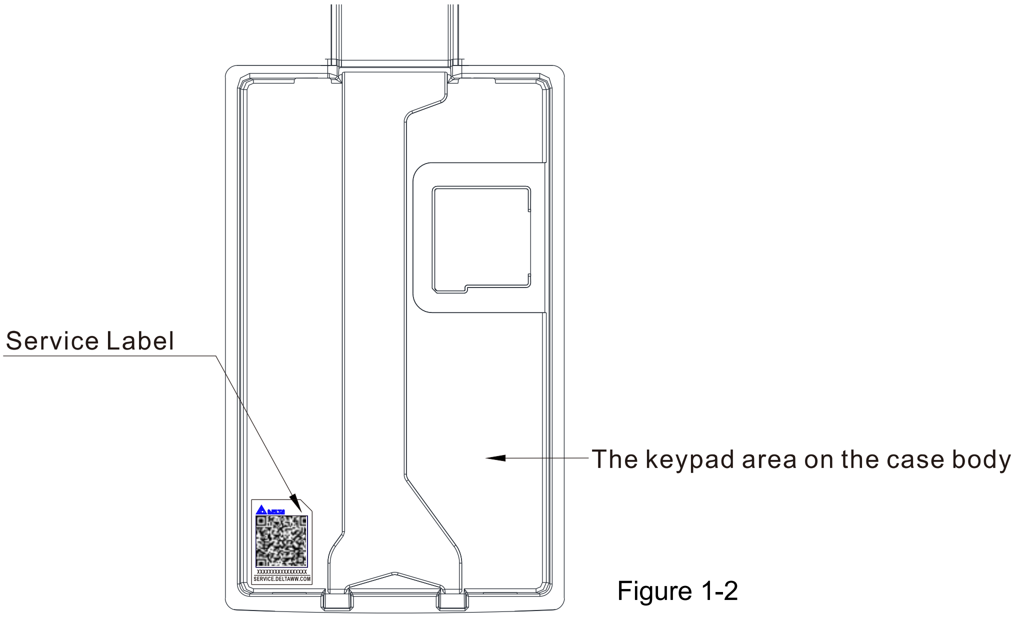


Figure 1-2

1-4-2 Service Link Label

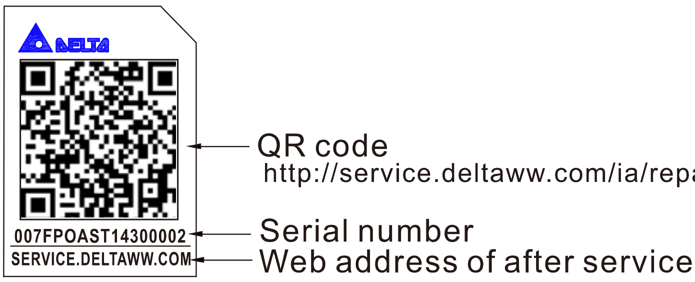


Figure 1-3

Scan QR Code to apply

1. Find out the QR code sticker (as above shown).
2. Using a Smartphone to run a QR Code reader APP.
3. Point your camera to the QR Code. Hold your camera steady so that the QR code comes into focus.
4. Access the Delta after Service website.
5. Fill your information into the column marked with an orange star.
6. Enter the CAPTCHA and click “Submit” to complete the application.

Cannot find out the QR Code?

1. Open a web browser on your computer or smart phone.
2. Key in https://service.deltaww.com/ia/repair in address bar and press enter.
3. Fill your information into the columns marked with an orange star.
4. Enter the CAPTCHA and click “Submit” to complete the application.

1-5 RFI Jumper

(1) In the drive there are Varistor / MOVs, which are connected from phase to phase and from phase to ground, to protect the drive against mains surges or voltage spikes.
Because the Varistors / MOVs from phase to ground are connected to ground via the RFI jumper, the protection will be ineffective when the RFI jumper is removed.

(2) In the models with built-in EMC filter the RFI jumper connects the filer capacitors to ground to form a return path for high frequency noise to isolate the noise from contaminating the mains power. Removing the RFI jumper strongly reduces the effect of the built-in EMC filter. Although a single drive complies with the international standards for leakage current, an installation with several drives with built-in EMC filter can trigger the RCD. Removing the RFI jumper helps, but the EMC performance of each drive would be no longer guaranteed.

Frame A

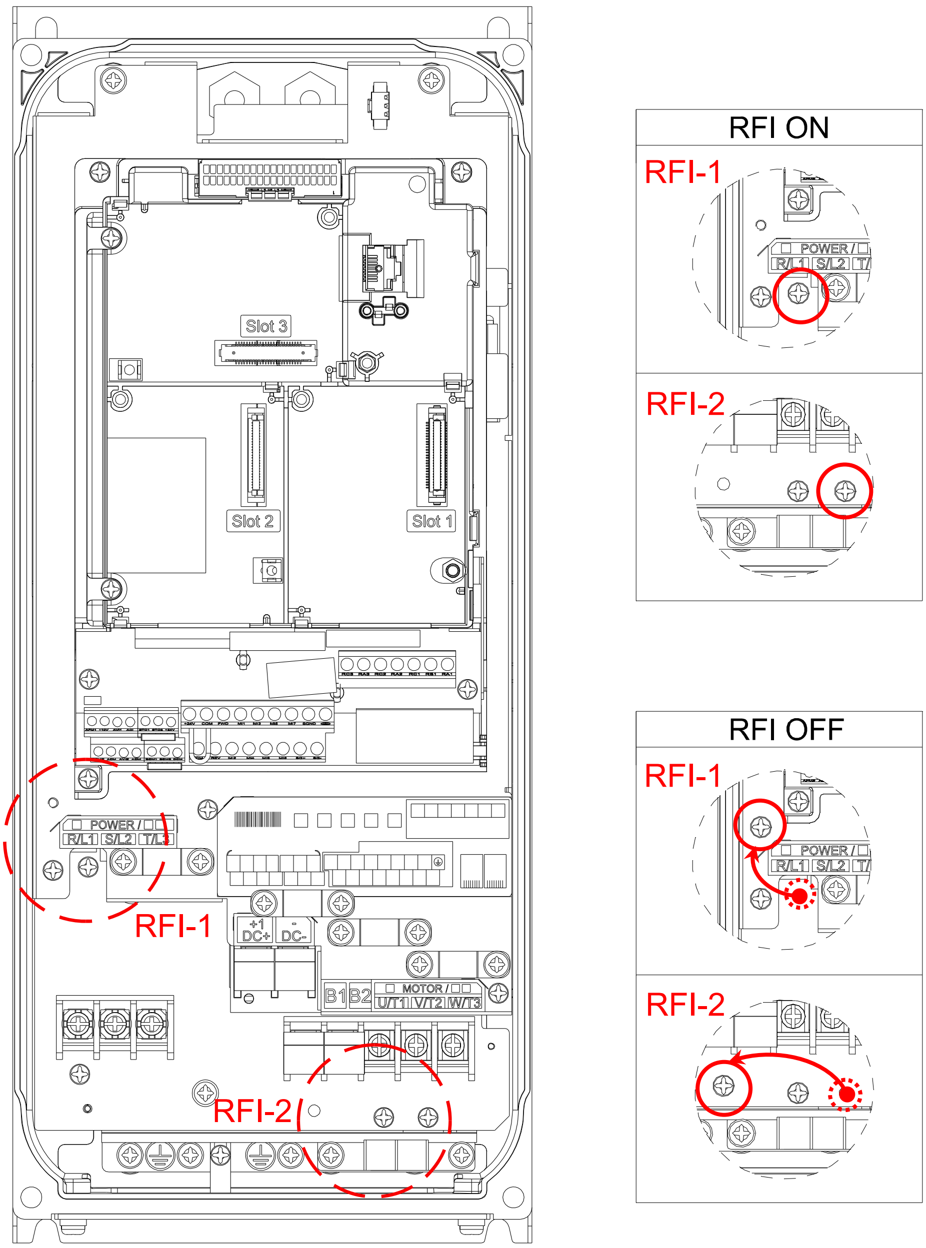


Figure 1-4

Frame B

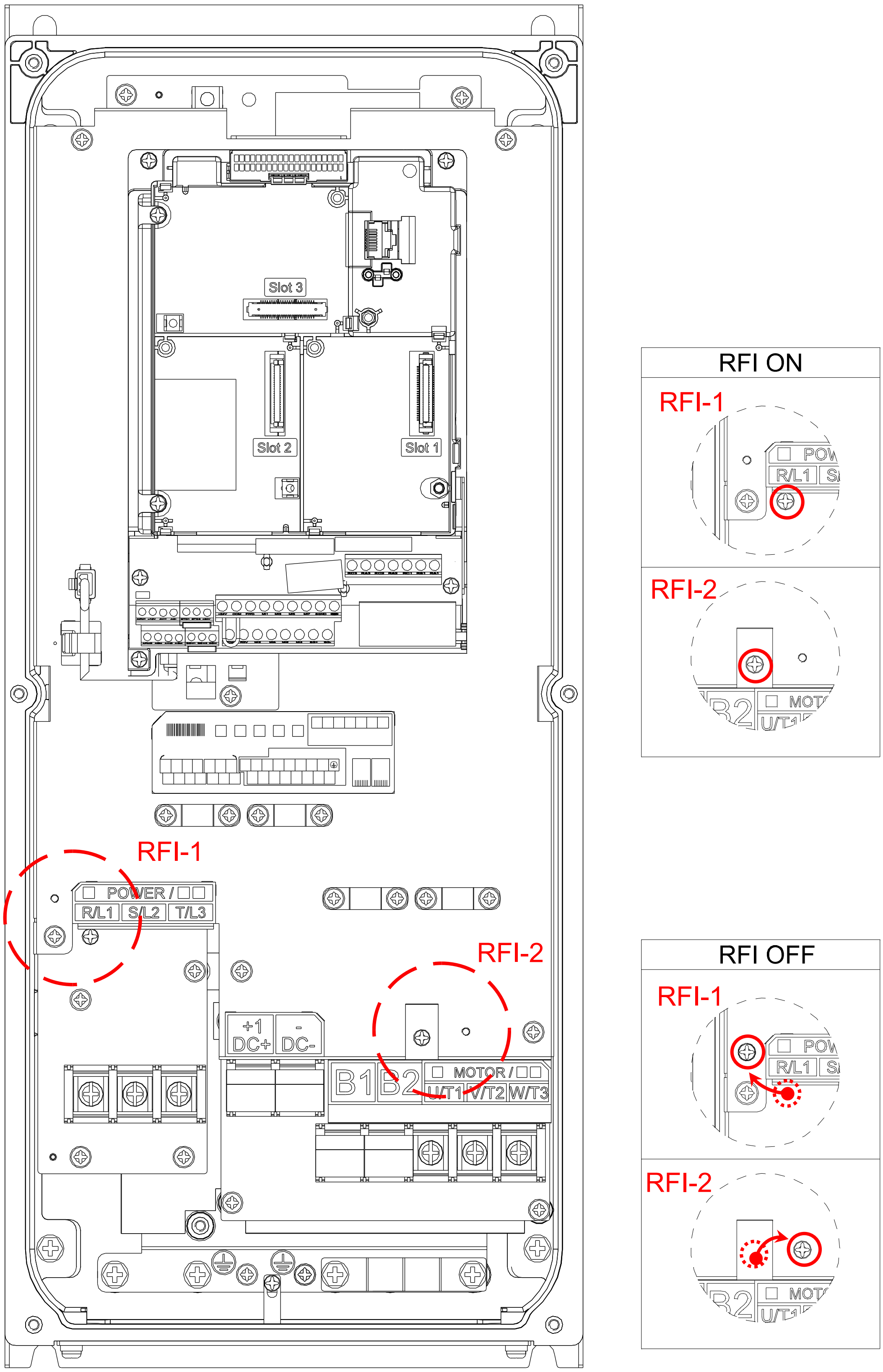


Figure 1-5

Frame C

By switching the position of the RFI jumper to control ON / OFF.

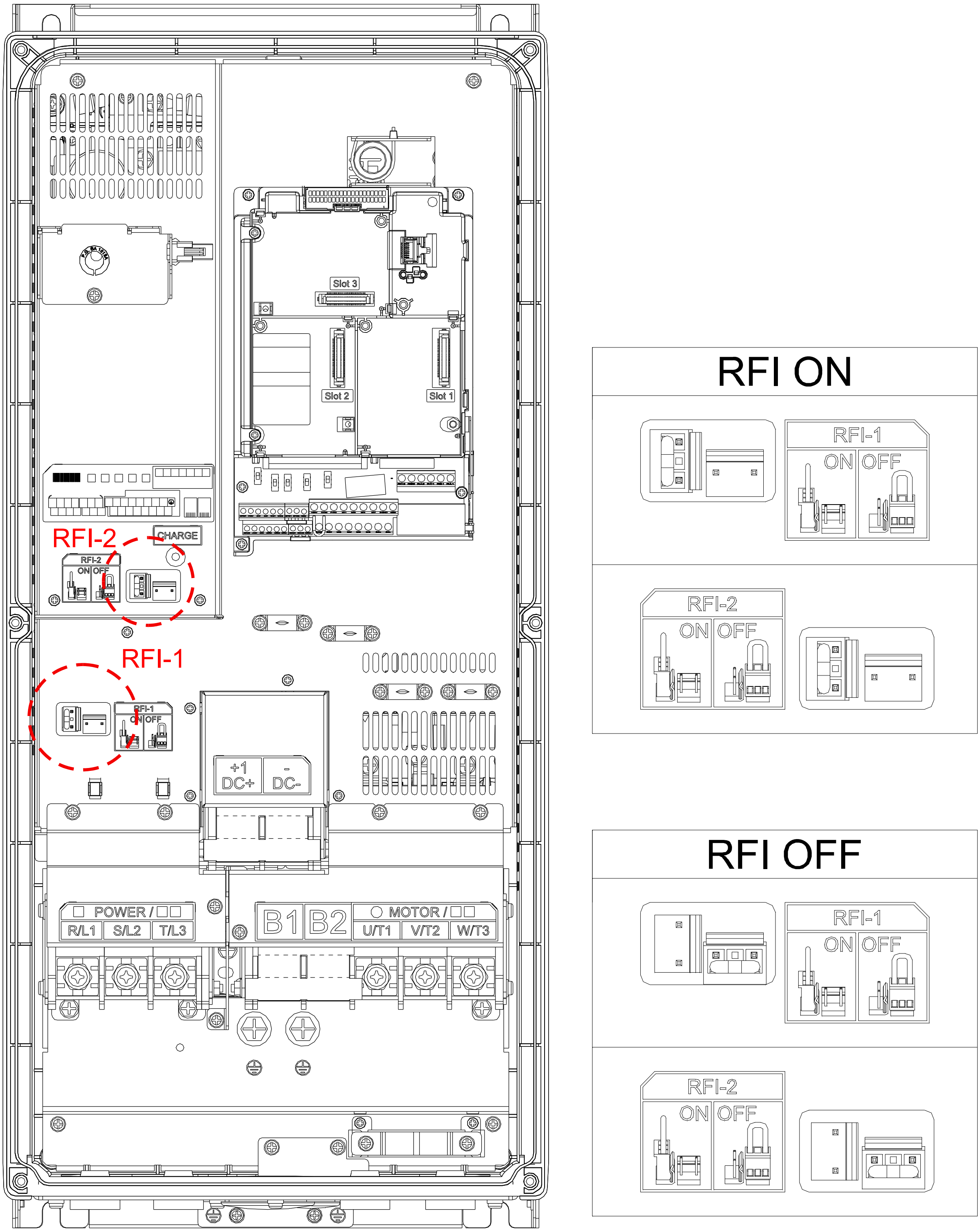


Figure 1-6

Frame D0

By switching the position of the RFI jumper to control ON / OFF.

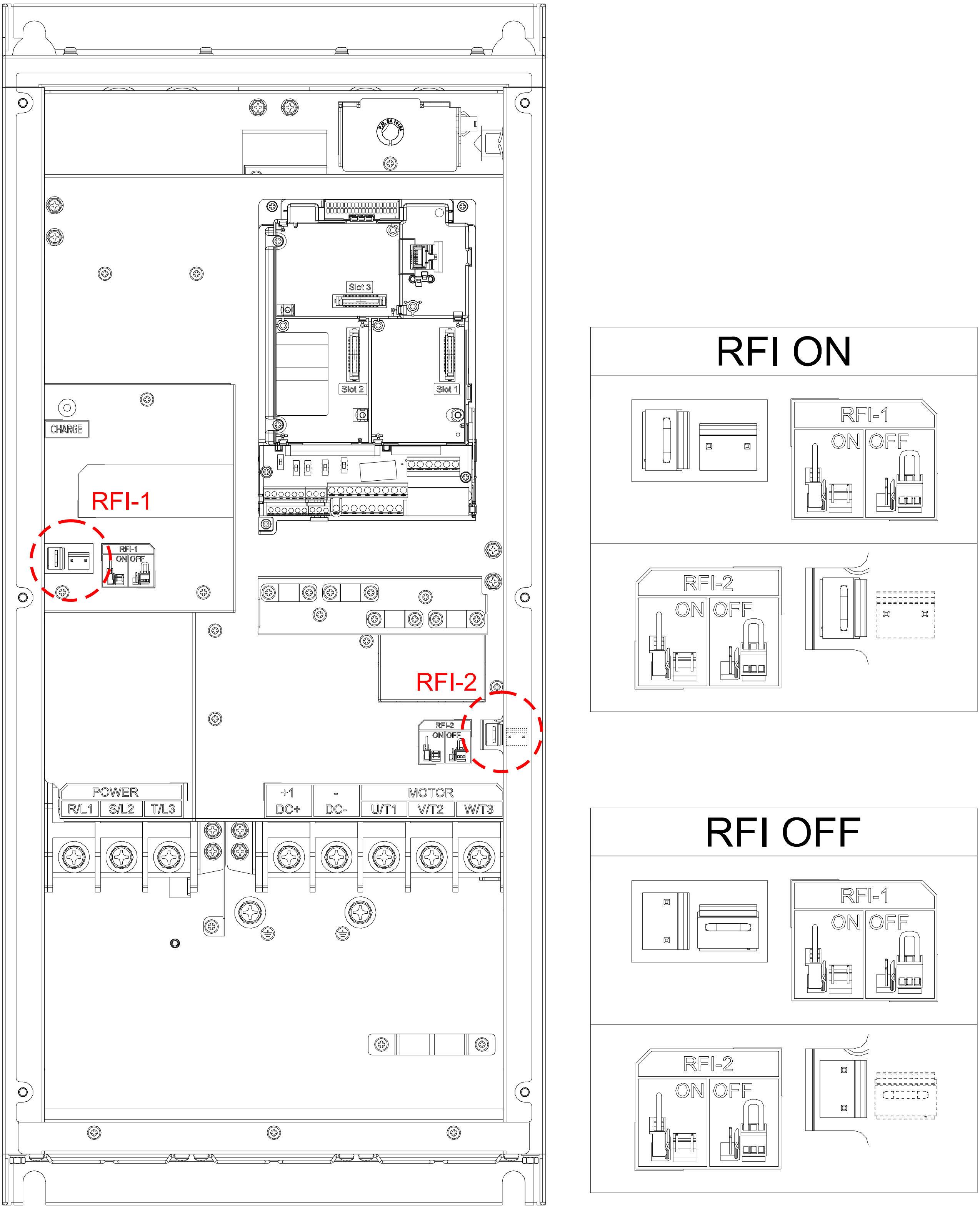
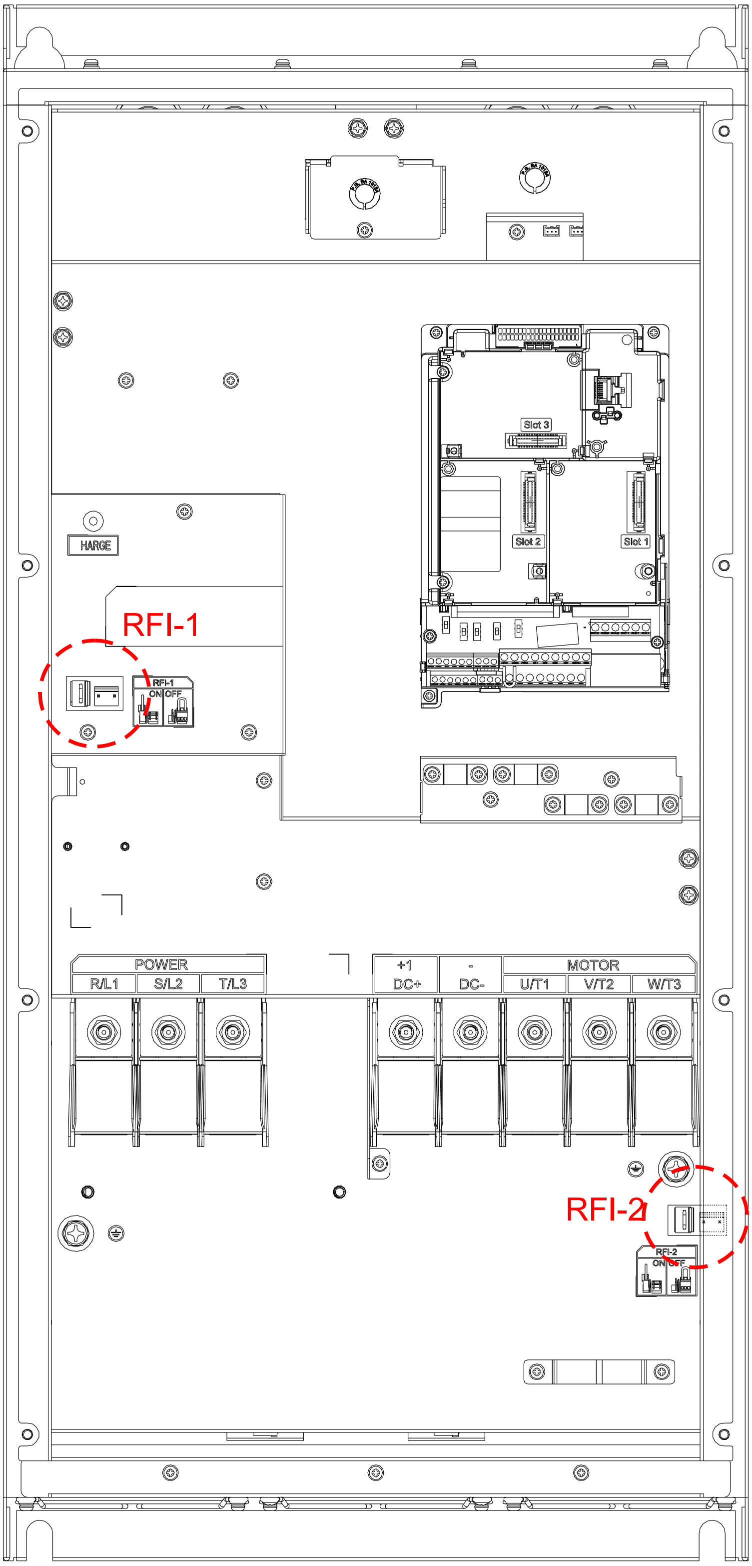
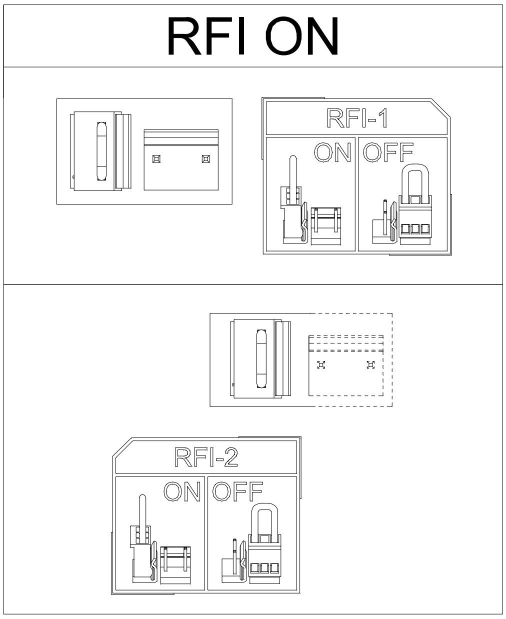


Figure 1-7

Frame D

By switching the position of the RFI jumper to control ON / OFF.





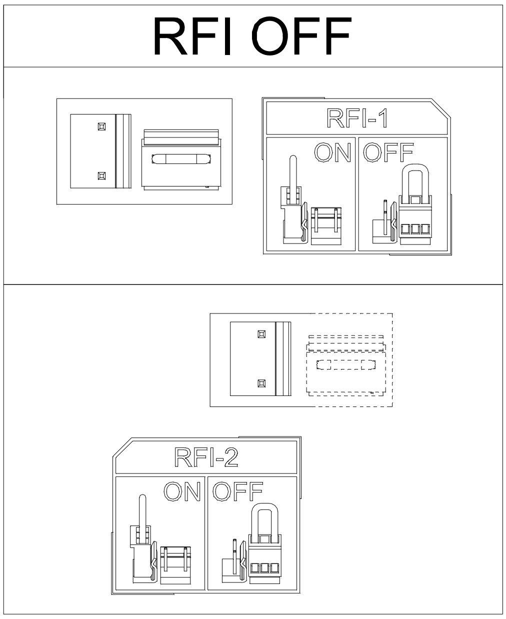


Figure 1-8

Remove the built-in EMC Filter:

In some specific power system, the shunt capacitors might cause damage to the motor drive or electrically charge the enclosure to cause electrical shock. Because of this, follow these recommendations for jumper / screw installation of these three power systems:

Jumper/screw	TN-S System	TT System	IT System
RFI-1	Keep	Keep	Remove
RFI-2	Keep	Remove	Remove

Note1: If any of the RFIs is removed, the EMC effect is affected.

Note 2: Using a LCB (leakage circuit breaker) designed for a motor drive is recommended. If an LCB has tripped, remove the RFI-2 (jumper/ screw) or contact an authorized Delta dealer near you.

Note 3: Grounding Systems

The international standard IEC60364 distinguishes three different grounding system categories, using the two-letter codes TN, TT, IT.

The **first letter** indicates the type of grounding for the power supply equipment (generator or transformer).

T: One or more points on the power supply equipment are connected directly to the same grounding point.

I: Either no point is connected to ground (isolated) or it is connected to ground with high impedance.

The **second letter** indicates the connection between ground and the power supply equipment.

T: Connected directly to ground. This grounding point is separated from other grounding points in the power supply.

N: Connected to ground by the conductor that is provided by the power supply system

Isolating main power from ground:

When the power distribution system of the drive is a floating ground system (IT Systems) or an asymmetric ground system (Corner Grounded TN Systems), you must remove the RFI Jumper. Removing the RFI Jumper disconnects the internal capacitors from ground to avoid damaging the internal circuits and to reduce the ground leakage current.

Important points regarding ground connection:

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

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

☑ The shield of shielded cables must be connected to the ground of the drive to meet safety regulations.

☑ The shield of shielded power cables can only be used as the ground for equipment when the aforementioned points are met.

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

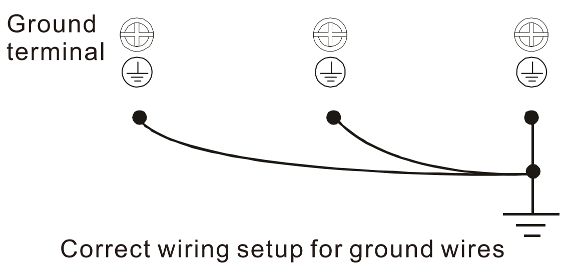


Figure 1-9

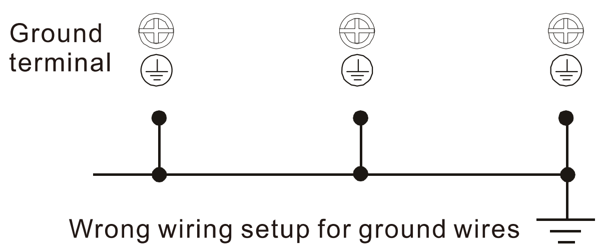


Figure 1-10

Pay particular attention to the following points:

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

☑ Removing the RFI jumper also disconnects the built-in EMC filter capacitors. Compliance with the EMC specifications is no longer guaranteed.

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

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

Floating Ground System(IT Systems)

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

☑ Disconnect the ground cable from the internal EMC filter.

☑ In situations where EMC is required, check whether there is 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 security.

☑ Do not install an external RFI/ EMC filter, the EMC filter will pass through a filter capacitors, thus connecting power input to ground. This is very dangerous and can easily damage the Power Regenerative Unit.

Asymmetric Ground System (Corner Grounded TN Systems)

Caution:

Do not remove the RFI jumper while the input terminal of the Power Regenerative Unit carries power.

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

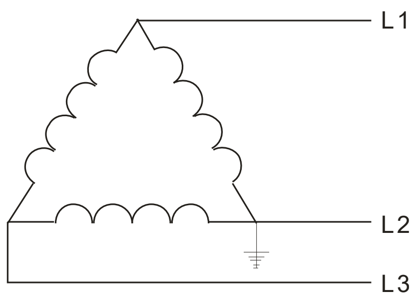
<table>
<tr><th colspan="2">RFI jumper must be removed</th></tr>
<tr><td>1. Grounding at a corner in a triangle configuration


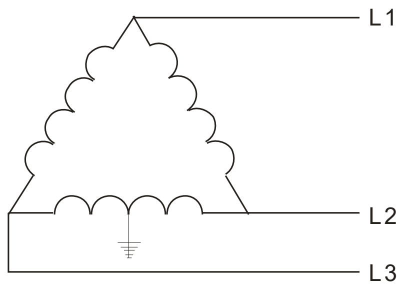
Figure 1-11</td><td>2. Grounding at a midpoint in a polygonal configuration


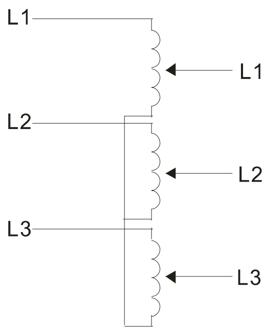
Figure 1-12</td></tr>
<tr><td colspan="2">3. No stable neutral grounding in a three-phase autotransformer configuration


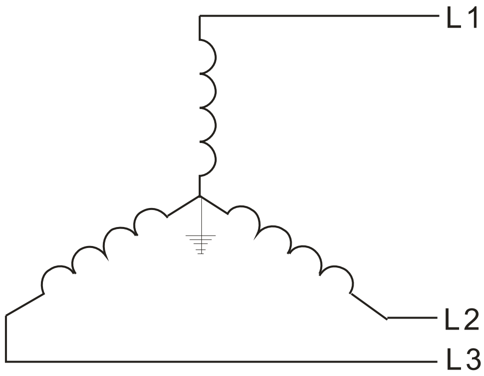
Figure 1-13</td></tr>
<tr><th colspan="2">RFI jumper can be used</th></tr>
<tr><td>Internal grounding through RFI capacitors, which reduces electromagnetic radiation. In a situation with higher requirements for electromagnetic compatibility, and using a symmetrical grounding power system, an EMC filter can be installed. As a reference, the diagram on the right is a symmetrical grounding power system.</td><td>

Figure 1-14</td></tr>
</table>

1-6 Dimensions

Frame A

A-1: VFD007FP4EA-52, VFD015FP4EA-52, VFD022FP4EA-52, VFD037FP4EA-52, VFD040FP4EA-52, VFD055FP4EA-52, VFD075FP4EA-52

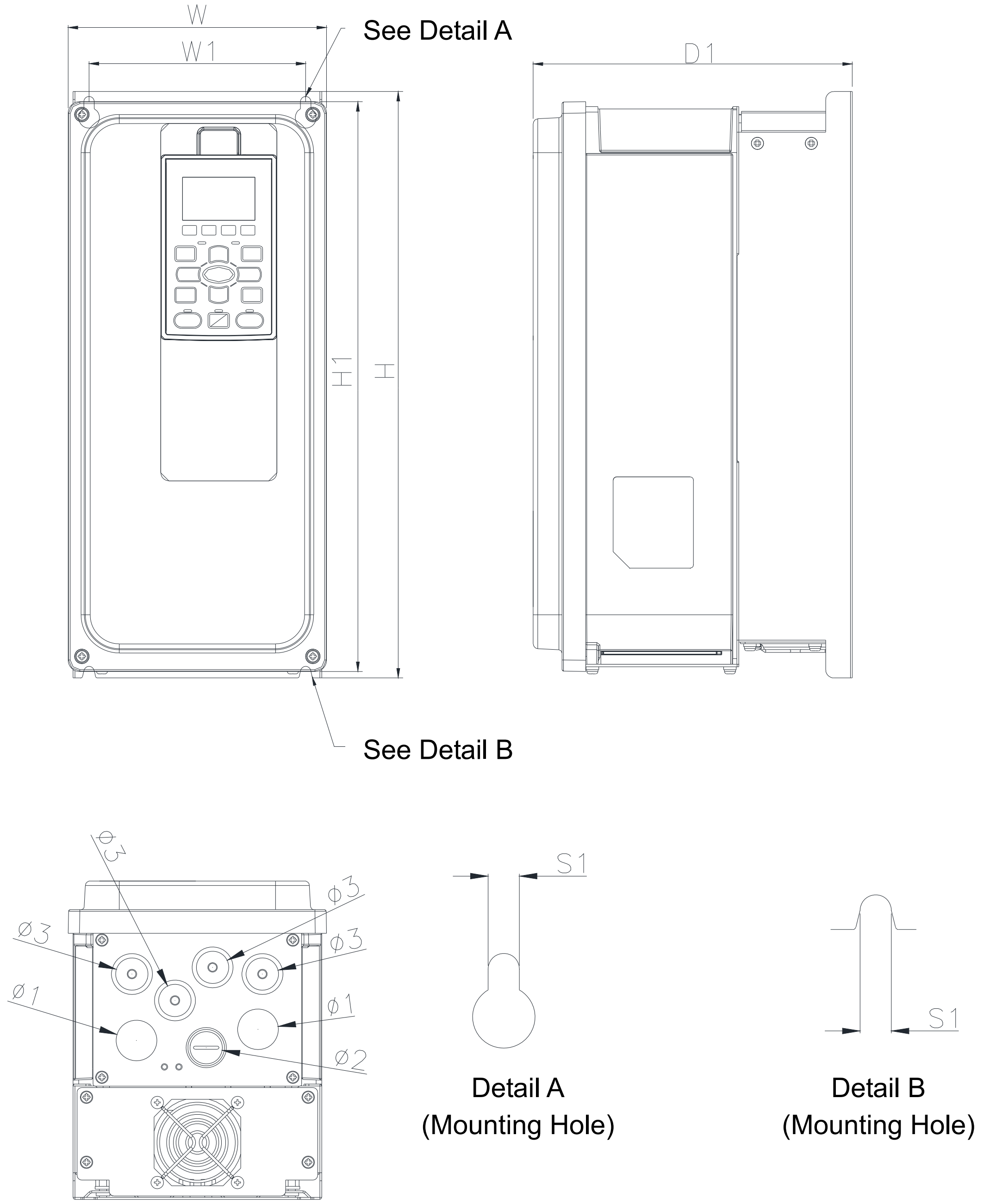


Figure 1-15

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
A-1	161.0 [6.34]	135.0 [5.31]	366.4 [14.43]	356.0 [14.02]	-	199.0 [7.83]	6.5 [0.26]	25.4 [1.00]	20.3 [0.80]	20.3 [0.80]

Table 1-1

Frame A

A-2: VFD007FP4EA-52S, VFD015FP4EA-52S, VFD022FP4EA-52S, VFD037FP4EA-52S, VFD040FP4EA-52S, VFD055FP4EA-52S, VFD075FP4EA-52S

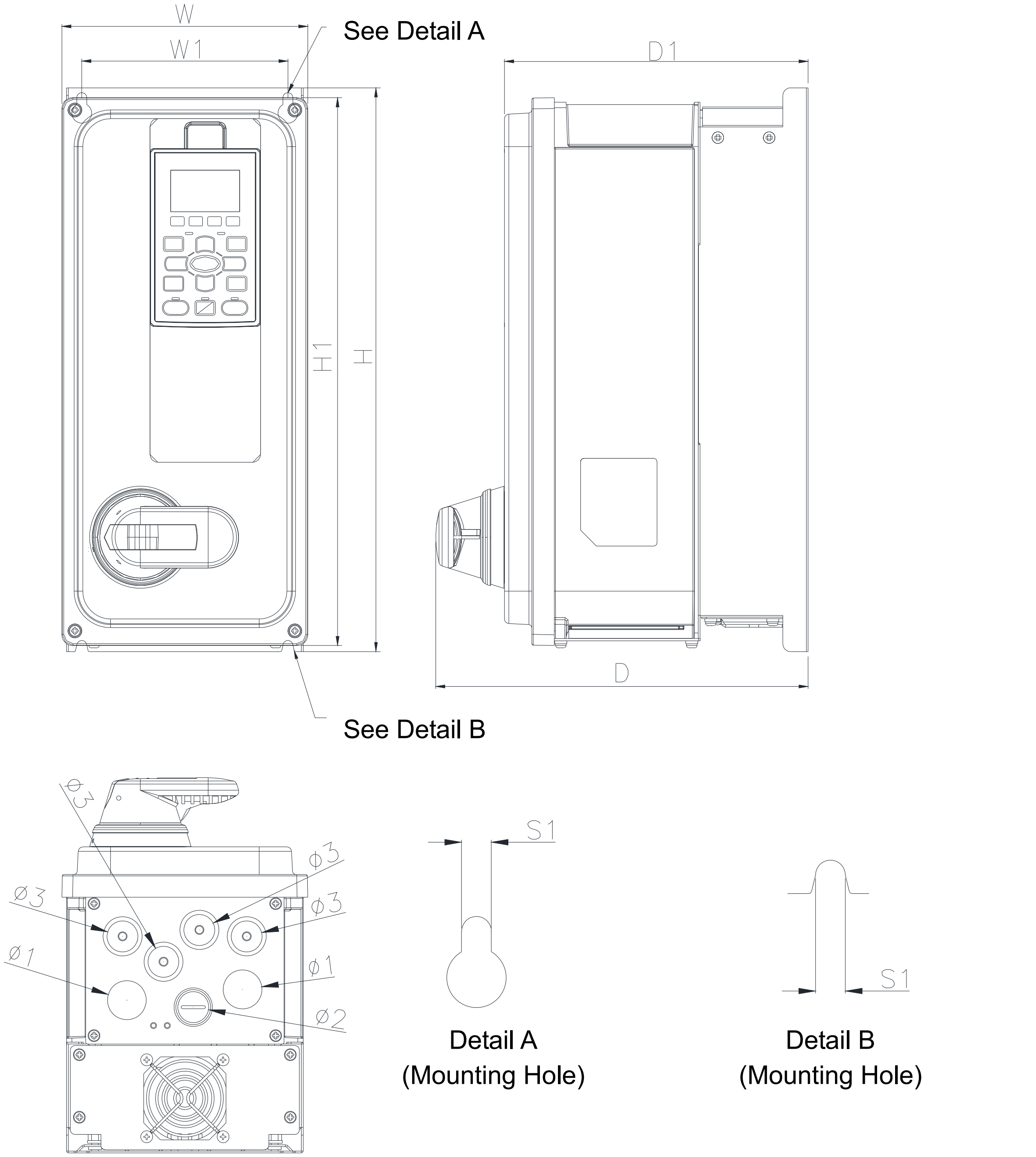


Figure 1-16

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
A-2	161.0 [6.34]	135.0 [5.31]	366.4 [14.43]	356.0 [14.02]	244.0 [9.61]	199.0 [7.83]	6.5 [0.26]	25.4 [1.00]	20.3 [0.80]	20.3 [0.80]

Table 1-2

Frame A

A-3: VFD007FP4EA-41, VFD015FP4EA-41, VFD022FP4EA-41, VFD037FP4EA-41, VFD040FP4EA-41, VFD055FP4EA-41, VFD075FP4EA-41

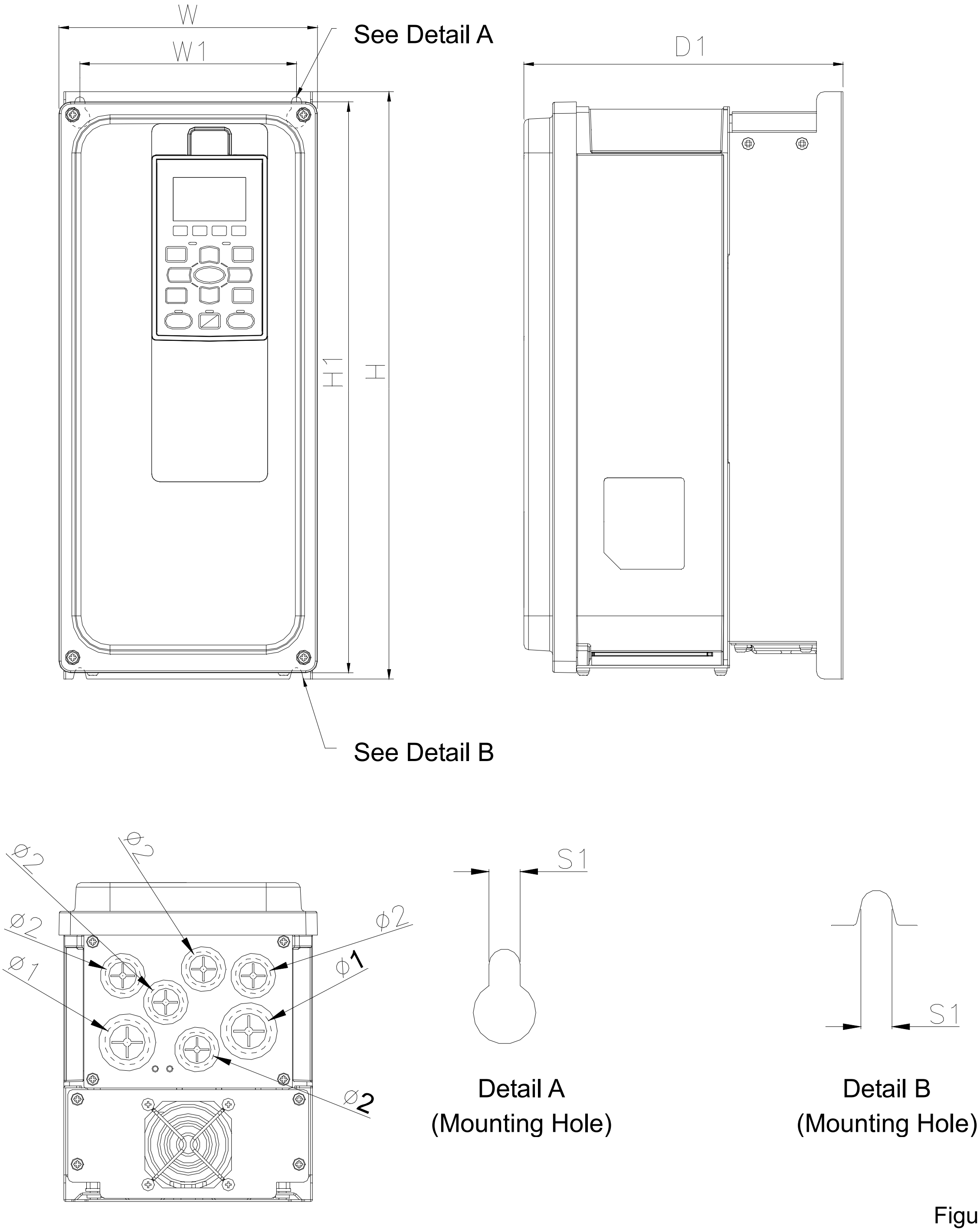


Figure 1-17

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
A-3	161.0 [6.34]	135.0 [5.31]	366.4 [14.43]	356.0 [14.02]	–	199.0 [7.83]	6.5 [0.26]	28.0 [1.10]	22.0 [0.87]	–

Table 1-3

Frame B

B-1: VFD110FP4EA-52, VFD150FP4EA-52, VFD185FP4EA-52, VFD220FP4EA-52

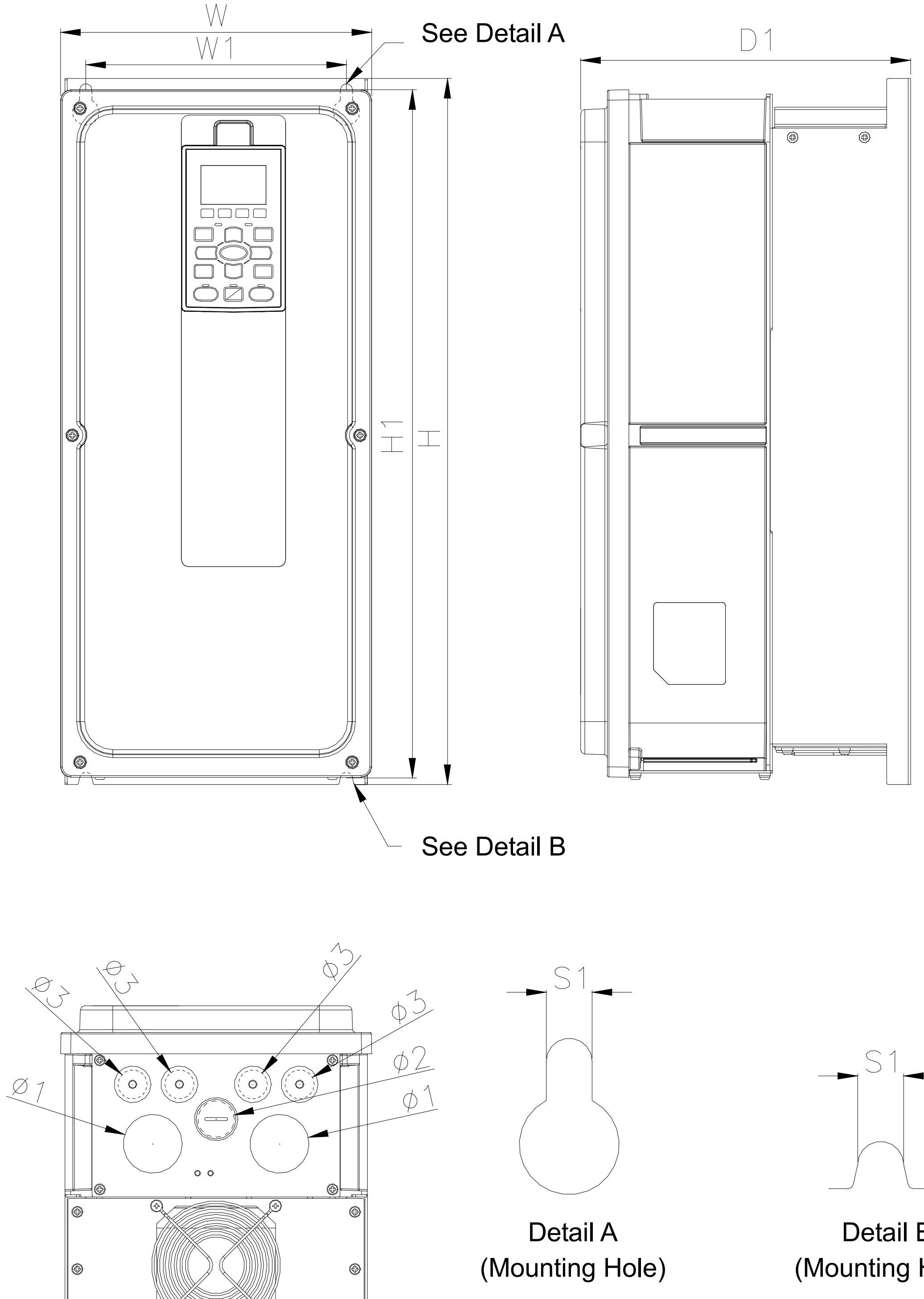


Figure 1-18

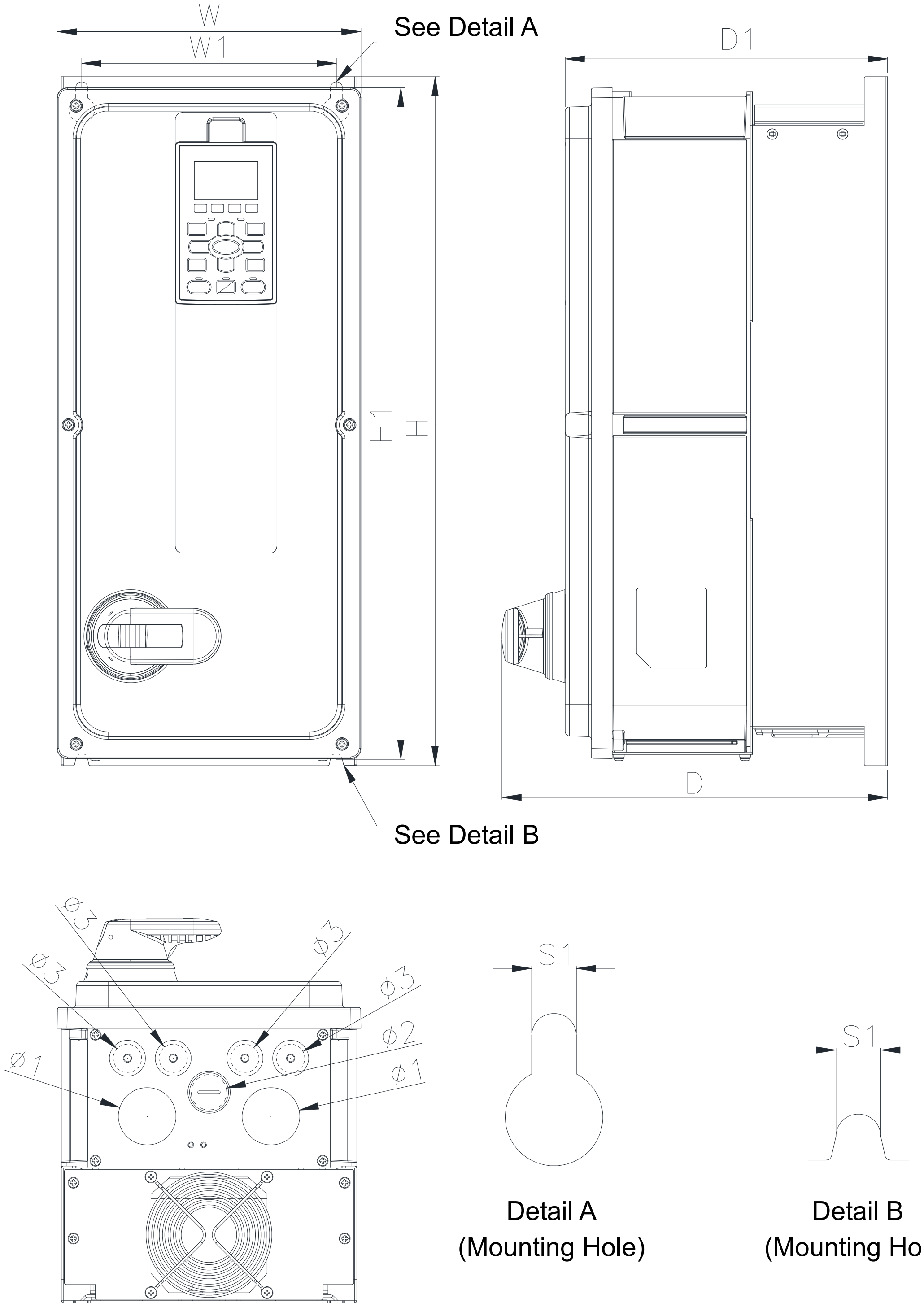
Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
B-1	216.0 [8.50]	181.0 [7.13]	491.4 [19.35]	479.0 [18.86]	-	229.0 [9.02]	8.5 [0.33]	41.0 [1.61]	25.4 [1.00]	20.3 [0.80]

Table 1-4

Frame B

B-2: VFD110FP4EA-52S, VFD150FP4EA-52S, VFD185FP4EA-52S, VFD220FP4EA-52S



Detail A
(Mounting Hole)

Detail B
(Mounting Hole)

Figure 1-19

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
B-2	216.0 [8.50]	181.0 [7.13]	491.4 [19.35]	479.0 [18.86]	274.0 [10.79]	229.0 [9.02]	8.5 [0.33]	41.0 [1.61]	25.4 [1.00]	20.3 [0.80]

Table 1-5

Frame B

B-3: VFD110FP4EA-41, VFD150FP4EA-41, VFD185FP4EA-41, VFD220FP4EA-41

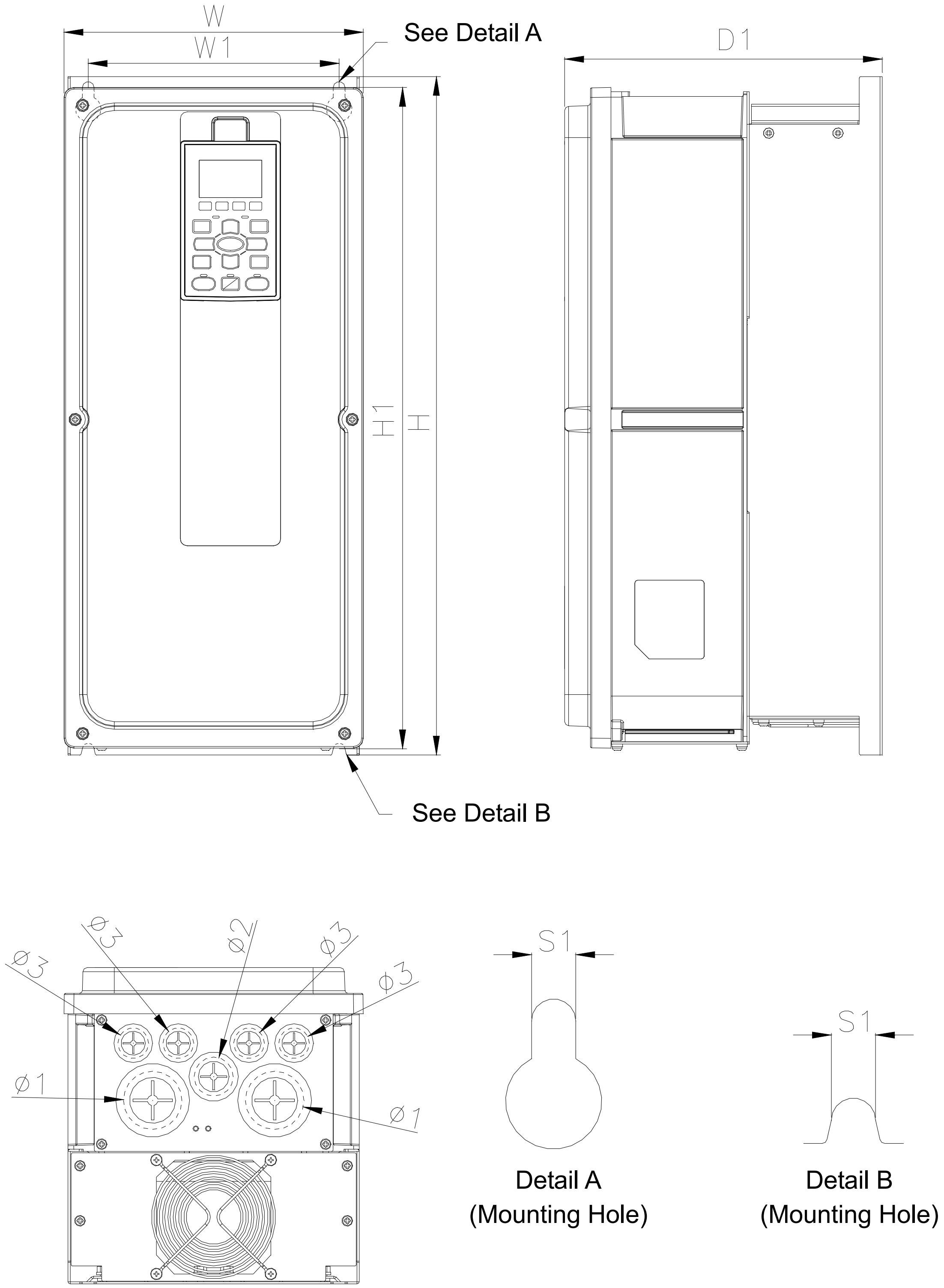


Figure 1-20

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
B-3	216.0 [8.50]	181.0 [7.13]	491.4 [19.35]	479.0 [18.86]	-	229.0 [9.02]	8.5 [0.33]	41.8 [1.65]	28.0 [1.10]	22.0 [0.87]

Table 1-6

Frame C

C-1: VFD300FP4EA-52, VFD370FP4EA-52

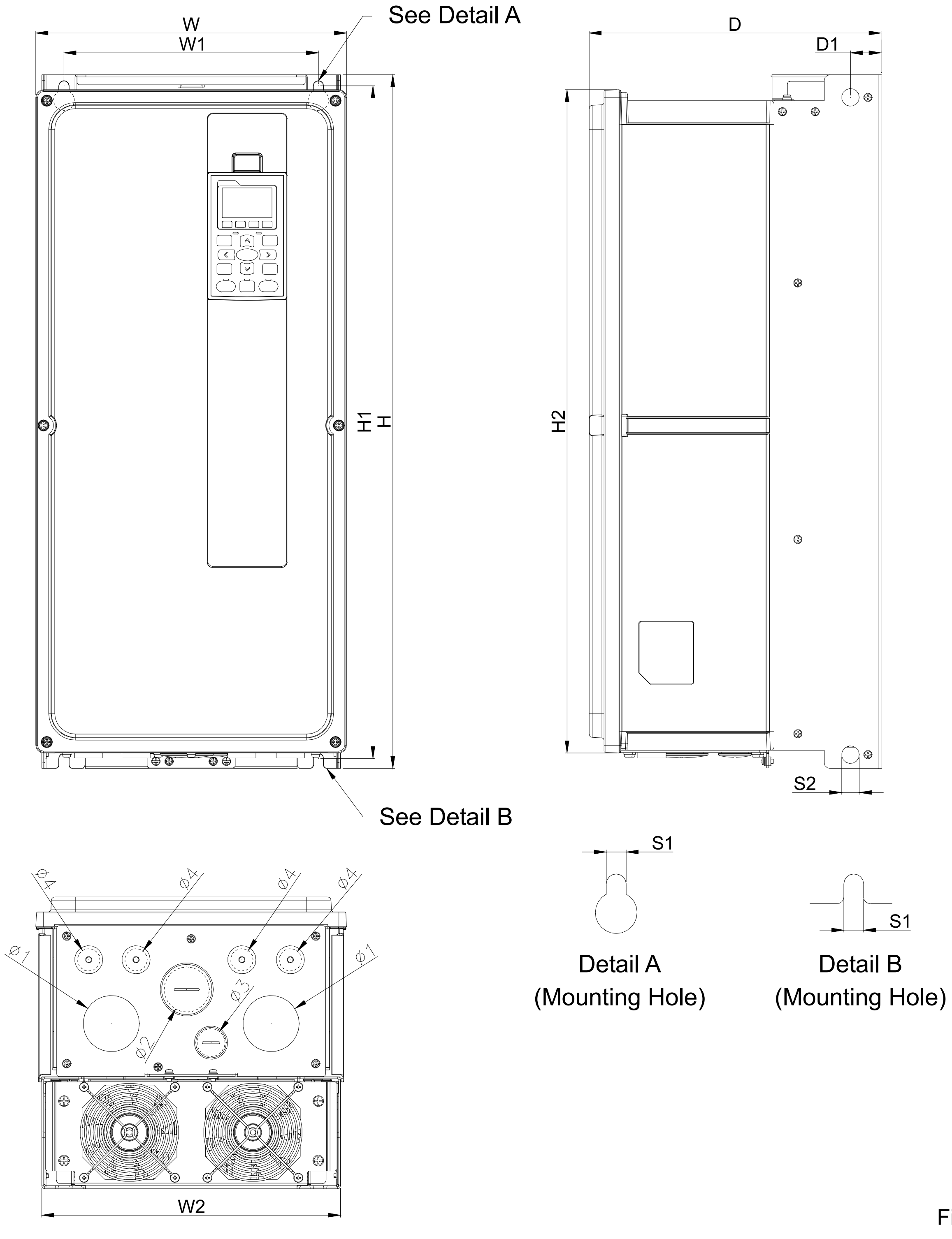


Figure 1-21

Unit: mm [inch]

Frame	W	W1	W2	H	H1	H2	D
C-1	282.0 [11.10]	231.0 [9.09]	271.0 [10.67]	630.0 [24.8]	611.0 [24.06]	602.5 [23.72]	265.0 [10.43]

Frame	D1	S1	S2	Φ1	Φ2	Φ3	Φ4
C-1	27.8 [1.09]	9.0 [0.35]	16.0 [0.63]	51.0 [2.01]	41.0 [1.61]	25.4 [1.00]	20.3 [0.80]

Table 1-7

Frame C

C-2: VFD300FP4EA-52S, VFD370FP4EA-52S

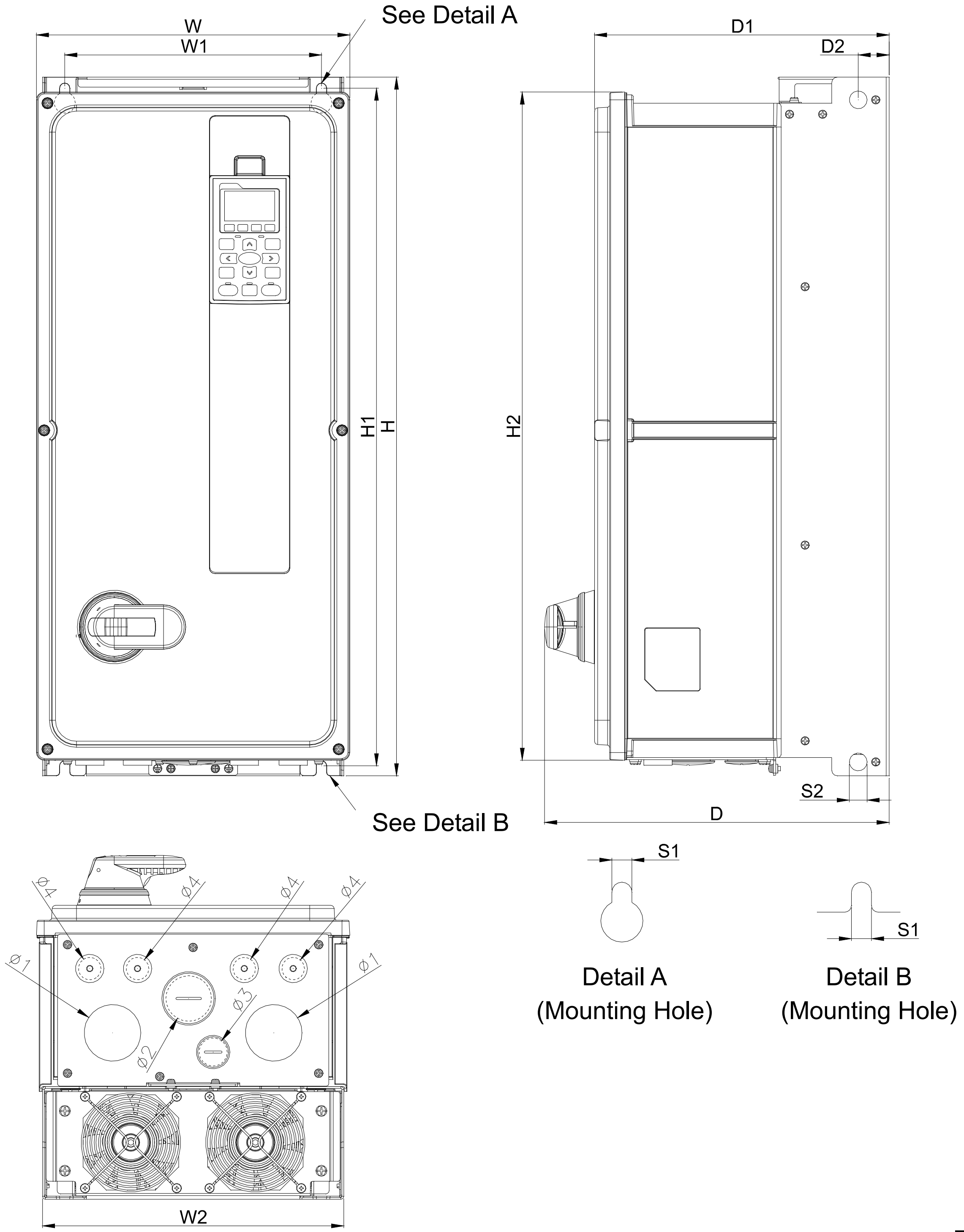


Figure 1-22

Unit: mm [inch]

Frame	W	W1	W2	H	H1	H2	D	D1
C-2	282.0 [11.10]	231.0 [9.09]	271.0 [10.67]	630.0 [24.8]	611.0 [24.06]	602.5 [23.72]	310.0 [12.20]	265.0 [10.43]

Frame	D2	S1	S2	Φ1	Φ2	Φ3	Φ4
C-2	27.8 [1.09]	9.0 [0.35]	16.0 [0.63]	51.0 [2.01]	41.0 [1.61]	25.4 [1.00]	20.3 [0.80]

Table 1-8

Frame C

C-3: VFD300FP4EA-41, VFD370FP4EA-41

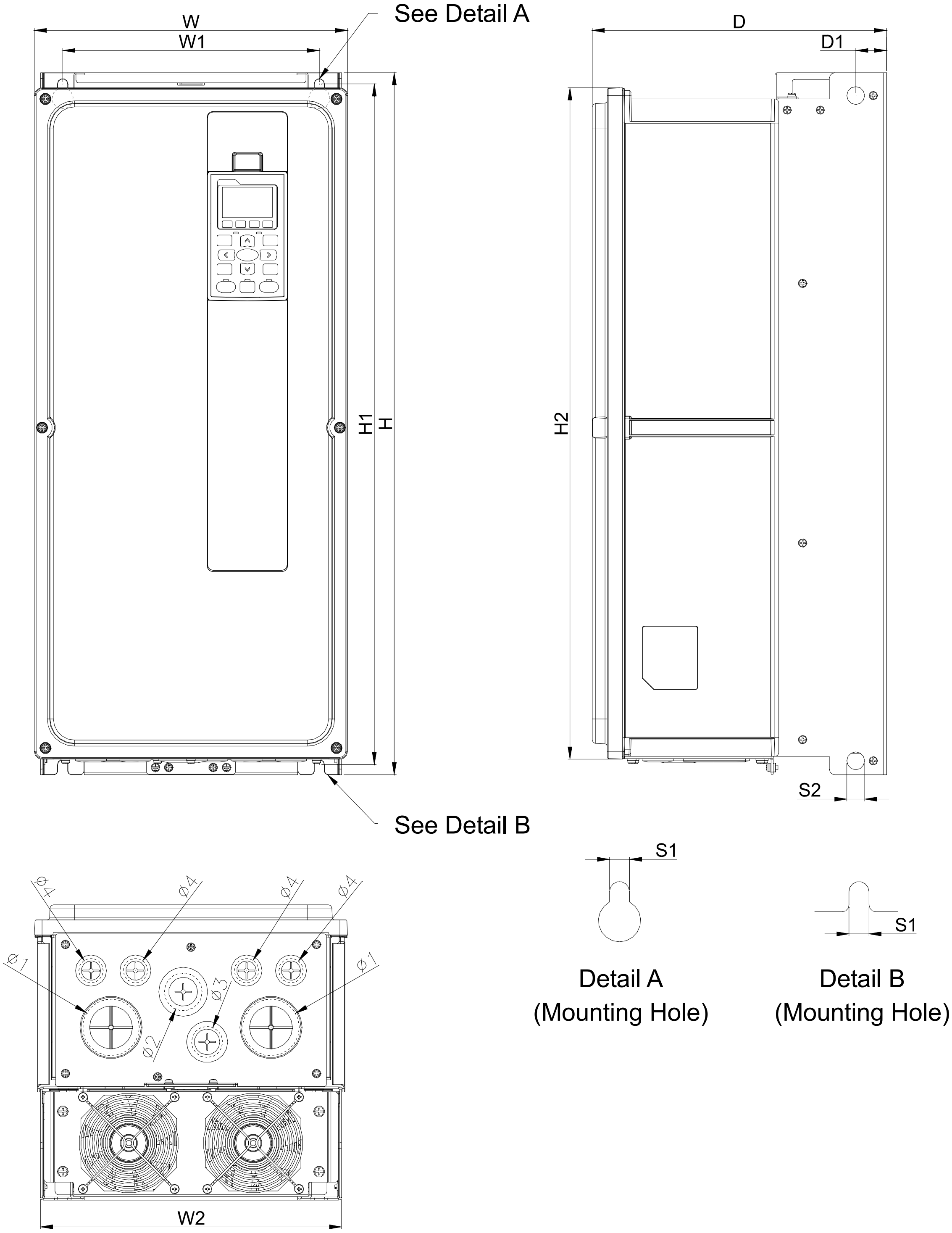


Figure 1-23

Unit: mm [inch]

Frame	W	W1	W2	H	H1	H2	D
C-3	282.0 [11.10]	231.0 [9.09]	271.0 [10.67]	630.0 [24.80]	611.0 [24.06]	602.5 [23.72]	265.0 [10.43]

Frame	D1	S1	S2	Φ1	Φ2	Φ3	Φ4
C-3	27.8 [1.09]	9.0 [0.35]	16.0 [0.63]	51.0 [2.01]	34.0 [1.34]	28.0 [1.10]	22.0 [0.87]

Table 1-9

Frame D0

D0-1: VFD450FP4EA-52, VFD550FP4EA-52

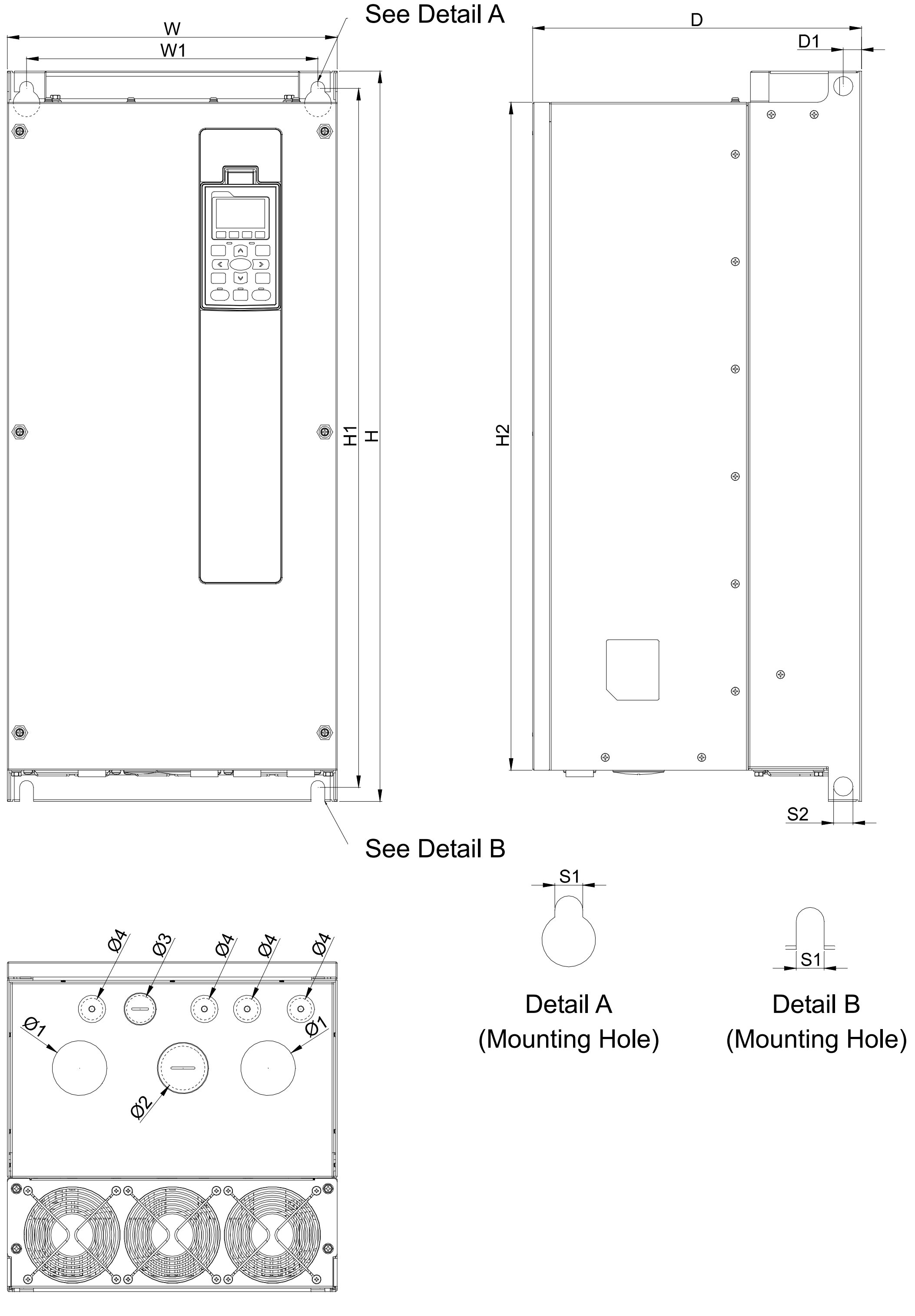


Figure 1-24

Unit: mm [inch]

Frame	W	W1	H	H1	H2	D
D0-1	308.0 [12.13]	272.0 [10.71]	680.0 [26.77]	651.0 [25.63]	622.0 [24.49]	307.0 [12.09]

Frame	D1	S1	S2	Φ1	Φ2	Φ3	Φ4
D0-1	17.0 [0.67]	13.0 [0.51]	18.0 [0.71]	51.0 [2.01]	41.0 [1.61]	25.4 [1.00]	20.3 [0.80]

Table 1-10

Frame D0

D0-2: VFD450FP4EA-52S, VFD550FP4EA-52S

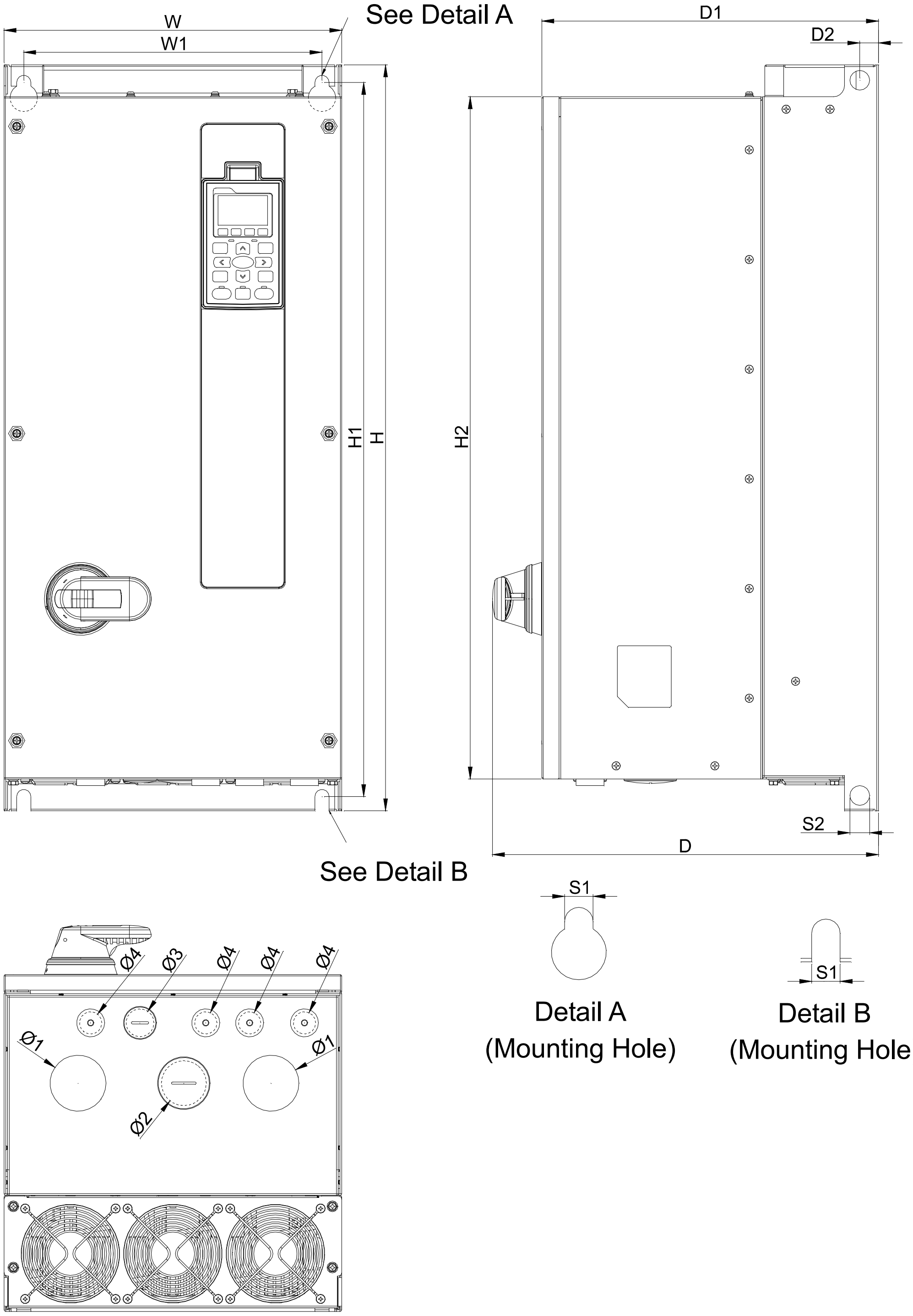


Figure 1-25

Unit: mm [inch]

Frame	W	W1	H	H1	H2	D	D1
D0-2	308.0 [12.13]	272.0 [10.71]	680.0 [26.77]	651.0 [25.63]	622.0 [24.49]	352.0 [13.86]	307.0 [12.09]

Frame	D2	S1	S2	Φ1	Φ2	Φ3	Φ4
D0-2	17.0 [0.67]	13.0 [0.51]	18.0 [0.71]	51.0 [2.01]	41.0 [1.61]	25.4 [1.00]	20.3 [0.80]

Table 1-11

Frame D0

D0-3: VFD450FP4EA-41, VFD550FP4EA-41

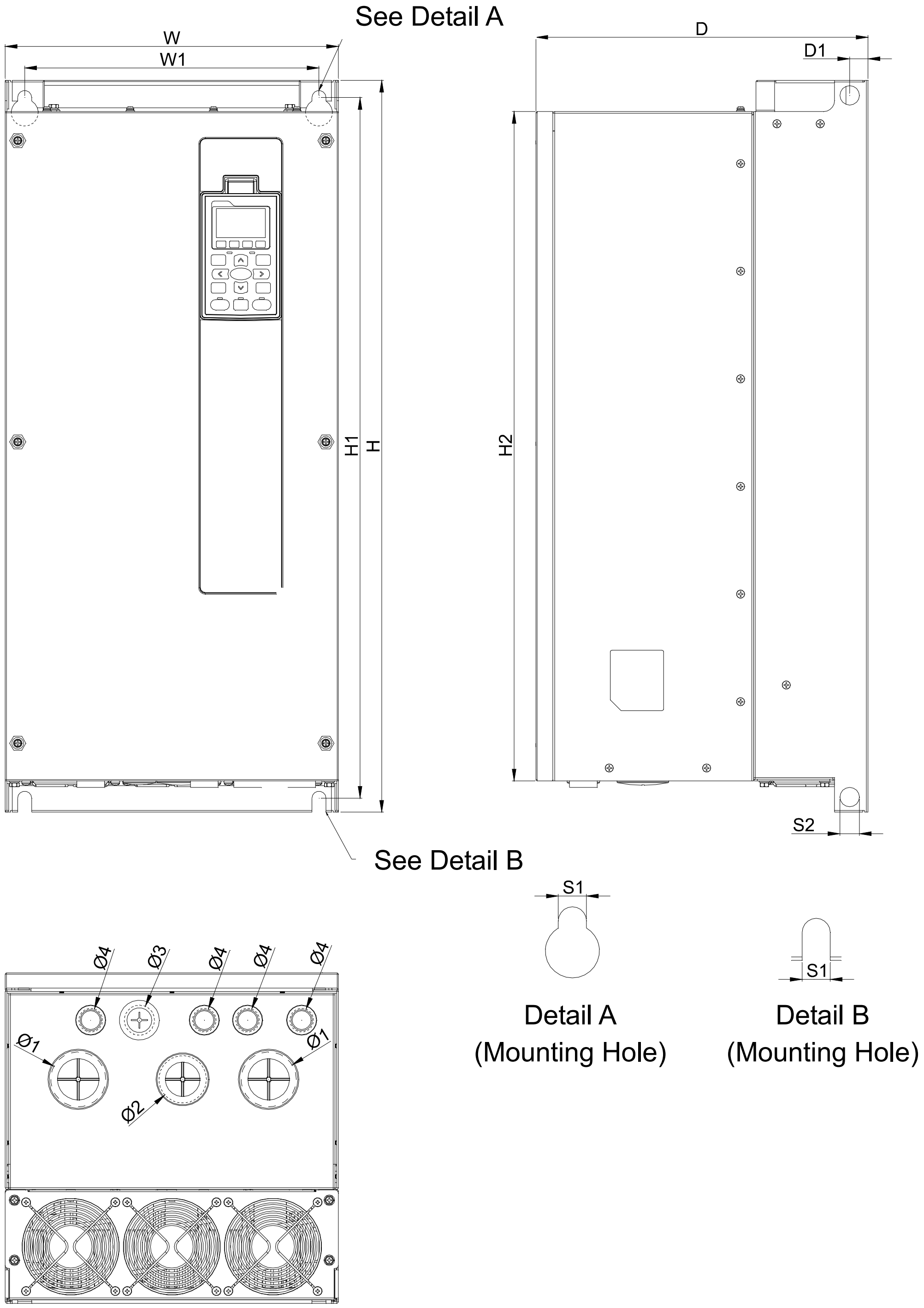


Figure 1-26

Unit: mm [inch]

Frame	W	W1	H	H1	H2	D
D0-3	308.0 [12.13]	272.0 [10.71]	680.0 [26.77]	651.0 [25.63]	622.0 [24.49]	307.0 [12.09]

Frame	D1	S1	S2	Φ1	Φ2	Φ3	Φ4
D0-3	17.0 [0.67]	13.0 [0.51]	18.0 [0.71]	51.0 [2.01]	44.0 [1.73]	28.0 [1.10]	22.0 [0.87]

Table 1-12

Frame D

D-1: VFD750FP4EA-52, VFD900FP4EA-52

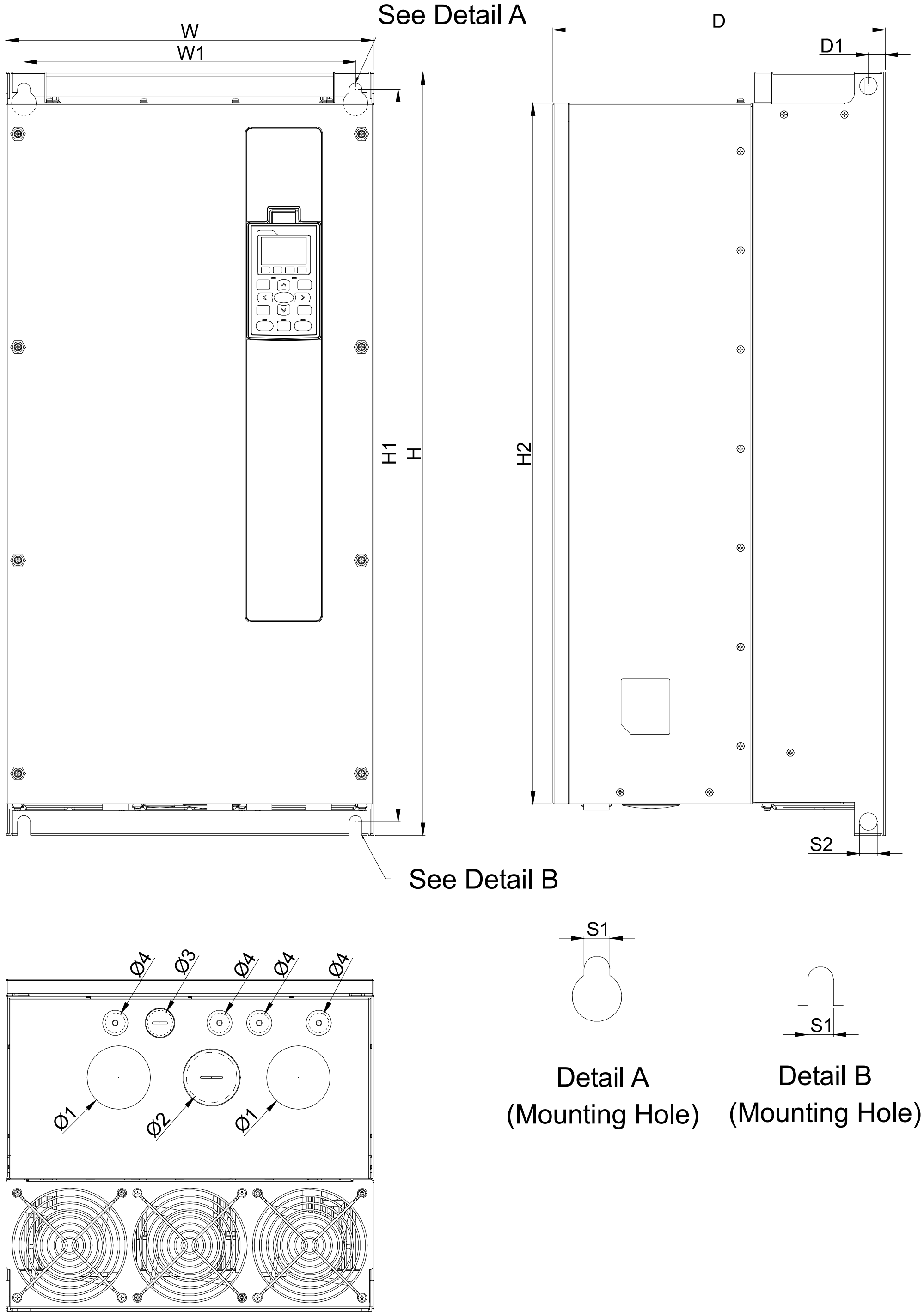


Figure 1-27

Unit: mm [inch]

Frame	W	W1	H	H1	H2	D
D-1	370.0 [14.57]	334.0 [13.15]	770.0 [30.31]	739.0 [29.09]	707.0 [27.83]	335.0 [13.19]

Frame	D1	S1	S2	Φ1	Φ2	Φ3	Φ4
D-1	17.0 [0.67]	13.0 [0.51]	18.0 [0.71]	64.0 [2.52]	51.0 [2.01]	25.4 [1.00]	20.3 [0.80]

Table 1-13

Frame D

D-2: VFD750FP4EA-52S, VFD900FP4EA-52S

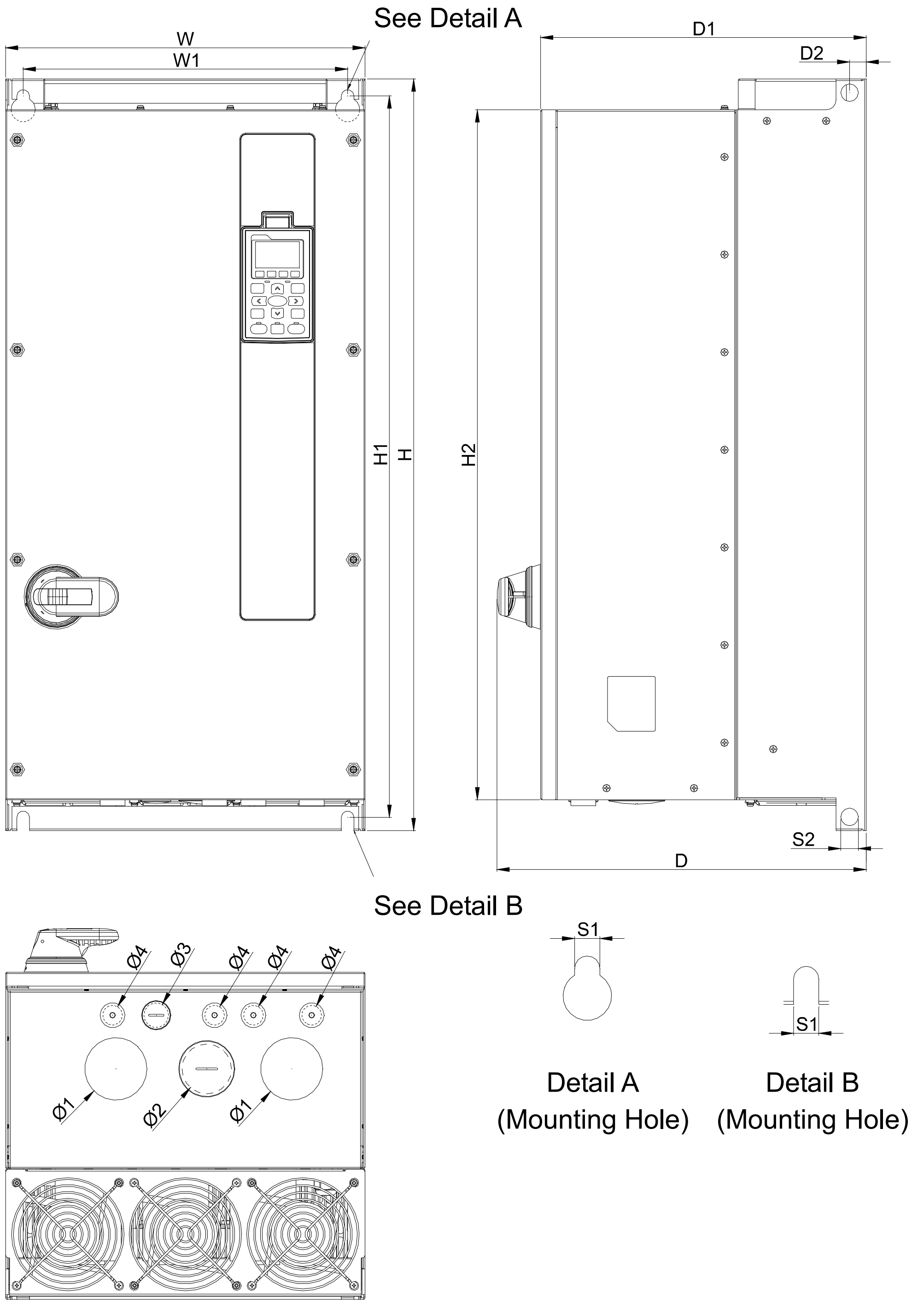


Figure 1-28

Unit: mm [inch]

Frame	W	W1	H	H1	H2	D	D1
D-2	370.0 [14.57]	334.0 [13.15]	770.0 [30.31]	739.0 [29.09]	707.0 [27.83]	380.0 [14.96]	335.0 [13.19]

Frame	D2	S1	S2	Φ1	Φ2	Φ3	Φ4
D-2	17.0 [0.67]	13.0 [0.51]	18.0 [0.71]	64.0 [2.52]	51.0 [2.01]	25.4 [1.00]	20.3 [0.80]

Table 1-14

Frame D

D-3: VFD750FP4EA-41, VFD900FP4EA-41

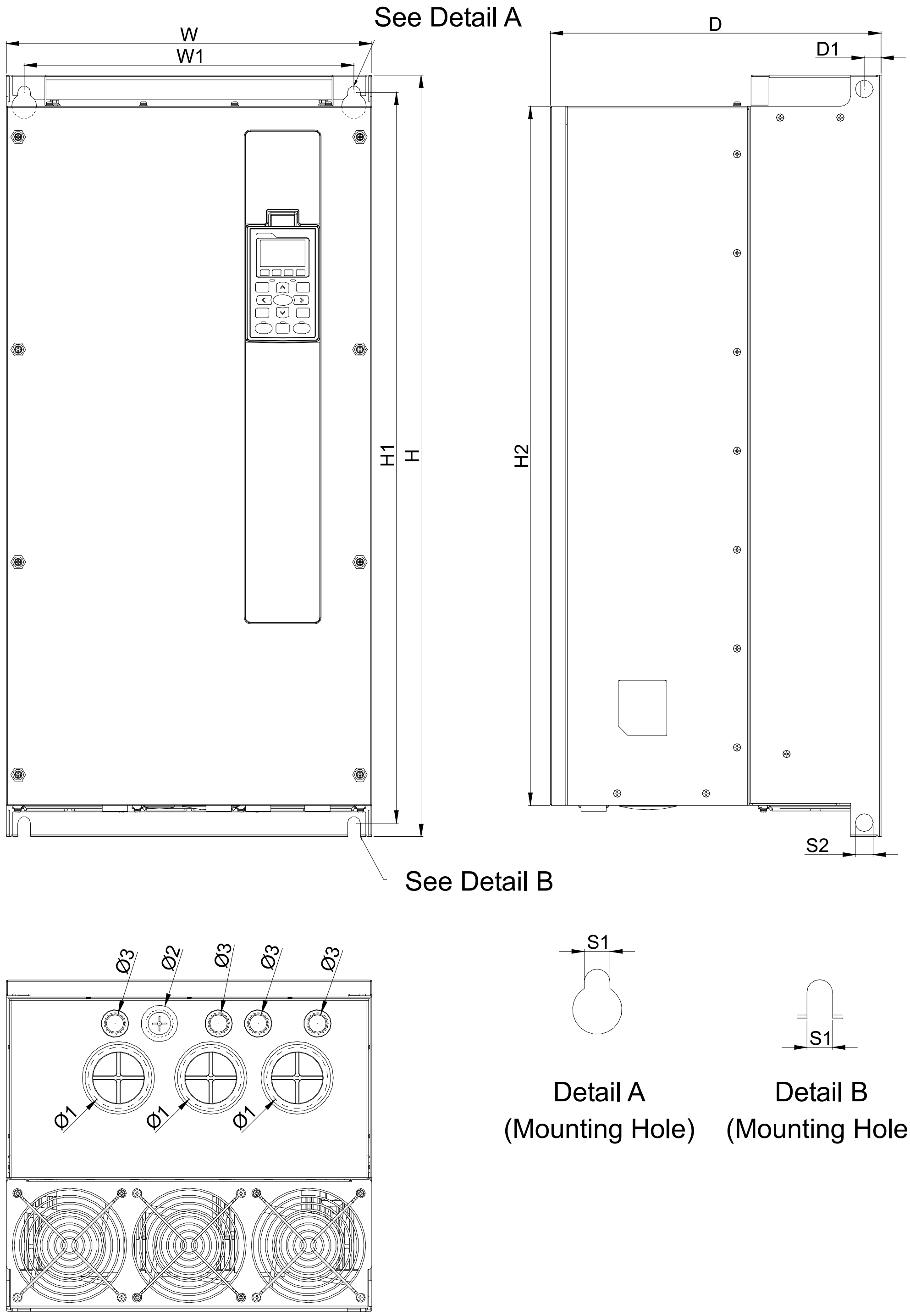


Figure 1-29

Unit: mm [inch]

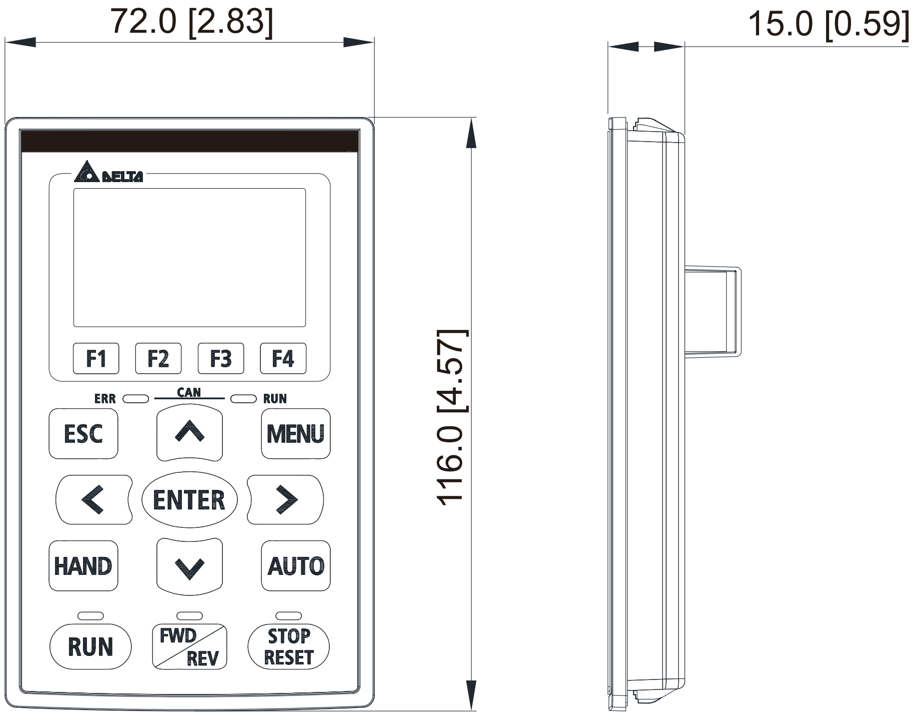
Frame	W	W1	H	H1	H2	D
D-3	370.0 [14.57]	334.0 [13.15]	770.0 [30.31]	739.0 [29.09]	707.0 [27.83]	335.0 [13.19]

Frame	D1	S1	S2	Φ1	Φ2	Φ3	Φ4
D-3	17.0 [0.67]	13.0 [0.51]	18.0 [0.71]	62.0 [2.44]	28.0 [1.10]	22.0 [0.87]	-

Table 1-15

1-7 Digital Keypad

KPC-CC01



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 (IP41 models). When installing one drive below another one, use a metal separation between the AC motor drives to prevent mutual heating and to prevent the risk of fire accident.

☑ Install the AC motor drive in Pollution Degree 2 environments only:
Normally only nonconductive pollution occurs and temporary conductivity caused by condensation is expected.

The appearances shown in the following figures are for reference only. The actual motor drives may look different.

Airflow direction: (Blue arrow) Inflow (Red arrow) Outflow (Black) Distance

Single drive installation (Frame A–D)

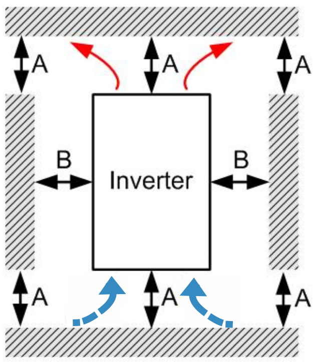


Figure 2-1

Side-by-side horizontal installation (Frame A–D)

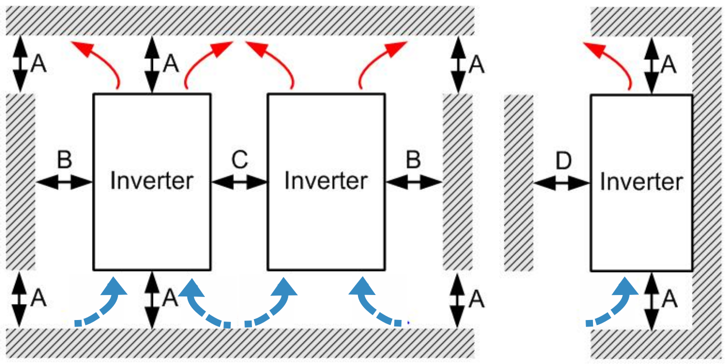


Figure 2-2

Multiple drives side-by-side vertical installation (Frame A–D)

Ta: Frame A–D

When installing one AC motor drive below another one (top-bottom installation), use a metal separation between the drives to prevent mutual heating. The temperature measured at the fan's inflow side must be lower than the temperature measured at the operation side. If the fan's inflow temperature is higher, use a thicker or larger size of metal separator. Operation temperature is the temperature measured at 50 mm away from the fan's inflow side. (As shown in the figure below)

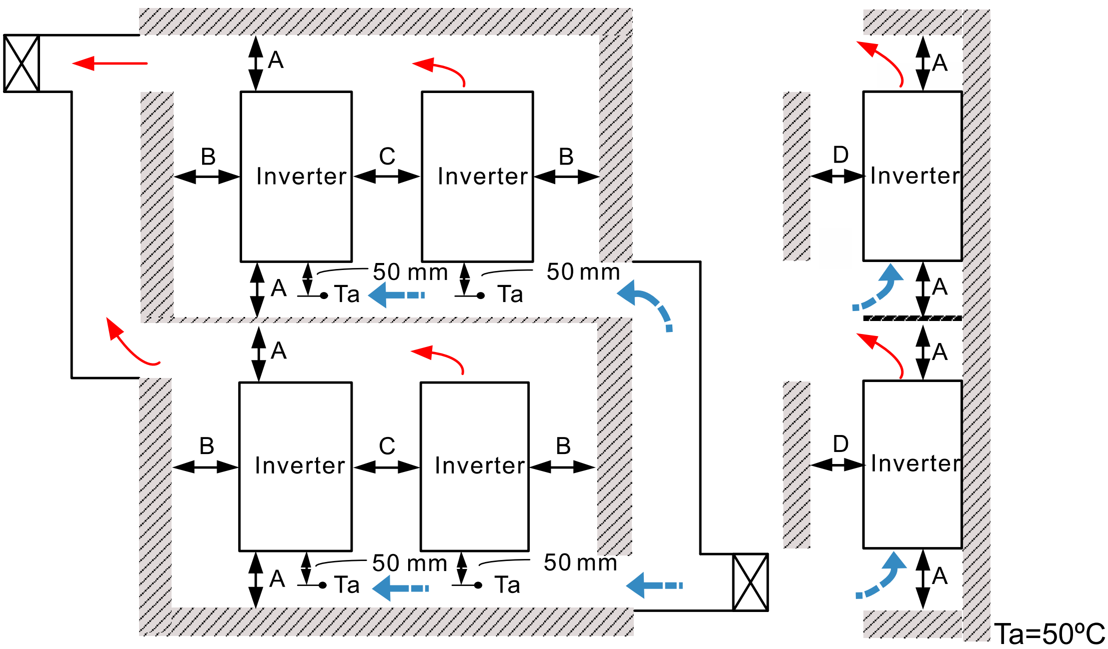


Figure 2-3

Minimum mounting clearance

Frame	A [mm]	B [mm]	C [mm]	D [mm]
A–B	60	15	-	-
C–D	100	25	-	-

NOTE

Table 2-1

The minimum mounting clearances A–D stated in the table above applies to AC motor drives installation. Failing to follow the minimum mounting clearances may cause the fan to malfunction and heat dissipation problems.

Frame A	VFD007FP4EA-41, VFD007FP4EA-52, VFD007FP4EA-52S, VFD015FP4EA-41, VFD015FP4EA-52, VFD015FP4EA-52S, VFD022FP4EA-41,VFD022FP4EA-52, VFD022FP4EA-52S, VFD037FP4EA-41,VFD037FP4EA-52, VFD037FP4EA-52S, VFD040FP4EA-41,VFD040FP4EA-52, VFD040FP4EA-52S, VFD055FP4EA-41,VFD055FP4EA-52, VFD055FP4EA-52S, VFD075FP4EA-41, VFD075FP4EA-52, VFD075FP4EA-52S
Frame B	VFD110FP4EA-41,VFD110FP4EA-52, VFD110FP4EA-52S, VFD150FP4EA-41,VFD150FP4EA-52, VFD150FP4EA-52S, VFD185FP4EA-41,VFD185FP4EA-52, VFD185FP4EA-52S, VFD220FP4EA-41, VFD220FP4EA-52, VFD220FP4EA-52S
Frame C	VFD300FP4EA-41, VFD300FP4EA-52, VFD300FP4EA-52S, VFD370FP4EA-41,VFD370FP4EA-52, VFD370FP4EA-52S
Frame D0	VFD450FP4EA-41,VFD450FP4EA-52, VFD450FP4EA-52S, VFD550FP4EA-41,VFD550FP4EA-52, VFD550FP4EA-52S
Frame D	VFD750FP4EA-41,VFD750FP4EA-52, VFD750FP4EA-52S, VFD900FP4EA-41,VFD900FP4EA-52, VFD900FP4EA-52S

Table 2-2

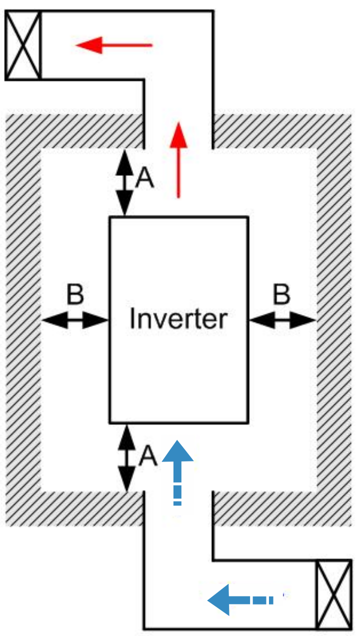


Figure 2-4

NOTE

※ The mounting clearance stated in the figure is for installing the drive in an open area. To install the drive in a confined space (such as cabinet or electric box), please follow the following rules: (1) Keep the minimum mounting clearances. (2) Install a ventilation equipment or an air conditioner to keep surrounding temperature lower than operation temperature. (3) Refer to parameter setting and set up Pr.00-16, Pr.00-17 and Pr.06-55.

※ The table below shows the heat dissipation and the required air volume when installing a single drive in a confined space. When installing multiple drives, the required air volume shall be multiplied by the number the drives.

※ Refer to the table below (Airflow Rate for Cooling) for ventilation equipment design and selection.

※ Refer to the table below (Power Dissipation for AC Motor Drive) for air conditioner design and selection.

※ Different control mode affects the derating. See Pr.06-55 for more information.

※ Refer to Section 9-4 for ambient temperature derating curve and derating curves under different control mode.

2-2 Airflow and Power Dissipation

Model No.	Airflow Rate for Cooling			Power Dissipation for AC Motor Drive		
	Flow Rate [cfm]			Power Dissipation [watt]		
	External	Internal	Total	Loss External	Internal	Total
VFD007FP4EA-41/ 52 / 52S	-	14	14	32	20	52
VFD015FP4EA-41/ 52 / 52S	-	14	14	43	21	64
VFD022FP4EA-41/ 52 / 52S	34	14	48	74	25	99
VFD037FP4EA-41/ 52 / 52S	34	14	48	92	26	118
VFD040FP4EA-41/ 52 / 52S	34	14	48	113	26	139
VFD055FP4EA-41/ 52 / 52S	34	14	48	139	27	166
VFD075FP4EA-41/ 52 / 52S	34	14	48	195	29	224
VFD110FP4EA-41/ 52 / 52S	88	14	102	240	34	274
VFD150FP4EA-41/ 52 / 52S	88	14	102	309	38	347
VFD185FP4EA-41/ 52 / 52S	88	14	102	353	39	392
VFD220FP4EA-41/ 52 / 52S	88	14	102	449	47	496
VFD300FP4EA-41/ 52 / 52S	200	29	229	618	84	702
VFD370FP4EA-41/ 52 / 52S	200	29	229	726	87	813
VFD450FP4EA-41/ 52 / 52S	285	29	314	864	82	946
VFD550FP4EA-41/ 52 / 52S	285	29	314	1068	84	1152
VFD750FP4EA-41/ 52 / 52S	330	29	359	1407	111	1518
VFD900FP4EA-41/ 52 / 52S	330	29	359	1623	114	1737
※ The required airflow shown in the table is for installing single drive in a confined space. ※ When installing multiple drives, the required air volume should be the required air volume for single drive X the number of the drives.				※ The heat dissipation shown in the table is for installing single drive in a confined space. ※ When installing multiple drives, volume of heat dissipation should be the heat dissipated for single drive X the number of the drives. ※ Heat dissipation for each model is calculated by rated voltage, current and default carrier.		

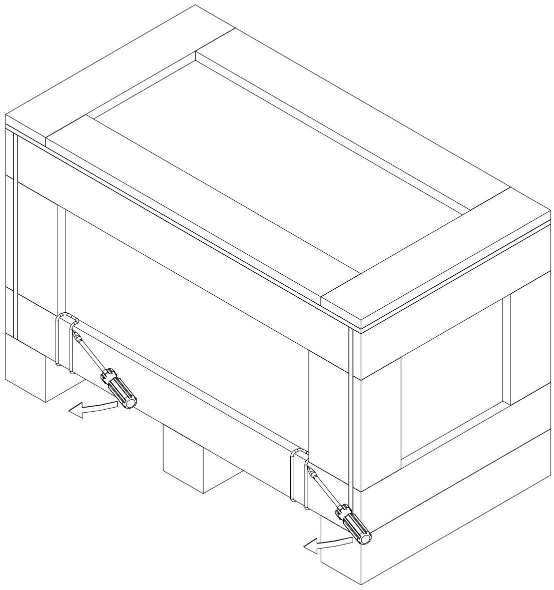
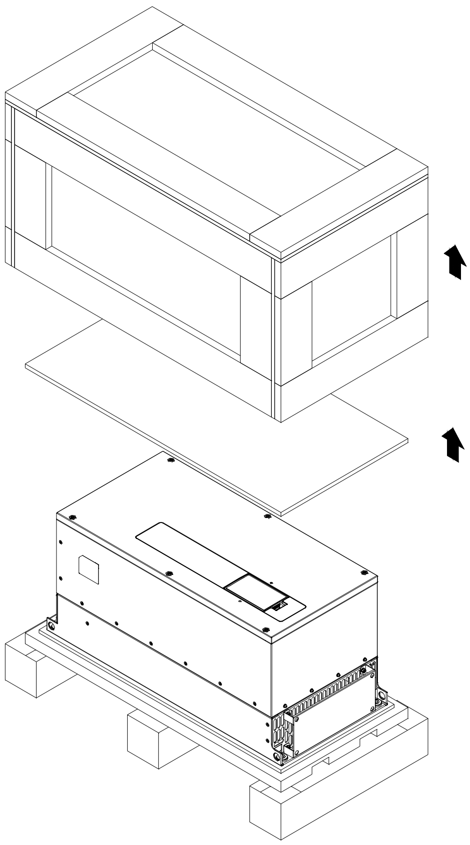
Table 2-3

Chapter 3 Unpacking

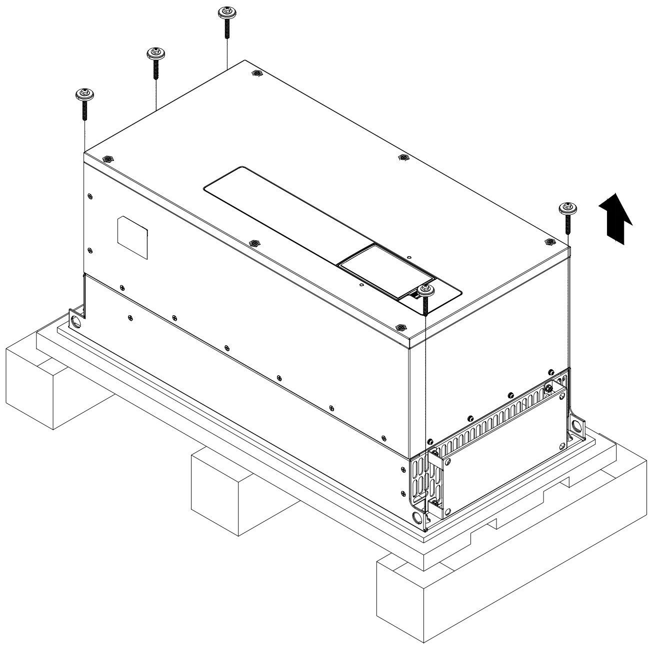
The AC motor drive should be kept in the shipping carton or crate before installation. In order to retain the warranty coverage, the AC motor drive should be stored properly when it is not to be used for an extended period of time.

3-1 Unpacking

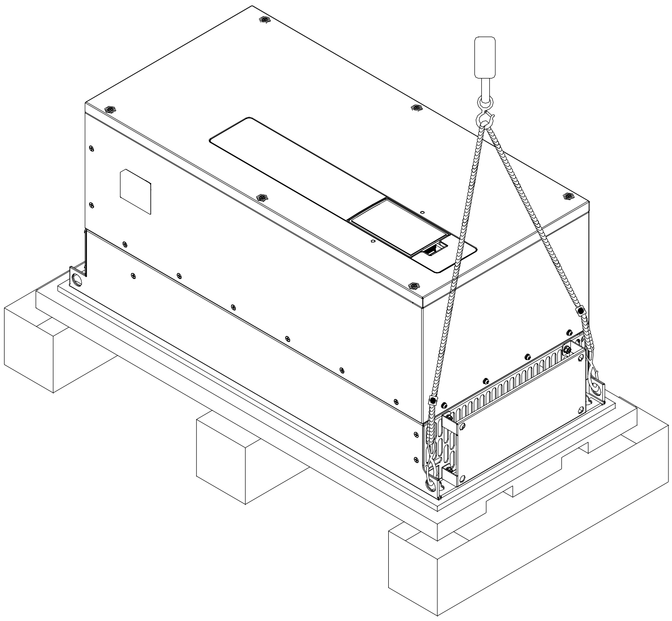
Follow these steps to unpack the AC motor drive:

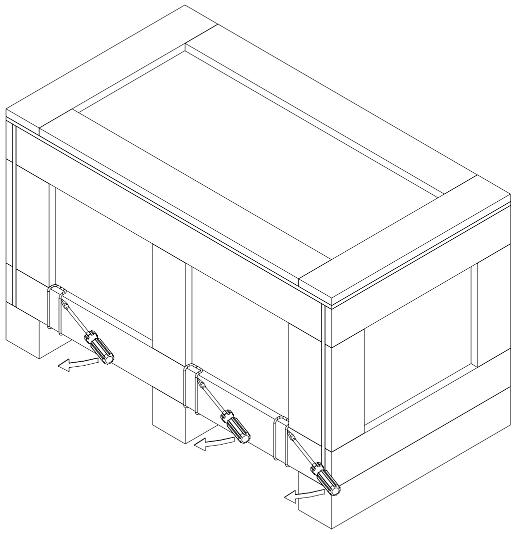
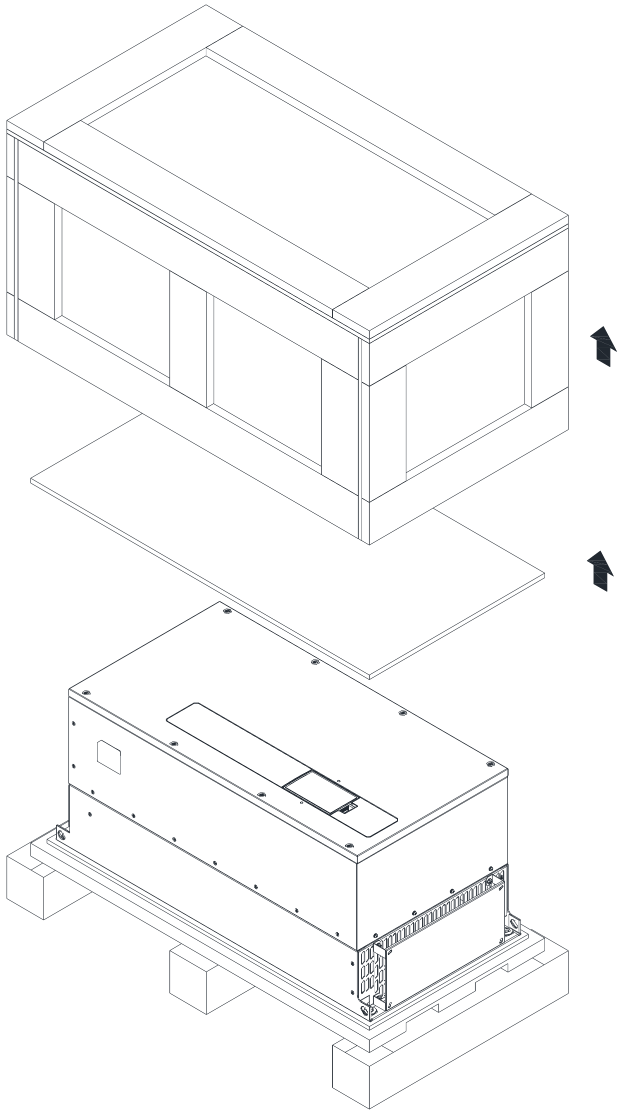
Frame D0
VFD450FP4EA-41, VFD450FP4EA-52, VFD450FP4EA-52S, VFD550FP4EA-41, VFD550FP4EA-52, VFD550FP4EA-52S
1. Remove the 4 clips by slotted screwdriver. 
2. Remove the cover of wood box and then take out the EPE tray and user manual. 

3. Loosen the 5 screws that fastened on the pallet.

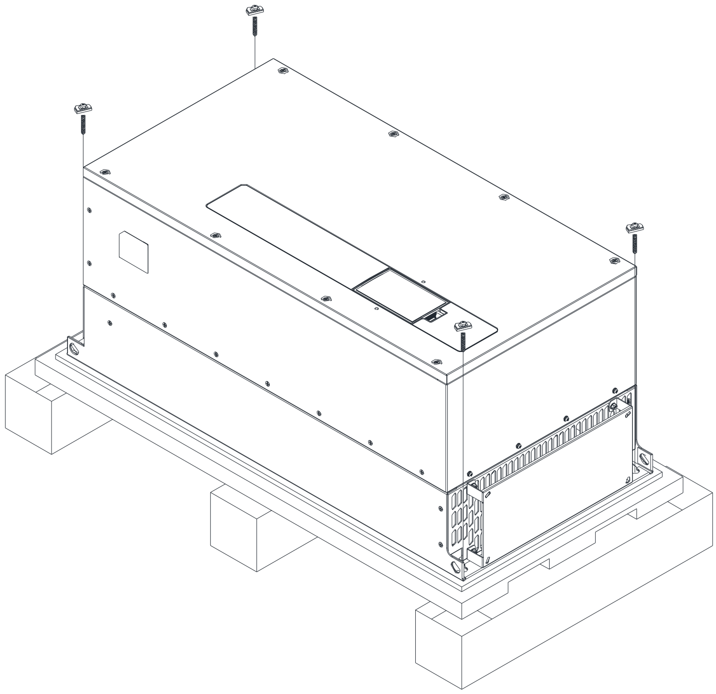


4. Lift up the drive by using hooks through the holes.

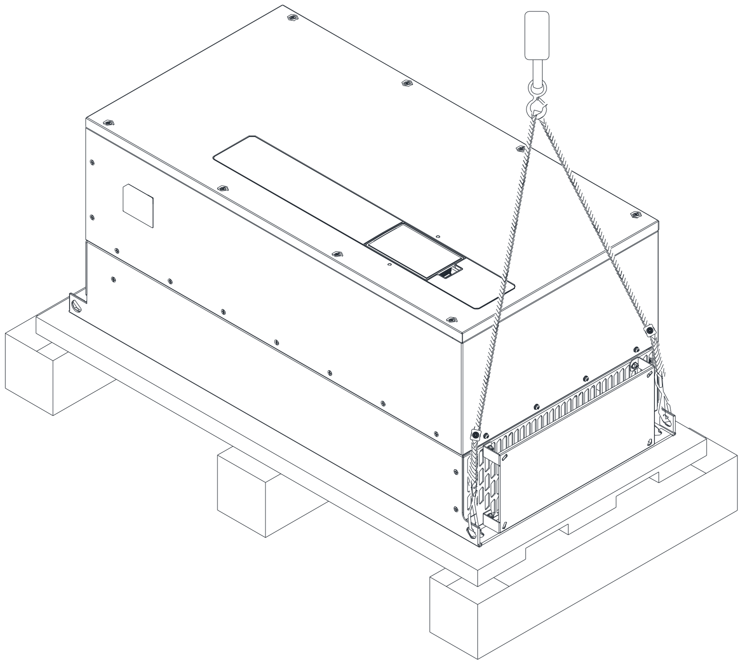


Frame D
VFD750FP4EA-41, VFD750FP4EA-52, VFD750FP4EA-52S, VFD900FP4EA-41, VFD900FP4EA-52, VFD900FP4EA-52S
1. Remove the 6 clips by slotted screwdriver. 
2. Remove the cover of wood box and then take out the EPE tray and user manual. 

3. Loosen the 4 screws that fastened on the pallet.



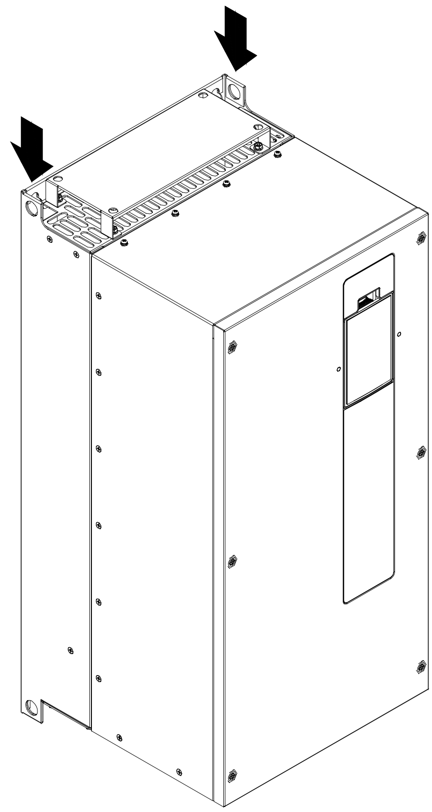
4. Lift up the drive by using hooks through the holes.



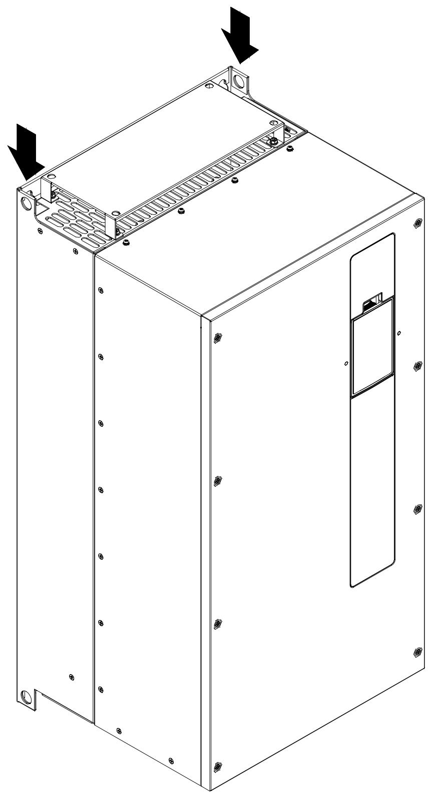
3-2 The Lifting Hook

The arrows indicate the location of the lifting holes, as shown in figure below:

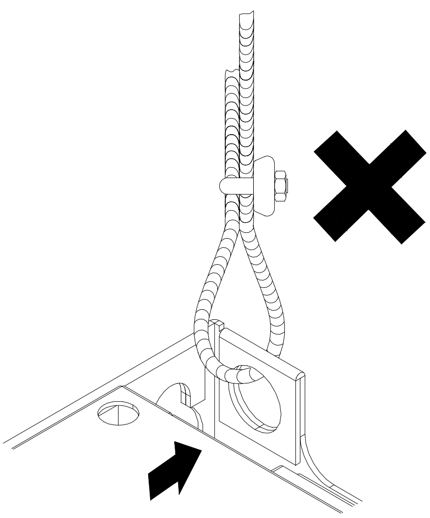
Frame D0

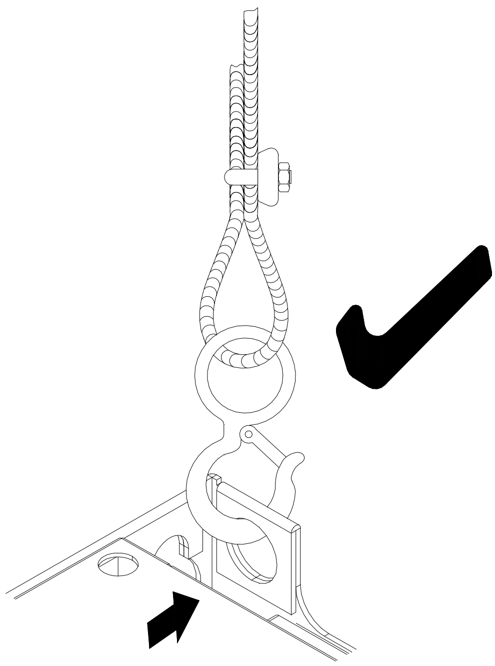


Frame D

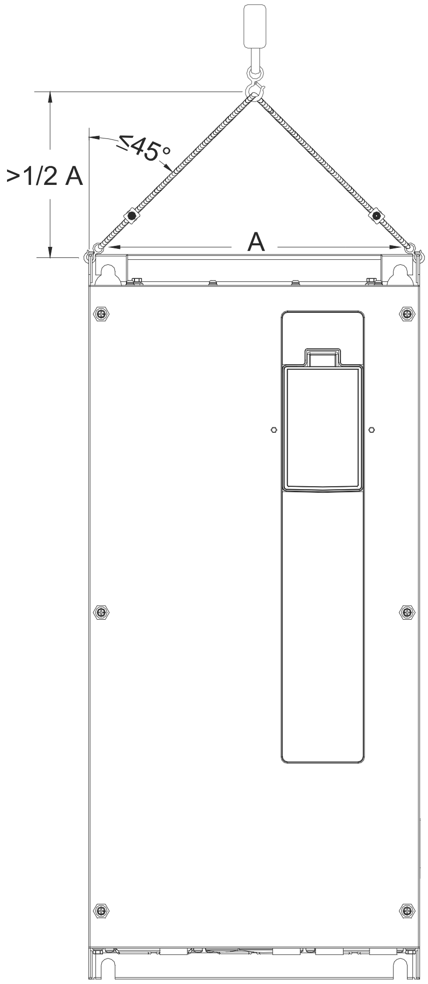


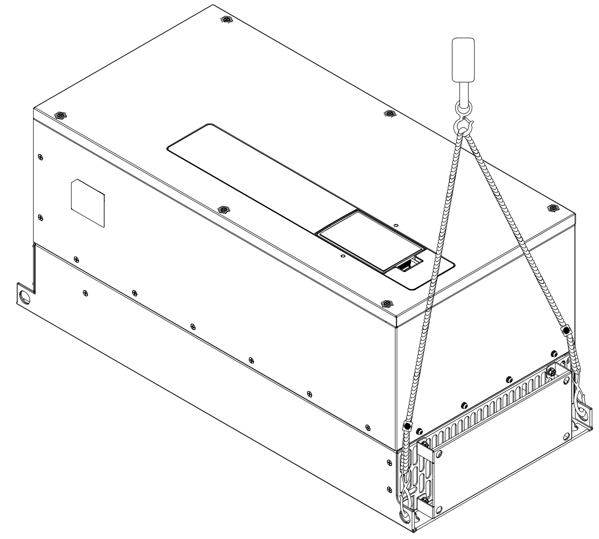
Ensure the lifting hook properly goes through the lifting hole, as shown in the following diagram.



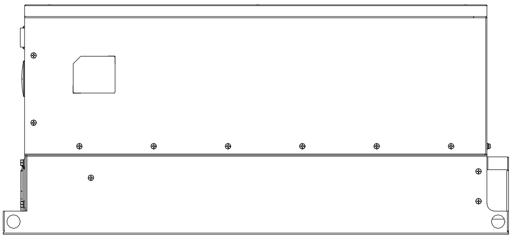
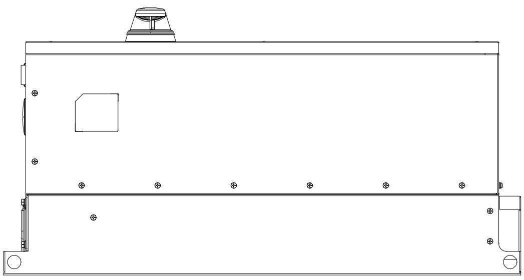
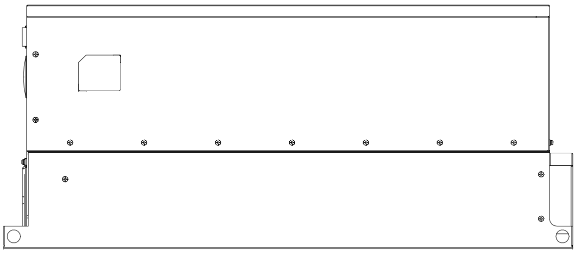
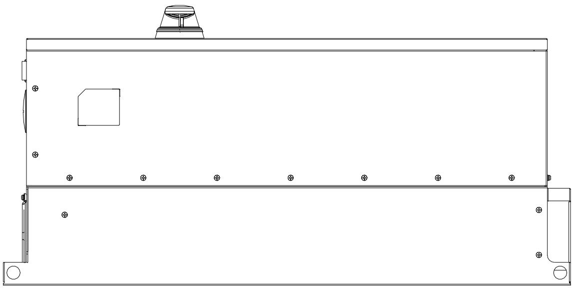


Ensure the angle between the lifting holes and the lifting device is within the specification, as shown in the following figure.





Weight

Frame	VFDXXXFP4EA-41 VFDXXXFP4EA-52	VFDXXXFP4EA-52S
D0	41.5 kg [91.4 lbs.] 	41.7 kg [91.9 lbs.] 
D	59.0 kg [130.0 lbs.] 	60.2 kg [132.6 lbs.] 

Chapter 4 Wiring

After removing the front cover, please check if the power and control terminals are clearly noted. Please read following precautions to avoid wiring mistakes.

DANGER	☑ It is crucial to cut off the AC motor drive power before any wiring installation are made. A charge may still remain in the DC bus capacitors with hazardous voltages even if the power has been turned off. Therefore it is suggested for users to measure the remaining voltage by DC voltage meter before wiring. For your personnel safety, please do not perform any wiring before the voltage drops to a safe level < 25 V_{DC}. Wiring installation with remaning voltage condition may cause sparks and short circuit. ☑ Only qualified personnel familiar with AC motor drives is 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 lie within the range as indicated on the nameplate (Chapter 1-1 Nameplate Information). ☑ All the units must be grounded directly to a common ground terminal to prevent lightning strike or electric shock. ☑ Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration
CAUTION	☑ When wiring, please choose the wires with specification that complies with local regulation for your personnel safety. ☑ Check following items after finishing the wiring: 1. Are all connections correct? 2. Any loosen wires? 3. Any short-circuits between the terminals or to ground?

4-1 System Wiring Diagram

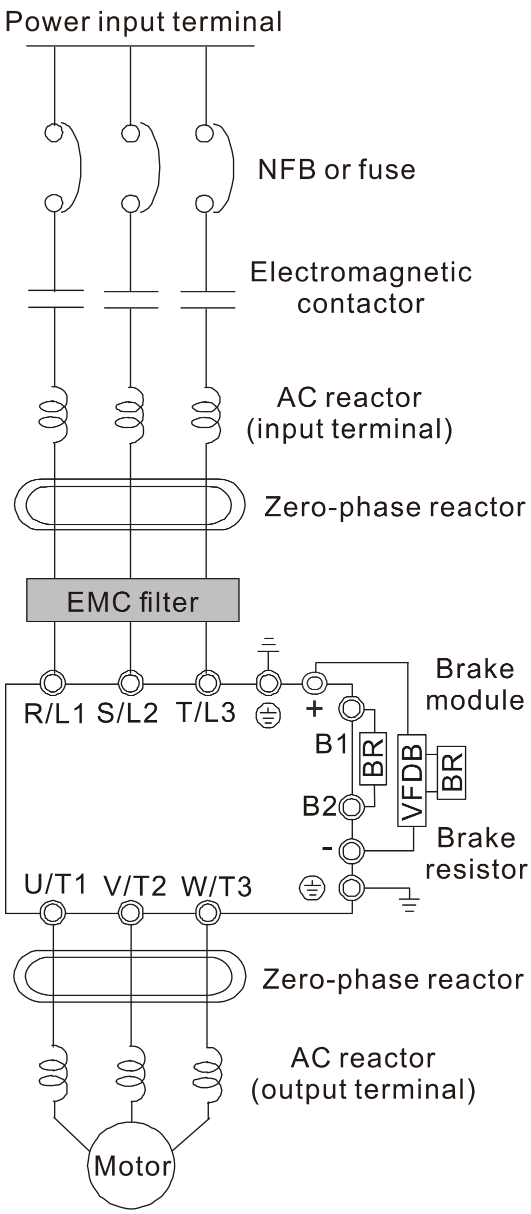


Figure 4-1

Power input terminal	Please refer to Section 9 Specification Table in user manual for detail.
NFB or fuse	There may be a large inrush current during power on. Refer to 7-2 NFB to select a suitable NFB or 7-3 Fuse Specification Chart.
Electromagnetic contactor	Switching the power ON/OFF before the magnetic contactor more than 1 x per hour can cause damage to the drive.
AC reactor (input terminal)	When the mains power capacity is > 500 kVA or when the drive is preceded by a capacitor bank, the instantaneous peaks voltages and current may destroy the drive. In that case it is recommended to install an AC input reactor which will also improve the power factor and harmonics. The cable between reactor and drive should be < 10 m. Please refer to Section 7-4.
Zero-phase reactor	Used to reduce radiated emission, especially in environments with audio devices, and reduce input and output side interference. The effective range is AM band to 10 MHz. Please refer to Section 7-5.
EMC filter	Can be used to reduce electromagnetic interference. Please refer to Section 7-6.
Brake module & Brake resistor (BR)	Used to shorten the deceleration time of the motor. Please refer to Section 7-1.
AC reactor (output terminal)	The wiring length of the motor will affect switching current peaks. It is recommended to install an AC output reactor when the motor wiring length exceeds the value listed in Section 7-4.

Table 4-1

NOTE Please refer to Section 4-2 Wiring Diagram for detailed wiring information.

4-2 Wiring

Wiring Diagram for Frame A–C

Input: 3-phase power

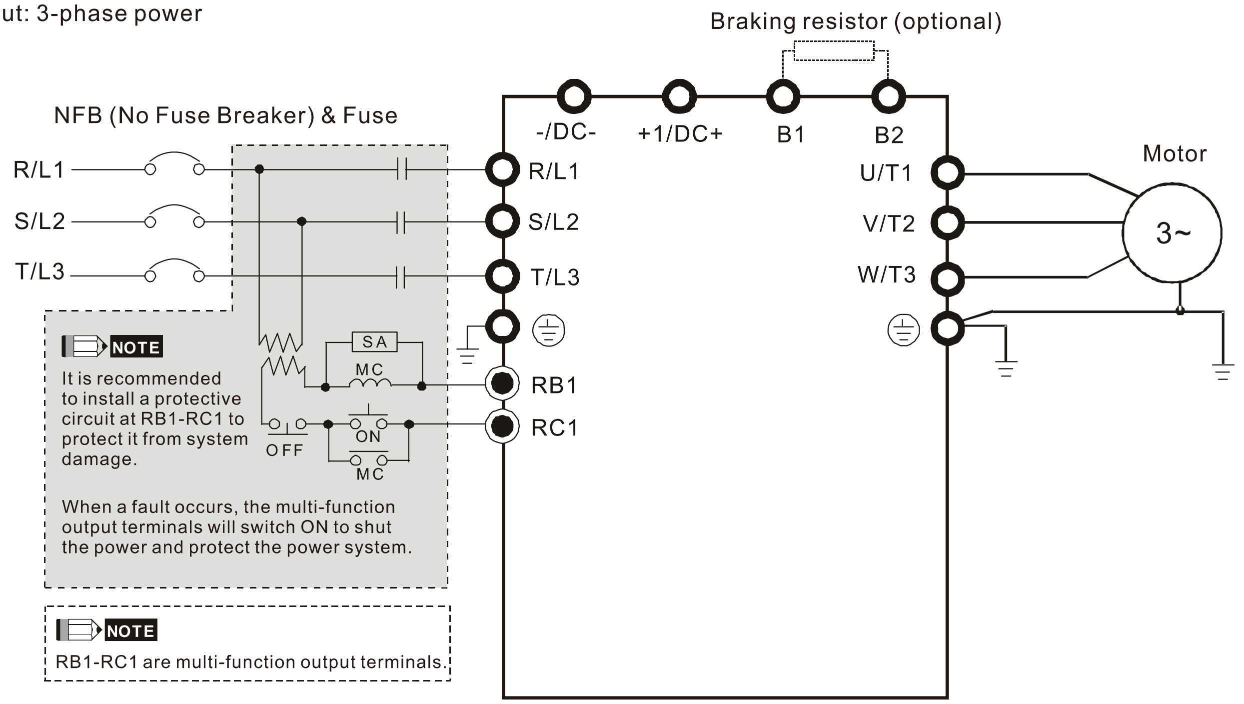
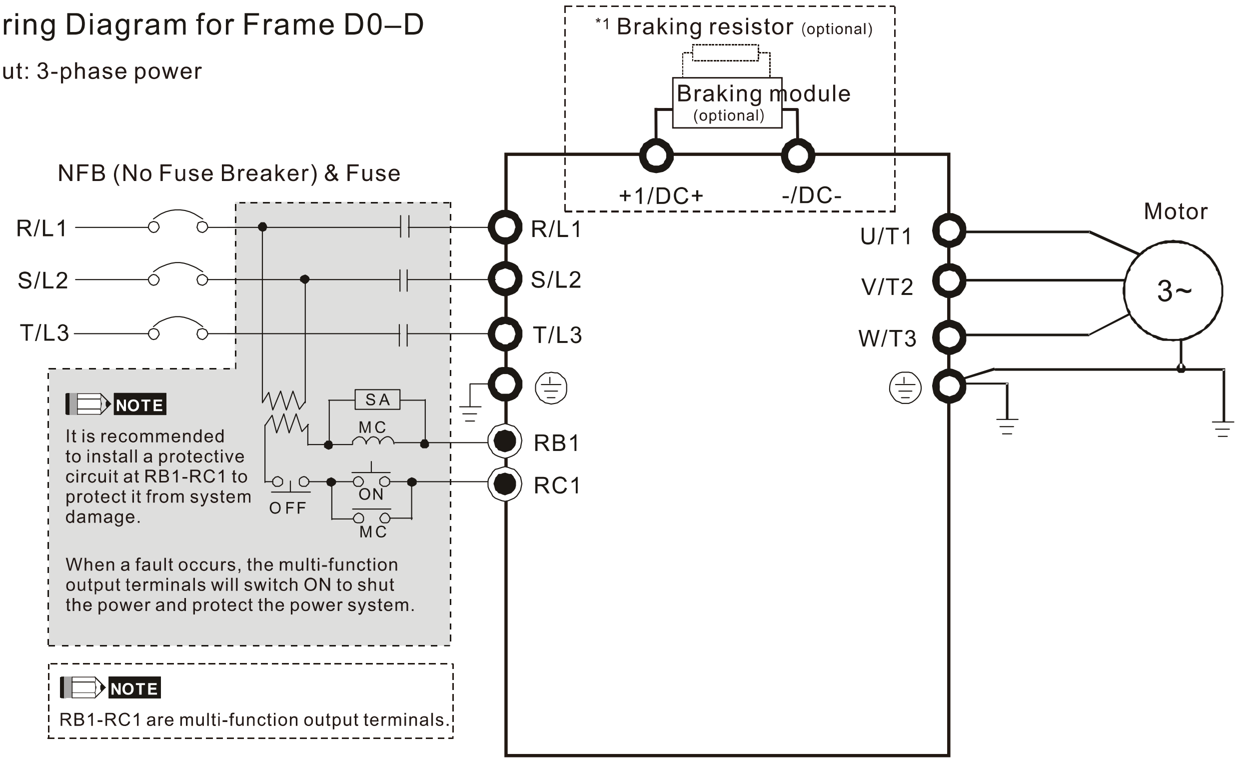


Figure 4-2

Wiring Diagram for Frame D0–D

Input: 3-phase power



*1 Please refer to Section 7-1 for brake units and resistor selection.

Figure 4-3

Wiring Diagram for Frame A–D

Input: 3-phase power

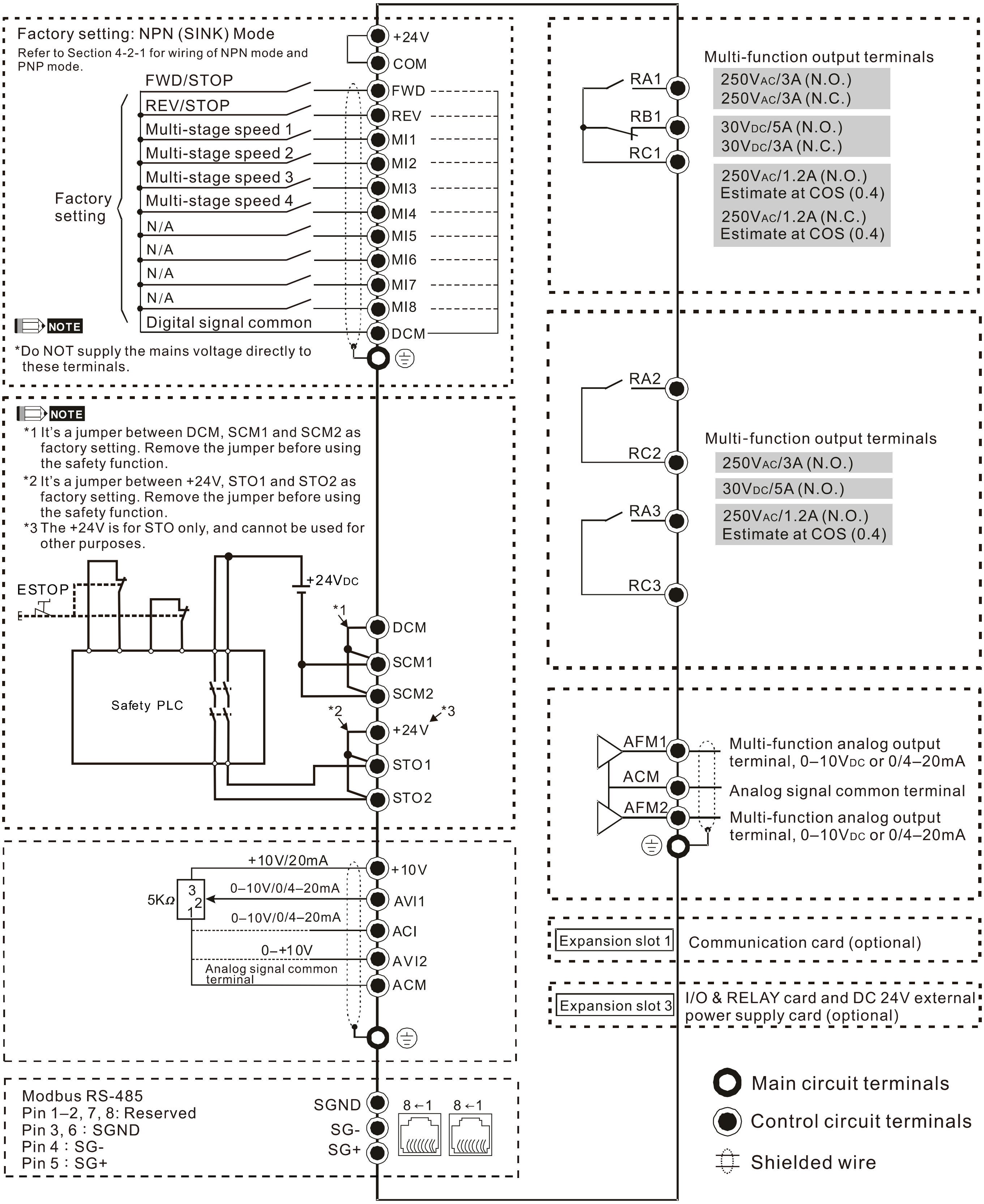


Figure 4-4

4-2-1 SINK (NPN) / SOURCE (PNP) Mode

① Sink Mode
with internal power (+24V DC)

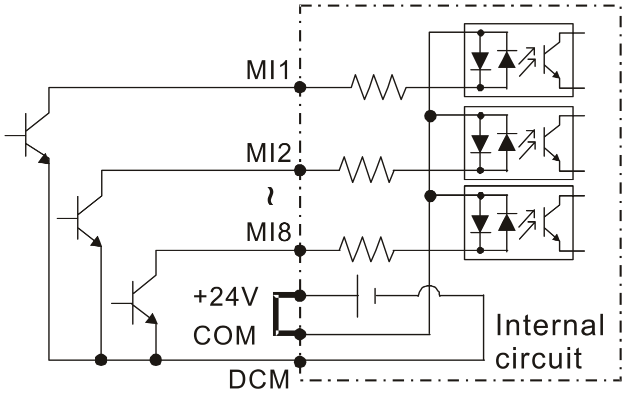


Figure 4-5

② Source Mode
with internal power (+24V DC)

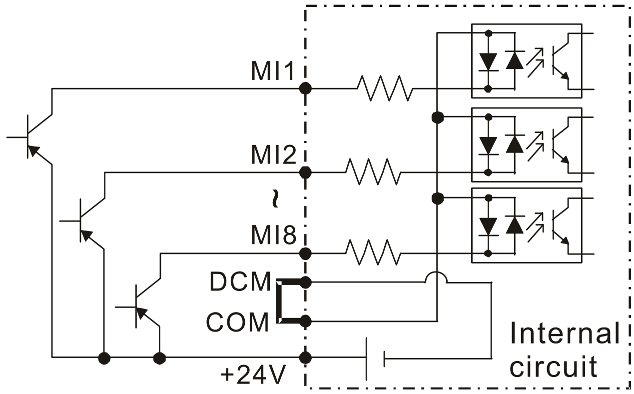


Figure 4-6

③ Sink Mode
with external power

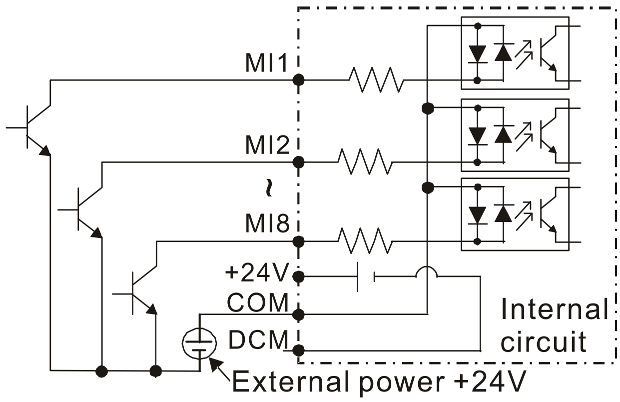


Figure 4-7

④ Source Mode
with external power

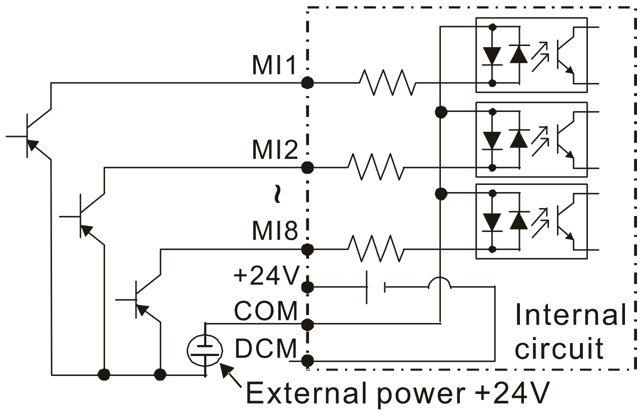
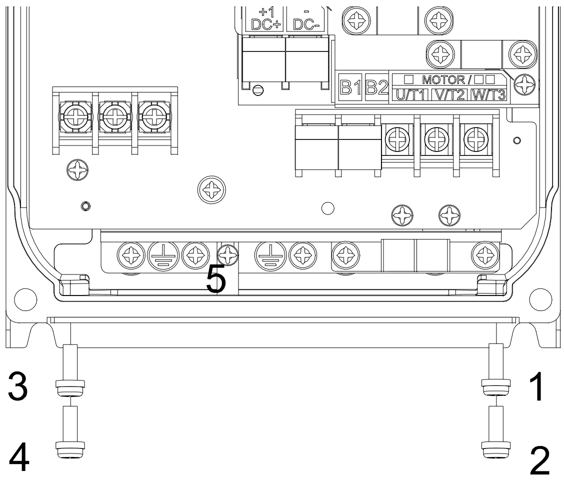


Figure 4-8

4-3 Wiring Plate Diagram

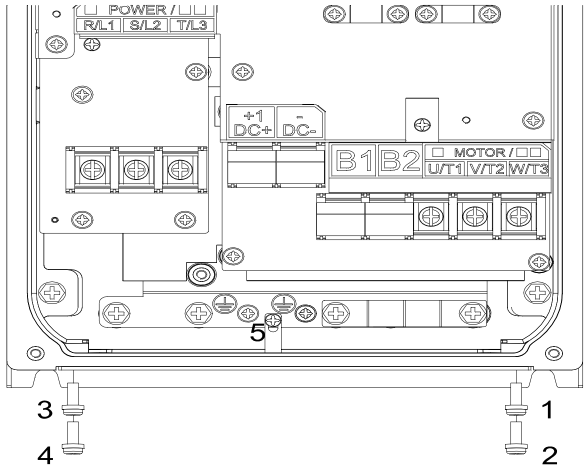
Frame A

Screw torque:
1–4: [14–16 kg-cm]
5: [6–8 kg-cm]



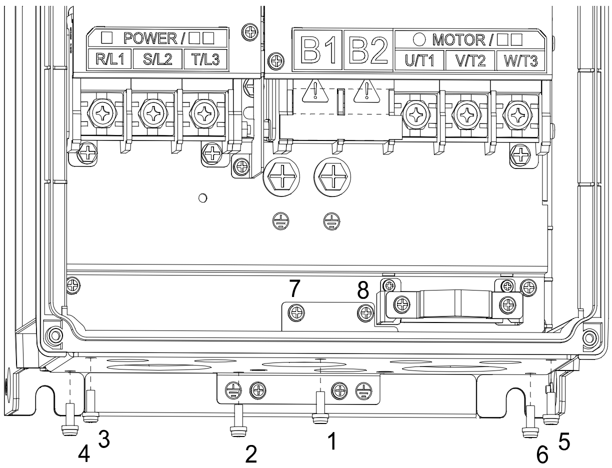
Frame B

Screw torque:
1–4: [14–16 kg-cm]
5: [6–8 kg-cm]



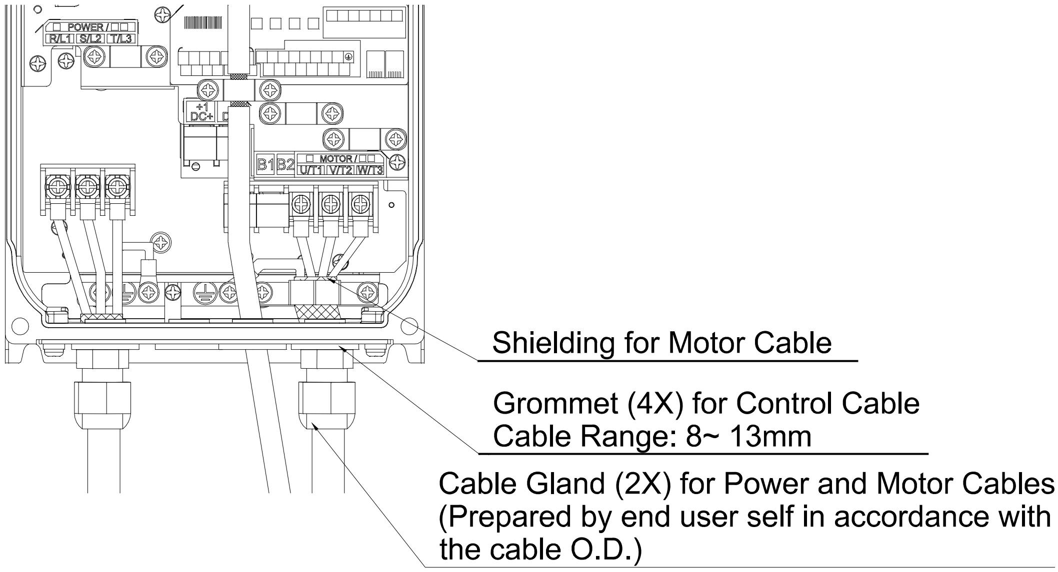
Frame C

Screw torque:
1–6: [12–15 kg-cm]
7–8: [12–15 kg-cm]

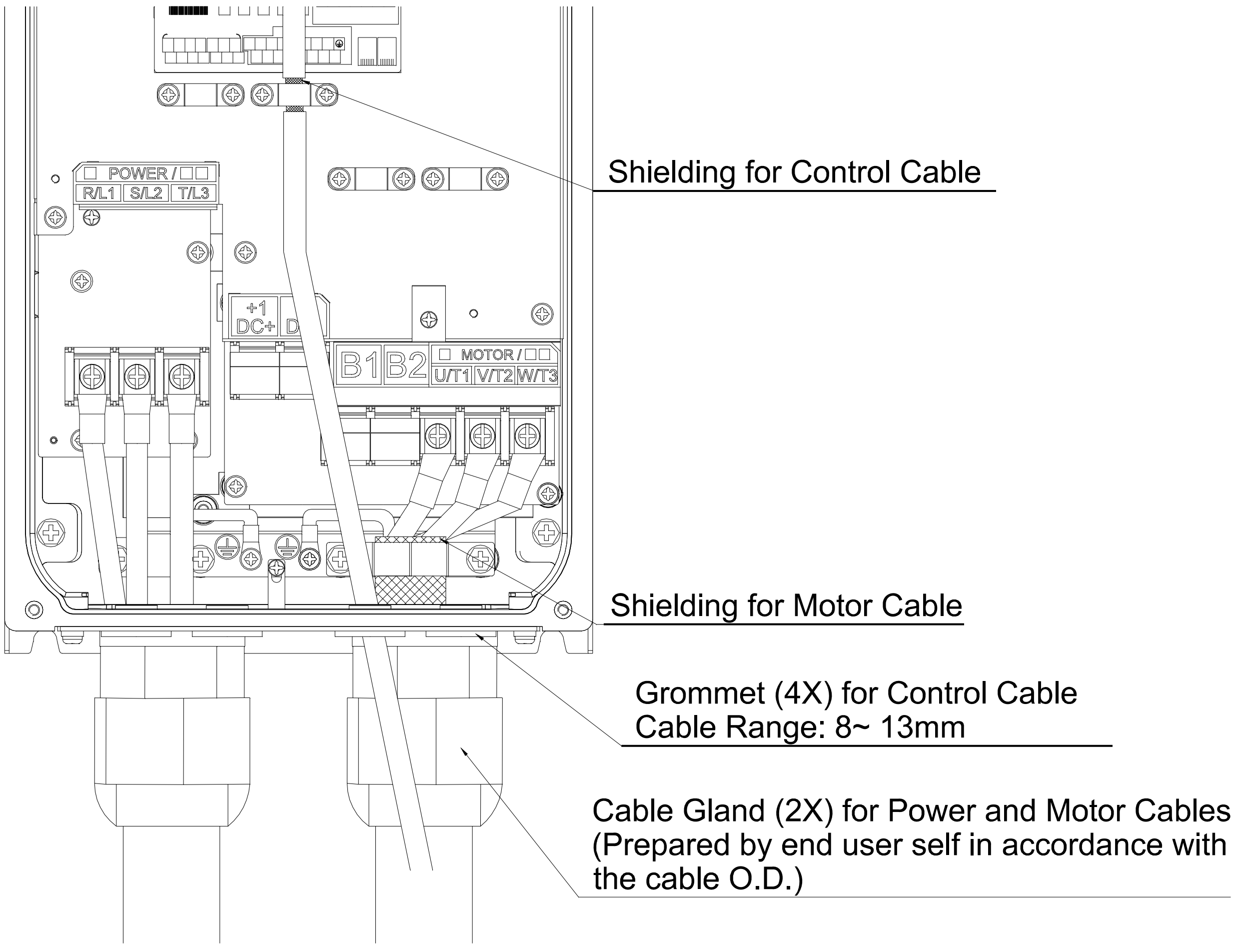


4-4 Basic Waterproof Component Wiring Diagram

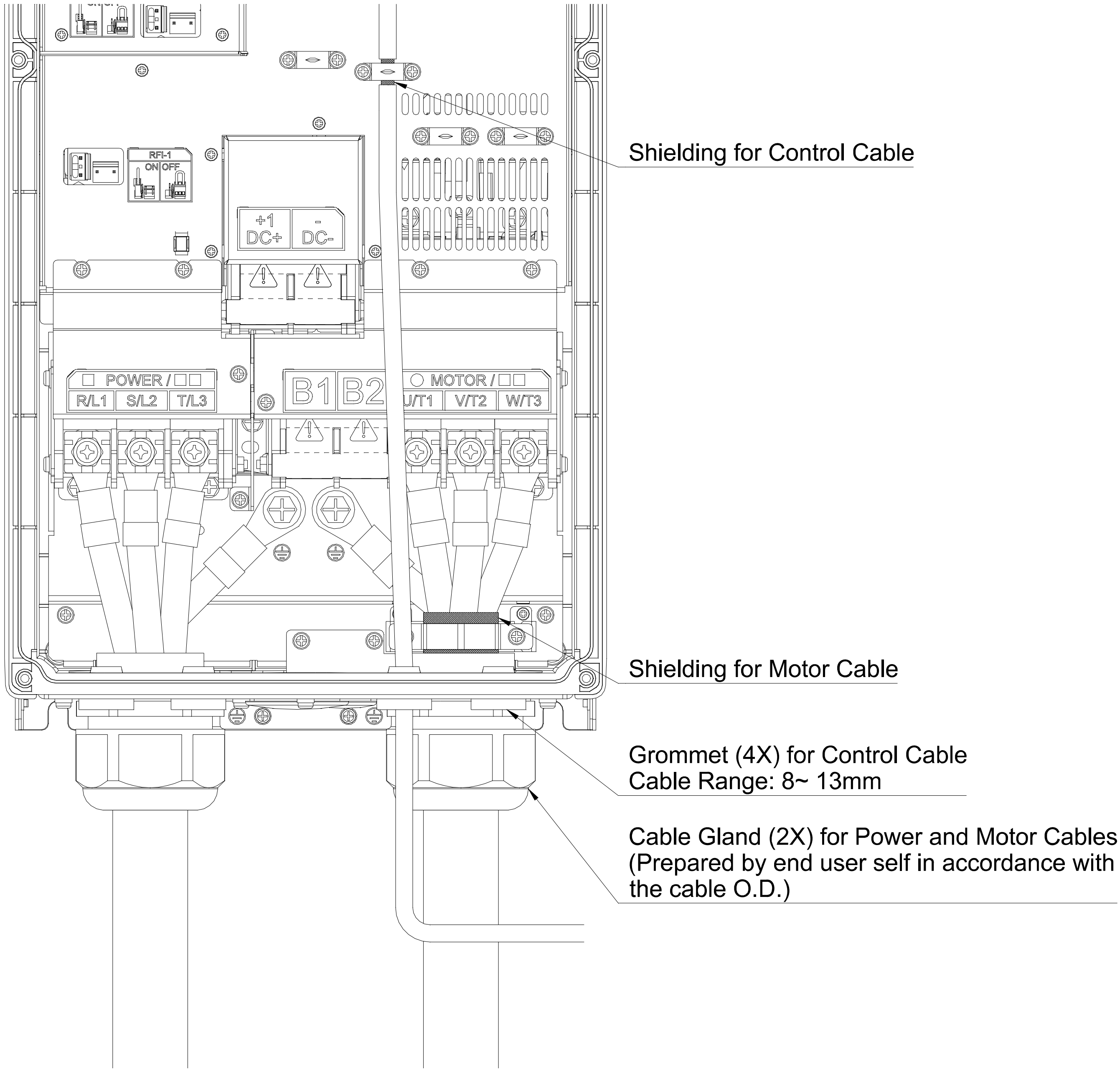
Frame A



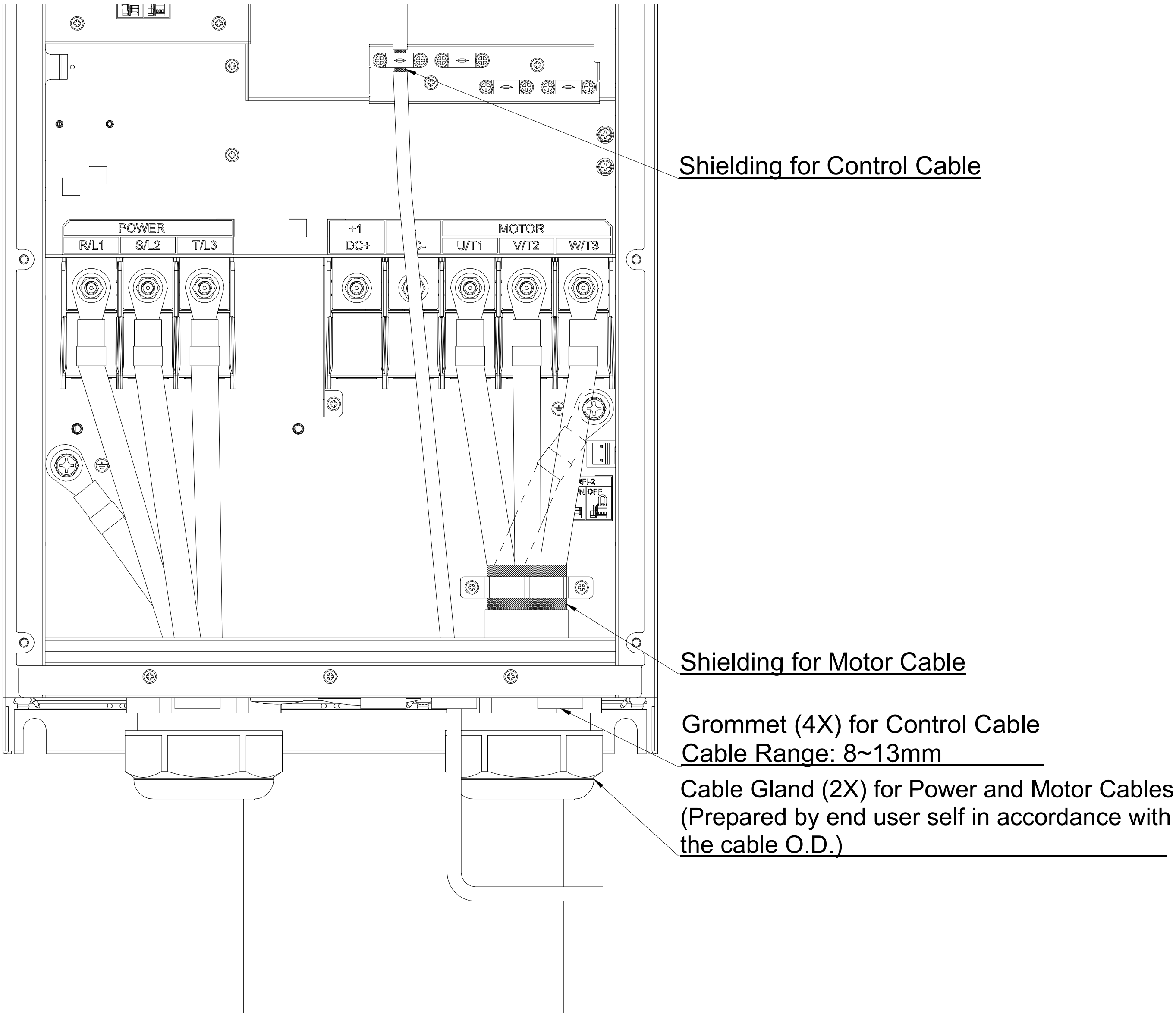
Frame B



Frame C/D0


RFI-1
ON OFF
+1
DC+
-
DC-
POWER
R/L1
S/L2
T/L3
B1
B2
MOTOR
U/T1
V/T2
W/T3
Shielding for Control Cable
Shielding for Motor Cable
Grommet (4X) for Control Cable
Cable Range: 8~ 13mm
Cable Gland (2X) for Power and Motor Cables
(Prepared by end user self in accordance with
the cable O.D.)

Frame D


POWER
R/L1
S/L2
T/L3
+1
DC+
DC-
MOTOR
U/T1
V/T2
W/T3
RFI-2
ON
OFF
Shielding for Control Cable
Shielding for Motor Cable
Grommet (4X) for Control Cable
Cable Range: 8~13mm
Cable Gland (2X) for Power and Motor Cables
(Prepared by end user self in accordance with
the cable O.D.)

Chapter 5 Main Circuit Terminals

DANGER

- ☑ Fasten the screws in the main circuit terminal to prevent sparks condition made by the loose screws due to vibration.
- ☑ When it needs to install the filter at the output side of terminals U/T1, V/T2, W/T3 on the AC motor drive, please use inductance filter. Do not use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.
- ☑ DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of AC motor drives.
- ☑ DO NOT connect [+1, -], [+2, -], [+1/DC+, -/DC-] or brake resistor directly to prevent drive damage.
- ☑ Ensure the insulation of the main circuit wiring in accordance with the relevant safety regulations.

CAUTION

Main power terminals

- ☑ Do not connect three-phase model to one-phase power. R/L1, S/L2 and T/L3 has no phase-sequence requirement, it can be used upon random selection.
- ☑ It is recommended to add a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunction when activating the protection function of the AC motor drive. Both ends of the MC should have an R-C surge absorber.
- ☑ Please use voltage and current within the specification.
- ☑ When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200 mA or above and not less than 0.1-second operation time to avoid nuisance tripping.
- ☑ Please use the shield wire or tube for the power wiring and ground the two ends of the shield wire or tube.
- ☑ Do NOT run/stop AC motor drives by turning the power ON/OFF. Run/stop AC motor drives by RUN/STOP command via control terminals or keypad. If you still need to run/stop AC motor drives by turning power ON/OFF, it is recommended to do so only ONCE per hour.
- ☑ Connect the drive to a three-phase three-wire or three-phase four-wire Wye system to comply with UL standards.

Output terminals for main circuit

- ☑ Use well-insulated motor, suitable for inverter operation.
- ☑ When the AC drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3 respectively, the motor will rotate counterclockwise (as viewed on the shaft end of the motor, refer to the pointed direction in the figure below) when a forward operation command is received. To permanently reverse the direction of motor rotation, switch over any of the two motor leads.

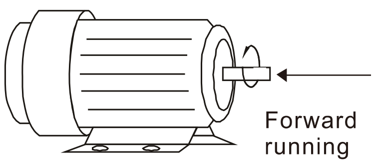


Figure 5-1

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

☑ Connect a brake resistor or brake unit in applications with frequent deceleration ramps, short deceleration time, too low brake torque or requiring increased brake torque.

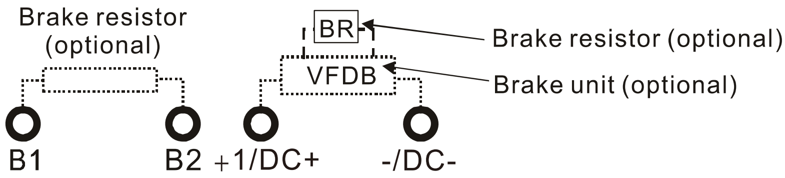


Figure 5-2

☑ The external brake resistor of Frame A, B and C should connect to the terminals (B1, B2) of AC motor drives.

☑ For those models without built-in brake resistor, please connect external brake unit and brake resistor (both of them are optional) to increase brake torque.

☑ When the terminals +1/DC+ and -/DC- are not used, please leave the terminals open.

☑ DC+ and DC- are connected by common DC bus, please refer to Section 5-1 (Main Circuit Terminal) for the wiring terminal specification and the wire gauge information.

☑ Please refer to the VFDB manual for more information on wire gauge when installing the brake unit.

5-1 Main Circuit Diagram

Wiring Diagram for Frame A–C

Input: 3-phase power

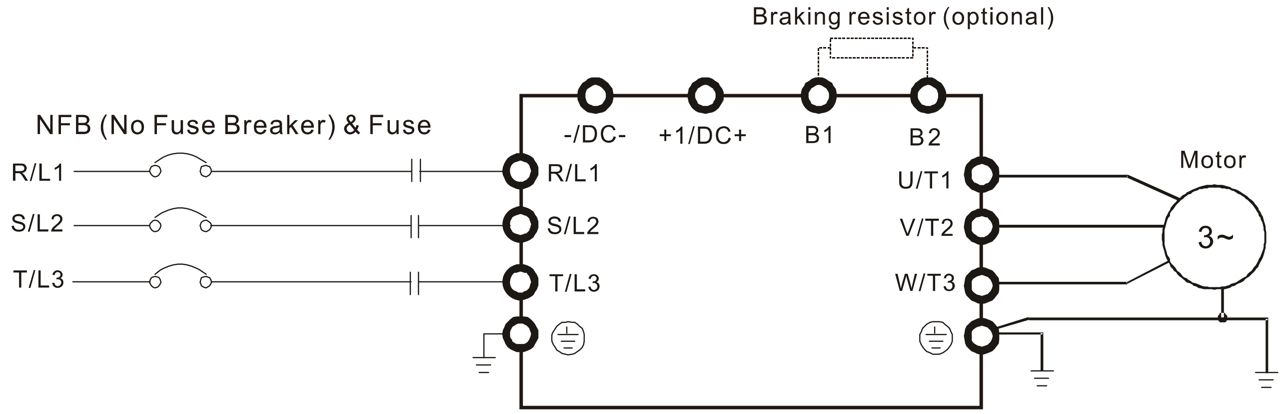
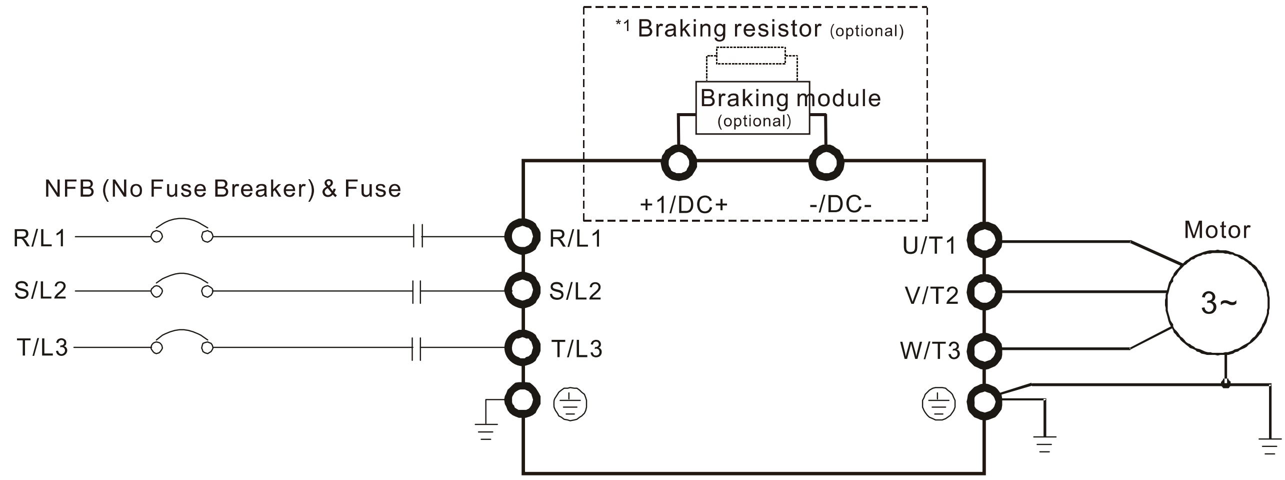


Figure 5-3

Wiring Diagram for Frame D0–D

Input: 3-phase power



*1 Please refer to Section 7-1 for brake units and resistors selection.

Figure 5-4

Terminals	Descriptions
R/L1, S/L2, T/L3	AC line input terminals 3-phase
U/T1, V/T2, W/T3	AC drive output terminals for connecting 3-phase induction motor
+1/DC+, -/DC-	Connections for brake module (VFDB series) (≤ 30 kW, built-in brake module) Common DC bus
B1, B2	Connections for brake resistor (optional)
⏚	Earth connection, please comply with local regulations.

Table 5-1

5-2 Specifications of Main Circuit Terminals

- Use the specified ring lug for main circuit terminal wiring. See figure 5-5 and figure 5-6 for ring lug specifications. For other types of wiring use the wires that comply with the local regulations.
- After crimping the wire to the ring lug (must be UL approved), UL and CSA approved recognized component (YDPU2), install heat shrink tube rated at a minimum of 600 V_{AC} insulation over the live part. Refer to figure 5-6 below.

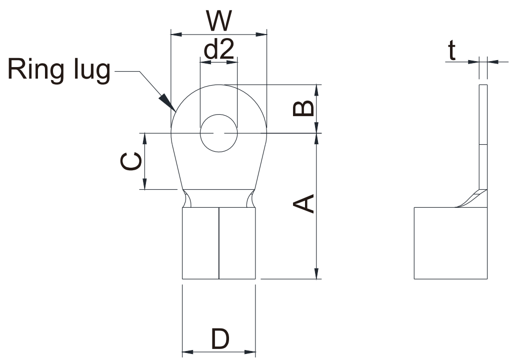


Figure 5-5

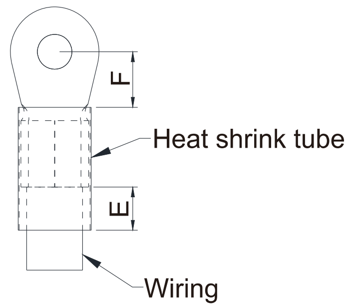


Figure 5-6

Terminal Specification

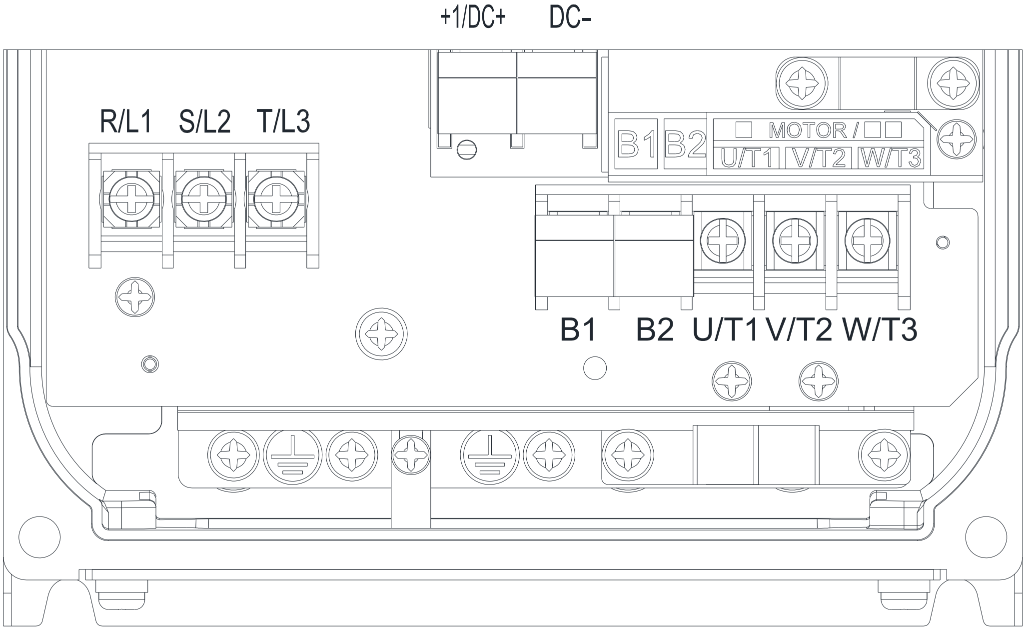
The part number of the ring lugs (produced by K.S. Terminals Inc.) in the table below are for reference only. You can buy the ring lugs of your choice to match with different frame sizes.

Frame	AWG	Kit P/N	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	t (MAX)
A	12	RNBL5-4	12.1	3.6	6.1	5.6	4.3	7.0	6.1	7.3	1.0
	10	RNBL5-4									
B	8	RNBM8-5	23.8	6.0	13.3	9.0	5.3	11.0	13.3	12.0	1.5
	6	RNB14-5									
C	4	RNB22-8	40.0	10.0	10.0	15.0	8.3	13.0	12.0*	22.0	2.5
	2	RNBS38-8									
D0	1	SQNBS60-8	40.0	11.0	10.0	23.0	8.3	13.0	14.0**	24.0	4.5
	1/0	SQNBS60-8									
D	3/0	RNB80-8	50.0	16.0	10.0	27.0	8.3	13.0	14.0	28.0	6.0
	4/0	SQNBS100-8									

*F(MAX.)=15.5
**F(MAX.)=16.5

Unit: mm
Table 5-2

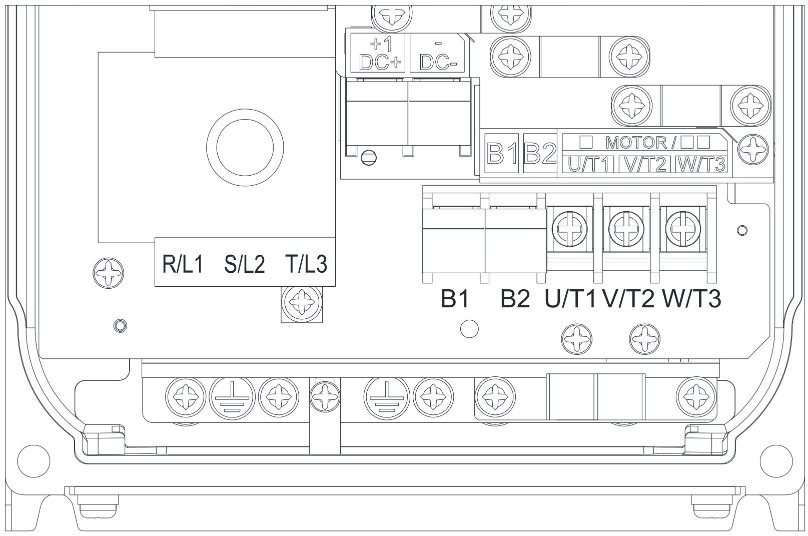
Frame A-1/A-3



- If you install at Ta 40°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C.
- If you install at Ta 40°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Nam	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1, B2			Terminals: ⏚, DC-, DC+		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD007FP4EA-41/52	12 AWG [4 mm^2]	12 AWG [4 mm^2]	M3.5 10 kg-cm [8.7 lb-in.] [0.98 Nm]	10 AWG [6 mm^2]	12 AWG [4 mm^2]	M4.0 18 kg-cm [15.6 lb-in.] [1.77 Nm]
VFD015FP4EA-41/52		12 AWG [4 mm^2]			12 AWG [4 mm^2]	
VFD022FP4EA-41/52		12 AWG [4 mm^2]			12 AWG [4 mm^2]	
VFD037FP4EA-41/52		12 AWG [4 mm^2]			12 AWG [4 mm^2]	
VFD040FP4EA-41/52	10 AWG [6 mm^2]	12 AWG [4 mm^2]	M4.0 18 kg-cm [15.6 lb-in.] [1.77 Nm]		12 AWG [4 mm^2]	
VFD055FP4EA-41/52		10 AWG [6 mm^2]			10 AWG [6 mm^2]	
VFD075FP4EA-41/52		10 AWG [6 mm^2]			10 AWG [6 mm^2]	

Frame A-2

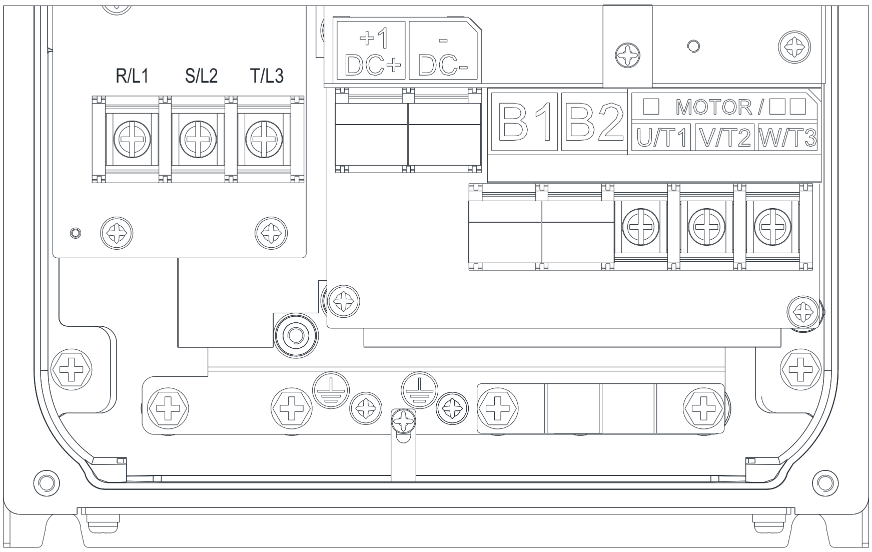


- If you install at Ta 40°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C.
- If you install at Ta 40°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Name	Main Circuit Terminals: R/L1, S/L2, T/L3			Terminals: ⏚, DC-, DC+		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque(±10%)
VFD007FP4EA-52S	10 AWG [6 mm²]	12 AWG [4 mm²]	8 kg-cm [6.9 lb-in.] [0.78 Nm]	10 AWG [6 mm²]	12 AWG [4 mm²]	M4.0 18 kg-cm [15.6 lb-in.] [1.77 Nm]
VFD015FP4EA-52S		12 AWG [4 mm²]			12 AWG [4 mm²]	
VFD022FP4EA-52S		12 AWG [4 mm²]			12 AWG [4 mm²]	
VFD037FP4EA-52S		12 AWG [4 mm²]			12 AWG [4 mm²]	
VFD040FP4EA-52S		12 AWG [4 mm²]			12 AWG [4 mm²]	
VFD055FP4EA-52S		10 AWG [6 mm²]			10AWG [6 mm²]	
VFD075FP4EA-52S		10 AWG [6 mm²]			10AWG [6 mm²]	

Model Name	Main Circuit Terminals: U/T1, V/T2, W/T3, B1, B2		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque(±10%)
VFD007FP4EA-52S	12 AWG [4 mm²]	12 AWG [4 mm²]	M3.5 10 kg-cm [8.7 lb-in.] [0.98 Nm]
VFD015FP4EA-52S	12 AWG [4 mm²]	12 AWG [4 mm²]	
VFD022FP4EA-52S	12 AWG [4 mm²]	12 AWG [4 mm²]	
VFD037FP4EA-52S	12 AWG [4 mm²]	12 AWG [4 mm²]	
VFD040FP4EA-52S	10 AWG [6 mm²]	12 AWG [4 mm²]	M4.0 18 kg-cm [15.6 lb-in.] [1.77 Nm]
VFD055FP4EA-52S	10 AWG [6 mm²]	10 AWG [6 mm²]	
VFD075FP4EA-52S	10 AWG [6 mm²]	10 AWG [6 mm²]	

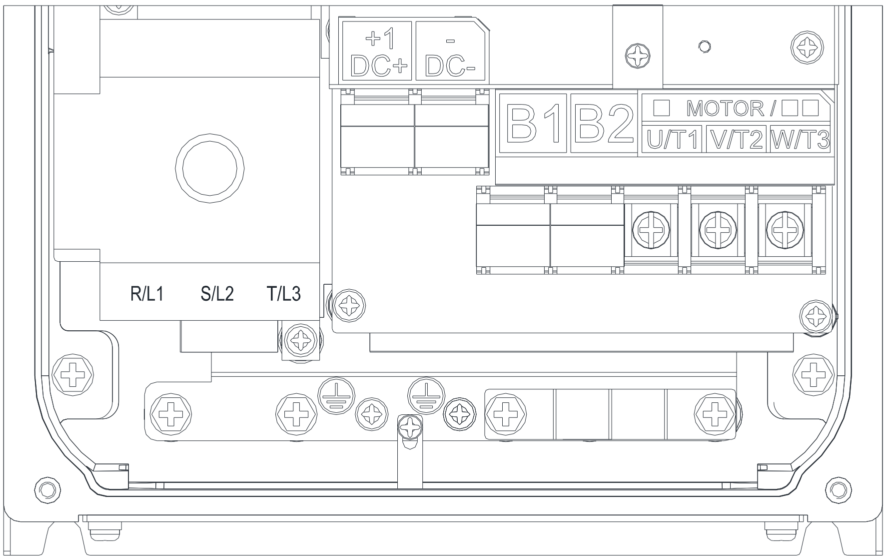
Frame B-1 / B-3



- If you install at Ta 40°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C.
- If you install at Ta 40°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Name	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1, B2, DC-, DC+, ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD110FP4EA-41/52	6 AWG [16 mm^2]	8 AWG [10 mm^2]	M5 25 kg-cm [21.7 lb-in.] [2.45 Nm]
VFD150FP4EA-41/52		8 AWG [10 mm^2]	
VFD185FP4EA-41/52		6 AWG [16 mm^2]	
VFD220FP4EA-41/52		6 AWG [16 mm^2]	

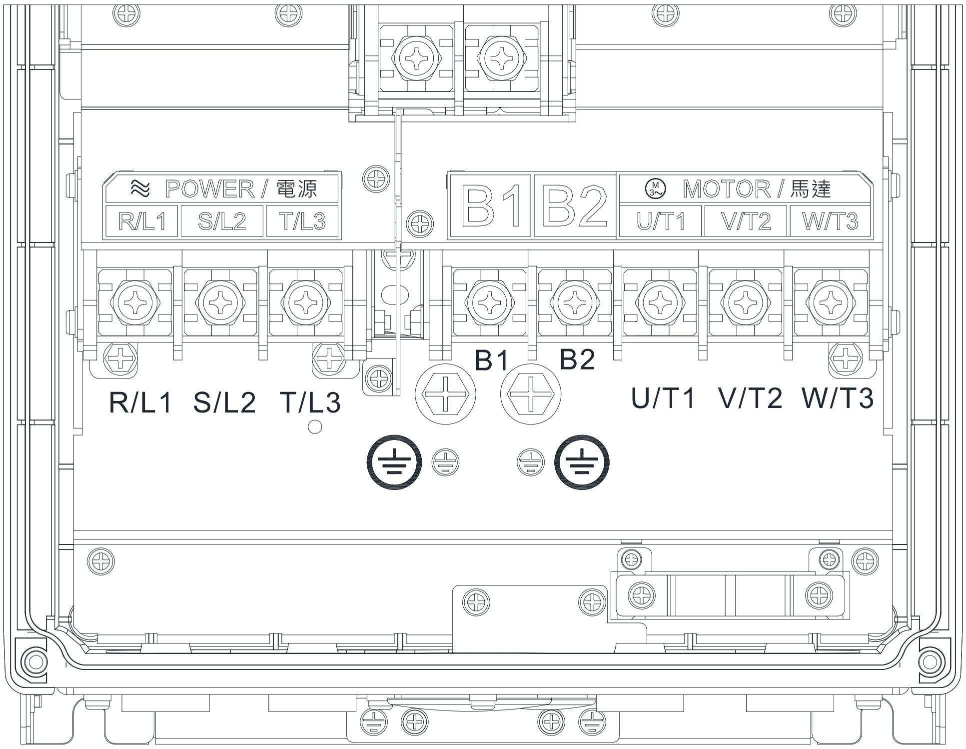
Frame B-2



- If you install at Ta 40°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C.
- If you install at Ta 40°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Name	Main Circuit Terminals: R/L1, S/L2, T/L3			Terminals: U/T1, V/T2, W/T3, B1, B2, ⏚, DC-, DC+		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD110FP4EA-52S	6 AWG [16 mm^2]	8 AWG [10 mm^2]	21 kg-cm [18.2 lb-in.] [2.06 Nm]	6 AWG [16 mm^2]	8 AWG [10 mm^2]	M5.0 25 kg-cm [21.7 lb-in.] [2.45 Nm]
VFD150FP4EA-52S		8 AWG [10 mm^2]			8 AWG [10 mm^2]	
VFD185FP4EA-52S		6 AWG [16 mm^2]			6 AWG [16 mm^2]	
VFD220FP4EA-52S		6 AWG [16 mm^2]			6 AWG [16 mm^2]	

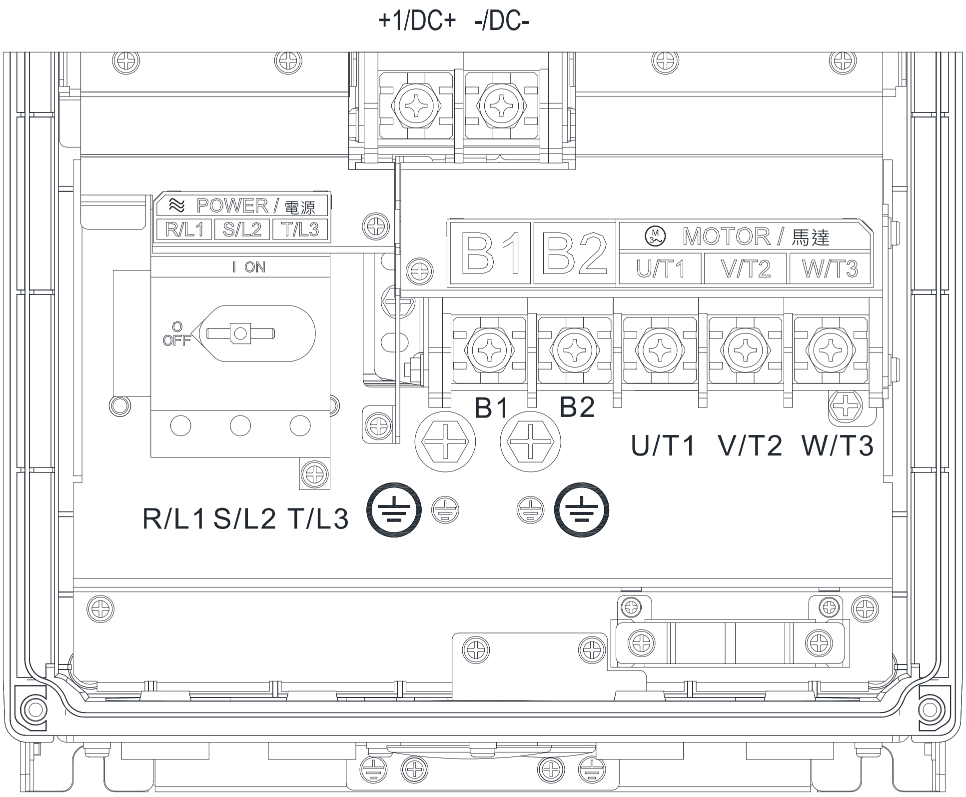
Frame C-1 / C-3



- If you install at Ta 40°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C
- If you install at Ta 40°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Name	Main Circuit Terminals: R/L1, S/L2, T/L3, DC+, DC-, B1, B2, U/T1, V/T2, W/T3			Terminal: ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD300FP4EA-41/52	2 AWG [35 mm^2]	4 AWG [25 mm^2]	M8 81.6 kg-cm [70.8 lb-in.] [8.00 Nm]	2 AWG [35 mm^2]	4 AWG [25 mm^2]	M8 81.6 kg-cm [70.8 lb-in.] [8.00 Nm]
VFD370FP4EA-41/52		2 AWG [35 mm^2]			2 AWG [35 mm^2]	

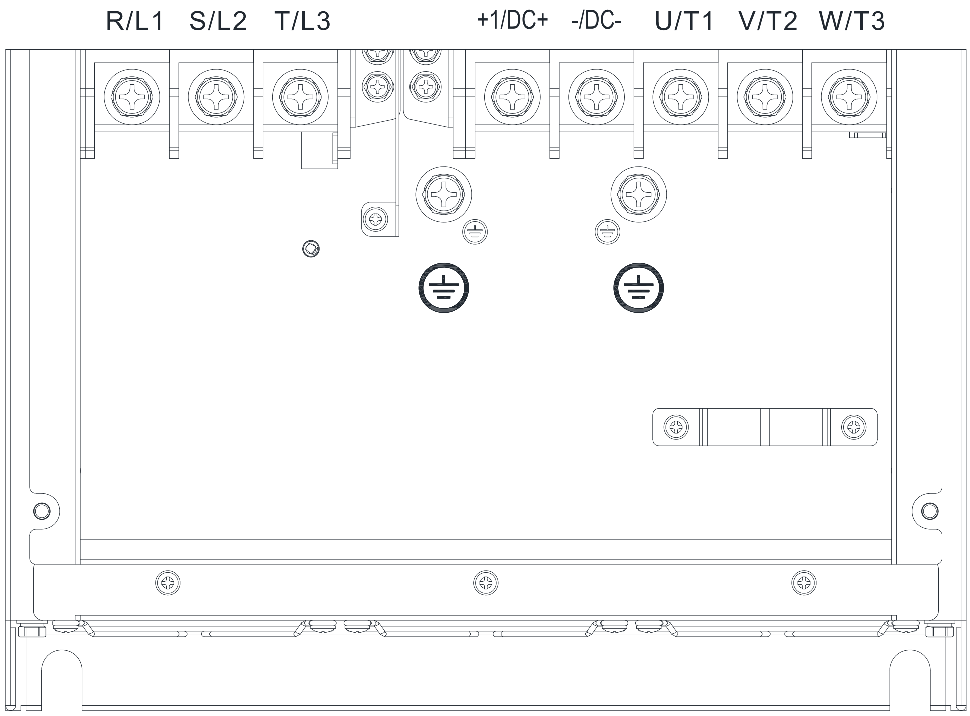
Frame C-2



- If you install at Ta 40°C environment, please select copper wire with voltage rating 600V and temperature resistant at 75°C or 90°C.
- If you install at Ta 40°C above environment, please select copper wire with voltage rating 600V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Name	Main Circuit Terminals: R/L1, S/L2, T/L3 (Stranded wire only)			Terminals: DC+, DC-, B1, B2, U/T1, V/T2，W/T3, ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD300FP4EA-52S	2 AWG [35 mm^2]	4 AWG [25 mm^2]	21 kg-cm [18.2 lb-in.] [2.07 Nm]	2 AWG [35 mm^2]	4 AWG [25 mm^2]	M8 81.6 kg-cm [70.8 lb-in.] [8.00 Nm]
VFD370FP4EA-52S		2 AWG [35 mm^2]			2 AWG [35 mm^2]	

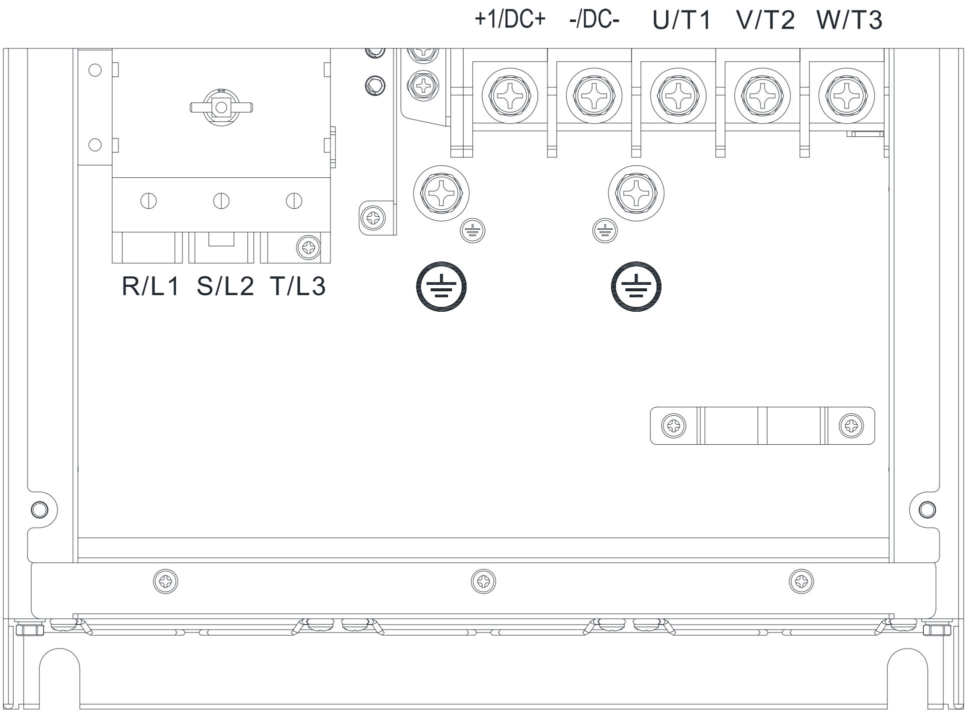
Frame D0-1 / D0-3



- If you install at Ta 35°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C.
- If you install at Ta 35°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

<table>
<tr><th rowspan="2">Model Name</th><th colspan="3">Main Circuit Terminals:
R/L1, S/L2, T/L3, DC+, DC-, U/T1, V/T2, W/T3</th><th colspan="3">Terminal: ⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th></tr>
<tr><td>VFD450FP4EA-41/52</td><td rowspan="2">1/0 AWG
[50 mm^2]</td><td>1 AWG [50 mm^2]</td><td rowspan="2">M8
82 kg-cm
[70.8 lb-in.]
[8.00 Nm]</td><td rowspan="2">1/0 AWG
[50 mm^2]</td><td>1 AWG [50 mm^2]</td><td rowspan="2">M8
82 kg-cm
[70.8 lb-in.]
[8.00 Nm]</td></tr>
<tr><td>VFD550FP4EA-41/52</td><td>1/0 AWG [50 mm^2]</td><td>1/0 AWG [50 mm^2]</td></tr>
</table>

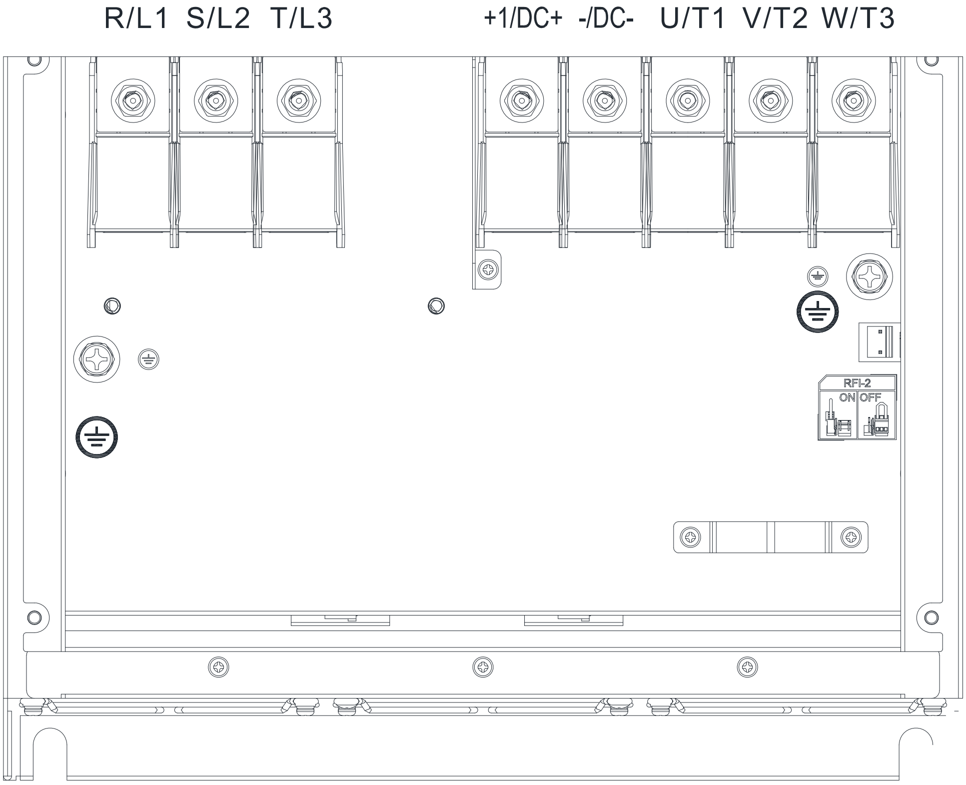
Frame D0-2



- If you install at Ta 35°C environment, please select copper wire with voltage rating 600V and temperature resistant at 75°C or 90°C.
- If you install at Ta 35°C above environment, please select copper wire with voltage rating 600V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

<table>
<tr><th rowspan="2">Model Name</th><th colspan="3">Main Circuit Terminals:
R/L1, S/L2, T/L3 (Stranded wire only)</th><th colspan="3">Terminals: DC+, DC-, U/T1, V/T2, W/T3, ⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th></tr>
<tr><td>VFD450FP4EA-52S</td><td rowspan="2">1/0 AWG [50 mm^2]</td><td>1 AWG [50 mm^2]</td><td rowspan="2">63 kg-cm [55.0 lb-in.] [6.20 Nm]</td><td rowspan="2">1/0 AWG [50 mm^2]</td><td>1 AWG [50 mm^2]</td><td rowspan="2">M8
82 kg-cm [70.8 lb-in.] [8.00 Nm]</td></tr>
<tr><td>VFD550FP4EA-52S</td><td>1/0 AWG [50 mm^2]</td><td>1/0 AWG [50 mm^2]</td></tr>
</table>

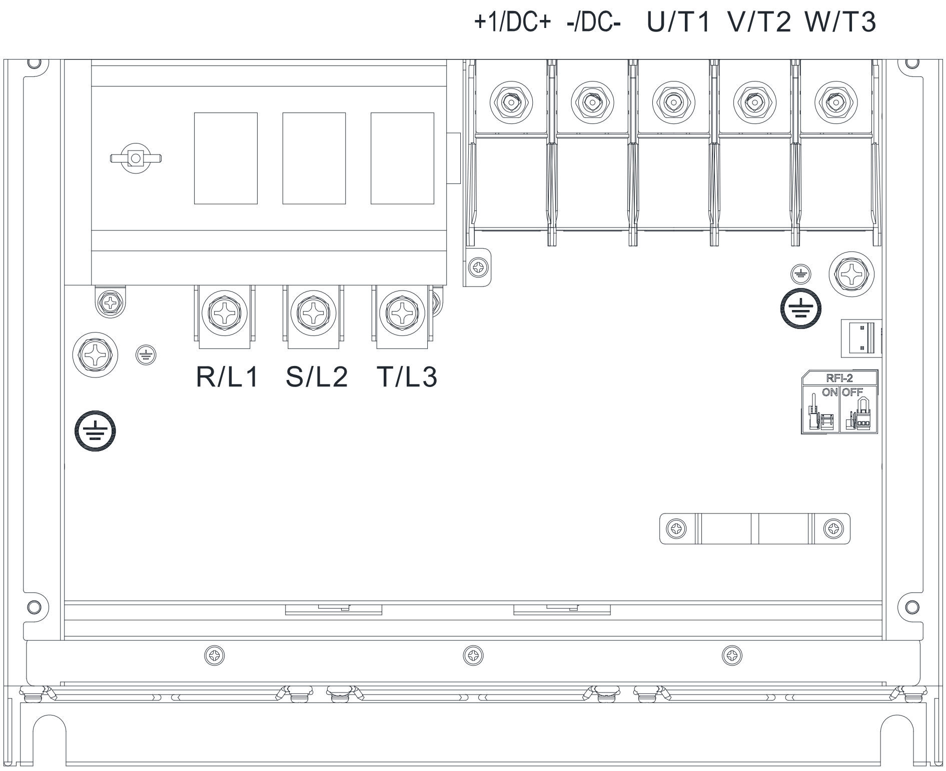
Frame D-1 / D-3



- If you install at Ta 30°C environment, please select copper wire with voltage rating 600V and temperature resistant at 75°C or 90°C.
- If you install at Ta 30°C above environment, please select copper wire with voltage rating 600V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

Model Name	Main Circuit Terminals: R/L1, S/L2, T/L3, DC+, DC-, U/T1, V/T2, W/T3			Terminal: ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD750FP4EA-41/52	4/0 AWG [120 mm^2]	3/0 AWG [95 mm^2]	M8 200 kg-cm [173.4 lb-in.] [19.62 Nm]	4/0 AWG [120 mm^2]	3/0 AWG [95 mm^2]	M8 200 kg-cm [173.4 lb-in.] [19.62 Nm]
VFD900FP4EA-41/52		4/0 AWG [120 mm^2]			4/0 AWG [120 mm^2]	

Frame D-2



- If you install at Ta 30°C environment, please select copper wire with voltage rating 600 V and temperature resistant at 75°C or 90°C.
- If you install at Ta 30°C above environment, please select copper wire with voltage rating 600 V and temperature resistant at 90°C or above.
- For UL installation compliant, please use copper wires for installation, the wire gauge is based on temperature resistant at 75°C which is requested and recommended from UL. Do not reduce the wire gauge when using higher temperature wire.

<table>
<tr><th rowspan="2">Model Name</th><th colspan="3">Main Circuit Terminals:
R/L1, S/L2, T/L3 (Stranded wire only)</th><th colspan="3">Terminal: DC+, DC-, U/T1, V/T2, W/T3, ⏚</th></tr>
<tr><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th><th>Max. Wire Gauge</th><th>Min. Wire Gauge</th><th>Screw Spec. and Torque (±10%)</th></tr>
<tr><td>VFD750FP4EA-52S</td><td rowspan="2">4/0 AWG
[120 mm^2]</td><td>3/0 AWG [95 mm^2]</td><td rowspan="2">M8
200 kg-cm
[173.4 lb-in.]
[19.62 Nm]</td><td rowspan="2">4/0 AWG
[120 mm^2]</td><td>3/0 AWG [95 mm^2]</td><td rowspan="2">M8
200 kg-cm
[173.4 lb-in.]
[19.62 Nm]</td></tr>
<tr><td>VFD900FP4EA-52S</td><td>4/0 AWG [120 mm^2]</td><td>4/0 AWG [120 mm^2]</td></tr>
</table>

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Chapter 6 Control Terminals

CAUTION

Analog input terminals (AVI1, AVI2, ACI, ACM)

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

☑ When using analog input signal in the circuit, twisted pair is suggested to use for dealing with weak signal.

☑ If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor and ferrite core as indicated in the following diagram.

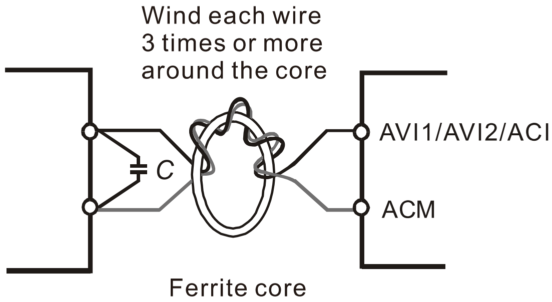


Figure 6-1

Digital inputs (FWD, REV, MI1–MI8, COM)

☑ The “COM” terminal is the common side of the photo-coupler. Any of wiring method, the “common point” of all photo-coupler must be the “COM”.

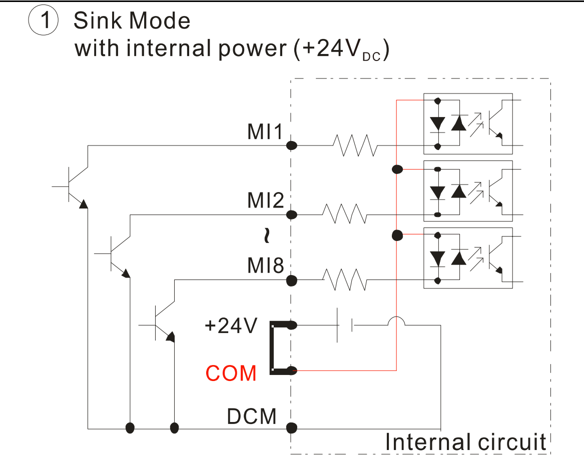


Figure 6-2

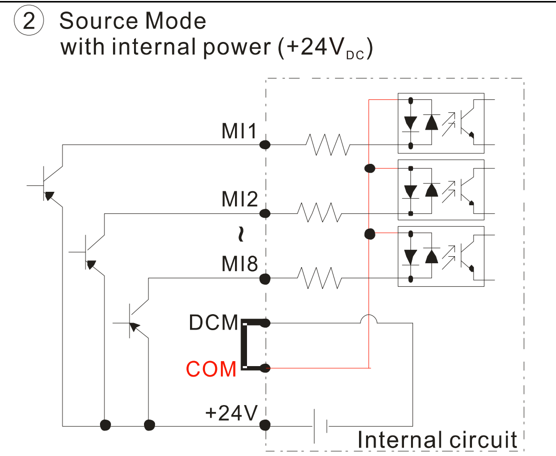


Figure 6-3

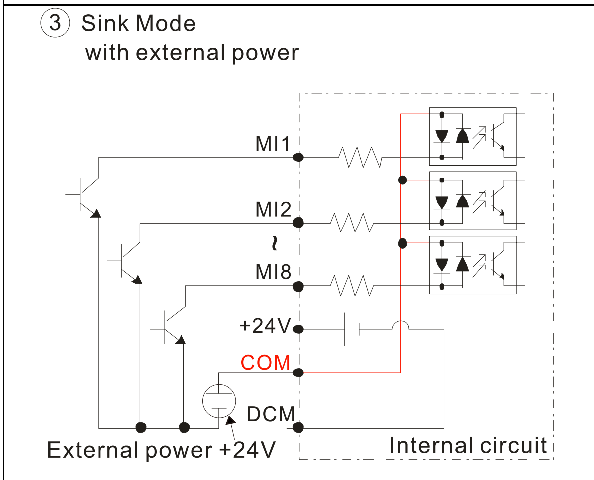


Figure 6-4

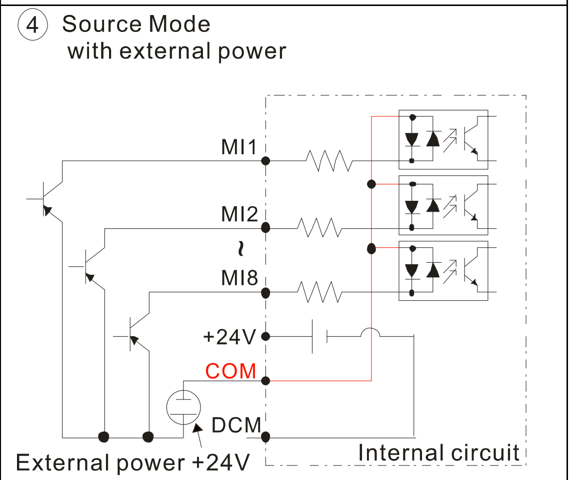


Figure 6-5

- ☑ When the photo-coupler is using internal power supply, the switch connection for Sink and Source as below:
  MI-DCM: Sink mode
  MI-+24V: Source mode
- ☑ When the photo-coupler is using external power supply, please remove the short circuit cable between the +24V and COM terminals. The connection mode is Sink mode or Source mode according to the below:
  The “+” of 24V connecting to COM: Sink mode
  The “-“ of 24V connecting to COM: Source mode

6-1 Remove the Cover for Wiring

Please remove the top cover before wiring the multi-function input and output terminals.

NOTE The drive appearances shown in the figures are for reference only, a real drive may look different.

Frame A & B

Applicable models:

VFD007FP4EA-41/-52/-52S, VFD015FP4EA-41/-52/-52S, VFD022FP4EA-41/-52/-52S, VFD037FP4EA-41/-52/-52S, VFD040FP4EA-41/-52/-52S, VFD055FP4EA-41/-52/-52S, VFD075FP4EA-41/-52/-52S, VFD110FP4EA-41/-52/-52S, VFD150FP4EA-41/-52/-52S, VFD185FP4EA-41/-52/-52S, VFD220FP4EA-41/-52/-52S

Screw torque: 12–15 kg-cm / [10.4–13 Ib-in.] / [1.2–1.5 Nm]

1) Remove the keypad. (As shown in figure 6-7)
2) Loosen the screws and press the tabs on both sides to remove the cover. (As shown in figure 6-8)

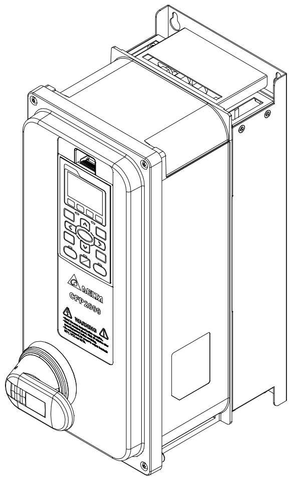


Figure 6-6

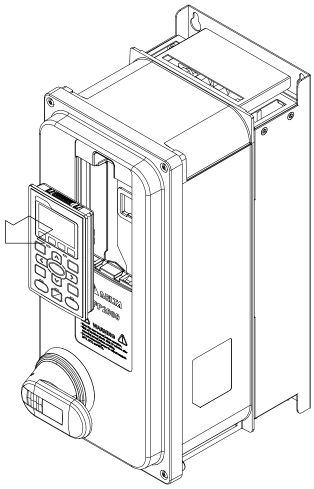


Figure 6-7

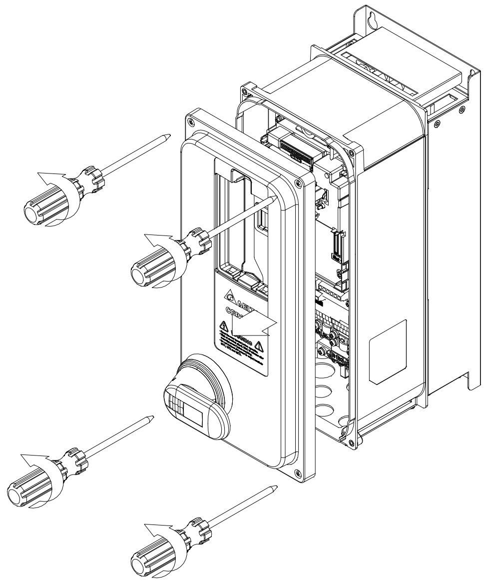


Figure 6-8

Frame C

Applicable models:

VFD300FP4EA-41/-52/-52S, VFD370FP4EA-41/-52/-52S

Screw torque: 12–15 kg-cm / [10.4–13 Ib-in.] / [1.2–1.5 Nm]

1) Remove the keypad. (As shown in figure 6-10)
2) Loosen the screws and press the tabs on both sides to remove the cover. (As shown in figure 6-11)

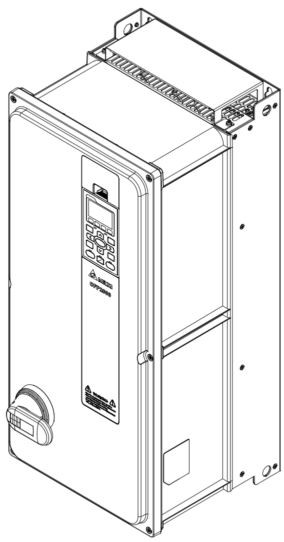


Figure 6-9

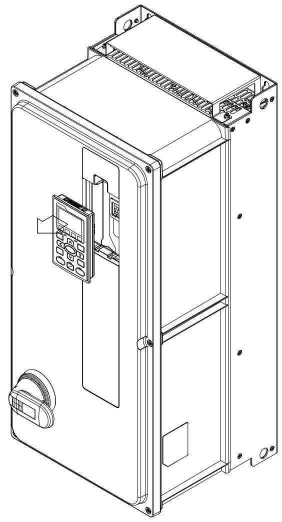


Figure 6-10

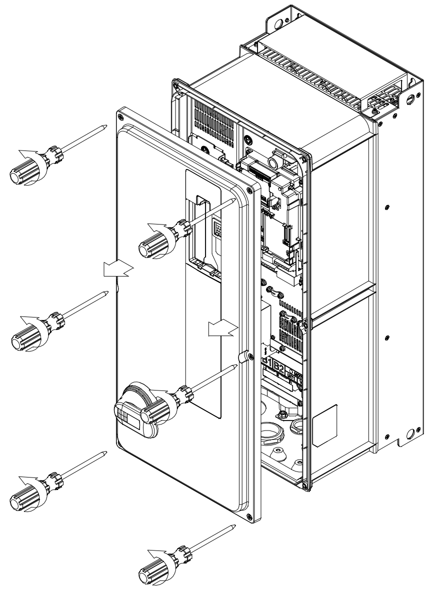


Figure 6-11

Frame D0

Applicable models:

VFD450FP4EA-41/-52/-52S, VFD550FP4EA-41/-52/-52S

Screw torque: 14–16 kg-cm / [12.1–13.9 Ib-in.] / [1.4–1.6 Nm]

1) Remove the keypad. (As shown in figure 6-13)
2) Loosen the screws and press the tabs on both sides to remove the cover. (As shown in figure 6-14)

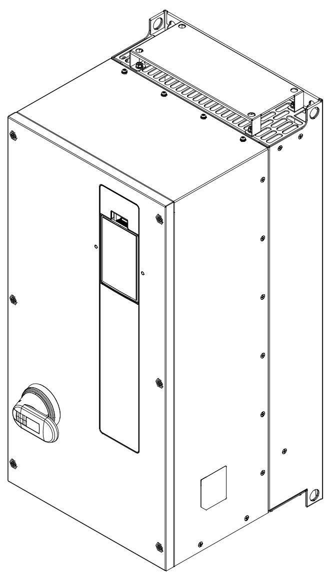


Figure 6-12

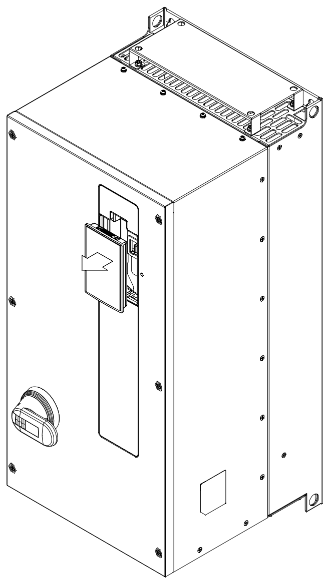


Figure 6-13

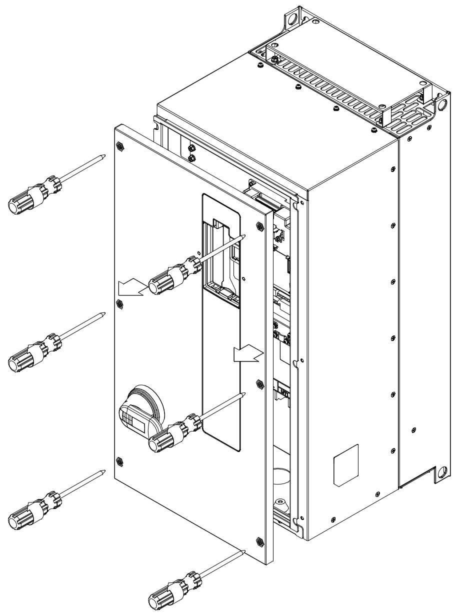


Figure 6-14

Frame D

Applicable models:
VFD750FP4EA-41/-52/-52S, VFD900FP4EA-41/-52/-52S

Screw torque: 14–16 kg-cm / [12.1–13.9 lb-in] / [1.4–1.6 Nm]

1) Remove the keypad. (As shown in figure 6-16)
2) Loosen the screw and press the tabs on both sides to remove the cover. (As shown in figure 6-17)

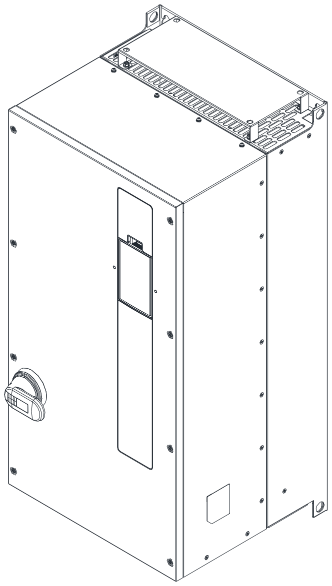


Figure 6-15

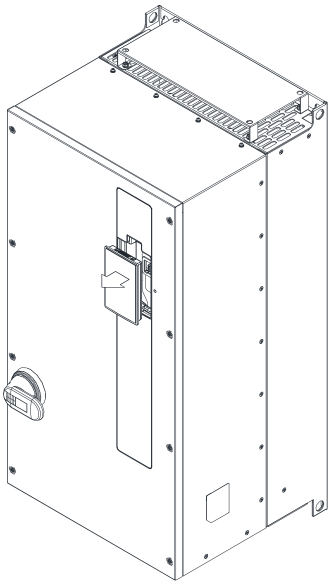


Figure 6-16

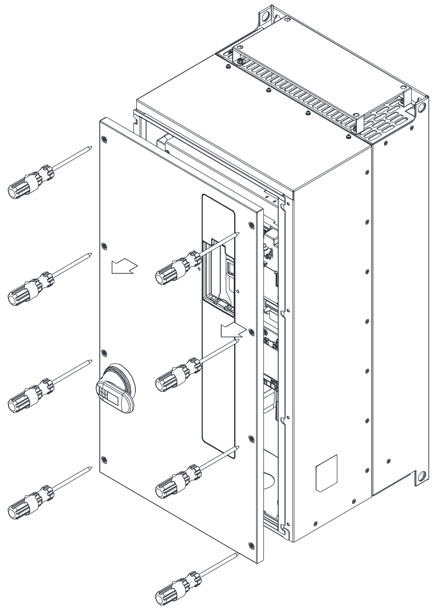
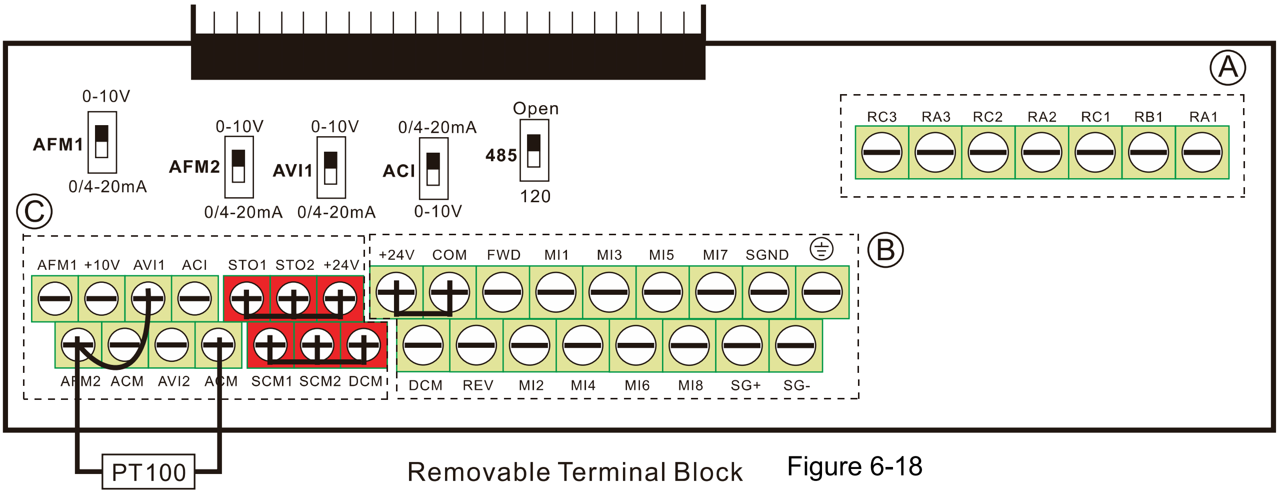


Figure 6-17

6-2 Specifications of Control Terminal



Removable Terminal Block Figure 6-18

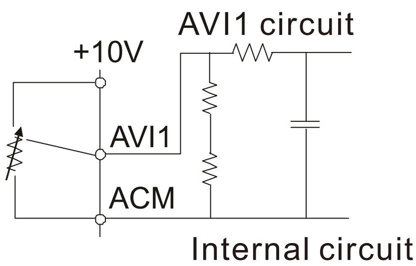
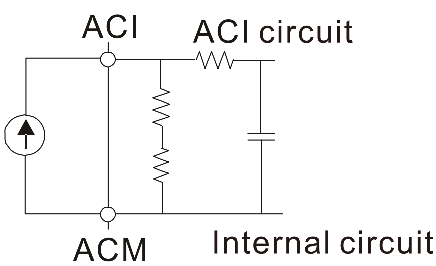
Terminal function	Group	Conductor	Stripping length [mm]	Max. wire gauge	Min. wire gauge	Torque (±10%)
Relay	Ⓐ	Solid	4–5	1.5 mm² [16 AWG]	0.2 mm² [26 AWG]	5 kg-cm [4.3 lb-in] [0.49 Nm]
		Strand				
Control board	Ⓑ	Solid	6–7			8 kg-cm [6.9 lb-in] [0.78 Nm]
		Strand				
Control board	Ⓒ	Solid				2 kg-cm [1.7 lb-in] [0.20 Nm]
		Strand				

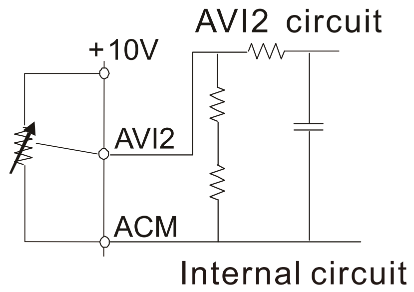
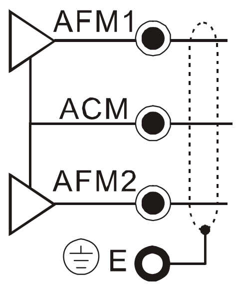
Table 6-1

Wiring precautions:

- In the figure above, the default for STO1, STO2, +24V and SCM1, SCM2, DCM are short circuit. The +24V from section Ⓒ of above figure is for STO only, and cannot be used for other purposes. The default for +24V-COM is short circuit and SINK mode (NPN); please refer to Section 4 Wiring for more detail.
- Tighten the wiring with slotted screwdriver:
  Ⓐ Ⓑ is 3.5 mm (wide) x 0.6 mm (thick); Ⓒ is 2.5 mm (wide) x 0.4 mm (thick)
- When wiring bare wires, make sure they are perfectly arranged to go through the wiring holes.

Terminals	Terminal Function	Factory Setting (NPN mode)
+24V	Digital control signal common (Source)	+24V ± 5% 200 mA
COM	Digital control signal common (Sink)	Common for multi-function input terminals
FWD	Forward-Stop command	FWD-DCM: ON➔ forward running OFF➔ deceleration to stop
REV	Reverse-Stop command	REV-DCM: ON➔ reverse running OFF➔ deceleration to stop

Terminals	Terminal Function	Factory Setting (NPN mode)
MI1 | MI8	Multi-function input 1–8	Refer to parameters 02-01–02-08 to program the multi-function inputs MI1–MI8. Source Mode ON: the activation voltage ≥ 11 V_{DC} OFF: cut-off current voltage ≤ 5 V_{DC} Sink Mode ON: the activation voltage ≤ 13 V_{DC} OFF: cut-off current voltage ≥ 19 V_{DC} The internal resistance is 3.6 kΩ.
DCM	Digital frequency signal common	Digital frequency signal common
RA1	Multi-function relay output 1 (N.O.) a	Resistive Load: 3A (N.O.) / 3A (N.C.) 250 V_{AC} 5A (N.O.) / 3A (N.C.) 30 V_{DC} Inductive Load (COS 0.4): 1.2A (N.O) / 1.2A (N.C.) 250 V_{AC} Various kinds of monitor signals output, e.g. operation, frequency reached, overload indication, etc.
RB1	Multi-function relay output 1 (N.C.) b	
RC1	Multi-function relay common	
RA2	Multi-function relay output 2 (N.O.) a	Resistive Load: 3A (N.O.) / 250 V_{AC} 5A (N.O.) / 30 V_{DC} Inductive Load (COS 0.4): 1.2A (N.O.) / 250 V_{AC} Various kinds of monitor signals output, e.g. operation, frequency reached, overload indication, etc.
RC2	Multi-function relay common	
RA3	Multi-function relay output 3 (N.O.) a	
RC3	Multi-function relay common	
+10V	Potentiometer power supply	Analog frequency setting: +10 V_{DC} 20 mA
AVI1	Analog voltage input  Figure 6-19	Impedance: 20 kΩ Range: 0–20 mA / 4–20 mA / 0–10 V = 0–Max. Output Frequency (Pr.01-00) AVI1 switch, default is 0–10 V
ACI	Analog current input  Figure 6-20	Impedance: 250 Ω Range: 0–20 mA / 4–20 mA / 0–10 V = 0–Max. Output Frequency (Pr.01-00) ACI Switch, default is 4–20 mA

Terminals	Terminal Function	Factory Setting (NPN mode)
AVI2	Auxiliary analog voltage input  Figure 6-21	Impedance: 20 kΩ Range: 0–10 V_{DC} = 0–Max. Output Frequency (Pr.01-00)
AFM1	Multi-function analog voltage output  Figure 6-22	0–10 V Max. output current 2 mA, Max. load 5 kΩ 0–20 mA Max. load 500 Ω Output current: 20 mA max. Resolution: 0–10 V corresponds to Max. operation frequency Range: 0–10 V → 4–20 mA AFM1 / AFM2 Switch, default is 0–10 V
AFM2		
ACM	Analog Signal Common	Common for analog terminals
STO1	Default setting is shorted Power removal safety function for EN ISO 13849 and IEC 61508 When STO1–SCM1; STO2–SCM2 is activated, the voltage of STO1–SCM1 / STO2–SCM2 must be ≥ 11 V_{DC}, the internal resistance for STO1–SCM1 / STO2–SCM2 is 3.6 kΩ Note: Please refer to Section 18 Safe Torque Off Function.	
SCM1		
STO2		
SCM2		
SG+	Modbus RS-485 Note: Please refer to Section 12 DESCRIPTION OF PARAMETER SETTINGS group 09 Communication Parameters for more information.	
SG-		
SGND		
RJ45	PIN 1, 2, 7, 8 : Reserved PIN 3, 6: SGND PIN 4: SG- PIN 5: SG+	

NOTE: Wire size of analog control signals: 0.75 mm^2 [18 AWG] with shielded wire.

Table 6-2

6-3 Remove the Terminal Block

1. Loosen the screws by screwdriver. (As shown in figure below).
   Screw torque: 6–8 kg-cm / [5.2–6.9 Ib-in] / [0.59–0.78 Nm]

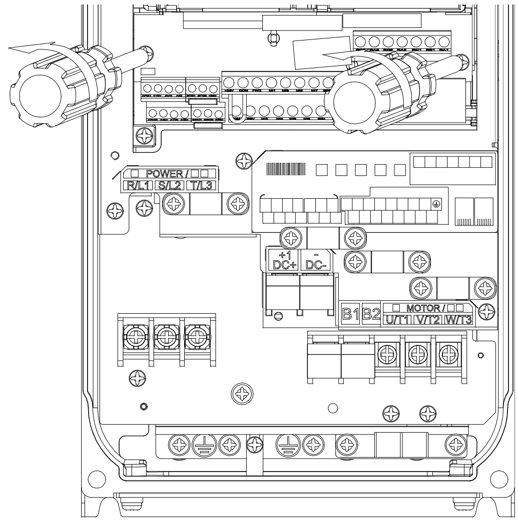


Figure 6-23

2. Remove the control board by pulling it out for a distance 6–8 cm (as 1 in the figure) then lift the control board upward (as 2 in the figure).

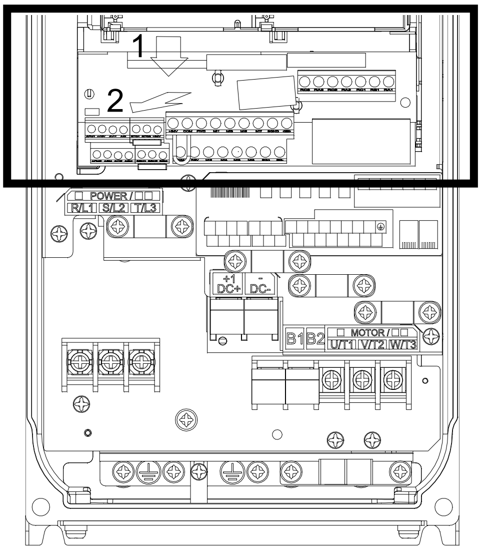


Figure 6-24

Chapter 7 Optional Accessories

The optional accessories listed in this chapter are available upon request. Installing additional accessories to your drive would substantially improve the drive's performance. Please select an applicable accessory according to your need or contact the local distributor for suggestion.

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

Applicable Motor		125%Braking Torque 10%ED*1							Max. Brake Torque*2		
HP	kW	Braking Torque [kg-m]	Brake Unit VFDB*4	Braking Resistor Series for Each Brake Unit*3 P/N	Q'ty	Usage	Resistor Value Spec. for Each AC Motor Drive	Total Braking Current [A]	Min. Resistor Value [Ω]	Max. Total Braking Current [A]	Peak Power [kW]
1	0.75	0.5	-	BR080W750	1	-	80W750Ω	1	190.0	4	3.0
2	1.5	0.5	-	BR080W750	1	-	80W750Ω	1	190.0	4	3.0
3	2.2	1.0	-	BR200W360	1	-	200W360Ω	2.1	126.7	6	4.6
5	3.7	1.5	-	BR300W250	1	-	300W250Ω	3	108.6	7	5.3
5	4.0	2.5	-	BR400W150	1	-	400W150Ω	5.1	84.4	9	6.8
7.5	5.5	2.7	-	BR1K0W075	1	-	1000W75Ω	10.2	54.3	14	10.6
10	7.5	3.7	-	BR1K0W075	1	-	1000W75Ω	10.2	54.3	14	10.6
15	11	5.1	-	BR1K0W075	1	-	1000W75Ω	10.2	47.5	16	12.2
20	15	7.4	-	BR1K5W043	1	-	1500W43Ω	17.6	42.2	18	13.7
25	18	10.2	-	BR1K0W016	2	2 series	2000W32Ω	24	26.2	29	22.0
30	22	12.2	-	BR1K0W016	2	2 series	2000W32Ω	24	23.0	33	25.1
40	30	14.9	-	BR1K5W013	2	2 series	3000W26Ω	29	23.0	33	25.1
50	37	20.3	-	BR1K0W016	4	2 parallel, 2 series	4000W16Ω	47.5	14.1	54	41.0
60	45	25	4045*1	BR1K2W015	4	2 parallel, 2 series	4800W15Ω	50	12.7	60	45.6
75	55	30.5	4045*1	BR1K5W013	4	2 parallel, 2 series	6000W13Ω	59	12.7	60	45.6
100	75	37.2	4030*2	BR1K0W5P1	4	4 series	8000W10.2Ω	76	9.5	80	60.8
125	90	50.8	4045*2	BR1K2W015	4	2 parallel, 2 series	9600W7.5Ω	100	6.3	120	91.2

Table 7-1

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

*2 Refer to Chapter 7 "Brake Module and Brake Resistors" in application manual for "Operation Duration & ED" vs. "Braking Current".

*3 For heat dissipation, a resistor of 400 W or lower should be fixed to the frame and maintain the surface temperature below 250°C; a resistor of 1000 W and above should maintain the surface temperature below 350°C.

*4 The calculation of the braking resistor is based on a four-pole motor (1800 rpm). Refer to VFDB series Braking Module Instruction for more details on the braking resistor.

NOTE

1. Specification and Appearances of Brake Resistors

1-1 Wire wound resistors: For 1000W and above, refer to the following appearance of wire wound resistor (Figure 7-1) and its model and specification comparison table (Table 7-2) for details.

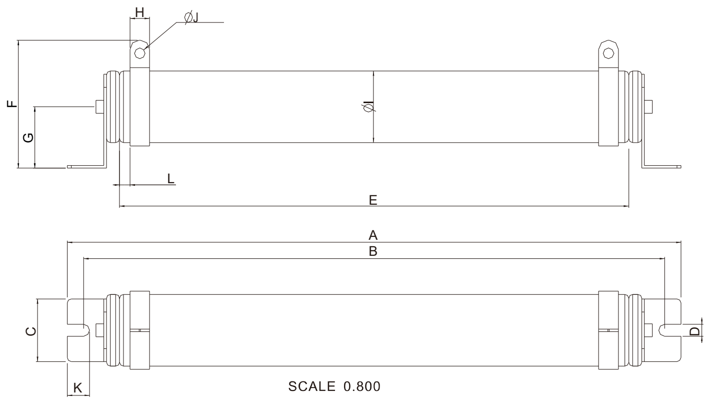


Figure 7-1

Models and Specifications Comparison Table of Wire Wound Resistors:

UNIT: MM

MODEL	A	B	C	D	E	F	G	H	∅I	∅J	K	L
BR1K0W4P3	470±10	445±5	48±0.2	9.1±0.1	390±3	98±5	47±5	15±1	55±5	8.1±0.1	21±0.2	8±1
BR1K0W5P1												
BR1K0W016												
BR1K0W020												
BR1K0W075												
BR1K2W3P9												
BR1K2W015												
BR1K5W3P3												
BR1K5W012												
BR1K5W013												
BR1K5W043												

Table 7-2

1-2 Aluminum housed resistors: for below 1000W, refer to the following appearance of aluminum-housed resistor (Figure 7-2) and its model and specification comparison table (Table 7-3) for details.

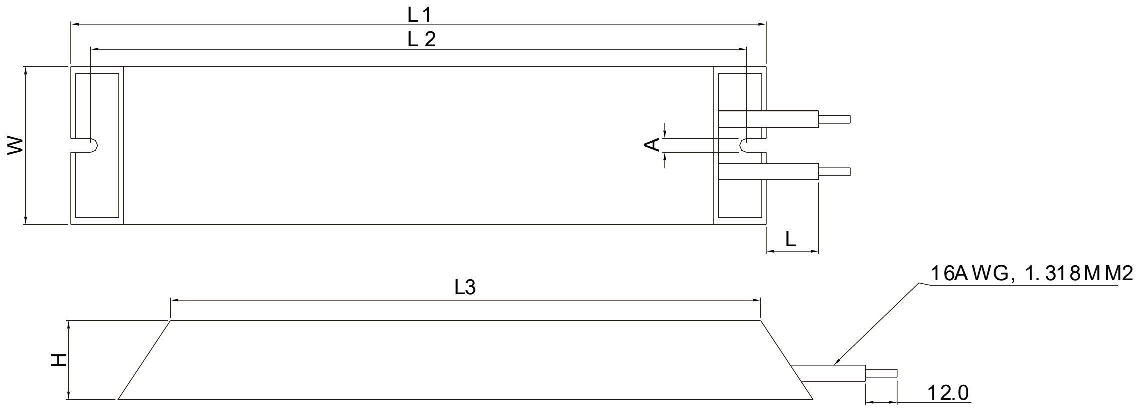


Figure 7-2

MODEL	L1	L2	L3	W	H	A	L
BR080W200	140±2	125±2	100±1	40±0.5	20±0.5	5.3±0.5	200±20
BR080W750							
BR200W091	165±2	150±2	125±1	60±0.5	30±0.5		
BR200W360							
BR300W070	215±2	200±2	175±1				
BR300W250							
BR400W040	265±2	250±2	225±1				
BR400W150							

Unit: mm

Table 7-3

2. How to install brake resistors?

2-1 Clearance around brake resistors (See Figure 7-3–7-8)

- The side clearance around the brake resistor should be over 150 mm.
- The top clearance above the brake resistor should be over 500 mm.
- The clearance between two brake resistors should be at least 150 mm.

Single brake resistor

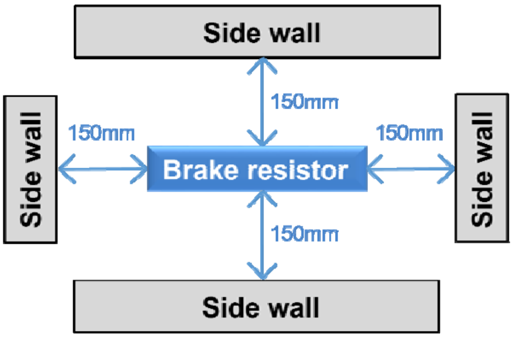
<table>
<tr><td rowspan="1">Horizontal mounting</td><td>Top view


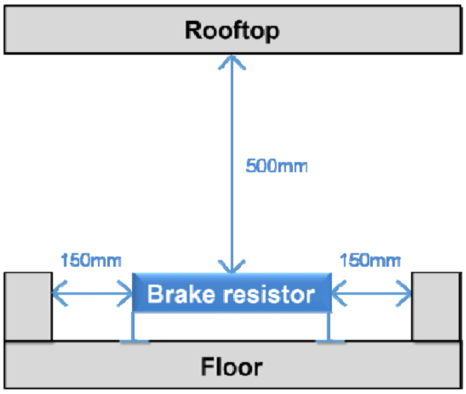
Figure 7-3</td><td>Side view


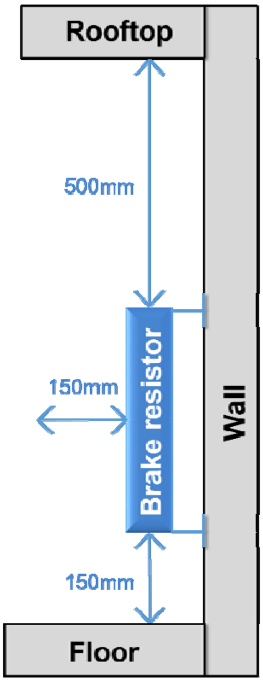
Figure 7-4</td></tr>
<tr><td>Vertical mounting</td><td colspan="2">

Figure 7-5</td></tr>
</table>

Multiple brake resistor

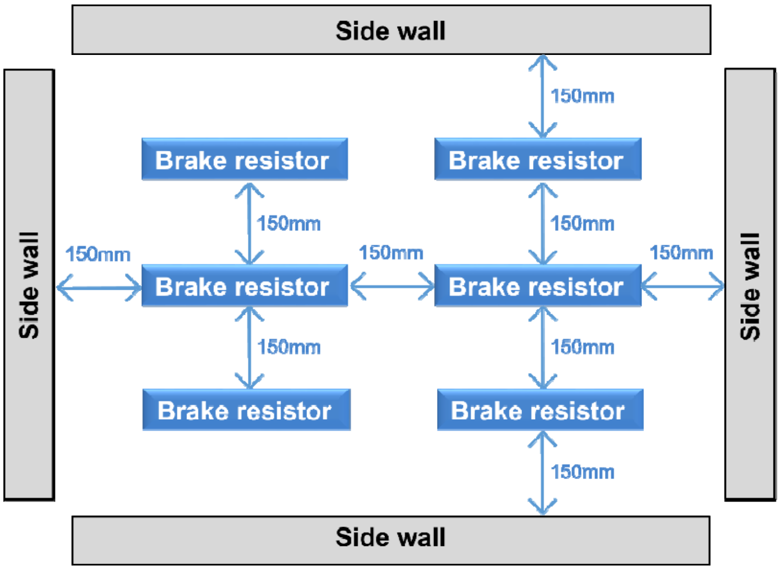
<table>
<tr><td rowspan="2">Horizontal mounting</td><td>Top view


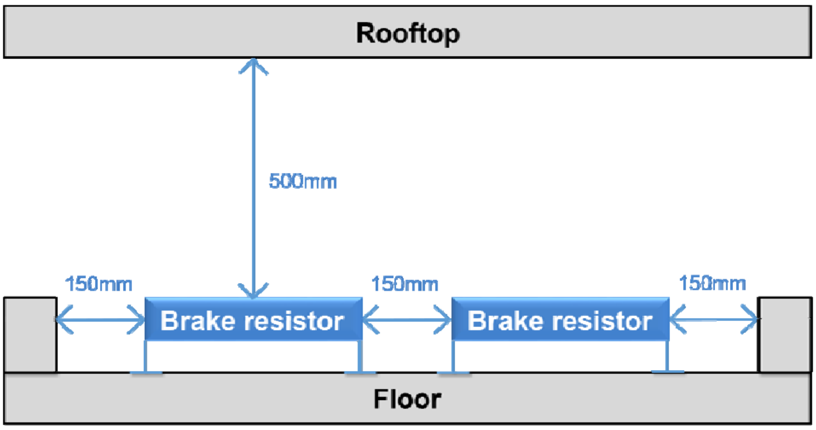
Figure 7-6</td></tr>
<tr><td>Side view


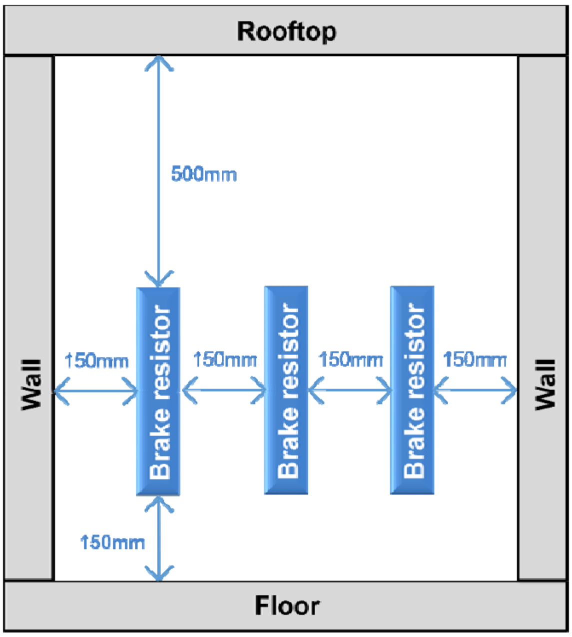
Figure 7-7</td></tr>
<tr><td>Vertical mounting</td><td>

Figure 7-8</td></tr>
</table>

2-2 Installation limits

Both horizontal and vertical mounting is safe if there is sufficient clearance and the brake resistor is installed in the correct position. Take notice on the following:

- Do not install brake resistors on another brake resistor or above any hot air source .
  (Do not mount as shown in Figure 7-9)
- When mounting vertically, the cable connection should not be on the top of the brake resistor.
  (Do not mount as shown in Figure 7-10)

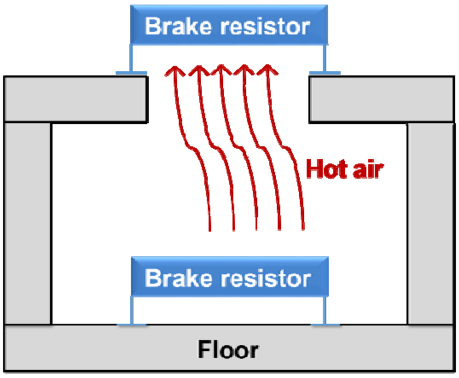


Figure 7-9

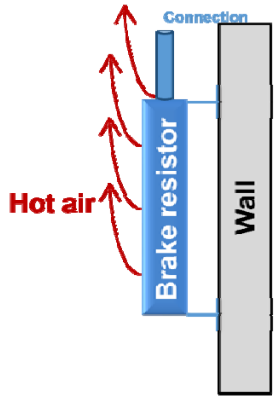
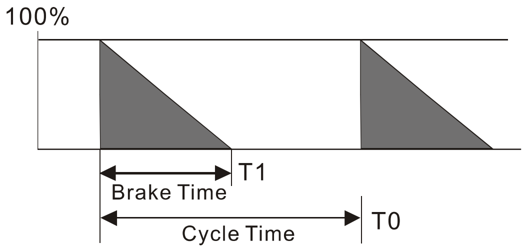


Figure 7-10

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

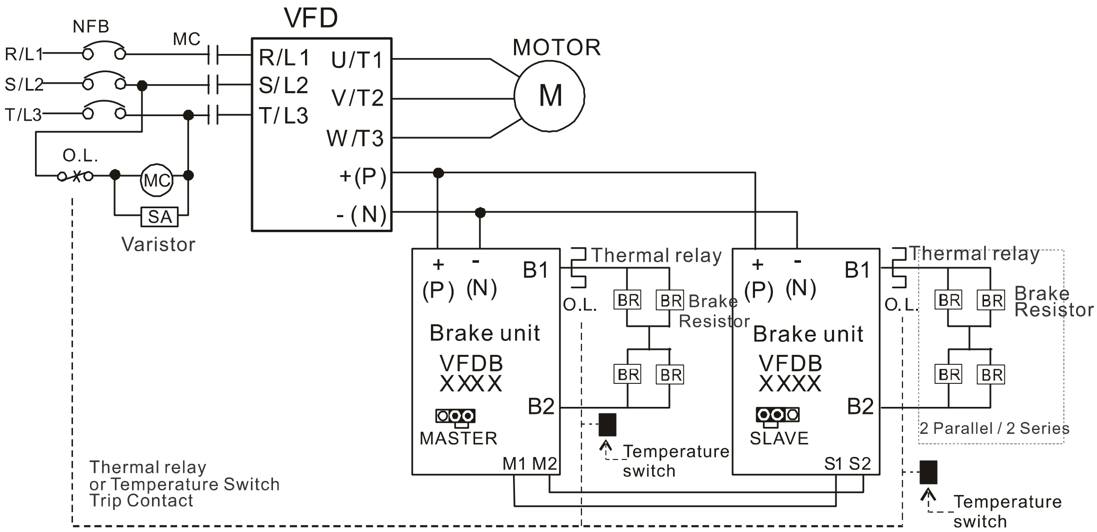


ED%=T1/T0x100(%)

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.

Figure 7-11

For safety, install a thermal overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) before the drive for additional protection. The thermal overload relay protects the brake resistor from damage due to frequent or continuous braking. Under such circumstances, turn off the power to prevent damage to the brake resistor, brake unit and drive.



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

Figure 7-12

4. Any damage to the drive or other equipment caused by using brake resistors and brake modules that are not provided by Delta voids the warranty.
5. Consider environmental safety factors when installing the brake resistors. If you use the minimum resistance value, consult local dealers for the power calculation.
6. When using more than two brake units, the equivalent resistor value of the parallel brake unit cannot be less than the value in the column "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/filecenter/Products/download/06/060101/Option/DELTA_IA-MDS_VFDB_I_EN_20070719.pdf
   - VFDB4110 / 4160 / 4185 Braking Modules Instruction Sheet
     http://www.deltaww.com/filecenter/Products/download/06/060101/Option/DELTA_IA-MDS_VFDB4110-4160-4185_I_EN_20101011.pdf
   - VFDB6055 / 6110 / 6160 / 6200 Braking Modules Instruction Sheet
     http://www.deltaww.com/filecenter/Products/download/06/060101/Option/DELTA_IA-MDS_VFDB6055-6110-6160-6200_I_TSE_20121030.pdf
7. This chart is for normal usage. If the AC motor drive requires frequent braking, increase the Watts by two to three times.
8. Thermal Overload Relay (TOR), for 460V models:
   Thermal overload relay selection is based on its overload capacity. A standard braking capacity of the CFP2000 is 10%ED (Tripping time=10s). As shown in the figure below, a 460V, 110 kW CFP2000 required the thermal relay to take 260% overload capacity for 10 seconds (hot starting) and the braking current is 126 A (refer to the tables in the section). In this case, select a thermal overload relay rated at 50 A. The property of each thermal relay may vary among different manufacturers. Carefully read the specification before using it.

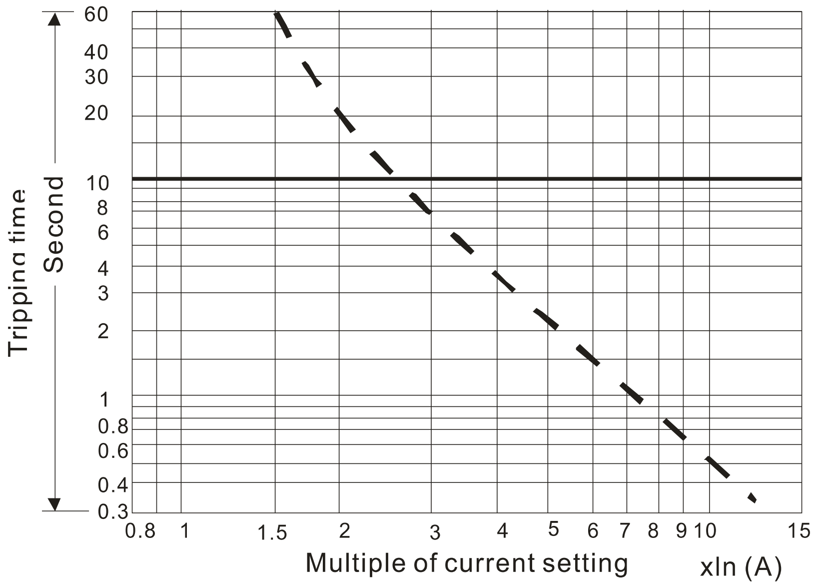


Figure 7-13

7-2 Magnetic Contactor / Air Circuit Breaker and Non-fuse Circuit Breaker

Magnetic Contactor (MC) and Air Circuit Breaker (ACB)

It is recommended the surrounding temperature for MC should be ≥ 60°C and that for ACB should be ≥ 50°C. In the meanwhile, consider temperature derating for components with ON/OFF switch in accordance with the ambient temperature of the on-site distribution panel.

Frame	Model	Light duty output current [A]	Light duty input current [A]	MC/ACB selection [A]
A	VFD007FP4EA-41/-52/-52S	3	3	7
	VFD015FP4EA-41/-52/-52S	4.2	4.2	7
	VFD022FP4EA-41/-52/-52S	5.5	5.5	9
	VFD037FP4EA-41/-52/-52S	8.5	8.5	18
	VFD040FP4EA-41/-52/-52S	10.5	10.5	18
	VFD055FP4EA-41/-52/-52S	13	13	22
	VFD075FP4EA-41/-52/-52S	18	18	32
B	VFD110FP4EA-41/-52/-52S	24	24	40
	VFD150FP4EA-41/-52/-52S	32	32	50
	VFD185FP4EA-41/-52/-52S	38	38	65
C	VFD220FP4EA-41/-52/-52S	45	45	75
	VFD300FP4EA-41/-52/-52S	60	60	105
	VFD370FP4EA-41/-52/-52S	73	73	130
D0	VFD450FP4EA-41/-52/-52S	91	91	150
	VFD550FP4EA-41/-52/-52S	110	110	185
D	VFD750FP4EA-41/-52/-52S	150	150	265
	VFD900FP4EA-41/-52/-52S	180	180	330

Table 7-4

Non-fuse Circuit Breaker

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

The rated current of the breaker shall be 1.6–2.6 times of the maximum rated input current of AC motor drive.

Model	Recommended non-fuse breaker [A]
VFD007FP4EA-41/-52/-52S	6
VFD015FP4EA-41/-52/-52S	6
VFD022FP4EA-41/-52/-52S	10
VFD037FP4EA-41/-52/-52S	15
VFD040FP4EA-41/-52/-52S	15
VFD055FP4EA-41/-52/-52S	20
VFD075FP4EA-41/-52/-52S	25
VFD110FP4EA-41/-52/-52S	35
VFD150FP4EA-41/-52/-52S	50
VFD185FP4EA-41/-52/-52S	60
VFD220FP4EA-41/-52/-52S	60
VFD300FP4EA-41/-52/-52S	90
VFD370FP4EA-41/-52/-52S	100
VFD450FP4EA-41/-52/-52S	125
VFD550FP4EA-41/-52/-52S	150
VFD750FP4EA-41/-52/-52S	200
VFD900FP4EA-41/-52/-52S	250

Table 7-5

7-3 Fuse Specification Chart

☑ Fuses specification lower than the table below are allowed.

☑ For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. Use UL classified fuses to fulfill this requirement."

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

Model	Input Current I [A]		Line Fuse	
	Light Duty	Normal Duty	I [A]	Bussmann P/N
VFD007FP4EA-41/-52/-52S	3.0	1.7	6	JJS-6
VFD015FP4EA-41/-52/-52S	4.2	3	6	JJS-6
VFD022FP4EA-41/-52/-52S	5.5	4	10	JJS-10
VFD037FP4EA-41/-52/-52S	8.5	6	15	JJS-15
VFD040FP4EA-41/-52/-52S	10.5	9	15	JJS-15
VFD055FP4EA-41/-52/-52S	13	10.5	20	JJS-20
VFD075FP4EA-41/-52/-52S	18	12	25	JJS-25
VFD110FP4EA-41/-52/-52S	24	18	35	JJS-35
VFD150FP4EA-41/-52/-52S	32	24	50	JJS-50
VFD185FP4EA-41/-52/-52S	38	32	60	JJS-60
VFD220FP4EA-41/-52/-52S	45	38	60	JJS-60
VFD300FP4EA-41/-52/-52S	60	45	90	JJS-90
VFD370FP4EA-41/-52/-52S	73	60	100	JJS-100
VFD450FP4EA-41/-52/-52S	91	73	125	JJS-125
VFD550FP4EA-41/-52/-52S	110	91	150	JJS-150
VFD750FP4EA-41/-52/-52S	150	110	200	JJS-200
VFD900FP4EA-41/-52/-52S	180	150	250	JJS-250

Table 7-6

7-4 AC Reactor

AC Input Reactor

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

Installation

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

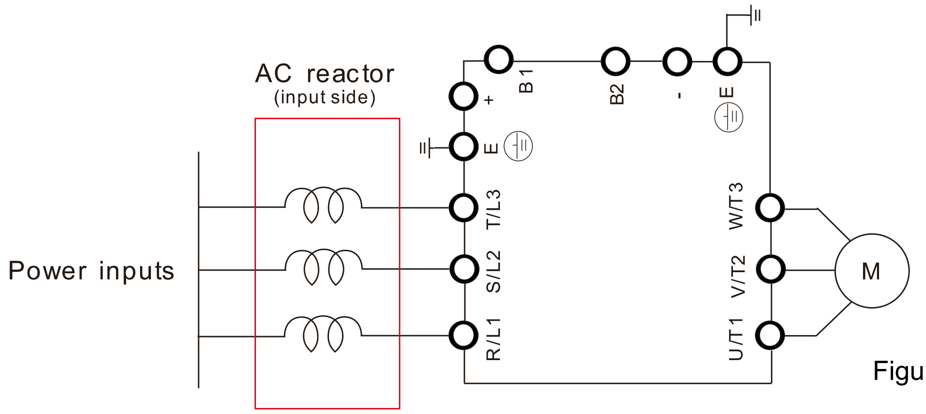


Figure 7-14

Wiring an AC input reactor

Following table shows the standard AC reactors specification of Delta CFP2000:

380V–460V / 50–60 Hz

Model	kW	HP	Rated Amps of AC Reactor (Arms)		Max. continuous Amps (Arms)		3% impedance(mH)		5% impedance(mH)		Built-in DC reactor	3% Input AC reactor Delta part #	
			Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty		Normal Duty	Light Duty
VFD007FP4EA-41/-52 / VFD007FP4EA-52S	0.75	1	1.7	3	2.72	3.6	14.918	8.102	24.863	13.503	Yes	DR003A0810*	DR003A0810
VFD015FP4EA-41/-52 / VFD015FP4EA-52S	1.5	2	3	4.2	4.8	5.04	8.102	6.077	13.503	10.128	Yes	DR003A0810	DR004A0607
VFD022FP4EA-41/-52 / VFD022FP4EA-52S	2.2	3	4	5.5	6.4	6.6	6.077	4.05	10.128	6.75	Yes	DR004A0607	DR006A0405
VFD037FP4EA-41/-52 / VFD037FP4EA-52S	3.7	5	6	8.5	9.6	10.2	4.05	2.7	6.75	4.5	Yes	DR006A0405	DR009A0270
VFD040FP4EA-41/-52 / VFD040FP4EA-52S	4	5	9	10.5	14.4	12.6	2.7	2.315	4.5	3.858	Yes	DR009A0270	DR010A0231
VFD055FP4EA-41/-52 / VFD055FP4EA-52S	5.5	7.5	10.5	13	16.8	15.6	2.315	2.025	3.858	3.375	Yes	DR010A0231	DR012A0202
VFD075FP4EA-41/-52 / VFD075FP4EA-52S	7.5	10	12	18	19.2	21.6	2.025	1.35	3.375	2.25	Yes	DR012A0202	DR018A0117
VFD110FP4EA-41/-52 / VFD110FP4EA-52S	11	15	18	24	28.8	28.8	1.35	1.01	2.25	1.683	Yes	DR018A0117	DR024AP881
VFD150FP4EA-41/-52 / VFD150FP4EA-52S	15	20	24	32	38.4	38.4	1.01	0.76	1.683	1.267	Yes	DR024AP881	DR032AP660
VFD185FP4EA-41/-52 / VFD185FP4EA-52S	18.5	25	32	38	51.2	45.6	0.76	0.639	1.267	1.065	Yes	DR032AP660	DR038AP639

Model	kW	HP	Rated Amps of AC Reactor (Arms)		Max. continuous Amps (Arms)		3% impedance(mH)		5% impedance(mH)		Built-in DC reactor	3% Input AC reactor Delta part #	
			Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty		Normal Duty	Light Duty
VFD220FP4EA-41/-52 / VFD220FP4EA-52S	22	30	38	45	60.8	54	0.639	0.541	1.065	0.902	Yes	DR038AP639	DR045AP541
VFD300FP4EA-41/-52 / VFD300FP4EA-52S	30	40	45	60	72	72	0.541	0.405	0.902	0.675	Yes	DR045AP541	DR060AP405
VFD370FP4EA-41/-52 / VFD370FP4EA-52S	37	50	60	73	96	87.6	0.405	0.334	0.675	0.557	Yes	DR060AP405	DR073AP334
VFD450FP4EA-41/-52 / VFD450FP4EA-52S	45	60	73	91	116.8	109.2	0.334	0.267	0.557	0.445	Yes	DR073AP334	DR091AP267
VFD550FP4EA-41/-52 / VFD550FP4EA-52S	55	75	91	110	145.6	132	0.267	0.221	0.445	0.368	Yes	DR091AP267	DR110AP221
VFD750FP4EA-41/-52 / VFD750FP4EA-52S	75	100	110	150	176	180	0.221	0.162	0.368	0.27	Yes	DR110AP221	DR150AP162
VFD900FP4EA-41/-52 / VFD900FP4EA-52S	90	125	150	180	240	216	0.162	0.135	0.27	0.225	Yes	DR150AP162	DR180AP135

NOTE * : Use with DR003A0810, but the inductance value will be 3% short.

Table 7-7

The following table is spec. of THDi that Delta AC motor drives use with AC reactors.

Motor Drive Spec	With Built in DC Reactor		
Reactor Spec.	Without installation AC/DC Reactor	3% Input AC Reactor	5% Input AC Reactor
5th	31.16%	27.01%	25.5%
7th	23.18%	9.54%	8.75%
11th	8.6%	4.5%	4.2%
13th	7.9%	0.22%	0.17%
THDi	42.28%	30.5%	28.4%
Note:	THDi may have some difference due to different installation conditions and environment.		

THDi Spec.

Table 7-8

AC input reactor dimensions and specification:

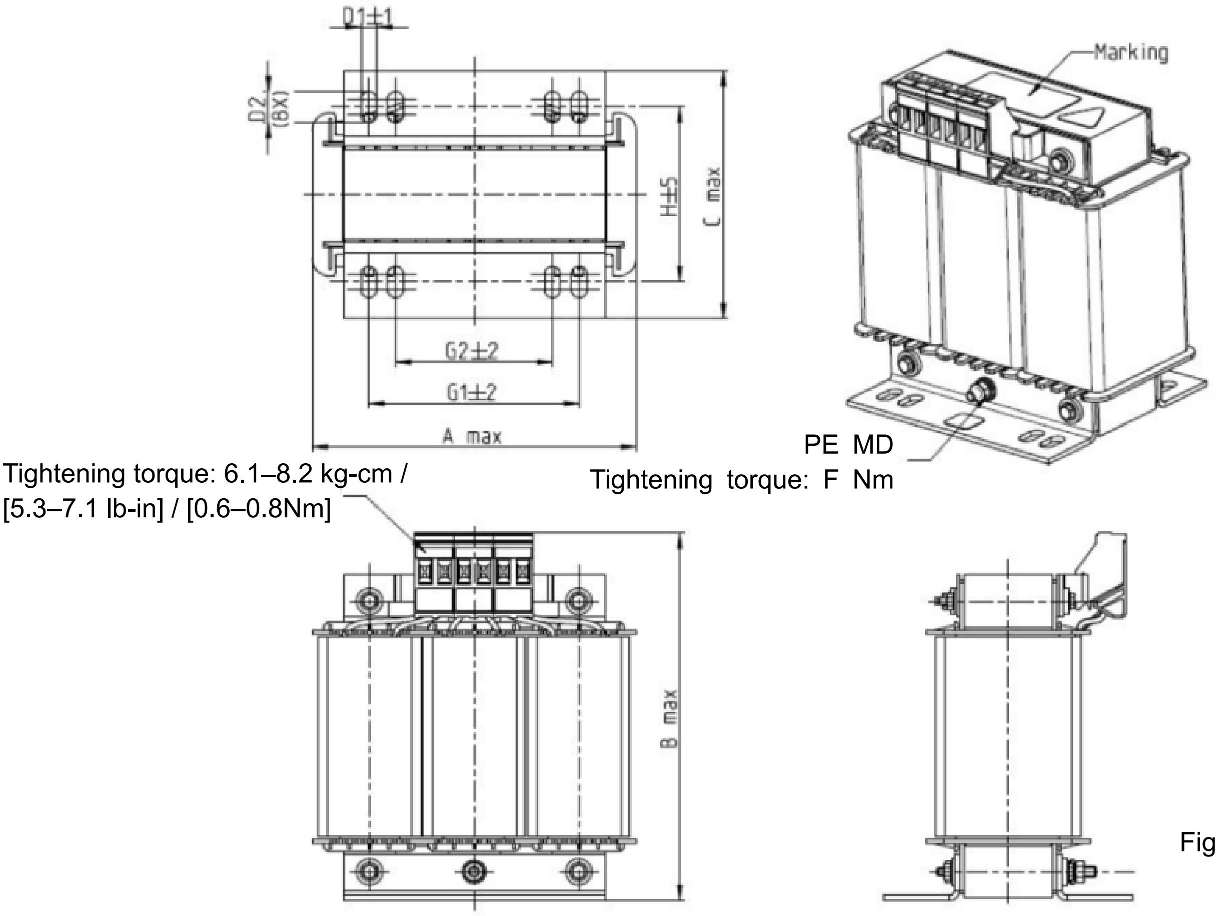


Figure 7-15

Unit: mm

Input AC reactor 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 7-9

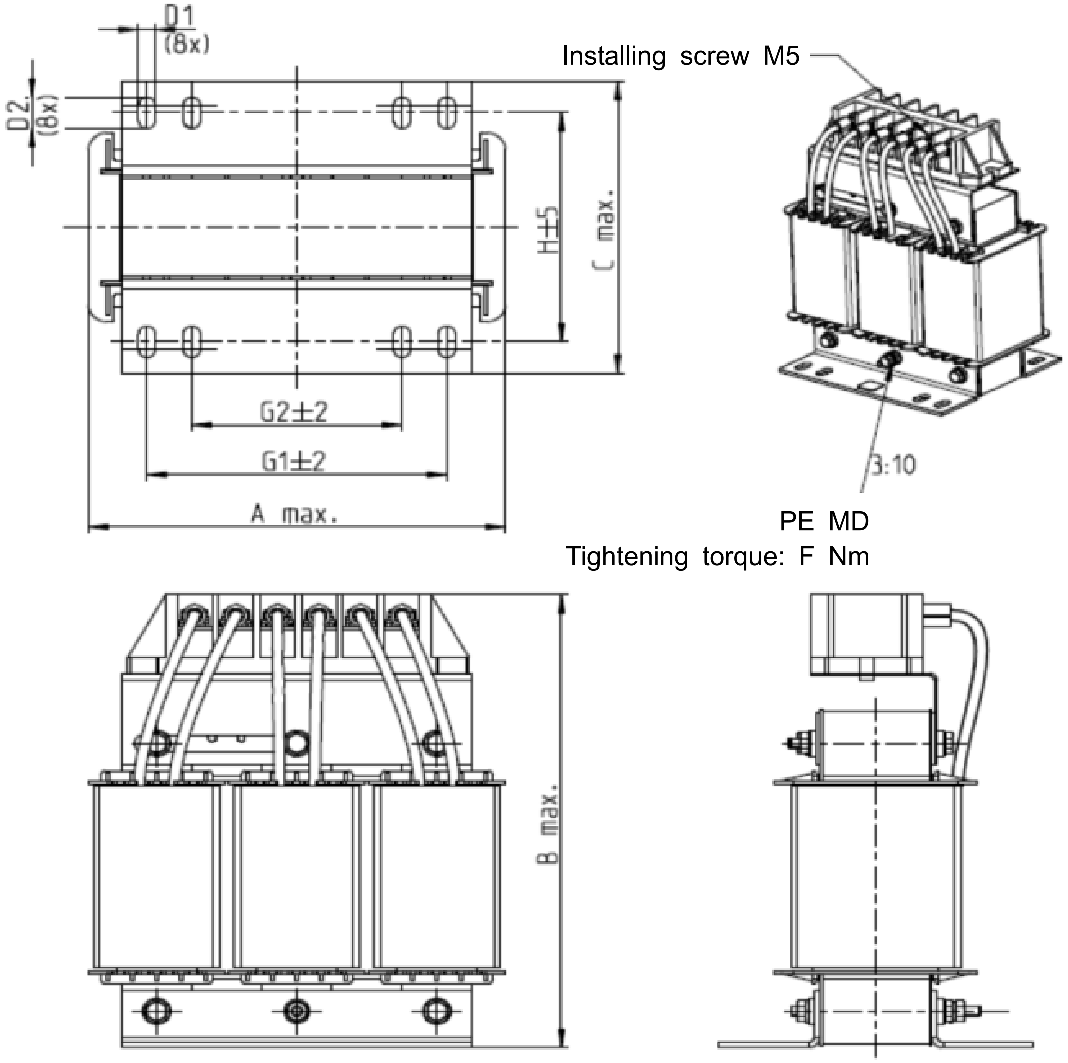


Figure 7-16

Unit: mm

Input AC reactor 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 7-10

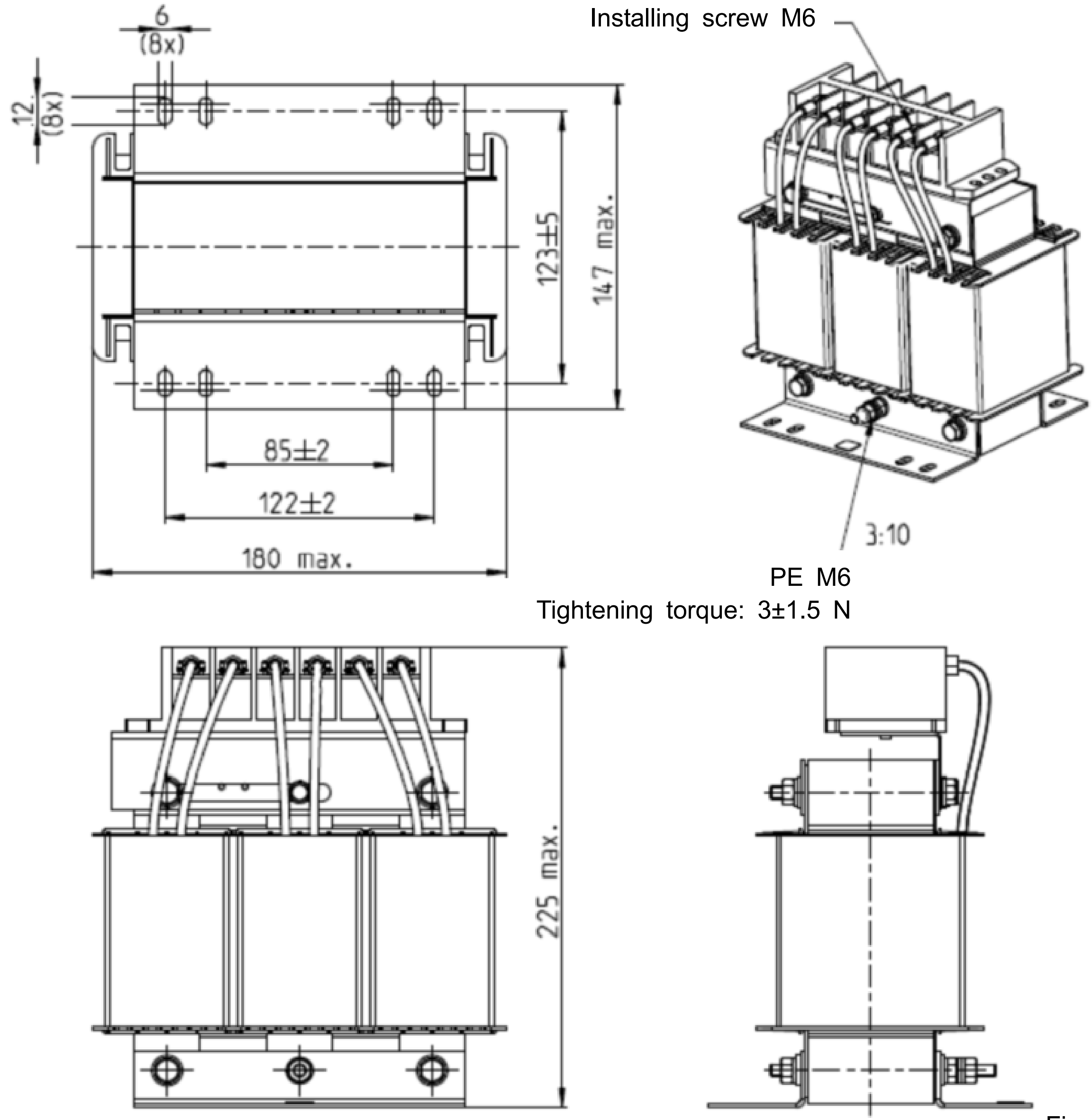


Figure 7-17

Unit: mm

Input AC reactor Delta part #	Dimensions
DR060AP405	Refer to the diagram above

Table 7-11

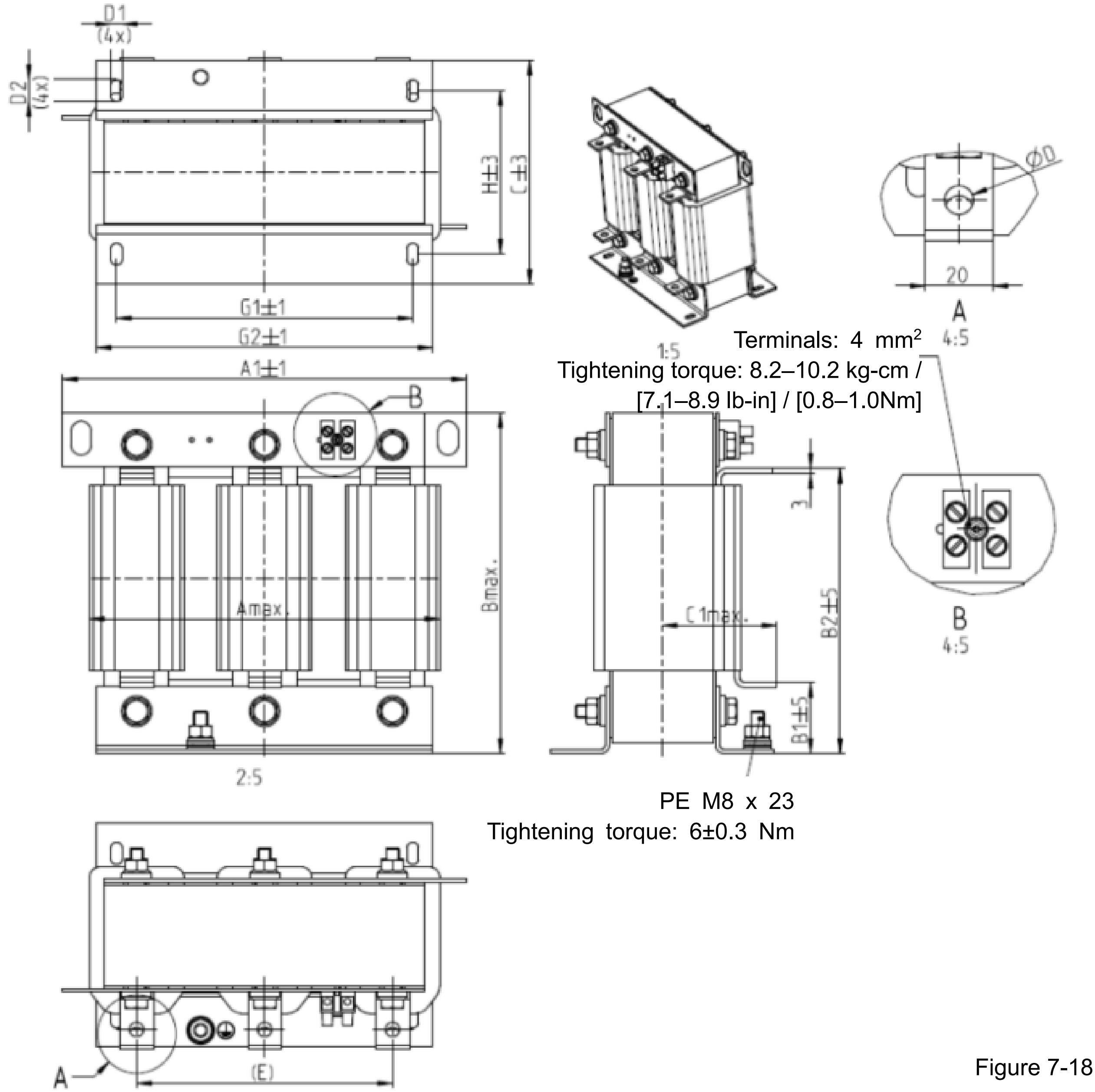


Figure 7-18

Unit: mm

Input AC reactor 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 7-12

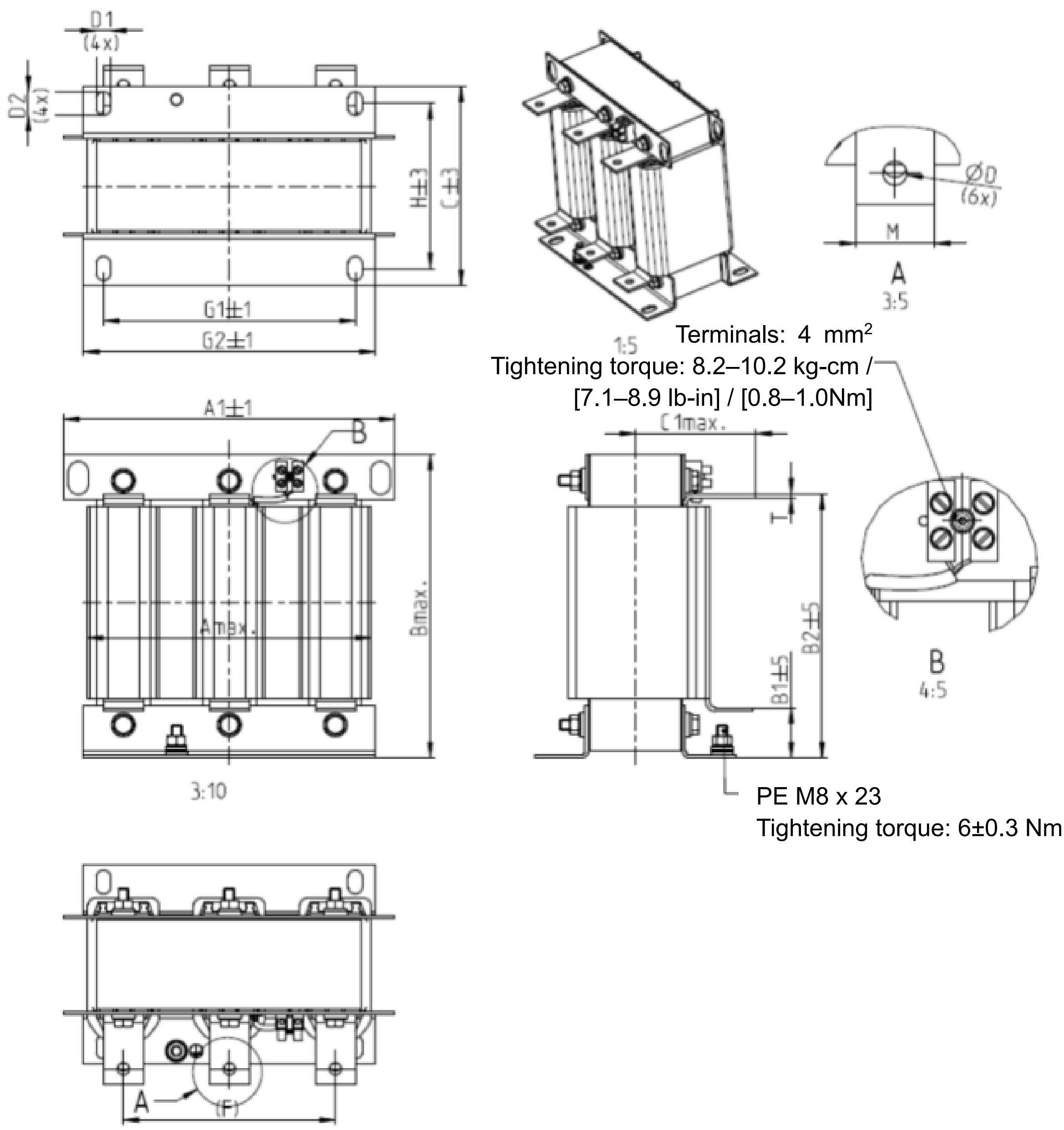


Figure 7-19

Unit: mm

Input AC reactor 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

Table 7-13

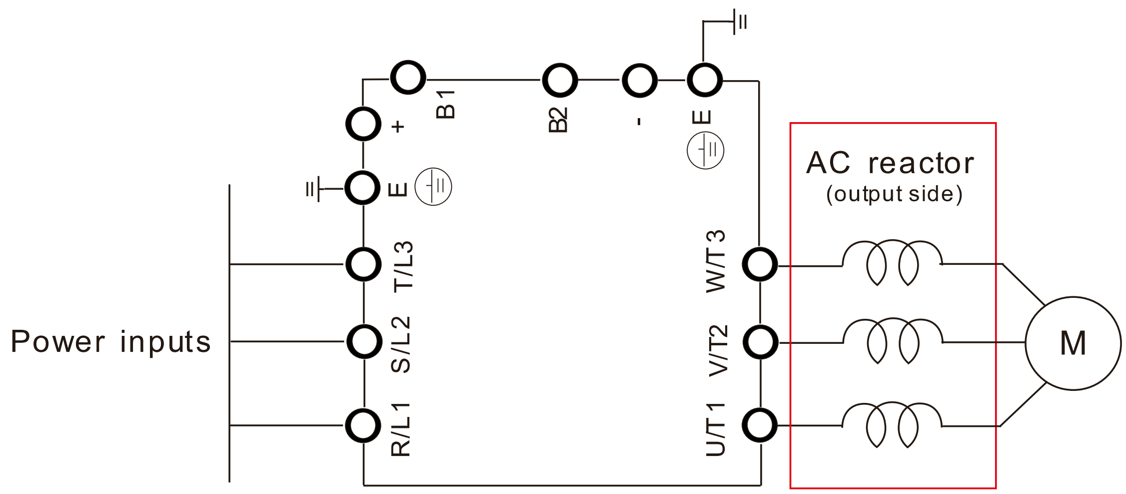
AC Output Reactor

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 drive's 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 increase 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:



Wiring an AC output reactor Figure 7-20

Specifications of AC output reactors (standard item)

Following tables show the standard AC output reactors specification of Delta CFP2000:

380V–460V / 50–60 Hz

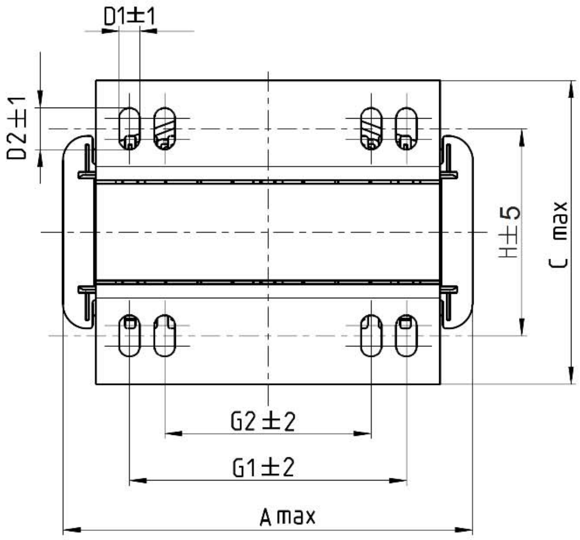
Model	kW	HP	Rated Amps of AC Reactor (Arms)		Max. continuous Amps (Arms)		3% Impedance (mH)		5% Impedance (mH)		Built-in DC reactor	3% Input AC reactor Delta part #	
			Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty		Normal Duty	Light Duty
VFD007FP4EA-41/-52 / VFD007FP4EA-52S	0.75	1	1.7	3	2.72	3.6	14.918	8.102	24.863	13.503	Yes	DR003L0810*	DR003L0810
VFD015FP4EA-41/-52 / VFD015FP4EA-52S	1.5	2	3	4.2	4.8	5.04	8.102	6.077	13.503	10.128	Yes	DR003L0810	DR004L0607
VFD022FP4EA-41/-52 / VFD022FP4EA-52S	2.2	3	4	5.5	6.4	6.6	6.077	4.050	10.128	6.75	Yes	DR004L0607	DR006L0405
VFD037FP4EA-41/-52 / VFD037FP4EA-52S	3.7	5	6	8.5	9.6	10.2	4.050	2.700	6.75	4.5	Yes	DR006L0405	DR009L0270
VFD040FP4EA-41/-52 / VFD040FP4EA-52S	4	5	9	10.5	14.4	12.6	2.700	2.315	4.5	3.858	Yes	DR009L0270	DR010L0231
VFD055FP4EA-41/-52 / VFD055FP4EA-52S	5.5	7.5	10.5	13	16.8	15.6	2.315	2.025	3.858	3.375	Yes	DR010L0231	DR012L0202
VFD075FP4EA-41/-52 / VFD075FP4EA-52S	7.5	10	12	18	19.2	21.6	2.025	1.35	3.375	2.25	Yes	DR012L0202	DR018L0117
VFD110FP4EA-41/-52 / VFD110FP4EA-52S	11	15	18	24	28.8	28.8	1.35	1.01	2.25	1.683	Yes	DR018L0117	DR024LP881
VFD150FP4EA-41/-52 / VFD150FP4EA-52S	15	20	24	32	38.4	38.4	1.01	0.76	1.683	1.267	Yes	DR024LP881	DR032LP660
VFD185FP4EA-41/-52 / VFD185FP4EA-52S	18.5	25	32	38	51.2	45.6	0.76	0.639	1.267	1.065	Yes	DR032LP660	DR038LP639

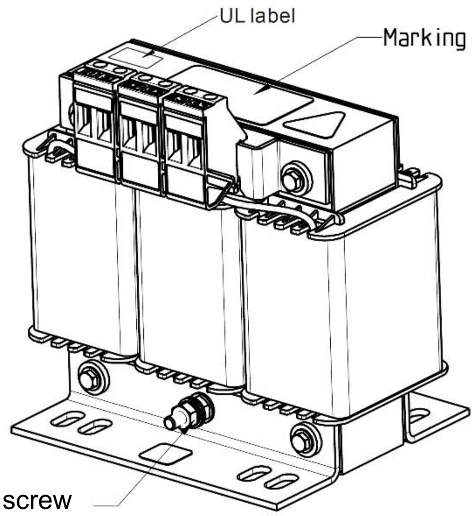
Model	kW	HP	Rated Amps of AC Reactor (Arms)		Max. continuous Amps (Arms)		3% Impedance (mH)		5% Impedance (mH)		Built-in DC reactor	3% Input AC reactor Delta part #	
			Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty	Normal Duty	Light Duty		Normal Duty	Light Duty
VFD220FP4EA-41/-52 / VFD220FP4EA-52S	22	30	38	45	60.8	54	0.639	0.541	1.065	0.902	Yes	DR038LP639	DR045LP541
VFD300FP4EA-41/-52 / VFD300FP4EA-52S	30	40	45	60	72	72	0.541	0.405	0.902	0.675	Yes	DR045LP541	DR060LP405
VFD370FP4EA-41/-52 / VFD370FP4EA-52S	37	50	60	73	96	87.6	0.405	0.334	0.675	0.557	Yes	DR060LP405	DR073LP334
VFD450FP4EA-41/-52 / VFD450FP4EA-52S	45	60	73	91	116.8	109.2	0.334	0.267	0.557	0.445	Yes	DR073LP334	DR091LP267
VFD550FP4EA-41/-52 / VFD550FP4EA-52S	55	75	91	110	145.6	132	0.267	0.221	0.445	0.368	Yes	DR091LP267	DR110LP221
VFD750FP4EA-41/-52 / VFD750FP4EA-52S	75	100	110	150	176	180	0.221	0.162	0.368	0.27	Yes	DR110LP221	DR150LP162
VFD900FP4EA-41/-52 / VFD900FP4EA-52S	90	125	150	180	240	216	0.162	0.135	0.27	0.225	Yes	DR150LP162	DR180LP135

NOTE * : Use with DR003L0810, but the inductance value will be 3% short.

Table 7-14

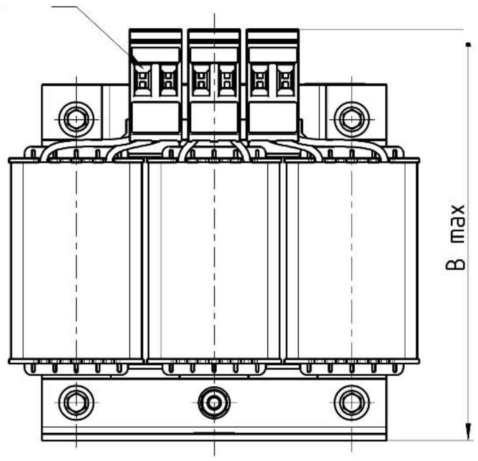
AC output reactor dimensions and specification:





Torque: 6.1–8.2 kg-cm / [5.3–7.1 lb-in] / [0.6–0.8 Nm]

Torque: 10.2–12.3 kg-cm / [8.9–10.6 lb-in] / [1.0–1.2 Nm]



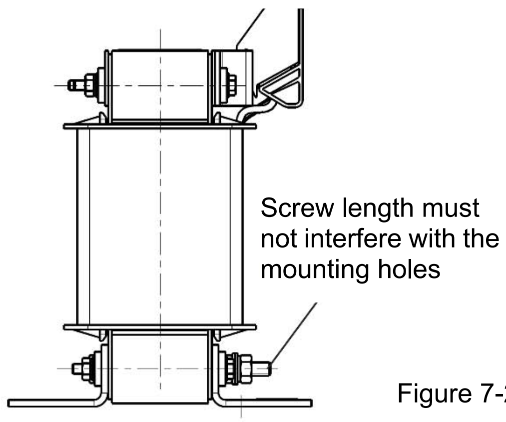


Figure 7-21

Unit: mm

Output AC reactor 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 7-15

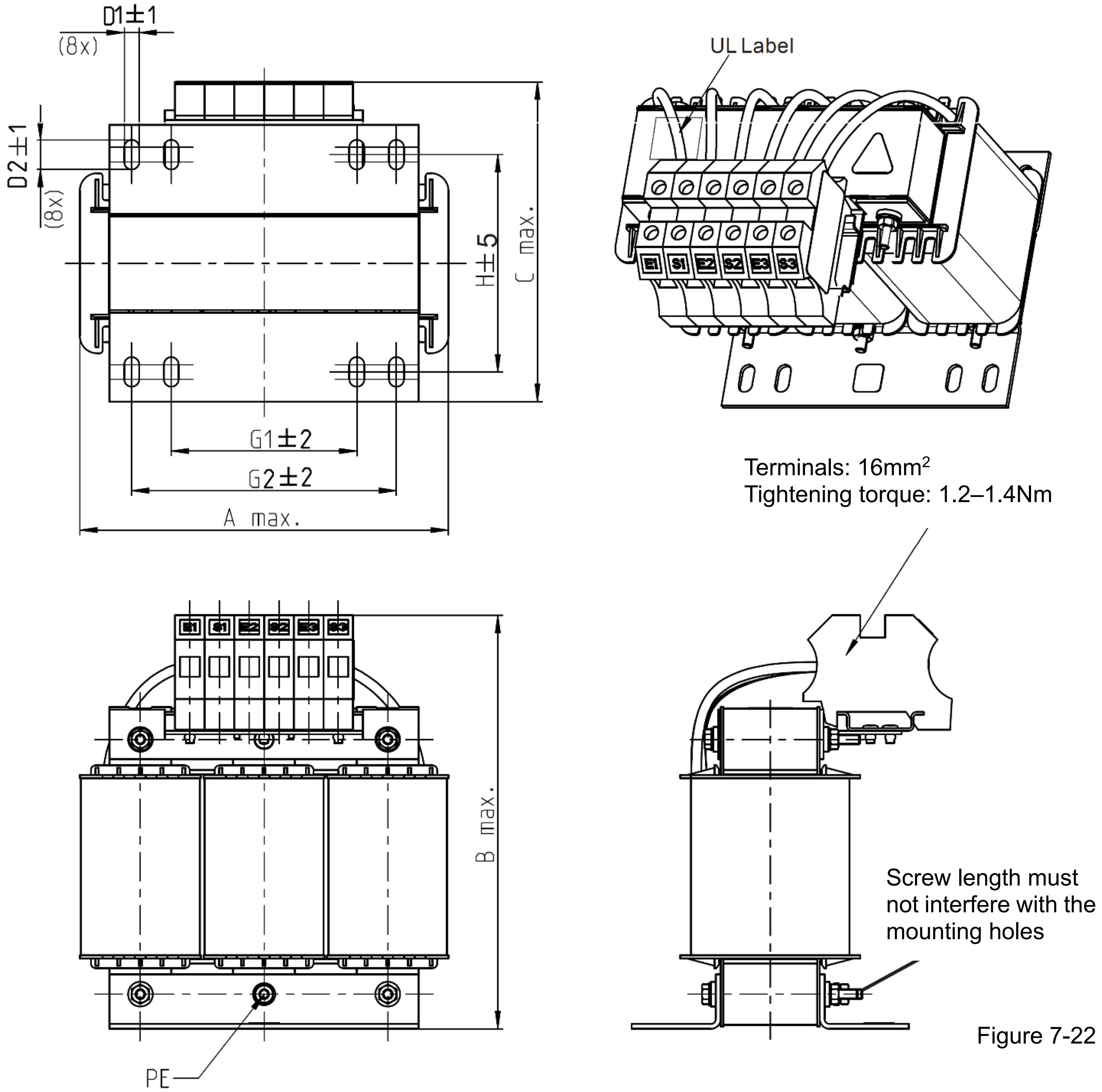


Figure 7-22

Unit: mm

Output AC reactor 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 7-16

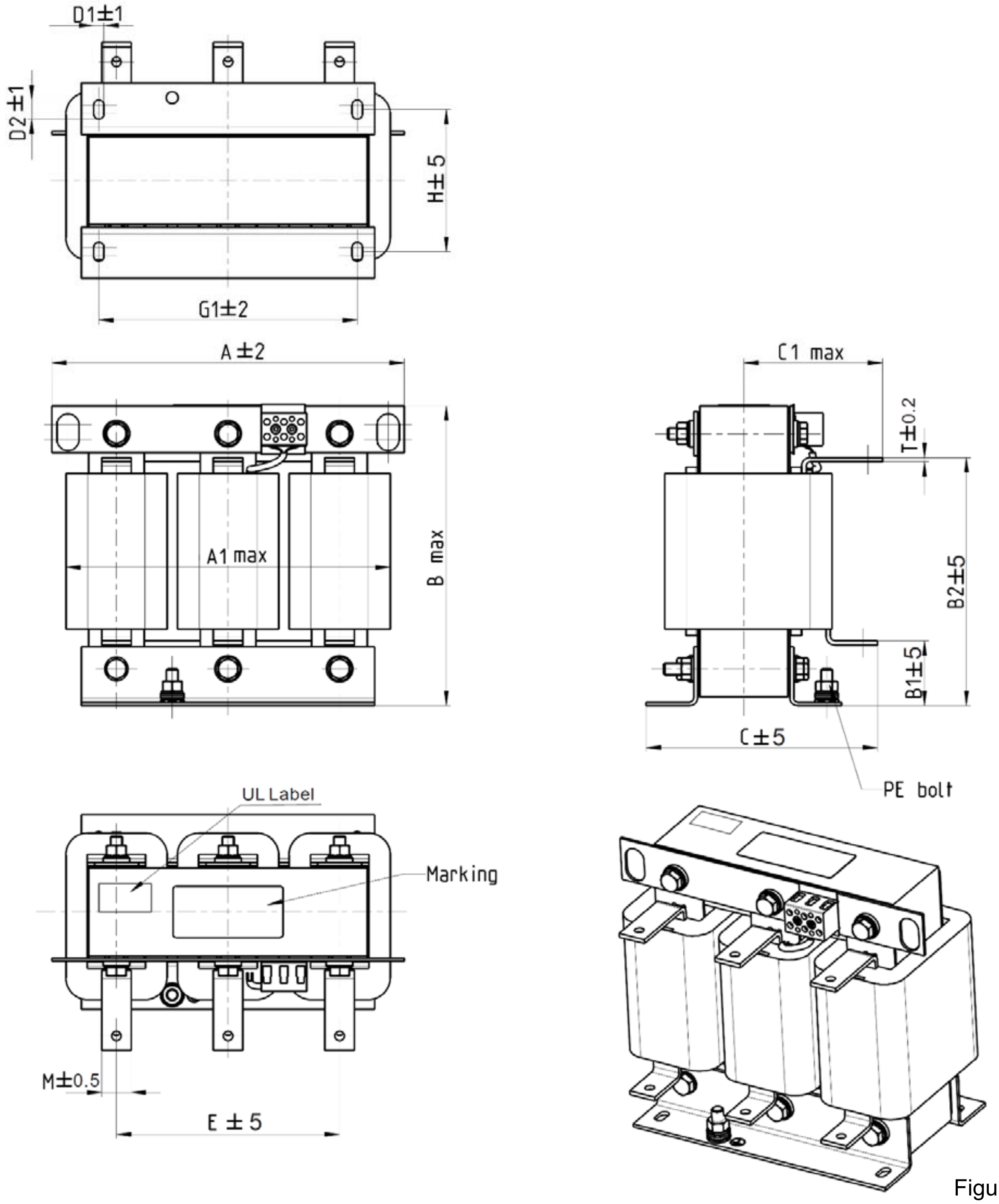


Figure 7-23

Unit: mm

Output AC reactor 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 7-17

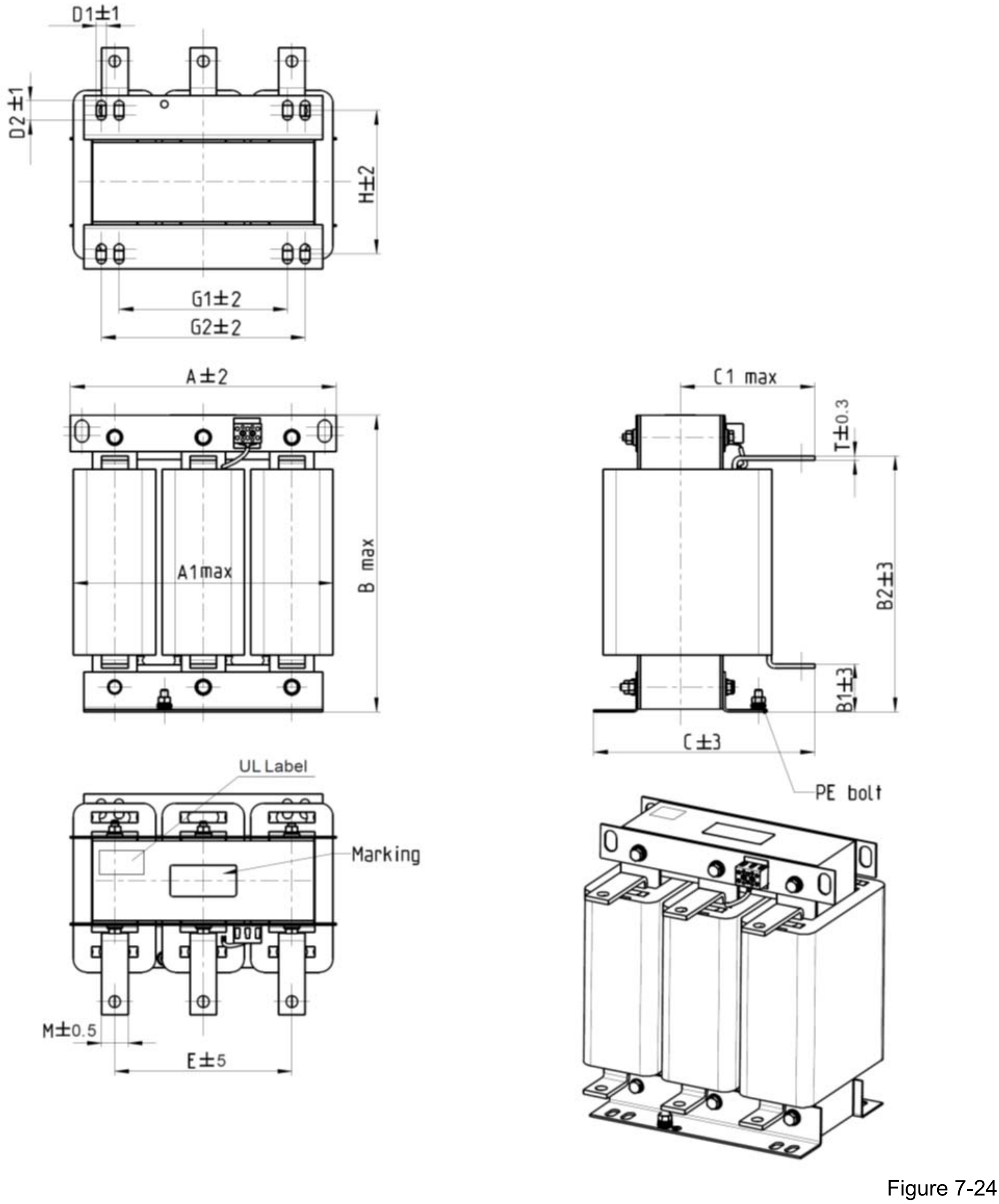


Figure 7-24

Unit: mm

Output AC reactor 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 7-18

Motor Cable Length

1. Leakage current to affect the motor and counter measurement

Due to larger parasitic capacitances in longer motor cables, longer cables increase the leakage current. This can activate the over-current protection and display the incorrect current. In the worst case, it can damage the drive.

If more than one motor is connected to the AC motor drive, the total motor cable length is the sum of the cable length from the AC motor drive to each motor. For 460V series AC motor drives, when an overload relay is installed between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50m.

However, the overload relay could still malfunction. To prevent this, install an AC output reactor (optional) to the drive and / or lower the carrier frequency setting (Pr.00-17).

2. Surge voltage to affect the motor and counter measurement

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

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

The following table list the suggested motor shielded cable length that comply with IEC 60034-17, which is suitable for the motor with rated voltage under 500 V_{AC}, and the insulation level of peak-to-peak over (including) 1.35 kV.

Model	kW	HP	Rated Amps of AC Reactor (Arms)		Without AC Output Reactor		3% With AC Output Reactor	
			Normal Duty	Light Duty	Shielded cable [meter]	Non-shielded cable [meter]	Shielded cable [meter]	Non-shielded cable [meter]
VFD007FP4EA-41/-52/ VFD007FP4EA-52S	0.75	1	1.7	3	50	75	75	115
VFD015FP4EA-41/-52/ VFD015FP4EA-52S	1.5	2	3	4.2				
VFD022FP4EA-41/-52/ VFD022FP4EA-52S	2.2	3	4	5.5				
VFD037FP4EA-41/-52/ VFD037FP4EA-52S	3.7	5	6	8.5				
VFD040FP4EA-41/-52/ VFD040FP4EA-52S	4	5	9	10.5				
VFD055FP4EA-41/-52/ VFD055FP4EA-52S	5.5	7.5	10.5	13				
VFD075FP4EA-41/-52/ VFD075FP4EA-52S	7.5	10	12	18	100	150	150	225
VFD110FP4EA-41/-52/ VFD110FP4EA-52S	11	15	18	24				
VFD150FP4EA-41/-52/ VFD150FP4EA-52S	15	20	24	32				
VFD185FP4EA-41/-52/ VFD185FP4EA-52S	18.5	25	32	38				
VFD220FP4EA-41/-52/ VFD220FP4EA-52S	22	30	38	45				
VFD300FP4EA-41/-52/ VFD300FP4EA-52S	30	40	45	60				
VFD370FP4EA-41/-52/ VFD370FP4EA-52S	37	50	60	73				
VFD450FP4EA-41/-52/ VFD450FP4EA-52S	45	60	73	91	150	225	225	325
VFD550FP4EA-41/-52/ VFD550FP4EA-52S	55	75	91	110				
VFD750FP4EA-41/-52/ VFD750FP4EA-52S	75	100	110	150				
VFD900FP4EA-41/-52/ VFD900FP4EA-52S	90	125	150	180				

Table 7-19

Requirements on insulation level of Curve B motor

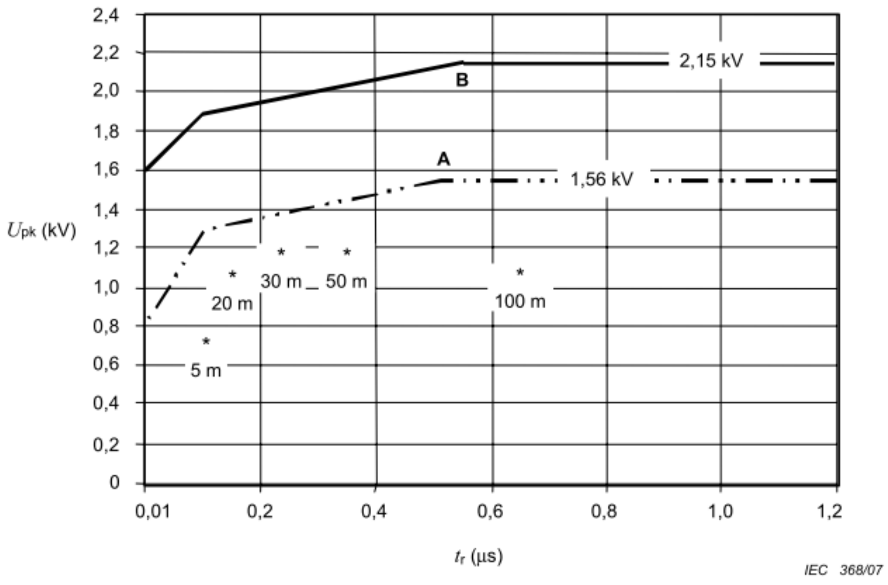


Figure 7-25

Key

A Without filters for motors up to 500 V a.c.

B Without filters for motors up to 690 V a.c.

* Examples of measured results at 415 V supply, for different lengths of steel armoured cable

The t_r is defined as:

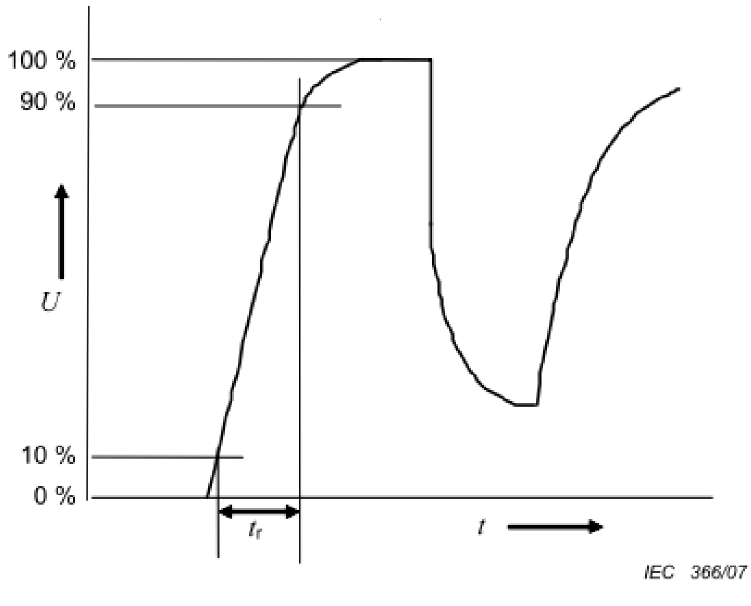


Figure 7-26

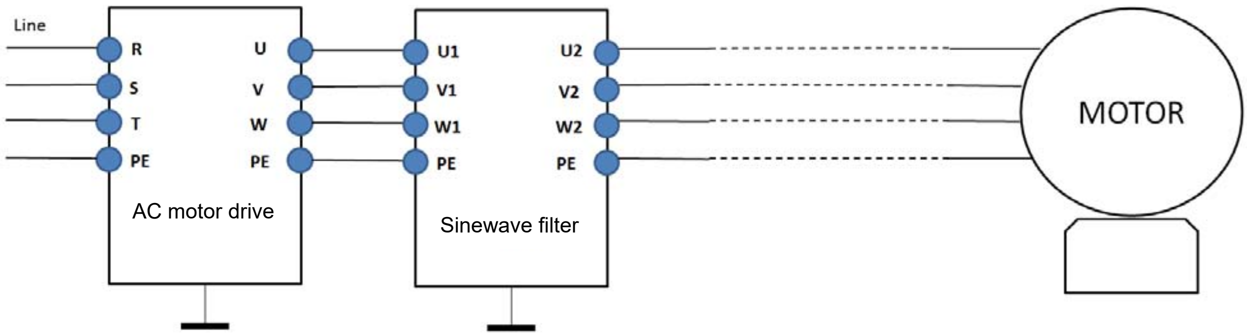
Sine-wave filter

When there is longer cable length connected between the motor drive and the motor, the damping leads to high frequency resonator, and makes impedance matching poor to enlarge the voltage reflection. This phenomenon will generate twice-input voltage in the motor side, which will easily make motor voltage overshoot to damage insulation.

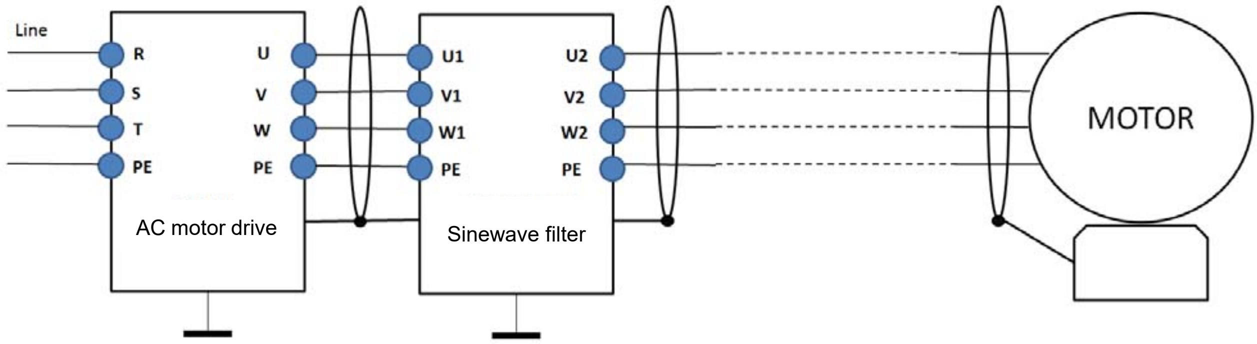
To prevent this, installing sine-wave filter can transform PWM output voltage to smooth and low-ripple sin wave, and motor cable length can be longer than 1000 meters.

Installation

Sine-wave filter is serially connected between motor drive UVW output side and motor, which is shown as below:



Wiring of non-shielded cable Figure 7-27



Wiring of shielded cable Figure 7-28

Following table shows the sine-wave filter specification of Delta CFP2000

380V–460V / 50–60 Hz

kW	HP	Rated current ND (Arms)	Sine wave filter model name for ND current	Rated current LD (Arms)	Sine wave filter model name for LD current	Output Motor Cable Length [m] (Shielding or Non-shielding)
0.75	1	2.8	B84143V0004R227	3	B84143V0004R227	1000
1.5	2	3		4.2		
2.2	3	4		5.5	B84143V0006R227	
3.7	5	6	B84143V0006R227	8.5	B84143V0011R227	
4	5	9	B84143V0011R227	10.5		
5.5	7.5	10.5		13	B84143V0016R227	
7.5	10	12	B84143V0016R227	18	B84143V0025R227	
11	15	18	B84143V0025R227	24		
15	20	24		32	B84143V0033R227	
18.5	25	32	B84143V0033R227	38	B84143V0050R227	
22	30	38	B84143V0050R227	45		
30	40	45		60	B84143V0066R227	
37	50	60	B84143V0066R227	73	B84143V0075R227	
45	60	73	B84143V0075R227	91	B84143V0095R227	
55	75	91	B84143V0095R227	110	B84143V0132R227	
75	100	110	B84143V0132R227	144	B84143V0180R227	
90	125	150	B84143V0180R227	180		

Table 7-20

Sine wave filter Model	Reference website：http://en.tdk.eu/inf/30/db/emc_2014/B84143V_R227.pdf
B84143V0004R227	I_R:4A, Sine-wave output filters for 3-phase systems
B84143V0006R227	I_R:6A, Sine-wave output filters for 3-phase systems
B84143V0011R227	I_R:11A, Sine-wave output filters for 3-phase systems
B84143V0016R227	I_R:16A, Sine-wave output filters for 3-phase systems
B84143V0025R227	I_R:25A, Sine-wave output filters for 3-phase systems
B84143V0033R227	I_R:33A, Sine-wave output filters for 3-phase systems
B84143V0050R227	I_R:50A, Sine-wave output filters for 3-phase systems
B84143V0066R227	I_R:66A, Sine-wave output filters for 3-phase systems
B84143V0075R227	I_R:75A, Sine-wave output filters for 3-phase systems
B84143V0095R227	I_R:95A, Sine-wave output filters for 3-phase systems
B84143V0132R227	I_R:132A, Sine-wave output filters for 3-phase systems
B84143V0180R227	I_R:180A, Sine-wave output filters for 3-phase systems

Table 7-21

7-5 Zero Phase Reactors

You can also suppress interference by installing a zero phase reactor. When you encounter any interference, buy and install a zero phase reactor.

Zero Phase Reactors for Signal Cable

To solve interference problems between signal cables and electric devices, install a zero phase reactor on the signal cable that is the source of the interference. This suppresses the noise for a better signal. The following table lists model names and dimensions.

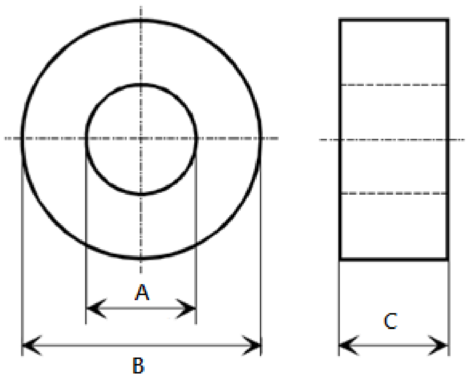


Figure 7-29

Unit: mm

Model	A	B	C
RF026X00N	10.7	17.8	8.0
RF020X00N	17.5	27.3	12.3

Table 7-22

7-6 EMC Filter

Following table is the external EMC filter of CFP2000 series. User can choose corresponding zero phase reactor and suitable shielded cable length in accord to required noise emission and electromagnetic interference level to have the best configuration to suppress the electromagnetic interference. When the application does not consider RE and only needs CE to comply with C2 or C1, there is no need to install zero phase reactor in the input side.

<table>
<tr><th colspan="3">CFP2000</th><th rowspan="3">Zero phase reactor*1</th><th colspan="4">CE Cable Length</th><th>Radiation Emission</th></tr>
<tr><th rowspan="2">Frame</th><th rowspan="2">Model</th><th rowspan="2">Rated Input Current [A]</th><th colspan="5">EN61800-3*5</th></tr>
<tr><th>Category C2</th><th>Carrier frequency [Hz]</th><th>Category C1*2</th><th>Carrier frequency [Hz]</th><th>C2*4</th></tr>
<tr><td rowspan="7">A</td><td>VFD007FP4EA-41/-52/-52S</td><td>3.0</td><td rowspan="7">RF010FP00A</td><td rowspan="17">75m</td><td rowspan="13">≤ 8K</td><td rowspan="17">25m</td><td rowspan="13">≤ 4K*3</td><td rowspan="17">Pass</td></tr>
<tr><td>VFD015FP4EA-41/-52/-52S</td><td>4.2</td></tr>
<tr><td>VFD022FP4EA-41/-52/-52S</td><td>5.5</td></tr>
<tr><td>VFD037FP4EA-41/-52/-52S</td><td>8.5</td></tr>
<tr><td>VFD040FP4EA-41/-52/-52S</td><td>10.5</td></tr>
<tr><td>VFD055FP4EA-41/-52/-52S</td><td>13</td></tr>
<tr><td>VFD075FP4EA-41/-52/-52S</td><td>18</td></tr>
<tr><td rowspan="4">B</td><td>VFD110FP4EA-41/-52/-52S</td><td>24</td><td rowspan="4">RF006FP00A</td></tr>
<tr><td>VFD150FP4EA-41/-52/-52S</td><td>32</td></tr>
<tr><td>VFD185FP4EA-41/-52/-52S</td><td>38</td></tr>
<tr><td>VFD220FP4EA-41/-52/-52S</td><td>45</td></tr>
<tr><td rowspan="2">C</td><td>VFD300FP4EA-41/-52/-52S</td><td>60</td><td rowspan="2">RF002FP00A</td></tr>
<tr><td>VFD370FP4EA-41/-52/-52S</td><td>73</td></tr>
<tr><td rowspan="2">D0</td><td>VFD450FP4EA-41/-52/-52S</td><td>91</td><td>-</td><td rowspan="2">≤ 10K</td><td rowspan="4">≤ 4K</td></tr>
<tr><td>VFD550FP4EA-41/-52/-52S</td><td>110</td><td>-</td></tr>
<tr><td rowspan="2">D</td><td>VFD750FP4EA-41/-52/-52S</td><td>150</td><td>-</td><td rowspan="2">≤ 9K</td></tr>
<tr><td>VFD900FP4EA-41/-52/-52S</td><td>180</td><td>-</td></tr>
</table>

Table 7-23

NOTE

*1: When the length of the cable is longer than 25 m, do not install the zero phase reactors listed in the table above.
*2: To comply with the C1 specifications, install an EMC magnetic core on the output side.
*3: For Frame A–C to comply with EN 61800-3 C1 regulations (when the length of the cable is less than 25 m, it complies with the C1 regulations), install a zero phase reactor on the output side. Pass the three UVW cables through the zero phase reactor. Do not pass the grounding cable and the pigtail of the insulation through the zero phase reactor.
*4: C2 specifications do not require installing a zero phase reactor.
*5: There is no need to install an external zero phase reactor at 45/55/75/90 kW to meet the EN61800-3 (Class C2/C1) standard.

EMC Filter Installation

All electrical equipment, including AC motor drives, will generate high frequency / low frequency noise and will interfere with peripheral equipment by radiation or conduction when in operation. By using an EMC filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EMC filter to have the best interference elimination performance.

We assure that it can comply with following rules when AC motor drive and EMC filter are installed and wired according to use manual:

- EN61000-6-4
- EN61800-3
- EN55011 Class A Group 1

General precaution

To ensure EMC filter can maximize the effect of suppressing the interference of AC motor drive, the installation and wiring of A motor drive should follow the user manual. In addition, be sure to observe the following precautions:

☑ All the cables should be divided into several classifications, and kept away from each other. The metal layer inside the control cabinet can separate the cables as well. For susceptible cables (Class 1), there should always be an uninterrupted partition between the two terminals. Use the following classifications (Class 1–4):

- Class 1: Cables susceptible to interference (e.g. low-voltage / high-speed signal cable, control cable, data cable…)
- Class 2: Cables susceptible to interference (e.g. low-speed communication cable, low-voltage (24 V) power cable…)
- Class 3: Disturbance cable (e.g. R.S.T. power input cable)
- Class 4: Strong disturbance cable. (e.g. U.V.W. motor output cable)
- The following figure shows the recommended cables and their installation clearance:

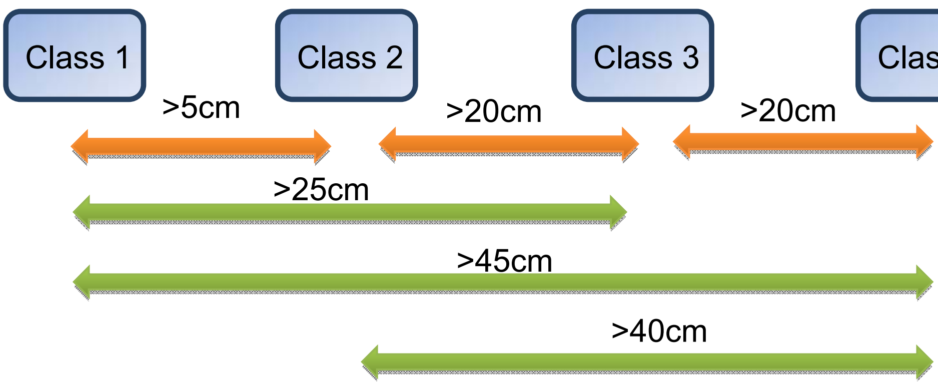


Figure 7-30

☑ If the installation distance does not meet the above separation requirement, connect a zero-phase reactor to the Class 4 cable in series, and use shielded cable or connect core in series to the Class 1 cable.

☑ When the installation distances of different cables do not meet the separation requirement, place the cables at right angles. For example, the filtered cable should be separated from the non-filtered cable; signal cable, data cable and filtered cable can only be placed at right angles with the non-filtered cable.

☑ All cables should be as short as possible.

☑ For extra cables, remove them or ground them on each end to avoid floating connection.

☑ Separate the motor cable from the data cables that connect to the motor (for example, encoder line or motor temperature sensors).

☑ Place the cable on the metal plate, do not hang it in the air.

☑ Use an independent isolated transformer to segregate susceptible equipment from equipment with stronger interference.

☑ The RC filter is required for the magnetic contactor coil, relay and solenoid valve to eliminate high-frequency radiation interference (for example, RC elements or varistors with AC coils and free-wheeling diodes or varistors for DC coils) that comes from turning the unit ON and OFF. All these protection circuit should be close to the coil.

☑ Make sure the cover, equipment and accessories installed inside the control cabinet (for example, motor drive or filter) are installed with good-conductivity mounting plate, and are connected to the cabinet frame with good connection and large contact areas. Most of all, the wiring should be connected to the PE and EMC isolation bar.

☑ To build up the grounding system, remove the cover with a protective layer or anodic treatment on its connection, or connect it to the non-conductive layer with a special metal sheet before connecting to the AC drive.

☑ Keep wires as short as possible and ground metal plates. The cover of the EMC filter and the AC motor drive or grounding should be fixed to the metal plate and the contact area should be as large as possible.

Choose suitable motor cable and precautions

Isolate the motor wires, signal wires and data wires.

The recommended shielded wire can be selected from the three types of shielding wire in Figure 1. The figure on the left is a symmetric three-phase power cord with symmetric PE wires. The middle figure is a three-phase power cord with a separated PE wire. The figure on the right is the asymmetric three-phase power cord with a PE wire.)

The size of the power cord should be based on the rated current. Using high density braided shielding avoids electromagnetic noise that results from high frequency signals, as well as prevents external sources from interfering with signal transmissions. We recommend two types of shielded cables:

- Braided copper shielding of 85% density or more (as shown in figure 2a).
- 100% aluminum foil / copper foil wrapping inside, and in braided shielding of 80% or more outside (as shown in figure 2b).

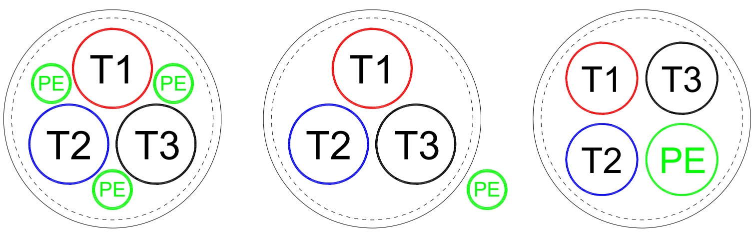


Figure 1 Types shielded cables recommended

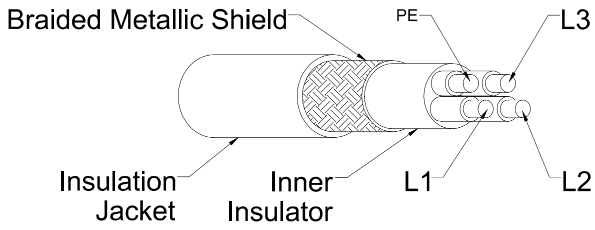


Figure 2a

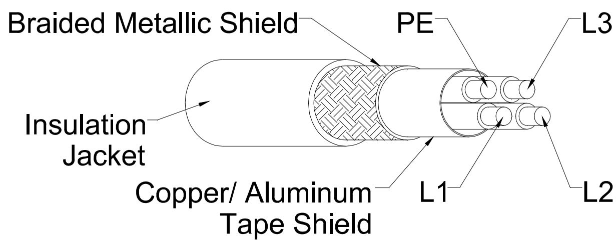


Figure 2b

Precautions for motor cable installation

Improper choice and installation of motor cable affect the performance of the EMC filter. Be sure to observe the following precautions when selecting a motor cable. The shielded layers of motor cable must be grounded by using omega clips or pigtail. If using omega clips, the shielded layers must have a 360-degree contact with the motor and the PE on motor drive (as shown in Figure 3).
If using a pigtail for grounding, the length of the pigtail cannot be more than five times of the wire size (WVW wire sizing)

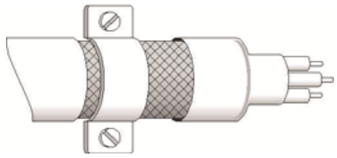
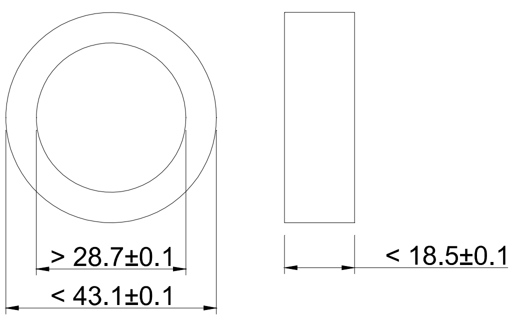


Figure 3

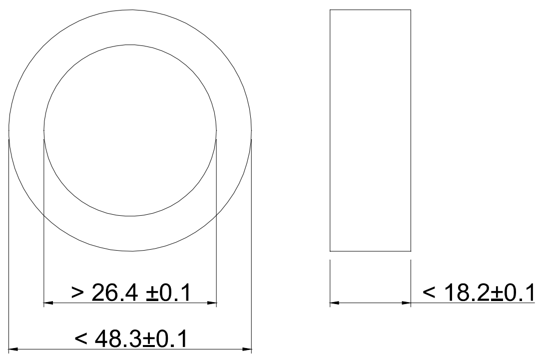
Zero phase reactor Dimensions

Unit: mm

Frame A RF010FP00A



Frame B RF006FP00A



Frame C RF002FP00A

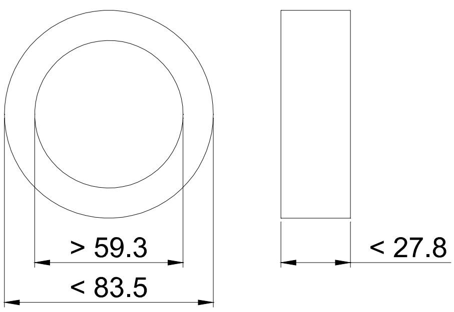


Table 7-24

EMC C1 with zero phase reactor installation

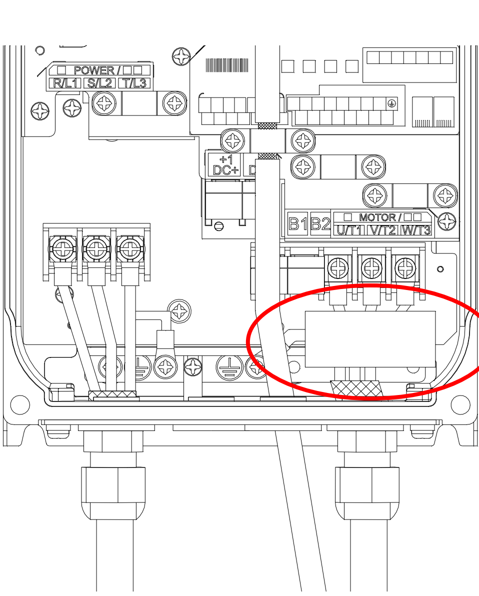
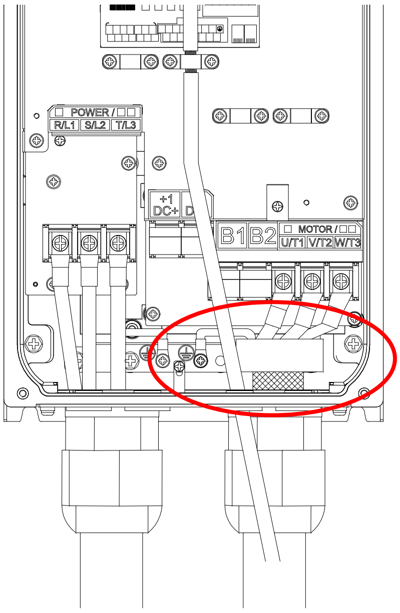
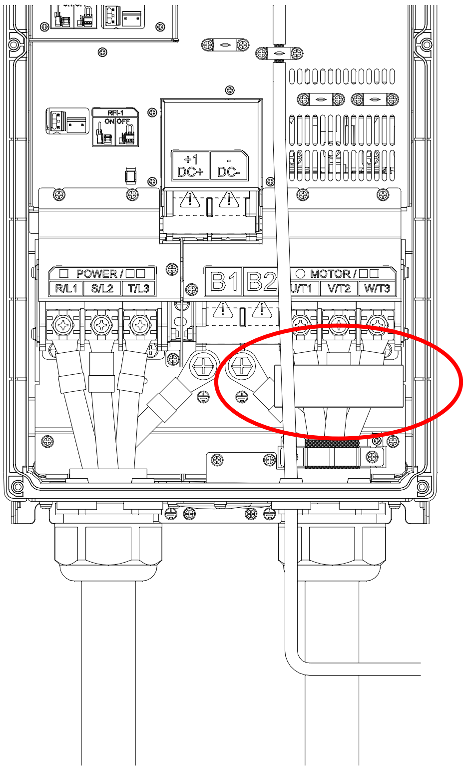
Frame A	Frame B
	
Frame C	
	

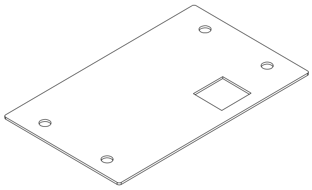
Table 7-25

7-7 Panel Mounting (MKC-KPPK)

For MKC-KPPK model, user can choose wall mounting or embedded mounting, protection level is IP66. It is applicable for the digital keypads (KPC-CC01).

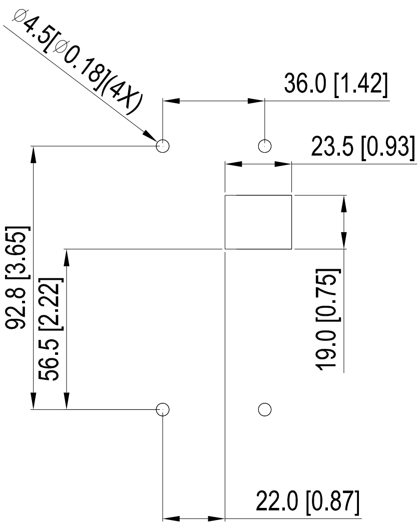
Wall Mounting

accessories*1



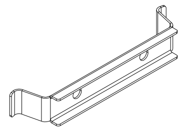
Screw *4–M4*p 0.7 *L8mm
Torque: 10–12kg-cm / [8.7–10.4lb-in.] / [1.0–1.2Nm]

Panel cutout dimension Unit: mm [inch]



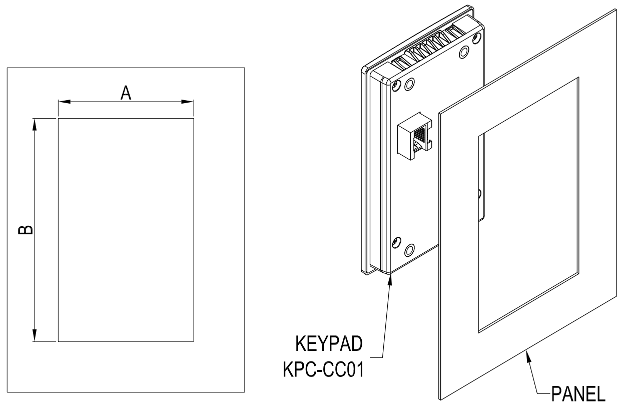
Embedded Mounting

accessories*2



Screw *4–M4*p 0.7 *L8mm
Torque: 10–12kg-cm / [8.7–10.4lb-in.] / [1.0–1.2Nm]

Panel cutout dimension Unit: mm [inch]



Normal cutout dimension

Panel thickness	1.2 mm	1.6 mm	2.0 mm
A	66.4 [2.614]		
B	110.2 [4.339]	111.3 [4.382]	112.5 [4.429]

*Deviation: ±0.15mm /±0.0059inch

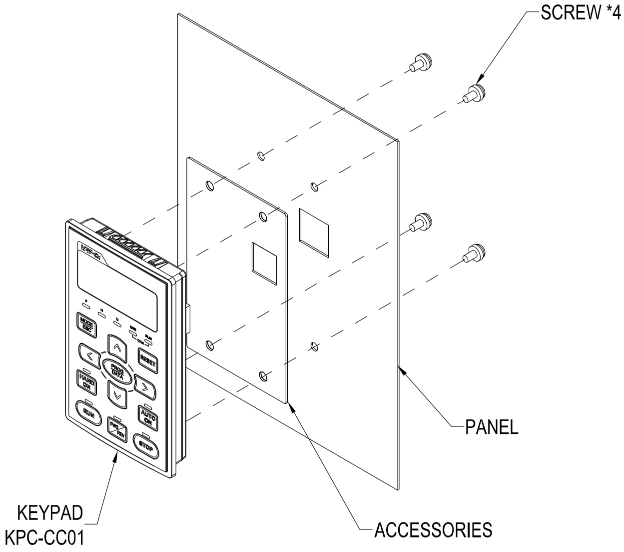
Table 7-26

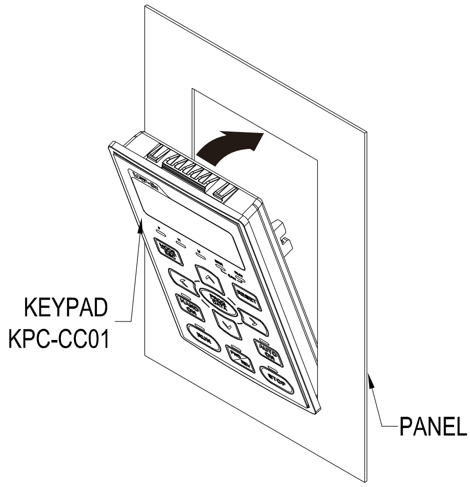
Cutout dimension (Waterproof level: IP66)

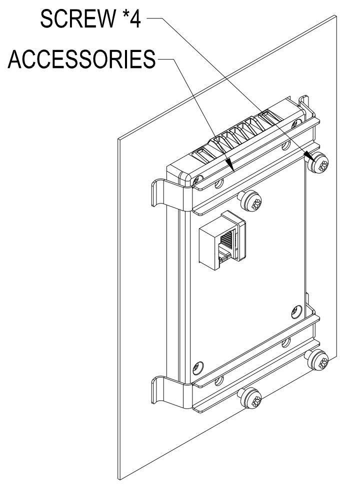
Panel thickness	1.2 mm	1.6 mm	2.0 mm
A	66.4 [2.614]		
B	110.8 [4.362]		

*Deviation: ±0.15mm /±0.0059inch

Table 7-27

<table>
<tr><th>Wall Mounting</th><th>Embedded Mounting</th></tr>
<tr><td>


</td><td>




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

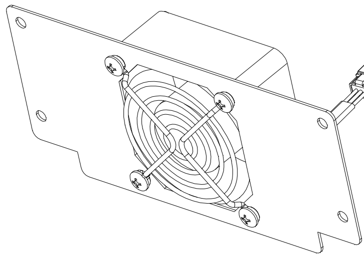
7-8 Fan Kit

■ Frames of heatsink fans:

NOTE: The fan does not support hot swap function. For replacement, turn the power off before replacing the fan.

Frame A

Heat sink Fan Model『MKFP-AFKM』

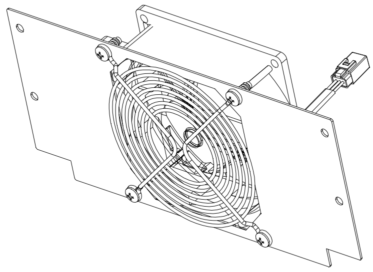


Applicable Model

VFD022FP4EA-41, VFD022FP4EA-52, VFD022FP4EA-52S,
VFD037FP4EA-41, VFD037FP4EA-52, VFD037FP4EA-52S,
VFD040FP4EA-41, VFD040FP4EA-52, VFD040FP4EA-52S,
VFD055FP4EA-41, VFD055FP4EA-52, VFD055FP4EA-52S,
VFD075FP4EA-41, VFD075FP4EA-52, VFD075FP4EA-52S

Frame B

Heat sink Fan Model『MKFP-BFKM』

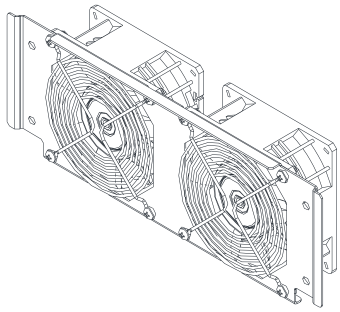


Applicable Model

VFD110FP4EA-41, VFD110FP4EA-52, VFD110FP4EA-52S,
VFD150FP4EA-41, VFD150FP4EA-52, VFD150FP4EA-52S,
VFD185FP4EA-41, VFD185FP4EA-52, VFD185FP4EA-52S,
VFD220FP4EA-41, VFD220FP4EA-52, VFD220FP4EA-52S

Frame C

Heat sink Fan Model 『MKFP-CFKM』

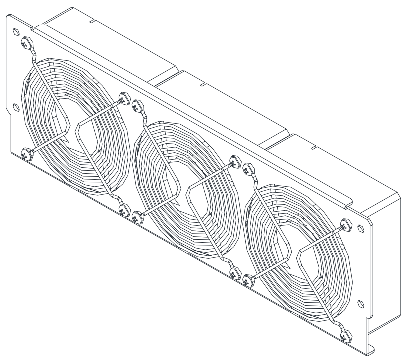


Applicable Model

VFD300FP4EA-41, VFD300FP4EA-52, VFD300FP4EA-52S,
VFD370FP4EA-41, VFD370FP4EA-52, VFD370FP4EA-52S

Frame D0

Heat sink Fan Model 『MKFP-D0FKM』

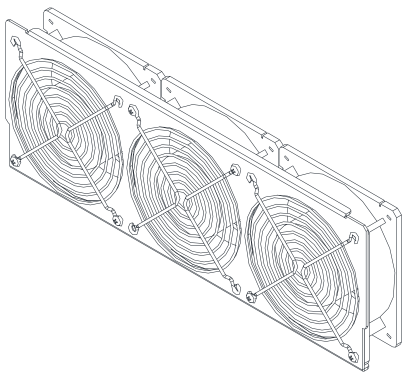


Applicable Model

VFD450FP4EA-41, VFD450FP4EA-52, VFD550FP4EA-52,
VFD550FP4EA-41, VFD450FP4EA-52S, VFD550FP4EA-52S

Frame D

Heat sink Fan Model 『MKFP-DFKM』



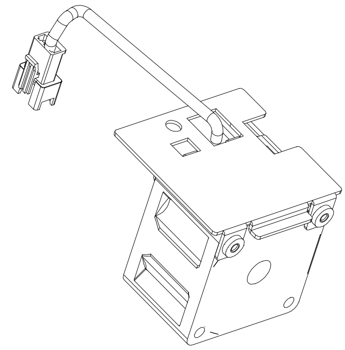
Applicable Model

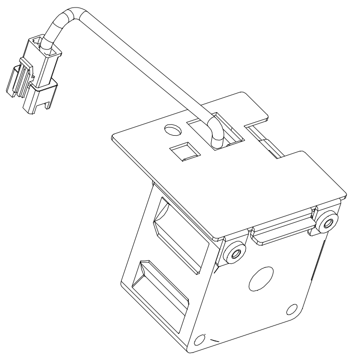
VFD750FP4EA-41, VFD750FP4EA-52, VFD750FP4EA-52S,
VFD900FP4EA-52, VFD900FP4EA-41, VFD900FP4EA-52S

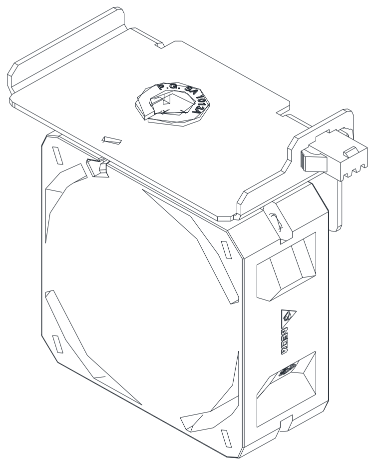
- Frames of capacitor fans:

NOTE: The fan does not support hot swap function. For replacement, turn the power off before replacing the fan.

<table>
<tr><td>Frame A

Applicable Model
VFD007FP4EA-41, VFD007FP4EA-52, VFD007FP4EA-52S,
VFD015FP4EA-41, VFD015FP4EA-52, VFD015FP4EA-52S,
VFD022FP4EA-41, VFD022FP4EA-52, VFD022FP4EA-52S,
VFD037FP4EA-41, VFD037FP4EA-52, VFD037FP4EA-52S,
VFD040FP4EA-41, VFD040FP4EA-52, VFD040FP4EA-52S,
VFD055FP4EA-41, VFD055FP4EA-52, VFD055FP4EA-52S,
VFD075FP4EA-41, VFD075FP4EA-52, VFD075FP4EA-52S</td><td>Capacitor Fan Model 『MKFP-AFKB』
</td></tr>
<tr><td>Frame B

Applicable Model
VFD110FP4EA-41, VFD110FP4EA-52, VFD110FP4EA-52S,
VFD150FP4EA-41, VFD150FP4EA-52, VFD150FP4EA-52S,
VFD185FP4EA-41, VFD185FP4EA-52, VFD185FP4EA-52S,
VFD220FP4EA-41, VFD220FP4EA-52, VFD220FP4EA-52S</td><td>Capacitor Fan Model 『MKFP-BFKB』
</td></tr>
<tr><td>Frame C

Applicable Model
VFD300FP4EA-41, VFD300FP4EA-52, VFD300FP4EA-52S,
VFD370FP4EA-41, VFD370FP4EA-52, VFD370FP4EA-52S</td><td rowspan="3">Capacitor Fan Model 『MKFP-CFKB』
</td></tr>
<tr><td>Frame D0

Applicable Model
VFD450FP4EA-41, VFD450FP4EA-52, VFD450FP4EA-52S,
VFD550FP4EA-41, VFD550FP4EA-52, VFD550FP4EA-52S</td></tr>
<tr><td>Frame D

Applicable Model
VFD750FP4EA-41, VFD750FP4EA-52, VFD750FP4EA-52S,
VFD900FP4EA-41, VFD900FP4EA-52, VFD900FP4EA-52S</td></tr>
</table>

■ Fan Removal

Frame A

Model『MKFP-AFKM』: Heat Sink Fan

Applicable model

VFD022FP4EA-41, VFD022FP4EA-52, VFD022FP4EA-52S,

VFD037FP4EA-41, VFD037FP4EA-52, VFD037FP4EA-52S,

VFD040FP4EA-41, VFD040FP4EA-52, VFD040FP4EA-52S,

VFD055FP4EA-41, VFD055FP4EA-52, VFD055FP4EA-52S,

VFD075FP4EA-41, VFD075FP4EA-52, VFD075FP4EA-52S

1. Refer to Figure 1, loosen the 4 screws then remove the fan kit.
2. Screw torque: 14–16 kg-cm / [12.2–13.9 lb-in.]

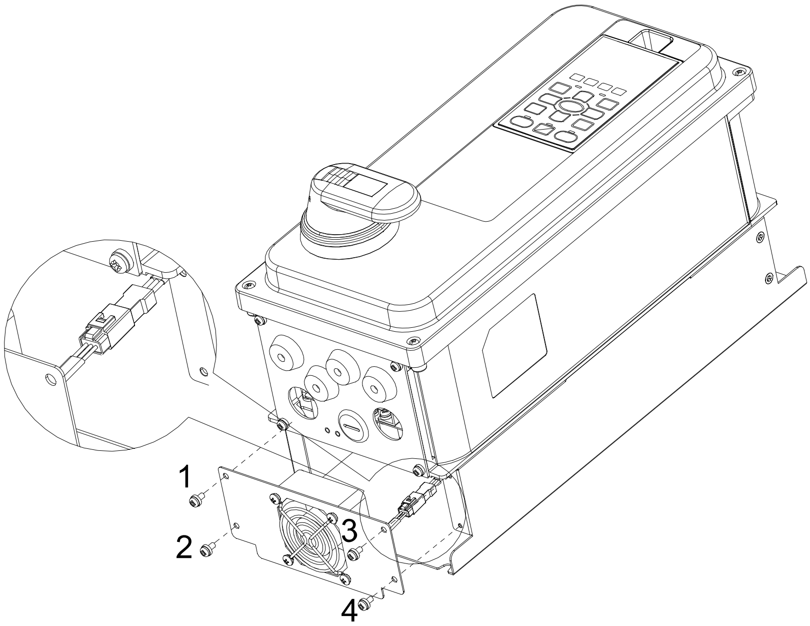


Figure 1

Frame A

Model 『MKFP-AFKB』: Capacitor Fan

Applicable model

VFD007FP4EA-41, VFD007FP4EA-52, VFD007FP4EA-52S,

VFD015FP4EA-41, VFD015FP4EA-52, VFD015FP4EA-52S,

VFD022FP4EA-41, VFD022FP4EA-52, VFD022FP4EA-52S,

VFD037FP4EA-41, VFD037FP4EA-52, VFD037FP4EA-52S,

VFD040FP4EA-41, VFD040FP4EA-52, VFD040FP4EA-52S,

VFD055FP4EA-41, VFD055FP4EA-52, VFD055FP4EA-52S,

VFD075FP4EA-41, VFD075FP4EA-52, VFD075FP4EA-52S

1. Press the hook in the top of digital keypad, then rotate to remove the digital keypad. (Refer to Figure 2)
2. Screw 1–4 torque: 14–16 kg-cm / [12.2–13.9 lb-in.]
3. Loosen the screws 7–13 then remove the fan kit. (Refer to Figure 3)
4. Screw 7–12 torque: 6–8 kg-cm / [5.2–6.9 lb-in.]; Screw 13 torque: 12–14 kg-cm / [10.4–12.2 lb-in.]

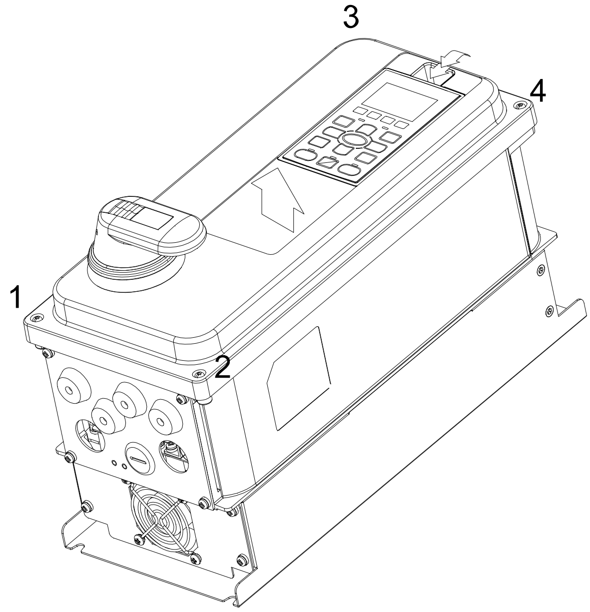


Figure 2

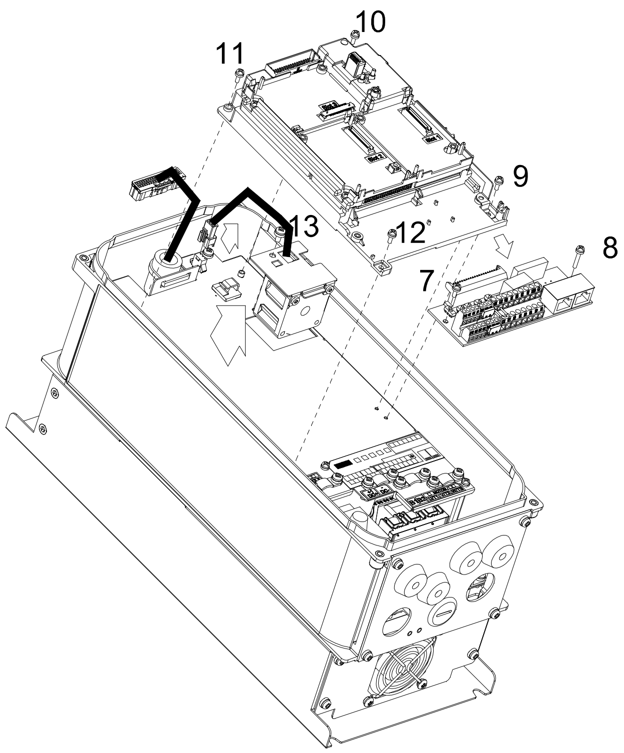


Figure 3

Frame B

Model『MKFP-BFKM』: Heat Sink Fan

Applicable model

VFD110FP4EA-41, VFD110FP4EA-52, VFD110FP4EA-52S,

VFD150FP4EA-41, VFD150FP4EA-52, VFD150FP4EA-52S,

VFD185FP4EA-41, VFD185FP4EA-52, VFD185FP4EA-52S,

VFD220FP4EA-41, VFD220FP4EA-52, VFD220FP4EA-52S

1. Refer to Figure 1, loosen the 4 screws then remove the fan kit.
2. Screw torque: 14–16kg-cm / [12.2–13.9lb-in.]

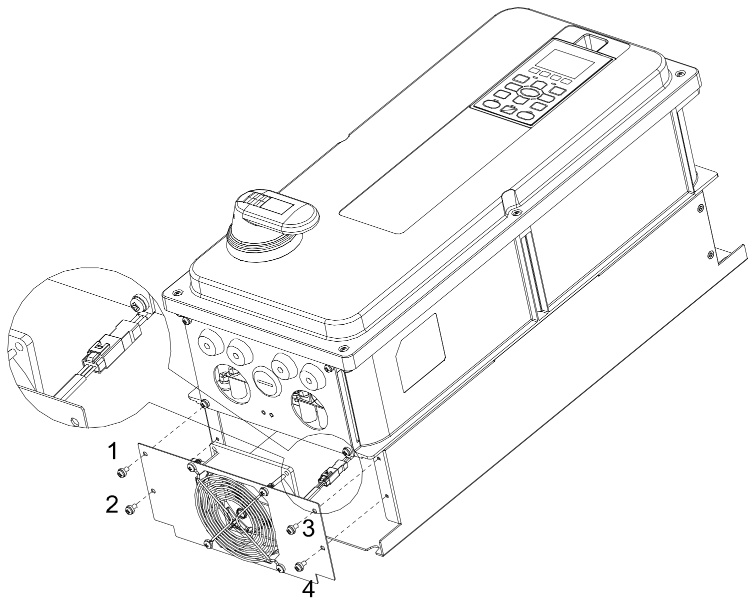


Figure 1

Frame B

Model『MKFP-BFKB』: Capacitor Fan

Applicable model

VFD110FP4EA-41, VFD110FP4EA-52, VFD110FP4EA-52S,

VFD150FP4EA-41, VFD150FP4EA-52, VFD150FP4EA-52S,

VFD185FP4EA-41, VFD185FP4EA-52, VFD185FP4EA-52S,

VFD220FP4EA-41, VFD220FP4EA-52, VFD220FP4EA-52S

1. Press the hook in the top of digital keypad, then rotate to remove the digital keypad. (Refer to Figure 2)
2. Screw 1–6 torque: 14–16 kg-cm / [12.2–13.9 lb-in.]
3. Loosen the screws 7–13 then remove the fan kit. (Refer to Figure 3)
4. Screw 7–12 torque: 6–8 kg-cm / [5.2–6.9 lb-in.]; Screw 13 torque: 12–14 kg-cm / [10.4–12.2 lb-in.]

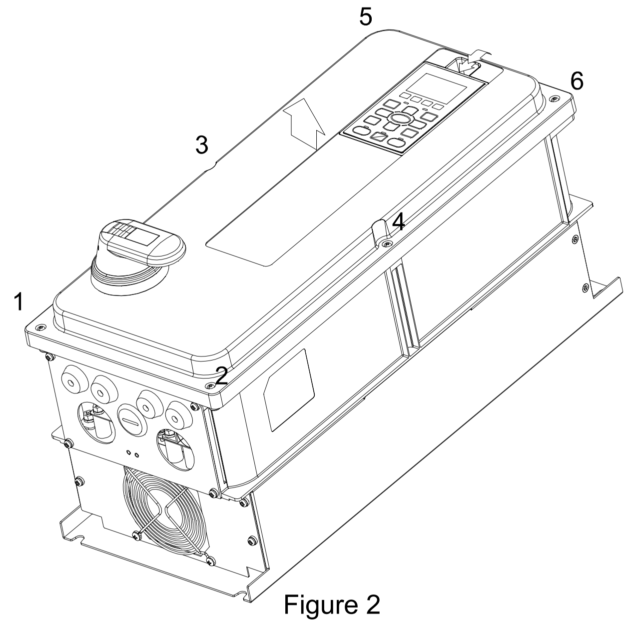


Figure 2

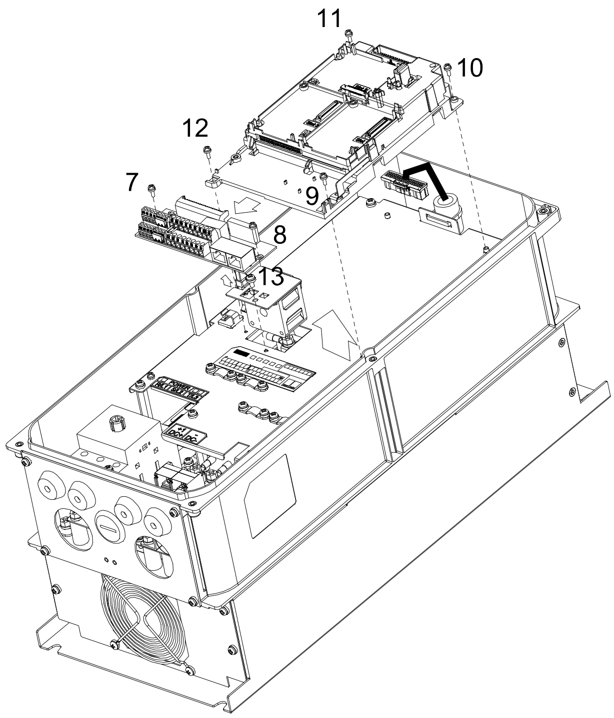


Figure 3

Frame C

Model『MKFP-CFKM』: Heat Sink Fan

Applicable model

VFD300FP4EA-41, VFD300FP4EA-52, VFD300FP4EA-52S,

VFD370FP4EA-41, VFD370FP4EA-52, VFD370FP4EA-52S

1. Refer to Figure 1, loosen the 4 screws then remove the fan kit.
2. Screw torque: 24–26 kg-cm / [20.8–22.6 lb-in.]

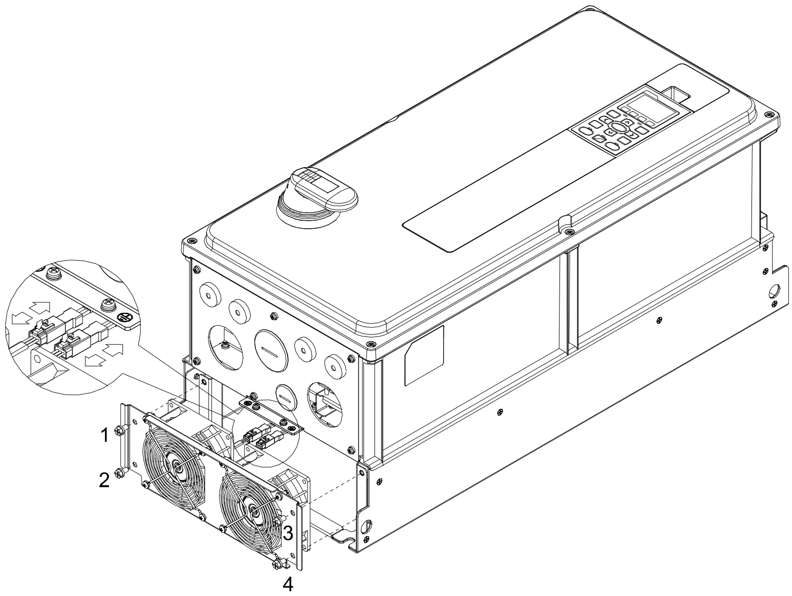


Figure 1

Frame C

Model『MKFP-CFKB』: Capacitor Fan

Applicable model

VFD300FP4EA-41, VFD300FP4EA-52, VFD300FP4EA-52S,

VFD370FP4EA-41, VFD370FP4EA-52, VFD370FP4EA-52S

1. Press the hook in the top of digital keypad, then rotate to remove the digital keypad. (Refer to Figure 2)
2. Screw 1–6 torque: 14–16 kg-cm / [12.1–13.9 lb-in.]
3. Loosen the screw 7 then remove the fan kit. (Refer to Figure 3)
4. Screw 7 torque: 12–15 kg-cm / [10.4–13 lb-in.]

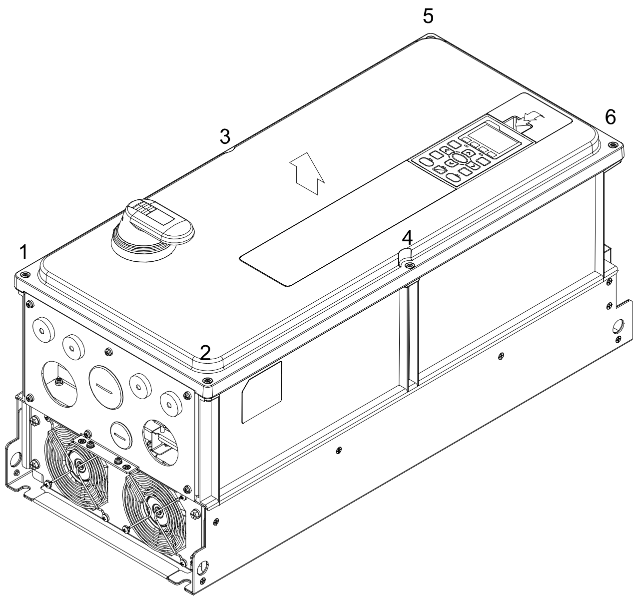


Figure 2

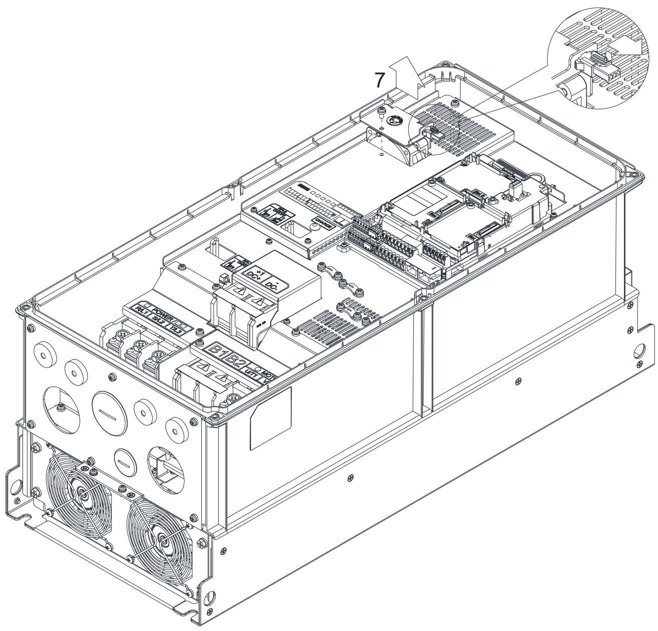


Figure 3

Frame D0

Model 『MKFP-D0FKM』: Heat Sink Fan

Applicable model

VFD450FP4EA-41, VFD450FP4EA-52, VFD450FP4EA-52S,

VFD550FP4EA-41, VFD550FP4EA-52, VFD550FP4EA-52S

1. Loosen the screw and remove the fan kit. Screw torque: 24–26 kg-cm / [20.8–22.6 lb-in]
2. Before pulling out the fan, make sure the fan power is disconnected. (Refer to Figure 1)

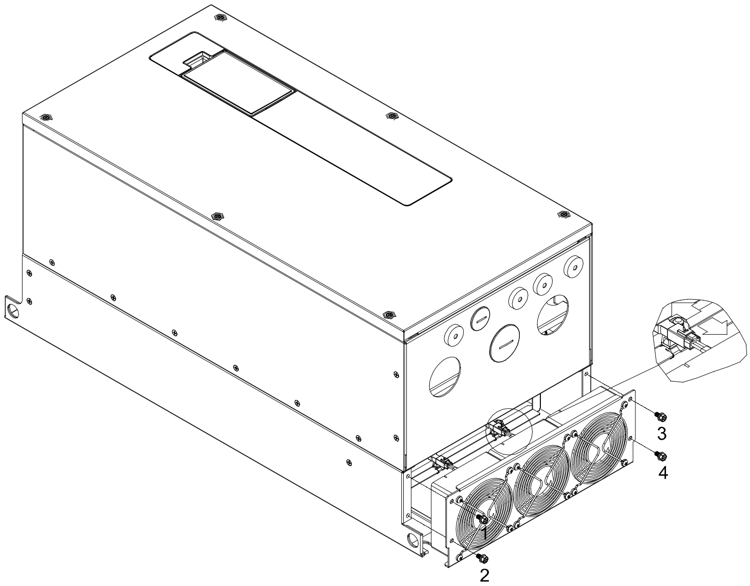


Figure 1

Frame D0

Model 『MKFP-CFKB』: Capacitor Fan

Applicable model

VFD450FP4EA-41, VFD450FP4EA-52, VFD450FP4EA-52S,

VFD550FP4EA-41, VFD550FP4EA-52, VFD550FP4EA-52S

1. Press the hook in the top of digital keypad, then rotate to remove the digital keypad. (Refer to Figure 2)
2. Screw 1–6 torque: 14–16 kg-cm / [12.1–13.9 lb-in.]
3. Loosen the screw 7 then remove the fan kit. (Refer to Figure 3)
4. Screw 7 torque: 12–15 kg-cm / [10.4–13 lb-in.]

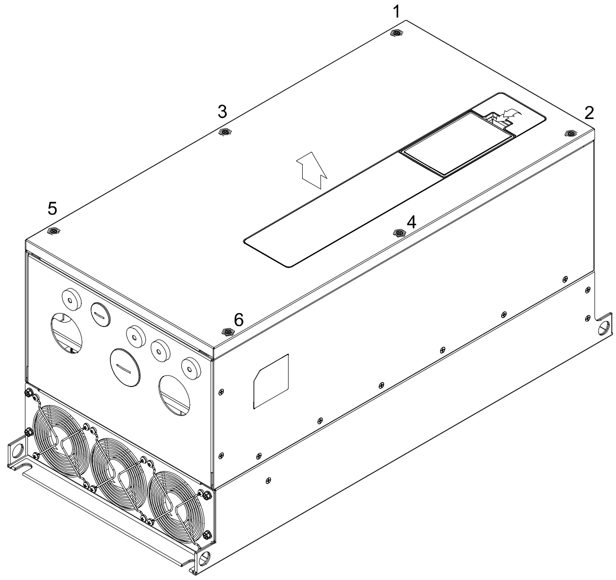


Figure 2

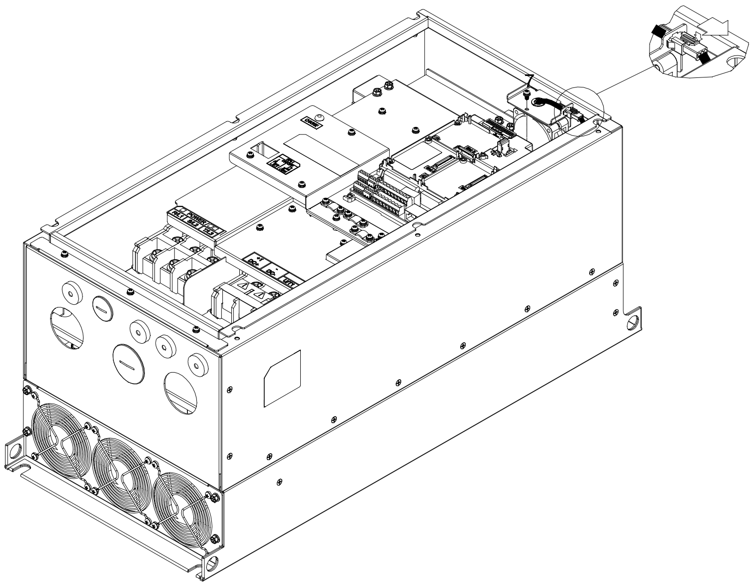


Figure 3

Frame D

Model『MKFP-DFKM』: Heat Sink Fan

Applicable model

VFD750FP4EA-41, VFD750FP4EA-52, VFD750FP4EA-52S,

VFD900FP4EA-41, VFD900FP4EA-52, VFD900FP4EA-52S

1. Loosen the screw and remove the fan kit. Screw torque: 14–16 kg-cm / [12.1–13.9 lb-in.]
2. Before pulling out the fan, make sure the fan power is disconnected. (Refer to Figure 1)

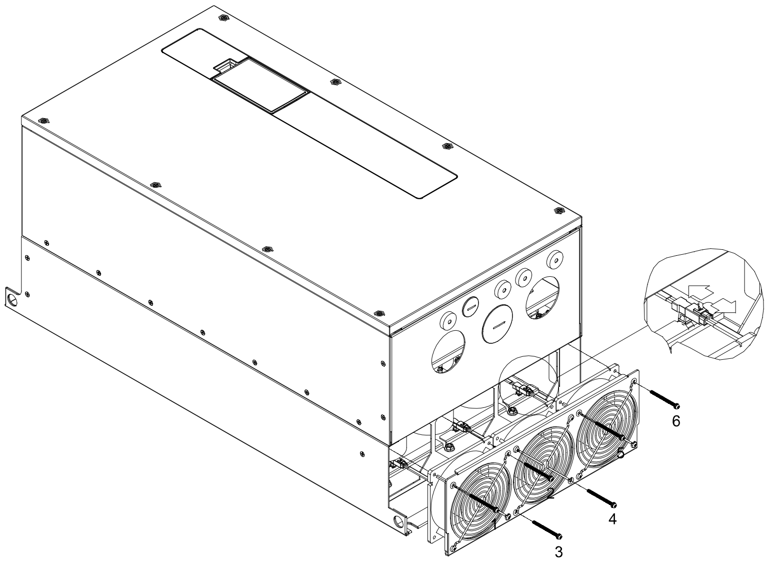


Figure 1

Frame D

Model 『MKFP-CFKB』: Capacitor Fan

Applicable model

VFD750FP4EA-41, VFD750FP4EA-52, VFD750FP4EA-52S,

VFD900FP4EA-41, VFD900FP4EA-52, VFD900FP4EA-52S

1. Press the hook in the top of digital keypad, then rotate to remove the digital keypad. (Refer to Figure 2)
2. Screw 1–8 torque: 14–16 kg-cm / [12.1–13.9 lb-in.]
3. Loosen the screw 9 then remove the fan kit. (Refer to Figure 3)
4. Screw 9 torque: 12–15 kg-cm / [10.4–13 lb-in.]

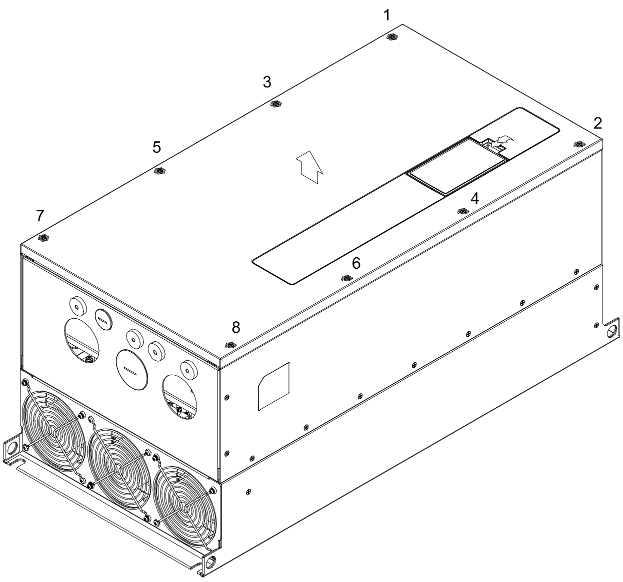


Figure 2

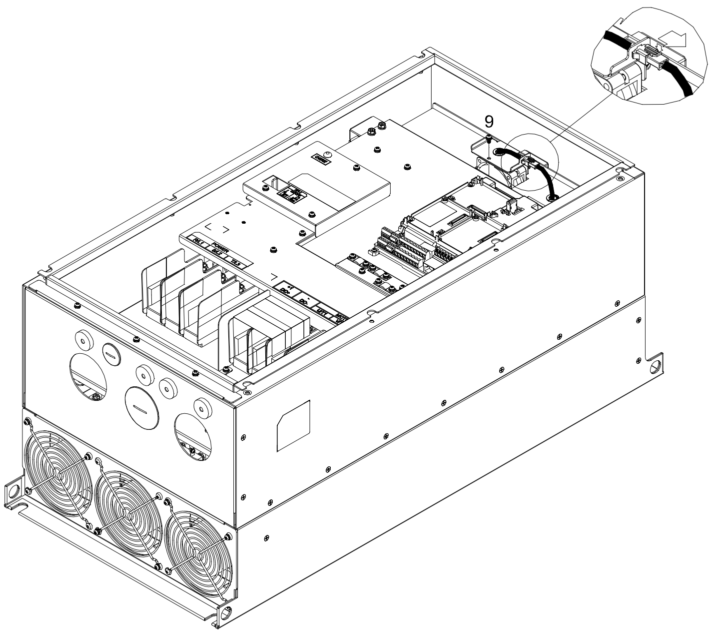


Figure 3

7-9 USB/RS-485 Communication Interface IFD6530

Warning

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

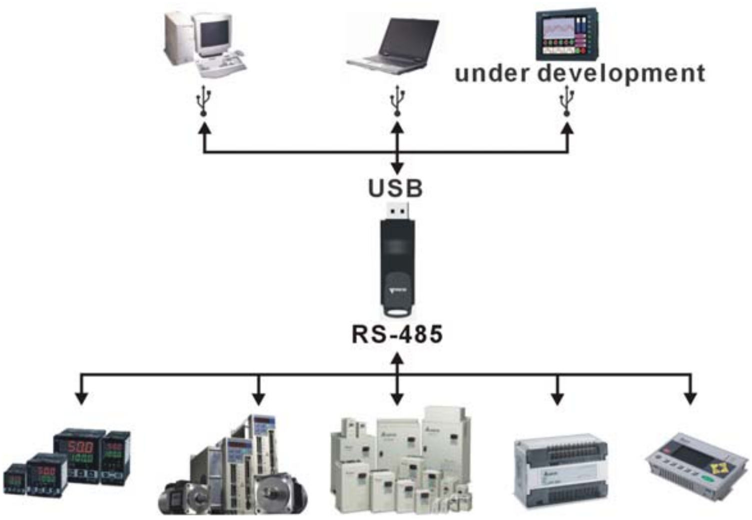
✓ *The content of this instruction sheet and the driver file may be revised without prior notice. Please consult our distributors or download the most updated instruction/driver version.*

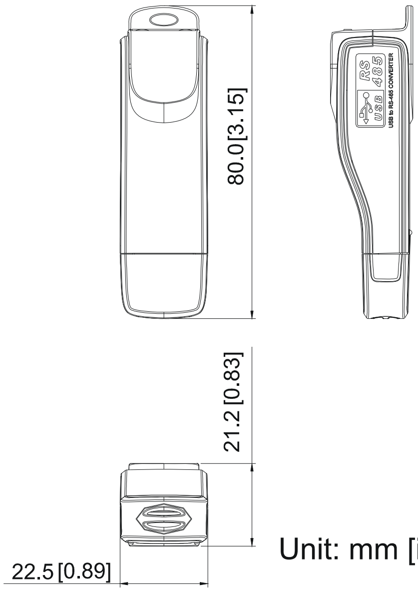
Introduction

IFD6530 is a convenient RS-485-to-USB converter, which does not require external power-supply and complex setting process. It supports baud rate from 75 to 115.2 Kbps and auto switching direction of data transmission. In addition, it adopts RJ45 in RS-485 connector for users to wire conveniently. And its tiny dimension, handy use of plug-and-play and hot-swap provide more conveniences for connecting all DELTA IABG products to your PC.

Applicable Models: All DELTA IABG products.

(Application & Dimension)



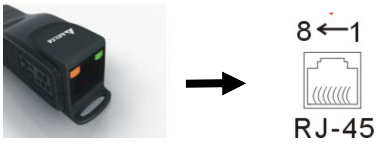


Unit: mm [inch]

Specifications

Power supply	No external power is needed
Power consumption	1.5 W
Isolated voltage	2,500 V_{DC}
Baud rate	75 Kbps, 150 Kbps, 300 Kbps, 600 Kbps, 1,200 Kbps, 2,400 Kbps, 4,800 Kbps, 9,600 Kbps, 19,200 Kbps, 38,400 Kbps, 57,600 Kbps, 115,200 Kbps
RS-485 connector	RJ45
USB connector	A type (plug)
Compatibility	Full compliance with USB V2.0 specification
Max. cable length	RS-485 Communication Port: 100 m
Support RS-485 half-duplex transmission	

■ **RJ45**



PIN	Description
1	Reserved
2	Reserved
3	GND
4	SG-

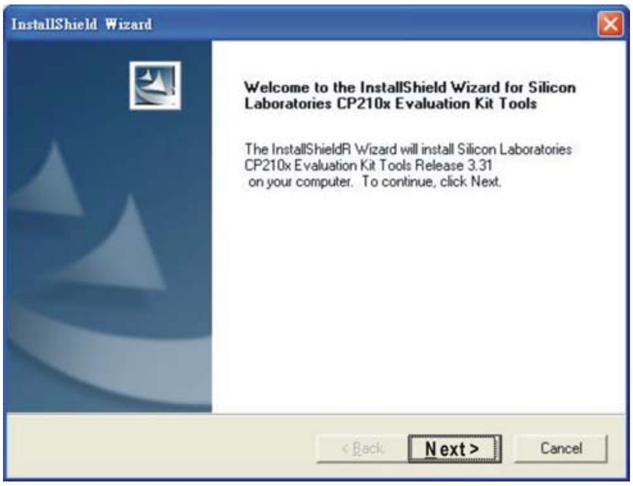
PIN	Description
5	SG+
6	GND
7	Reserved
8	+9V

Preparations before Driver Installation

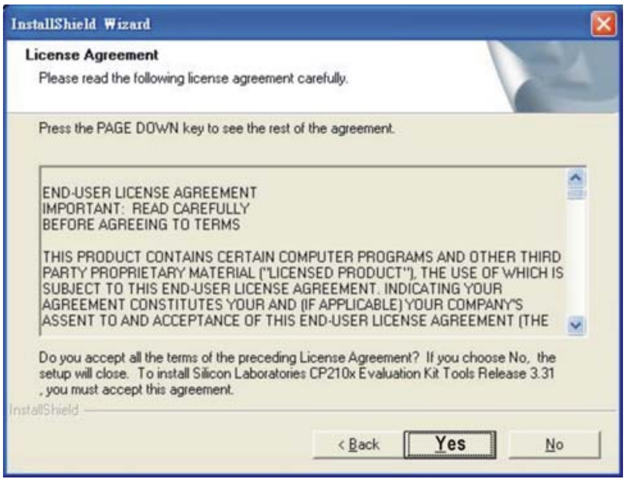
Extract the driver file (IFD6530_Drivers.exe) by following steps. Download the driver file (IFD-6530_Drivers.exe) at www.deltaww.com/iadownload_acmotordrive/IFD6530_Drivers.

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

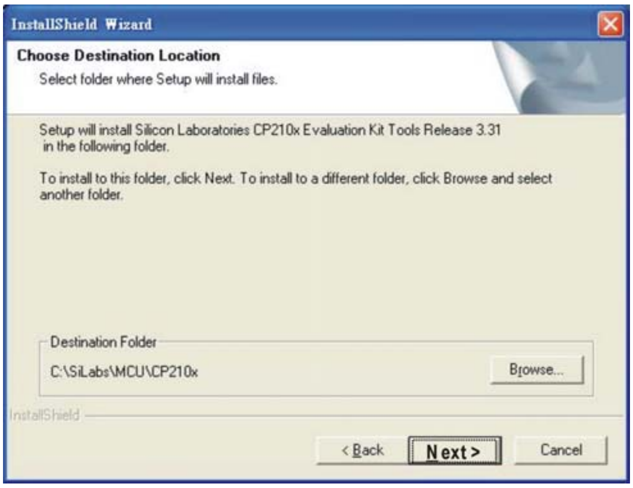
STEP 1



STEP 2



STEP 3



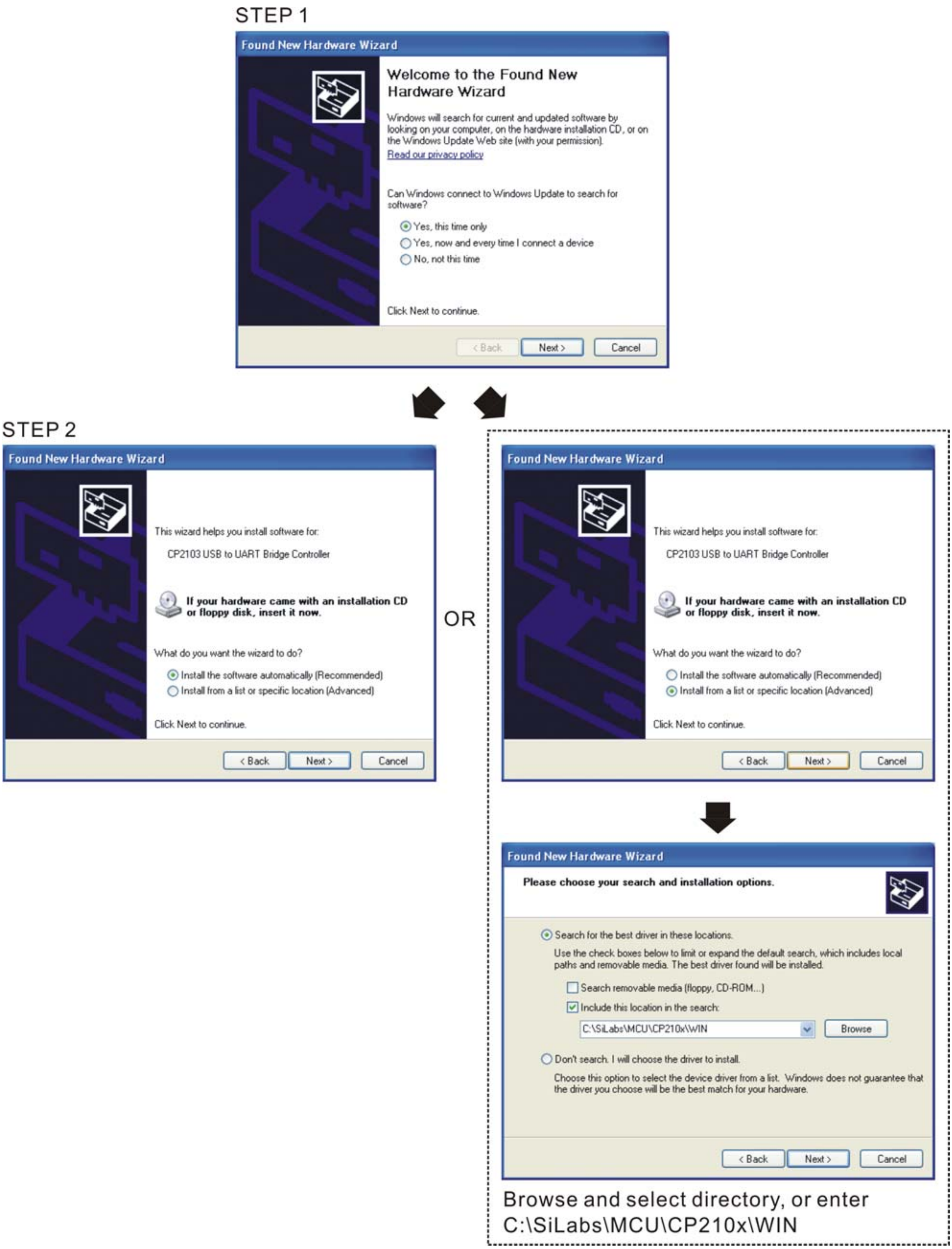
STEP 4

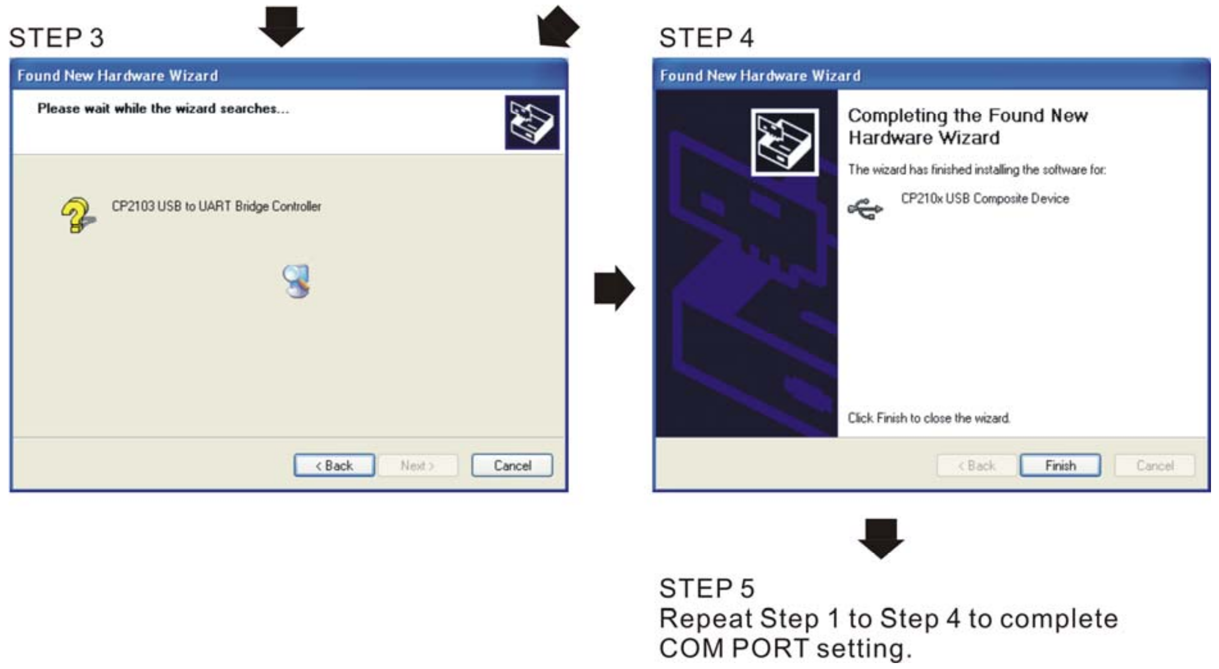
STEP 5

You should have a folder marked SiLabs under drive C. c:\ SiLabs

1. Driver Installation

After connecting IFD6530 to PC, please install driver by following steps.





2. LED Display

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

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Chapter 8 Option Cards

Please select applicable option cards for your drive or contact local distributor for suggestion.
To prevent drive damage during installation, please remove the digital keypad and the cover before wiring.
Refer to the following instruction.

8-1 Option Card Installation

8-1-1 Remove the top cover

Frame A & B
Screw Torque: 12–15 kg-cm / [10.4–13 lb-in.] / [1.2–1.5 Nm]

1. Remove the keypad (as shown in below figure 2).
2. Loosen the screws, then remove the top cover (as shown in below figure 3).

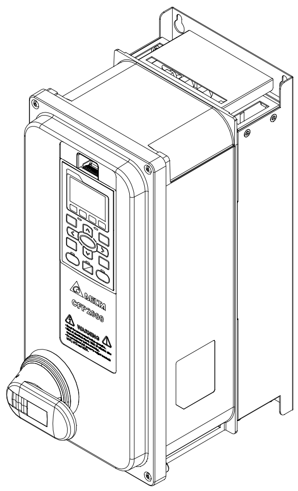


Figure 1

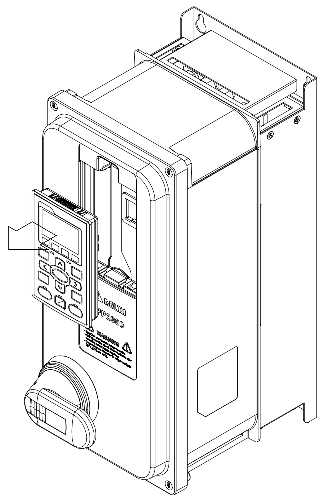


Figure 2

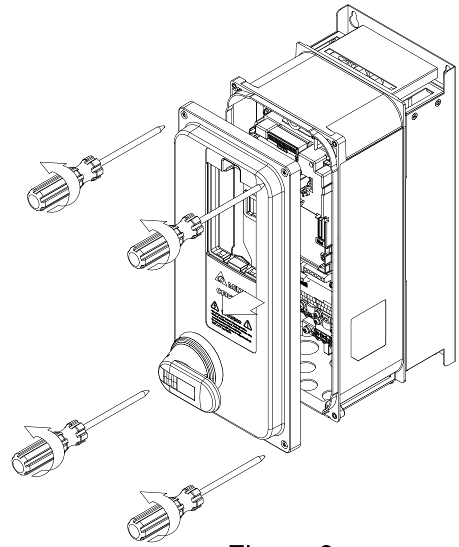


Figure 3

Frame C
Screw Torque: 12–15 kg-cm / [10.4–13lb-in.] / [1.2–1.5 Nm]

1. Remove the keypad (as shown in below figure 2).
2. Loosen the screws, then remove the top cover (as shown in below figure 3).

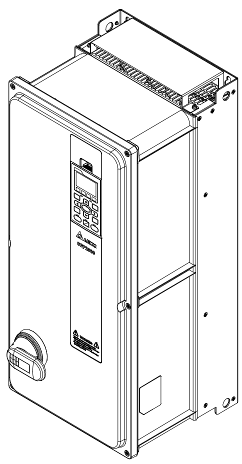


Figure 1

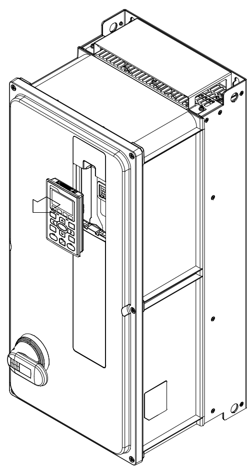


Figure 2

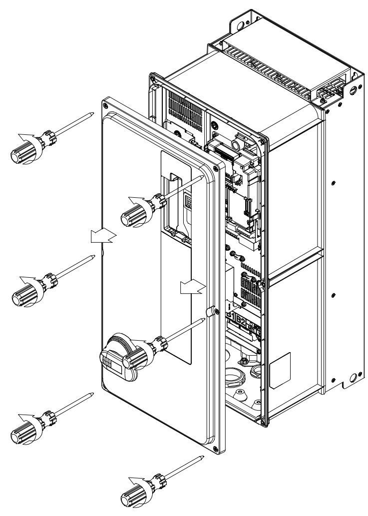


Figure 3

Frame D0–D
Screw Torque: 14–16 kg-cm / [12.1–13.9 Ib-in.] / [1.4–1.6 Nm]
1. Remove the keypad (as shown in below figure 2).
2. Loosen the screws, then remove the top cover (as shown in below figure 3).

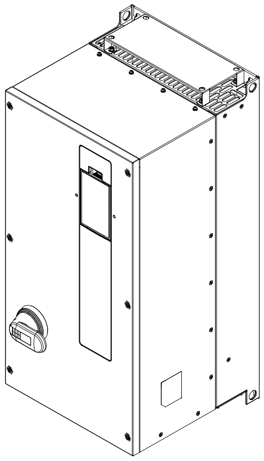


Figure 1

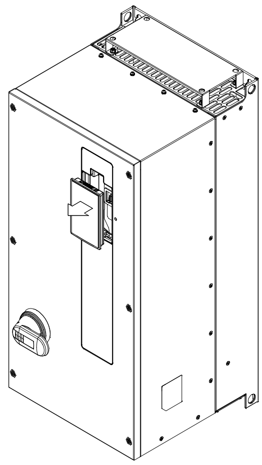


Figure 2

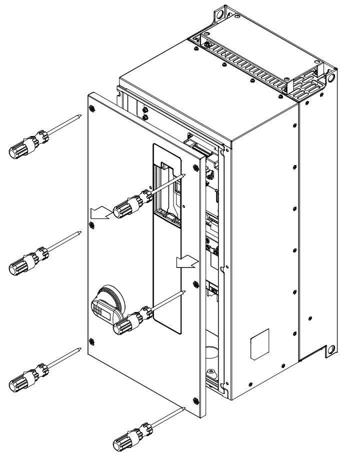
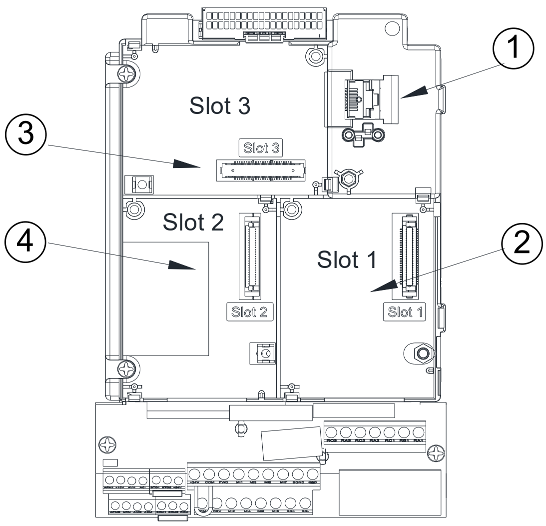


Figure 3

8-1-2 Location to Install Extension Card



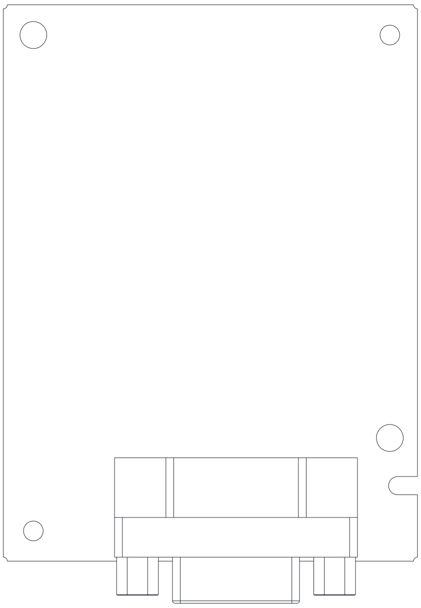
1	RJ45 (Socket) for digital keypad KPC-CC01 Please refer to Section 10 for more details on digital keypad. Please refer to Section 10 for more details on optional accessory RJ45 extension cable.
2	Communication extension card (Slot 1) CMC-PD01; CMC-DN01; CMC-EIP01; EMC-COP01; CMC-PN01
3	I/O & Relay extension card (Slot 3) EMC-D42A; EMC-D611A; EMC-A22A; EMC-R6AA; EMC-BPS01
4	PG Card (Slot 2) ※CFP2000 does not support PG card.

Screws Specification for option card terminals:

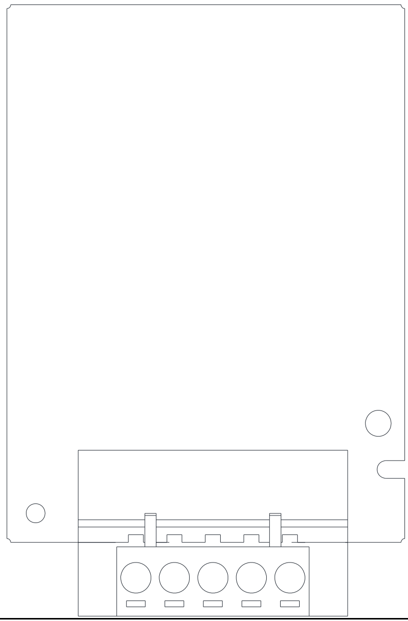
EMC-D42A; EMC-D611A; EMC-BPS01	Wire gauge	0.2–0.5 mm² [26–20 AWG]
	Torque	5 kg-cm / [4.4 Ib-in.] / [0.5 Nm]
EMC-R6AA	Wire gauge	0.2–0.5 mm² [26–20 AWG]
	Torque	8 kg-cm / [7 Ib-in.] / [0.8 Nm]
EMC-A22A	Wire gauge	0.2–4 mm² [24–12 AWG]
	Torque	5 kg-cm / [4.4 Ib-in] / [0.5 Nm]

Communication extension card (Slot 1)

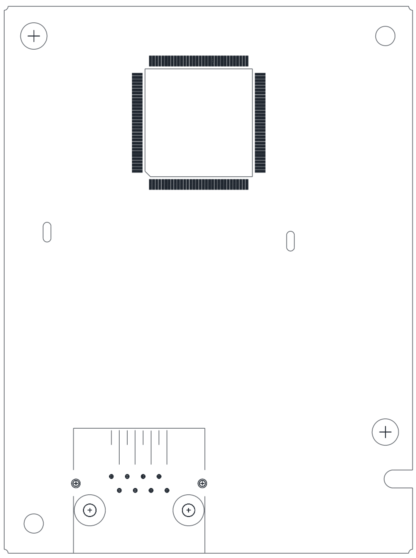
CMC-PD01



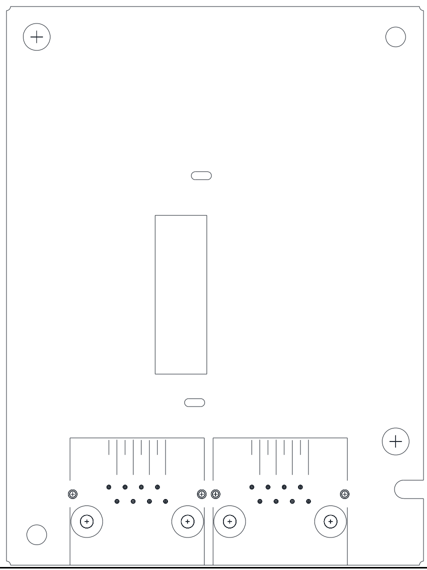
CMC-DN01



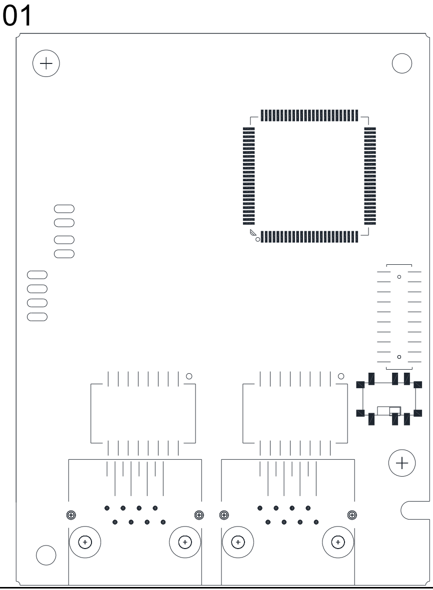
CMC-EIP01



EMC-COP01

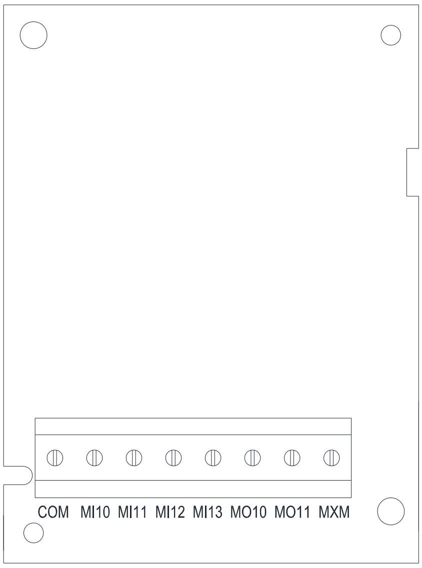


CMC-PN01

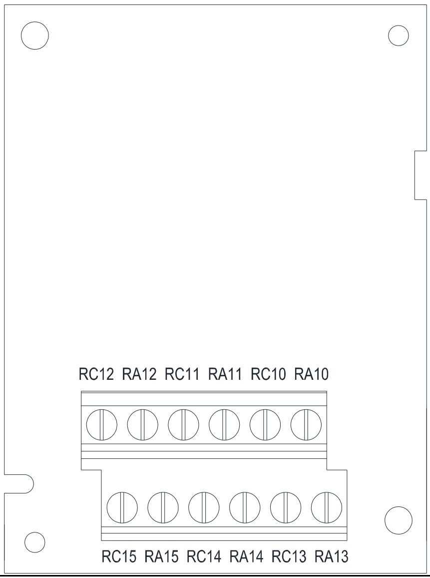


I/O / Relay extension card & 24V Power extension card (Slot 3)

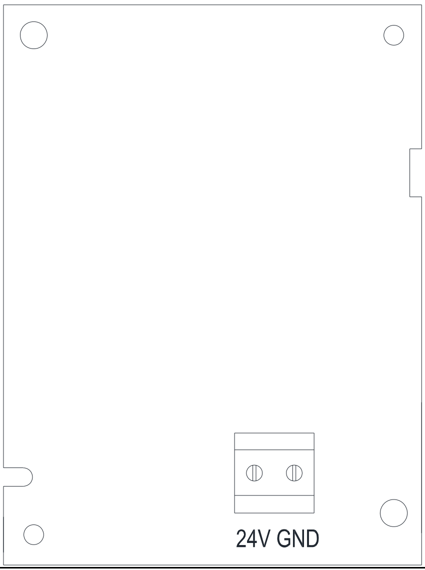
EMC-D42A



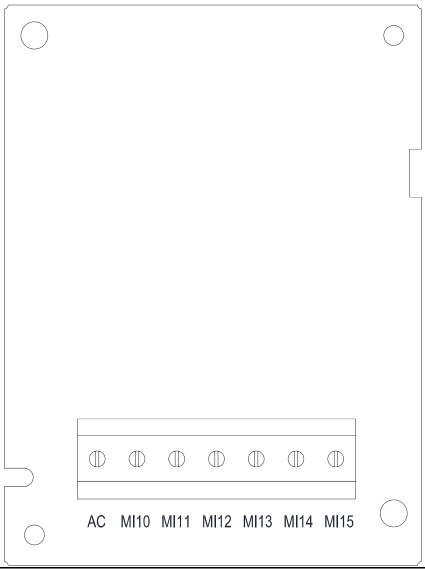
EMC-R6AA



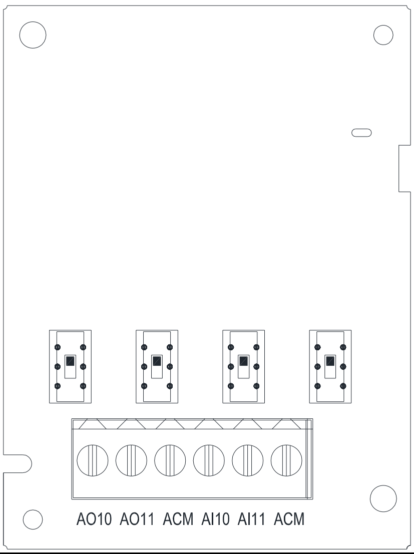
EMC-BPS01



EMC-D611A



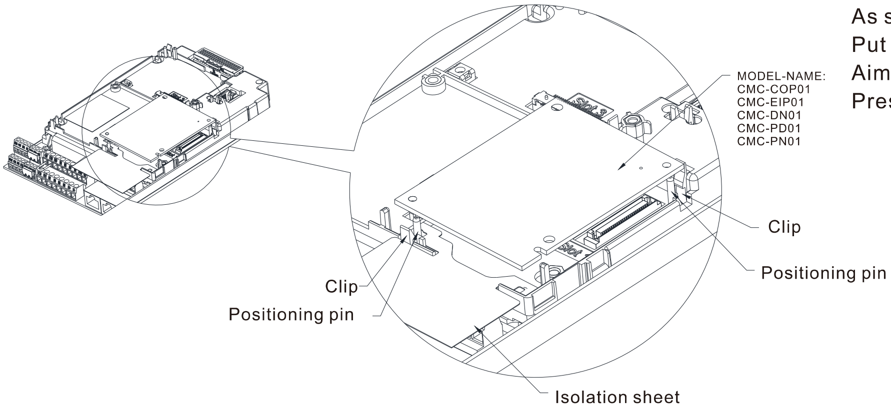
EMC-A22A



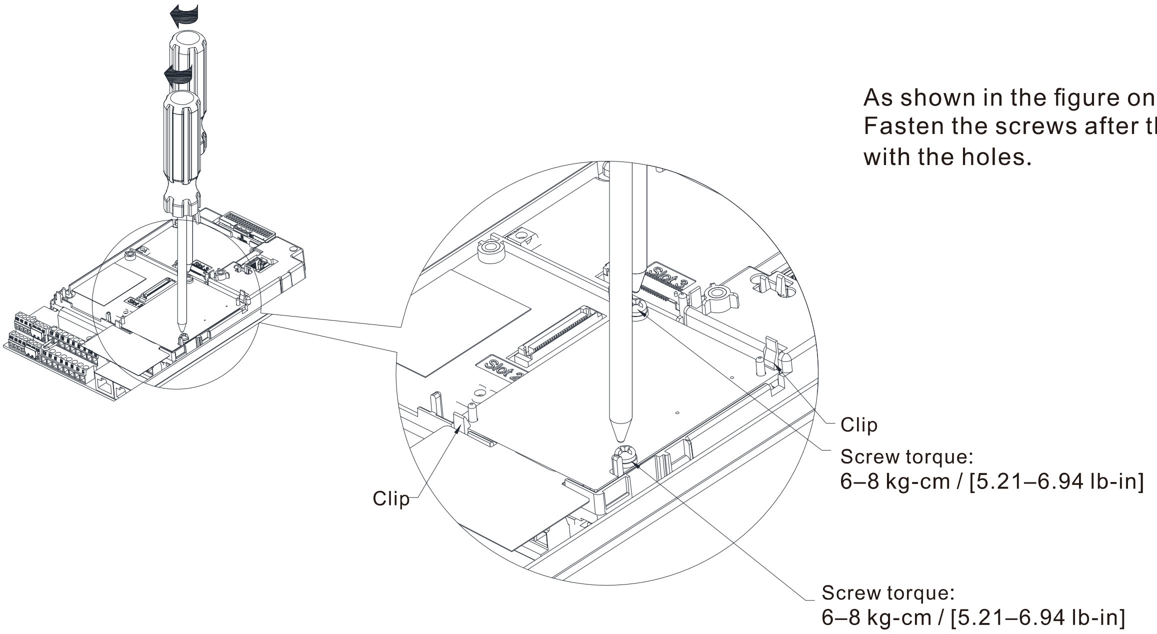
8-1-3 Install and Uninstall of Extension Cards

8-1-3-1 Installation

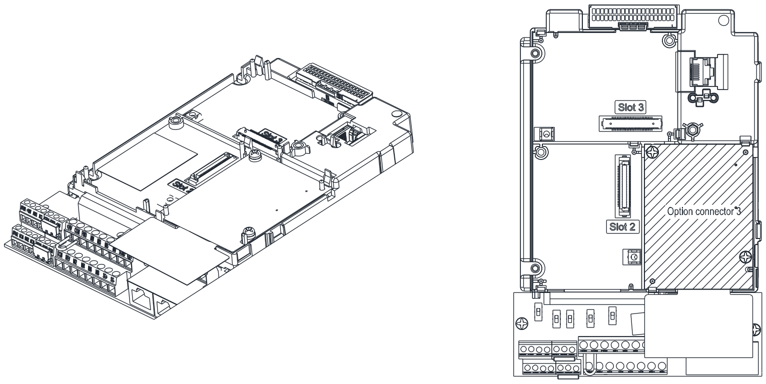
Communication card: EMC-COP01, CMC-EIP01, CMC-DN01, CMC-PD01, CMC-PN01



As shown in the figure on the left.
Put the isolation sheet into the positioning pin.
Aim the two holes at the positioning pin.
Press the pin to clip the holes with the PCB.

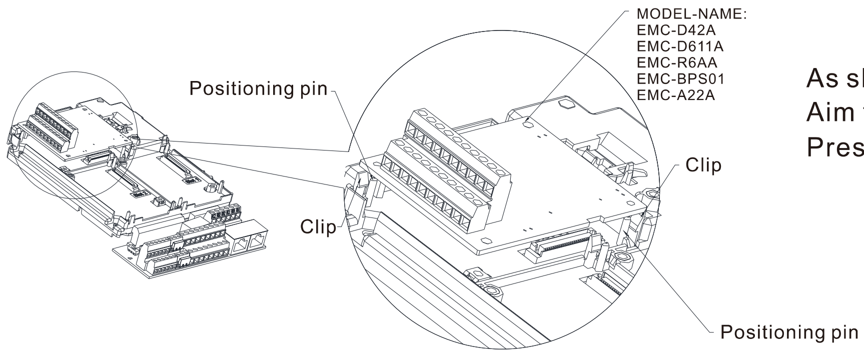


As shown in the figure on the left.
Fasten the screws after the PCB is clipped with the holes.

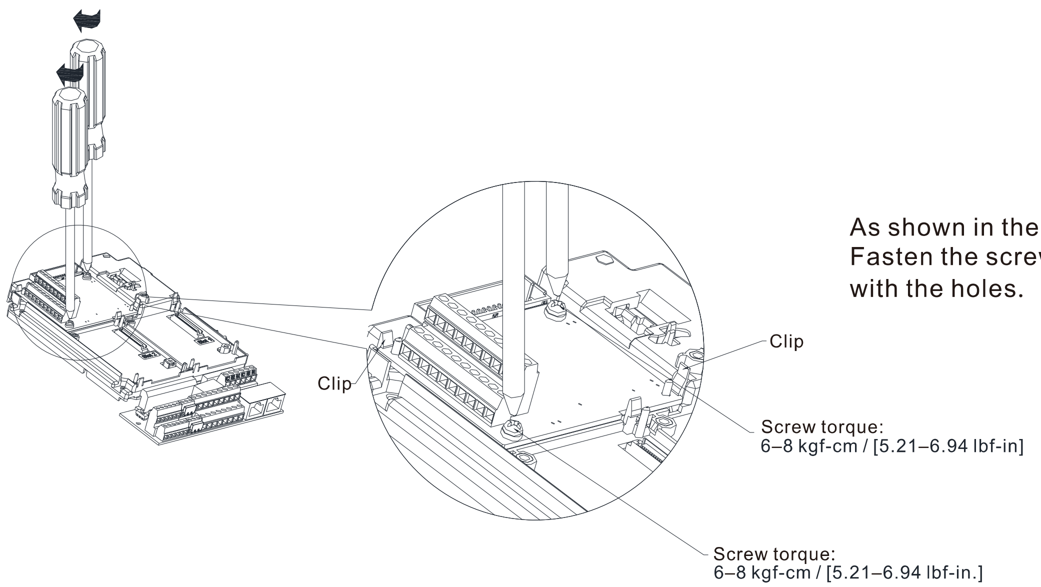


As shown in the figure on the left, installation is completed.

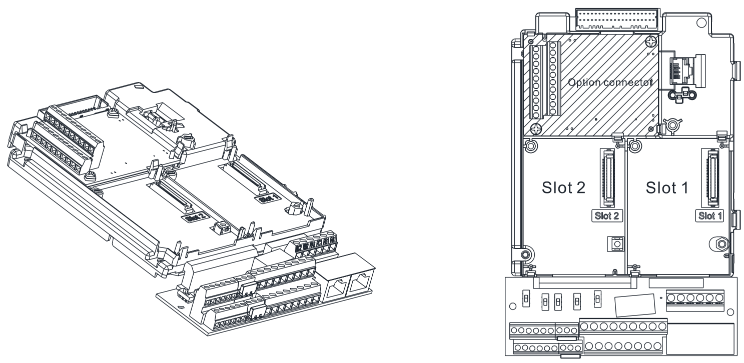
I/O & Relay Card: EMC-D42A, EMC-D611A, EMC-R6AA, EMC-BPS01, EMC-A22A



As shown in the figure on the left.
Aim the two holes at the positioning pin.
Press the pin to clip the holes with the PCB.



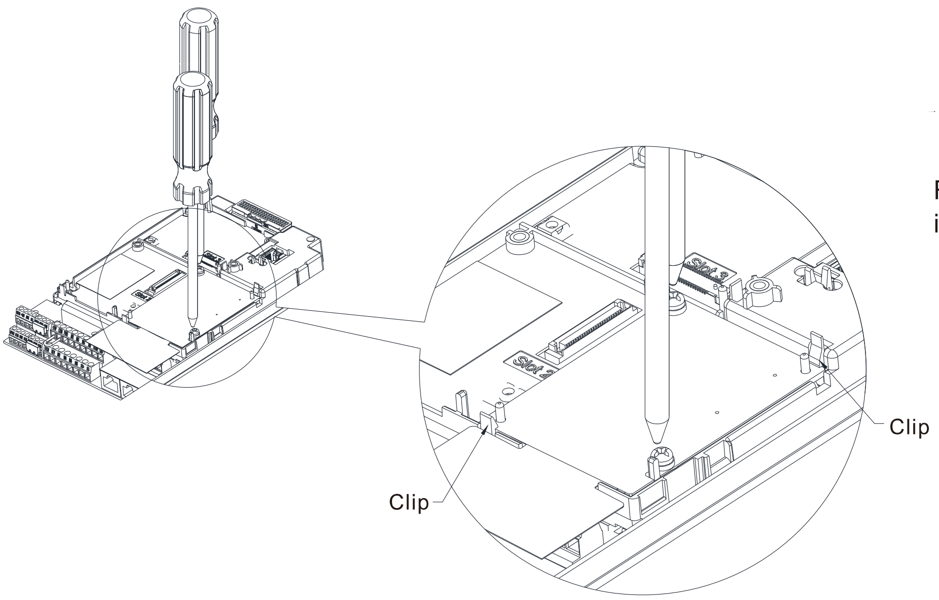
As shown in the figure on the left.
Fasten the screws after the PCB is clipped with the holes.



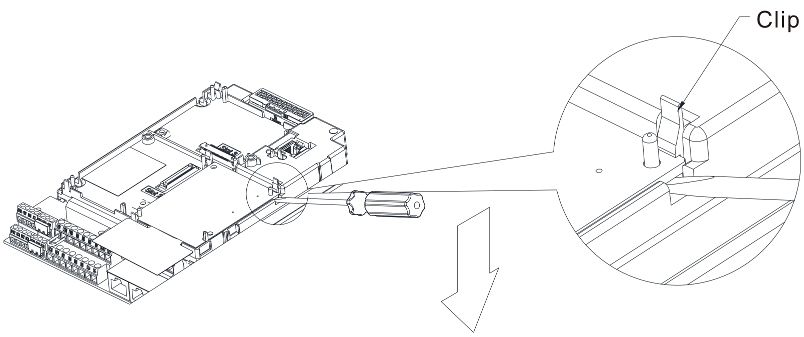
As shown in the figure on the left, installation is completed.

8-1-3-2 Disconnect the extension card

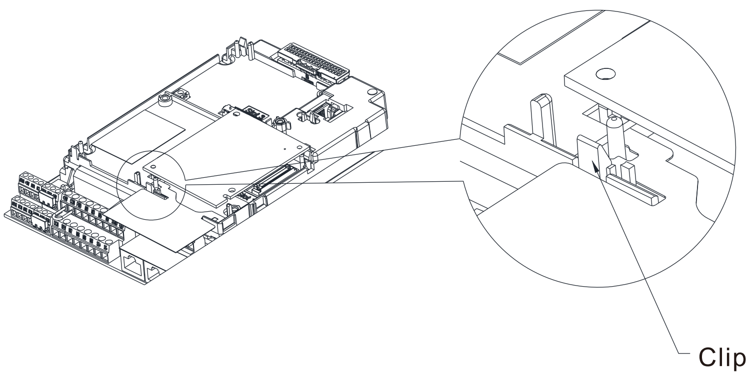
Communication Card: EMC-COP01, CMC-EIP01, CMC-DN01, CMC-PD01, CMC-PN01



Remove the two screws as shown in the figure on the left.

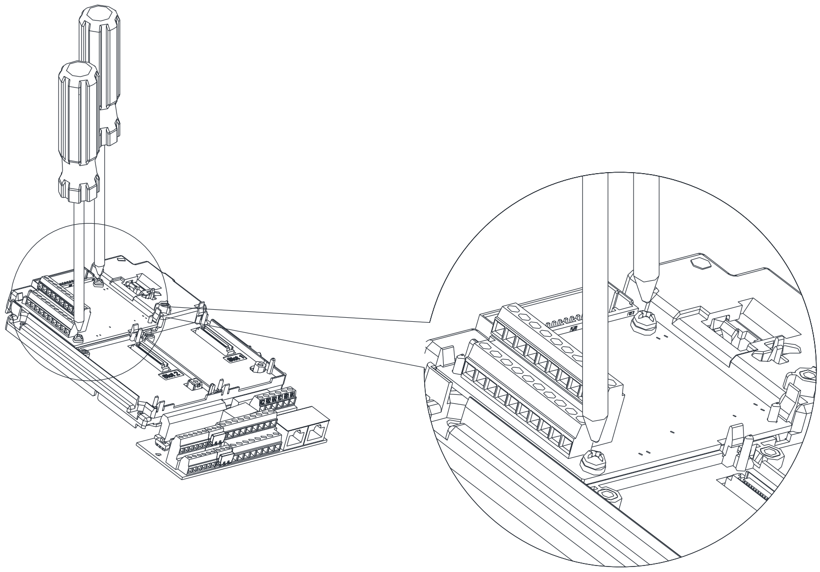


As shown in the figure on the left.
Twist to open the clip.
Insert a slot type screwdriver into the hollow to prize the PCB off the clip.

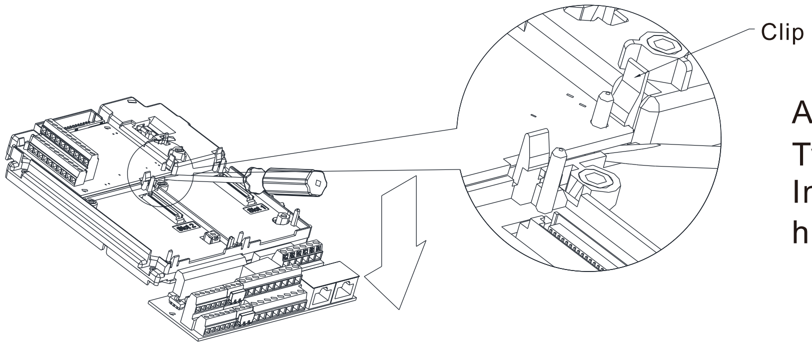


Twist to open the other clip to remove the PCB.

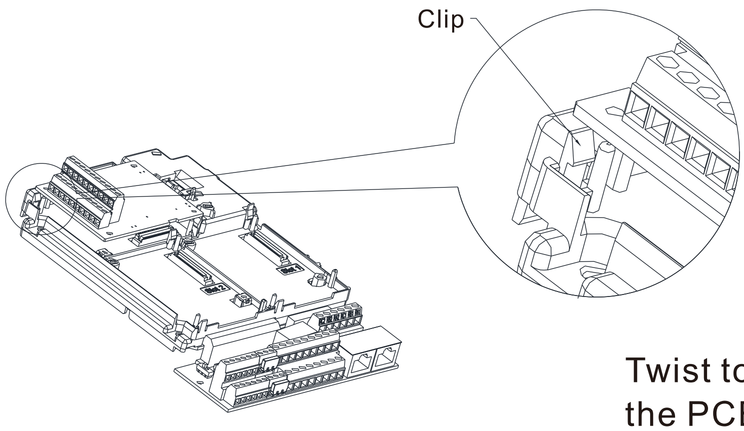
I/O & Relay Card: EMC-D42A, EMC-D611A, EMC-R6AA, EMC-BPS01, EMC-A22A



Remove the two screws as shown in the figure on the left.

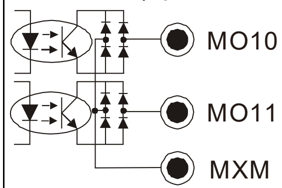


As shown in the figure on the left.
Twist to open the clip.
Insert a slot type screwdriver into the hollow to prize the PCB off the clip.



Twist to open the other clip to remove the PCB, as shown in the figure on the left.

8-2 EMC-D42A -- Extension card for 4-point digital input / 2-point digital input

	Terminals	Descriptions
I/O Extension Card	COM	Common for Multi-function input terminals Select SINK (NPN) / SOURCE (PNP) in J1 jumper / external power supply
	MI10–MI13	Refer to Pr.02-26–Pr.02-29 to program the multi-function inputs MI10–MI13. Internal power is applied from terminal E24: +24 V_{DC}± 5% 200 mA, 5 W External power +24 V_{DC}: max. voltage 30 V_{DC}, min. voltage 19 V_{DC} ON: the activation current is 6.0 mA OFF: leakage current tolerance is 10 μA
	MO10–MO11	Multi-function output terminals (photocoupler) The AC motor drive releases various monitor signals, such as drive in operation, frequency attained and overload indication, via transistor (open collector). 
	MXM	Common for multi-function output terminals MO10, MO11 (photo coupler) Max 48 V_{DC} 50 mA

8-3 EMC-D611A -- Extension card for 6-point digital input (110 V_{AC} input voltage)

	Terminals	Descriptions
I/O Extension Card	AC	AC power Common for multi-function input terminal (Neutral)
	MI10–MI15	Refer to Pr.02-26–Pr.02-31 for multi-function input selection Input voltage: 100–130 V_{AC} Input frequency: 47–63 Hz Input impedance: 27 kΩ Terminal response time: ON: 10 ms OFF: 20 ms

8-4 EMC-R6AA -- Relay output extension card (6-point N.O. output contact)

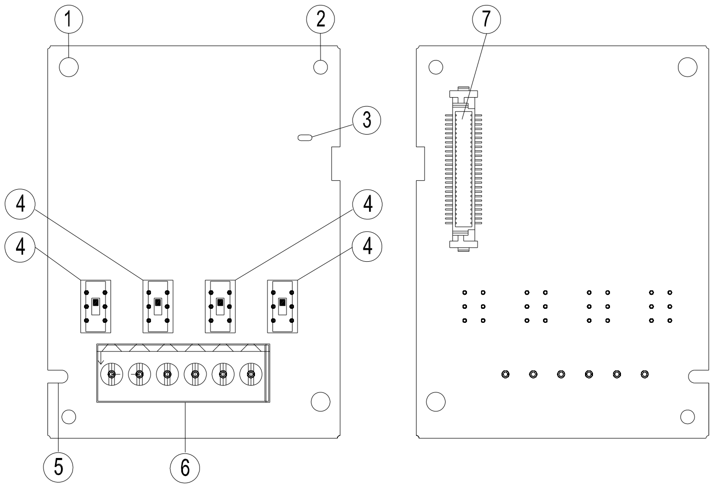
	Terminals	Descriptions
Relay Extension Card	RA10–RA15 RC10–RC15	Refer to Pr.02-36–Pr.02-41 for multi-function relay selection Resistive load: 3 A (N.O.) / 250 V_{AC} 5 A (N.O.) / 30 V_{DC} Inductive load (COS 0.4) 1.2 A (N.O.) / 250 V_{AC} 2.0 A (N.O.) / 30 V_{DC} It is used to output each monitor signal, such as drive is in operation, frequency attained or overload indication.

8-5 EMC-BPS01 -- +24V power card

	Terminals	Descriptions
External Power Supply	24V GND	Input power: 24V ± 5% Maximum input current: 0.5 A Note: Do not connect drive control terminal GND directly to the EMC-BPS01 input terminal GND.
		Function: When the drive is only powered by EMC-BPS01, the communications can be assured and support all communication cards and following functions: Parameters read and write. Keypad can be displayed. Keypad button can be operated (except RUN). Analog input is effective. Multi-function (FWD, REV, MI1–MI8) needs external power supply to operate. The following functions are NOT supported. Relay out (including extension card), PG card and PLC function.

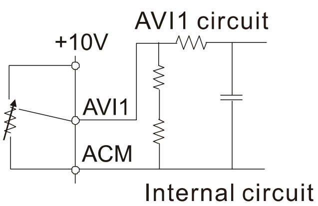
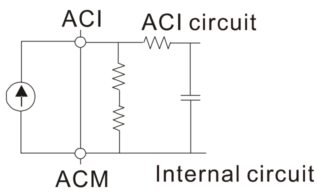
8-6 EMC-A22A – Extension card for 2-point analog input / 2-point analog output

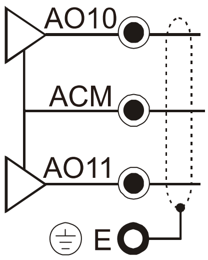
8-6-1 Product File



1. Screw fixing hole
2. Positioning hole
3. POWER indicator
4. Switch
5. Fool-proof groove
6. Terminal block
7. AC motor drive connection port

8-6-2 Terminal Specification

<table>
<tr><th rowspan="5">Analog I/O
Extension Card</th><th>Terminals</th><th colspan="2">Descriptions</th></tr>
<tr><td rowspan="3">AI10, AI11</td><td colspan="2">Refer to Pr.14-00–Pr.14-01 for function selection (input), and Pr.14-18–Pr.14-19 for mode selection.
There are two sets of AI port, SSW3 (AI10) and SSW4 (AI11), which can be switched to Voltage or Current mode.
Voltage mode: Input 0–10 V
Current mode: Input 0–20 mA / 4–20 mA</td></tr>
<tr><td>Analog voltage frequency command

</td><td>Impedance: 20 kΩ
Range: 0–10 V = 0–Max. Output Frequency (Pr.01-00)
Switch: AI10 / AI11 Switch, default 0–10 V</td></tr>
<tr><td>Analog current frequency command

</td><td>Impedance: 250 Ω
Range: 0–20 mA / 4–20 mA = 0–Max. Output Frequency (Pr.01-00)
Switch: AI10 / AI11 Switch, default 0–10 V</td></tr>
<tr><td>AO10, AO11</td><td colspan="2">Refer to Pr.14-12–Pr.14-13 for function selection (output), and Pr.14-36–Pr.14-37 for mode selection.
There are two sets of AO port, SSW1 (AO10) and SSW2 (AO11), which can be switched to Voltage or Current mode.
Voltage mode: Output 0–10 V
Current mode: Output 0–20 mA / 4–20 mA</td></tr>
</table>

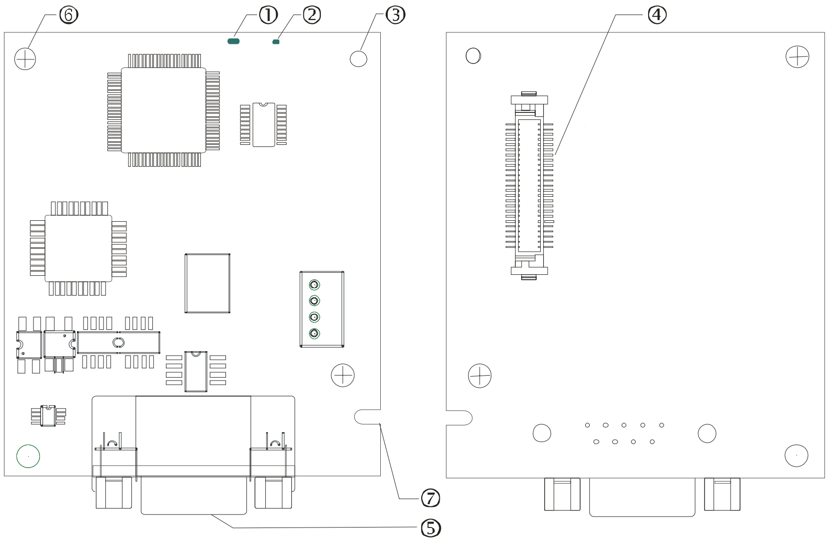
		Multi-function analog output 	AVO: 0–10 V Max. output current 2 mA, Max. load 5 kΩ Output current: 2 mA max Resolution: 0–10 V corresponds to Max. operation frequency Switch: AO10 / AO11 Switch, default 0–10 V
			ACO: 0–20 mA Max. Load 500 Ω Output current: 20 mA max Resolution: 0–20 mA / 4–20 mA corresponds to Max. operation frequency Switch: AO10 / AO11 Switch, default 0–10 V
	ACM	Analog Signal Common	Common for analog terminals

8-7 CMC-PD01 – Communication card, PROFIBUS DP

8-7-1 Features

1. Supports PZD control data exchange.
2. Supports PKW polling AC motor drive parameters.
3. Supports user diagnosis function.
4. Auto-detects baud rates; supports Max. 12 Mbps.

8-7-2 Product Profile



1. NET indicator
2. POWER indicator
3. Positioning hole
4. AC motor drive connection port
5. PROFIBUS DP connection port
6. Screw fixing hole
7. Fool-proof groove

8-7-3 Specifications

PROFIBUS DP Connector

Interface	DB9 connector
Transmission	High-speed RS-485
Transmission cable	Shielded twisted pair cable
Electrical isolation	500 V_{DC}

Communication

Message type	Cyclic data exchange
Module name	CMC-PD01
GSD document	DELA08DB.GSD
Company ID	08DB (HEX)
Serial transmission speed supported (auto-detection)	9.6 Kbps, 19.2 Kbps, 93.75 Kbps, 187.5 Kbps, 500 Kbps, 1.5 Mbps, 3 Mbps, 6 Mbps, 12 Mbps (bit per second)

Electrical Specification

Power supply	5 V_{DC} (supplied by AC motor drive)
Insulation voltage	500 V_{DC}
Power consumption	1 W
Weight	28 g

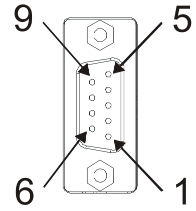
Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Teat (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation /storage	Operation: -10ºC–50ºC (temperature), 90% (humidity) Storage: -25ºC–70ºC (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC61131-2, IEC60068-2-6 (TEST Fc) / IEC61131-2 & IEC60068-2-27 (TEST Ea)

8-7-4 Installation

PROFIBUS DP Connector

PIN	PIN name	Definition
1	-	Not defined
2	-	Not defined
3	Rxd/Txd-P	Sending/receiving data P(B)
4	-	Not defined
5	DGND	Data reference ground
6	VP	Power voltage – positive
7	-	Not defined
8	Rxd/Txd-N	Sending/receiving data N(A)
9	-	Not defined



8-7-5 LED Indicator & Troubleshooting

There are 2 LED indicators on CMC-PD01: POWER LED and NET LED. POWER LED displays the status of the working power. NET LED displays the connection status of the communication.

POWER LED

LED status	Indication	How to correct it?
Green light ON	Power supply in normal status.	--
OFF	No power	Check if the connection between CMC-PD01 and AC motor drive is normal.

NET LED

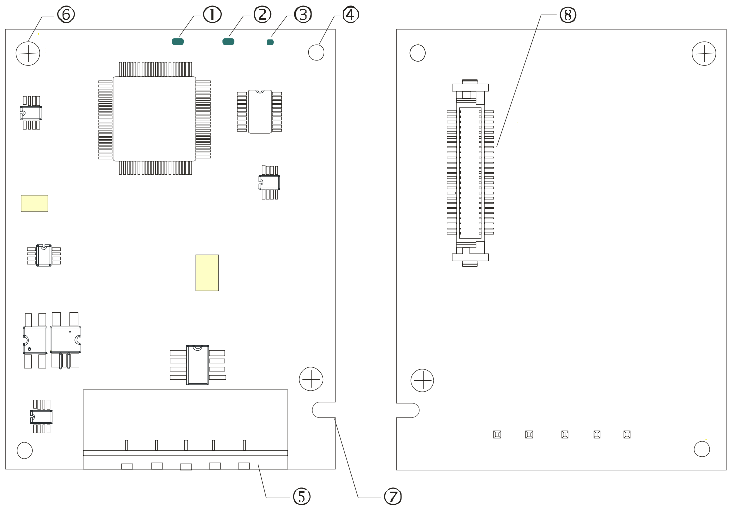
LED status	Indication	How to correct it?
Green light ON	Normal status	--
Red light ON	CMC-PD01 is not connected to PROFIBUS DP bus.	Connect CMC-PD01 to PROFIBUS DP bus.
Red light flashes	Invalid PROFIBUS communication address	Set the PROFIBUS address of CMC-PD01 between 1–125 (decimal)
Orange light flashes	CMC-PD01 fails to communicate with AC motor drive.	Switch off the power and check whether CMC-PD01 is correctly and normally connected to AC motor drive.

8-8 CMC-DN01 – Communication card, DeviceNet

8-8-1 Functions

1. Based on the high-speed communication interface of Delta HSSP protocol, able to conduct immediate control to AC motor drive.
2. Supports Group 2 only connection and polling I/O data exchange.
3. For I/O mapping, supports Max. 32 words of input and 32 words of output.
4. Supports EDS file configuration in DeviceNet configuration software.
5. Supports all baud rates on DeviceNet bus: 125 Kbps, 250 Kbps, 500 Kbps and extendable serial transmission speed mode.
6. Node address and serial transmission speed can be set up on AC motor drive.
7. Power supplied from AC motor drive.

8-8-2 Product Profile



1. NS indicator
2. MS indicator
3. POWER indicator
4. Positioning hole
5. DeviceNet connection port
6. Screw fixing hole
7. Fool-proof groove
8. AC motor drive connection port

8-8-3 Specifications

DeviceNet Connector

Interface	5-PIN open removable connector of 5.08 mm PIN interval
Transmission	CAN
Transmission cable	Shielded twisted pair cable (with 2 power cables)
Transmission speed	125 Kbps, 250 Kbps, 500 Kbps and extendable serial transmission speed
Network protocol	DeviceNet protocol

AC Motor Drive Connection Port

Interface	50 PIN communication terminal
Transmission method	SPI communication
Terminal function	1. Communicating with AC motor drive 2. Transmitting power supply from AC motor drive
Communication	Delta HSSP protocol

Electrical Specification

Power supply voltage	5 V_{DC} (supplied by AC motor drive)
Insulation voltage	500 V_{DC}
Communication wire power consumption	0.85 W
Power consumption	1 W
Weight	23 g

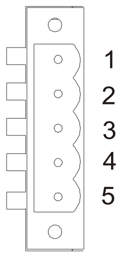
Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Teat (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation /storage	Operation: -10ºC–50ºC (temperature), 90% (humidity) Storage: -25ºC–70ºC (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1 & IEC 60068-2-27

8-8-4 Installation

DeviceNet Connector

PIN	Signal	Color	Definition
1	V+	Red	DC24V
2	H	White	Signal+
3	S	-	Earth
4	L	Blue	Signal-
5	V-	Black	0V



8-8-5 LED Indicator & Troubleshooting

There are 3 LED indicators on CMC-DN01: POWER LED, MS LED and NS LED. POWER LED displays the status of power supply. MS LED and NS LED are dual-color LED, displaying the connection status of the communication and error messages.

POWER LED

LED status	Indication	How to correct it?
OFF	Power supply in abnormal status.	Check the power supply of CMC-DN01.
Green light ON	Power supply in normal status	--

NS LED

LED status	Indication	How to correct it?
OFF	No power supply or CMC-DN01 has not completed MAC ID test yet.	1. Check the power of CMC-DN01 and see if the connection is normal. 2. Make sure at least one or more nodes are on the bus. 3. Check if the serial transmission speed of CMC-DN01 is the same as that of other nodes.
Green light flashes	CMC-DN01 is on-line but has not established connection to the master.	1. Configure CMC-DN01 to the scan list of the master. 2. Re-download the configured data to the master.
Green light ON	CMC-DN01 is on-line and is normally connected to the master	--
Red light flashes	CMC-DN01 is on-line, but I/O connection is timed-out.	1. Check if the network connection is normal. 2. Check if the master operates normally.
Red light ON	1. The communication is down. 2. MAC ID test failure. 3. No network power supply. 4. CMC-DN01 is off-line.	1. Make sure all the MAC IDs on the network are not repeated. 2. Check if the network installation is normal. 3. Check if the baud rate of CMC-DN01 is consistent with that of other nodes. 4. Check if the node address of CMC-DN01 is illegal. 5. Check if the network power supply is normal.

MS LED

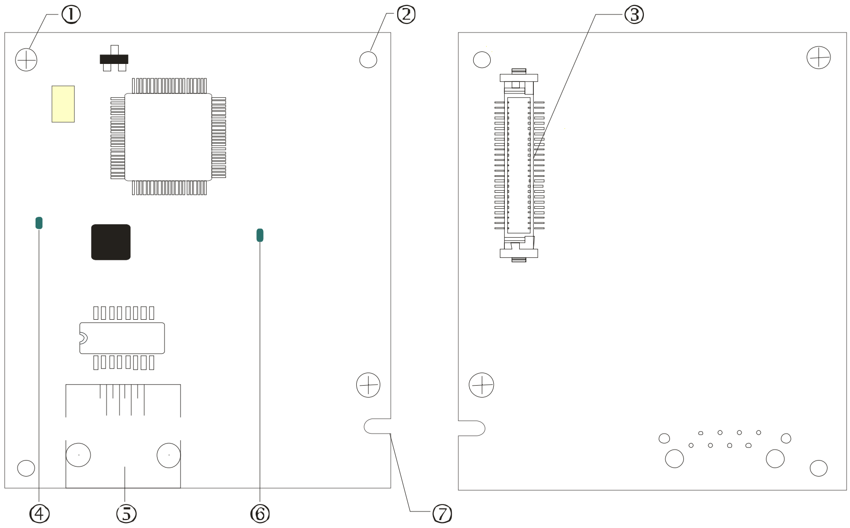
LED status	Indication	How to correct it?
OFF	No power supply or being off-line	Check the power supply of CMC-DN01 and see if the connection is normal.
Green light flashes	Waiting for I/O data	Switch the master PLC to RUN status
Green light ON	I/O data are normal	--
Red light flashes	Mapping error	1. Reconfigure CMC-DN01 2. Re-power AC motor drive
Red light ON	Hardware error	1. See the error code displayed on AC motor drive. 2. Send back to the factory for repair if necessary.
Orange light flashes	CMC-DN01 is establishing connection with AC motor drive.	If the flashing lasts for a long time, turn off the power and check if CMC-DN01 and AC motor drive are correctly installed and normally connected to each other.

8-9 CMC-EIP01 – Communication card, EtherNet/IP

8-9-1 Features

1. Supports Ethernet/IP and Modbus TCP protocol
2. User-defined corresponding parameters (EIP V1.06 and above)
3. Simple firewall function for IP Filter
4. MDI/MDI-X auto-detect
5. Baud rate: 10/100 Mbps auto-detect mail alarm

8-9-2 Product Profile



[Figure1]

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. LINK indicator
5. RJ45 connection port
6. POWER indicator
7. Fool-proof groove

8-9-3 Specifications

Network Interface

Interface	RJ45 with Auto MDI/MDIX
Number of ports	1 Port
Transmission method	IEEE 802.3, IEEE 802.3u
Transmission cable	Category 5e shielding 100M
Transmission speed	10/100 Mbps Auto-Detect
Network protocol	ICMP, IP, TCP, UDP, DHCP, BOOTP, SMTP, EtherNet/IP, Modbus TCP

Electrical Specification

Weight	25 g
Insulation voltage	500 V_{DC}
Power consumption	0.8 W
Power supply voltage	5 V_{DC}

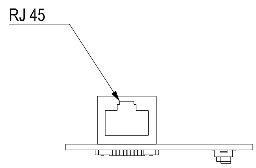
Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation/storage	Operation: -10°C–50°C (temperature), 90% (humidity) Storage: -25°C–70°C (temperature), 95% (humidity)
Vibration/shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

8-9-4 Installation

Connecting CMC-EIP01 to Network

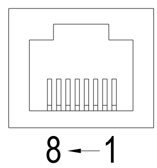
1. Turn off the power of AC motor drive.
2. Open the cover of AC motor drive.
3. Connect CAT-5e network cable to RJ45 port on CMC-EIP01 (See Figure 2).



[Figure 2]

RJ45 PIN Definition

PIN	Signal	Definition	PIN	Signal	Definition
1	Tx+	Positive pole for data transmission	5	--	N/C
2	Tx-	Negative pole for data transmission	6	Rx-	Negative pole for data receiving
3	Rx+	Positive pole for data receiving	7	--	N/C
4	--	N/C	8	--	N/C



8-9-5 Communication Parameters for CFP2000 Connected to Ethernet

When the CFP2000 is connected to an Ethernet network, set up the communication parameters for it according to the table below. The Ethernet master is only able to read/write the frequency word and control word of CFP2000 after the communication parameters are set.

Parameter	Function	Set value (Dec)	Explanation
Pr.00-20	Source of frequency command setting	8	The frequency command is controlled by communication card.
Pr.00-21	Source of operation command setting	5	The operation command is controlled by communication card.
Pr.09-30	Decoding method for communication	0	The decoding method for Delta AC motor drive
Pr.09-75	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
Pr.09-76	IP address -1	192	IP address 192.168.1.5
Pr.09-77	IP address -2	168	IP address 192.168.1.5
Pr.09-78	IP address -3	1	IP address 192.168.1.5
Pr.09-79	IP address -4	5	IP address 192.168.1.5

Parameter	Function	Set value (Dec)	Explanation
Pr.09-80	Netmask -1	255	Netmask 255.255.255.0
Pr.09-81	Netmask -2	255	Netmask 255.255.255.0
Pr.09-82	Netmask -3	255	Netmask 255.255.255.0
Pr.09-83	Netmask -4	0	Netmask 255.255.255.0
Pr.09-84	Default gateway -1	192	Default gateway 192.168.1.1
Pr.09-85	Default gateway -2	168	Default gateway 192.168.1.1
Pr.09-86	Default gateway -3	1	Default gateway 192.168.1.1
Pr.09-87	Default gateway -4	1	Default gateway 192.168.1.1

8-9-6 LED Indicator & Troubleshooting

There are 2 LED indicators on CMC-EIP01: POWER LED and LINK LED. The POWER LED displays the status of power supply, and the LINK LED displays the connection status of the communication.

LED Indicators

LED	Status		Indication	How to correct it?
POWER	Green	ON	Power supply in normal status	--
		OFF	No power supply	Check the power supply.
LINK	Green	ON	Network connection in normal status	--
		Flashes	Network in operation	--
		OFF	Network not connected	Check if the network cable is connected.

Troubleshooting

Abnormality	Cause	How to correct it?
POWER LED OFF	AC motor drive not powered	Check if AC motor drive is powered, and if the power supply is normal.
	CMC-EIP01 not connected to AC motor drive	Make sure CMC-EIP01 is connected to AC motor drive.
LINK LED OFF	CMC-EIP01 not connected to network	Make sure the network cable is correctly connected to network.
	Poor contact to RJ45 connector	Make sure RJ45 connector is connected to Ethernet port.
No communication card found	CMC-EIP01 not connected to network	Make sure CMC-EIP01 is connected to network.
	PC and CMC-EIP01 in different networks and blocked by network firewall.	Search by IP or set up relevant settings by AC motor drive keypad.
Fail to open CMC-EIP01 setup page	CMC-EIP01 not connected to network	Make sure CMC-EIP01 is connected to the network.
	Incorrect communication setting in DCISoft	Make sure the communication setting in DCISoft is set to Ethernet.
	PC and CMC-EIP01 in different networks and blocked by network firewall.	Conduct the setup by AC motor drive keypad.

Abnormality	Cause	How to correct it?
Able to open CMC-EIP01 setup page but fail to utilize webpage monitoring	Incorrect network setting in CMC-EIP01	Check if the network setting for CMC-EIP01 is correct. For the Intranet setting in your company, please consult your IT staff. For the Internet setting in your home, please refer to the network setting instruction provided by your ISP.
Fail to send e-mail	Incorrect network setting in CMC-EIP01	Check if the network setting for CMC-EIP01 is correct.
	Incorrect mail server setting	Please confirm the IP address for SMTP-Server.

8-10 CMC-PN01 – Communication card, PROFINET

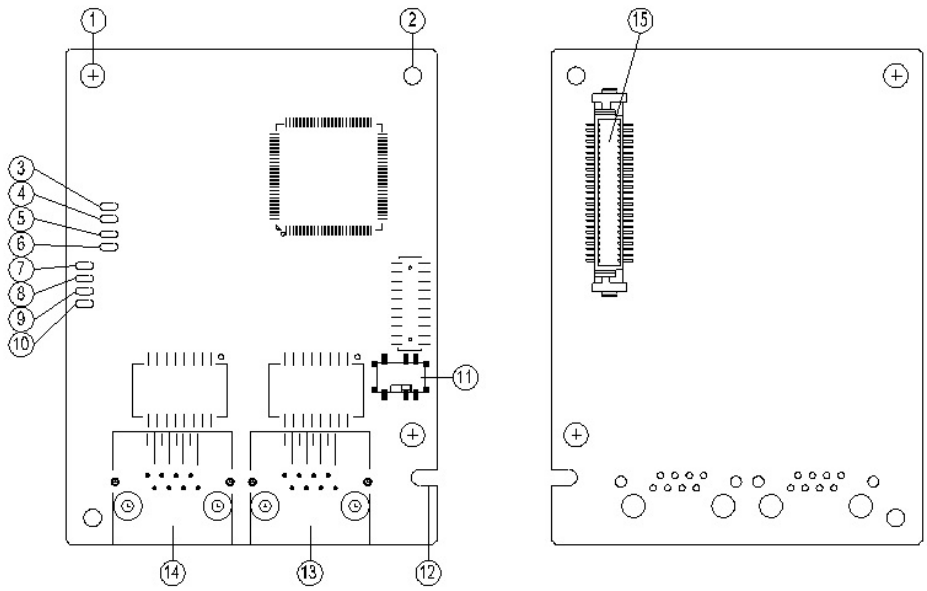
8-10-1 Features

CMC-PN01 connects CFP2000 to PROFINET, so the drive is able to exchange data with the upper unit. It is a simple NET solution, which can reduce the cost and time of connection/ installing factory automation, also provide compatibility of similar components from multiple suppliers.

Connect CMC-PN01 to CFP2000 via PROFINET device:

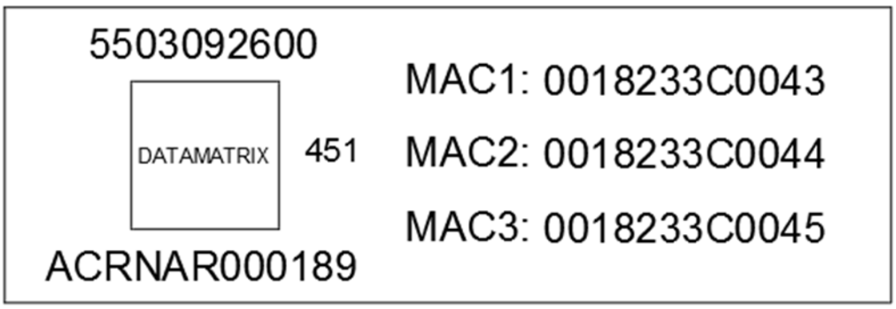
1. Control the AC motor drive via PROFINET
2. Change the drive parameters via PROFINET
3. Monitor the drive status via PROFINET

8-10-2 Product Profile



1. Screw fixing hole
2. Positioning hole
3. Ready out indicator
4. MT out indicator
5. SD indicator
6. BF out indicator
7. ACT PHY2 indicator
8. Link PHY2 indicator
9. ACT PHY1 indicator
10. Link PHY1 indicator
11. Switch
12. Fool-proof groove
13. RJ45 connection port (Port 2)
14. RJ45 connection port (Port 1)
15. Connection port of control board

MAC Address label definition



Def.	Explanation
MAC1	Port 1 MAC Address
MAC2	Port 2 MAC Address
MAC3	Interface MAC Address

8-10-3 Specifications

Network Interface

Interface	RJ45
Number of ports	2 ports
Transmission method	IEEE 802.3
Transmission cable	Category 5e shielding 100 M
Transmission speed	10/100 Mbps auto-negotiate
Network protocol	PROFINET

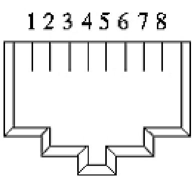
Electrical Specification

Power supply voltage	5 V_{DC}
Power consumption	0.8 W
Insulation voltage	500 V_{DC}
Weight (g)	27

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation	-10°C–50°C (temperature), 90% (humidity)
Storage	-25°C–70°C (temperature), 95% (humidity)
Vibration / Shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

8-10-4 RJ45 PIN Definition

RJ45	PIN No.	Signal	Definition
	1	Tx+	Positive pole for data transmission
	2	Tx-	Negative pole for data transmission
	3	Rx+	Positive pole for data receiving
	4	--	N/C
	5	--	N/C
	6	Rx-	Negative pole for data receiving
	7	--	N/C
	8	--	N/C

8-10-5 Communication Parameters for CFP2000 Conneted to PROFINET

When operating CFP2000 via CMC-PN01, please set the control and operation command as controlled by communication card. When CFP2000 is connected to PROFINET network, please set up the communication parameters according to the table below.

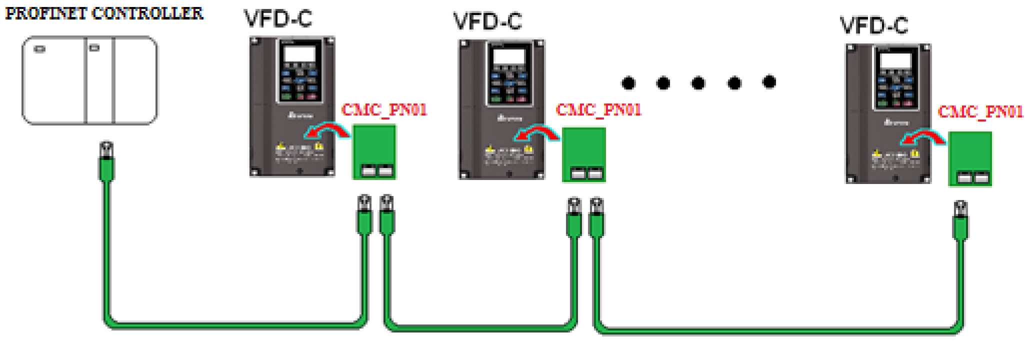
Parameter	Set value (Dec)	Explanation
Pr.00-20	8	The frequency command is controlled by communication card.
Pr.00-21	5	The operation command is controlled by communication card.
Pr.09-30	1	Set Pr.09-30 to 60xx or 20xx as the decoding method.
Pr.09-60	12	Identification: when CMC-PN01 is connected, Pr.09-60 will show value 12.

8-10-6 LED Indicator

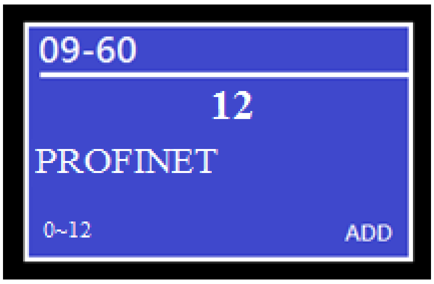
LED	Status		Indication
Ready out	Yellow	ON	PN Stack operates in normal status
		Flashes	PN Stack operates in normal status, and waiting to sync with MCU
		OFF	PN Stack operates with error
MT out	Green	-	-
SD	Red	-	-
BF out	Red	ON	Connection with PROFINET Controller breaks off
		Flashes	Connection is normal, but an error occurs to the communication with PROFINET Controller
		OFF	Connection with PROFINET Controller is normal
ACT PHY1	Orange	ON	Online, exchanging data with the master
		Flashes	Off line, but handshaking data with the master
		OFF	Initial status
LINK PHY1	Green	ON	Network connection is normal
		OFF	Network is not connected
ACT PHY2	Orange	ON	On line, exchanging data with the master
		Flashes	Off line, but handshaking data with the master
		OFF	Initial status
LINK PHY2	Green	ON	Network connection is normal
		OFF	Network is not connected

8-10-7 Network Connection

Wiring of CMC-PN01 is as following:

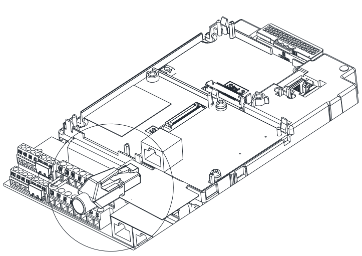


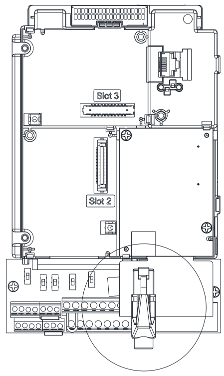
When the hardware is installed and power on, the current set value of Pr.09-60 will be 12, and shows “PROFINET” on the display.If the above information does not show on the display, please check the version of CFP2000 and the connection of the card.



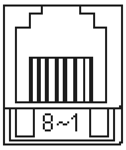
8-11 EMC-COP01 – Communication card, CANopen

8-11-1 Terminal Resistor Position





8-11-2 RJ45 Pin definition



RS-485 socket

Pin	Pin name	Definition
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground/0V/V-
7	CAN_GND	Ground/0V/V-

8-11-3 Specifications

Interface	RJ45
Number of ports	1 Port
Transmission method	CAN
Transmission cable	CAN standard cable
Transmission speed	1 Mbps, 500 Kbps, 250 Kbps, 125 Kbps, 100 Kbps, 50 Kbps
Communication protocol	CANopen

8-12 Delta Standard Fieldbus Cables

Delta Cables	Part Number	Description	Length
CANopen Cable	UC-CMC003-01A	CANopen Cable, RJ45 Connector	0.3 m
	UC-CMC005-01A	CANopen Cable, RJ45 Connector	0.5 m
	UC-CMC010-01A	CANopen Cable, RJ45 Connector	1 m
	UC-CMC015-01A	CANopen Cable, RJ45 Connector	1.5 m
	UC-CMC020-01A	CANopen Cable, RJ45 Connector	2 m
	UC-CMC030-01A	CANopen Cable, RJ45 Connector	3 m
	UC-CMC050-01A	CANopen Cable, RJ45 Connector	5 m
	UC-CMC100-01A	CANopen Cable, RJ45 Connector	10 m
	UC-CMC200-01A	CANopen Cable, RJ45 Connector	20 m
DeviceNet Cable	UC-DN01Z-01A	DeviceNet Cable	305 m
	UC-DN01Z-02A	DeviceNet Cable	305 m
Ethernet / EtherCAT Cable	UC-EMC003-02A	Ethernet/EtherCAT cable, Shielding	0.3 m
	UC-EMC005-02A	Ethernet/EtherCAT cable, Shielding	0.5 m
	UC-EMC010-02A	Ethernet/EtherCAT cable, Shielding	1 m
	UC-EMC020-02A	Ethernet/EtherCAT cable, Shielding	2 m
	UC-EMC050-02A	Ethernet/EtherCAT cable, Shielding	5 m
	UC-EMC100-02A	Ethernet/EtherCAT cable, Shielding	10 m
	UC-EMC200-02A	Ethernet/EtherCAT cable, Shielding	20 m
CANopen / DeviceNet TAP	TAP-CN01	1 in 2 out, built-in 121Ω terminal resistor	1 in 2 out
	TAP-CN02	1 in 4 out, built-in 121Ω terminal resistor	1 in 4 out
	TAP-CN03	1 in 4 out, RJ45 connector, built-in 121Ω terminal resistor	1 in 4 out
PROFIBUS Cable	UC-PF01Z-01A	PROFIBUS DP Cable	305 m

Chapter 9 Specification

9-1 460V Models

		Frame Size	A							B			
		Model VFD_ _ _ FP4EA- _ _ _	007	015	022	037	040	055	075	110	150	185	220
Output Rating	Light duty	Rated output capacity [kVA]	2.4	3.3	4.4	6.8	8.4	10.4	14.3	19	25	30	36
		Rated output current [A]	3.0	4.2	5.5	8.5	10.5	13	18	24	32	38	45
		Applicable motor output [kW]	0.75	1.5	2.2	3.7	4	5.5	7.5	11	15	18.5	22
		Applicable motor output [HP]	1	2	3	5	5	7.5	10	15	20	25	30
		Overload tolerance	120% of rated current can endure for 1 minute during every 5 minutes										
		Max. output frequency [Hz]	599 Hz										
		Carrier frequency [kHz]	2–15 (6 kHz)										2–10 (6kHz)
	Normal duty	Rated output capacity [kVA]	1.4	2.4	3.2	4.8	7.2	8.4	9.6	14.3	19	25	30
		Rated output current [A]	1.7	3.0	4.0	6.0	9.0	10.5	12	18	24	32	38
		Applicable motor output [kW]	0.4	0.75	1.5	2.2	3.7	4	5.5	7.5	11	15	18.5
		Applicable motor output [HP]	0.5	1	2	3	5	5	7.5	10	15	20	25
		Overload tolerance	120% of rated current can endure for 1 minute during every 5 minutes 160% of rated current can endure for 3 seconds during every 30 seconds.										
		Max. output frequency [Hz]	599 Hz										
		Carrier frequency [kHz]	2–15 (6 kHz)										2–10 (6kHz)
Input Rating		Input current [A] Light duty	3.0	4.2	5.5	8.5	10.5	13	18	24	32	38	45
		Input current [A] Normal duty	1.7	3	4	6	9.0	10.5	12	18	24	32	38
		Rated voltage / Frequency	3-phase 380–480 V_{AC} [-15%–10%], 50/60 Hz										
		Operating voltage range	323–528 V_{AC}										
		Frequency tolerance	47–63 Hz										
		Efficiency [%]	97										
		Power factor	>0.98										
		Weight [kg]	6.8							14.5			
		Cooling method	Natural cooling	Fan cooling									
		Braking chopper	Frame A to C: built-in										
		DC choke	Built-in DC reactor EN61000-3-12										
		EMC Filter	Built-in EMC Filter EN61800-3 C1 & C2										

NOTE

- The carrier frequency is default. Increasing the carrier frequency requires a reduction in current. Please refer to Section 9-4 Derating Curve for Ambient Temperature.
- Select the AC motor drive with capacity one grade oarger for the impact load application.

460V Models

Frame Size			C		D0		D	
Model VFD_ _ _ FP4EA- _ _ _			300	370	450	550	750	900
Output Rating	Light duty	Rated output capacity [kVA]	48	58	73	88	120	143
		Rated output current [A]	60	73	91	110	150	180
		Applicable motor output [kW]	30	37	45	55	75	90
		Applicable motor output [HP]	40	50	60	75	100	125
		Overload tolerance	120% of rated current can endure for 1 minute during every 5 minutes					
		Max. output frequency [Hz]	599 Hz					
		Carrier frequency [kHz]	2–10 (6 kHz)					2–9 (4 kHz)
	Normal duty	Rated output capacity [kVA]	36	48	58	73	88	120
		Rated output current [A]	45	60	73	91	110	150
		Applicable motor output [kW]	22	30	37	45	55	75
		Applicable motor output [HP]	30	40	50	60	75	100
		Overload tolerance	120% of rated current can endure for 1 minute during every 5 minutes 160% of rated current can endure for 3 seconds during every 30 seconds.					
		Max. output frequency [Hz]	599 Hz					
		Carrier frequency [kHz]	2–10 (6 kHz)					2–9 (4 kHz)
Input Rating	Input current [A] Light duty		60	73	91	110	150	180
	Input current [A] Normal duty		45	60	73	91	110	150
	Rated voltage / Frequency		3-phase 380–480 V_{AC} (-15%–10%), 50/60 Hz					
	Operating voltage range		323–528 V_{AC}					
	Frequency tolerance		47–63 Hz					
Efficiency [%]			97					
Power factor			>0.98					
Weight [kg]			26.5		42		59.5	
Cooling method			Fan cooling					
Braking chopper			Frame A to C (built-in)					
DC choke			Built-in DC reactor EN61000-3-12					
EMC Filter			Built-in EMC Filter EN61800-3 C1 & C2					

NOTE

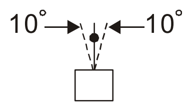
- The carrier frequency is default. Increasing the carrier frequency requires a reduction in current. Please refer to Section 9-4 Derating Curve for Ambient Temperature.
- Select the AC motor drive with capacity one grade oarger for the impact load application.

General Specifications

Control Characteristics	Control Method	Pulse-Width Modulation (PWM)
	Control Mode	1: V/F, 2: SVC, 3: PMSVC
	Starting Torque	Reach up to 150% above at 0.5 Hz.
	V/F Curve	4 point adjustable V/F curve and square curve
	Speed Response Ability	5 Hz (vector control can reach up to 40 Hz)
	Torque Limit	Light duty: max. 130% torque current Normal duty: max. 160% torque current
	Torque Accuracy	±5%
	Max. Output Frequency (Hz)	599.00 Hz
	Frequency Output Accuracy	Digital command: ±0.01%, -10°C– +40°C; Analog command: ±0.1%, 25±10°C
	Output Frequency Resolution	Digital command: 0.01 Hz Analog command: 0.03 X max. output frequency / 60 Hz (±11 bit)
	Overload Tolerance	Light duty: 120% of rated current can endure for 1 minute Normal duty: 120% of rated current can endure for1 minute; 160% of rated current can endure for 3 sec.
	Frequency Setting Signal	0– +10V, 4–20 mA, 0–20 mA
	Accel./decel. Time	0.00–600.00 / 0.0–6000.0 seconds
	Main control function	Momentary power loss ride thru, Speed search, Over-torque detection, Torque limit, 16-step speed (max), Accel/Decel time switch, S-curve accel./decel., 3-wire sequence, Auto-Tuning, Dwell, Slip compensation, Torque compensation, JOG frequency, Frequency upper/lower limit settings, DC injection braking at start/stop, High slip braking, PID control (with sleep function),Energy saving control, Modbus communication (RS-485 RJ45, max. 5.2 Kbps)
	Fan Control	Models above VFD300FP4E (incloudingVFD300FP4E) are PWM control Models below VFD220FP4E (including VFD220FP4E) are ON/OFF switch control
Protection Characteristics	Motor Protection	Electronic thermal relay protection
	Over-current Protection	Over-current protection: 185% rated current for light duty; 240% rated current for normal duty Current clamp: 『Light duty: 130–135%』;『Normal duty: 170–175%』
	Over-voltage Protection	Drive will stop when DC bus voltage exceeds 820V
	Over-temperature Protection	Built-in temperature sensor
	Stall Prevention	Stall prevention during acceleration, deceleration and running independently
	Restart After Instantaneous Power Failure	Parameter setting up to 20 seconds
	Grounding Leakage Current Protection	Leakage current is higher than 50% of rated current of the AC motor drive
	Short-circuit Current Rating (SCCR)	Per UL508C, the drive is suitable for use on a circuit capable of delivering not more than 100 kA symmetrical amperes (rms) when protected by fuses given in the fuse table.
Certifications		UL, CE, GB/T12668-2, RCM, EAC

9-2 Environment for Operation, Storage and Transportation

Do NOT expose the AC motor drive in the bad environment, such as dust, direct sunlight, corrosive/inflammable gasses, humidity, liquid and vibration environment. The salt in the air must be less than 0.01mg/cm^2 every year.

Environment	Installation location	IEC60364-1/IEC60664-1 Pollution degree 2, Indoor use only	
	Surrounding Temperature (°C)	Operation	- 15– + 50 without derating, +51–60 with derating
		Storage	-25– +70
		Transportation	-25– +70
		Non-condensation, non-frozen	
	Rated Humidity	Operation	Max. 95%
		Storage/ Transportation	Max. 95%
		No condense water	
	Air Pressure (kPa)	Operation/ Storage	86–106
		Transportation	70–106
	Pollution Level	IEC 60721-3-3	
		Operation	Class 3C3, Class 3S2
		Storage	Class 1C2, Class 1S2
		Transportation	Class 2C2, Class 2S2
	Altitude	Operation	If the AC motor drive is installed at an altitude 0–1000 m, follow normal operation restriction. For every 100 m increase in altitude, the AC motor drive needs to either lower rated current by 1% or by 0.5 ºC of temperature for operation. If the drive is installed at an altitude above 2000 m, please refer to the voltage derating graph in the user manual for more instructions. Note: Voltage derating is not needed for a Center Ground System, and maximum installation altitude is 4000m.
	Vibration Operating	IEC 60068-2-6	
		Frame A: 2 Hz ≦ f ≦ 13.2 Hz / Amplitude 1 mm; 13.2 Hz < f ≦ 55 Hz / Gravity 0.7 G to 2.0 G; 55 Hz < f ≦ 512 Hz / Gravity 2.0 G Frame B: 2 Hz ≦ f ≦ 13.2 Hz / Amplitude 1 mm; 13.2 Hz < f ≦ 55 Hz / Gravity 0.7 G to 1.5 G; 55 Hz < f ≦ 512 Hz / Gravity 1.5 G Frame C / D0 / D: 2 Hz ≦ f ≦ 13.2 Hz / Amplitude 1 mm; 13.2 Hz < f ≦ 55 Hz / Gravity 0.7 G to 1.0 G; 55 Hz < f ≦ 512 Hz / Gravity 1.0 G	
	Shock Operating	IEC 60068-2-27	
		Frame A; B; C; D0: Max 30 G; 11 ms Frame D: Max 15 G; 11 ms	
In protective shipping package	Vibration	IEC 60068-2-64	
		10Hz ≦ f ≦ 100Hz / ASD: 1.0m2/s3 100Hz ≦ f ≦ 200Hz / Slope: -3dB/octave	
	Shock	Cardboard box type: Free fall drop in accordance with ISTA 1A Wooden box type: In accordance with ISTA 1E (4 side incline) and ISTA 2B (Bottom side drop)	
Operation Position	Maximum permanent angle in relation to the normal vertical mounting position		

9-3 Specifications for Operation Temperature and Protection Level

Model	Frame	Protection Level	Operation Temperature
VFDxxxFPxxx-52	A–D: 0.75–90 kW	IP55/NEMA12	-10°C–50°C
VFDxxxFPxxx-41	A–D: 0.75–90 kW	IP41/NEMA1	-10°C–50°C

9-4 Derating Curve for Ambient Temperature, Altitude and Carrier Frequency

Ambient Temperature Derating Curve

460V

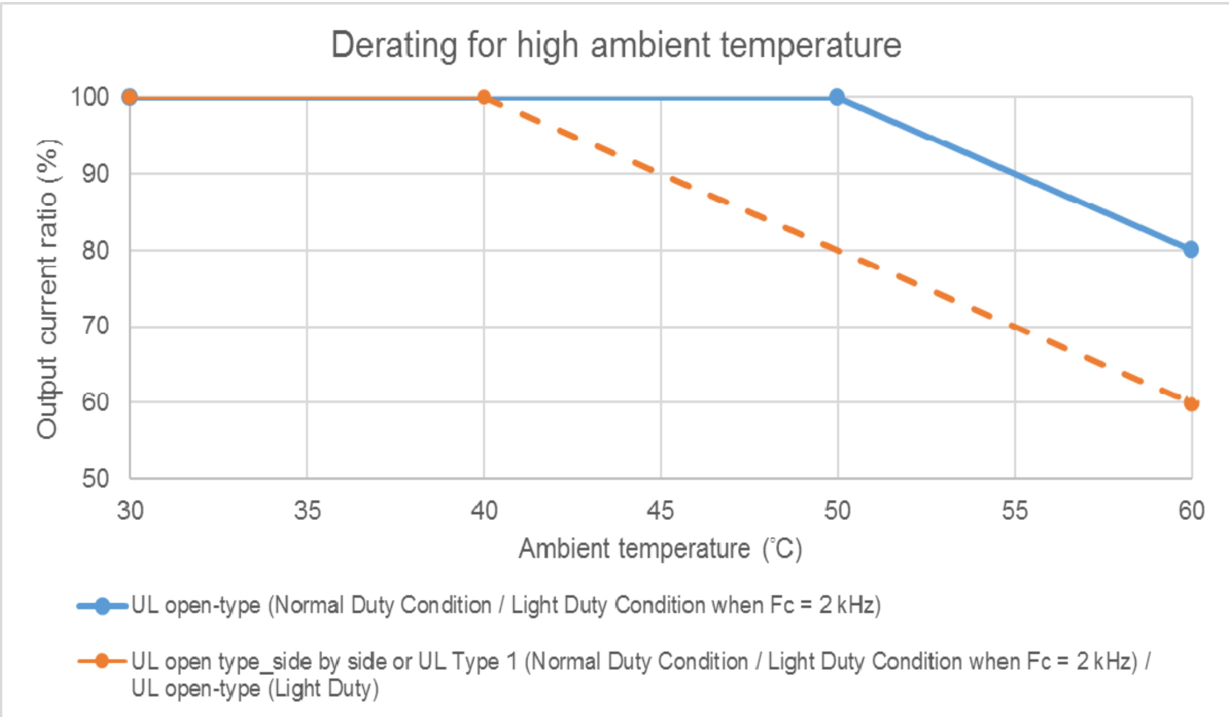


Figure 9-1

Altitude Derating Curve

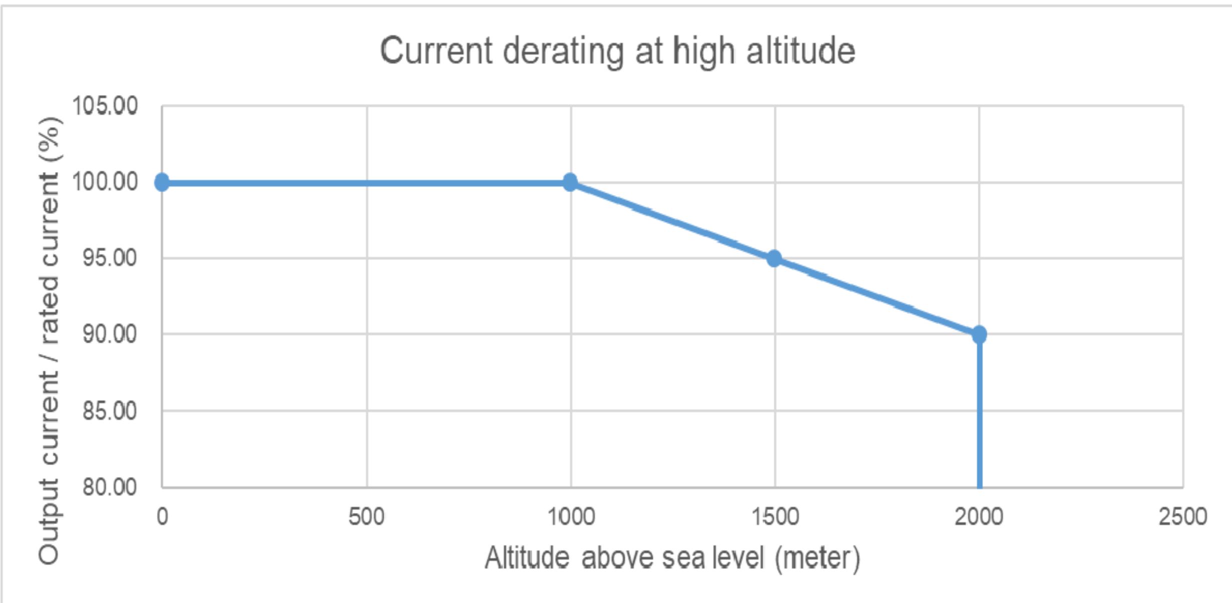


Figure 9-2

Carrier Frequency Derating Curve

- 460V Normal Control

  Pr.00-11 = 0 (IMVF)

  = 2 (IM SVC, Pr.05-33 = 0)

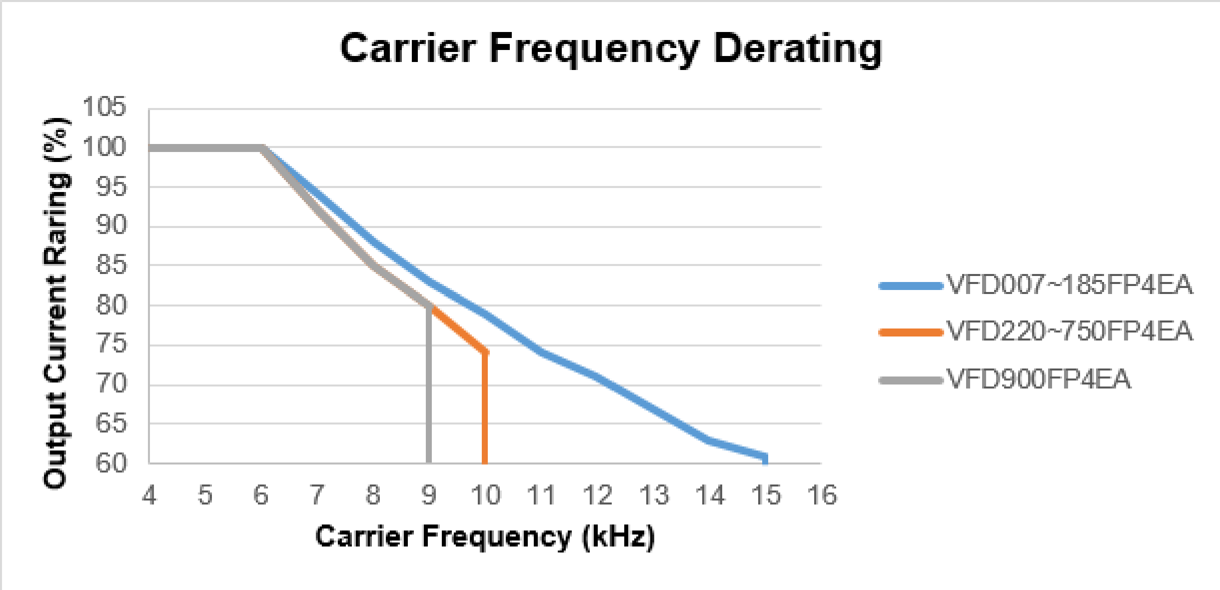


Figure 9-3

- 460V Advanced Control

  Pr.00-11 = 2 (PM SVC, Pr.05-33 = 1, 2)

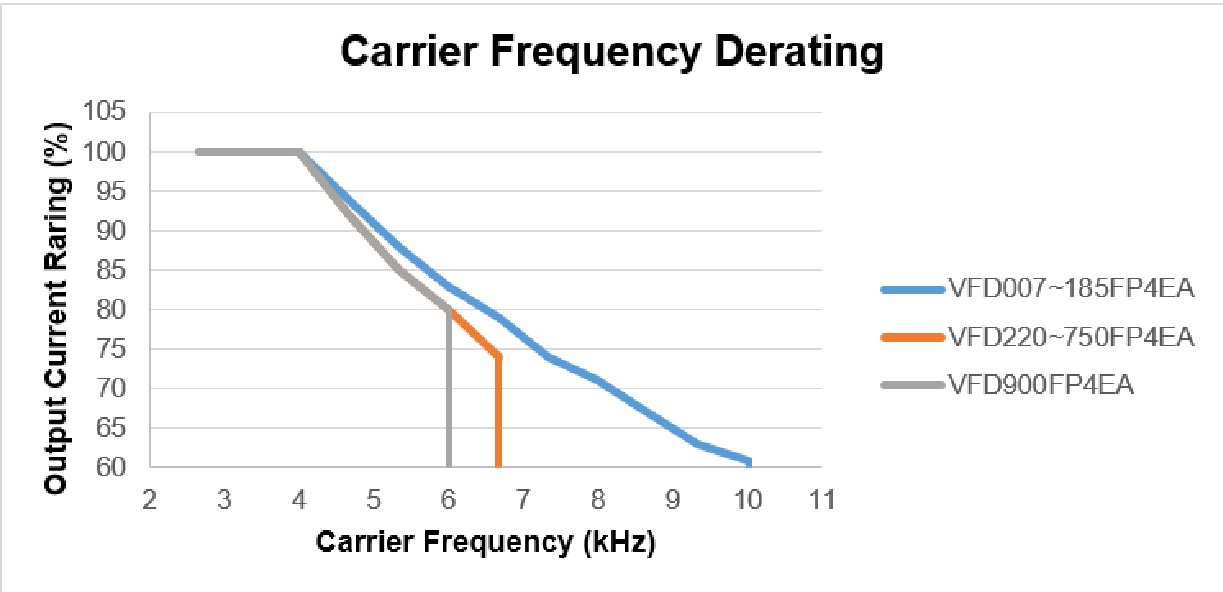


Figure 9-4

9-5 Efficiency Curve

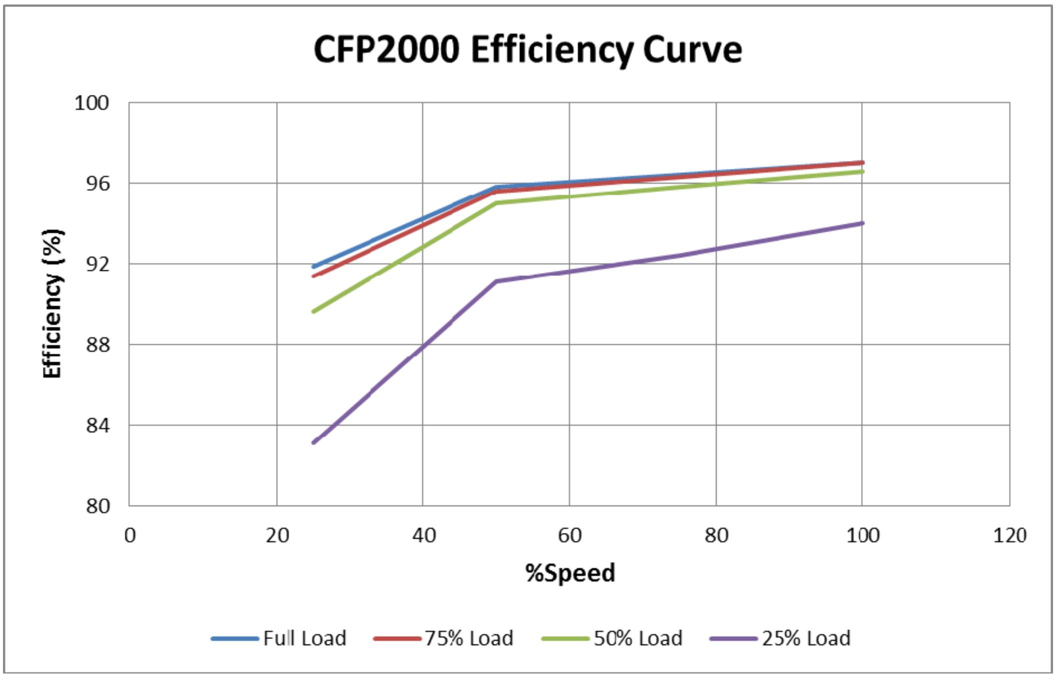


Figure 9-5

Chapter 10 Digital Keypad

10-1 Descriptions of Digital Keypad

KPC-CC01

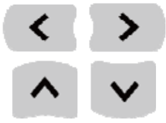
Communication Interface
RJ45 (socket), RS-485 interface

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 CFP2000.

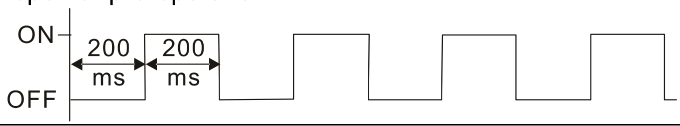
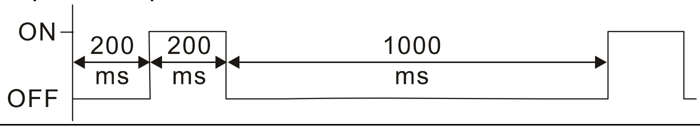
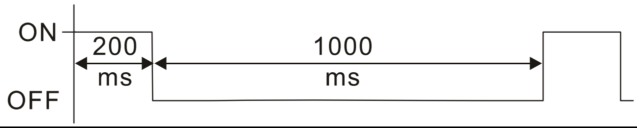
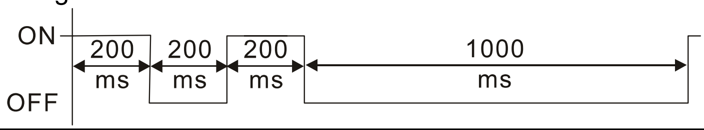
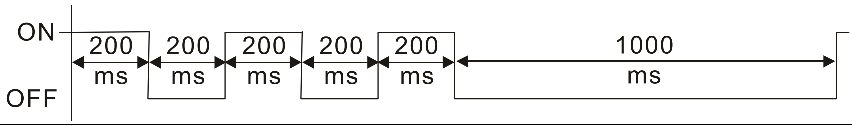
Descriptions of Keypad Functions

Key	Descriptions
RUN	Start Operation Key 1. It is only valid when the source of operation command is from the keypad. 2. It can operate the AC motor drive by the function setting and the RUN LED will be ON. 3. It can be pressed again and again at stop process.
STOP RESET	Stop Command Key. This key has the highest priority in any situation. 1. When it receives STOP command, no matter if the AC motor drive is in operation or stop status, the AC motor drive needs to execute "STOP" command. 2. The RESET key can be used to reset the drive after the fault occurs. 3. The reasons why the error cannot be reset: a. Because the condition which triggers the fault is not cleared. When the condition is cleared, the fault can be reset. b. Because it's the fault status checking when power-on. When the condition is cleared, re-power again, and the fault can be reset.
FWD REV	Operation Direction Key 1. This key only controls the operation direction, and will NOT activate the drive. FWD: forward, REV: reverse. 2. Refer to the LED descriptions for more details.
ENTER	ENTER Key Press ENTER and go to the next level. If it is the last level then press ENTER to execute the command.
ESC	ESC Key ESC key function is to leave current menu and return to the last menu. It also functions as a return key or cancel key in the sub-menu.
MENU	Press menu to return to main menu. Menu content: 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. Startup Menu 14. Main Page 15. PC Link 16. Start Wizard

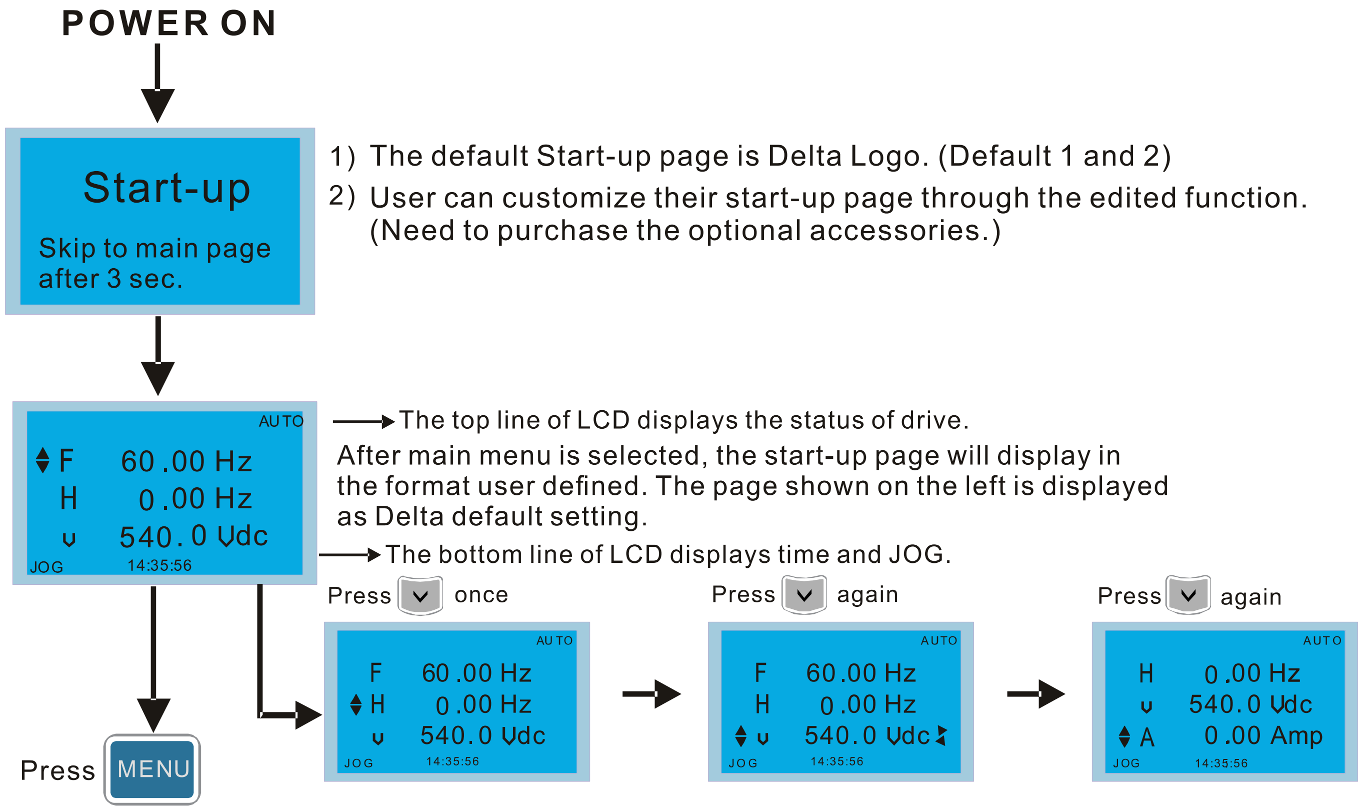
Key	Descriptions
	Direction: Left / Right / Up / Down 1. In the numeric value setting mode, it is used to move the cursor and change the numeric value. 2. In the menu/text selection mode, it is used for item selection.
	Function Key 1. The functions keys have factory settings and can be defined by users. The factory settings of F1 and F4 work with the function list below. For example, F1 is JOG function, F4 is a speed setting key for adding/deleting user defined parameters. 2. Other functions must be defined by TPEditor first. (Download TPEditor software at Delta website, select TPEditor version 1.60 or above. Refer to instruction for TPEditor in Chapter 10-3.)
	HAND Key 1. This key is executed by the parameter settings of the source of Hand frequency and hand operation. The factory settings of both source of Hand frequency and hand operation are the digital keypad. 2. Press HAND key at stop status, the setting will switch to hand frequency source and hand operation source. Press HAND key at operation status, it stops the AC motor drive first (display AHSP warning), and switch to hand frequency source and hand operation source. 3. When the operation mode switches successfully, the KPC-CC01 displays HAND mode on the screen.
	AUTO Key 1. This key is executed by the parameter settings of the source of AUTO frequency and AUTO operation. The factory setting is the external terminal (source of operation is 4–20 mA). 2. Press Auto key at stop status, the setting will switch to hand frequency source and hand operation source. Press Auto key at operation status, it stops the AC motor drive first (display AHSP warning), and switch to auto frequency source and auto operation source. 3. When the operation mode switches successfully, the KPC-CC01 displays AUTO on the screen.

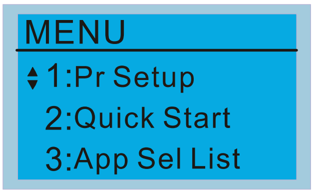
Descriptions of LED Functions

LED	Descriptions
	Steady ON: stop indicator of the AC motor drive. Blinking: drive is in the standby status. Steady OFF: drive doesn't execute "STOP" command.
	Operation Direction LED 1. Green light is on, the drive is running forward. 2. Red light is on, the drive is running backward. 3. Twinkling light: the drive is changing direction. Operation Direction LED under Torque Mode 1. Green light is ON: when the torque command $\geq$ 0, and the motor is running forward. 2. Red light is ON: when the torque command < 0, and the motor is running backward. 3. Twinkling light: when the torque command < 0, and the motor is running forward.

LED	Descriptions	
	RUN LED:	
	LED status	**Condition / State**
CANopen– “RUN”	OFF	CANopen at initial No LED
	Blinking	CANopen at pre-operation 
	Single flash	CANopen at stop 
	ON	CANopen at operation status 
	ERR LED:	
	LED status	**Condition / State**
CANopen– “ERR”	OFF	No Error
	Single flash	One message fail 
	Double flash	Guarding fail or heartbeat fail 
	Triple flash	SYNC fail 
	ON	Bus off 

10-2 Function of Digital Keypad KPC-CC01





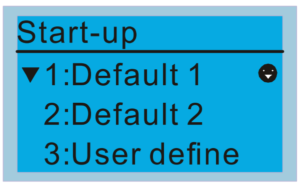
MENU

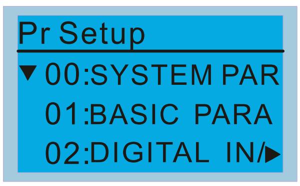
1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Startup Menu
14: Main Page
15: PC Link
16: Start Wizard

NOTE

1. Startup page can only display pictures, no flash.
2. When Power ON, the startup page displays on the screen first, then enters the main page. The main page displays Delta's default setting F/H/A/U, the display order can be set by Pr.00-03 (Startup display). When the selected item is U page, use left key and right key to switch between the items, the display order of U page is set by Pr.00-04 (User display).

Display Icon





● : present setting

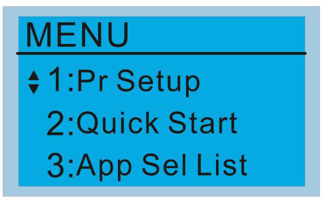
▼ : roll down the page for more options

Press for more options

▶ : show complete sentence

Press for complete information

Display item



MENU

1: Parameter Setup
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10: PLC Function
11: Copy PLC
12: Display Setup
13: Startup Menu
14: Main Page
15: PC Link
16: Start Wizard

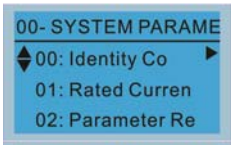
1. Parameter Setup

Press ENTER to select.

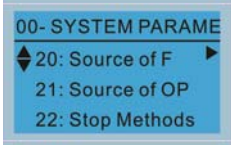
Press to select a parameter group.

Once a parameter group is selected, press ENTER to go into that group.

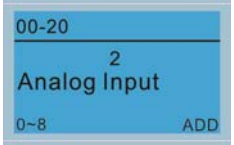
Example: Setup source of master frequency command.



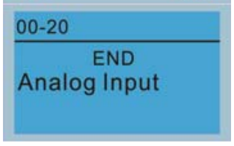
Once in the Group 00 Motor Drive Parameter, Use Up/Down key to select parameter 20: Auto Frequency Command.



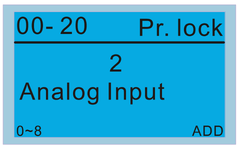
When this parameter is selected, press ENTER key to go to this parameter's setting menu.



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

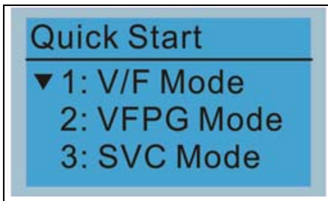


After pressing the ENTER key, an END will be displayed which means the parameter setting is done.



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

2. Quick Start

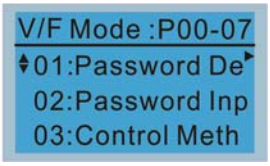


Press ENTER to select.

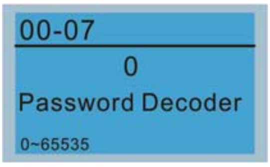
Quick Start:
1. V/F Mode
2. SVC Mode
3. My Mode

Description:

1. VF Mode



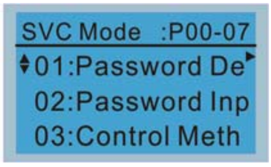
01:Password Decoder



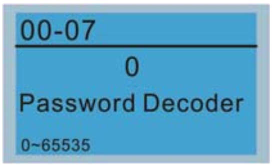
Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Speed control mode (Pr.00-11)
4. Load selection (Pr.00-16)
5. Carrier frequency (Pr.00-17)
6. Master frequency command (AUTO) source / Source selection of the PID target (Pr.00-20)
7. Operation command (AUTO) source (Pr.00-21)
8. Stop method (Pr.00-22)
9. Digital keypad STOP function (Pr.00-32)
10. Max. operation frequency (Pr.01-00)
11. Output frequency of motor 1 (Pr.01-01)
12. Output voltage of motor 1 (Pr.01-02)
13. Mid-point frequency 1 of motor 1 (Pr.01-03)
14. Mid-point voltage 1 of motor 1 (Pr.01-04)
15. Mid-point frequency 2 of motor 1 (Pr.01-05)
16. Mid-point voltage 2 of motor 1 (Pr.01-06)
17. Min. output frequency of motor 1 (Pr.01-07)
18. Min. output voltage of motor 1 (Pr.01-08)
19. Output frequency upper limit (Pr.01-10)
20. Output frequency lower limit

(Pr.01-11)
21. Acceleration time 1 (Pr.01-12)
22. Deceleration time 1 (Pr.01-13)
23. Over-voltage stall prevention (Pr.06-01)
24. Derating protection (Pr.06-55)
25. Speed tracking during start-up (Pr.07-12)
26. Emergency stop (EF) & force to stop selection (Pr.07-20)
27. Torque command filter time (Pr.07-24)
28. Slip compensation filter time (Pr.07-25)
29. Torque compensation gain (Pr.07-26)
30. Slip Compensation Gain (Pr.07-27)

2. SVC Mode



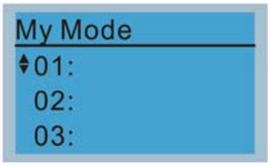
01: Password Decoder



Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Speed control mode (Pr.00-11)
4. Load selection (Pr.00-16)
5. Carrier frequency (Pr.00-17)
6. Master frequency command (AUTO) source / Source selection of the PID target (Pr.00-20)
7. Operation command (AUTO) source (Pr.00-21)
8. Stop method (Pr.00-22)
9. Digital keypad STOP function (Pr.00-32)
10. Max. operation frequency (Pr.01-00)
11. Output frequency of motor 1 (Pr.01-01)
12. Output voltage setting of motor 1 (Pr.01-02)
13. Min. output frequency of motor 1 (Pr.01-07)
14. Min. output voltage of motor 1 (Pr.01-08)
15. Output frequency upper limit (Pr.01-10)
16. Output frequency lower limit (Pr.01-11)
17. Acceleration time 1 (Pr.01-12)
18. Deceleration time 1 (Pr.01-13)
19. Full-load current for induction motor 1 (Pr.05-01)
20. Rated power for induction motor 1 (Pr.05-02)
21. Rated speed for induction motor 1 (Pr.05-03)
22. Number of poles for induction motor 1 (Pr.05-04)
23. No-load current for induction motor 1 (Pr.05-05)
24. Over-voltage stall prevention (Pr.06-01)
25. Over-current stall prevention during acceleration (Pr.06-03)
26. Derating protection (Pr.06-55)
27. Emergency stop (EF) & Force to stop selection (Pr.07-20)
28. Torque command filter time

(Pr.07-24)
29. Slip compensation filter time (Pr.07-25)
30. Slip compensation gain (Pr.07-27)

3. My Mode



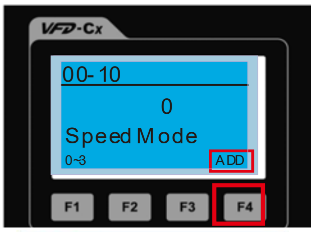
Click F4 in parameter setting page, the parameter is saved to My Mode. To delete or correct the parameter, enter this parameter and click the "DEL" on the bottom right corner.

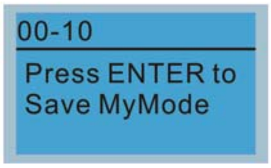
Items

It saves 01–32 sets of parameters (Pr).

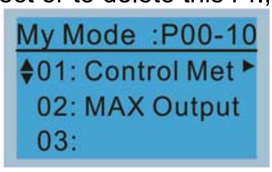
Setup process

1. Go to "Parameter Setup" function.
   Press ENTER to go to the parameter which you need to use. There is an ADD on the bottom right-hand corner of the screen. Press F4 on the keypad to add this parameter to My Mode.

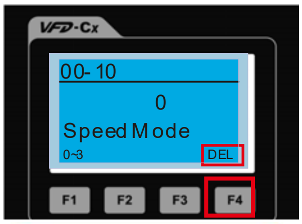


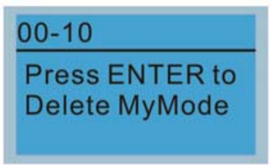


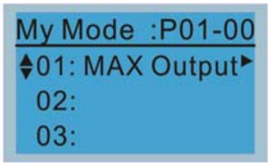
2. The parameter (Pr) will be displayed in My mode if it is properly saved.
   To correct or to delete this Pr., click DEL.



3. To delete a parameter, go to "My Mode" and select a parameter which you need to delete.
   Press ENTER to enter the parameter setting screen. There is a DEL on the bottom left-hand corner of the screen. Press F4 on the keypad to delete this parameter from My Mode.

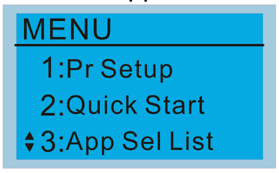


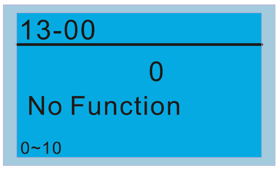


<table>
<tr><td></td><td>4. After pressing ENTER to delete <01 Control Mode>, the <02 Maximum Operating Frequency > automatically replaces <01 Control Mode>.

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

3. Application Selection List

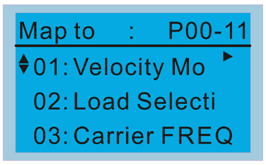
<table>
<tr><td>
</td><td>This function allows user to select application and its parameters sets.

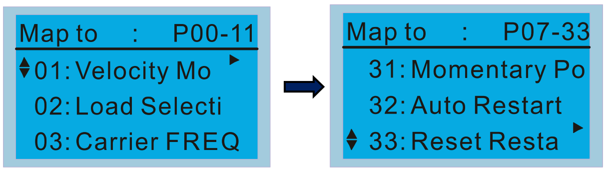
Example:
Select 3: Application Selection List


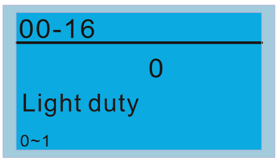
Press ENTER to go into the Application Selection List


Select Application


Press ENTER to enter the application selection screen, the selected application set will be “Fan”.

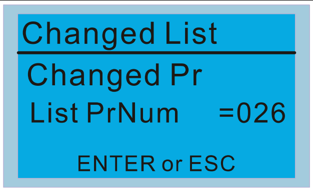

Press ENTER to enter the Fan application set screen.


Press Up/ Down key to select the parameter.


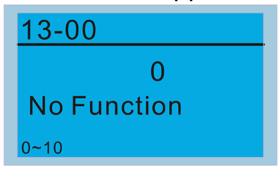


Choose 0: Light load on the needs, then press ENTER.</td></tr>
</table>

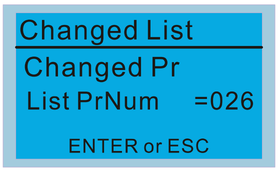
4. Changed List



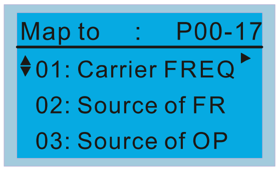
This function displays the parameter that user has set.
Example:
Set Pr.13-00 Application Selection = 3: Fan



Enter the changed list screen. List PrNum=026 means there are 26 parameters that have been changed.

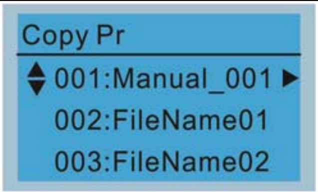


Press ENTER to enter the changed list screen.



Use Up / Down key to select the parameters that need to be checked or changed.
Press ENTER to enter the parameter.

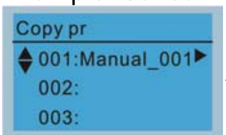
5. Copy Parameter



Press ENTER key to go to

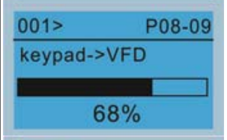
001–004: content storage

Four duplicates are provided
The steps are shown in the example below.
Example: Saved in the motor drive.

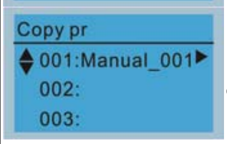


1. Go to “Copy Parameter”
2. Select the parameter group which needs to be copied and press ENTER key.

1. Select 1: Save in the motor drive.
2. Press ENTER key to go to “Save in the motor drive” screen.

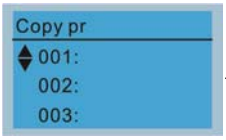


Begin to copy parameters until it is done.



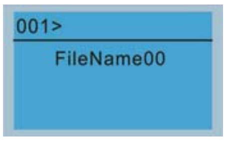
Once copying parameters is done, keypad automatically goes back to this screen.

Example: Saved in the keypad.



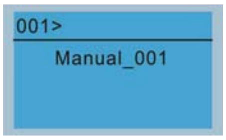
1. Go to “Copy parameter”
2. Select the parameter group which needs to be copied and press ENTER key.

Press ENTER key to go to “Save in the motor drive” screen.

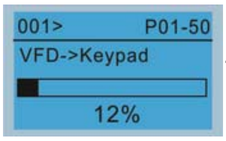


Use Up / Down key to select a symbol.
Use Left / Right key to move the cursor to select a file name.

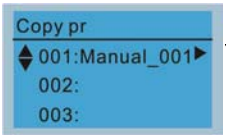
String & Symbol Table:
! ” # $ % & ’ ( ) * + , − . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ^ _ ‘ a b c d f g h i j k l m n o p q r s t u v w x y z { | } ~



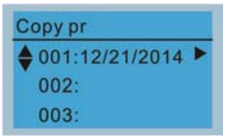
Once the file name is confirmed, press ENTER key.



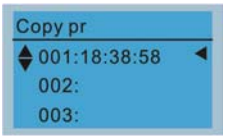
To begin copying parameters until it is done.



When copying parameters is completed, keypad will automatically be back to this screen.



Press Right key to see the date of copying parameters.

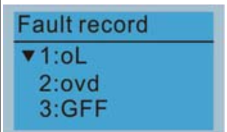


Press Right key to see the time of copying parameters.

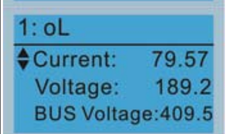
6. Fault Record

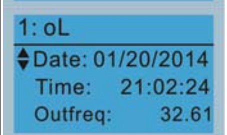
Press  to select.

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

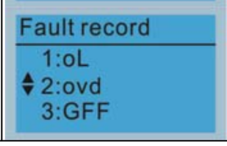


Press Up / Down key to select an error record.
After selecting an error code, press ENTER to see that error record’s detail

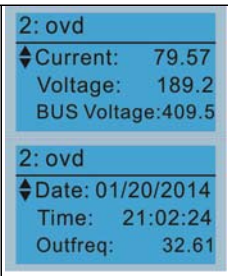




Press Up / Down key to see an error record’s detail such as date, time, frequency, current, voltage, DC bus voltage.



Press Up / Down key to select an error record.
After selecting an error code, press ENTER to see that error record’s detail



Press Up / Down key to see an error record's detail such as date, time, frequency, current, voltage, DC bus voltage.

NOTE

Fault actions of AC motor drive are recorded and saved to KPC-CC01. When KPC-CC01 is removed and applied to another AC motor drive, the previous fault records will not be deleted. The new fault records of the present AC motor drive will accumulate to KPC-CC01.

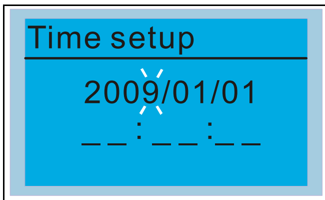
7. Language Setup

Use Up / Down key to select language, than press ENTER.

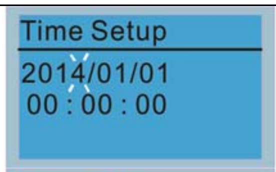
Language setting option is displayed in the language of the user's choice.
Language setting options:

1. English
2. 繁體中文
3. 简体中文
4. Türkçe
5. Русский
6. Español
7. Português
8. français

8. Time Setup

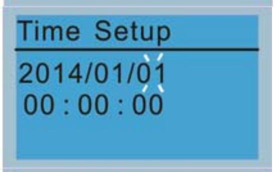


Use Left / Right key to select Year, Month, Day, Hour, Minute or Second to set up



Use Up / Down key to set up Year

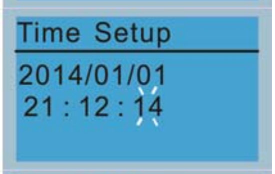
Use Up / Down key to set up Month



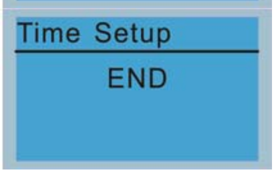
Use Up / Down key to set up Day

Use Up / Down key to set up Hour

Use Up / Down key to set up Minute



Use Up / Down key to set up Second

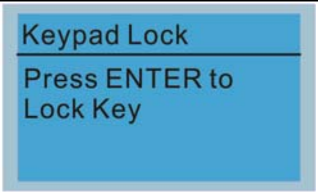


After setting up, press ENTER to confirm the setup.

NOTE

Limitation: The charging process of the super capacitor will finish in about 6 minutes. **When the digital keypad is removed, the time setting will be in standby status for 7 days.** After this period, the time needs to be reset.

9. Keypad Locked

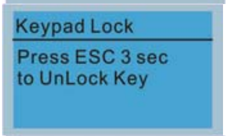


Press ENTER to lock

Keypad Locked

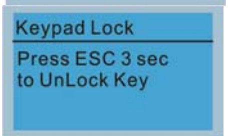
This function is used to lock the keypad. The main page would not display "keypad locked" when the keypad is locked, however it will display the message" please press ESC and then ENTER to unlock the keypad" when any key is pressed.

When the keypad is locked, the main screen doesn't display any status to show that.



Press any key on the keypad; a screen as shown in image on the left will be displayed.

If ESC key is not pressed, the keypad will automatically be back to this screen.

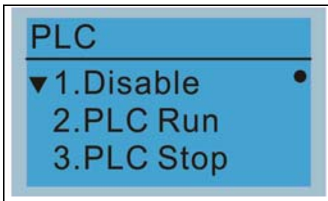


The keypad is still locked at this moment. By pressing any key, a screen as shown in the image on the left will still be displayed.

Press ESC for 3 seconds to unlock the keypad and the keypad will be back to this screen. Then each key on the keypad is functional.

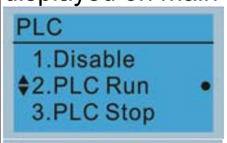
After the above steps, the keypad will not be locked when turning off the power and turning on the power again.

10. PLC Function

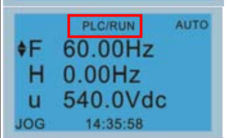


Press Up/Down key to select a PLC's function.
Then press ENTER.

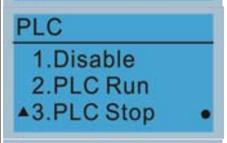
When the PLC function is activated or stopped, the PLC status will be displayed on main page of Delta default setting.



Option 2: Enable PLC function

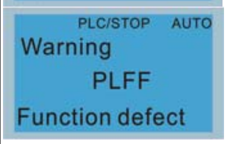


Default on the main screen displays PLC/RUN status bar.



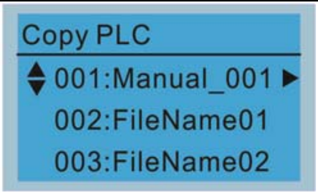
Option 3: Disable PLC function

Default on the main screen displays PLC/STOP status bar



If the PLC program is not available in the control board, PLFF warning will be displayed when choosing option 2 or 3.
In this case, select option 1: No Function to clear PLFF warning.

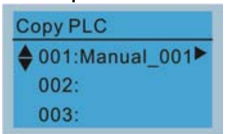
11. Copy PLC



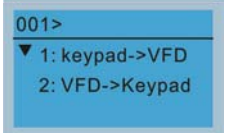
Four duplicates are provided

The steps are shown in the example below.

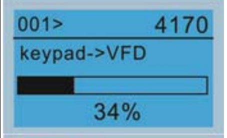
Example: Saved in the motor drive.



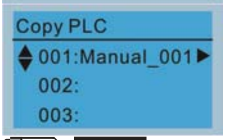
1. Go to “Copy PLC”
2. Select a parameter group to copy, then press ENTER.



1. Select 1: Save in the motor drive.
2. Press ENTER key to go to “Save in the motor drive” screen.



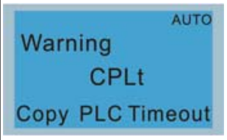
Begin to copy PLC until it is done.



Once copying PLC is done, keypad will automatically be back to this screen.

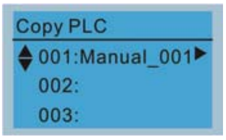
NOTE

If “Option 1: Save in the motor drive” is selected, verify if the PLC program is built-in to KPC-CC01 keypad. If PLC program is not available in the keypad while “Option 1: Save in the motor drive” is selected, an “ERR8 Warning: Type not matching” will be displayed on the screen.



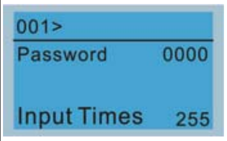
Unplug and plug back the keypad while copying the PLC program will cause a CPLt warning.

Example: Saved in the keypad.

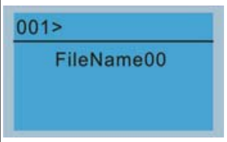


1. Go to “Copy PLC”.
2. Select the parameter group which needs to be copied and press ENTER key.

Press ENTER key to go to “Save in the motor drive” screen.



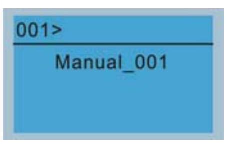
If WPLSoft editor is installed and password is set, enter the password to save the file onto digital display.



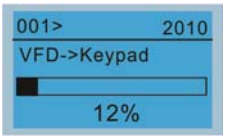
Use Up/ Down key to select a symbol.
Use Left/ Right key to move the cursor to select a file name.

String & Symbol Table:

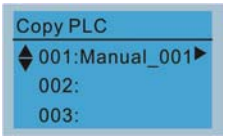
! ” # $ % &’ ( ) * + , − . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A
B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ^ _ ‘ a b
c d f g h i j k l m n o p q r s t u v w x y z { | } ~



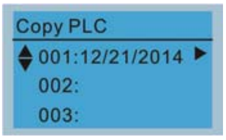
Once the file name is confirmed, press ENTER key.



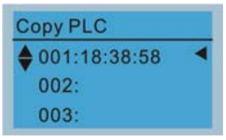
To begin copying parameters until it is done.



When copying parameters is completed, keypad will automatically be back to this screen.



Press Right key to see the date of copying parameters.

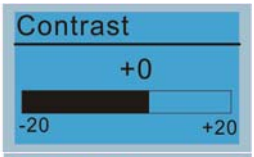


Press Right key to see the time of copying parameters.

12. Display setup

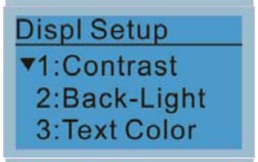
Press ENTER to setting menu.

1. Contrast



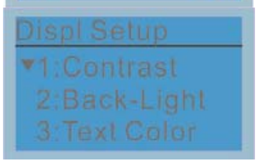
Use Up / Down key to adjust the setting value.

After selecting a setting value. Press ENTER to see screen's display after contrast is adjusted to be +10.



When the setting value is 0 Min, the backlight will be steady on.

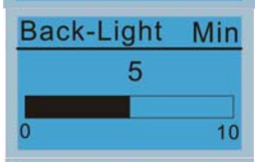
Then press ENTER.



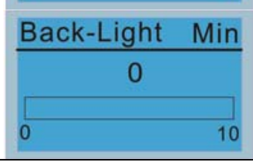
After select a setting value Press ENTER to see screen's display result after contrast is adjusted to be -10.

2. Back-light

Press ENTER to go to "Back Light Time Setting" screen.



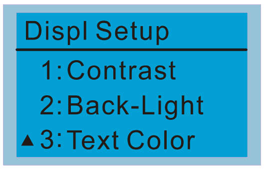
Use Up / Down key to adjust the setting value.



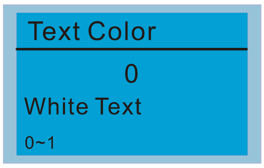
When the setting value is 0 Min, the backlight will be steady on.

When the setting value is 10 Min, the backlight will be OFF in 10 minutes.

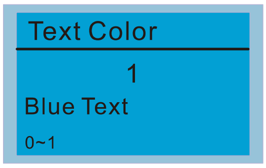
3. Text Color



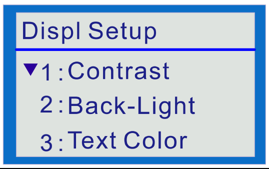
Press ENTER to go to Text Color Setting screen.



The default value is White Text.

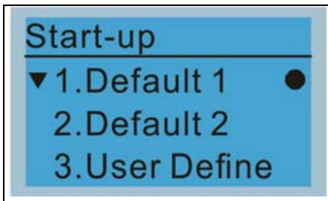


Use Up / Down key to adjust the setting value.

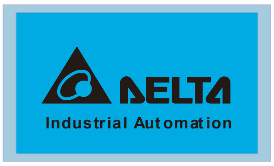


The setting value changes to Blue Text.

13. Start-up



1. Default 1 DELTA LOGO



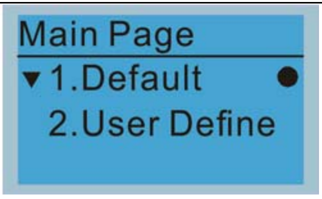
2. Default 2 DELTA Text

3. User Defined: optional accessory is require (TPEditor & USB / RS-485 Communication Interface-IFD6530)
Install an editing accessory would allow users to design their own start-up page. If editor accessory is not installed, “user defined” option will display a blank page.

USB/RS-485 Communication Interface-IFD6530
Please refer to Chapter 07 Optional Accessories for more detail.

TPEditor
Download TPEditor software at Delta website, select TPEditor version 1.60 or above. Refer to instruction for TPEditor in Chapter 10-3.

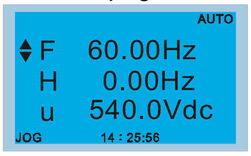
14. Main page



Default picture and editable picture are available upon selection.

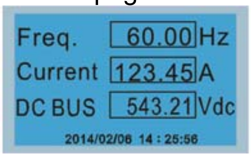
Press ENTER to select.

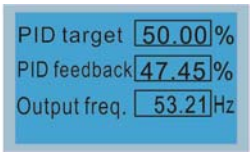
1. Default page



F 60.00Hz >>> H >>> A >>> U (circulate)

2. User Defined: optional accessory is require (TPEditor & USB / RS-485 Communication Interface-IFD6530)
   Install an editing accessory would allow users to design their own main page. If editor accessory is not installed, "user defined" option will display a blank page.

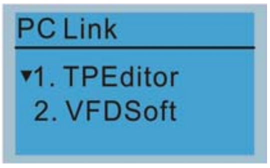




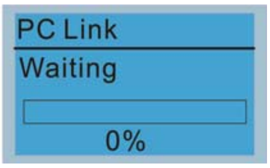
USB/RS-485 Communication Interface-IFD6530
Please refer to Chapter 07 Optional Accessories for more detail.

TPEditor
Download TPEditor software at Delta website, select TPEditor version 1.60 or above. Refer to instruction for TPEditor in Chapter 10-3.

15. PC Link

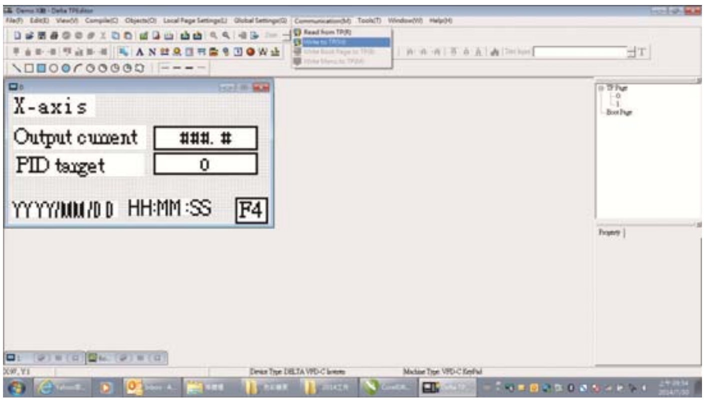


1. TPEditor: This function allows users to connect the keypad to a computer then to download and edit user defined pages.

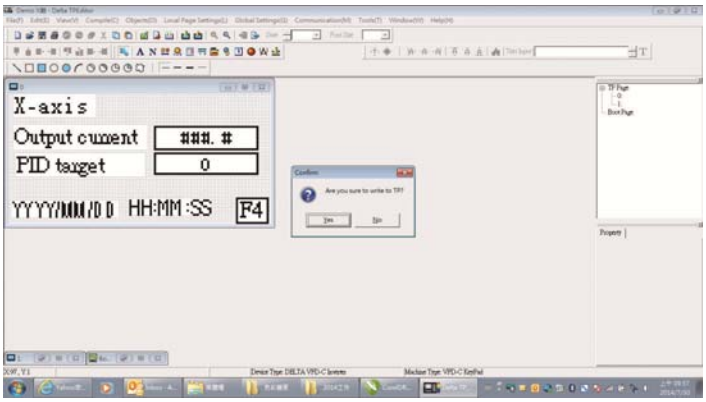


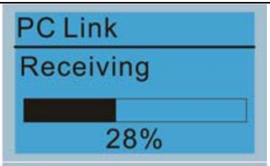
Click ENTER to go to <Waiting to connect to PC>

In TPEditor, choose <Communication>, then choose "Write to HMI"

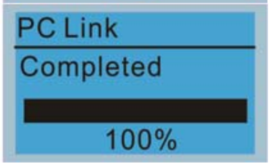


Choose <YES> in the <Confirm to Write> dialogue box.





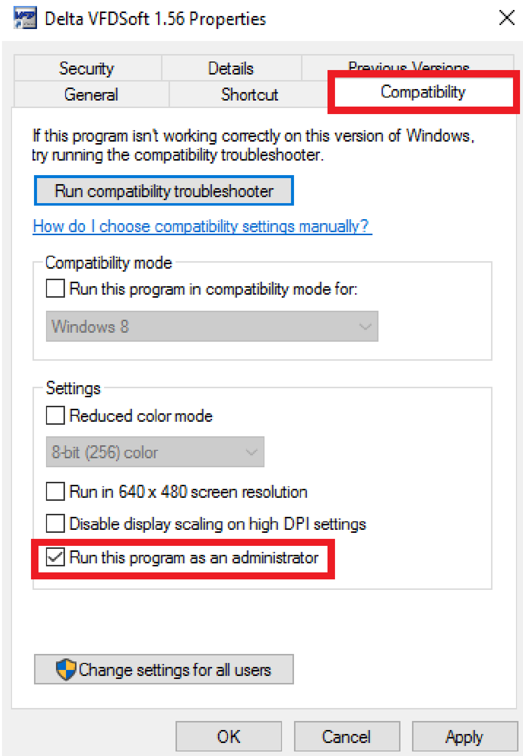
Start downloading pages to edit KPC-CC01.



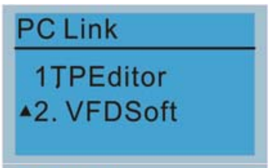
Download completed

2. VFDSoft: this function allows user to link to the VFDSoft Operating software then to upload data.
Copy parameter 1–4 in KPC-CC01

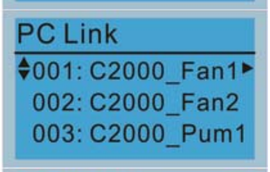
NOTE When the Operation System (OS) of your computer is Windows 10, right click on the icon of VFDSoft to enter <Property> (as shown in the red color square in the image below). Then click on the <Compatibility> tab and select the <Run this program as an administrator.> (also as shown in the red color square in the image below)



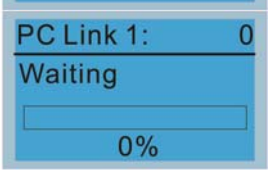
Connect KPC-CCO1 to a computer



Start downloading pages to edit to KPC-CC01

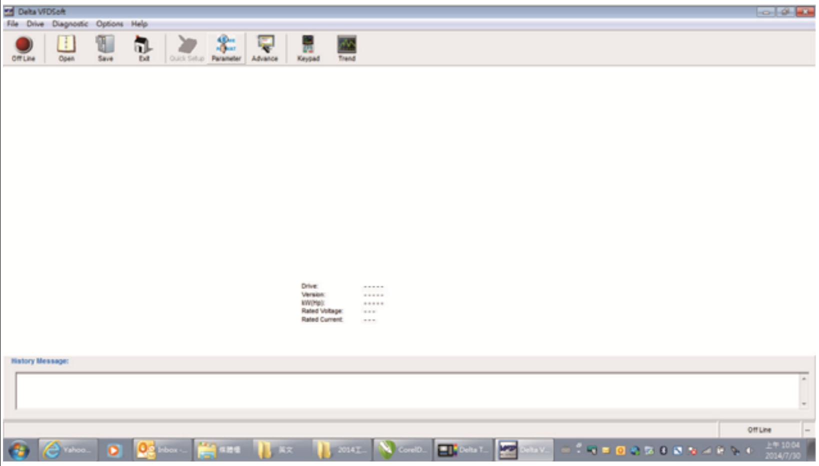


Use Up / Down key to select a parameter group to upload to VFDSoft.
Press ENTER

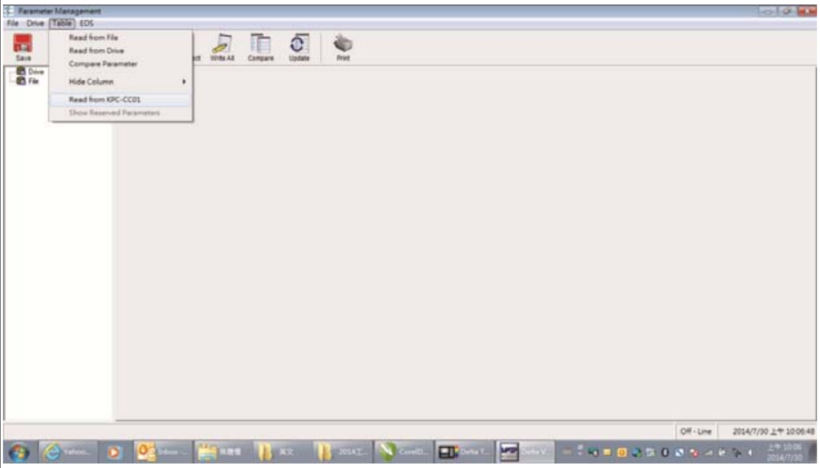


Waiting to connect to PC

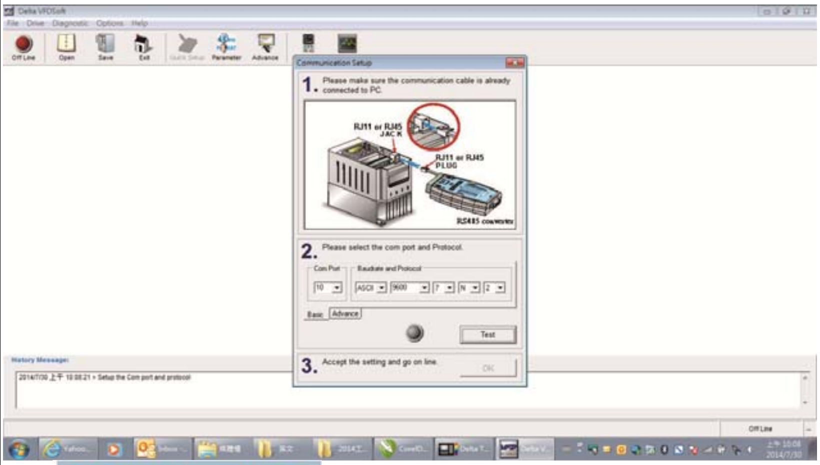
Open VFDSoft, choose <Parameter Manager function>

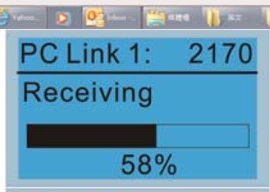


In Parameter Manager, choose <Load parameter table from KPC-CC01>

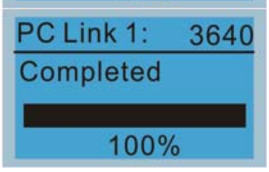


Choose the right communication port and click OK





Start to upload parameters to VFDSoft



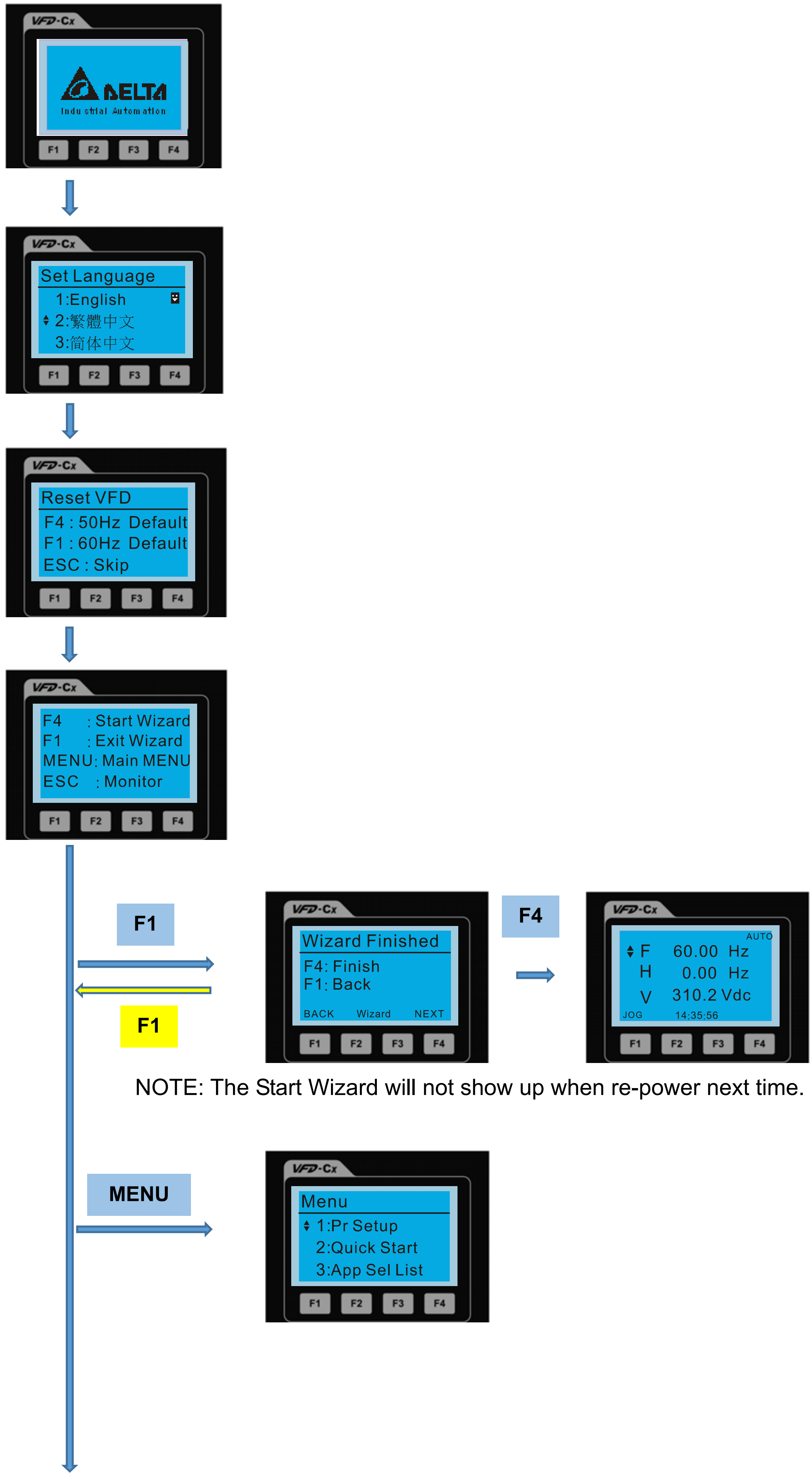
Uploading parameter is completed

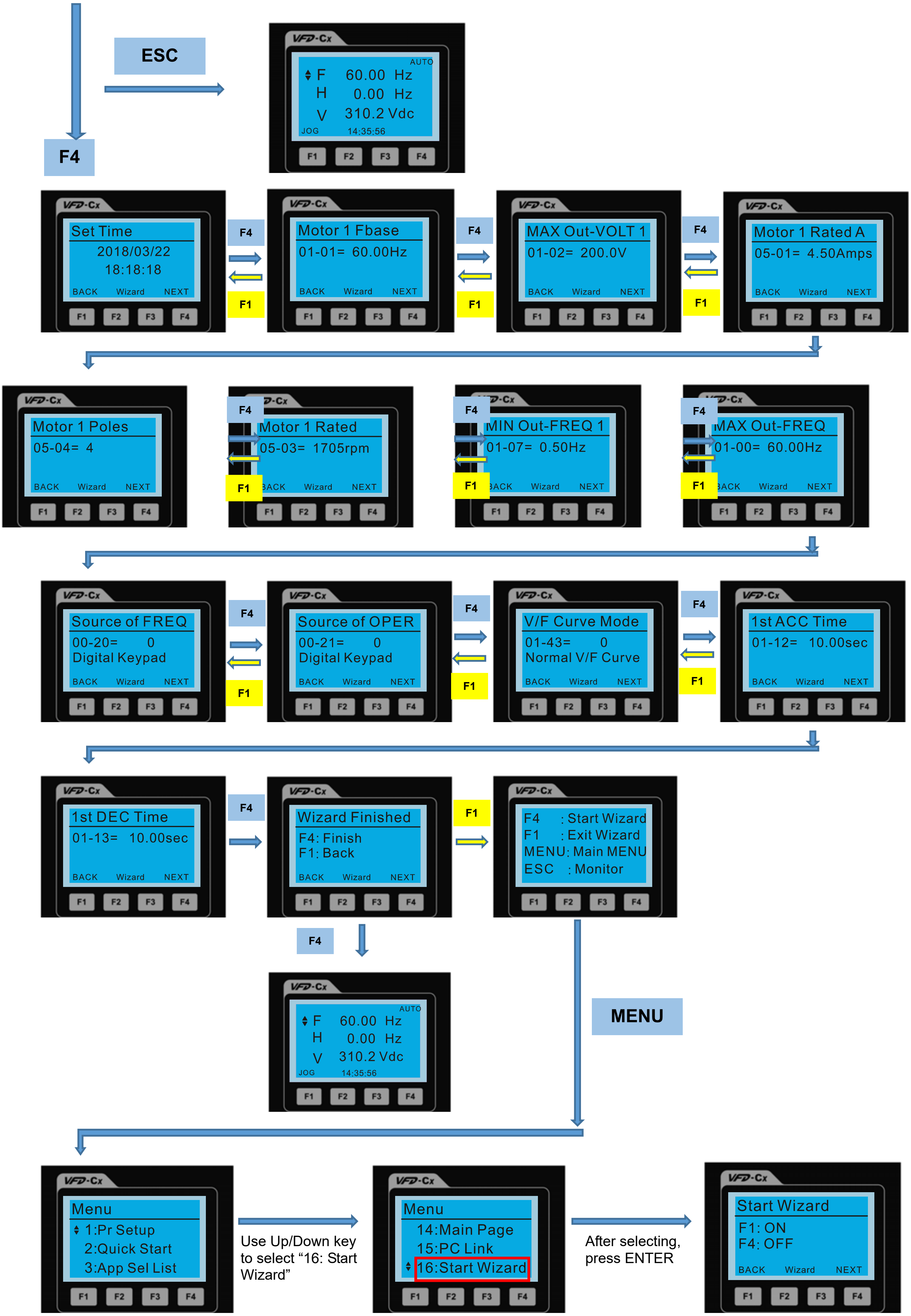
Before using the user defined starting screen and user defined main screen, the starting screen setup and the main screen setup have to be preset as user defined.

If the user defined page are not downloaded to KPC-CC01, the starting screen and the main screen will be blank.

16. Start Wizard

F1 : Next ; F1 : Back

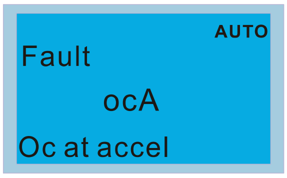


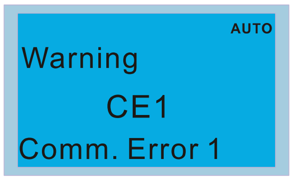


NOTE: The “16: Start Wizard” on the menu is to set whether shows start wizard when start up the drive.

Other display

When a fault occurs, the menu displays:





1. Press STOP / RESET button to reset the fault code. If the drive has still no response, contact local distributor or return to the factory. To view the fault DC bus voltage, output current and output voltage, press “MENU”→“Fault Record”.
2. After resetting, if the screen returns to main page and shows no fault after pressing ESC, the fault is cleared.
3. When fault or warning message appears, backlight LED will blink until the fault or the 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: When you need to buy communication cables, buy non-shielded, 24 AWG, 4 twisted pair, 100 ohms communication cables.

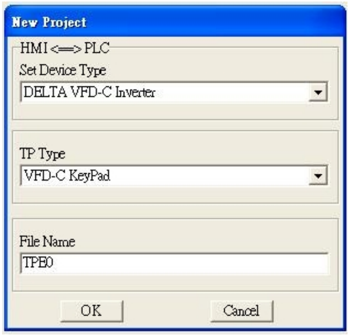
10-3 TPEditor Installation Instruction

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

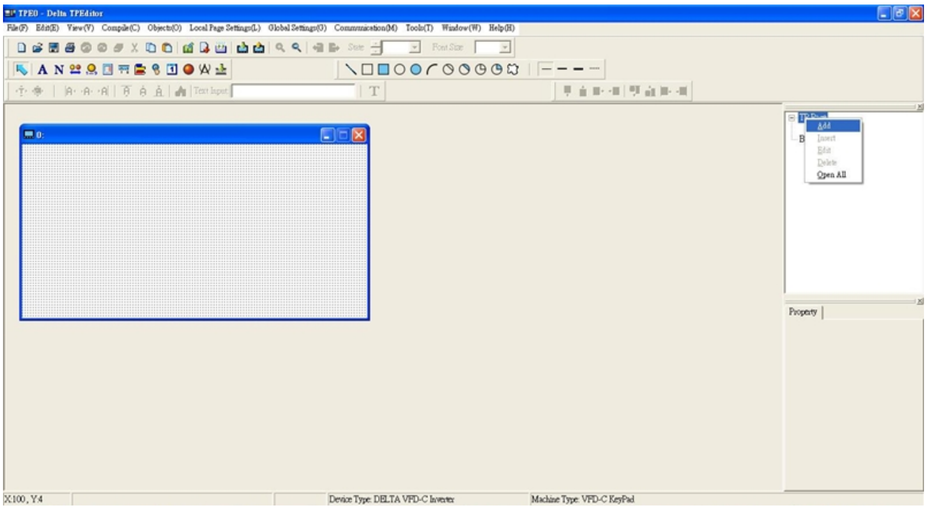
1) TPEditor: Setup & Basic Functions

1. Run TPEditor version 1.60 or above

2. Go to File (F) →Click on New. The Window below will pop up. At the device type, click on the drop down menu and choose DELTA VFD-C Inverter. At the TP type, click on the drop down menu and choose VFD-C Keypad. As for File Name, enter TPE0. Now click on OK.

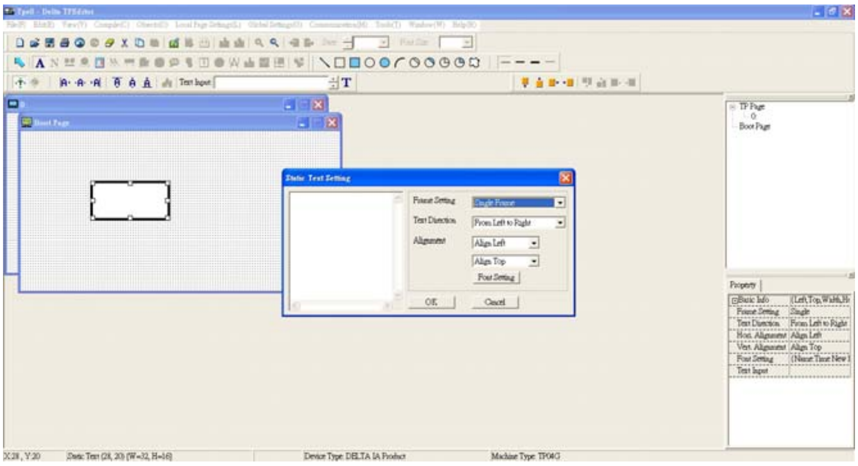


3. You are now at the designing page. Go to Edit (E) →Click on Add a New Page (A) or go to the TP page on the upper right side, right click once on TP page and choose Add to increase one more page for editing.

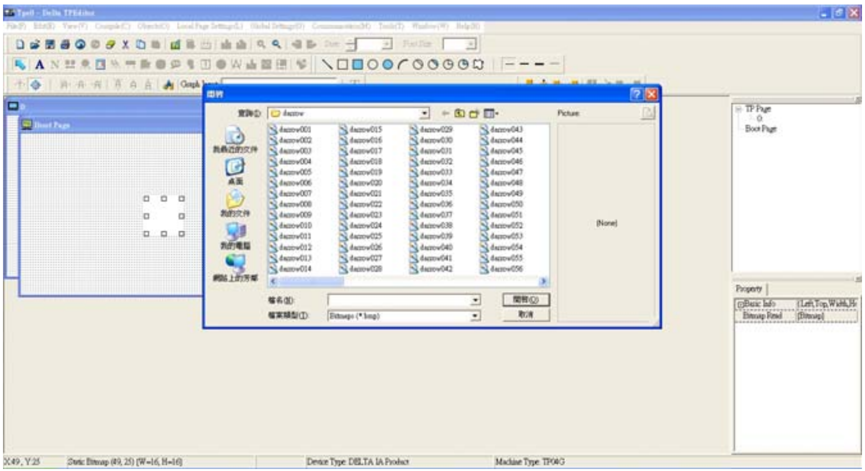


4. Edit Startup Page

5. Static Text . Open a blank page, click once on this button , and then double click on that blank page. The following window will pop up.



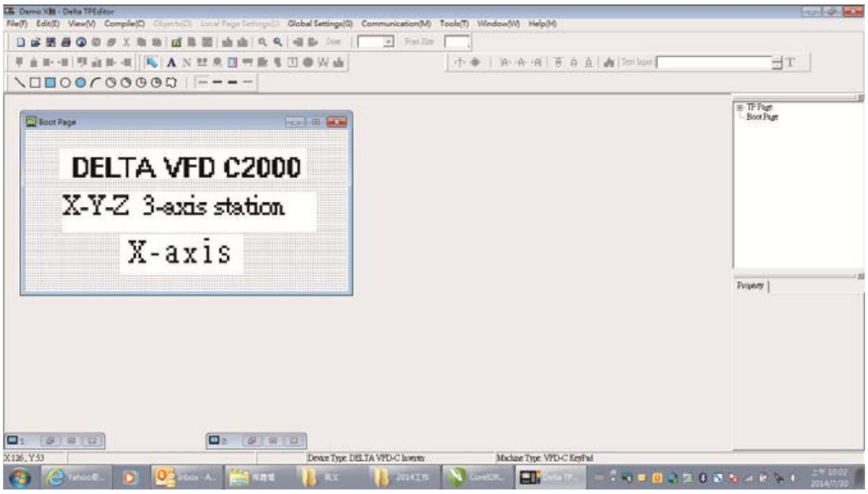
6. Static Bitmap  →Open a blank page, then click once on this button  and then double click on that blank page. The following window will pop up.



Please note that Static Bitmap setting supports only images in BMP format. Now choose an image that you need and click open, then that image will appear in the Static Bitmap window.

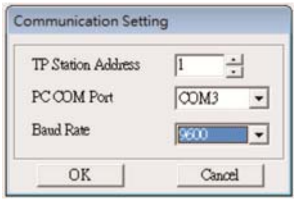
7. Geometric Bitmap  → As shown in the picture on the left, there are 11 kinds of geometric bitmap to choose. Open a new blank page then click once on a geometric bitmap icon that you need. Then drag that icon and enlarge it to the size that you need on that blank page.

8. Finish editing the keypad starting screen and select **Communication>Input User Defined Keypad Starting Screen.**

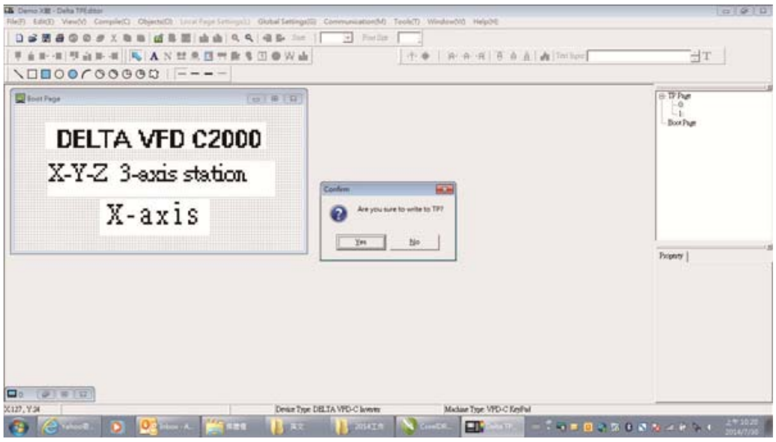


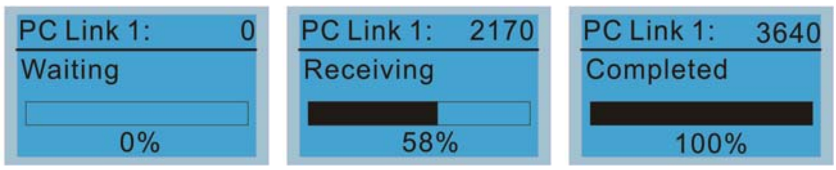
9. Downloading setting: Go to Tool > Communication. Set up communication port and speed of IFD6530.

10. Only three speed selections are available: 9600 bps, 19200 bps and 38400 bps.



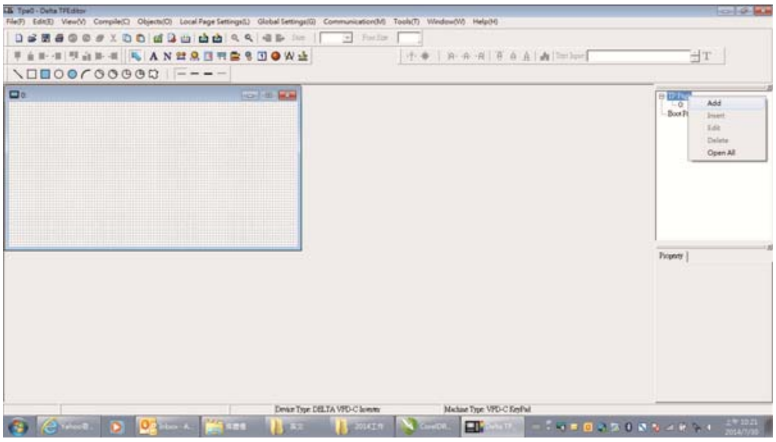
11. When a dialogue box displayed on the screen asking to confirm writing or not, press buttons on the keypad to go to MENU, select PC LINK and then press ENTER and wait for few seconds. Then select YES on the screen to start downloading.



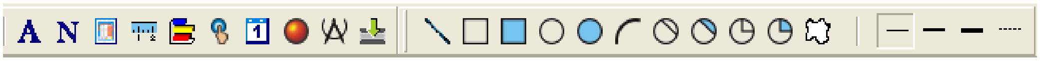


2) Edit Main Page & Example of Download

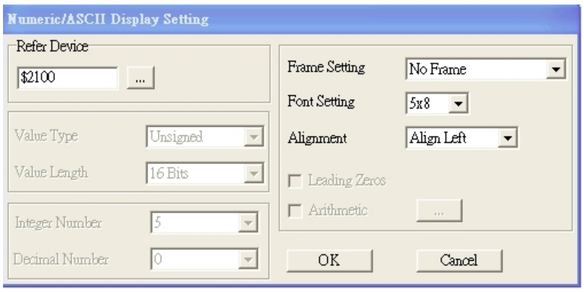
1. Go to editing page, select Edit > Add one page or press the button ADD on the right hand side of the HMI page to increase number of pages to edit. This keypad currently supports up to 256 pages.



2. On the bottom right-hand corner of the HMI, click on a page number to edit or go to VIEW > HMI page to start editing main page. As shown in the image, the following objects are available. From left to right: Static Text, ASCII Display, Static Bitmap, Scale, Bar Graph, Button, Clock Display, Multi-state bit map, Units, Numeric Input and 11 geometric bitmaps and lines of different width. The application of Static Text, Static Bitmap, and geometric bitmap is the same as the editing startup page.

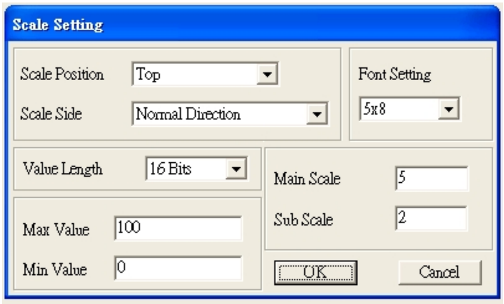


3. Numeric / ASCII Display: To add a Numeric / ASCII Display object to a screen, double click on the object to set up Related Devices, Frame Setting, Fonts and Alignment.

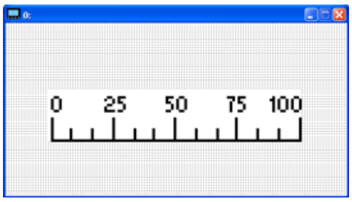


Related Device: Choose the VFD Communication Port that you need, if you want to read output frequency (H), set the VFD Communication Port to $2202. For other values, please refer to ACMD Modbus Comm Address List.

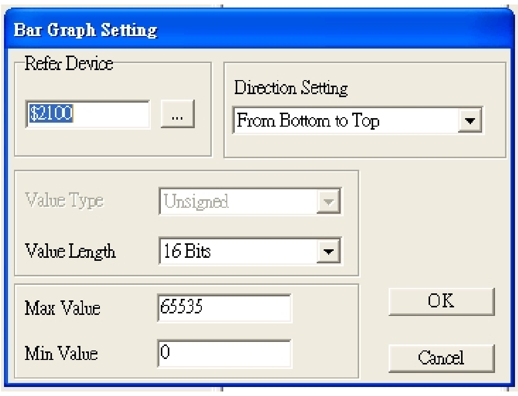
4. Scale Setting : On the Tool Bar, click on  for Scale Setting. You can also edit Scale Setting in the Property Window on the right hand side of your computer screen.



a. Scale Position: Click on the drop down list to choose which position that you need to place a scale.
b. Scale Side: Click on the drop down list to choose if you want to number your scale from smaller number to bigger number or from big to small. Click OK to accept this setting or click Cancel to abort.
c. Font Setting: Click on the drop down list to choose the Font setting that you need then click OK to accept the setting or click Cancel to abort.
d. Value Length: Click on the drop down to choose 16 bits or 32 bits. Then click OK to accept the setting or click Cancel to abort.
e. Main Scale & Sub Scale: In order to divide the whole scale into equal parts, key in the numbers of your choices for main scale and sub scale.
f. Maximum value & Minimum Value are the numbers on the two ends of a scale. They can be negative numbers. But the values allowed to be input are limited by the length of value. For example, when the length of value is set to **be hexadecimal**, the maximum and the minimum value cannot be input as -4000.
   Follow the Scale setting mentioned above; you will have a scale as shown below.



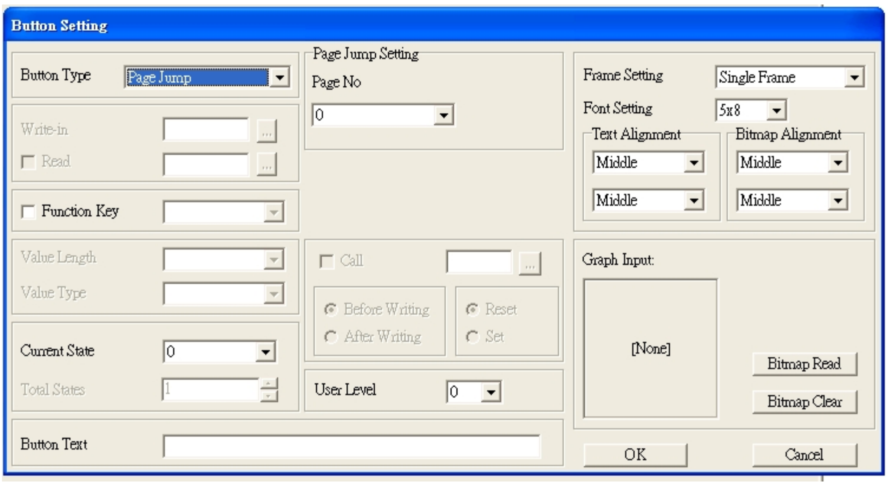
5. Bar Graph setting  :



a. Related Device: Choose the VFD Communication Port that you need.
b. Direction Setting: Click on the drop down menu to choose one of the following directions: From Bottom to Top, From Top to Bottom, From Left to Right or From Right to Left.
c. Maximum Value & Minimum Value: They define the range covered by the maximum value and minimum value. If a value is smaller than or equal to the minimum value, then the bar graph will be blank. If a value is bigger or equal to the maximum value, then the bar graph will be full. If a value is between minimum and maximum value, then the bar graph will be filled proportionally.

6. Button : Currently this function only allows the Keypad to switch pages, other functions are not yet available. Text input function and Image inserted functions are not yet supported.

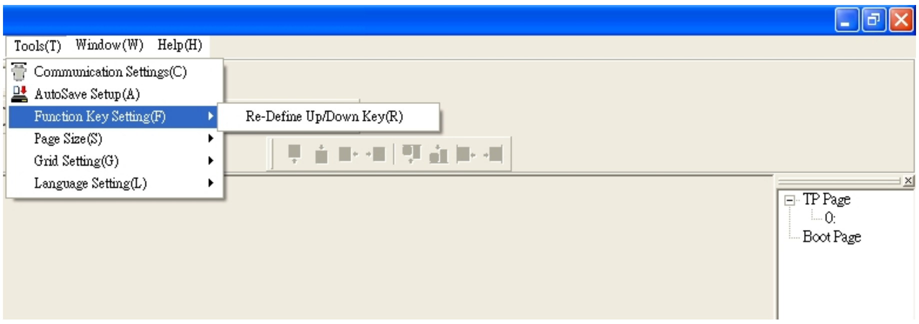
Double click on to open set up window.



<Button Type> allows users set up buttons' functions. <Page Jump> and <Constant Setting> are the only two currently supported functions.

A. [Page Jump] function setting

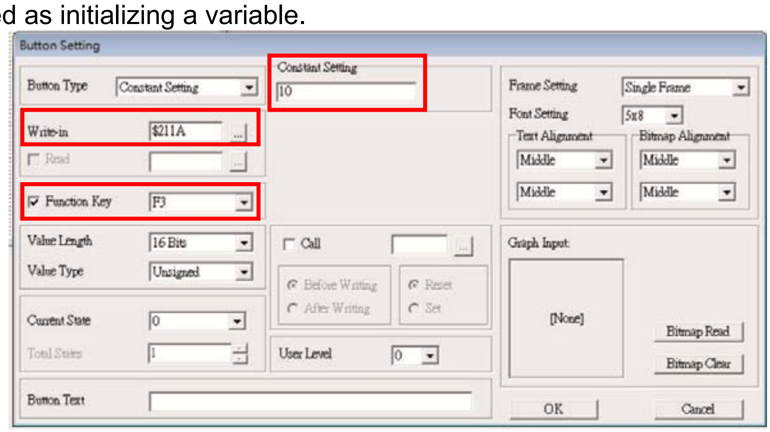
- Page Jump setting: After you choose the Page Jump function in the drop down list, you will see this Page Jump Setting Menu
- <Function Key> allows you to assign functions to the following keys on the KPC-CC01 keypad: F1, F2, F3, F4, Up, Down, Left and Right. Please note that the Up and Down keys are locked by TPEditor. These two keys cannot be programmed. If you want to program Up and Down keys, go to Tool→Function Key Settings (F) →Re-Define Up / Down Key (R).



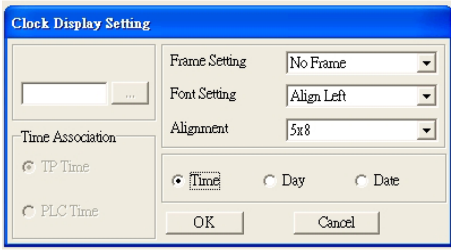
- Button Text: This function allows user to name buttons. For example, key in <Next Page> in the empty space, a button will have the wording <Next Page> displayed on it.

B. [Constant setting] function

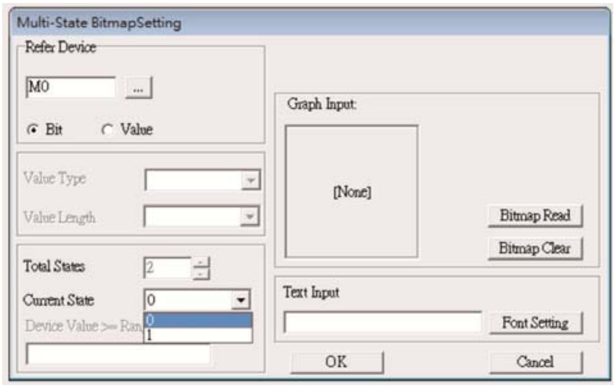
This function is to set up the memory address' value of the VFD or PLC. When pressing the <function button> set up in before, a value will be written to the memory address of the <Constant Setting>. This function can be used as initializing a variable.



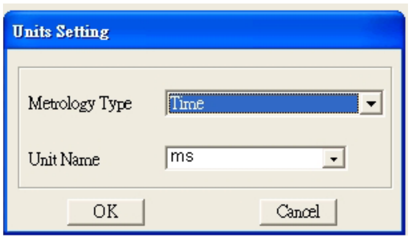
7. Clock Display Setting  : The setup window of the Clock Display is shown as the image below. Time, Day or Date can be displayed on the keypad.
Open a new file and click once in that window, you will see the following
In the clock display setting, you can choose to display Time, Day or Date on the Keypad. To adjust time, go to #9 on the Keypad's menu. You can also adjust Frame Setting, Font Setting and Alignment.



8. Multi-state bitmap  : The setup window of the multi-state is shown as the image below. This object reads the bit's property value of the PLC. It defines what image or wording is when this bit is 0 or when this bit is 1. Set the initial status to be 0 or 1 to define the displayed image or wording.



9. Unit Measurement  : Click once on this Button
Open a new file and double click on that window, you will see the following:



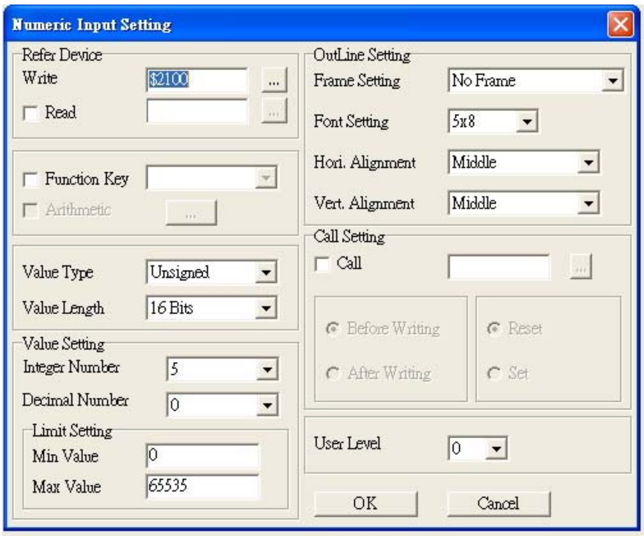
Choose from the drop down list the Metrology and the Unity Name that you need.
As for Metrology, you have the following choices: Length, Square Measure, Volume/Solid Measure, Weight, Speed, Time and Temperature. The unit name changes automatically when you change metrology type.

10. Numeric Input Setting :

This menu allows you to provide parameters or communication ports and to input numbers.

Click once on this button .

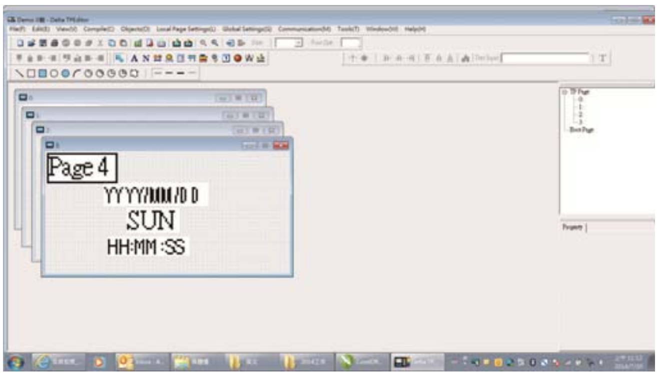
Open a new file and double click on that window, you will see the following:

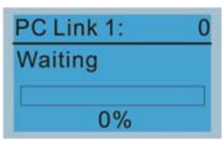


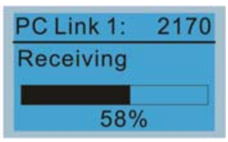
a. Related Device: There are two blank spaces to fill in, one is <Write> and another one is <Read>. Input the numbers that you want to display and the corresponding numbers of a parameter and that of a communication port. For example, input 012C to Read and Write Parameter Pr.01-44.
b. Outline Setting: The Frame setting, Font setting, Vertical Alignment and Horizontal Alignment are the same as mentioned before. Click on the drop down menu and choose the setting that you need.
c. Function key: The setting here allows you to program keys on the keypad. Press the key on the menu then the corresponding key on the keypad will start to blink, then press Enter to confirm the setting.
d. Value Type & Value Length: These two factors influence the range of the Minimum and Maximum Value of the Limit Setting. Please note that the corresponding supporting values for CFP2000 have to be 16bits. The 32bits values are not supported.
e. Value Setting: This part is set automatically by the keypad itself.
f. Limit Setting: Input the range the security setting here.

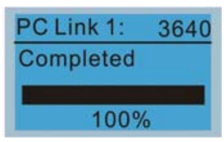
For example, if you set Function Key as F1, Minimum Value as 0 and Maximum Value as 4, then press F1 on Keypad. Then you can press Up and Down key on the keypad to increase or decrease the value. Press Enter Key on the keypad to confirm your setting. You can also go to parameter table 01-44 to verify if your input value is correct.

11. Download TP Page: Press Up or Down key on the keypad until you reach #13 PC Link.
Then press Enter on the keypad and you will see the word “Waiting” on keypad’s screen. Now choose a page that you have created then go to Communication (M) →Write to TP (W) to start downloading the page to the keypad.
When you see the word Completed on the keypad’s screen, that means the download is done.
Then you can press ESC on the keypad to go back to the menu of the keypad.

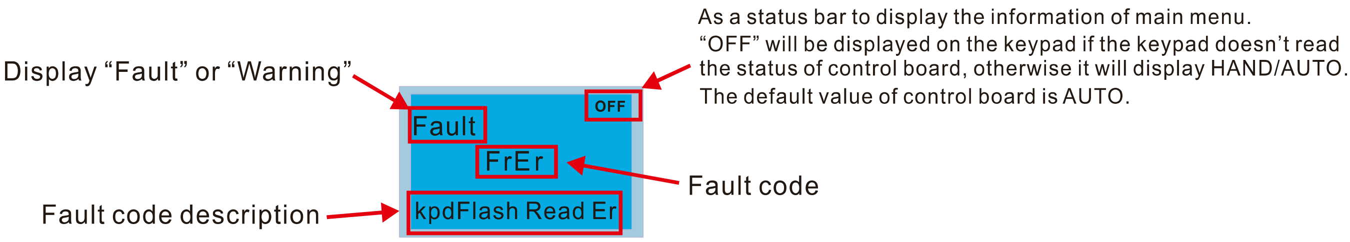








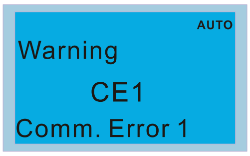
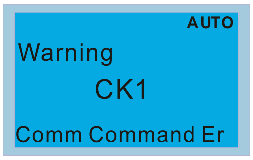
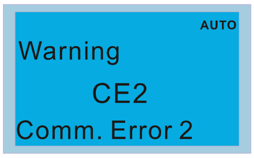
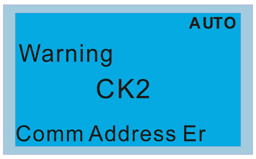
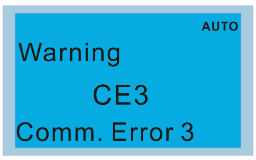
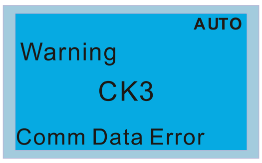
10-4 Fault Code Description of Digital Keypad KPC-CC01

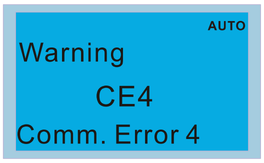
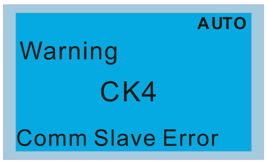
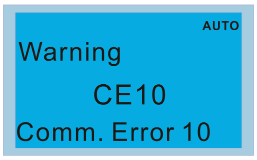
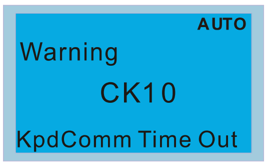
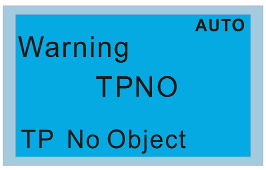


Fault Codes

LCD Display *	Description	Corrective Actions
AUTO Fault FrEr kpd Flash Read Er	Keypad flash memory read error	An error has occurred on keypad's flash memory. 1. Press RESET on the keypad to clear errors. 2. Verify if there's any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your authorized local dealer.
AUTO Fault FsEr kpd Flash Save Er	Keypad flash memory save error	An error has occurred on keypad's flash memory. 1. Press RESET on the keypad to clear errors. 2. Verify if there's any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your authorized local dealer.
AUTO Fault FPEr kpd Flash Pr Er	Keypad flash memory parameter error	Errors occurred on factory setting of parameters. It might be caused by firmware update. 1. Press RESET on the keypad to clear errors. 2. Verify if there's any problem on Flash IC. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your local authorized dealer.
AUTO Fault VFDr Read VFD Info Er	Keypad flash memory when read AC drive data error	Keypad cannot read any data sent from VFD. 1. Verify if 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. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your local authorized dealer.
AUTO Fault CPUEr CPU Error	A serious CPU error occurs to the Keypad	A Serious error has occurred on keypad's CPU. 1. Verify if there's any problem on CPU clock. 2. Verify if there's any problem on Flash IC. 3. Verify if there's any problem on RTC IC. 4. Verify if the communication quality of the RS-485 is good. 5. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your local authorized dealer.

Warning Codes

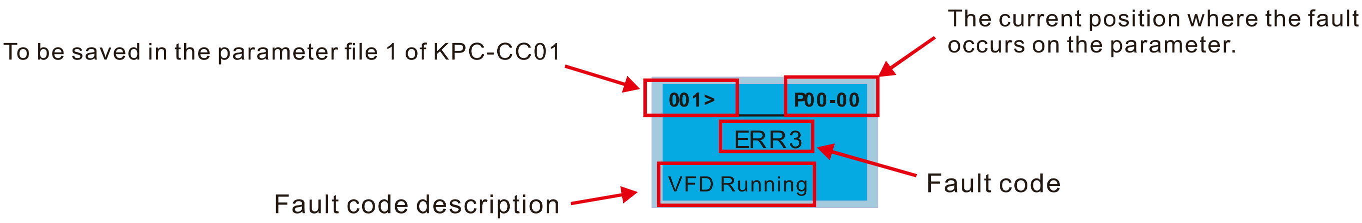
LCD Display *	Description	Corrective Actions
	Modbus function code error	Motor drive doesn't accept the communication command sent from keypad. 1. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. If none of the above solution works, contact your local authorized dealer.
	Digital keypad function code error (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 solution works, contact your local authorized dealer.
	Modbus data address error	Motor drive doesn't accept keypad's communication address. 1. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. If none of the above solution works, contact your local authorized dealer.
	Digital keypad data address error (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 solution works, contact your local authorized dealer.
	Modbus data value error	Motor drive doesn't accept the communication data sent from keypad. 1. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. If none of the above solution works, contact your local authorized dealer.
	Digital keypad data value error (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 solution works, contact your local authorized dealer.

LCD Display *	Description	Corrective Actions
	Modbus slave drive error	Motor drive cannot process the communication command sent from keypad. 1. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the above solution works, contact your local authorized dealer.
	Digital keypad slave drive error (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 solution works, contact your local authorized dealer.
	Modbus transmission time-Out	Motor drive doesn't respond to the communication command sent from keypad. 1. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the above solution works, contact your local authorized dealer.
	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 solution works, contact your local authorized dealer.
	Object not supported by TP Editor	Keypad's TP Editor uses unsupported object or Drive series. 1. Verify how the TP Editor should use that object. Delete unsupported object and unsupported setting. 2. Reedit the TP editor and then download it. 3. Make sure the Drive series support TP functions. If it didn't, the main page will display default. If none of the above solution works, contact your local authorized dealer.

NOTE The warning code which shows as "CExx" only occurs when the communication problem between the drive and keypad, and it's nothing to do with the drive and other device. Be noted that the warning code description to judge the cause of error if "CExx" occurs.

File Copy Setting Fault Description:

These faults will happen when KPC-CC01 cannot perform the command after clicking the Enter button in copy function.



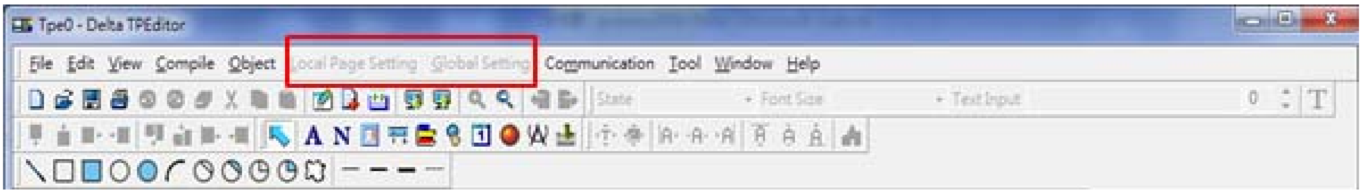
LCD Display *	Description	Corrective Actions
001> P00-00 ERR1 Read Only	Parameter and file are read only	The property of the parameter / file is read-only and cannot be written to. 1. Verify the specification on the user manual. If the solution above doesn't work, contact your local authorized dealer.
001> P00-00 ERR2 Write Fail	Fail to write parameter and file	An error occurred while writing to a parameter / file. 1. Verify if there's any problem on the Flash IC. 2. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above work, contact your local authorized dealer.
001> P00-00 ERR3 VFD Running	AC drive is in operating status	A setting cannot be made while motor drive is in operation. 1. Verify if the drive is not in operation. If the solution above doesn't work, contact your local authorized dealer.
001> P00-00 ERR4 Pr Lock	AC drive parameter is locked	A setting cannot be made because a parameter is locked. 1. Verify if the parameter is locked or not. If it is locked, unlock it and try to set up the parameter again. If the solution above doesn't work, contact your local authorized dealer.
001> P00-00 ERR5 Pr Changing	AC drive parameter changing	A setting cannot be made because a parameter is being modified. 1. Verify if the parameter is being modified. If it is not being modified, try to set up that parameter again. If the solution above doesn't work, contact your local authorized dealer.
001> P00-00 ERR6 Fault Code	Fault code	A setting cannot be made because an error has occurred on the motor drive. 1. Verify if there's any error occurred on the motor drive. If there isn't any error, try to make the setting again. If the solution above doesn't work, contact your local authorized dealer.
001> P00-00 ERR7 Warning Code	Warning code	A setting cannot be made because of a warning message given to the motor drive. 1. Verify if there's any warning message given to the motor drive. If the solution above doesn't work, contact your local authorized dealer.
001> P00-00 ERR8 Type Dismatch	File type dismatch	The copied data are not the same type, so the setting cannot be made. 1. Verify if the products' serial numbers need to be copied fall in the category. If they are in the same category, try to make the setting again. If the solution above doesn't work, contact your authorized dealer.

LCD Display *	Description	Corrective Actions
001> P00-00 ERR9 Password Lock	File is locked with password	A setting cannot be made, because some data are locked. 1. Verify if the data are unlocked or able to be unlocked. If the data are unlocked, try to make the setting again. 2. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your local authorized dealer.
001> P00-00 ERR10 Password Fail	File password is incorrect	A setting cannot be made because the password is incorrect. 1. Verify if the password is correct. If the password is correct, try to make the setting again. 2. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your local authorized dealer.
001> P00-00 ERR11 Version Fail	Different version of copied data	A setting cannot be made, because the version of the data is incorrect. 1. Verify if the version of the data matches the motor drive. If it matches, try to make the setting again. If none of the solution above works, contact your local authorized dealer.
001> P00-00 ERR12 VFD Time Out	AC drive copy function time-out	A setting cannot be made, because data copying timeout expired. 1. Redo data copying. 2. Verify if copying data is authorized. If it is authorized, try again to copy data. 3. Shut down the system, wait for ten minutes, and then power on again the system. If none of the solution above works, contact your local authorized dealer.

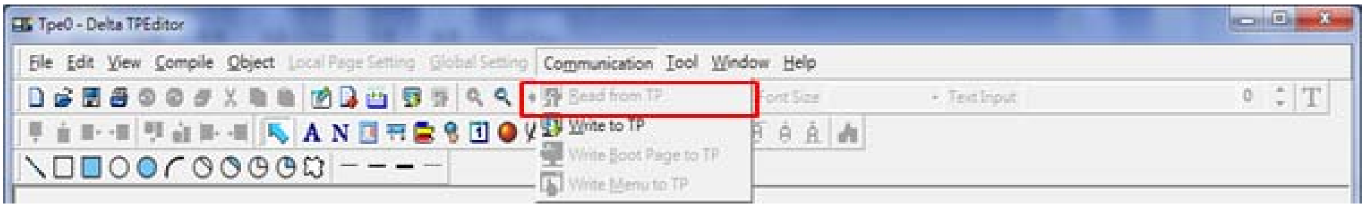
※ The content in this chapter only applies on V1.01 and above of KPC-CC01 keypad.

10-5 Unsupported Functions when using TPEditor on KPC-CC01 Keypad

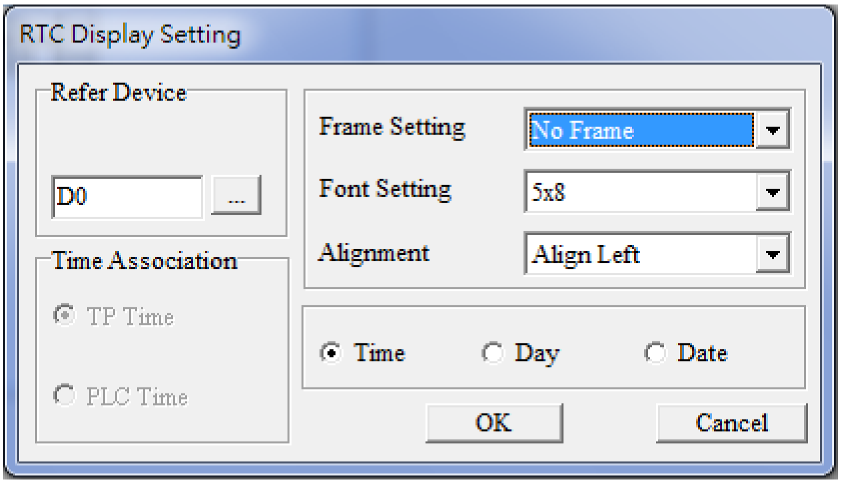
1. Local Page Setting and Global Setting functions are not supported.



2. [Communication]→[Read from TP] functions are not supported.



3. In RTC Display Setting, the Refer Device cannot be modified.



Chapter 11 Summary of Parameter Settings

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

NOTE

1) ✓: You can set this parameter during operation
2) The following are abbreviations for different types of motors:
   - IM: Induction motor
   - PM: Permanent magnet synchronous AC motor
   - IPM: Interior permanent magnet synchronous AC motor
   - SPM: Surface permanent magnet synchronous AC motor

00 Drive Parameters

NOTE IM: Induction Motor; PM: Permanent Magnet Motor

Pr.	Parameter Name	Settings Range	Default
00-00	Identity code of the AC motor drive	5: 460V, 0.75 kW 7: 460V, 1.50 kW 9: 460V, 2.20 kW 11: 460V, 3.70 kW 13: 460V, 5.50 kW 15: 460V, 7.50 kW 17: 460V, 11.0 kW 19: 460V, 15.0 kW 21: 460V, 18.5 kW 23: 460V, 22.0 kW 25: 460V, 30.0 kW 27: 460V, 37.0 kW 29: 460V, 45.0 kW 31: 460V, 55.0 kW 33: 460V, 75.0 kW 35: 460V, 90.0 kW 93: 460V, 4.00 kW	Read only
00-01	Display AC motor drive rated current	Display by models	Read only
00-02	Parameter reset	0: No function 1: Write protection for parameters 5: Reset kWh display to 0 6: Reset PLC (including CANopen Master Index) 7: Reset CANopen Index (Slave) 9: Reset all parameters to defaults (base frequency is 50 Hz) 10: Reset all parameters to defaults (base frequency is 60 Hz)	0

	Pr.	Parameter Name	Settings Range	Default
✗	00-03	Start-up display selection	0: F (frequency command) 1: H (output frequency) 2: U (user-defined, see Pr.00-04) 3: A (output current)	0
✗	00-04	Content of multi-function display (user-defined)	0: Display output current (A) (Unit: Amp) 1: Display counter value (c) (Unit: CNT) 2: Display actual output frequency (H.) (Unit: Hz) 3: Display DC bus voltage (v) (Unit: V_{DC}) 4: Display output voltage (E) (Unit: V_{AC}) 5: Display output power angle (n) (Unit: deg) 6: Display output power in kW (P) (Unit: kW) 7: Display actual motor speed rpm (r) (Unit: rpm) 10: Display PID feedback (b) (Unit: %) 11: Display AVI1 in % (1.) (Unit: %) 12: Display ACI in % (2.) (Unit: %) 13: Display AVI2 in % (3.) (Unit: %) 14: Display temperature of IGBT (i.) (Unit: °C) 15: Display temperature of capacitance (c.) (Unit: °C) 16: The status of digital input (ON / OFF) (i) 17: The status of digital output (ON / OFF) (o) 18: Multi-step speed (S) 19: The corresponding CPU pin status of digital input (d) 20: The corresponding CPU pin status of digital output (0.) 26: Ground fault GFF (G.) (Unit: %) 27: DC bus voltage ripple (r.) (Unit: V_{DC}) 28: Display PLC register D1043 data (C) 30: Display output of user-defined (U) 31: Display Pr.00-05 user gain (K) 34: Operation speed of fan (F.) (Unit: %) 36: Present operating carrier frequency of drive (J.) (Unit: Hz) 38: Display drive status (6.) 41: kWh display (J) (Unit: kWh) 42: PID target value (h.) (Unit: %) 43: PID offset (o.) (Unit: %) 44: PID output frequency (b.) (Unit: Hz) 45: Hardware ID 51: PMSVC torque offset 52: AI10% 53: AI11% 68: STO version 69: STO checksum high 70: STO checksum low	3
✗	00-05	Coefficient gain in actual output frequency	0.00–160.00	1.00

<table>
<tr><th>Pr.</th><th>Parameter Name</th><th>Settings Range</th><th>Default</th></tr>
<tr><td>00-06</td><td>Software version</td><td>Read only</td><td>Read only</td></tr>
<tr><td>00-07</td><td>Parameter protection password input</td><td>0–65535
0–4: the number of password attempts allowed</td><td>0</td></tr>
<tr><td>00-08</td><td>Parameter protection password setting</td><td>0–65535
0: No password protection / password entered correctly (Pr.00-07)
1: Parameter has been set</td><td>0</td></tr>
<tr><td>00-11</td><td>Speed control mode</td><td>0: IMVF (IM V/F control)
2: IM / PM SVC (IM / PM Space vector control)</td><td>0</td></tr>
<tr><td>00-16</td><td>Load selection</td><td>0: Light duty
1: Normal duty</td><td>0</td></tr>
<tr><td rowspan="2">00-17</td><td rowspan="2">Carrier Frequency</td><td>Light duty
<table><tr><th>Model / Carrier Frequency</th><th>460V</th></tr><tr><td>2–15 kHz</td><td>1–25 HP</td></tr><tr><td>2–10 kHz</td><td>30–100 HP</td></tr><tr><td>2–9 kHz</td><td>125 HP</td></tr></table></td><td>6</td></tr>
<tr><td>Normal duty
<table><tr><th>Model / Carrier Frequency</th><th>460V</th></tr><tr><td>2–15 kHz</td><td>0.5–20 HP</td></tr><tr><td>2–10 kHz</td><td>25–75 HP</td></tr><tr><td>2–9 kHz</td><td>100 HP</td></tr></table></td><td>6</td></tr>
<tr><td>00-19</td><td>PLC command mask</td><td>bit0: Control command by PLC force control
bit1: Frequency command by PLC force control</td><td>Read only</td></tr>
<tr><td>00-20</td><td>Master frequency command (AUTO) source / Source selection of the PID target</td><td>0: Digital keypad
1: RS-485 communication
2: External analog input (Pr.03-00–Pr.03-02)
3: External UP / DOWN terminal (multi-function input terminal)
6: CANopen communication card
8: Communication card (does not include CANopen card)</td><td>0</td></tr>
<tr><td>00-21</td><td>Operation command (AUTO) source</td><td>0: Digital keypad
1: External terminals
2: RS-485 communication
3: CANopen communication card
5: Communication card (does not include CANopen card)</td><td>0</td></tr>
<tr><td>00-22</td><td>Stop method</td><td>0: Ramp to stop
1: Coast to stop</td><td>0</td></tr>
<tr><td>00-23</td><td>Control of motor direction</td><td>0: Enable forward / reverse
1: Disable reverse
2: Disable forward</td><td>0</td></tr>
</table>

	Pr.	Parameter Name	Settings Range	Default
	00-24	Digital operator (keypad) frequency command memory	Read only	Read only
✓	00-25	User-defined characteristics	bit0–3: user-defined decimal place 0000b: no decimal place 0001b: one decimal place 0010b: two decimal places 0011b: three decimal places bit4–15: user-defined unit 000xh: Hz 001xh: rpm 002xh: % 003xh: kg 004xh: m/s 005xh: kW 006xh: HP 007xh: ppm 008xh: 1/m 009xh: kg/s 00Axh: kg/m 00Bxh: kg/h 00Cxh: lb/s 00Dxh: lb/m 00Exh: lb/h 00Fxh: ft/s 010xh: ft/m 011xh: m 012xh: ft 013xh: degC 014xh: degF 015xh: mbar 016xh: bar 017xh: Pa 018xh: kPa 019xh: mWG 01Axh: inWG 01Bxh: ftWG 01Cxh: psi 01Dxh: atm 01Exh: L/s 01Fxh: L/m 020xh: L/h 021xh: m3/s 022xh: m3/h 023xh: GPM 024xh: CFM xxxxh: Hz	0

Pr.	Parameter Name	Settings Range	Default
00-26	Max. user defined value	0: No function 0–65535 (when Pr.00-25 set to no decimal place) 0.0–6553.5 (when Pr.00-25 set to 1 decimal place) 0.00–655.35 (when Pr.00-25 set to 2 decimal places) 0.000–65.535 (when Pr.00-25 set to 3 decimal places)	0
00-27	User-defined value	Read only	Read only
00-28	Switching from Auto mode to Hand mode	bit0: Sleep function control bit 0: Cancel sleep function 1: Sleep function and Auto mode are the same bit1: Control bit unit 0: Displaying unit in Hz 1: Same unit as the Auto mode bit2: PID control bit 0: Cancel PID control 1: PID control and Auto mode are the same bit3: Frequency source control bit 0: Frequency source set up by parameter, if the multi-step speed is activated, then multi-speed has the priority. 1: Frequency command set up by Pr.00-30, regardless of whether the multi-step speed is activated.	
00-29	LOCAL / REMOTE selection	0: Standard HOA function 1: Switching Local / Remote, the drive stops 2: Switching Local / Remote, the drive runs as the REMOTE setting for frequency and operation status 3: Switching Local / Remote, the drive runs as the LOCAL setting for frequency and operation status 4: Switching Local / Remote, the drive runs as LOCAL setting when switched to Local and runs as REMOTE setting when switched to Remote for frequency and operation status.	0
00-30	Master frequency command source (HAND)	0: Digital keypad 1: RS-485 serial communication 2: External analog input (Pr.03-00) 3: External UP / DOWN terminal 6: CANopen communication card 8: Communication card (no CANopen card)	0
00-31	Operation command source (HAND)	0: Digital keypad 1: External terminals 2: RS-485 serial communication 3: CANopen communication card 5: Communication card (no CANopen card)	0
00-32	Digital keypad STOP function	0: STOP key disable 1: STOP key enable	0
00-48	Display filter time (Current)	0.001–65.535 sec.	0.100

	Pr.	Parameter Name	Settings Range	Default
✔	00-49	Display filter time (Keypad)	0.001–65.535 sec.	0.100
	00-50	Software version (Date)	Read only	Read only

01 Basic Parameters

	Pr.	Parameter Name	Settings Range	Default
✔	01-00	Maximum operation frequency	50.00–599.00 Hz Setting range for 90 kW (125 HP): 0.00–400 Hz	60.00 / 50.00
	01-01	Output frequency of motor 1	0.00–599.00 Hz	60.00 / 50.00
	01-02	Output voltage of motor 1	0.0–510.0 V	400.0
	01-03	Mid-point frequency 1 of motor 1	0.00–599.00 Hz	3.00
✔	01-04	Mid-point voltage 1 of motor 1	0.0–480.0 V	22.0
	01-05	Mid-point frequency 2 of motor 1	0.00–599.00 Hz	1.50
✔	01-06	Mid-point voltage 2 of motor 1	0.0–480.0 V	10.0
	01-07	Min. output frequency of motor 1	0.00–599.00 Hz	0.50
✔	01-08	Min. output voltage of motor 1	0.0–480.0 V	2.0
	01-09	Start-up frequency	0.00–599.00 Hz	0.50
✔	01-10	Output frequency upper limit	0.00–599.00 Hz	599.00
✔	01-11	Output frequency lower limit	0.00–599.00 Hz	0.00
✔	01-12	Acceleration time 1	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-13	Deceleration time 1	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-14	Acceleration time 2	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-15	Deceleration time 2	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-16	Acceleration time 3	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-17	Deceleration time 3	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-18	Acceleration time 4	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-19	Deceleration time 4	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-20	JOG acceleration time	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00
✔	01-21	JOG deceleration time	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec. Motor drive with 22 kW and above: 60.00 / 60.0	10.00

	Pr.	Parameter Name	Settings Range	Default
✔	01-22	JOG frequency	0.00–599.00 Hz	6.00
✔	01-23	First / Fourth acceleration / deceleration frequency	0.00–599.00 Hz	0.00
✔	01-24	S-curve acceleration begin time 1	Pr.01-45=0: 0.00–25.00 sec. Pr.01-45=1: 0.0–250.0 sec.	0.20
✔	01-25	S-curve acceleration arrival time 2	Pr.01-45=0: 0.00–25.00 sec. Pr.01-45=1: 0.0–250.0 sec.	0.20
✔	01-26	S-curve deceleration begin time 1	Pr.01-45=0: 0.00–25.00 sec. Pr.01-45=1: 0.0–250.0 sec.	0.20
✔	01-27	S-curve deceleration arrival time 2	Pr.01-45=0: 0.00–25.00 sec. Pr.01-45=1: 0.0–250.0 sec.	0.20
	01-28	Skip frequency 1 (upper limit)	0.00–599.00 Hz	0.00
	01-29	Skip frequency 1 (lower limit)	0.00–599.00 Hz	0.00
	01-30	Skip frequency 2 (upper limit)	0.00–599.00 Hz	0.00
	01-31	Skip frequency 2 (lower limit)	0.00–599.00 Hz	0.00
	01-32	Skip frequency 3 (upper limit)	0.00–599.00 Hz	0.00
	01-33	Skip frequency 3 (lower limit)	0.00–599.00 Hz	0.00
	01-34	Zero-speed mode	0: Waiting for output 1: Zero-speed operation 2: Minimum frequency (Refer to Pr.01-07, Pr.01-41)	0
	01-35	Output frequency of motor 2	0.00–599.00 Hz	60.00 / 50.00
	01-36	Output voltage of motor 2	0.0–510.0 V	400.0
	01-37	Mid-point frequency 1 of motor 2	0.00–599.00 Hz	3.00
✔	01-38	Mid-point voltage 1 of motor 2	0.0–480.0 V	22.0
	01-39	Mid-point frequency 2 of motor 2	0.00–599.00 Hz	1.50
✔	01-40	Mid-point voltage 2 of motor 2	0.0–480.0 V	10.0
	01-41	Min. output frequency of motor 2	0.00–599.00 Hz	0.50
✔	01-42	Min. output voltage of motor 2	0.0–480.0 V	2.0
	01-43	V/F curve selection	0: V/F curve determined by Pr.01-00–01-08 1: 1.5th V/F curve 2: 2nd V/F curve 3: 60 Hz, voltage saturation in 50 Hz 4: 72 Hz, voltage saturation in 60 Hz 5: 50 Hz, decrease gradually with cube 6: 50 Hz, decrease gradually with square 7: 60 Hz, decrease gradually with cube 8: 60 Hz, decrease gradually with square 9: 50 Hz, medium starting torque 10: 50 Hz, high starting torque 11: 60 Hz, medium starting torque 12: 60 Hz, high starting torque 13: 90 Hz, voltage saturation in 60 Hz 14: 120 Hz, voltage saturation in 60 Hz 15: 180 Hz, voltage saturation in 60 Hz	0

	Pr.	Parameter Name	Settings Range	Default
✓	01-44	Auto-acceleration and auto-deceleration setting	0: Linear acceleration and linear deceleration 1: Auto-acceleration and linear deceleration 2: Linear acceleration and auto-deceleration 3: Auto-acceleration and auto-deceleration 4: Stall prevention by auto-acceleration and auto-deceleration (limited by Pr.01-12–01-21)	0
	01-45	Time unit for acceleration / deceleration and S curve	0: Unit: 0.01 sec. 1: Unit: 0.1 sec.	0
✓	01-46	CANopen quick stop time	Pr.01-45=0: 0.00–600.00 sec. Pr.01-45=1: 0.0–6000.0 sec.	1.00 1.0
	01-49	Regenerative energy restriction control method	0: Disable 1: Over voltage energy restriction 2: Traction energy control (TEC)	0

02 Digital Input / Output Parameters

Pr.	Parameter Name	Setting Range	Default
02-00	Two-wire / Three-wire operation control	0: Two-wire mode 1, power on for operation control 1: Two-wire mode 2, power on for operation control 2: Three-wire, power on for operation control	0
02-01	Multi-function input command 1 (MI1)	0: No function	1
02-02	Multi-function input command 2 (MI2)	1: Multi-step speed command 1	2
02-03	Multi-function input command 3 (MI3)	2: Multi-step speed command 2	3
02-04	Multi-function input command 4 (MI4)	3: Multi-step speed command 3	4
02-05	Multi-function input command 5 (MI5)	4: Multi-step speed command 4	0
02-06	Multi-function input command 6 (MI6)	5: Reset	0
02-07	Multi-function input command 7 (MI7)	6: JOG command (By KPC-CC01 or external	0
02-08	Multi-function input command 8 (MI8)	control)	0
02-26	Input terminal of I/O extension card (MI10)	7: Acceleration / deceleration speed inhibit 8: 1st, 2nd acceleration / deceleration time selection	0
02-27	Input terminal of I/O extension card (MI11)	9: 3rd, 4th acceleration / deceleration time selection 10: EF input (Pr.07-20)	0
02-28	Input terminal of I/O extension card (MI12)	11: Base Block (B.B) input from external 12: Output stop	0
02-29	Input terminal of I/O extension card (MI13)	13: Cancel the setting of auto-acceleration / auto-deceleration time	0
02-30	Input terminal of I/O extension card (MI14)	14: Switch between motor 1 and motor 2 15: Rotating speed command from AVI1	0
02-31	Input terminal of I/O extension card (MI15)	16: Rotating speed command from ACI 17: Rotating speed command from AVI2	0
		18: Forced to stop (Pr.07-20) 19: Digital up command 20: Digital down command 21: PID function disabled 22: Clear the counter 23: Input the counter value (MI6) 24: FWD JOG command 25: REV JOG command 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for Δ-connection 38: Disable write EEPROM function 40: Force coasting to stop 41: HAND switch 42: AUTO switch 49: Enable drive 50: Slave dEb action to execute 51: Selection for PLC mode bit0 52: Selection for PLC mode bit1 53: Trigger CANopen quick stop 54: UVW output electromagnetic valve switch 55: Brake release	

Pr.	Parameter Name	Setting Range	Default
		56: Local / Remote selection 58: Enable fire mode (with RUN command) 59: Enable fire mode (without RUN command) 60: Disable all the motors 61: Disable Motor 1 62: Disable Motor 2 63: Disable Motor 3 64: Disable Motor 4 65: Disable Motor 5 66: Disable Motor 6 67: Disable Motor 7 68: Disable Motor 8 69: Preheating command	
02-09	UP / DOWN key mode	0: UP / DOWN by acceleration / deceleration time 1: UP / DOWN constant speed (Pr.02-10)	0
02-10	Constant speed, acceleration / deceleration speed of the UP / DOWN key	0.001–1.000 Hz / ms	0.001
02-11	Multi-function input response time	0.000–30.000 sec.	0.005
02-12	Multi-function input mode selection	0000h–FFFFh (0: N.O.; 1: N.C.)	0000h
02-13	Multi-function output 1 RLY1	0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (Pr.02-22) 4: Desired frequency reached 2 (Pr.02-24) 5: Zero speed (Frequency command) 6: Zero speed including STOP (Frequency command) 7: Over-torque 1 (Pr.06-06–06-08) 8: Over-torque 2 (Pr.06-09–06-11) 9: Drive is ready 10: Low voltage warning (Lv) (Pr.06-00) 11: Malfunction indication 12: Mechanical brake release (Pr.02-32) 13: Over-heat warning (Pr.06-15) 14: Software brake signal indication (Pr.07-00) 15: PID feedback error (Pr.08-13, Pr.08-14) 16: Slip error (oSL) 17: Count value reached, does not return to 0 (Pr.02-20) 18: Count value reached, returns to 0 (Pr.02-19) 19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage 22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation mode	11
02-14	Multi-function output 2 RLY2		1
02-15	Multi-function output 3 RLY3		66
02-36	Output terminal of the I/O extension card (MO10) or (RA10)		0
02-37	Output terminal of I/O extension card (MO11) or (RA11)		0
02-38	Output terminal of I/O extension card (RA12)		0
02-39	Output terminal of I/O extension card (RA13)		0
02-40	Output terminal of I/O extension card (RA14)		0
02-41	Output terminal of I/O extension card (RA15)		0
02-42	Output terminal of I/O extension card (MO16 virtual terminal)		0
02-43	Output terminal of I/O extension card (MO17 virtual terminal)		0
02-44	Output terminal of I/O extension card (MO18 virtual terminal)		0
02-45	Output terminal of I/O extension card (MO19 virtual terminal)		0
02-46	Output terminal of I/O extension card (MO20 virtual terminal)		0

	Pr.	Parameter Name	Setting Range	Default
			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: Y-connection for the motor coil 32: ∆-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed include stop (actual output frequency) 35: Error output selection 1 (Pr.06-23) 36: Error output selection 2 (Pr.06-24) 37: Error output selection 3 (Pr.06-25) 38: Error output selection 4 (Pr.06-26) 40: Speed reached (including stop) 44: Low current output (use with Pr.06-71–06-73) 45: UVW output electromagnetic valve switch 46: Master dEb output 50: Output control for CANopen 51: Analog output control for RS-485 interface (InnerCOM / Modbus) 52: Output control for communication cards 53: Fire mode indication 54: Bypass fire mode indication 55: Motor 1 output 56: Motor 2 output 57: Motor 3 output 58: Motor 4 output 59: Motor 5 output 60: Motor 6 output 61: Motor 7 output 62: Motor 8 output 66: SO output logic A 67: Analog input level reached 68: SO output logic B 69: Preheating output indication 70: FAN warning output	
✓	02-18	Multi-function output direction	0000h–FFFFh (0: N.O.; 1: N.C.)	0000h
✓	02-19	Terminal counting value reached (returns to 0)	0–65500	0
✓	02-20	Preliminary counting value reached (does not return to 0)	0–65500	0
✓	02-22	Desired frequency reached 1	0.00–599.00 Hz	60.00 / 50.00
✓	02-23	The width of the desired frequency reached 1	0.00–599.00 Hz	2.00
✓	02-24	Desired frequency reached 2	0.00–599.00 Hz	60.00 / 50.00

Pr.	Parameter Name	Setting Range	Default
02-25	The width of the desired frequency reached 2	0.00–599.00 Hz	2.00
02-32	Brake delay time	0.000–65.000 sec.	0.000
02-33	Output current level setting for multi-function output terminal	0–150%	0
02-34	Output frequency setting for multi-function output terminal	0.00–599.00 Hz	3.00
02-35	External operation control selection after reset and activate	0: Disable 1: Drive runs if the RUN command remains after reset or reboot	0
02-50	Display the status of multi-function input terminal	Monitor the status of multi-function input terminals	Read only
02-51	Display the status of multi-function output terminal	Monitor the status of multi-function output terminals	Read only
02-52	Display the external multi-function input terminals used by PLC	Monitor the status of PLC input terminals	Read only
02-53	Display the external multi-function output terminals used by PLC	Monitor the status of PLC output terminals	Read only
02-54	Display the frequency command executed by external terminal	0.00–599.00 Hz (Read only)	Read only
02-70	IO card types	1: EMC-BPS01 4: EMC-D611A 5: EMC-D42A 6: EMC-R6AA 11: EMC-A22A	Read only
02-72	Preheating output current level	0–100%	0
02-73	Preheating output cycle	0–100%	0

03 Analog Input / Output Parameters

	Pr.	Parameter Name	Setting Range	Default
✓	03-00	Analog input selection (AVI1)	0: No function 1: Frequency command (speed limit under torque control mode) 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 11: PT100 thermistor input value 13: PID compensation value	1
✓	03-01	Analog input selection (ACI)		0
✓	03-02	Analog input selection (AVI2)		0
✓	03-03	Analog input bias (AVI1)	-100.0–100.0%	0.0
✓	03-04	Analog input bias (ACI)		
✓	03-05	Analog positive voltage input bias (AVI2)		
✓	03-07	Positive / negative bias mode (AVI1)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0
✓	03-08	Positive / negative bias mode (ACI)		
✓	03-09	Positive / negative bias mode (AVI2)		
✓	03-10	Reverse setting when analog signal input is negative frequency	0: Negative frequency is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency is allowed. Positive frequency = run in forward direction; negative frequency = run in reverse direction. The digital keypad or external terminal control cannot switch the running direction.	0
✓	03-11	Analog input gain (AVI1)	-500.0–500.0%	100.0
✓	03-12	Analog input gain (ACI)		
✓	03-13	Analog positive input gain (AVI2)		
✓	03-14	Analog negative input gain (AVI2)		
✓	03-15	Analog input filter time (AVI1)	0.00–20.00 sec.	0.01
✓	03-16	Analog input filter time (ACI)		
✓	03-17	Analog input filter time (AVI2)		
✓	03-18	Analog input addition function	0: Disable (AVI1, ACI, AVI2) 1: Enable	0
	03-19	Signal loss selection for analog input 4–20 mA	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display ACE	0
✓	03-20	Multi-function output 1 (AFM1)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage	0
✓	03-23	Multi-function output 2 (AFM2)		0

Pr.	Parameter Name	Setting Range	Default
		6: Power factor 7: Power 9: AVI1% 10: ACI% 11: AVI2% 20: CANopen analog output 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage output	
03-21	Analog output gain 1 (AFM1)	0.0–500.0%	100.0
03-22	Analog output 1 in REV direction (AFM1)	0: Absolute value of output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	0
03-24	Analog output gain 2 (AFM2)	0.0–500.0%	100.0
03-25	Analog output 2 in REV direction (AFM2)	0: Absolute value of output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	0
03-27	AFM2 output bias	-100.00–100.00%	0.00
03-28	AVI1 terminal input selection	0: 0–10 V 1: 0–20 mA 2: 4–20 mA	0
03-29	ACI terminal input selection	0: 4–20 mA 1: 0–10 V 2: 0–20 mA	0
03-30	PLC analog output terminal status	Monitor the status of PLC analog output terminals	Read only
03-31	AFM2 output selection	0: 0–20 mA output 1: 4–20 mA output	0
03-32	AFM1 DC output setting level	0.00–100.00%	0.00
03-33	AFM2 DC output setting level		
03-34	AFM1 output selection	0: 0–20 mA output 1: 4–20 mA output	0
03-35	AFM1 filter output time	0.00–20.00 sec.	0.01
03-36	AFM2 filter output time		
03-44	Multi-function MO output by AI level source	0: AVI1 1: ACI 2: AVI2	0
03-45	AI upper level	-100.00–100.00%	50.00
03-46	AI lower level	-100.00–100.00%	10.00
03-50	Analog input curve selection	0: Regular curve 1: Three-point curve of AVI1 2: Three-point curve of ACI 3: Three-point curve of AVI1 & ACI 4: Three-point curve of AVI2 5: Three-point curve of AVI1 & AVI2 6: Three-point curve of ACI & AVI2 7: Three-point curve of AVI1 & ACI & AVI2	7

	Pr.	Parameter Name	Setting Range	Default
✓	03-51	AVI1 lowest point	Pr.03-28 = 0, 0.00–10.00 V Pr.03-28 = 1, 0.00–20.00 mA Pr.03-28 = 2, 0.00–20.00 mA	0.00 0.00 4.00
✓	03-52	AVI1 proportional lowest point	-100.00–100.00%	0.00
✓	03-53	AVI1 mid-point	Pr.03-28 = 0, 0.00–10.00 V Pr.03-28 = 1, 0.00–20.00 mA Pr.03-28 = 2, 0.00–20.00 mA	5.00 10.00 12.00
✓	03-54	AVI1 proportional mid-point	-100.00–100.00%	50.00
✓	03-55	AVI1 highest point	Pr.03-28 = 0, 0.00–10.00 V Pr.03-28 = 1, 0.00–20.00 mA Pr.03-28 = 2, 0.00–20.00 mA	10.00 20.00 20.00
✓	03-56	AVI1 proportional highest point	-100.00–100.00%	100.00
✓	03-57	ACI lowest point	Pr.03-29 = 0, 0.00–20.00 mA Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 = 2, 0.00–20.00 mA	4.00 0.00 0.00
✓	03-58	ACI proportional lowest point	-100.00–100.00%	0.00
✓	03-59	ACI mid-point	Pr.03-29 = 0, 0.00–20.00 mA Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 = 2, 0.00–20.00 mA	12.00 5.00 10.00
✓	03-60	ACI proportional mid-point	-100.00–100.00%	50.00
✓	03-61	ACI high point	Pr.03-29 = 0, 0.00–20.00 mA Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 = 2, 0.00–20.00 mA	20.00 10.00 20.00
✓	03-62	ACI proportional highest point	-100.00–100.00%	100.00
✓	03-63	Positive AVI2 voltage lowest point	0.00–10.00 V	0.00
✓	03-64	Positive AVI2 proportional lowest point	-100.00–100.00%	0.00
✓	03-65	Positive AVI2 voltage mid-point	0.00–10.00 V	5.00
✓	03-66	Positive AVI2 proportional mid-point	-100.00–100.00%	50.00
✓	03-67	Positive AVI2 voltage highest point	0.00–10.00 V	10.00
✓	03-68	Positive AVI2 proportional highest point	-100.00–100.00%	100.00

04 Multi-step Speed Parameters

Pr.	Parameter Name	Setting Range	Default
04-00	1st step speed frequency	0.00–599.00 Hz	0.00
04-01	2nd step speed frequency	0.00–599.00 Hz	0.00
04-02	3rd step speed frequency	0.00–599.00 Hz	0.00
04-03	4th step speed frequency	0.00–599.00 Hz	0.00
04-04	5th step speed frequency	0.00–599.00 Hz	0.00
04-05	6th step speed frequency	0.00–599.00 Hz	0.00
04-06	7th step speed frequency	0.00–599.00 Hz	0.00
04-07	8th step speed frequency	0.00–599.00 Hz	0.00
04-08	9th step speed frequency	0.00–599.00 Hz	0.00
04-09	10th step speed frequency	0.00–599.00 Hz	0.00
04-10	11th step speed frequency	0.00–599.00 Hz	0.00
04-11	12th step speed frequency	0.00–599.00 Hz	0.00
04-12	13th step speed frequency	0.00–599.00 Hz	0.00
04-13	14th step speed frequency	0.00–599.00 Hz	0.00
04-14	15th step speed frequency	0.00–599.00 Hz	0.00
04-50	PLC buffer 0	0–65535	0
04-51	PLC buffer 1	0–65535	0
04-52	PLC buffer 2	0–65535	0
04-53	PLC buffer 3	0–65535	0
04-54	PLC buffer 4	0–65535	0
04-55	PLC buffer 5	0–65535	0
04-56	PLC buffer 6	0–65535	0
04-57	PLC buffer 7	0–65535	0
04-58	PLC buffer 8	0–65535	0
04-59	PLC buffer 9	0–65535	0
04-60	PLC buffer 10	0–65535	0
04-61	PLC buffer 11	0–65535	0
04-62	PLC buffer 12	0–65535	0
04-63	PLC buffer 13	0–65535	0
04-64	PLC buffer 14	0–65535	0
04-65	PLC buffer 15	0–65535	0
04-66	PLC buffer 16	0–65535	0
04-67	PLC buffer 17	0–65535	0
04-68	PLC buffer 18	0–65535	0
04-69	PLC buffer 19	0–65535	0
04-70	PLC Application parameter 0	0–65535	0
04-71	PLC Application parameter 1	0–65535	0
04-72	PLC Application parameter 2	0–65535	0
04-73	PLC Application parameter 3	0–65535	0
04-74	PLC Application parameter 4	0–65535	0
04-75	PLC Application parameter 5	0–65535	0
04-76	PLC Application parameter 6	0–65535	0
04-77	PLC Application parameter 7	0–65535	0
04-78	PLC Application parameter 8	0–65535	0
04-79	PLC Application parameter 9	0–65535	0

	Pr.	Parameter Name	Setting Range	Default
✔	04-80	PLC Application parameter 10	0–65535	0
✔	04-81	PLC Application parameter 11	0–65535	0
✔	04-82	PLC Application parameter 12	0–65535	0
✔	04-83	PLC Application parameter 13	0–65535	0
✔	04-84	PLC Application parameter 14	0–65535	0
✔	04-85	PLC Application parameter 15	0–65535	0
✔	04-86	PLC Application parameter 16	0–65535	0
✔	04-87	PLC Application parameter 17	0–65535	0
✔	04-88	PLC Application parameter 18	0–65535	0
✔	04-89	PLC Application parameter 19	0–65535	0
✔	04-90	PLC Application parameter 20	0–65535	0
✔	04-91	PLC Application parameter 21	0–65535	0
✔	04-92	PLC Application parameter 22	0–65535	0
✔	04-93	PLC Application parameter 23	0–65535	0
✔	04-94	PLC Application parameter 24	0–65535	0
✔	04-95	PLC Application parameter 25	0–65535	0
✔	04-96	PLC Application parameter 26	0–65535	0
✔	04-97	PLC Application parameter 27	0–65535	0
✔	04-98	PLC Application parameter 28	0–65535	0
✔	04-99	PLC Application parameter 29	0–65535	0

05 Motor Parameters

	Pr.	Parameter Name	Setting Range	Default
	05-00	Motor parameter auto tuning	0: No function 1: Simple rolling auto-tuning test for induction motor (IM) 2: Static auto-tuning for induction motor (IM) 5: Rolling auto-tuning for PM (IPM / SPM) 13: Static auto-tuning for PM (IPM / SPM)	0
	05-01	Full-load current for induction motor 1 (A)	Depending on the model power	Depending on the model power
✓	05-02	Rated power for induction motor 1 (kW)	0.00–655.35 kW	Depending on the model power
✓	05-03	Rated speed for induction motor 1 (rpm)	0–xxxx rpm (Depending on the number of motor poles) 1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)	Depending on the number of motor poles
	05-04	Number of poles for induction motor 1	2–64	4
	05-05	No-load current for induction motor 1 (A)	0.00–Pr.05-01 default	Depending on the model power
	05-06	Stator resistance (Rs) for induction motor 1	0.000–65.535 Ω	Depending on the model power
	05-07	Rotor resistance (Rr) for induction motor 1	0.000–65.535 Ω	0.000
	05-08	Magnetizing inductance (Lm) for induction motor 1	0.0–6553.5 mH	0.0
	05-09	Stator inductance (Lx) for induction motor 1	0.0–6553.5 mH	0.0
	05-13	Full-load current for induction motor 2 (A)	Depending on the model power	Depending on the model power
✓	05-14	Rated power for induction motor 2 (kW)	0.00–655.35 kW	Depending on the model power
✓	05-15	Rated speed for induction motor 2 (rpm)	0–xxxx rpm (Depending on the number of motor poles) 1710 (60 Hz 4 poles) ; 1410 (50 Hz 4 poles)	Depending on the number of motor poles
	05-16	Number of poles for induction motor 2	2–64	4
	05-17	No-load current for induction motor 2 (A)	0.00–Pr.05-13 default	Depending on the model power
	05-18	Stator resistance (Rs) for induction motor 2	0.000–65.535 Ω	Depending on the model power
	05-19	Rotor resistance (Rr) for induction motor 2	0.000–65.535 Ω	0.000
	05-20	Magnetizing inductance (Lm) for induction motor 2	0.0–6553.5 mH	0.0

	Pr.	Parameter Name	Setting Range	Default
	05-21	Stator inductance (Lx) for induction motor 2	0.0–6553.5 mH	0.0
	05-22	Induction motor 1 / 2 selection	1: Motor 1 2: Motor 2	1
✎	05-23	Frequency for Y-connection / Δ-connection switch for an induction motor	0.00–599.00 Hz	60.00
	05-24	Y-connection / Δ-connection switch for induction motor	0: Disable 1: Enable	0
✎	05-25	Delay time for Y-connection / Δ-connection switch for an induction motor	0.000–60.000 sec.	0.200
	05-28	Accumulated Watt-hour for a motor (W-hour)	Read only	0.0
	05-29	Accumulated Watt-hour for a motor in low word (kW-hour)	Read only	0.0
	05-30	Accumulated Watt-hour for a motor in high word (MW-hour)	Read only	0.0
	05-31	Accumulated motor operation time (Min.)	0–1439	0
	05-32	Accumulated motor operation time (Day)	0–65535	0
	05-33	Induction motor (IM) or permanent magnet Synchronous AC motor (PM) selection	0: IM (Induction motor) 1: SPM (Surface permanent magnet synchronous AC motor) 2: IPM (Interior permanent magnet synchronous AC motor)	0
	05-34	Full-load current for a permanent magnet Synchronous AC motor	Depending on the model power	Depending on the model power
✎	05-35	Rated power for a permanent magnet Synchronous AC motor	0.00–655.35 kW	Depending on the motor power
✎	05-36	Rated speed for a permanent magnet Synchronous AC motor	0–65535 rpm	2000
	05-37	Pole number for a permanent magnet Synchronous AC motor	0–65535	10
	05-38	System inertia for a permanent magnet Synchronous AC motor	0.0–6553.5 kg-cm^2	Depending on the motor power
	05-39	Stator resistance for a permanent magnet Synchronous AC motor	0.000–65.535 Ω	0.000
	05-40	Permanent magnet motor Synchronous AC Ld	0.00–655.35 mH	0.00
	05-41	Permanent magnet motor Synchronous AC Lq	0.00–655.35 mH	0.00
✎	05-43	Ke parameter for a permanent magnet Synchronous AC motor	0–65535 (Unit: V / krpm)	0

06 Protection Parameters

	Pr.	Parameter Name	Setting Range	Default
✎	06-00	Low voltage level	300.0–440.0 V_{DC}	360.0
✎	06-01	Over-voltage stall prevention	0.0–900.0 V_{DC}	760.0
✎	06-02	Selection for over-voltage stall prevention	0: Traditional over-voltage and traditional over-current stall prevention 1: Smart over-voltage and traditional over-current stall prevention 2: Traditional over-voltage and smart over-current stall prevention 3: Smart over-voltage and smart over-current stall prevention	0
✎	06-03	Over-current stall prevention during acceleration	Light load: 0–130% (100% corresponds to the rated current of the drive) Normal load: 0–160% (100% corresponds to the rated current of the drive)	120
✎	06-04	Over-current stall prevention during operation	Light load: 0–130% (100% corresponds to the rated current of the drive) Normal load: 0–160% (100% corresponds to the rated current of the drive)	120
✎	06-05	Acceleration / deceleration time selection for stall prevention at constant speed	0: By current acceleration / deceleration time 1: By the 1st acceleration / deceleration time 2: By the 2nd acceleration / deceleration time 3: By the 3rd acceleration / deceleration time 4: By the 4th acceleration / deceleration time 5: By auto acceleration / deceleration	0
✎	06-06	Over-torque detection selection (OT1)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
✎	06-07	Over-torque detection level (OT1)	10–200% (100% corresponds to the light-load rated current of the drive)	120
✎	06-08	Over-torque detection time (OT1)	0.0–60.0 sec.	0.1
✎	06-09	Over-torque detection selection (OT2)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
✎	06-10	Over-torque detection level (OT2)	10–200% (100% corresponds to the light-load rated current of the drive)	120
✎	06-11	Over-torque detection time (OT2)	0.0–60.0 sec.	0.1

	Pr.	Parameter Name	Setting Range	Default
⌿	06-13	Electronic thermal relay selection 1 (Motor 1)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disable	2
⌿	06-14	Electronic thermal relay action time 1 (Motor 1)	30.0–600.0 sec.	60.0
⌿	06-15	Temperature level over-heat (OH) warning	0.0–110.0°C	105.0
⌿	06-16	Stall prevention limit level (Weak magnetic area current stall prevention level)	0–100% (Pr.06-03, Pr.06-04)	50
	06-17	Fault record 1	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during constant speed (ocn) 4: Ground fault (GFF) 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: Phase loss protection (OrP) 16: IGBT over-heat (oH1) 17: Capacitance over-heat (oH2) 18: TH1 open: IGBT over-heat protection error (tH1o) 19: TH2 open: capacitance over-heat protection error (tH2o) 21: Drive over-load (oL) 22: Electronics thermal relay protection 1 (EoL1) 23: Electronics thermal relay protection 2 (EoL2) 24: Motor overheat (oH3) (PTC / PT100) 26: Over-torque 1 (ot1) 27: Over-torque 2 (ot2) 28: Low current (uC) 30: Memory write-in error (cF1) 31: Memory read-out error (cF2) 33: U-phase current detection error (cd1) 34: V-phase current detection error (cd2) 35: W-phase current detection error (cd3) 36: Clamp current detection error (Hd0) 37: Over-current detection error (Hd1) 38: Over-voltage detection error (Hd2) 39: IGBT short-circuit detection error (Hd3) 40: Auto-tuning error (AUE) 41: PID feedback loss (AFE)	0
	06-18	Fault record 2		0
	06-19	Fault record 3		0
	06-20	Fault record 4		0
	06-21	Fault record 5		0
	06-22	Fault record 6		0

Pr.	Parameter Name	Setting Range	Default
		48: Analog current input loss (ACE) 49: External fault input (EF) 50: Emergency stop (EF1) 51: External base block (bb) 52: Password error (Pcod) 53: Firmware version error 54: Communication error (CE1) 55: Communication error (CE2) 56: Communication error (CE3) 57: Communication error (CE4) 58: Communication time-out (CE10) 60: Brake transistor error (bF) 61: Y-connection / ∆-connection switch error (ydc) 62: Deceleration energy backup error (dEb) 63: Slip error (oSL) 64: Electromagnet switch error (ryF) 71: Watchdog 72: Channel 1 (STO1–SCM1) safety loop error (STL1) 73: External safety gate (S1) 74: FIRE mode output 76: Safe torque off (STO) 77: Channel 2 (STO2–SCM2) safety loop error (STL2) 78: Internal loop error (STL3) 79: Uoc (U-phase output short-circuit) 80: Voc (V-phase output short-circuit) 81: Woc (W-phase output short-circuit) 82: U phase output phase loss (OPHL) 83: V phase output phase loss (OPHL) 84: W phase output phase loss (OPHL) 89: RoPd initial rotor position detection error 90: Inner PLC function is forced to stop 93: CPU error 99: CPU instruction error（TRAP） 101: CANopen software disconnect 1 (CGdE) 102: CAN open software disconnect 2 (CHbE) 103: CANopen synchronous error (CSyE) 104: CANopen hardware disconnect (CbFE) 105: CANopen index setting error (CIdE) 106: CANopen slave station number setting error (CAdE) 107: CANopen index setting exceed limit (CFrE) 111: ictE Internal communication overtime error (InerCOM) 142: Auto-tuning error 1 (no feedback current error) (AUE1) 143: Auto-tuning error 2 (motor phase loss error) (AUE2) 144: Auto-tuning error 3 (no-load current I_0 measuring error) (AUE3)	

	Pr.	Parameter Name	Setting Range	Default
			148: Auto-tuning error 4 (leakage inductance Lsigma measuring error) (AUE4)	
✓	06-23	Fault output option 1	0–65535 (refer to bit table for fault code)	0
✓	06-24	Fault output option 2		
✓	06-25	Fault output option 3		
✓	06-26	Fault output option 4		
✓	06-27	Electronic thermal relay selection 2 (Motor 2)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disable	2
✓	06-28	Electronic thermal relay action time 2 (Motor 2)	30.0–600.0 sec.	60.0
✓	06-29	PTC detection selection / PT100 motion	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0
✓	06-30	PTC level	0.0–100.0%	50.0
	06-31	Frequency command at malfunction	0.00–599.00 Hz	Read only
	06-32	Output frequency at malfunction	0.00–599.00 Hz	Read only
	06-33	Output voltage at malfunction	0.0–6553.5 V	Read only
	06-34	DC voltage at malfunction	0.0–6553.5 V	Read only
	06-35	Output current at malfunction	0.0–6553.5 Amp	Read only
	06-36	IGBT temperature at malfunction	-3276.7–3276.7°C	Read only
	06-37	Capacitance temperature at malfunction	-3276.7–3276.7°C	Read only
	06-38	Motor speed at malfunction	-32767–32767 rpm	Read only
	06-40	Status of the multi-function input terminal at malfunction	0000h–FFFFh	Read only
	06-41	Status of the multi-function output terminal at malfunction	0000h–FFFFh	Read only
	06-42	Drive status at malfunction	0000h–FFFFh	Read only
✓	06-44	STO latch selection	0: STO latch 1: STO no latch	0
✓	06-45	Treatment to output phase loss protection (OPHL)	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	3
✓	06-46	Detection time of output phase loss	0.000–65.535 sec.	0.500
✓	06-47	Current detection level for output phase loss	0.00–100.00%	1.00

	Pr.	Parameter Name	Setting Range	Default
⚡	06-48	DC brake time of output phase loss	0.000–65.535 sec.	0.000
⚡	06-49	LvX auto-reset	0: Disable 1: Enable	0
⚡	06-50	Time for input phase loss detection	0.00–600.00 sec.	0.20
⚡	06-52	Ripple of input phase loss	0.0–200.0 V_{DC}	60.0
⚡	06-53	Detected input phase loss (OrP) action	0: Fault and ramp to stop 1: Fault and coast to stop	0
⚡	06-55	Derating protection	0: Constant rated current and limit carrier wave by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier wave 2: Constant rated current (same as setting 0), but close current limit	0
⚡	06-56	PT100 voltage level 1	0.000–10.000 V	5.000
⚡	06-57	PT100 voltage level 2	0.000–10.000 V	7.000
⚡	06-58	PT100 level 1 frequency protect	0.00–599.00 Hz	0.00
⚡	06-59	PT100 activation level 1 protect frequency delay time	0–6000 sec.	60
⚡	06-60	Software detection GFF current level	0.0–6553.5% (100% corresponds to the light-load rated current of the drive)	60.0
⚡	06-61	Software detection GFF filter time	0.00–655.35 sec.	0.10
	06-63	Operation time of fault record 1 (Day)	0–65535 days	Read only
	06-64	Operation time of fault record 1 (Minutes)	0–1439 min.	Read only
	06-65	Operation time of fault record 2 (Day)	0–65535 days	Read only
	06-66	Operation time of fault record 2 (Minutes)	0–1439 min.	Read only
	06-67	Operation time of fault record 3 (Day)	0–65535 days	Read only
	06-68	Operation time of fault record 3 (Minutes)	0–1439 min.	Read only
	06-69	Operation time of fault record 4 (Day)	0–65535 days	Read only
	06-70	Operation time of fault record 4 (Minutes)	0–1439 min.	Read only
⚡	06-71	Low current setting level	0.0–100.0% (100% corresponds to the light-load rated current of the drive)	0.0
⚡	06-72	Low current detection time	0.00–360.00 sec.	0.00
⚡	06-73	Low current action	0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the 2^{nd} deceleration time 3: Warn and continue operation	0
⚡	06-76	dEb motion offset	0.0–200.0 V_{DC}	40.0

	Pr.	Parameter Name	Setting Range	Default
	06-80	Fire mode	0: Disable 1: Operates in counter clockwise direction 2: Operates in clockwise direction	0
✓	06-81	Operating frequency when running fire mode	0.00–599.00 Hz	60.00
✓	06-82	Enable bypass on fire mode	0: Disable bypass 1: Enable bypass	0
✓	06-83	Bypass delay time on fire mode	0.0–6550.0 sec.	0.0
✓	06-84	Number of times of reset in fire mode	0–10	0
✓	06-85	Length of time of reset in fire mode	0.0–6000.0 sec.	60.0
	06-86	Fire mode motion	bit0: 0=Open Loop; 1=Close Loop (PID control) bit1: 0=Manual reset fire mode; 1=Auto reset fire mode 0: Open loop control and manual reset fire mode 1: Close loop control and manual reset fire mode 2: Open loop control and auto reset fire mode 3: Close loop control and auto reset fire mode	0
✓	06-87	Fire mode PID set point	0.00–100.00%	0.00

07 Special Parameters

	Pr.	Parameter Name	Setting Range	Default
ϟ	07-00	Built-in Software brake level	700.0–900.0 V_{DC}	740.0
ϟ	07-01	DC brake current level	0–100%	0
ϟ	07-02	DC brake time at run	0.0–60.0 sec.	0.0
ϟ	07-03	DC brake time at stop	0.0–60.0 sec.	0.0
ϟ	07-04	DC brake frequency at stop	0.00–599.00 Hz	0.00
ϟ	07-05	Voltage increasing gain	1–200%	100
ϟ	07-06	Restart after momentary power loss	0: Stop operation 1: Speed tracking by speed before the power loss 2: Speed tracking by minimum output frequency	0
ϟ	07-07	Allowed power loss duration	0.0–20.0 sec.	2.0
ϟ	07-08	Base block time	0.0–5.0 sec. (Depending on the model power)	Depending on the model power
ϟ	07-09	Current limit of speed tracking	20–200% (100% corresponds to the light-load rated current of the drive)	100
ϟ	07-10	Restart after fault action	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	0
ϟ	07-11	Number of times of restart after fault	0–10	0
ϟ	07-12	Speed tracking during start-up	0: Disable 1: Speed tracking by maximum output frequency 2: Speed tracking by motor frequency at start 3: Speed tracking by minimum output frequency	0
ϟ	07-13	dEb function selection	0: Disable 1: dEb with auto acceleration / deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored.	0
ϟ	07-15	Dwell time at acceleration	0.00–600.00 sec.	0.00
ϟ	07-16	Dwell frequency at acceleration	0.00–599.00 Hz	0.00
ϟ	07-17	Dwell time at deceleration	0.00–600.00 sec.	0.00
ϟ	07-18	Dwell frequency at deceleration	0.00–599.00 Hz	0.00
ϟ	07-19	Fan cooling control	0: Fan always ON 1: Fan is OFF after the AC motor drive stops for one minute 2: Fan is ON when AC motor drive runs; fan is OFF when AC motor drive stops 3: Fan turns ON when temperature (IGBT) reaches around 60°C. 4: Fan always OFF	0

Pr.	Parameter Name	Setting Range	Default
07-20	Emergency stop (EF) & force to stop selection	0: Coast to stop 1: Stop by the 1^{st} deceleration time 2: Stop by the 2^{nd} deceleration time 3: Stop by the 3^{rd} deceleration time 4: Stop by the 4^{th} deceleration time 5: System deceleration 6: Automatic deceleration	0
07-21	Automatic energy-saving selection	0: Disable 1: Enable	0
07-22	Energy-saving gain	10–1000%	100
07-23	Auto voltage regulation (AVR) function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0
07-24	Torque command filter time (V/F and SVC control mode)	0.001–10.000 sec.	0.500
07-25	Slip compensation filter time (V/F and SVC control mode)	0.001–10.000 sec.	0.100
07-26	Torque compensation gain (V/F control mode)	IM: 0–10 (when Pr.05-33 = 0) PM: 0–5000 (when Pr.05-33 = 1 or 2)	0
07-27	Slip compensation gain (V/F and SVC control mode)	0.00–10.00	0.00 (Default value is 1.00 in SVC mode)
07-29	Slip deviation level	0.0–100.0% 0：No detection	0.0
07-30	Over slip deviation detection time	0.0–10.0 sec.	1.0
07-31	Over slip deviation treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0
07-32	Motor shock compensation factor	0–10000 0: Disable	1000
07-33	Auto-restart internal of fault	0.0–6000.0 sec.	60.0
07-38	PMSVC voltage feedback forward gain	0.00–2.00	1.00
07-50	PWM fan speed	60–100%	60

08 High-function PID Parameters

	Pr.	Parameter Name	Setting Range	Default
✓	08-00	Terminal selection of PID feedback	0: No function 1: Negative PID feedback by analog input (Pr.03-00–03-02) 4: Positive PID feedback by analog input (Pr.03-00–03-02)	0
✓	08-01	Proportional gain (P)	0.0–100.0	1.0
✓	08-02	Integral time (I)	0.00–100.00 sec. 0.00: No integral	1.00
✓	08-03	Differential time (D)	0.00–1.00 sec.	0.00
✓	08-04	Upper limit of integral control	0.0–100.0%	100.0
✓	08-05	PID output command limit	0.0–110.0%	100.0
✓	08-06	PID feedback value by communication protocol	-200.00–200.00%	Read only
✓	08-07	PID delay time	0.0–35.0 sec.	0.0
✓	08-08	Feedback signal detection time	0.0–3600.0 sec.	0.0
✓	08-09	Feedback signal fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency	0
✓	08-10	Sleep frequency	0.00–599.00 Hz or 0–200.00%	0.00
✓	08-11	Wake-up frequency	0.00–599.00 Hz or 0–200.00%	0.00
✓	08-12	Sleep time	0.0–6000.0 sec.	0.0
✓	08-13	PID deviation level	1.0–50.0%	10.0
✓	08-14	PID deviation time	0.1–300.0 sec.	5.0
✓	08-15	PID feedback filter time	0.1–300.0 sec.	5.0
✓	08-16	PID compensation selection	0: Parameter setting (Pr.08-17) 1: Analog input	0
✓	08-17	PID compensation	-100.0–100.0%	0.0
	08-18	Sleep mode function setting	0: Refer to PID output command 1: Refer to PID feedback signal	0
✓	08-19	Wake-up integral limit	0.0–200.0%	50.0
	08-20	PID mode selection	0: Serial connection 1: Parallel connection	0
	08-21	Enable PID to change the operation direction	0: Operation direction cannot be changed 1: Operation direction can be changed	0
✓	08-22	Wake-up delay time	0.00–600.00 sec.	0.00

09 Communication Parameters

	Pr.	Parameter Name	Setting Range	Default
✓	09-00	COM1 communication address	1–254	1
✓	09-01	COM1 transmission speed	4.8–115.2 Kbps	9.6
✓	09-02	COM1 transmission fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault and continue operation	3
✓	09-03	COM1 time-out detection	0.0–100.0 sec.	0.0
✓	09-04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	1
✓	09-09	Communication response delay time	0.0–200.0 ms	2.0
	09-10	Communication main frequency	0.00–599.00 Hz	60.00
✓	09-11	Block transfer 1	0000–FFFFh	0000h
✓	09-12	Block transfer 2	0000–FFFFh	0000h
✓	09-13	Block transfer 3	0000–FFFFh	0000h
✓	09-14	Block transfer 4	0000–FFFFh	0000h
✓	09-15	Block transfer 5	0000–FFFFh	0000h
✓	09-16	Block transfer 6	0000–FFFFh	0000h
✓	09-17	Block transfer 7	0000–FFFFh	0000h
✓	09-18	Block transfer 8	0000–FFFFh	0000h
✓	09-19	Block transfer 9	0000–FFFFh	0000h
✓	09-20	Block transfer 10	0000–FFFFh	0000h
✓	09-21	Block transfer 11	0000–FFFFh	0000h
✓	09-22	Block transfer 12	0000–FFFFh	0000h
✓	09-23	Block transfer 13	0000–FFFFh	0000h
✓	09-24	Block transfer 14	0000–FFFFh	0000h
✓	09-25	Block transfer 15	0000–FFFFh	0000h
✓	09-26	Block transfer 16	0000–FFFFh	0000h
	09-30	Communication decoding method	0: Decoding method 1 (20xx) 1: Decoding method 2 (60xx)	1

	Pr.	Parameter Name	Setting Range	Default
	09-31	Internal communication protocol	1: BACnet 0: Modbus 485 -1: Internal communication Slave 1 -2: Internal communication Slave 2 -3: Internal communication Slave 3 -4: Internal communication Slave 4 -5: Internal communication Slave 5 -6: Internal communication Slave 6 -7: Internal communication Slave 7 -8: Internal communication Slave 8 -10: Internal communication Master -12: Internal PLC control	0
⌁	09-33	PLC command force to 0	bit0: Before PLC scans, set up PLC target frequency = 0	0000h
	09-35	PLC address	1–254	2
	09-36	CANopen slave address	0: Disable 1–127	0
	09-37	CANopen speed	0: 1 Mbps 1: 500 Kbps 2: 250 Kbps 3: 125 Kbps 4: 100 Kbps (Delta only) 5: 50 Kbps	0
	09-39	CANopen warning record	bit0: CANopen Guarding Time out bit1: CANopen heartbeat Time out bit2: CANopen SYNC Time out bit3: CANopen SDO Time out bit4: CANopen SDO buffer overflow bit5: Can Bus off bit6: Error protocol of CANopen bit8: The setting values of CANopen indexes are fail bit9: The setting value of CANopen address is fail bit10: The checksum value of CANopen indexes is fail	Read only
	09-40	CANopen decoding method	0: Disable (Delta-defined decoding method) 1: Enable (CANopen DS402 standard protocol)	1
	09-41	CANopen communication status	0: Node Reset 1: Com Reset 2: Boot up 3: Pre Operation 4: Operation 5: Stop	Read only
	09-42	CANopen control status	0: Not Ready for Use 1: Inhibit Start 2: Ready to Switch on 3: Switched on	Read only

Pr.	Parameter Name	Setting Range	Default
		4: Enable Operation 7: Quick Stop Active 13: Error Reaction Active 14: Error	
09-45	CANopen master function	0: Disable 1: Enable	0
09-46	CANopen master address	0–127	100
09-50	BACnet MS / TP node address	0–127	10
09-51	BACnet baud rate	9.6–76.8 Kbps	38.4
09-52	BACnet Device index L	0–65535	10
09-53	BACnet Device index H	0–63	0
09-55	BACnet Max Address	0–127	127
09-56	BACnet password	0–65535	0
09-60	Communication card identifications	0: No communication card 1: DeviceNet slave 2: Profibus-DP slave 3: CANopen slave / master 4: Modbus–TCP Slave 5: EtherNet/IP Slave 8: BACnet IP 12: PROFINET	Read only
09-61	Firmware version of communication card	Read only	Read only
09-62	Product code	Read only	Read only
09-63	Fault code	Read only	Read only
09-70	Communication card address (for DeviceNet or PROFIBUS)	DeviceNet: 0–63 Profibus-DP: 1–125	1
09-71	Communication card speed setting (for DeviceNet)	Standard DeviceNet: 0: 125 Kbps 1: 250 Kbps 2: 500 Kbps 3: 1 Mbps (Delta only) Non-standard DeviceNet: (Delta only) 0: 10 Kbps 1: 20 Kbps 2: 50 Kbps 3: 100 Kbps 4: 125 Kbps 5: 250 Kbps 6: 500 Kbps 7: 800 Kbps 8: 1 Mbps	2
09-72	Additional settings for communication card speed (for DeviceNet)	0: Standard DeviceNet In this mode, baud rate can only be 125 Kbps, 250 Kbps, 500 Kbps in standard DeviceNet speed	0

	Pr.	Parameter Name	Setting Range	Default
			1: Non-standard DeviceNet In this mode, the baud rate of DeviceNet can be the same as CANopen (0–8).	
✓	09-75	Communication card IP configuration (for Modbus TCP)	0: Static IP 1: Dynamic IP (DHCP)	0
✓	09-76	Communication card IP address 1 (for Modbus TCP)	0–65535	0
✓	09-77	Communication card IP address 2 (for Modbus TCP)	0–65535	0
✓	09-78	Communication card IP address 3 (for Modbus TCP)	0–65535	0
✓	09-79	Communication card IP address 4 (for Modbus TCP)	0–65535	0
✓	09-80	Communication card address mask 1 (for Modbus TCP)	0–65535	0
✓	09-81	Communication card address mask 2 (for Modbus TCP)	0–65535	0
✓	09-82	Communication card address mask 3 (for Modbus TCP)	0–65535	0
✓	09-83	Communication card address mask 4 (for Modbus TCP)	0–65535	0
✓	09-84	Communication card gateway address 1 (for Modbus TCP)	0–65535	0
✓	09-85	Communication card gateway address 2 (for Modbus TCP)	0–65535	0
✓	09-86	Communication card gateway address 3 (for Modbus TCP)	0–65535	0
✓	09-87	Communication card gateway address 4 (for Modbus TCP)	0–65535	0
✓	09-88	Communication card password (Low word) (for Modbus TCP)	0–99	0
✓	09-89	Communication card password (High word) (for Modbus TCP)	0–99	0
✓	09-90	Reset communication card (for Modbus TCP)	0: Disable 1: Reset, return to default	0
✓	09-91	Additional settings for the communication card (for Modbus TCP)	bit0: Enable IP filter bit1: Enable internet parameters (1 bit). When IP address is set, this bit is enabled. After updating the communication card parameters, this bit changes to disabled. bit2: Enable login password (1 bit). When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to disabled.	0

Pr.	Parameter Name	Setting Range	Default
09-92	Communication card status (for Modbus TCP)	bit0: Enable password When the communication card is set with password; this bit is enabled. When the password is cleared; this bit is disabled.	0

10 Sensorless Motor Control Parameters

	Pr.	Parameter Name	Setting Range	Default
✓	10-31	I/F mode, current command	0–150% of motor rated current	40
✓	10-32	PM FOC sensorless speed estimator bandwidth	0.00–600.00 Hz	5.00
✓	10-34	PM sensorless speed estimator low-pass filter gain	0.00–655.35	1.00
✓	10-39	Frequency point to switch from I/F mode to PM sensorless mode	0.00–599.00 Hz	20.00
✓	10-40	Frequency point to switch from PM sensorless mode to I/F mode	0.00–599.00 Hz	20.00
✓	10-41	I/F mode, Id current low-pass filter time	0.0–6.0 sec.	0.2
✓	10-42	Initial angle detection pulse value	0.0–3.0	1.0
✓	10-49	Zero voltage time during start-up	0.000–60.000 sec.	0.000
✓	10-51	Injection frequency	0–1200 Hz	500
✓	10-52	Injection magnitude	0.0–200.0 V	30.0
✓	10-53	PM initial rotor position detection method	0: Disable 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	0

11 Advanced Parameters

Group 11 Advanced Parameters are reserved.

12 PUMP Parameters

Pr.	Parameter Name	Setting Range	Default
12-00	Circulation Control	0: No operation 1: Fixed time circulation (by time) 2: Fixed quantity circulation 3: Fixed quantity control 4: Fixed time circulation + fixed quantity circulation 5: Fixed time circulation + fixed quantity control	0
12-01	Number of Motors to be connected	1–8	1
12-02	Operating time for each motor (minutes)	0–65500 min.	0
12-03	Delay time due to the acceleration (or the increment) at motor switching (seconds)	0.0–3600.0 sec.	1.0
12-04	Delay time due to the deceleration (or the decrement) at motor switching (seconds)	0.0–3600.0 sec.	1.0
12-05	Delay time due to fixed quantity circulation at motor switching (seconds)	0.0–3600.0 sec.	10.0
12-06	Frequency when switching motors at fixed quantity circulation (Hz)	0.00–599.00 Hz	60.0
12-07	Action when fixed 1uantity circulation breaks down	0: Turn off all output 1: Motors powered by mains electricity continues to operate	0
12-08	Frequency for stopping auxiliary motor (Hz)	0.00–599.00 Hz	0.00
12-09	Fixed quantity circulation output delay	1.0–3600.0 sec.	1.0
12-10	Motor 1 operation record (min./sec.)	Read only	Read only
12-11	Motor 1 operation record (hour)	Read only	Read only
12-12	Motor 2 operation record (min./sec.)	Read only	Read only
12-13	Motor 2 operation record (hour)	Read only	Read only
12-14	Motor 3 operation record (min./sec.)	Read only	Read only
12-15	Motor 3 operation record (hour)	Read only	Read only
12-16	Motor 4 operation record (min./sec.)	Read only	Read only
12-17	Motor 4 operation record (hour)	Read only	Read only

Pr.	Parameter Name	Setting Range	Default
12-18	Motor 5 operation record (min./sec.)	Read only	Read only
12-19	Motor 5 operation record (hour)	Read only	Read only
12-20	Motor 6 operation record (min./sec.)	Read only	Read only
12-21	Motor 6 operation record (hour)	Read only	Read only
12-22	Motor 7 operation record (min./sec.)	Read only	Read only
12-23	Motor 7 operation record (hour)	Read only	Read only
12-24	Motor 8 operation record (min./sec.)	Read only	Read only
12-25	Motor 8 operation record (hour)	Read only	Read only
12-26	Clear motor's operation time	0: No function 1: Clear operation time for motor 1 2: Clear operation time for motor 2 3: Clear operation time for motor 3 4: Clear operation time for motor 4 5: Clear operation time for motor 5 6: Clear operation time for motor 6 7: Clear operation time for motor 7 8: Clear operation time for motor 8 10: Clear operation time for all motors	0
12-27	Priority for circulated operation	0: Terminal order 1: Minimum operation time	0

13 Application Parameters by Industry

Pr.	Parameter Name	Setting Range	Default
13-00	Industry Parameters combination	0: Disable 1: User-defined Parameter 2: Compressor (IM) 3: Fan 4: Pump 10: Air Handling Unit, AHU	0
13-01 | 13-99	Industry Parameters 1–99	0.00–655.35	0.00

14 Extension Card Parameter

	Pr.	Parameter Name	Setting Range	Default
✓	14-00	Extension card Input terminal selection (AI10)	0: Disable 1: Frequency command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 11: PT100 thermistor input value 13: PID compensation amount	0
✓	14-01	Extension card Input terminal selection (AI11)		0
✓	14-08	Analog input filter time (AI10)	0.00–20.00 sec.	0.01
✓	14-09	Analog input filter time (AI11)	0.00–20.00 sec.	0.01
	14-10	Analog input 4–20 mA signal loss selection (AI10)	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display ACE	0
	14-11	Analog input 4–20 mA signal loss selection (AI11)		0
✓	14-12	Extension card output terminal selection (AO10)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 9: AVI1 proportional 10: ACI proportional 11: AVI2 proportional 20: CANopen analog output 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage output	0
✓	14-13	Extension card output terminal selection (AO11)		0
✓	14-14	Analog output 1 gain output (AO10)	0.0–500.0%	100.0
✓	14-15	Analog output 1 gain output (AO11)	0.0–500.0%	100.0
✓	14-16	Analog output 1 in REV direction (AO10)	0: Absolute value of output voltage 1: Reverse output 0 V; Forward output 0–10 V 2: Reverse output 5–0 V; Forward output 5–10 V	0
✓	14-17	Analog output 1 in REV direction (AO11)		0

	Pr.	Parameter Name	Setting Range	Default
ᴎ	14-18	Extension card input selection (AI10)	0: 0–10 V (AVI10) 1: 0–20 mA (ACI10) 2: 4–20 mA (ACI10)	0
ᴎ	14-19	Extension card input selection (AI11)	0: 0–10 V (AVI11) 1: 0–20 mA (ACI11) 2: 4–20 mA (ACI11)	0
	14-20	AO10 DC output setting level	0.00–100.00%	0.00
	14-21	AO11 DC output setting level	0.00–100.00%	0.00
ᴎ	14-22	AO10 filter output time	0.00–20.00 sec.	0.01
ᴎ	14-23	AO11 filter output time	0.00–20.00 sec.	0.01
ᴎ	14-36	AO10 output selection	0: 0–10 V 1: 0–20 mA 2: 4–20 mA	0
ᴎ	14-37	AO11 output selection		0

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Chapter 12 Description of Parameter Settings

12-1 Description of parameter settings

00 Drive Parameters

✓ This parameter can be set during operation.

00-00 Identity Code of the AC Motor Drive

Default: Read only

Settings Read only

00-01 Display AC Motor Drive Rated Current

Default: Read only

Settings Read only

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

📖 The default is the rated current for light load. Set Pr.00-16 to 1 to display the rated current for normal load.

Frame	A							B	
kW	0.75	1.5	2.2	3.7	4.0	5.5	7. 5	11	15
HP	1	2	3	5	5.5	7.5	10	15	20
Identity code	5	7	9	11	93	13	15	17	19
Rated current for light load [A]	3	4.2	5.5	8.5	10.5	13	18	24	32
Rated current for normal load [A]	1.7	3.0	4.0	6.0	9.0	10.5	12	18	24

Frame	B		C		D0		D	
kW	18.5	22	30	37	45	55	75	90
HP	25	30	40	50	60	75	100	125
Identity code	21	23	25	27	29	31	33	35
Rated current for light load [A]	38	45	60	73	91	110	150	180
Rated current for normal load [A]	32	38	45	60	73	91	110	150

00-02 Parameter Reset

Default: 0

Settings 0: No Function
1: Write protection for parameters
5: Reset kWh display to 0
6: Reset PLC (including CANopen Master Index)
7: Reset CANopen Index (Slave)
9: Reset all parameters to defaults with base frequency at 50 Hz
10: Reset all parameters to defaults with base frequency at 60 Hz

📖 When set to 1, all parameters are read only except Pr.00-02, Pr.00-07 and Pr.00-08. Set Pr.00-02 to 0 before changing other parameter settings.

📖 When set to 5, kWh displayed value can be reset to 0 even when the drive is operating. Pr.05-26, Pr.05-27, Pr.05-28, Pr.05-29 and Pr.05-30 are reset to 0.

- When set to 6, clear internal PLC program (includes the related settings of PLC internal CANopen master)
- When set to 7, reset the related settings of CANopen slave.
- When set to 9 or 10, reset all parameters to defaults. If there is a password set in Pr.00-08, enter the password set in Pr.00-07 to reset to default.
- When it is set to 6, 7, 9 and 10, reboot the motor drive after setting.

00-03 Start-up Display Selection

Default: 0

Settings
0: F (Frequency command)
1: H (Output frequency)
2: U (User defined)
3: A (Output current)

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

00-04 Content of Multi-function Display

Default: 3

Settings
0: Display output current (A) (Unit: Amp)
1: Display counter value (c) (Unit: CNT)
2: Display actual output frequency (H) (Unit: Hz)
3: Display DC bus voltage (v) (Unit: V_{DC})
4: Display output voltage (E) (Unit: V_{AC})
5: Display output power angle (n) (Unit: deg)
6: Display output power in kW (P) (Unit: kW)
7: Display actual motor speed rpm (Unit: rpm)
10: Display PID feedback (b) (Unit: %)
11: Display AVI1 in % (1.) (Unit: %)
12: Display ACI in % (2.) (Unit: %)
13: Display AVI2 in % (3.) (Unit: %)
14: Display the temperature of IGBT (i.) (Unit: °C)
15: Display the temperature of capacitance (c.) (Unit: °C)
16: The status of digital input (ON/OFF) (i)
17: The status of digital output (ON/OFF) (o)
18: Multi-step speed (S)
19: The corresponding CPU pin status of digital input (d)
20: The corresponding CPU pin status of digital output (0.)
26: Ground Fault GFF (G.) (Unit: %)
27: DC bus voltage ripple (r.) (Unit: V_{DC})
28: Display PLC register D1043 data (C)
30: Display output of user defined (U)
31: Display Pr.00-05 user Gain (K)

34: Operation speed of fan (F.) (Unit: %)
36: Present operating carrier frequency of drive (Hz) (J.)
38: Display drive status (6.)
41: kWh display (J) (Unit: kWh)
42: PID reference (h) (Unit: %)
43: PID offset (o.) (Unit: %)
44: PID output frequency (b.) (Unit: Hz)
45: Hardware ID
51: PMSVC torque offset
52: AI10%
53: AI11%
68: STO version
69: STO checksum high
70: STO checksum low

Explanation 1

It can display negative values when setting analog input bias (Pr.03-03–03-10).

Example: Assume that AVI1 input voltage is 0 V, Pr.03-03 is 10.0% and Pr.03-07 is 4 (Bias serves as the center).

Explanation 2

Example: If REV, MI1 and MI6 are ON, the following table shows the status of the terminals.

Normally opened contact (N.O.), 0: OFF, 1: ON

Terminal	MI15	MI14	MI13	MI12	MI11	MI10	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD
Status	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0

- MI10–MI15 are the terminals for extension cards (Pr.02-26–02-31).
- The value is 0000 0000 1000 0110 in binary and 0086h in HEX. When Pr.00-04 is set to 16 or 19, the u page on the keypad displays “0086h”.
- The setting value 16 is ON / OFF status of digital input according to Pr.02-12 setting, and the setting value 19 is the corresponding CPU pin ON / OFF status of the digital input.
- You can set 16 to monitor the digital input status, and then set 19 to check if the circuit is normal.

Explanation 3

Assume that RY1: Pr.02-13 is set to 9 (Drive ready). After the AC motor drive powers on, if there is no other abnormal status, the contact is ON. The display status is shown as below.

Normally opened contact (N.O.):

Terminal	MO20	MO19	MO18	MO17	MO16	MO15	MO14	MO13	MO12	MO11	MO10	Reserved	Reserved	RY3	RY2	RY1
Status	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

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

- You can set 17 to monitor the digital output status, and then set 20 to check if the circuit is normal.

📖 Explanation 4

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

📖 Explanation 5

Setting value 38:

bit 0: The drive is running forward.

bit 1: The drive is running backward.

bit 2: The drive is ready.

bit 3: Errors occurred on the drive.

bit 4: The drive is running.

bit 5: Warnings occurred on the drive.

✓ 00-05 Coefficient Gain in Actual Output Frequency

Default: 1.00

Settings 0.00–160.00

📖 Sets the user-defined unit coefficient gain. Set Pr.00-04= 31 to display the calculation result on the screen (calculation = output frequency * Pr.00-05).

00-06 Software Version

Default: Read only

Settings Read only

✓ 00-07 Parameter Protection Password Input

Default: 0

Settings 0–65535

Display 0–4 (the number of password attempts)

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

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

📖 Pr.00-07 and Pr.00-08 are used to prevent personnel from setting other parameters by accident.

📖 If you forget the password, clear the password setting by entering 9999 and press the ENTER key, then enter 9999 again and press ENTER within 10 seconds. After decoding, all the settings return to default.

📖 When setting is under password protection, all the parameters read 0, except Pr.00-08.

✓ 00-08 Parameter Protection Password Setting

Default: 0

Settings 0–65535

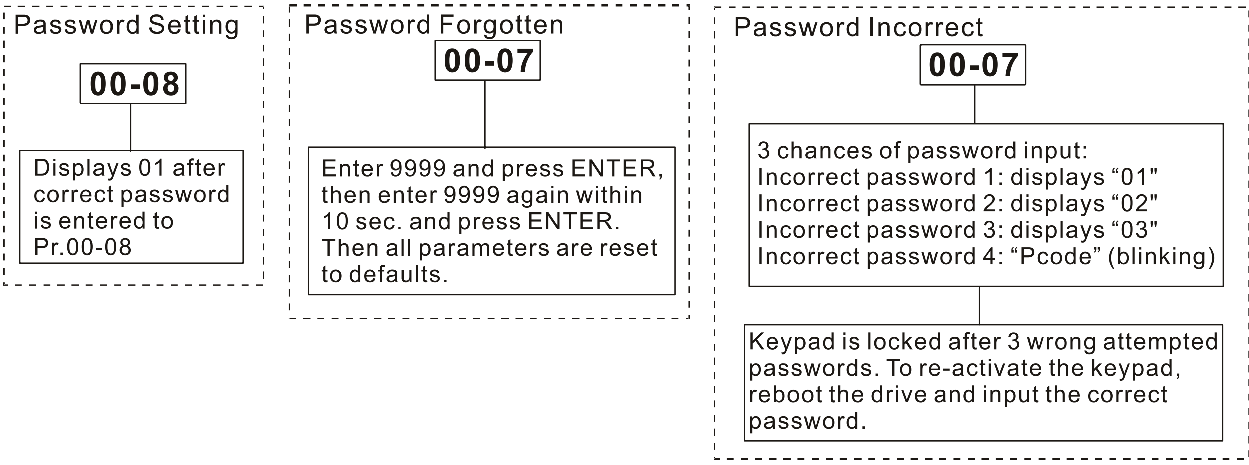
0: No password protection or password entered correctly (Pr.00-07)

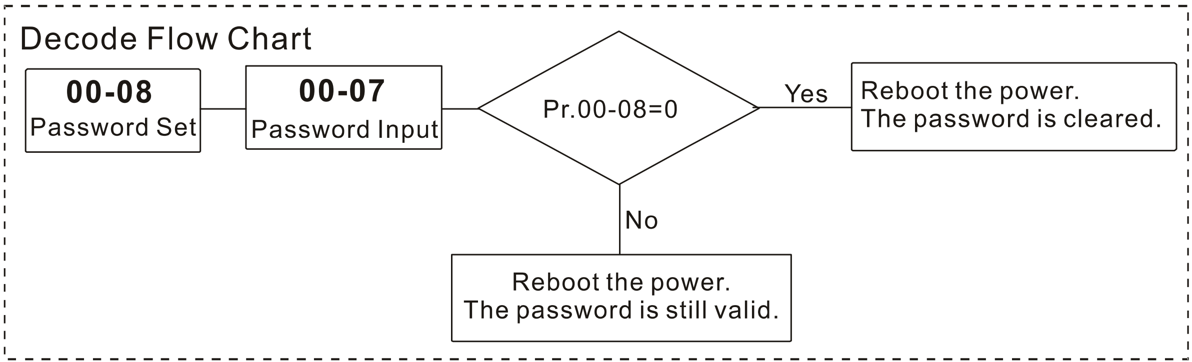
1: Password has been set

📖 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 1, which means password protection is activated. At this time, if you want to change any parameter settings, you must enter the correct password in Pr.00-07 to deactivate the password temporarily, and this would make Pr.00-08 become 0. After you finish setting the parameters, reboot the motor drive and the password is activated again.

- 🕮 Entering the correct password in Pr.00-07 only temporarily deactivates the password. To permanently deactivate password protection, set Pr.00-08 to 0 manually. Otherwise, password protection is always reactivated after you reboot the motor drive.
- 🕮 The keypad copy function works only when the password protection is deactivated (temporarily or permanently), and the password set in Pr.00-08 cannot be copied to the keypad. So when copying parameters from the keypad to the motor drive, set the password manually again to activate password protection.

Password Decode Flow Chart





00-11 Speed Control Mode

Default: 0

Settings 0: IMVF (IM V/F control)

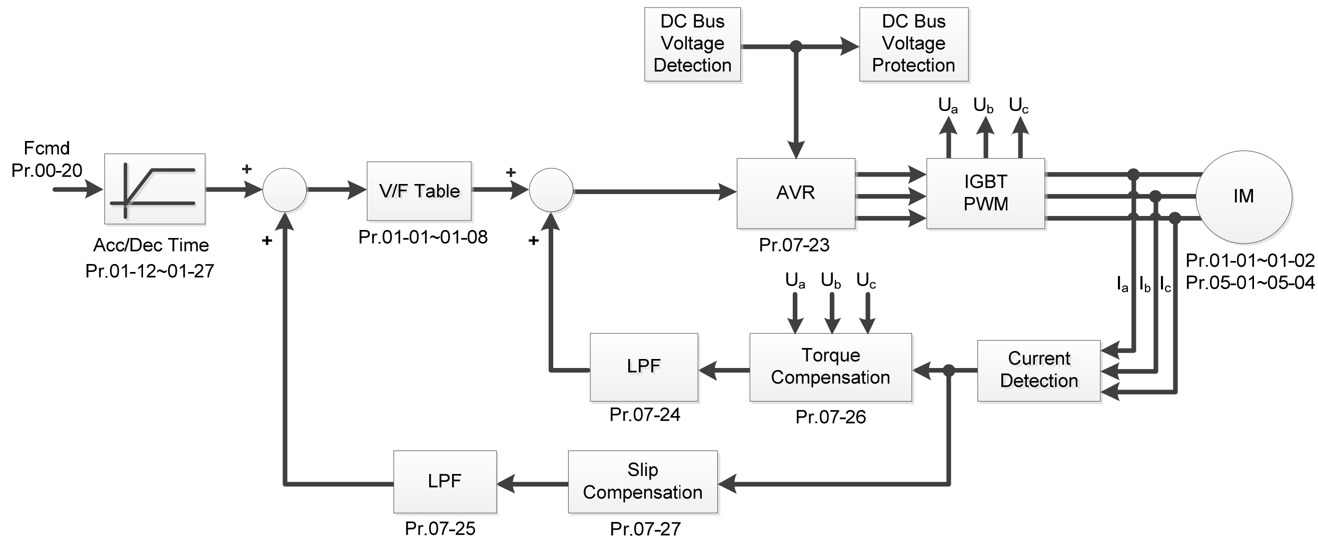
2: IM / PM SVC (IM / PM space vector control)

- 🕮 Determines the control method of the AC motor drive:

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

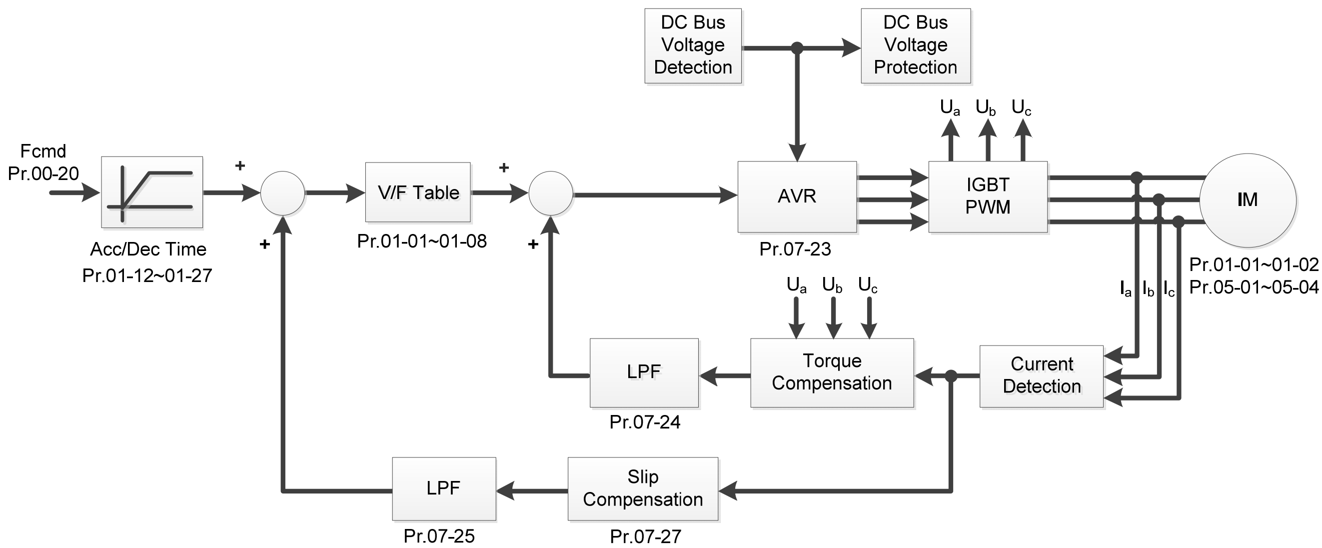
  2: IM / PM space vector control: get the optimal control by auto-tuning the motor parameters.

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

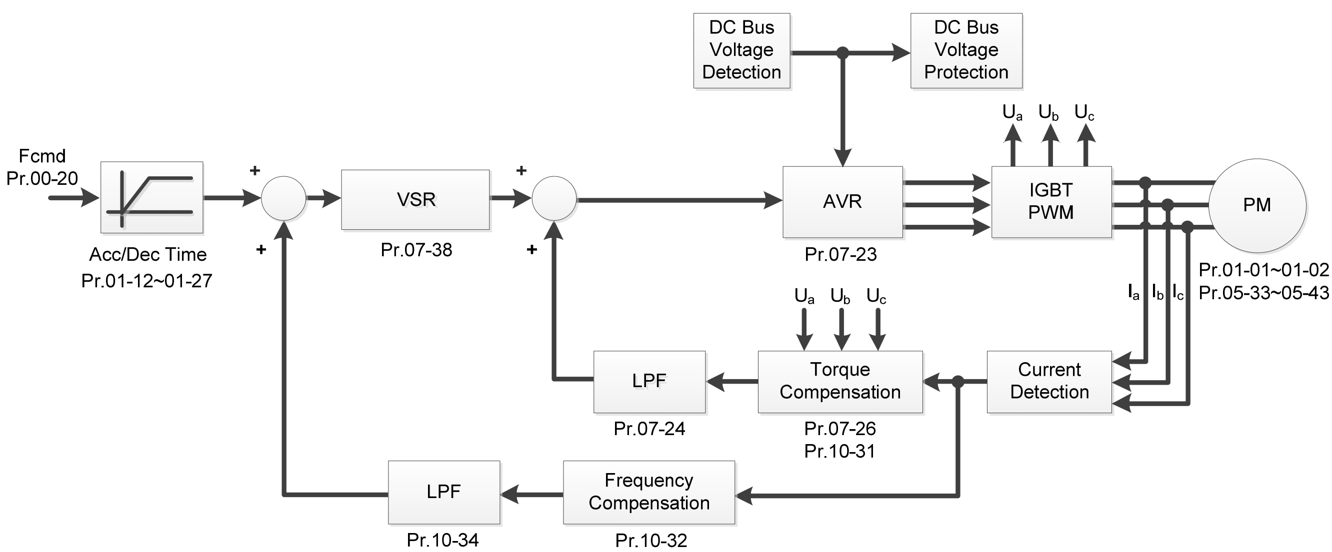


📖 When Pr.00-10=0, and you set Pr.00-11 to 2, the space vector control diagram is as follows.

Induction Motor Space Vector Control (IMSVC)



Permanent Magnetic Motor Space Vector Control (PMSVC)



00-16 Load Selection

Default: 0

Settings 0: Light load

1: Normal load

- Light load: over-load rated output current 120% in 60 seconds. Refer to Pr.00-17 for the setting for the carrier wave. Refer to Pr.00-01 or the specification table in Section 09 for the rated current.
- Normal load: over-load rated output current 120% in 60 seconds (160%, 3 seconds). Refer to Pr.00-17 for the setting for the carrier wave. Refer to Pr.00-01 or the specification table in Section 9 for the rated current.
- Pr.00-01 varies with the setting value for Pr.00-16. The default value and maximum setting value for Pr.06-03 and Pr.06-04 also vary with the setting value for Pr.00-16.

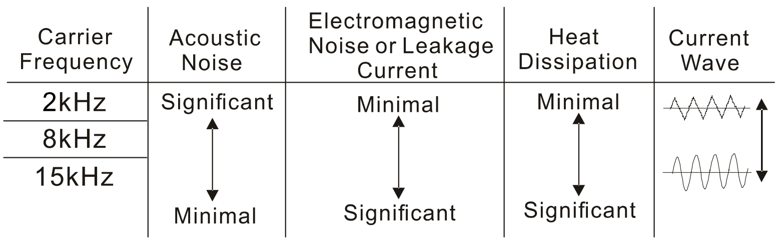
00-17 Carrier Frequency

Default: Table below

Settings 2–15 kHz

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

460V				
Settings		2–15 kHz	2–10 kHz	2–9 kHz
Light Load	Models	1–25 HP [0.75–18.5 kW]	30–100 HP [22–75 kW]	125 HP [90 kW]
	Default	6 kHz	6 kHz	6 kHz
Normal Load	Models	0.5–20 HP [0.4–15 kW]	25–75 HP [18.5–55 kW]	100 HP [75 kW]
	Default	6 kHz	6 kHz	6 kHz



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

00-19 PLC Command Mask

Default: Read Only

Settings bit0: Control command forced by PLC control

bit1: Frequency command forced by PLC control

- Determines if frequency command or control command is locked by PLC

00-20 Master Frequency Command (AUTO) Source / Source Selection of the PID Target

Default: 0

Settings 0: Digital keypad
1: RS-485 communication
2: External analog input (Pr.03-00–Pr.03-02)
3: External UP/DOWN terminal (multi-function input terminal)
6: CANopen communication card
8: Communication card (does not include CANopen card)

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

00-21 Operation Command (AUTO) Source

Default: 0

Settings 0: Digital keypad
1: External terminals
2: RS-485 communication
3: CANopen communication card
5: Communication card (does not include CANopen card)

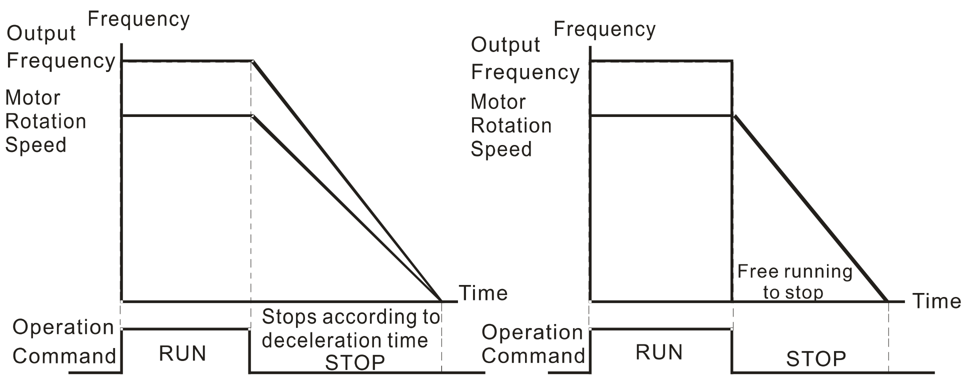
- Determines the operation command source in AUTO mode.
- When you control the operation command by the keypad KPC-CC01, keys RUN, STOP and JOG (F1) are valid.

✎ 00-22 Stop Method

Default: 0

Settings 0: Ramp to stop
1: Coast to stop

- Determines how the motor is stopped when the drive receives the Stop command.



Ramp to Stop and Coast to Stop

📖 **Ramp to stop:** the AC motor drive decelerates to 0 or the minimum output frequency according to the set deceleration time, and then to stop (according to Pr.01-07).

📖 **Coast to stop:** the AC motor drive stops output immediately, and the motor coasts to stop according to the load inertia.

(1) Use "ramp to stop" for the safety of personnel, or to prevent material from being wasted in applications where the motor must stop immediately after the drive stops. You must set the deceleration time accordingly.

(2) If idling is allowed, or the load inertia is large, use "coast to stop". For example, blowers, punching machines and pumps

✓ 00-23 Motor Direction Control

Default: 0

Settings 0: Enable forward / reverse

1: Disable reverse

2: Disable forward

📖 Enables the AC motor drives to run in the forward and reverse direction. You can use it to prevent a motor from running in a direction that would cause injure or damage to the equipment.

00-24 Digital Operator (Keypad) Frequency Command Memory

Default: Read only

Settings Read only

📖 If keypad is the frequency command source, when Lv or Fault occurs, this parameter stores the current frequency command.

✓ 00-25 User-Defined Characteristics

Default: 0

Settings bit0–3: user-defined decimal place

0000b: no decimal place

0001b: one decimal place

0010b: two decimal place

0011b: three decimal place

bit4–15: user-defined unit

000xh: Hz

001xh: rpm

002xh: %

003xh: kg

004xh: m/s

005xh: kW

006xh: HP

007xh: ppm

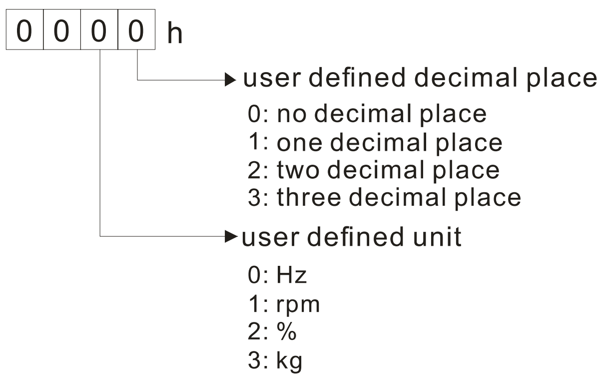
008xh: 1/m

009xh: kg/s

00Axh: kg/m

00Bxh: kg/h
00Cxh: lb/s
00Dxh: lb/m
00Exh: lb/h
00Fxh: ft/s
010xh: ft/m
011xh: m
012xh: ft
013xh: degC
014xh: degF
015xh: mbar
016xh: bar
017xh: Pa
018xh: kPa
019xh: mWG
01Axh: inWG
01Bxh: ftWG
01Cxh: psi
01Dxh: atm
01Exh: L/s
01Fxh: L/m
020xh: L/h
021xh: m3/s
022xh: m3/h
023xh: GPM
024xh: CFM
xxxxh: Hz

- bit0–3: the control frequency F page, user-defined unit (Pr.00-04=d10, PID feedback value) and the number of decimal places (Pr.00-26) which supports up to three decimal places.
- bit4–15: the control frequency F page, user-defined unit (Pr.00-04=d10, PID feedback value) and the displayed units for Pr.00-26.



- The keypad should be set to decimal when setting parameters.
  Example: defined unit shows inWG and three decimal places.
  In above data we could find inWG corresponds to 01Axh (x as the setting place of the decimal place), and the three decimal places corresponds to 0003h, which displays 01A3h in hexadecimal, and turns to decimal 01A3h=419. Set Pr.00-25=419 to complete the setting.

00-26 Maximum User-Defined Value

Default: 0

Settings 0: Disable
0–65535 (when Pr.00-25 set to no decimal place)
0.0–6553.5 (when Pr.00-25 set to 1 decimal place)
0.00–655.35 (when Pr.00-25 set to 2 decimal place)
0.000–65.535 (when Pr.00-25 set to 3 decimal place)

- When Pr.00-26 is NOT set to 0. The user-defined value is enabled. The setting value of Pr.00-26 corresponds to Pr.01-00 (Maximum motor operating frequency).
  Example: When the user-defined value is set as 100.0% corresponded to the maximum output frequency 60.00 Hz, Pr.00-25 is set at 0021h, and Pr.00-26 is set as 100.0%.

  NOTE

  The drive display is controlled by the Pr.00-25 setting when Pr.00-25 is properly set and Pr.00-26 is not 0.

00-27 User-Defined Value

Default: Read only

Settings Read only

- Pr.00-27 displays the user-defined value when Pr.00-26 is not set to 0.
- The user-defined value is valid when Pr.00-20 (frequency source) is set to the digital keypad or to RS-485 communication.

✓ 00-28 Switching from Auto mode to Hand mode

Default: 0

Settings bit0: Sleep function control bit
0: Sleep function control bit
1: Sleep function and Auto mode are the same
bit1: Control bit unit
0: Displaying unit in Hz
1: Same unit as the Auto mode
bit2: PID control bit
0: Cancel PID control
1: PID control and Auto mode are the same.
bit3: Frequency source control bit
0: Frequency source set up by parameter, if the multi-step speed is activated, then multi-step speed has the priority.
1: Frequency command set up by Pr.00-30, regardless of whether the multi-step speed is activated.

00-29 LOCAL / REMOTE Selection

Default: 0

Settings 0: Standard HOA function
1: Switch Local / Remote, the drive stops
2: Switch Local / Remote, the drive runs as the REMOTE setting for frequency and operation status
3: Switch Local / Remote, the drive runs as the LOCAL setting for frequency and operation status
4: Switch Local / Remote, the drive runs as LOCAL setting when switched to Local, and runs as REMOTE setting when switch to Remote for frequency and operation status.

- The default for Pr.00-29 is 0 (standard Hand-Off-Auto function). Set the AUTO frequency and operation source with Pr.00-20 and Pr.00-21. Set the HAND frequency and operation source with Pr.00-30 and Pr.00-31. Select or switch AUTO / HAND mode by using the digital keypad KPC-CC01 or setting the multi-function input terminal MIx= 41, 42.
- When you set the external terminal (MI) to 41 and 42 (AUTO / HAND mode), Pr.00-29=1, 2, 3, 4 are disabled. The external terminal has the highest command priority, and Pr.00-29 functions in standard HOA mode.
- When you do not set Pr.00-29 to 0, the Local / Remote function is enabled, and the top right corner of digital keypad KPC-CC01 (firmware version 1.021 and above) displays "LOC" or "REM". Set the REMOTE frequency and operation source with Pr.00-20 and Pr.00-21. Set the LOCAL frequency and operation source with Pr.00-30 and Pr.00-31. Select or switch Local / Remote mode with the digital keypad KPC-CC01 or set the multi-function input terminal MIx=56. The AUTO key of the digital keypad is for the REMOTE function, and HAND key is for the LOCAL function.
- When you set the external terminal (MI) to 56 for LOC / REM mode selection, if you set Pr.00-29 to 0, then the external terminal function is disabled.
- When you set the external terminal (MI) to 56 for LOC / REM mode selection, if Pr.00-29 is not set to 0, then AUTO / HAND key is disabled, and the external terminal has the highest command priority.
- Following table is the corresponded setting value for the PLC address:

PLC address / Mode	HOA mode		LOC / REM mode		HOA mode
	HAND-ON	AUTO-ON	LOC-ON	REM-ON	OFF
M1090 =	0	0	0	0	1
M1091 =	1	0	0	0	0
M1092 =	0	1	0	0	0
M1100 =	0	0	1	0	0
M1101 =	0	0	0	1	0

00-30 Master Frequency Command Source (HAND)

Default: 0

Settings 0: Digital keypad
1: RS-485 serial communication
2: External analog input (Pr.03-00)
3: External UP/DOWN terminal
6: CANopen communication card
8: Communication card (does not include CANopen card)

- Determines the master frequency source in HAND mode.

00-31 Operation Command Source (HAND)

Default: 0

Settings 0: Digital keypad
1: External terminals
2: RS-485 serial communication
3: CANopen communication card
5: Communication card (does not include CANopen card)

- Determines the operation frequency source in HAND mode.
- Use Pr.00-20 and Pr.00-21 to set the frequency source and the operation source in AUTO mode, and use Pr.00-30 and Pr.00-31 to set the frequency source and operation source in HAND mode. Select or switch AUTO / HAND mode by using the digital keypad KPC-CC01 or setting the multi-function input terminal (MI).
- The default for the frequency source or operation source is AUTO mode. It returns to AUTO mode whenever you cycle the power. If you use a multi-function input terminal to switch AUTO / HAND mode, the multi-function input terminal has the highest priority. When the external terminal is OFF, the drive does not accept any operation signal and cannot execute JOG.

✓ 00-32 Digital Keypad STOP Function

Default: 0

Settings 0: STOP key disable
1: STOP key enable

- This parameter is valid when the digital keypad is not set as the operation command source (Pr.00-21≠0). When Pr.00-21=0, the STOP key on the digital keypad is not affected by this parameter.

✓ 00-48 Display Filter Time (Current)

Default: 0.100

Settings: 0.001–65.535 sec.

- Minimizes the current fluctuation displayed by digital keypad.

✓ 00-49 Display Filter Time (Keypad)

Default: 0.100

Settings: 0.001–65.535 sec.

- Minimizes the value fluctuation displayed by digital keypad.

00-50 Software Version (date)

Default: Read only

Settings: Read only

Displays the current drive software version by date.

01 Basic Parameters

✓ You can set this parameter during operation.

✓ **01-00** Maximum Operation Frequency

Default: 60.00 / 50.00

Settings 50.00–599.00 Hz

Setting range for 90 kW (125 HP): 0.00–400.00 Hz

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

Minimum Carrier Wave Requirement	Maximum Operation Frequency (IM VF/ IM SVC)
2k	200 Hz
3k	300 Hz
4k	400 Hz
5k	500 Hz
6k	599 Hz
For 90 kW model, maximum operation frequency is 400 Hz (carrier should be set at least 4k)	

01-01 Output Frequency of Motor 1

01-35 Output Frequency of Motor 2

Default: 60.00 / 50.00

Settings 0.00–599.00 Hz

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

01-02 Output Voltage of Motor 1

01-36 Output Voltage of Motor 2

Default: 400.0

Settings 0.0–510.0 V

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

01-03 Mid-point Frequency 1 of Motor 1

Default: 3.00

Settings 0.00–599.00 Hz

✓ **01-04** Mid-point Voltage 1 of Motor 1

Default: 22.0

Settings 0.0–480.0 V

01-37 Mid-point Frequency 1 of Motor 2

Default: 3.00

Settings 0.00–599.00 Hz

01-38 Mid-point Voltage 1 of Motor 2

Default: 22.0

Settings 0.0–480.0 V

01-05 Mid-point Frequency 2 of Motor 1

Default: 1.50

Settings 0.00–599.00 Hz

01-06 Mid-point Voltage 2 of Motor 1

Default: 10.0

Settings 0.0–480.0 V

01-39 Mid-point Frequency 2 of Motor 2

Default: 1.50

Settings 0.00–599.00 Hz

01-40 Mid-point Voltage 2 of Motor 2

Default: 10.0

Settings 0.0–480.0 V

01-07 Min. Output Frequency of Motor 1

Default: 0.50

Settings 0.00–599.00 Hz

01-08 Min. Output Voltage of Motor 1

Default: 2.0

Settings 0.0–480.0 V

01-41 Min. Output Frequency of Motor 2

Default: 0.50

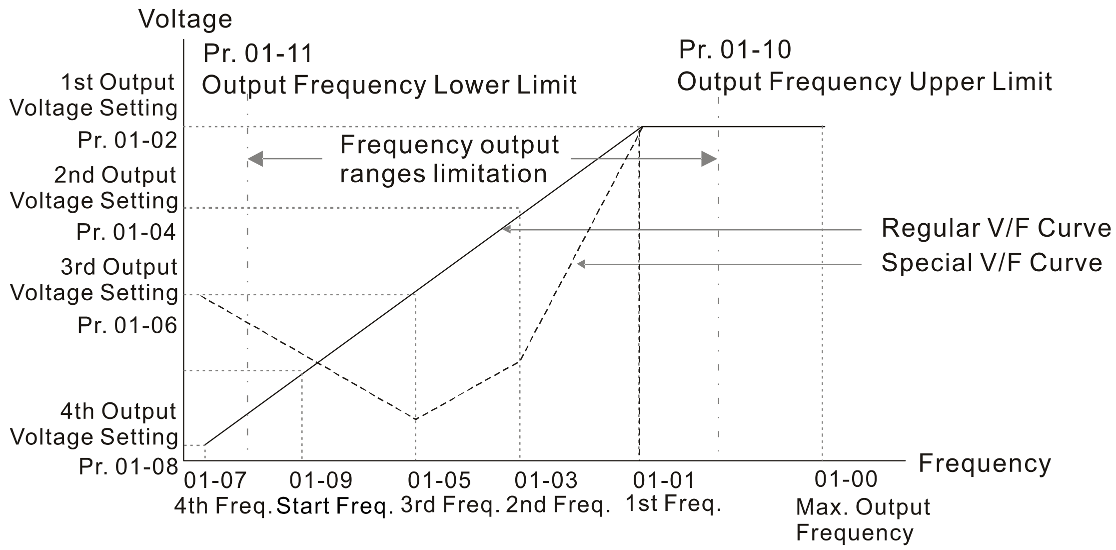
Settings 0.00–599.00 Hz

01-42 Min. Output Voltage of Motor 2

Default: 2.0

Settings 0.0–480.0 V

- The V/F curve setting is usually set by the motor's allowable loading characteristics. If the loading characteristics exceeds the loading limit of the motor, you must pay more attention to the heat dissipation, dynamic balance, and bearing lubrication of the motor.
- If the voltage is too high when the motor is at low frequencies, it may cause motor damage, overheating, and may trigger stalling or over-current protection. To prevent motor damage or motor fault, be careful when you set the voltage.
- Pr.01-35 to Pr.01-42 is the V/F curve for the motor 2. When multi-function input terminals Pr.02-01–02-08 and Pr.02-26–Pr.02-31 are set to 14 and enabled, the AC motor drive will act as the 2nd V/F curve.
- The diagram below shows the V/F curve for motor 1. You can also find the V/F curve for motor 2 from the same diagram.

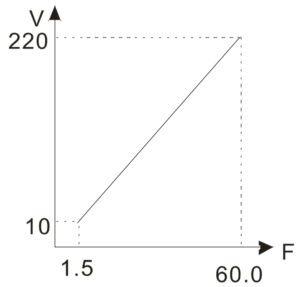


V/F Curve

Common settings of the V/F curve:

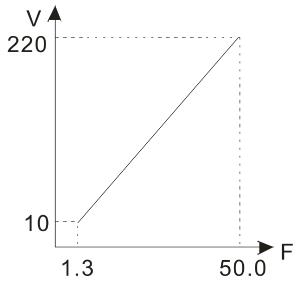
(1) General purpose

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	1.50
01-04 01-06	10.0
01-07	1.50
01-08	10.0

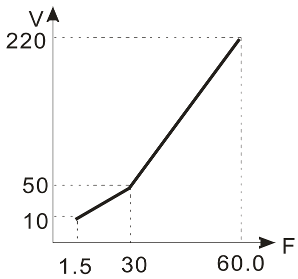
Motor spec. 50Hz



Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	1.30
01-04 01-06	10.0
01-07	1.30
01-08	10.0

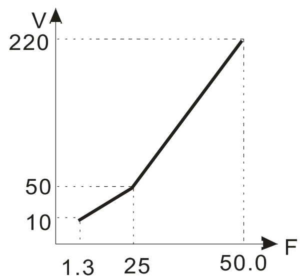
(2) For fan and hydraulic machinery

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	30.0
01-04 01-06	50.0
01-07	1.50
01-08	10.0

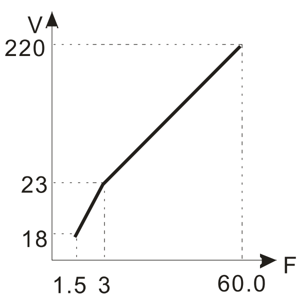
Motor spec. 50Hz



Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	25.0
01-04 01-06	50.0
01-07	1.30
01-08	10.0

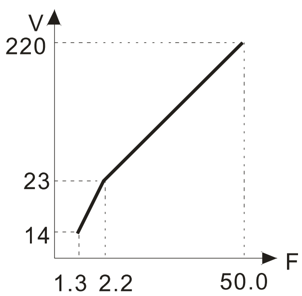
(3) High starting torque

Motor spec. 60Hz



Pr.	Setting
01-00	60.0
01-01	60.0
01-02	220.0
01-03 01-05	3.00
01-04 01-06	23.0
01-07	1.50
01-08	18.0

Motor spec. 50Hz



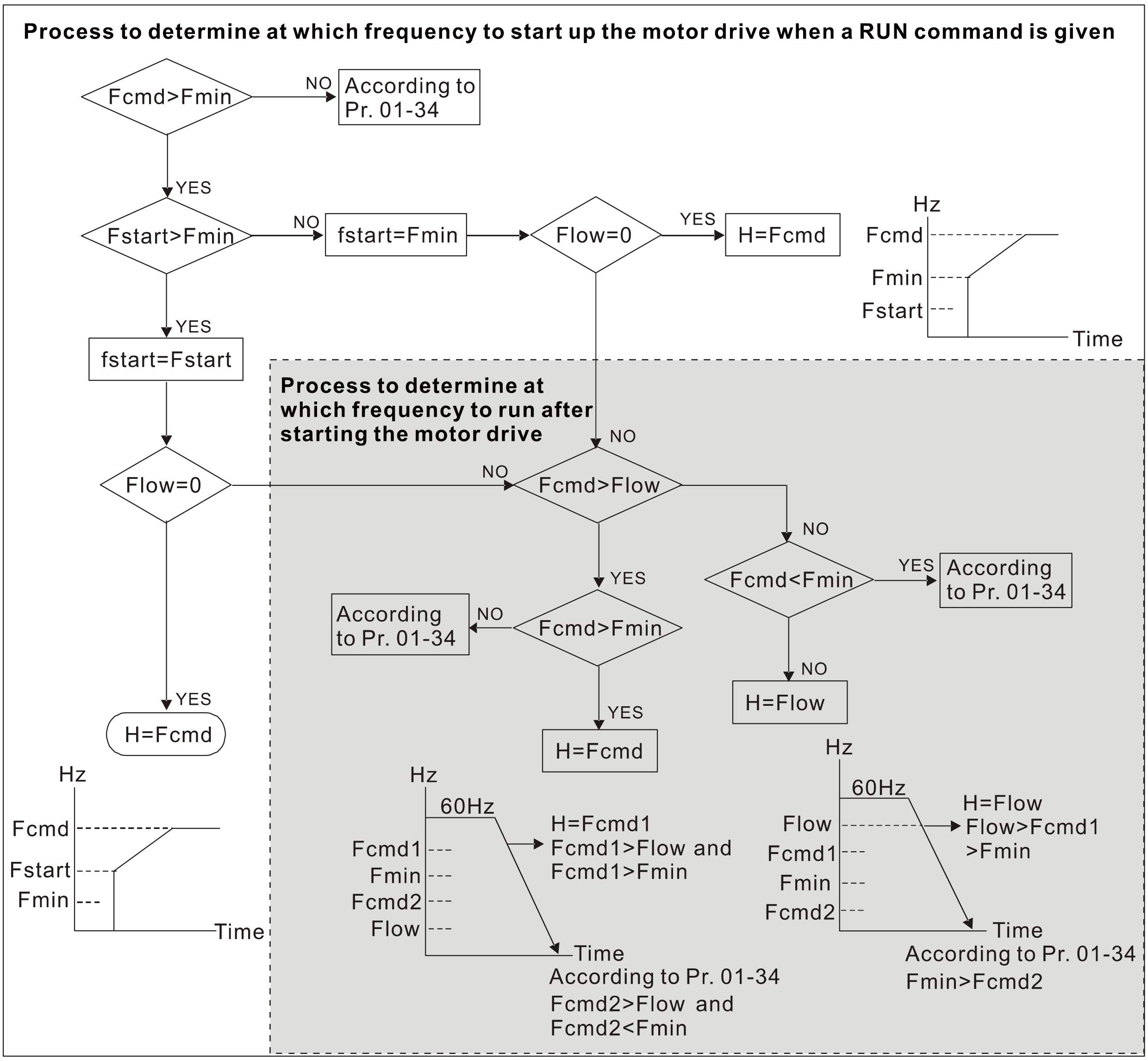
Pr.	Setting
01-00	50.0
01-01	50.0
01-02	220.0
01-03 01-05	2.20
01-04 01-06	23.0
01-07	1.30
01-08	14.0

01-09 Start-Up Frequency

Default: 0.50

Settings 0.00–599.00 Hz

- When the starting frequency is higher than the minimum output frequency, the drives' output is from the starting frequency to the setting frequency. Refer to the following diagram for details.
  Fcmd: frequency command
  Fstart: start-up frequency (Pr.01-09)
  fstart: actual start-up frequency of drive
  Fmin: 4th output frequency setting (Pr.01-07 / Pr.01-41)
  Flow: output frequency lower limit (Pr.01-11)



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

01-10 Output Frequency Upper Limit

Default: 599.00

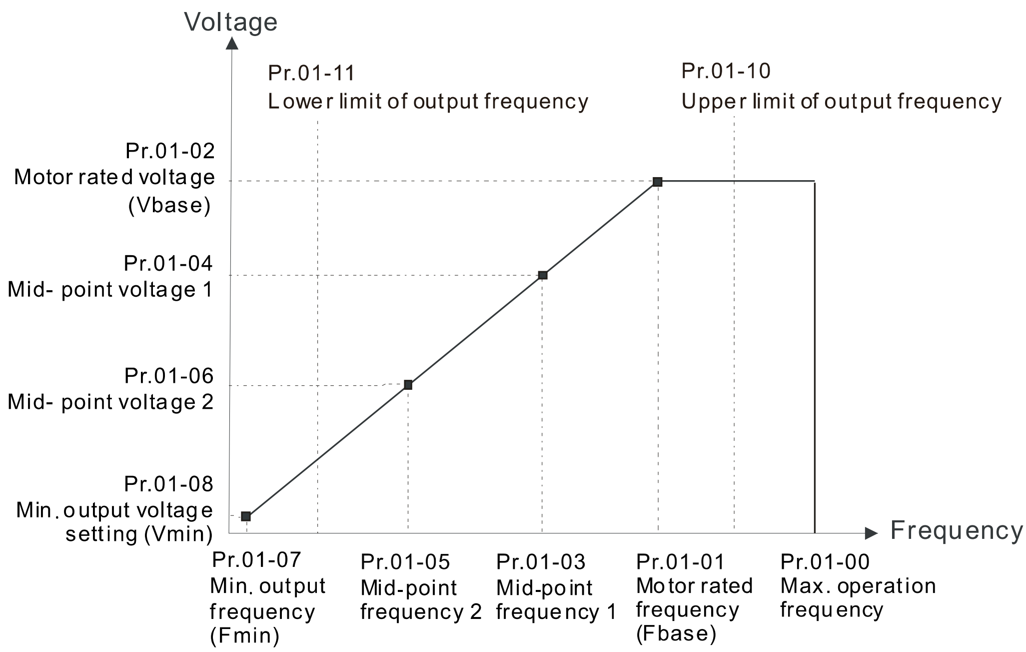
Settings 0.00–599.00 Hz

01-11 Output Frequency Lower Limit

Default: 0.00

Settings 0.00–599.00 Hz

- Use the upper and lower limit output frequency setting to limit the actual output frequency. If the frequency setting is higher than the upper limit (Pr.01-10), the drive uses the upper limit frequency. If output frequency is lower than lower limit (Pr.01-11) and frequency setting is higher than minimum frequency (Pr.01-07), the drive uses the lower limit frequency. Set the upper limit frequency > lower limit frequency (Pr.01-10 setting value must be > Pr.01-11 setting value).
- The upper output frequency limits the maximum output frequency of the drive. If frequency setting is higher than Pr.01-10, the Pr.01-10 setting limits the output frequency.
- When the drive starts the slip compensation function (Pr.07-27) or PID feedback control, the drive output frequency may exceed frequency command but is still limited by this setting.
- Related parameters: Pr.01-00 Maximum Operation Frequency.



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

- If the frequency output upper limit is 60 Hz and frequency setting is also 60 Hz, only the frequency command is limited in 60 Hz. The actual frequency output may exceed 60 Hz if the drive starts the slip compensation function.

01-12	Acceleration Time 1
01-13	Deceleration Time 1
01-14	Acceleration Time 2
01-15	Deceleration Time 2
01-16	Acceleration Time 3
01-17	Deceleration Time 3
01-18	Acceleration Time 4
01-19	Deceleration Time 4
01-20	JOG Acceleration Time
01-21	JOG Deceleration Time

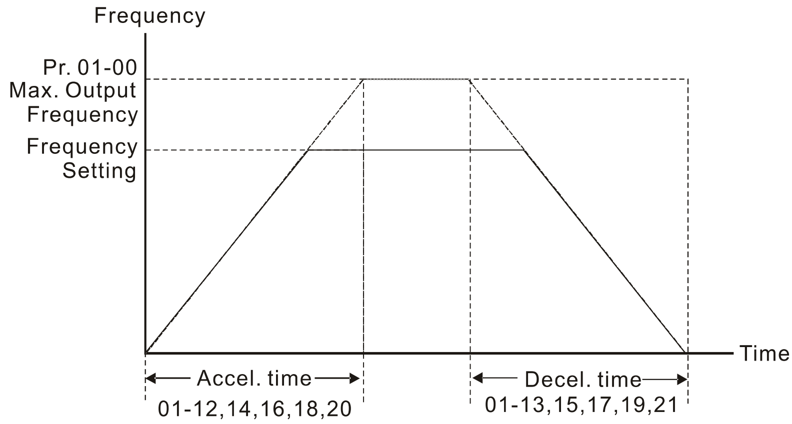
Default: 10.00

Default: 60.00 / 60.0 (22 kW and above models)

Settings Pr.01-45=0: 0.00–600.00 seconds

Pr.01-45=1: 0.0–6000.0 seconds

- Use the acceleration time to determine the time required for the AC motor drive to accelerate from 0.00 Hz to maximum output frequency (Pr.01-00). Use the deceleration time to determine the time required for the AC motor drive to decelerate from maximum output frequency (Pr.01-00) down to 0.00 Hz.
- The acceleration and deceleration time are invalid when using Pr.01-44 Auto-acceleration and Auto-deceleration Setting
- Select the acceleration and deceleration time 1, 2, 3 and 4 with the multi-function input terminals settings. The defaults are acceleration and deceleration time 1.
- With the enabled torque limits and stall prevention functions, the actual acceleration and deceleration time are longer than the above action time.
- Note that setting the acceleration time too short may trigger the protection function (Pr.06-03 Over-current Stall Prevention during Acceleration or Pr.06-01 Over-voltage Stall Prevention).
- Note that setting the deceleration time too short may cause motor damage or trigger drive protection due to over-current during deceleration or over-voltage.
- Use suitable brake resistor (refer to Section 07 Optional Accessories) to decelerate in a short time and prevent over-voltage.
- When you enable Pr.01-24–Pr.01-27, the actual acceleration and deceleration time are longer than the setting.



Accel./Decel. Time

01-22 JOG Frequency

Default: 6.00

Settings 0.00–599.00 Hz

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

01-23 First / Fourth Acceleration / Deceleration Frequency

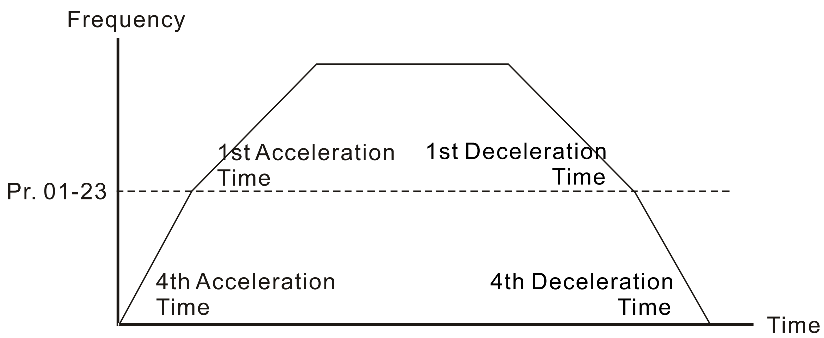
Default: 0.00

Settings 0.00–599.00 Hz

- This function does not require the external terminal switching function; it switches the acceleration and deceleration time automatically by the Pr.01-23 setting. If you set the external terminal, it is based on the external terminal first, and not on Pr.01-23.
- When using this function, set S-curve acceleration time to 0 if the fourth acceleration time is set too short.

  As the usage of Pr.01-23, for instance, under Pr.01-00=80 Hz and Pr.01-23=40 Hz:

  a. If Pr.01-02=10 sec., Pr.01-18=6 sec., then the 0–40 Hz acceleration time is 3 sec. and 40–80 Hz acceleration time is 5 sec.
  b. If Pr.01-13=8 sec., Pr.01-19=2 sec., then 80–40 Hz deceleration time is 4 sec. and 40–0 Hz deceleration time is 1 sec.



1st/4th Acceleration/Deceleration Frequency Switching

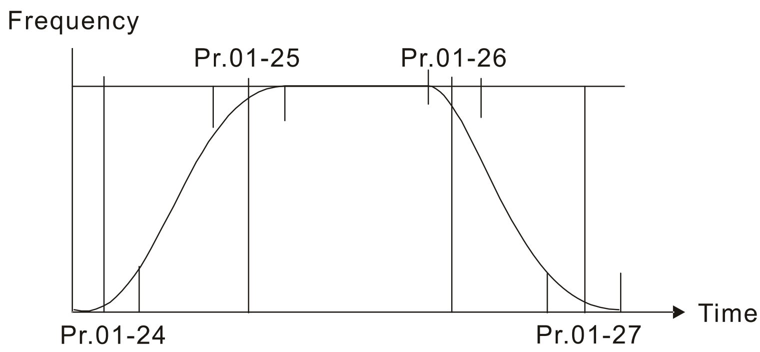
⚡ 01-24	S-curve Acceleration Begin Time 1
⚡ 01-25	S-curve Acceleration Arrival Time 2
⚡ 01-26	S-curve Deceleration Begin Time 1
⚡ 01-27	S-curve Deceleration Arrival Time 2

Default: 0.20

Settings Pr.01-45=0: 0.00–25.00 seconds

Pr.01-45=1: 0.0–250.0 seconds

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



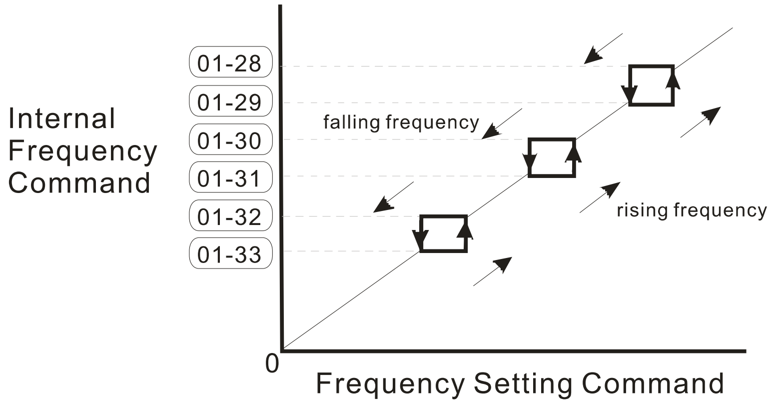
01-28	Skip Frequency 1 (upper limit)
01-29	Skip Frequency 1 (lower limit)
01-30	Skip Frequency 2 (upper limit)
01-31	Skip Frequency 2 (lower limit)
01-32	Skip Frequency 3 (upper limit)
01-33	Skip Frequency 3 (lower limit)

Default: 0.00

Settings 0.00–599.00 Hz

- Set the AC motor drive's skip frequency. The drive's frequency setting skips these frequency ranges. However, the frequency output is continuous. There are no limits for these six parameters and you can combine them. Pr.01-28 does not need to be greater than Pr.01-29; Pr.01-30 does not need to be greater than Pr.01-31; Pr.01-32 does not need to be greater than Pr.01-33.
- These parameters set the skip frequency ranges for the AC motor drive. You can use this function to avoid frequencies that cause mechanical resonance. The skip frequencies are useful when a motor has resonance vibration at a specific frequency bandwidth. Skipping this frequency avoids the vibration. There are three frequency skip zones available.

- You can set the frequency command (F) within the range of skip frequencies. Then the output frequency (H) is limited to the lower limit of skip frequency ranges.
- When accelerating and decelerating, the output frequency still passes the skip frequency ranges.

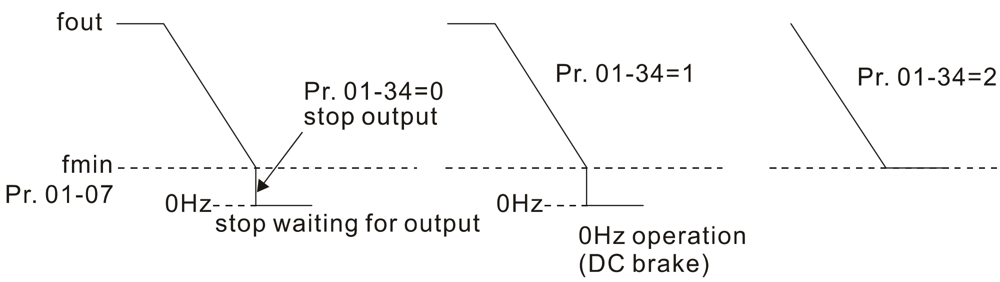


01-34 Zero-speed Mode

Default: 0

Settings 0: Waiting for output
1: Zero-speed operation
2: Minimum frequency (Refer to Pr.01-07, Pr.01-41)

- When the frequency command of drive is less than Fmin (Pr.01-07 or Pr.01-41), the drive operates according to the setting value.
- 0: the AC motor drive is in waiting mode without voltage output from terminals U, V, W.
- 1: the drive executes the DC brake by Vmin (Pr.01-08 and Pr.01-42) in V/F and SVC modes.
- 2: the AC motor drive runs using Fmin (Pr.01-07, Pr.01-41) and Vmin (Pr.01-08, Pr.01-42) in V/F and SVC modes.
- In V/F and SVC modes



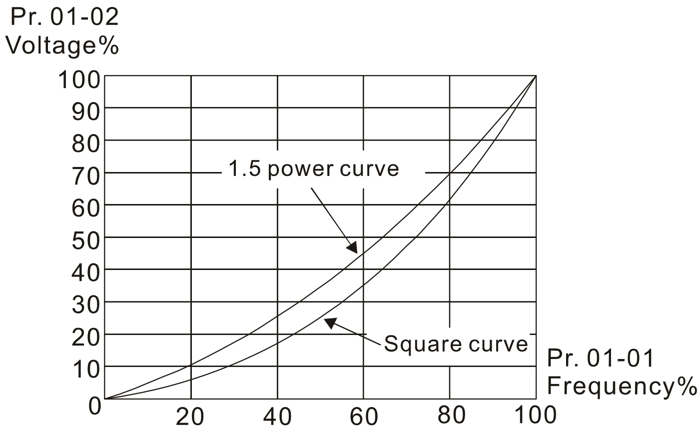
01-43 V/F Curve Selection

Default: 0

Settings 0: V/F curve determined by Pr.01-00–01-08
1: 1.5th V/F curve
2: 2nd V/F curve
3: 60 Hz, voltage saturation in 50 Hz
4: 72 Hz, voltage saturation in 60 Hz
5: 50 Hz, decrease gradually with cube
6: 50 Hz, decrease gradually with square
7: 60 Hz, decrease gradually with cube

8: 60 Hz, decrease gradually with square
9: 60 Hz, medium starting torque
10: 60 Hz, high starting torque
11: 60 Hz, medium starting torque
12: 60 Hz, high starting torque
13: 90 Hz, voltage saturation in 60 Hz
14: 120 Hz, voltage saturation in 60 Hz
15: 180 Hz, voltage saturation in 60 Hz

- When setting to 0, refer to Pr.01-01–01-08 for the motor 1 V/F curve. For motor 2, refer to Pr.01-35–01-42.
- When setting to 1 or 2, the second and third voltage frequency setting are invalid.
- If the load on the motor is a variable torque load (torque is in direct proportion to rotating speed, such as the load of fan or pump), the load torque is low at low rotating speed. Decreasing the input voltage to make the magnetic field of the input current smaller and reduce flux loss and iron loss for the motor to increase efficiency.
- When you set the V/F curve to high power, it has lower torque at low frequency, and the drive is not suitable for rapid acceleration and deceleration. Do NOT use this parameter for rapid acceleration and deceleration.



01-44 Auto-acceleration and Auto-deceleration Setting

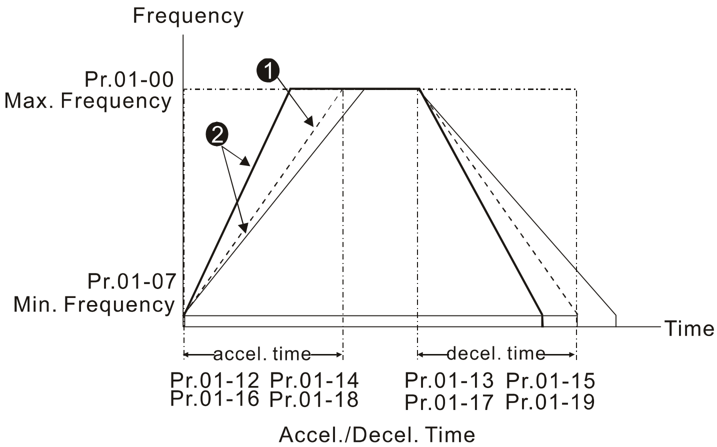
Default: 0

Settings 0: Linear acceleration and linear deceleration
1: Auto-acceleration and linear deceleration
2: Linear acceleration and auto-deceleration
3: Auto-acceleration and auto-deceleration
4: Stall prevention by auto-acceleration and auto-deceleration (limited by Pr.01-12 to Pr.01-21)

- 0 (linear acceleration and linear deceleration): the drive accelerates and decelerates according to the setting for Pr.01-12–01-19.
- 1 or 2 (auto/linear acceleration and auto/linear deceleration): the drive reduces the mechanical vibration and prevents the complicated auto-tuning processes. It does not stall during acceleration and has no need for a brake resistor. It can also improve operation efficiency and save energy.

📖 3 (auto-acceleration and deceleration-decelerate by actual load): the drive auto-detects the load torque and accelerates from the fastest acceleration time and smoothest start current to the setting frequency. When decelerating, the drive auto-detects the load re-generation and stops the motor smoothly with the fastest deceleration time.

📖 4 (stall prevention by auto-acceleration and deceleration –refer to acceleration and deceleration time): if the acceleration and deceleration is within a reasonable range, the drive accelerates and decelerates according to Pr.01-12–01-19. If the acceleration and deceleration time is too short, the actual acceleration and deceleration time are greater than the acceleration and deceleration time settings.



❶ When Pr.01-44 is set to 0.

❷ When Pr.01-44 is set to 3.

01-45 Time Unit for Acceleration / Deceleration and S Curve

Default: 0

Settings 0: Unit 0.01 sec.

1: Unit 0.1 sec.

01-46 CANopen Quick Stop Time

Default: 1.00

Settings Pr.01-45=0: 0.00–600.00 sec.

Pr.01-45=1: 0.0–6000.0 sec.

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

01-49 Regenerative Energy Restriction Control Method

Default: 0

Settings 0: Disable

1: Over voltage energy restriction

2: Traction energy control (TEC)

📖 0: decelerate or stop in accordance with the original deceleration setting.

📖 1: during deceleration, the drive controls the motor according to the setting of Pr.06-01 and the voltage recovery rate of the DC bus. The controller starts when the DC bus voltage reaches 95% of Pr.06-01. When Pr. 06-01 is set to 0, the drive controls the motor according to the operating voltage and the voltage recovery rate of the DC bus. This method decelerates according to the setting for the deceleration time. The fastest actual deceleration time is not less than the deceleration time setting.

📖 2: this function can auto-tune the output frequency and output voltage to accelerate consumption of DC bus energy according to drive's ability, so that the actual deceleration time can comply with the parameter setting. Use this setting when over-voltage occurs due to unexpected deceleration time.

02 Digital Input/Output Parameter

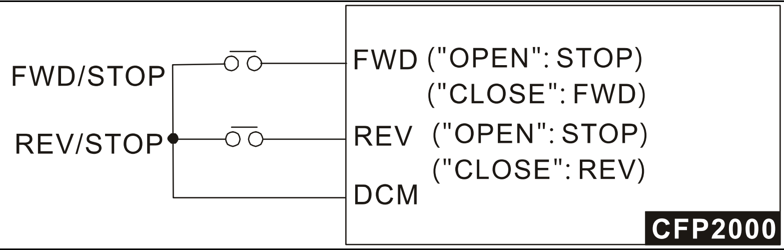
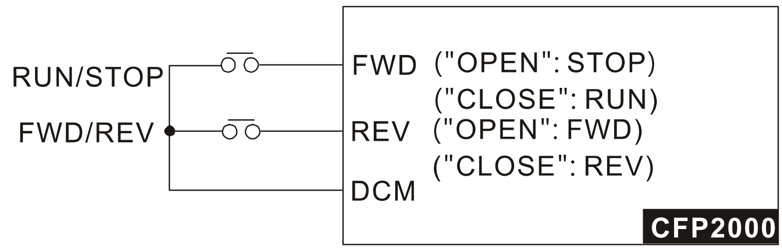
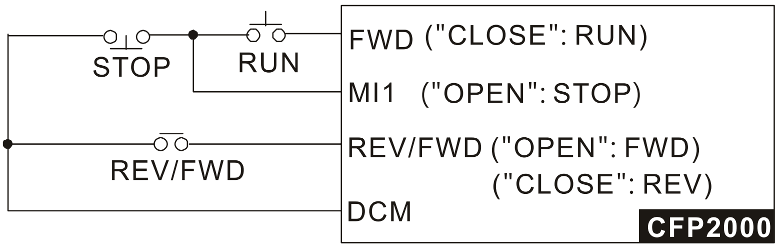
⚡ This parameter can be set during operation.

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

Default: 0

Settings 0: Two-wire mode 1, power on for operation control
1: Two-wire mode 2, power on for operation control
2: Three-wire, power on for operation control

📖 This parameter sets the configuration of the terminals (Pr.00-21=1 or Pr.00-31=1) which control the operation. There are three different control modes listed in the following table.

Pr.02-00	Control Circuits of the External Terminal
Settings: 0 Two-wire mode 1 FWD/STOP REV/STOP	
Settings: 1 Two-wire mode 2 RUN/STOP REV/FWD	
Settings: 2 Three-wire operation control	

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

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)

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

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

02-08 Multi-function Input Command 8 (MI8)

02-26 Input terminal of I/O extension card (MI10)

02-27	Input terminal of I/O extension card (MI11)
02-28	Input terminal of I/O extension card (MI12)
02-29	Input terminal of I/O extension card (MI13)
02-30	Input terminal of I/O extension card (MI14)
02-31	Input terminal of I/O extension card (MI15)

Default: 0

Settings

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 (by KPC-CC01 or external control)

7: Acceleration / deceleration speed inhibit

8: The 1^{st}, 2^{nd} acceleration / deceleration time selection

9: The 3^{rd}, 4^{th} acceleration / deceleration time selection

10: EF input (Pr.07-20)

11: Base Block (B.B.) input from external

12: Output stop

13: Cancel the setting of auto-acceleration / auto-deceleration time

14: Switch between motor 1 and motor 2

15: Rotating speed command from AVI1

16: Rotating speed command from ACI

17: Rotating speed command from AVI2

18: Forced to stop (Pr.07-20)

19: Digital up command

20: Digital down command

21: PID function disabled

22: Clear the counter

23: Input the counter value (MI6)

24: FWD JOG command

25: REV JOG command

28: Emergency stop (EF1)

29: Signal confirmation for Y-connection

30: Signal confirmation for Δ-connection

38: Disable write EEPROM function

40: Force coasting to stop

41: HAND switch

42: AUTO switch

49: Enable drive

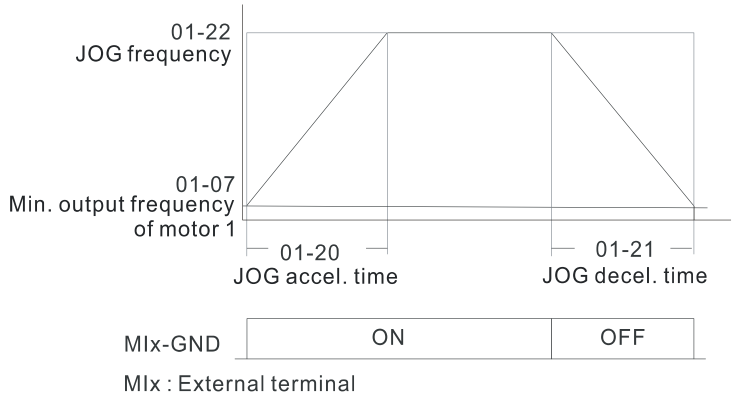
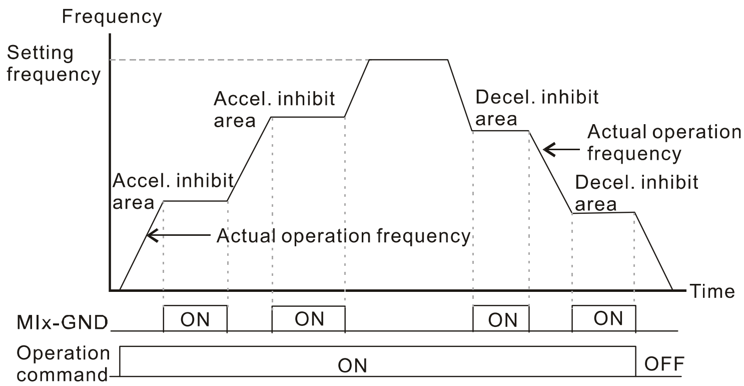
50: Slave dEb action to execute
51: Selection for PLC mode bit0
52: Selection for PLC mode bit1
53: Trigger CANopen quick stop
54: UVW output electromagnetic valve switch
55: Brake release
56: Local / Remote Selection
58: Enable fire mode with RUN command
59: Enable fire mode without RUN command
60: Disable all the motors
61: Disable Motor 1
62: Disable Motor 2
63: Disable Motor 3
64: Disable Motor 4
65: Disable Motor 5
66: Disable Motor 6
67: Disable Motor 7
68: Disable Motor 8
69: Preheating command

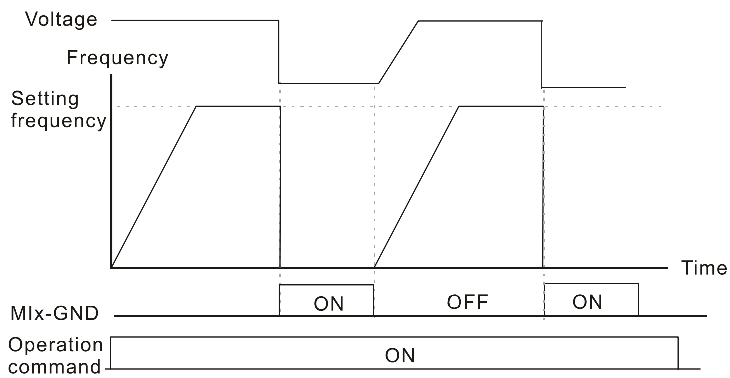
- This parameter selects the functions for each multi-function terminal.
- Pr.02-26–Pr.02-31 are entity input terminals only when the extension cards are installed, otherwise, there are virtual terminals. For example, when using the multi-function extension card EMC-D42A, Pr.02-26–Pr.02-29 are defined as the corresponded parameters for MI10–MI13. In this case, Pr.02-30–Pr.02-31 are virtual terminals.
- When Pr.02-12 is defined as virtual terminal, use digital keypad KPC-CC01 or communication method to change its status (0: ON; 1: OFF) of bit8–15.
- If Pr.02-00 is set to three-wire operation control, terminal MI1 is for the STOP contact. The function set previously for this terminal is automatically invalid.

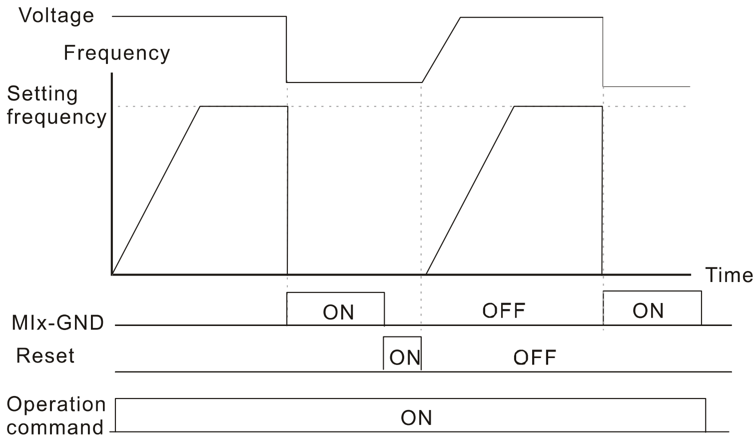
Summary of function settings

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

Settings	Functions	Descriptions
0	No Function	
1	Multi-step speed command 1	You can set 15 steps of speed or 15 positions with the digital status of these 4 terminals. You can use 16-steps of speed if you include the master speed when setting as 15 steps of speed. (Refer to Parameter Group 04 Multi-step Speed Parameters.)
2	Multi-step speed command 2	
3	Multi-step speed command 3	
4	Multi-step speed command 4	

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>5</td><td>Reset</td><td>Use this terminal to reset the drive after clearing a drive fault.</td></tr>
<tr><td>6</td><td>JOG Command</td><td>This function is valid when the source of the operation command is the external terminals.
The JOG operation executes when the drive stops completely. When the STOP key on the digital keypad is enabled (Pr.00-32), you can stop the drive through the digital keypad. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to Pr.01-20–01-22 for details.

</td></tr>
<tr><td>7</td><td>Acceleration / deceleration speed inhibit</td><td>When you enable this function, the drive stops acceleration and deceleration immediately. After you disable this function, the AC motor drive starts to accelerate or decelerate from the inhibit point.

</td></tr>
<tr><td>8</td><td>The 1st, 2nd acceleration or deceleration time selection</td><td rowspan="2">You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selection.
<table>
<tr><th>MIx=9</th><th>MIx=8</th><th>Accel./Decel.</th></tr>
<tr><td>OFF</td><td>OFF</td><td>1st Accel./Decel.</td></tr>
<tr><td>OFF</td><td>ON</td><td>2nd Accel./Decel.</td></tr>
<tr><td>ON</td><td>OFF</td><td>3rd Accel./Decel.</td></tr>
<tr><td>ON</td><td>ON</td><td>4th Accel./Decel.</td></tr>
</table></td></tr>
<tr><td>9</td><td>The 3rd, 4th acceleration or deceleration time selection</td></tr>
<tr><td>10</td><td>EF Input
(EF: External fault)</td><td>For external fault input. The drive decelerates according to the Pr.07-20 setting, and the keypad shows EF. (It shows the fault record when an external fault occurs). The drive keeps running until the fault is cleared (terminal status restored) after RESET.</td></tr>
</table>

Settings	Functions	Descriptions
11	B.B. input from external (B.B.: Base Block)	ON: the output of the drive stops immediately. The motor is in free run and the keypad displays the B.B. signal. Refer to Pr.07-08 for details.
12	Output Stop (Output pause)	When the switch is ON, output of the drive stops immediately and the motor is in free run status. The drive is in output waiting status until the switch is turned to OFF, and then the drive restarts and runs to the current setting frequency. 
13	Cancel the setting for auto-acceleration / auto-deceleration time	Set Pr.01-44 to one of the Pr.01-04 setting modes before using this function. When this function is enabled, OFF is for auto mode and ON is for linear acceleration / deceleration.
14	Switch between motor 1 and motor 2	ON: use parameters for motor 2 . OFF: use parameters for motor 1.
15	Rotating speed command from AVI1	ON: force the source of the frequency to be AVI1. (If the rotating speed commands are set to AVI1, ACI and AVI2 at the same time, the priority is AVI1＞ACI＞AVI2)
16	Rotating speed command from ACI	ON: force the source of the frequency to be ACI. (If the rotating speed commands are set to AVI1, ACI and AVI2 at the same time. The priority is AVI1＞ACI＞AVI2)
17	Rotating speed command from AVI2	ON: force the source of the frequency to be AVI2. (If the rotating speed commands are set to AVI1, ACI and AVI2 at the same time. The priority is AVI1＞ACI＞AVI2)
18	Forced to stop (Pr.07-20)	ON: the drive ramps to stop according to Pr.07-20 setting.
19	Digital Up command	ON: the frequency of the drive increases or decreases by one unit. If this function remains ON continuously, the frequency increases or decreases according to Pr.02-09 / Pr.02-10. The Frequency command returns to zero when the drive stops, and the displayed frequency is 0.0 Hz. If you select Pr.11-00, bit7 = 1, the frequency is not saved.
20	Digital Down command	
21	PID function disabled	ON: the PID function is disabled.
22	Clear the counter	ON: the current counter value is cleared and displays “0”. The drive counts up when this function is disabled.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>23</td><td>Input the counter value</td><td>ON: the counter value increases by 1. Use the function with Pr.02-19.</td></tr>
<tr><td>24</td><td>FWD JOG command</td><td>This function is valid when the source of the operation command is external terminal. ON: the drive executes forward JOG.</td></tr>
<tr><td>25</td><td>REV JOG command</td><td>This function is valid when the source of the operation command is external terminal. ON: the drive executes reverse JOG.</td></tr>
<tr><td>28</td><td>Emergency stop (EF1)</td><td>ON: the output of the drive stops immediately, displays EF1 on the keypad, and the motor is in the free run status. The drive keeps running until the fault is cleared after you press RESET on the keypad (EF: External Fault).

</td></tr>
<tr><td>29</td><td>Signal confirmation for Y-connection</td><td>When the control mode is V/F, ON: the drive operates by the first V/F.</td></tr>
<tr><td>30</td><td>Signal confirmation for Δ-connection</td><td>When the control mode is V/F, ON: the drive operates by the second V/F.</td></tr>
<tr><td>38</td><td>Disable EEPROM write function (parameters memory disable)</td><td>ON: writing to EEPROM is disabled. Changed parameters are not saved after power off</td></tr>
<tr><td>40</td><td>Force coasting to stop</td><td>ON: during operation, the drive free runs to stop.</td></tr>
<tr><td>41</td><td>HAND switch</td><td rowspan="2">1. When the MI terminal switches to OFF, it executes a STOP command. Therefore, if the MI terminal switches to OFF during operation, the drive stops.
2. Use the keypad KPC-CC01 to switch between HAND and AUTO. The drive stops first, and then switches to HAND or AUTO status.
3. The digital keypad KPC-CC01 displays the current status of the drive (HAND/OFF/AUTO).
<table><tr><th></th><th>bit1</th><th>bit0</th></tr><tr><td>OFF</td><td>0</td><td>0</td></tr><tr><td>AUTO</td><td>0</td><td>1</td></tr><tr><td>HAND</td><td>1</td><td>0</td></tr><tr><td>OFF</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>42</td><td>AUTO switch</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>49</td><td>Enable drive</td><td>When the drive is enabled, the RUN command is valid.
When the drive is disabled, the RUN command is invalid.
When drive is operating, the motor coasts to stop.
This function varies with MOx=45.</td></tr>
<tr><td>50</td><td>Slave dEb action to execute</td><td>Enter the message setting in this parameter when the master triggers dEb. This prevents over-low voltage of the slave DC bus, causes the Lv error occurs and the drive coasts to stop.</td></tr>
<tr><td>51</td><td>Selection for PLC mode bit0</td><td rowspan="2"><table><tr><td>PLC status</td><td>bit1</td><td>bit0</td></tr><tr><td>Disable PLC function (PLC 0)</td><td>0</td><td>0</td></tr><tr><td>Trigger PLC to operation (PLC 1)</td><td>0</td><td>1</td></tr><tr><td>Trigger PLC to stop (PLC 2)</td><td>1</td><td>0</td></tr><tr><td>No function</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>52</td><td>Selection for PLC mode bit1</td></tr>
<tr><td>53</td><td>Trigger CANopen quick stop</td><td>When this function is enabled under CANopen control, it changes to Quick Stop. Refer to Section 15 CANopen Overview for more details.</td></tr>
<tr><td>54</td><td>UVW output electromagnetic valve switch</td><td>Allows receiving confirmation signals while there is UVW magnetic contactor during output.</td></tr>
<tr><td>55</td><td>Brake release</td><td>When Pr.02-56 ≠ 0, connect the brake release signal to multi-function input terminals. When the brake is opened, and the drive does not receive its confirming signal, the Brk error occurs.</td></tr>
<tr><td>56</td><td>LOCAL / REMOTE Selection</td><td>Use Pr.00-29 to select for LOCAL / REMOTE mode (refer to Pr.00-29). When Pr.00-29 is not set to 0, the digital keypad KPC-CC01 displays the LOC / REM status. (KPC-CC01 firmware version 1.021 and above).<table><tr><td></td><td>bit 0</td></tr><tr><td>REM</td><td>0</td></tr><tr><td>LOC</td><td>1</td></tr></table></td></tr>
<tr><td>58</td><td>Enable fire mode with RUN Command</td><td>Enable this function under fire mode to force the drive to run (while there is RUN command).</td></tr>
<tr><td>59</td><td>Enable fire mode without RUN Command</td><td>Enable this function under fire mode to force the drive to run (while there is not a RUN command).</td></tr>
<tr><td>60</td><td>Disable all the motors</td><td>ON: when the multi-motor circulative control is enable, all motors coast to stop.</td></tr>
<tr><td>61</td><td>Disable Motor 1</td><td rowspan="7">These functions work with multi-motor circulative control, motor 1 to 8 can be set to coast to stop. If any of Auxiliary Motor 1 to Motor 8 is out of order or under maintenance, enable this terminal to bypass that motor.</td></tr>
<tr><td>62</td><td>Disable Motor 2</td></tr>
<tr><td>63</td><td>Disable Motor 3</td></tr>
<tr><td>64</td><td>Disable Motor 4</td></tr>
<tr><td>65</td><td>Disable Motor 5</td></tr>
<tr><td>66</td><td>Disable Motor 6</td></tr>
<tr><td>67</td><td>Disable Motor 7</td></tr>
</table>

Settings	Functions	Descriptions
68	Disable Motor 8	
69	Preheating Command	ON: if the preheating function is open and drive is in STOP status, the preheating function is executed; until the contact status changes to OFF, or the drive status turns to RUN and stops the preheating function. Refer to Pr.02-72–02-73 for detail.

02-09 UP/DOWN Key Mode

Default: 0

Settings 0: Up / Down by the acceleration or deceleration time

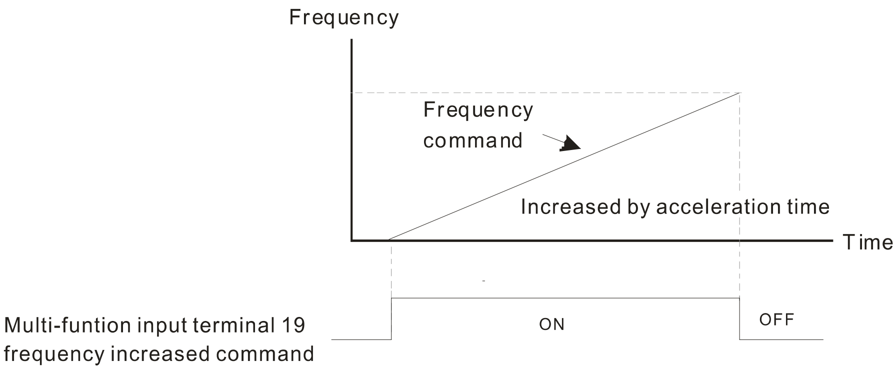
1: Up / Down constant speed (Pr.02-10)

02-10 Constant speed, Acceleration or Deceleration Speed of the UP/DOWN Key

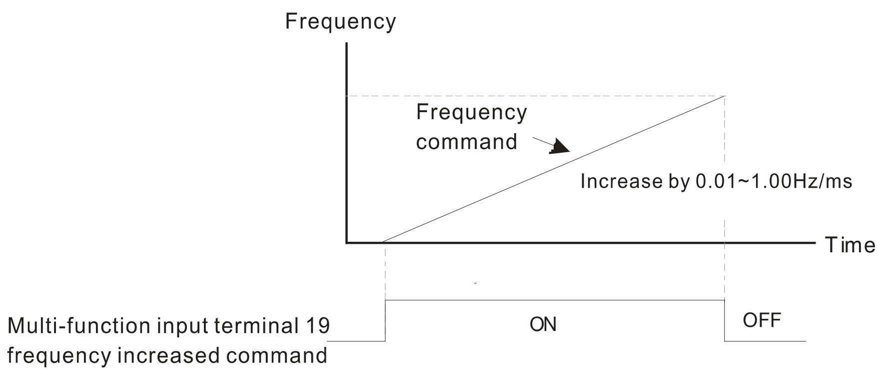
Default: 0.001

Settings 0.001–1.000 Hz/ms

- Use when the multi-function input terminals are set to 19, 20 (UP / DOWN command). The frequency increases or decreases according to Pr.02-09 and Pr.02-10.
- When Pr.02-09 is set to 0: the increasing or decreasing frequency command (F) operates according to the setting for acceleration or deceleration time (refer to Pr.01-12–Pr.01-19)



- When Pr.02-09 is set to 1: the increasing / decreasing frequency command (F) operates according to the setting for Pr.02-10 (0.01–1.00 Hz/ms).



02-11 Multi-function Input Response Time

Default: 0.005

Settings 0.000–30.000 sec.

- Sets the response time of the digital input terminals FWD, REV and MI1–MI8.
- This function is to delay and confirm the digital input terminal signal. The time for delay is also the

time for confirmation. The confirmation prevents interference that could cause error in the input to the digital terminals. In the meanwhile, it delays the response time, though confirmation improves accuracy.

02-12 Multi-function Input Mode Selection

Default: 0000h

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

- The parameter setting is in hexadecimal.
- This parameter sets the status of the multi-function input signal (0: normal open；1: normal close) and it is not affected by the status of SINK / SOURCE.
- bit2–bit15 correspond to MI1–MI14.
- The default for bit0 is FWD terminal, and the default for bit1 is REV terminal. You cannot use this parameter to change the input mode.
- You can change the terminal ON / OFF status through communications.

  For example, MI1 is set to 1 (multi-step speed command 1), MI2 is set to 2 (multi-step speed command 2). Then the forward + 2nd step speed command=1001_2 =9_{10}. As long as Pr.02-12=9 is set through communications, there is no need to wire any multi-function terminal to run forward with the second step speed.

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
MI15	MI14	MI13	MI12	MI11	MI10	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD

02-13 Multi-function Output 1 (Relay1)

Default: 11

02-14 Multi-function Output 2 (Relay2)

Default: 1

02-15 Multi-function Output 3 (Relay3)

Default: 66

02-36 Output Terminal of I/O Extension Card (MO10) or (RA10)

02-37 Output Terminal of I/O Extension Card (MO11) or (RA11)

02-38 Output Terminal of I/O Extension Card (RA12)

02-39 Output Terminal of I/O Extension Card (RA13)

02-40 Output Terminal of I/O Extension Card (RA14)

02-41 Output Terminal of I/O Extension Card (RA15)

02-42 Output Terminal of I/O Extension Card (MO16 Virtual Terminal)

02-43 Output Terminal of I/O Extension Card (MO17 Virtual Terminal)

02-44 Output Terminal of I/O Extension Card (MO18 Virtual Terminal)

02-45 Output Terminal of I/O Extension Card (MO19 Virtual Terminal)

02-46 Output Terminal of I/O Extension Card (MO20 Virtual Terminal)

Default: 0

Settings

0: No function

1: Indication during RUN

2: Operation speed reached
3: Desired frequency reached 1 (Pr.02-22)
4: Desired frequency reached 2 (Pr.02-24)
5: Zero speed (Frequency command)
6: Zero speed including STOP (Frequency command)
7: Over-torque 1 (Pr.06-06–06-08)
8: Over-torque 2 (Pr.06-09–06-11)
9: Drive is ready
10: Low voltage warning (Lv) (Pr.06-00)
11: Malfunction indication
12: Mechanical brake release (Pr.02-32)
13: Over-heat warning (Pr.06-15)
14: Software brake signal indication (Pr.07-00)
15: PID feedback error (Pr.08-13, Pr.08-14)
16: Slip error (oSL)
17: Count value reached, does not return to 0 (Pr.02-20)
18: Count value reached, returns to 0 (Pr.02-19)
19: External interrupt B.B. input (Base Block)
20: Warning output
21: Over-voltage
22: Over-current stall prevention
23: Over-voltage stall prevention
24: Operation mode
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: Y-connection for the motor coil
32: △ -connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed including stop (actual output frequency)
35: Error output selection 1 (Pr.06-23)
36: Error output selection 2 (Pr.06-24)
37: Error output selection 3 (Pr.06-25)
38: Error output selection 4 (Pr.06-26)
40: Speed reached (including stop)
44: Low current output (use with Pr.06-71–Pr.06-73)
45: UVW output electromagnetic valve switch
46: Master dEb output
50: Output control for CANopen

51: Analog output control for RS-485 interface (InnerCOM / Modbus)
52: Output control for communication cards
53: Fire mode indication
54: Bypass fire mode indication
55: Motor 1 output
56: Motor 2 output
57: Motor 3 output
58: Motor 4 output
59: Motor 5 output
60: Motor 6 output
61: Motor 7 output
62: Motor 8 output
66: SO output logic A
67: Analog input level reached
68: SO output logic B
69: Preheating output indication
70: Fan warning detection output

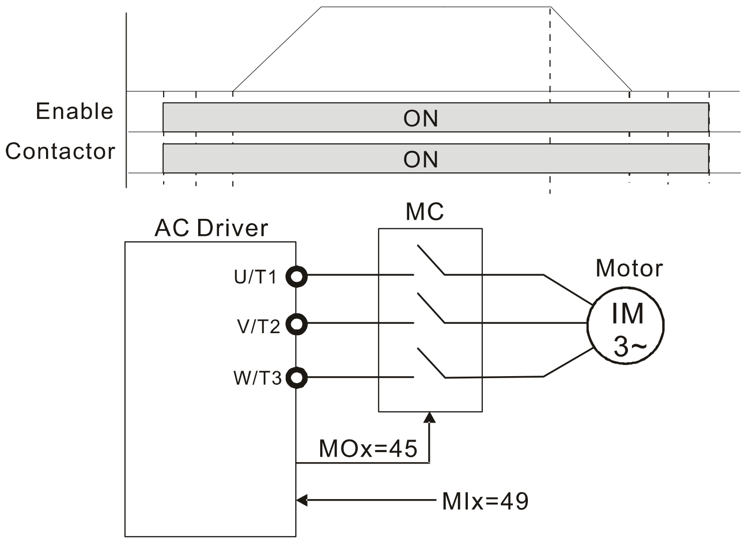
- Use this parameter to set the function of the multi-function terminals.
- Pr.02-36–Pr.02-41 requires additional extension cards to display the parameters; the choices of optional cards are EMC-D42A and EMC-R6AA.
- The optional card EMC-D42A provides two output terminals, use with Pr.02-36–02-37.
- The optional card EMC-R6AA provides six output terminals, use with Pr.02-36–02-41.
- MO16–MO20 are virtual terminals, set the status of bit11–15 of Pr.02-18 to control these virtual terminals.

Summary of function settings

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

Settings	Functions	Descriptions
0	No function	
1	Operation indication	Active when the drive is not in STOP.
2	Operation speed reached	Active when output frequency of the drive reaches the setting frequency.
3	Desired frequency reached 1 (Pr.02-22)	Active when the desired frequency (Pr.02-22) reached.
4	Desired frequency reached 2 (Pr.02-24)	Active when the desired frequency (Pr.02-24) reached.
5	Zero Speed (frequency command)	Active when frequency command = 0 (the drive must be in RUN status)
6	Zero Speed, includes Stop (frequency command)	Active when frequency command = 0 or stopped.
7	Over-torque 1	Active when the drive detects over-torque. Pr.06-07 sets the over-torque detection level, Pr.06-08 sets the over-torque detection time. Refer to Pr.06-06–Pr.06-08.
8	Over-torque 2	Active when the drive detects over-torque. Pr.06-10 sets the over-torque detection level, and Pr.06-11 sets the over-torque detection time. Refer to Pr.06-09–06-11.

Settings	Functions	Descriptions
9	Drive is ready	Active when the drive is ON with no error detected.
10	Low voltage warning (Lv)	Active when the DC bus voltage is too low (refer to Pr.06-00 low voltage level).
11	Malfunction indication	Active when fault occurs (except Lv stop).
12	Mechanical Brake Release (Pr.02-32)	Active when the drive runs after the set delayed time for Pr.02-32. This function must use with DC brake function.
13	Over-heat warning	Active when IGBT or heat sink overheats, to prevent the drive from shutting down due to over-heating (refer to Pr.06-15).
14	Software brake signal indication	Active when the soft brake function is ON (refer to Pr.07-00).
15	PID feedback error	Active when the PID feedback signal error is detected.
16	Slip Error (oSL)	Active when the slip error is detected.
17	Count value reached, does not return to 0 (Pr.02-20)	When the drive executes external counter, this contact is active if the count value is equal to the setting value for Pr.02-20. This contact is not active when the setting value for Pr.02-20 > Pr.02-19.
18	Counter value reached, returns to 0 (Pr.02-19)	When the drive executes the external counter, this contact is active if the count value is equal to the setting value for Pr.02-19.
19	External interrupt B.B. input (Base Block)	Active when external interrupt (B.B.) stop output occurs in the drive.
20	Warning Output	Active when a warning is detected.
21	Over-voltage	Active when the over-voltage is detected.
22	Over-current stall prevention	Active when the over-current stall prevention is detected.
23	Over-voltage stall prevention	Active when the over-voltage stall prevention is detected.
24	Operation mode indication	Active when the operation command is NOT controlled by digital keypad. (Pr.00-21≠0)
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 the current is ≥ Pr.02-33.
28	Output when Current < Pr.02-33	Active when the current is < Pr.02-33
29	Output when frequency ≥ Pr.02-34	Active when the frequency is ≥ Pr.02-34.
30	Output when Frequency < Pr.02-34	Active when the frequency is < Pr.02-34.
31	Y-connection for the motor coil	Active when Pr.05-24=1, the frequency output is lower than Pr.05-23 minus 2Hz, and the time is longer than Pr.05-25.
32	Δ-connection for the motor coil	Active when Pr.05-24=1, the frequency output is higher than Pr.05-23 plus 2Hz, and the time is longer than Pr.05-25.
33	Zero Speed (actual output frequency)	Active when the actual output frequency is 0. (the drive is in RUN mode)
34	Zero Speed includes stop (actual output frequency)	Active when the actual output frequency is 0 or Stopped.
35	Error output selection 1 (Pr.06-23)	Active when Pr.06-23 is ON.
36	Error output selection 2 (Pr.06-24)	Active when Pr.06-24 is ON.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>37</td><td>Error output selection 3 (Pr.06-25)</td><td>Active when Pr.06-25 is ON.</td></tr>
<tr><td>38</td><td>Error output selection 4 (Pr.06-26)</td><td>Active when Pr.06-26 is ON.</td></tr>
<tr><td>40</td><td>Speed reached (including STOP)</td><td>Active when the output frequency reaches the setting frequency or stopped.</td></tr>
<tr><td>44</td><td>Low current output</td><td>This function needs to be used with Pr.06-71–Pr.06-73</td></tr>
<tr><td>45</td><td>UVW output electromagnetic valve switch</td><td>Use this function with external terminal input = 49 (drive enabled) and external terminal output = 45 (electromagnetic valve enabled), and then the electromagnetic valve is ON or OFF according to the status of the drive.

</td></tr>
<tr><td>46</td><td>Master dEb output</td><td>When dEb rises at master, MO sends a dEb signal to the slave.
Output the message when the master triggers dEb. This ensures that the slave also triggers dEb. Then slave follows the deceleration time of the master to stop simultaneously with the master.</td></tr>
<tr><td>50</td><td>Output control for CANopen</td><td>Control multi-function output terminals through CANopen.
To control RY2, set Pr.02-14 = 50.
The mapping table of the CANopen DO is shown in the following table:
<table>
<tr><th>Physical terminal</th><th>Setting of related parameters</th><th>Attribute</th><th>Corresponding Index</th></tr>
<tr><td>RY1</td><td>Pr.02-13 = 50</td><td>RW</td><td>The bit0 at 2026-41</td></tr>
<tr><td>RY2</td><td>Pr.02-14 = 50</td><td>RW</td><td>The bit1 at 2026-41</td></tr>
<tr><td>RY3</td><td>Pr.02-15 = 50</td><td>RW</td><td>The bit2 at 2026-41</td></tr>
<tr><td>MO10/RY10</td><td>Pr.02-36 = 50</td><td>RW</td><td>The bit5 at 2026-41</td></tr>
<tr><td>MO11/RY11</td><td>Pr.02-37 = 50</td><td>RW</td><td>The bit6 at 2026-41</td></tr>
<tr><td>RY12</td><td>Pr.02-38 = 50</td><td>RW</td><td>The bit7 at 2026-41</td></tr>
<tr><td>RY13</td><td>Pr.02-39 = 50</td><td>RW</td><td>The bit8 at 2026-41</td></tr>
<tr><td>RY14</td><td>Pr.02-40 = 50</td><td>RW</td><td>The bit9 at 2026-41</td></tr>
<tr><td>RY15</td><td>Pr.02-41 = 50</td><td>RW</td><td>The bit10 at 2026-41</td></tr>
</table>
Refer to Section 15-3-5 for more information.</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>51</td><td>Analog output control for RS-485 interface</td><td>For RS-485 interface (InnerCOM / Modbus) communication control output.
<table>
<tr><th>Physical terminal</th><th>Setting of related parameters</th><th>Attribute</th><th>Corresponding Index</th></tr>
<tr><td>RY1</td><td>Pr.02-13 = 51</td><td>RW</td><td>The bit0 at 2640h</td></tr>
<tr><td>RY2</td><td>Pr.02-14 = 51</td><td>RW</td><td>The bit1 at 2640h</td></tr>
<tr><td>MO1</td><td>Pr.02-16 = 51</td><td>RW</td><td>The bit3 at 2640h</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 51</td><td>RW</td><td>The bit 4 at 2640h</td></tr>
<tr><td>MO10/RA10</td><td>Pr.02-36 = 51</td><td>RW</td><td>The bit5 at 2640h</td></tr>
<tr><td>MO11/RA11</td><td>Pr.02-37 = 51</td><td>RW</td><td>The bit6 at 2640h</td></tr>
<tr><td>RY12</td><td>Pr.02-38 = 51</td><td>RW</td><td>The bit7 at 2640h</td></tr>
<tr><td>RY13</td><td>Pr.02-39 = 51</td><td>RW</td><td>The bit8 at 2640h</td></tr>
<tr><td>RY14</td><td>Pr.02-40 = 51</td><td>RW</td><td>The bit9 at 2640h</td></tr>
<tr><td>RY15</td><td>Pr.02-41 = 51</td><td>RW</td><td>The bit10 at 2640h</td></tr>
</table></td></tr>
<tr><td>52</td><td>Output control for communication cards</td><td>Control the output through communication cards (CMC-EIP01, CMC-PN01 and CMC-DN01)
<table>
<tr><th>Physical terminal</th><th>Setting of related parameters</th><th>Attribute</th><th>Corresponding Index</th></tr>
<tr><td>RY1</td><td>Pr.02-13 = 52</td><td>RW</td><td>The bit0 at 2640</td></tr>
<tr><td>RY2</td><td>Pr.02-14 = 52</td><td>RW</td><td>The bit1 at 2640</td></tr>
<tr><td>RY3</td><td>Pr.02-15 = 52</td><td>RW</td><td>The bit2 at 2640</td></tr>
<tr><td>MO10/RY10</td><td>Pr.02-36 = 52</td><td>RW</td><td>The bit5 at 2640</td></tr>
<tr><td>MO11/RY11</td><td>Pr.02-37 = 52</td><td>RW</td><td>The bit6 at 2640</td></tr>
<tr><td>RY12</td><td>Pr.02-38 = 52</td><td>RW</td><td>The bit7 at 2640</td></tr>
<tr><td>RY13</td><td>Pr.02-39 = 52</td><td>RW</td><td>The bit8 at 2640</td></tr>
<tr><td>RY14</td><td>Pr.02-40 = 52</td><td>RW</td><td>The bit9 at 2640</td></tr>
<tr><td>RY15</td><td>Pr.02-41 = 52</td><td>RW</td><td>The bit10 at 2640</td></tr>
</table></td></tr>
<tr><td>53</td><td>Fire mode indication</td><td>This function is enabled when setting 58 or 59 is enabled.</td></tr>
<tr><td>54</td><td>Bypass fire mode indication</td><td>The contact works when bypass function is enabled in the fire mode.</td></tr>
<tr><td>55</td><td>Motor 1 output</td><td rowspan="8">When setting multi-motor circulative function, the multi-function output terminal automatically sets up Pr.02-13–Pr.02-15 and Pr.02-36–Pr.02-40 in accordance with the setting for Pr.12-01.</td></tr>
<tr><td>56</td><td>Motor 2 output</td></tr>
<tr><td>57</td><td>Motor 3 output</td></tr>
<tr><td>58</td><td>Motor 4 output</td></tr>
<tr><td>59</td><td>Motor 5 output</td></tr>
<tr><td>60</td><td>Motor 6 output</td></tr>
<tr><td>61</td><td>Motor 7 output</td></tr>
<tr><td>62</td><td>Motor 8 output</td></tr>
<tr><td>66</td><td>SO output logic A (N.O.)</td><td rowspan="2">
<table>
<tr><th rowspan="2">Status of drive</th><th colspan="2">Status of safety output</th></tr>
<tr><th>N.O. (MOx=66)</th><th>N.C. (MOx=68)</th></tr>
<tr><td>Normal</td><td>Broken circuit (Open)</td><td>Short circuit (Close)</td></tr>
<tr><td>STO</td><td>Short circuit (Close)</td><td>Broken circuit (Open)</td></tr>
<tr><td>STL1–STL3</td><td>Short circuit (Close)</td><td>Broken circuit (Open)</td></tr>
</table></td></tr>
<tr><td>68</td><td>SO output logic B (N.C.)</td></tr>
<tr><td>67</td><td>Analog input level reached</td><td>The multi-function output terminals operate when the analog input level is between the high level and the low level.
Pr.03-44: Select one of the analog signal channels (AVI1, ACI, and AVI2) to be compared.
Pr.03-45: The high level for the analog input, default is 50.00%
Pr.03-46: The low level for the analog input, default is 10.00%.
If analog input > Pr.03-45, the multi-function output terminal operates.
If analog input < Pr.03-46, the multi-function output terminal stops output.</td></tr>
</table>

Settings	Functions	Descriptions
69	Preheating output indication	Active when the preheating is detected.
70	FAN warning detection output	The terminal works when the internal fan warning activates.

📖 Remote IO function is added to directly make the drive control its AO/DO and read current AI/DI status through the standard Modbus. The corresponding index of 26xx is as follows.

	bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
2600h	MI15	MI14	MI13	MI12	MI11	MI10	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD
2640h	-	-	-	-	-	MO15	MO14	MO13	MO12	MO11	MO10	-	-	RY3	RY2	RY1
2660h	AVI1		-	-	-	-	-	-	-	-	-	-	-	-	-	-
2661h	ACI		-	-	-	-	-	-	-	-	-	-	-	-	-	-
2662h	AVI2		-	-	-	-	-	-	-	-	-	-	-	-	-	-
266Ah	AI10		-	-	-	-	-	-	-	-	-	-	-	-	-	-
266Bh	AI11		-	-	-	-	-	-	-	-	-	-	-	-	-	-
26A0h	AFM1			-	-	-	-	-	-	-	-	-	-	-	-	-
26A1h	AFM2			-	-	-	-	-	-	-	-	-	-	-	-	-
26AAh	AO10			-	-	-	-	-	-	-	-	-	-	-	-	-
26ABh	AO11			-	-	-	-	-	-	-	-	-	-	-	-	-

In addition, the AI and DI values can be read directly, and DO and AO have to be controlled by Modbus for corresponding parameter functions. The tables below shown the related parameter definition.

DO

Terminal	Pr. Setting	Direct control the index corresponded to Modbus
RY1	Pr.02-13 = 51	bit0 of 2640h
RY2	Pr.02-14 = 51	bit1 of 2640h
RY3	Pr.02-15 = 51	bit2 of 2640h
MO10 / RY10	Pr.02-36 = 51	bit5 of 2640h
MO11 / RY11	Pr.02-37 = 51	bit6 of 2640h
MO12	Pr.02-38 = 51	bit7 of 2640h
MO13	Pr.02-39 = 51	bit8 of 2640h
MO14	Pr.02-40 = 51	bit9 of 2640h
MO15	Pr.02-41 = 51	bit10 of 2640h

AO

Terminal	Pr. Setting	Direct control the index corresponded to Modbus
AFM1	Pr.03-20 = 21	The value of 26A0h
AFM2	Pr.03-23 = 21	The value of 26A1h
AFM10	Pr.14-12 = 21	The value of 26AAh
AFM11	Pr.14-13 = 21	The value of 26ABh

✓ 02 - 18 Multi-function Output Direction

Default: 0000h

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

📖 This parameter is in hexadecimal.

📖 This parameter is set by a bit. If the bit is 1, the corresponding multi-function output acts in an opposite way.

Example: Assume Pr.02-13=1 (indication when the drive is operating). If the output is positive, the bit is set to 0, and then Relay is ON when the drive runs and is OFF when the drive stops. On the contrary, if the output is negative, and the bit is set to 1, then the Relay is OFF when the drive runs and is ON when the drive stops.

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
MO20	MO19	MO18	MO17	MO16	MO15	MO14	MO13	MO12	MO11	MO10	Reserved		RY3	RY2	RY1

02-19 Terminal Counting Value Reached (return to 0)

Default: 0

Settings 0–65500

You can set the input point for the counter using the multi-function terminal MI6 as a trigger terminal (set Pr.02-06 to 23). When counting is completed, the specified multi-function output terminal is activated (Pr.02-13, Pr.02-14, Pr.02-36, Pr.02-37 are set to 18), and Pr.02-19 cannot be set to 0 at this time.

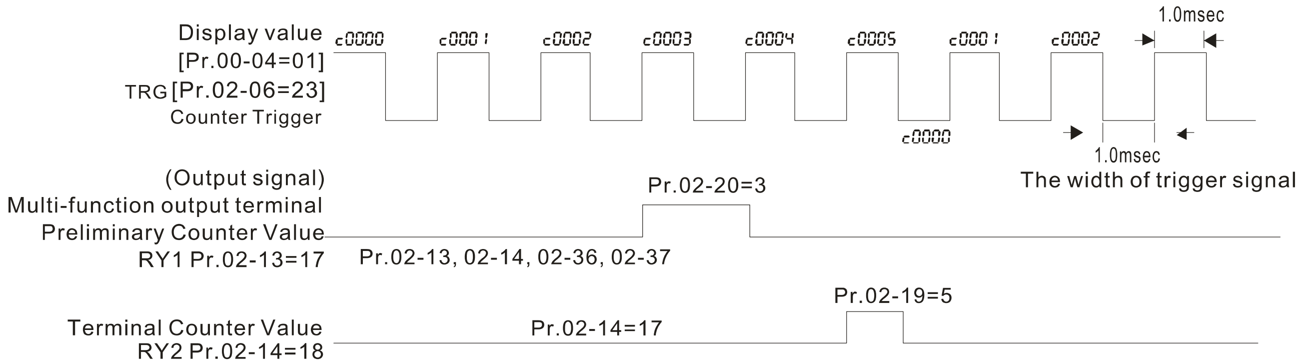
Example: When the displayed value is c5555, the drive count is 5,555 times. If the displayed value is c5555•, the actual count value is 55,550–55,559.

02-20 Preliminary Counting Value Reached (does not return to 0)

Default: 0

Settings 0–65500

When the count value counts from 1 to reach this value, the corresponding multi-function output terminal is activated (Pr.02-13, Pr.02-14, Pr.02-36, Pr.02-37 are set to 17). You can use this parameter as the end of counting to make the drive run from the low speed to stop.



02-22 Desired Frequency Reached 1

02-24 Desired Frequency Reached 2

Default: 60.00 / 50.00

Settings 0.00–599.00 Hz

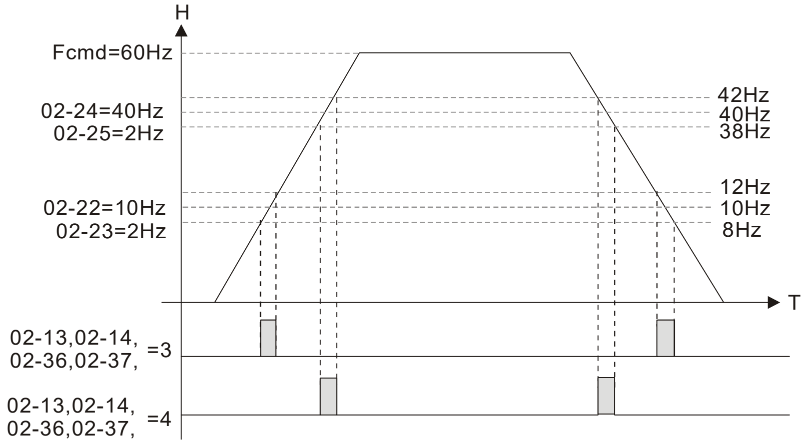
02-23 The Width of the Desired Frequency Reached 1

02-25 The Width of the Desired Frequency Reached 2

Default: 2.00

Settings 0.00–599.00 Hz

Once output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3–4 (Pr.02-13, Pr.02-14, Pr.02-36, and Pr.02-37), this multi-function output terminal is "closed".

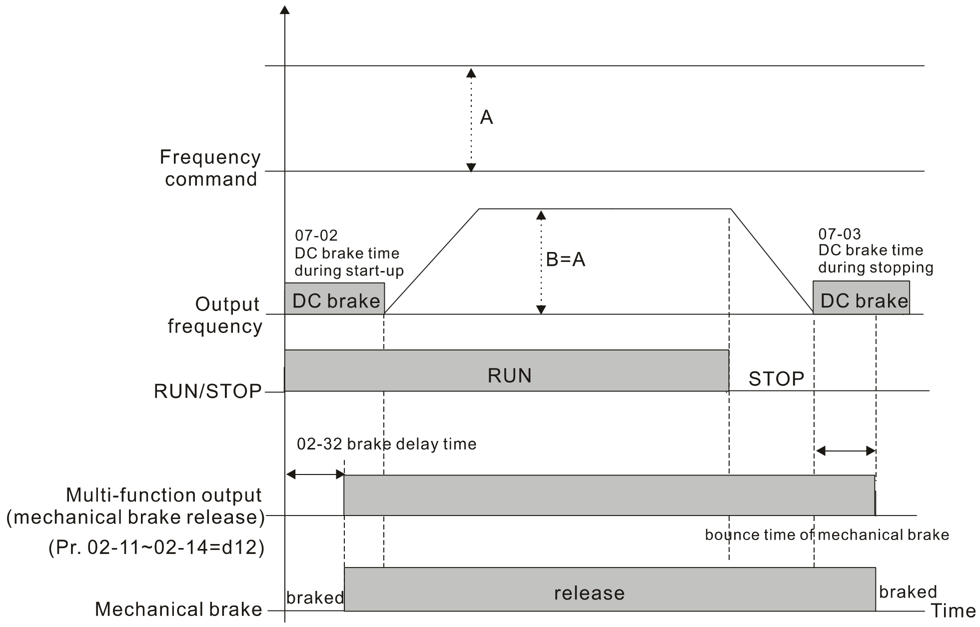


02-32 Brake Delay Time

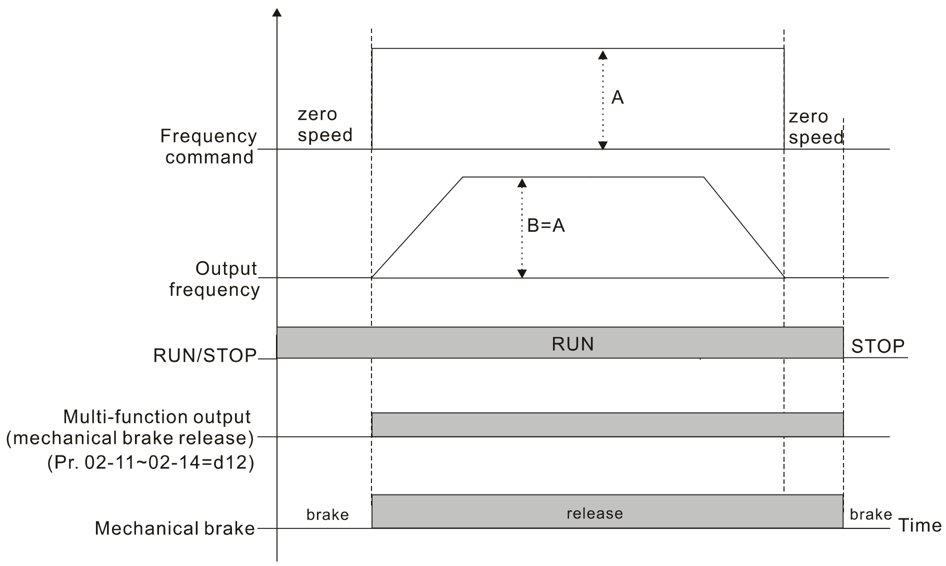
Default: 0.000

Settings 0.000–65.000 sec.

- When the AC motor drive runs after the setting delay time of Pr.02-32, the corresponding multi-function output terminal (12: mechanical brake release) is “closed”. The function must be used with DC brake.



- This parameter is invalid if it is used without DC brake. Refer to the following operation timing.



02-33 Output Current Level Setting for Multi-function Output Terminals

Default: 0

Settings 0–150%

- When the drive outputs current higher than or equal to Pr.02-33, the multi-function output parameters active (Pr.02-13, Pr.02-14, and Pr.02-15 are set to 27).
- When the drive outputs current lower than Pr.02-33, the multi-function output parameters active (Pr.02-13, Pr.02-14, and Pr.02-15 are set to 28).

02-34 Output Frequency Setting for Multi-function Output Terminals

Default: 3.00

Settings 0.00–599.00 Hz

- When the drive outputs frequency higher than or equal to Pr.02-34 (actual output frequency H ≥ Pr.02-34), the multi-function terminal active (Pr.02-13, Pr.02-14 and Pr.02-15 are set to 29).
- When the drive outputs frequency lower than Pr.02-34 (actual output frequency H < Pr.02-34), the multi-function terminals active (Pr.02-13, Pr.02-14 and Pr.02-15 are set to 30).

02-35 External Operation Control Selection after Reset and Activate

Default: 0

Settings 0: Disable

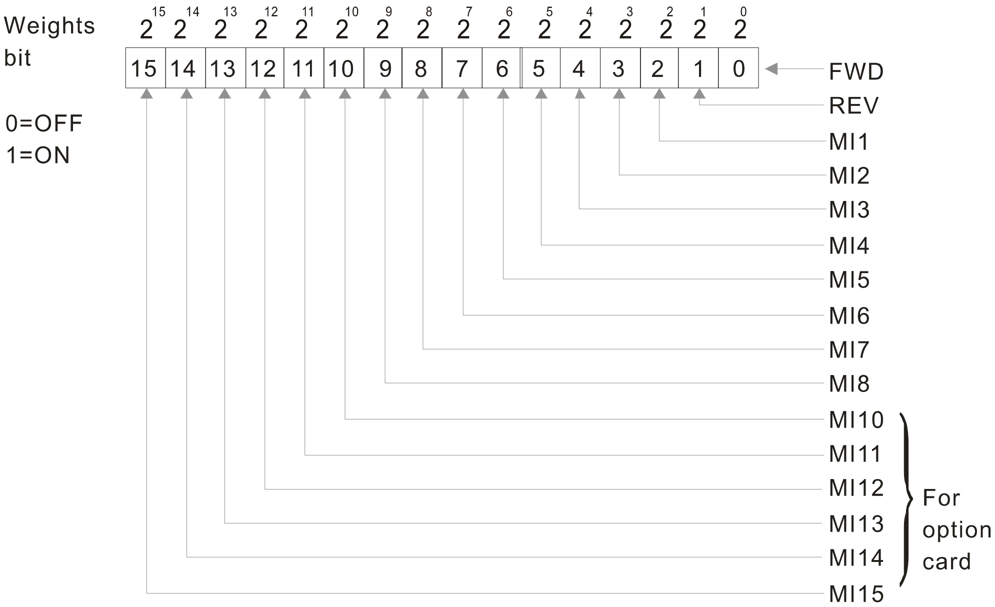
1: Drive runs if the RUN command remains after reset or re-boot

- Setting 1: **the drive automatically executes the RUN command under the following circumstances, pay extra attention on this.**
  - Status 1: **After the drive is powered on and the external terminal for RUN stays ON**, the drive runs.
  - Status 2: After clearing a fault once a fault is detected and the external terminal for RUN stays ON, you can run the drive by pressing RESET key.

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

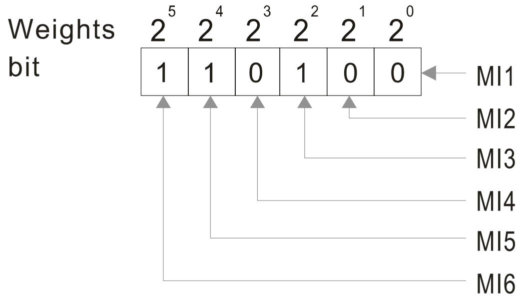
Default: Read only

Settings Monitoring status of multi-function input terminal



For Example:

When Pr.02-50 displays 0034h (hex), (that is, the value is 52 (decimal), and 110100 (binary)). It means MI1, MI3 and MI4 are ON.



0=OFF
1=ON

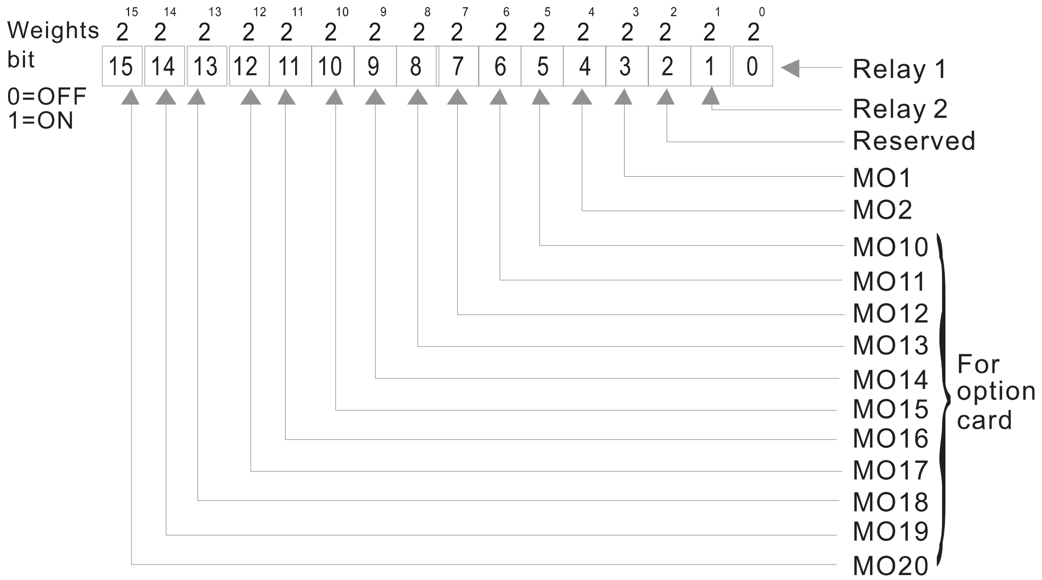
Settings
$= bit5 \times 2^5 + bit4 \times 2^4 + bit2 \times 2^2$
$= 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^2$
$= 32 + 16 + 4 = 52$

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

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

Default: Read only

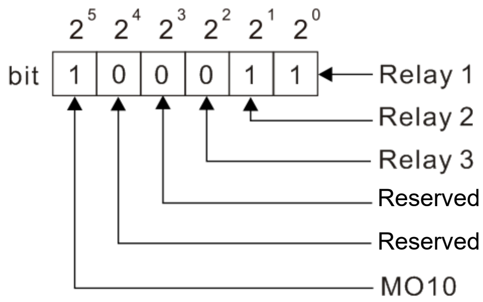
Settings	Monitoring status of multi-function output terminal



NOTE
$2^7=128$ $2^6=64$
$2^5=32$ $2^4=16$ $2^3=8$
$2^2=4$ $2^1=2$ $2^0=1$

Example:

When Pr.02-51 displays 35 (decimal) the value is 23 (hex) and 100011 (binary). It means RY1, RY2 and MO10 are ON.



0=OFF
1=ON

Setting
$= bit\ 5 \times 2^5 + bit\ 1 \times 2^1 + bit\ 0 \times 2^0$
$= 1 \times 2^5 + 1 \times 2^1 + 1 \times 2^0$
$= 32 + 2 + 1$
$= 35$

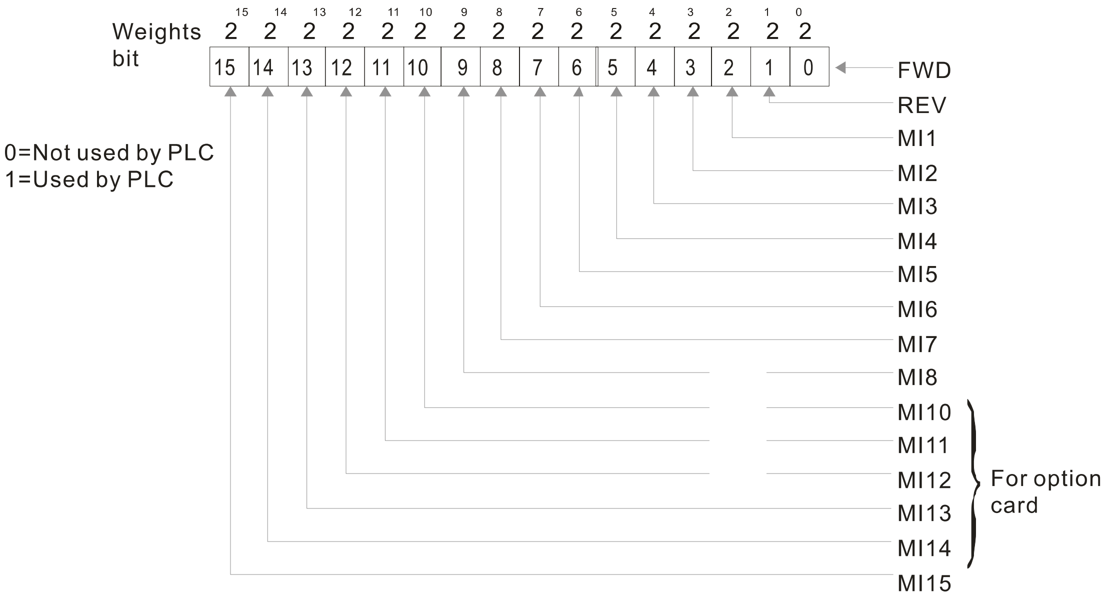
Note
$2^5= 32$ $2^4= 16$ $2^3= 8$
$2^2= 4$ $2^1= 2$ $2^0= 1$

02-52 Display the External Multi-function Input Terminals Used by PLC

Default: Read only

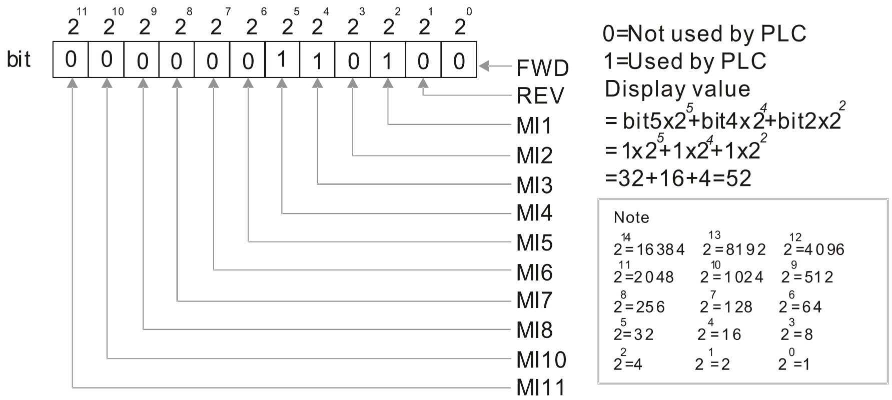
Settings	Monitoring status of PLC external output terminal

Pr.02-52 displays the external multi-function input terminals that used by PLC.



📖 Example:

When Pr.02-52 displays 0034h (hex) (that is, the value is 110100 (binary)), it means MI1, MI3 and MI4 are used by PLC.

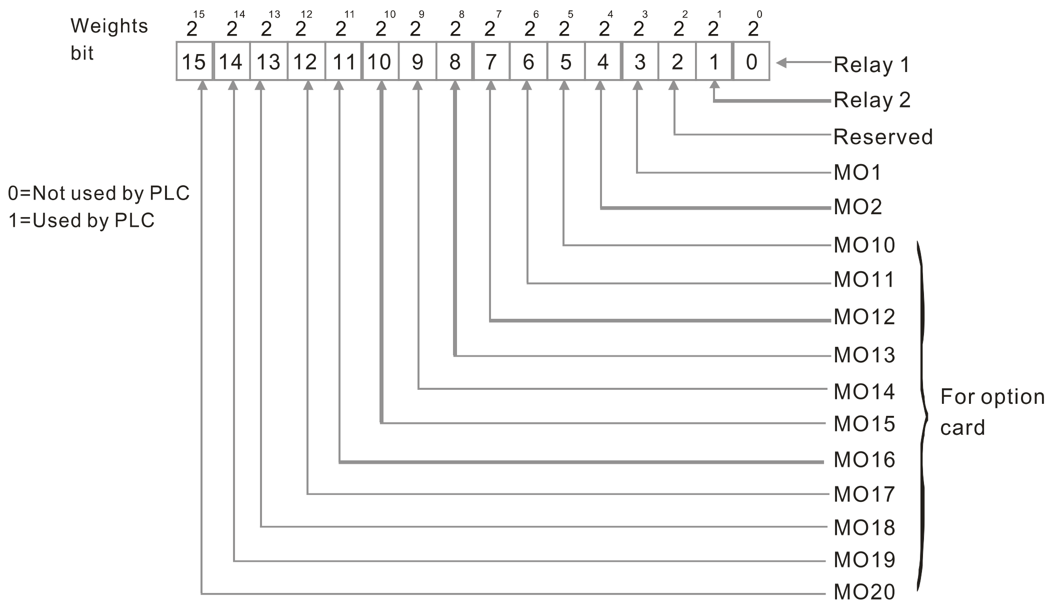


02-53 Display the External Multi-function Output Terminal Used by PLC

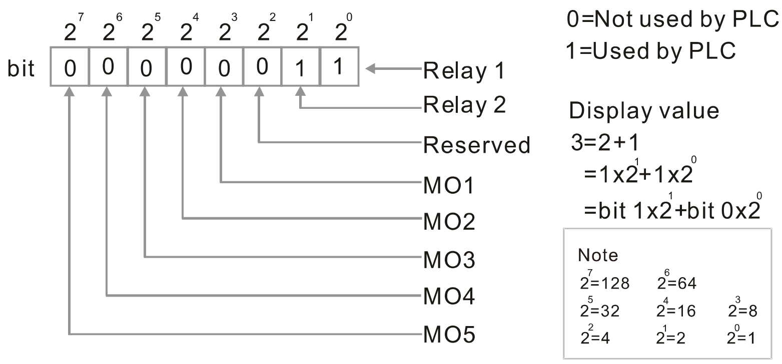
Default: Read only

Settings	Monitoring status of PLC external multi-function output terminal

📖 Pr.02-53 displays the external multi-function output terminal that used by PLC.



📖 Example:
When Pr.02-53 displays 0003h (hex), it means that RY1 and RY2 are used by PLC.



02-54 Display the Frequency Command Executed by External Terminal

Default: Read only

Settings 0.00–599.00 Hz (Read only)

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

02-70 IO Card Types

Default: Read only

Settings 1: EMC-BPS01
4: EMC-D611A
5: EMC-D42A
6: EMC-R6AA
11: EMC-A22A

✓ 02-72 Preheating Output Current Level

Default: 0

Settings 0–100%

📖 When a motor drive is not in operation (STOP) and is placed in a cold and humid environment, enabling the preheating function to output DC current to heat up the motor drive can prevent the invasion of humidity into the motor drive, which creates condensation affects the normal function of the motor drive.

📖 Sets the output current level from the motor drive to the motor after enabling the preheating. The percentage of the preheating DC current is 100% of the rated current of the motor drive (Pr.05-01, Pr.05-13 and Pr.05-34). When setting this parameter, slowly increase the percentage to reach the sufficient preheating temperature.

✓ 02-73 Preheating Output Cycle

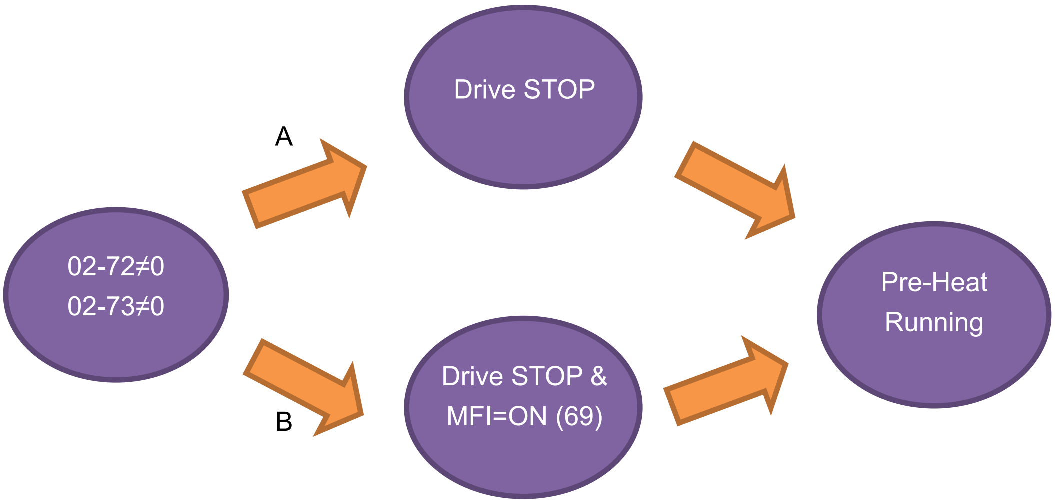
Default: 0

Settings 0–100%

📖 Sets the output current cycle of preheating. 0–100% corresponds to 0–10 seconds. When set to 0%, there is no output current. When set to 100%, there is a continuous output. For example, when set to 50%, a cycle of preheating goes from OFF (5 seconds) to ON (5 seconds), and vice versa.

📖 Related Parameters of Preheating

Parameter	Description	Setting Range	Explanation
02-72	Output current level of preheating	0–100% (rated current of the motor) 0% No output	Output current level of preheating
02-73	Output cycle of preheating	0–100% (0–10 sec.) 0% No output 100% Continuous output	Output cycle of preheating
02-01–08 02-26–31	Multi-input function commands (MFI)	69 Preheating command	Enable or disable the preheating
02-13–15 02-36–46	Multi-output function commands (MFO)	69 Output command of preheating	Indication of the preheating



📖 Enable preheating: When Pr.02-72 and Pr.02-73 are NOT set to zero.

📖 Preheating function A: If Pr.07-72 and Pr.07-23 are set before the motor drive stops operation (STOP), preheating is enabled right after the motor drive stops. However, if Pr.07-72 and Pr.07-73 are set after the motor drives stops operation, preheating is not enabled. Preheating is enabled only when the motor drive stops again or restarts.

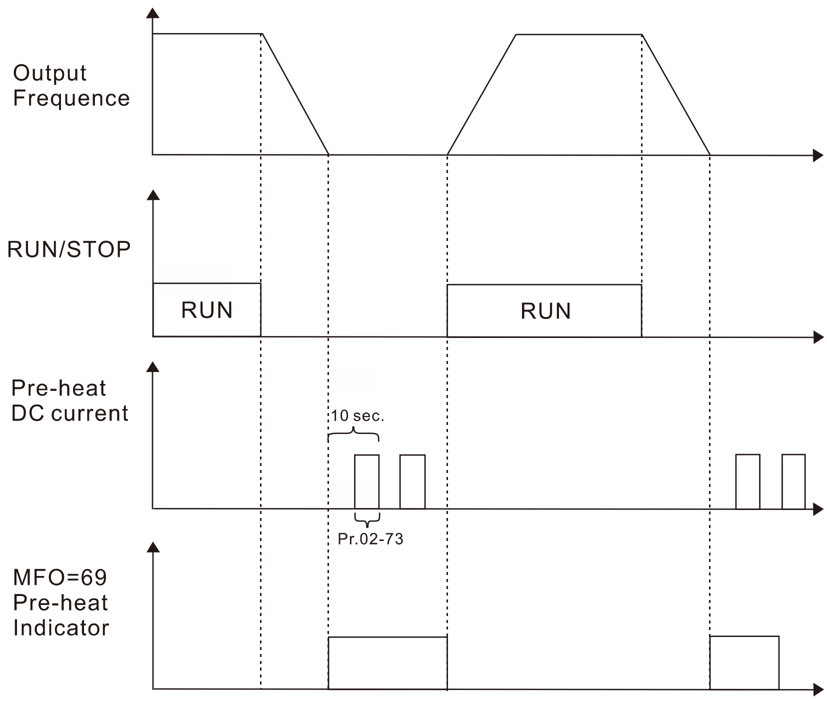
📖 Preheating function B: When the motor drive is in operation (RUN) or stops operating (STOP), set Pr.02-72 and Pr.02-73 between 1–100% and set MFI = 69 and MFI = ON. Preheating is enabled whenever the motor drive stops; no matter the motor drive is in operation (RUN) or stops operating (STOP).

📖 Preheating priority: if preheating function A and B are both enabled, function B takes priority.

Sequential Diagram of the Preheating Function:

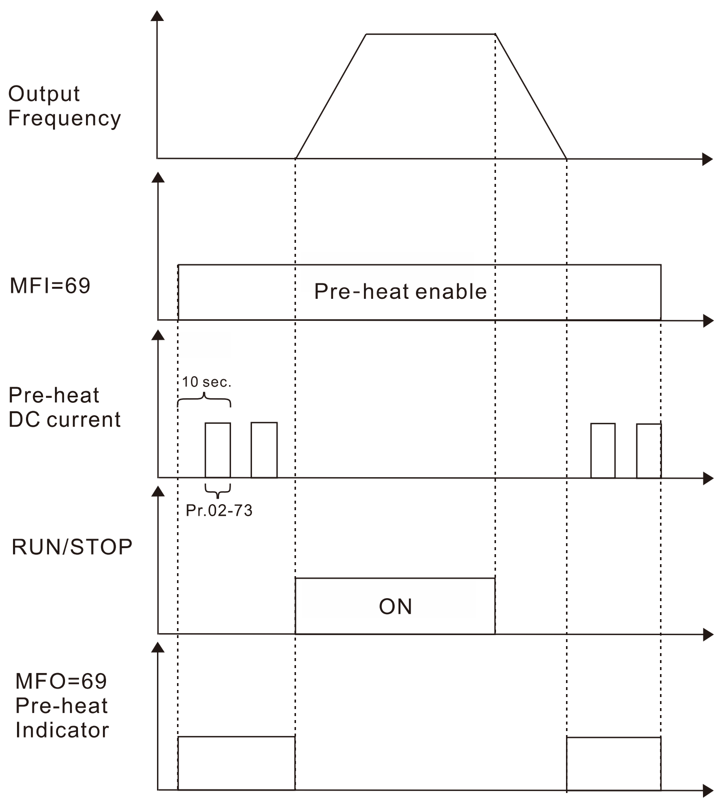
1. Setting parameters to enable preheating (Function A)

   Set Pr.02-72 and Pr.02-73 not equal to zero (50% in the diagram) and stop running the motor drive, then preheating is enabled to output DC current. At the same time, MFO (Output Command of Preheating) is ON (MFO=69). Once the drive is rebooted, the preheating function is enabled right away. The sequence of preheating goes from OFF (5 seconds) to ON (5 seconds). When the motor is in operation (RUN), the preheating function is OFF even it is enabled. Meanwhile, MFO is OFF (MFO=69) and the preheating is enabled when the motor drive stops.



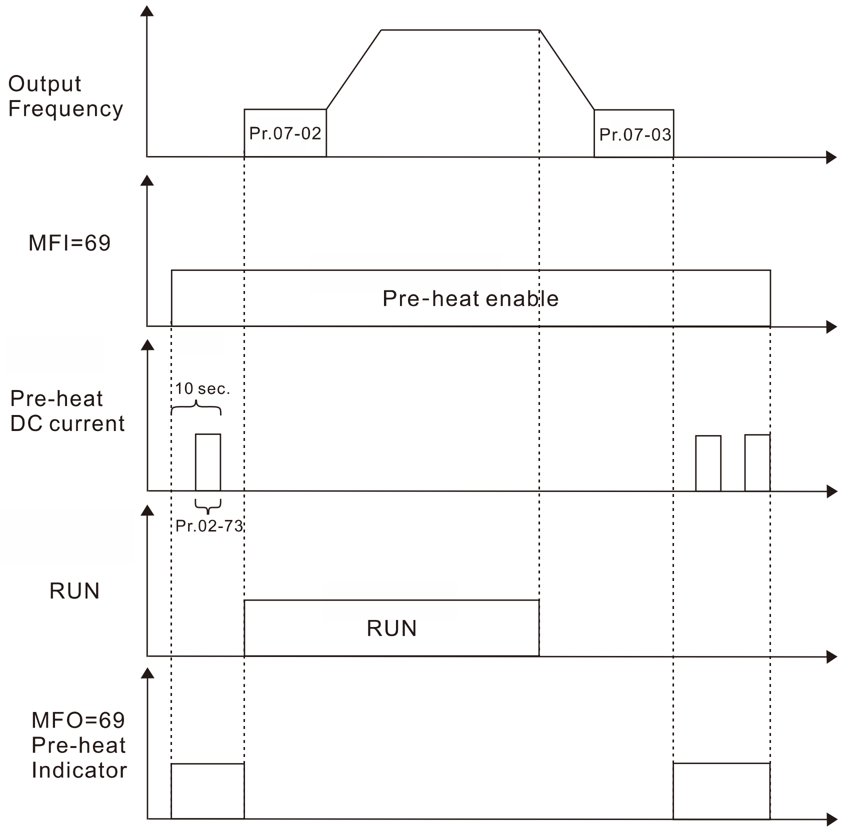
2. Enable preheating via multi-input terminals (Function B)

Set Pr.02-72 and Pr.02-73 (50% in the diagram) not equal to zero and set MFI=69, and MFI= ON, then Function B takes priority to enable / disable preheating on the motor drive. At the same time, enabling preheating by parameters is automatically invalid. If, at this moment, the motor drive is already STOP, the preheating function is enabled to output DC current and the MFO (Output Command of Preheating) is ON (MFO=69). The sequence of preheating goes from OFF (5 seconds) to ON (5 seconds). When the motor is in operation (RUN), the preheating function is OFF even it is enabled. Meanwhile, MFO is OFF (MFO=69) and the preheating is enabled when the motor drive stops.



3. Enable DC brake function

DC brake and preheating are enabled at the same time. The motor drive operates with the same logic described above for preheating. The only difference is that no matter the motor drive is in operation (RUN) or stops operating (STOP), DC brake enables first. When the motor drive stops, preheating is activated.



03 Analog Input / Output Parameter

✍ This parameter can be set during operation.

✍ **03-00** Analog Input Selection (AVI1)

Default: 1

✍ **03-01** Analog Input Selection (ACI)

Default: 0

✍ **03-02** Analog Input Selection (AVI2)

Default: 0

Settings
0: No function
1: Frequency command
4: PID target value
5: PID feedback signal
6: Thermistor (PTC) input value
11: PT100 thermistor input value
13: PID compensation value

- When you use analog input as the PID reference target value, you must set Pr.00-20 to 2 (analog input).
  Setting method 1: Pr.03-00–03-02 set 1 as PID reference target input.
  If the setting value 1 and setting value 4 exist at the same time, the AVI1 input has the highest priority to become the PID reference target input value.
- When you use analog input as the PID compensation value, you must set Pr.08-16 to 1 (source of PID compensation value is analog input). You can see the compensation value with Pr.08-17.
- When you use the frequency command, the corresponding value for 0– ±10 V / 4–20 mA is 0 to maximum output frequency (Pr.01-00).
- When the settings for Pr.03-00–Pr.03-02 are the same, the AVI1 input is selected first.

✍ **03-03** Analog Input Bias (AVI1)

Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding AVI1 voltage for the external analog input 0.

✍ **03-04** Analog Input Bias (ACI)

Default: 0.0

Settings -100.0–100.0%

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

✍ **03-05** Analog Voltage Input Bias (AVI2)

Default: 0.0

Settings -100.0–100.0%

- Sets the corresponding AVI2 voltage for the external analog input 0.
- The corresponding external input voltage / current signal and the set frequency is 0–10 V (4–20 mA) corresponds to 0–maximum frequency (Pr.01-00).

03-07	Positive / Negative Bias Mode (AVI1)
03-08	Positive / Negative Bias Mode (ACI)
03-09	Positive / Negative Bias Mode (AVI2)

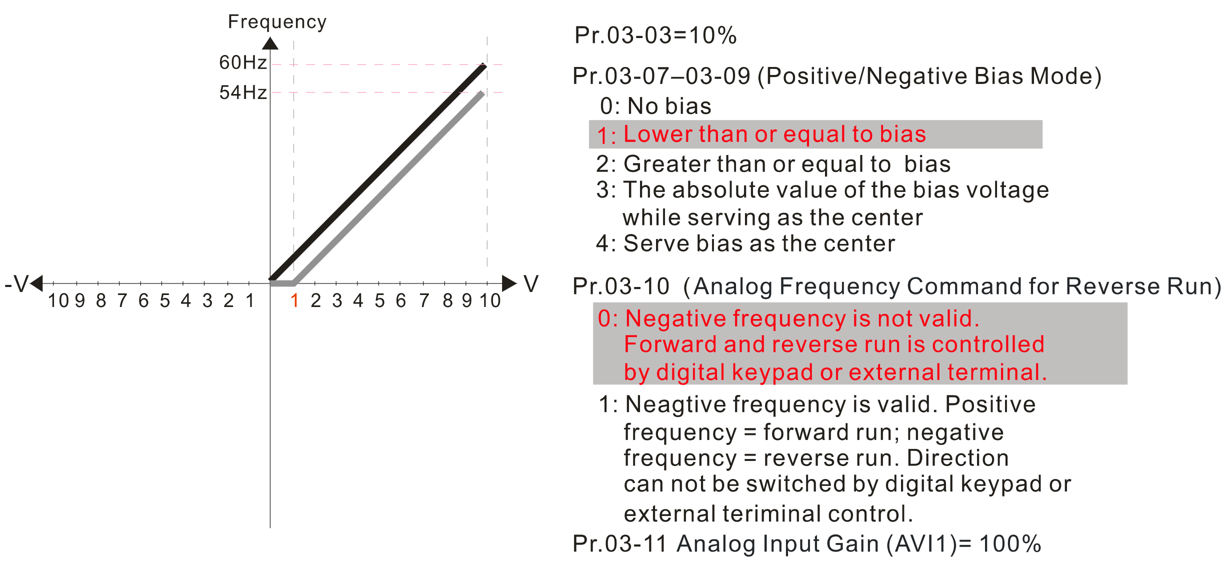
Default: 0

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

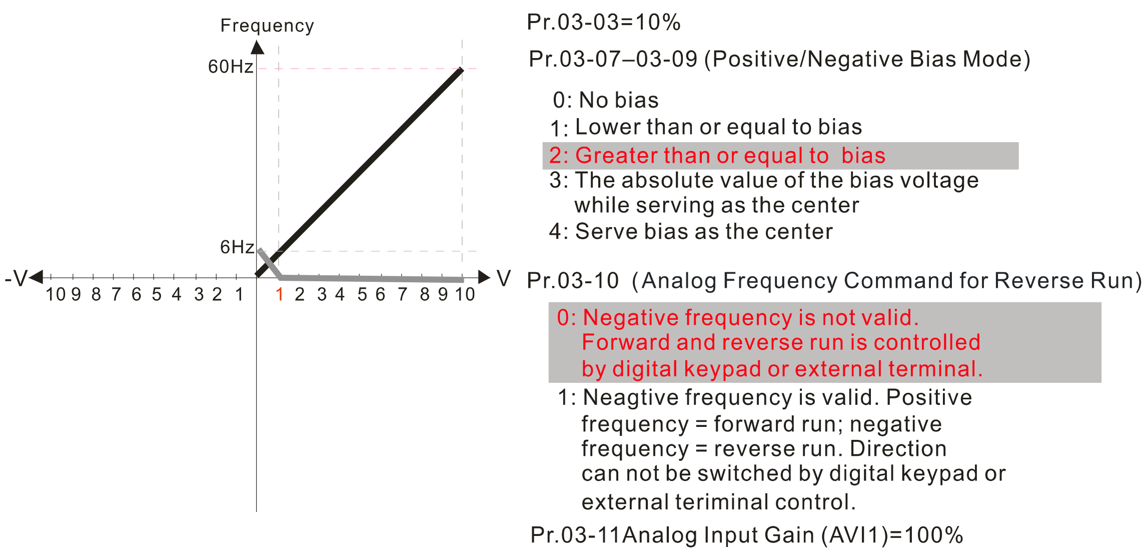
In a noisy environment, use negative bias to provide a noise margin. Do NOT use less than 1V to set the operation frequency.

In the diagram below: Black line: Curve with no bias. Gray line: curve with bias

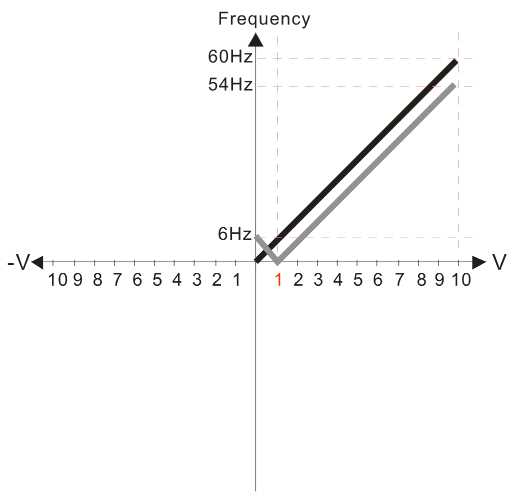
1.



2.



3.



Pr.03-03=10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)

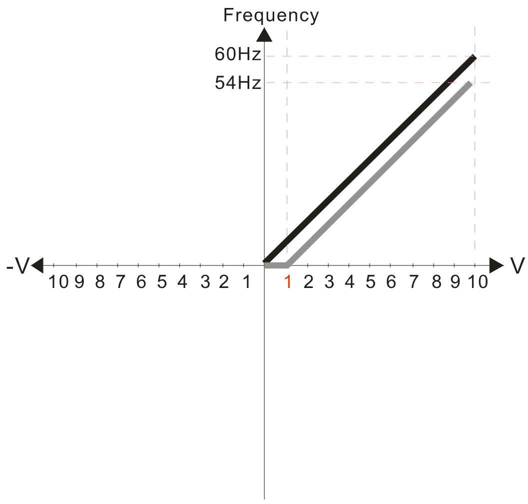
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain (AVI1) = 100%

4.



Pr.03-03=10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)

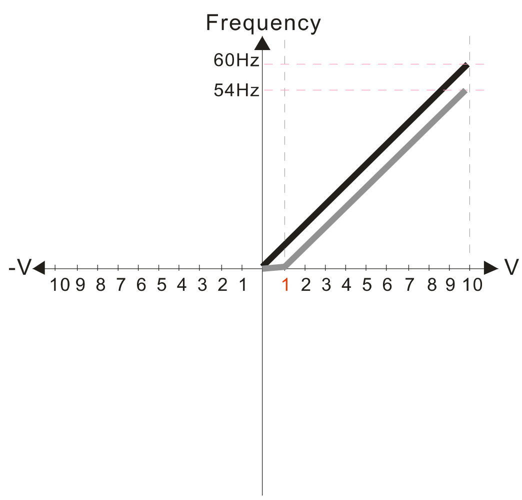
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain (AVI1) = 100%

5.



Pr.03-03=10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)

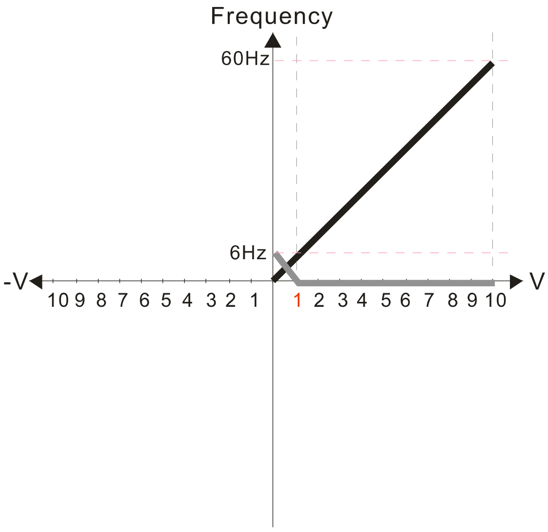
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-10 (Analog Frequency Command for Reverse Run)

0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain (AVI1)= 100%

6.



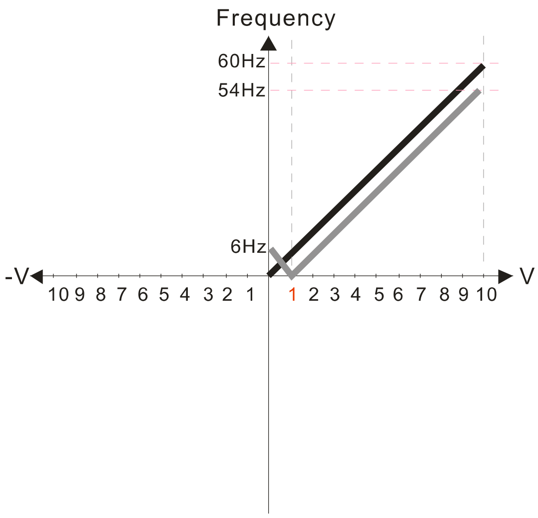
Pr.03-03=10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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

Pr.03-11Analog Input Gain (AVI1)= 100%

7.



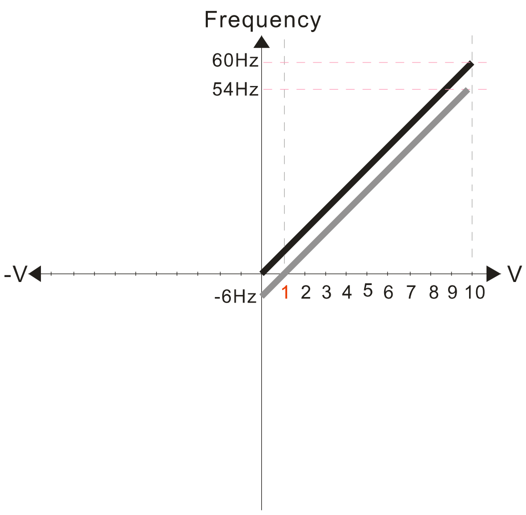
Pr.03-03=10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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

Pr.03-11 Analog Input Gain (AVI1) = 100%

8.



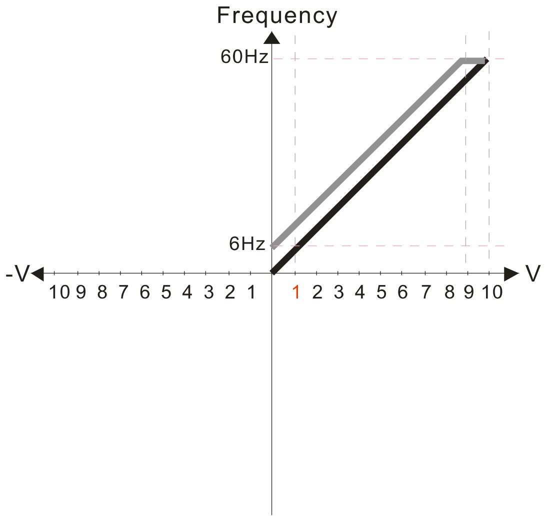
Pr.03-03=10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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

Pr.03-11 Analog Input Gain (AVI1) = 100%

9.



Pr.03-03=-10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)

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

Pr.03-10 (Analog Frequency Command for Reverse Run)

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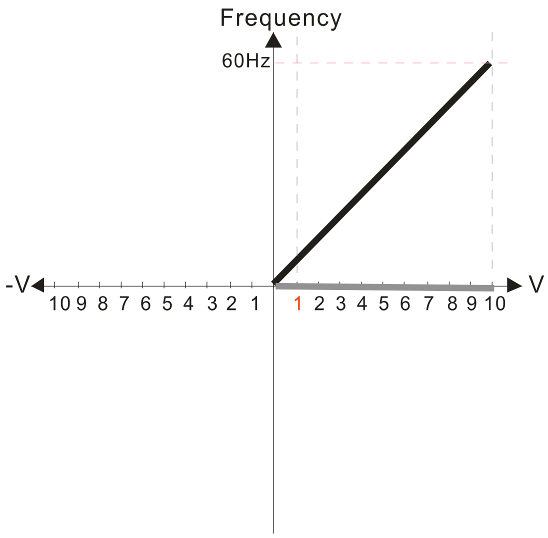
Pr.03-11 Analog Input Gain (AVI1)= 100%

10.



Pr.03-03=-10%

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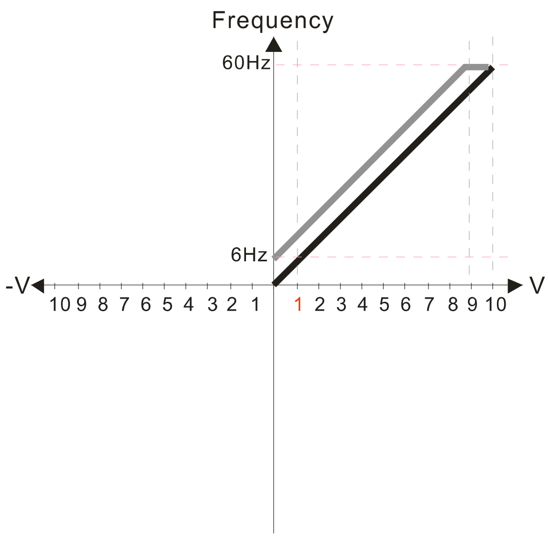
11.



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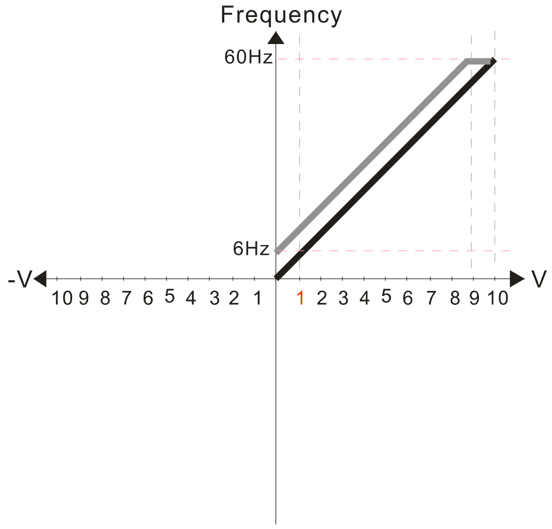
12.



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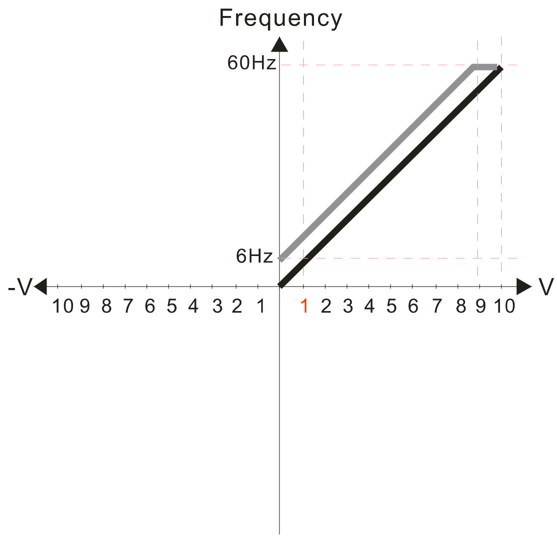

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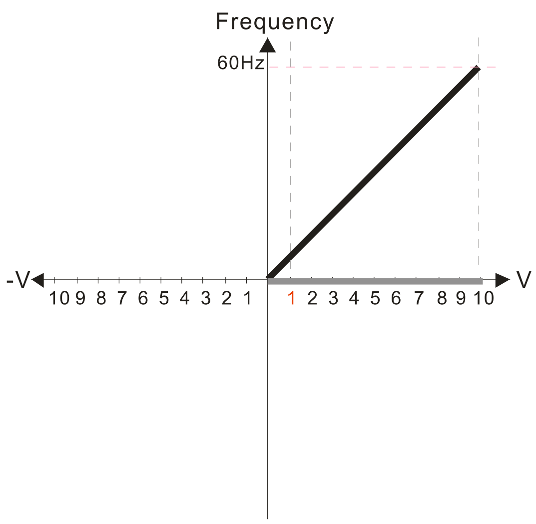

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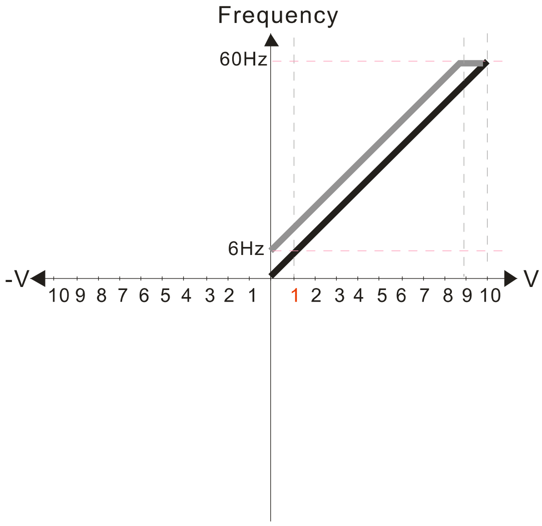

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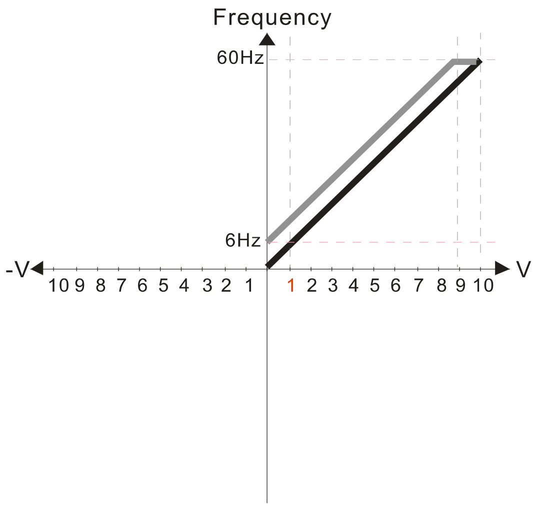

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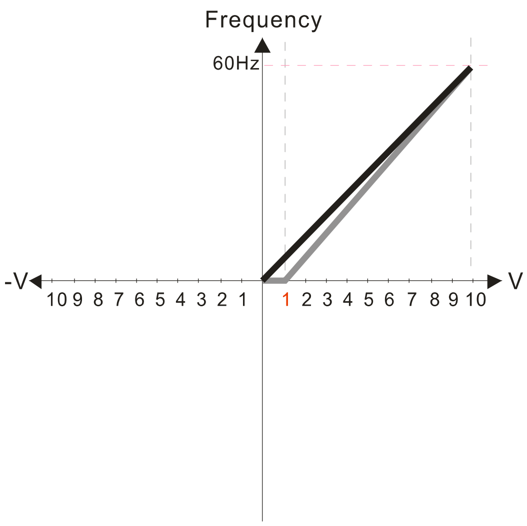

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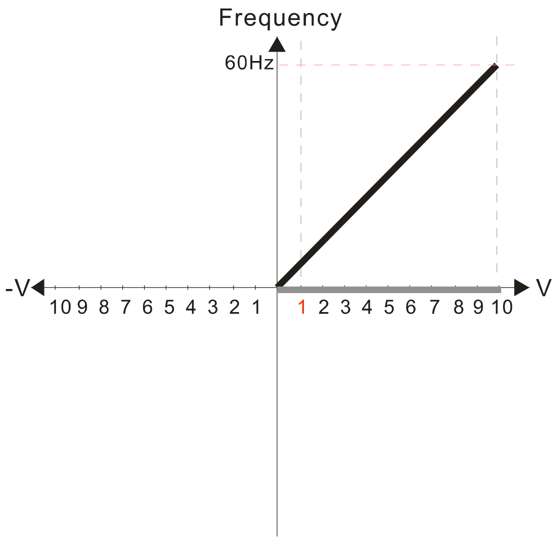
Pr.03-11 Analog Input Gain (AVI1)= 111.1%

10/9=111.1%

18.



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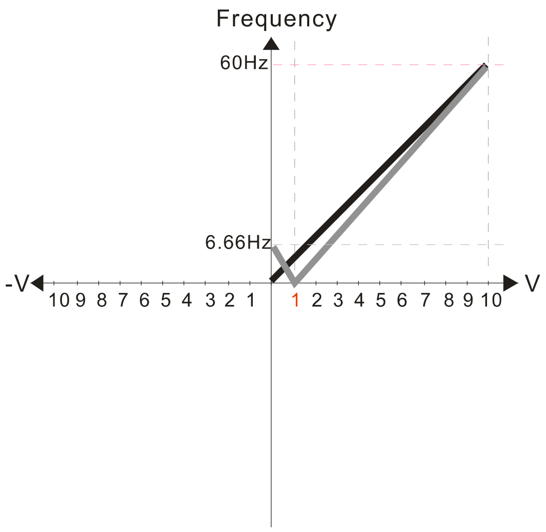
19.



Pr.03-03=10%

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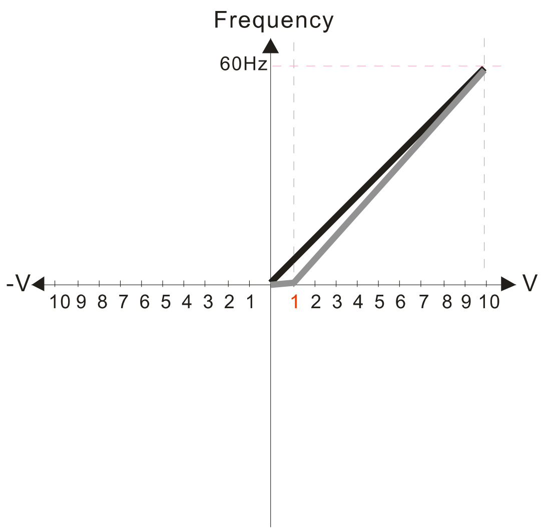

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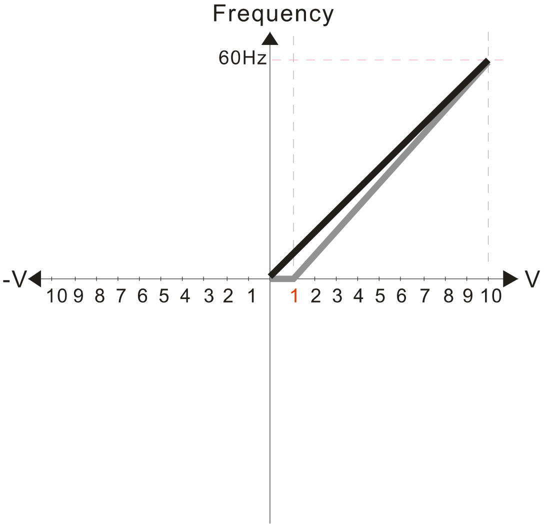

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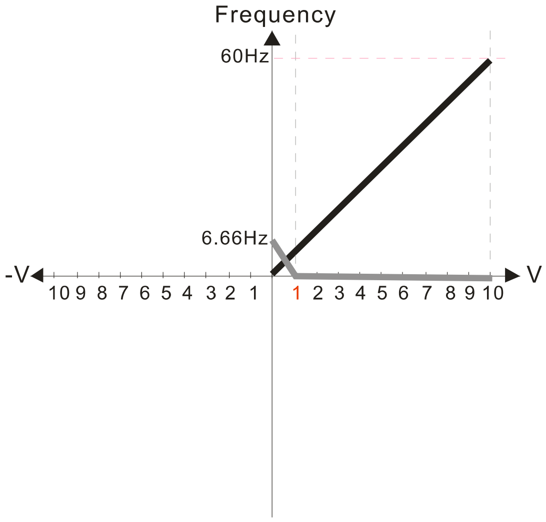

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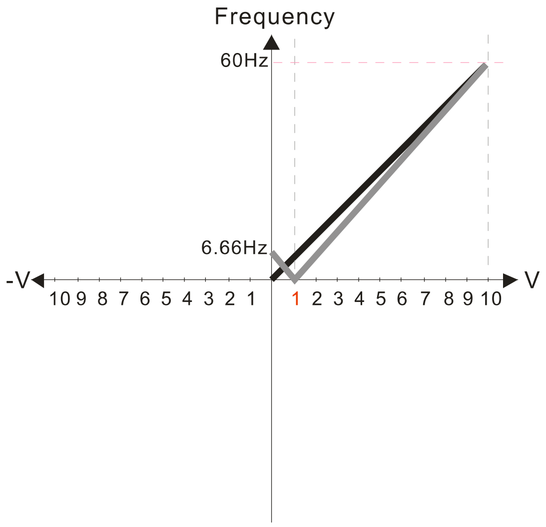

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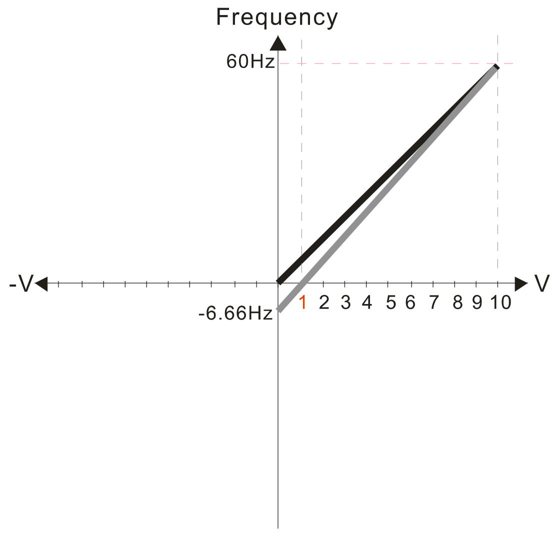

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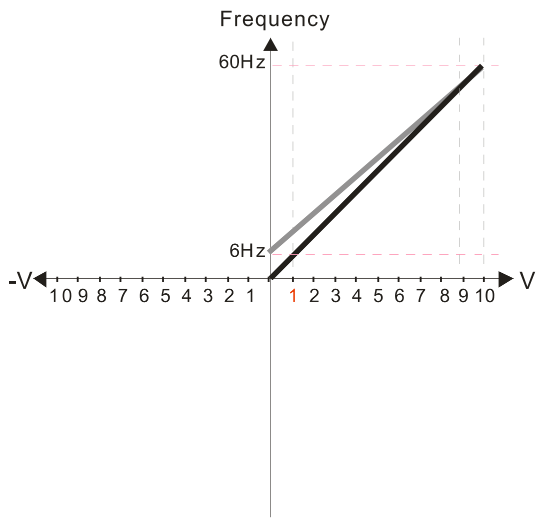
25.



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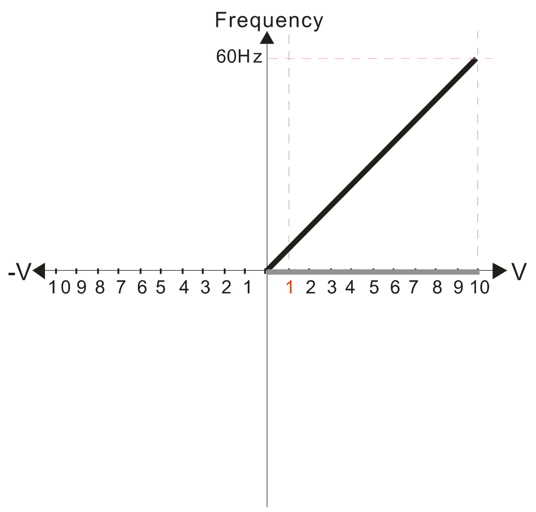
Calculate the bias:

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

Calculate the gain: $03\text{-}11=\frac{10\text{V}}{11.1\text{V}}\times 100\%=90.0\%$

26.



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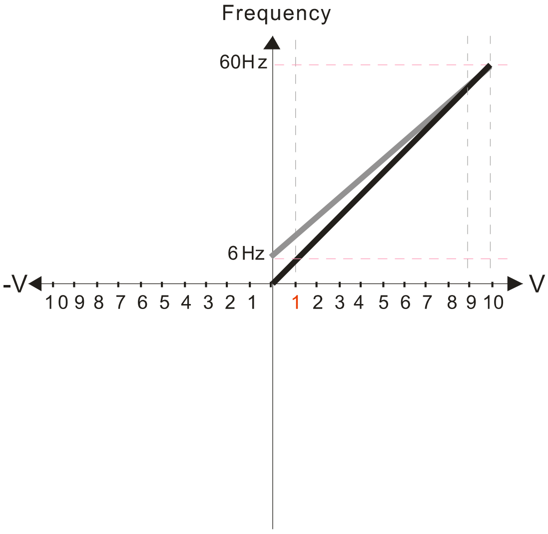

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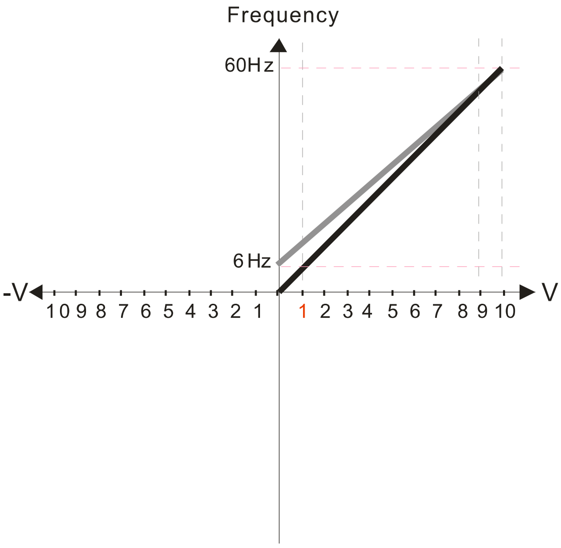

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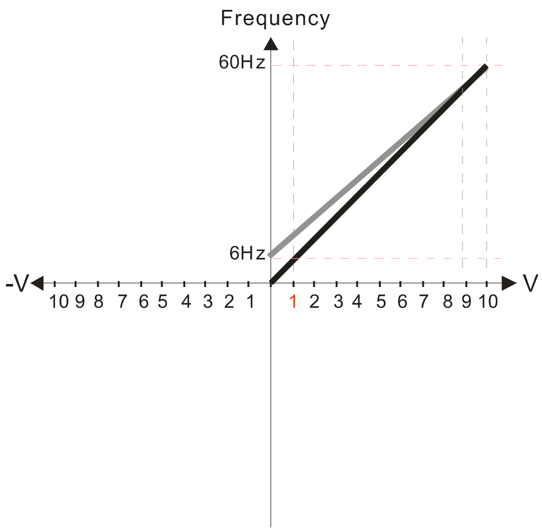

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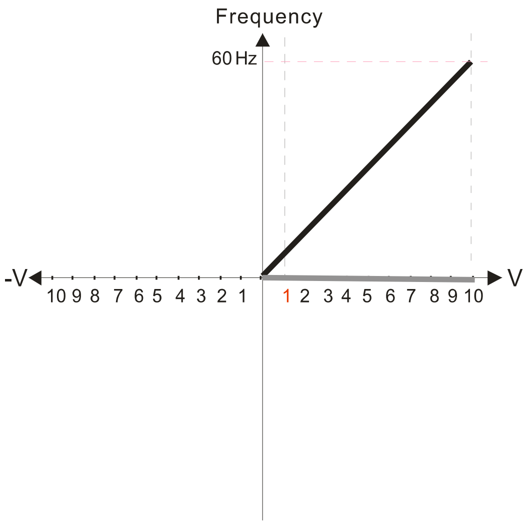

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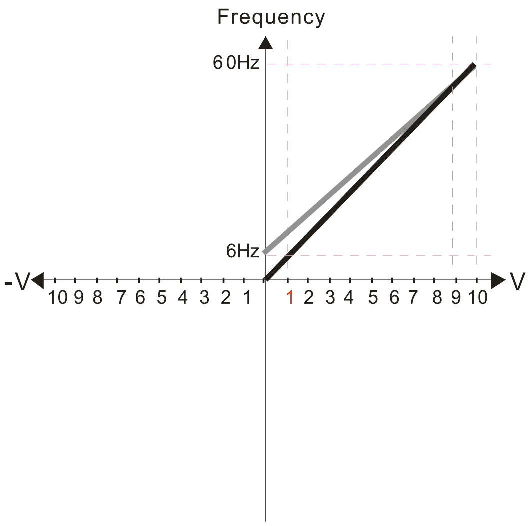
31.



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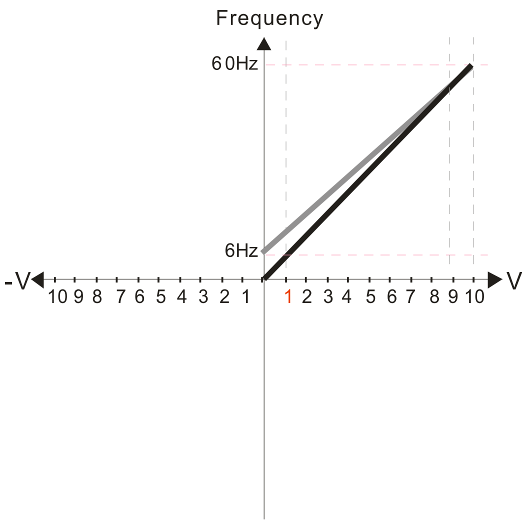

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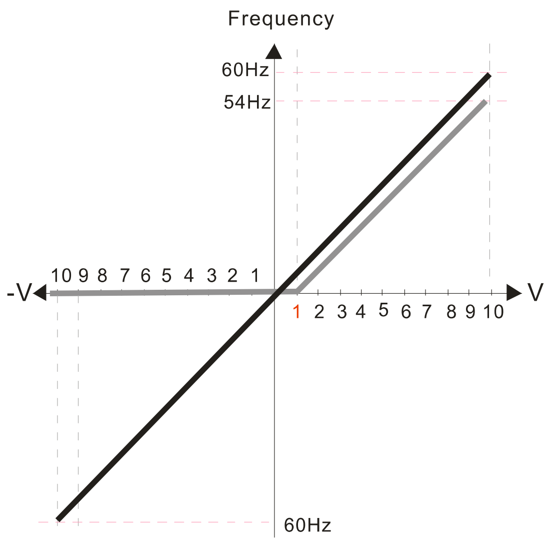

Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%
Pr.03-07–03-09 (Positive/Negative Bias Mode)
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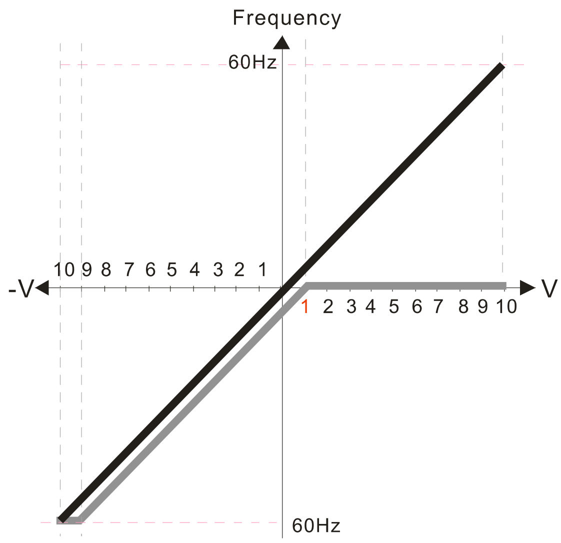
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-13 Analog Positive Input Gain (AVI2) = 100%
Pr.03-14 Analog Positive Input Gain (AVI2) = 100%

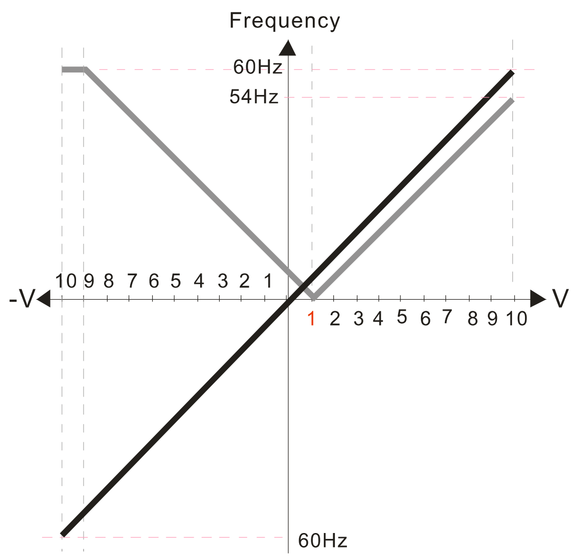
34.



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%
Pr.03-07–03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-13 Analog Positive Input Gain (AVI2) = 100%
Pr.03-14 Analog Positive Input Gain (AVI2) = 100%

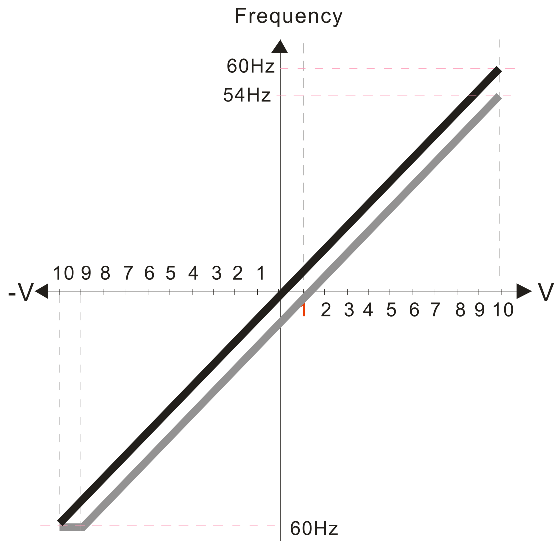
35.



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%
Pr.03-07–03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

Pr.03-13 Analog Positive Input Gain (AVI2) = 100%
Pr.03-14 Analog Positive Input Gain (AVI2) = 100%

36.

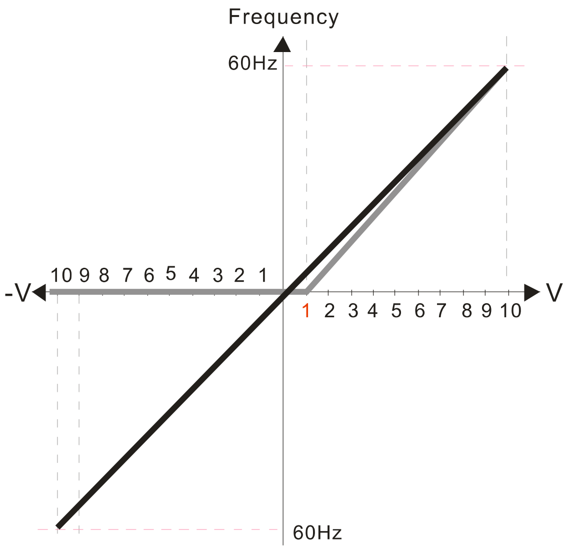


Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%
Pr.03-07–03-09 (Positive/Negative Bias Mode)

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

Pr.03-13 Analog Positive Input Gain (AVI2) = 100%
Pr.03-14 Analog Positive Input Gain (AVI2) = 100%

37.

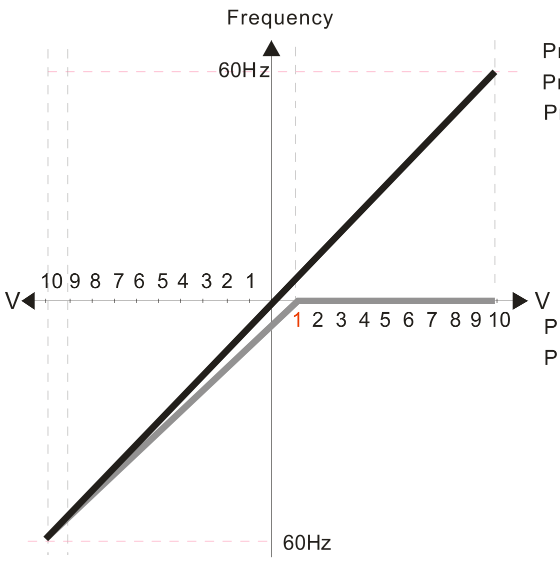


Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%
Pr.03-07–03-09 (Positive/Negative Bias Mode)

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

Pr.03-13 Analog Positive Input Gain (AVI2) = 111.1%
(10/9) × 100% = 111.1%
Pr.03-14 Analog Positive Input Gain (AVI2) = 100%

38.

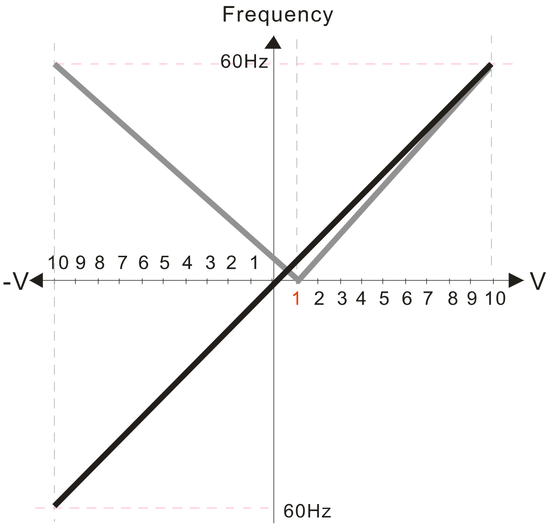


Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%
Pr.03-07–03-09 (Positive/Negative Bias Mode)

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

Pr.03-13 Analog Positive Input Gain (AVI2) = 100%
Pr.03-14 Analog Positive Input Gain (AVI2) = 90.0%
(10/11) × 100% = 90.9%

39.



Pr.00-21=0 (Digital keypad control and run in FWD direction)

Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)

0: No bias

1: Lower than or equal to bias

2: Greater than or equal to bias

3: The absolute value of the bias voltage while serving as the center

4: Serve bias as the center

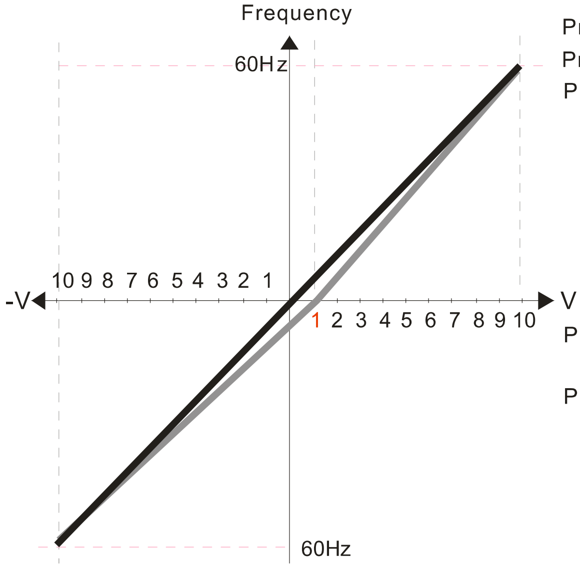
Pr.03-13 Analog Positive Input Gain (AVI2) = 111.1%

(10/9) × 100% = 111.1%

Pr.03-14 Analog Positive Input Gain (AVI2) = 90.9%

(10/11) × 100% = 90.9%

40.



Pr.00-21=0 (Digital keypad control and run in FWD direction)

Pr.03-05 Analog Positive Voltage Input Bias (AVI2) = 10%

Pr.03-07–03-09 (Positive/Negative Bias Mode)

0: No bias

1: Lower than or equal to bias

2: Greater than or equal to bias

3: The absolute value of the bias voltage while serving as the center

4: Serve bias as the center

Pr.03-13 Analog Positive Input Gain (AVI2) = 111.1%

(10/9) × 100% = 111.1%

Pr.03-14 Analog Positive Input Gain (AVI2) = 90.9%

(10/11) × 100% = 90.9%

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

Default: 0

Settings 0: Negative frequency is not allowed. The digital keypad or external terminal controls the forward and reverse direction.

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

- Use Pr.03-10 to enable running in the reverse direction command when a negative frequency (negative bias and gain) is input to the AVI1 or ACI analog signal input (except AVI2).
- Condition for negative frequency (reverse):

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

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

✓ **03-11** Analog Input Gain (AVI1)
✓ **03-12** Analog Input Gain (ACI)
✓ **03-13** Analog Positive Input Gain (AVI2)
✓ **03-14** Analog Negative Input Gain (AVI2)

Default: 100.0

Settings -500.0–500.0%

📖 Use Pr.03-03–Pr.03-14 when the frequency command source is the analog voltage or current signal.

✓ **03-15** Analog Input Filter Time (AVI1)
✓ **03-16** Analog Input Filter Time (ACI)
✓ **03-17** Analog Input Filter Time (AVI2)

Default: 0.01

Settings 0.00–20.00 sec.

📖 Use these input delays to filter a noisy analog signal.

📖 When the time constant setting is too large, the control is stable but the control response is slow. When the time constant setting is too small, the control response is be faster but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

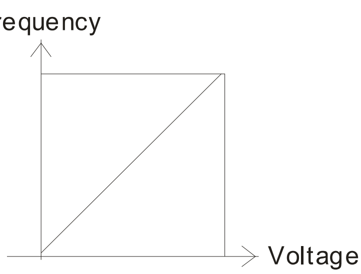
✓ **03-18** Analog Input Addition Function

Default: 0

Settings 0: Disable (AVI1, ACI, AVI2)
1: Enable

📖 When Pr.03-18 is set to 1:
EX1: Pr.03-00=Pr.03-01=1, Frequency command= AVI1+ACI
EX2: Pr.03-00=Pr.03-01=Pr.03-02=1, Frequency command = AVI1+ACI+AVI2
EX3: Pr.03-00=Pr.03-02=1, Frequency command = AVI1+AVI2
EX4: Pr.03-01=Pr.03-02=1, Frequency command = ACI+AVI2

📖 When Pr.03-18 is set to 0 and the analog input setting is the same, the priority for AVI1, ACI and AVI2 are AVI1>ACI>AVI2.



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

Fcmd: the corresponding frequency of 10V or 20mA
ay : 0~10V, 4~20mA, 0~20mA
bias : Pr.03-03, Pr. 03-04, Pr.03-05
gain : Pr.03-11, Pr.03-12, Pr.03-13, Pr.03-14

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

Default: 0

Settings 0: Disable
1: Continue operation at the last frequency
2: Decelerate to 0 Hz
3: Stop immediately and display ACE

- Determines the response when the 4–20 mA signal is lost, when AVIc (Pr.03-28=2) or ACIc (Pr.03-29=0).
- When Pr.03-28 is not set to 2, the voltage input to AVI1 terminal is 0–10 V or 0–20 mA, and the Pr.03-19 is invalid.
- When Pr.03-29 is not set to 0, the voltage input to ACI terminal is 0–10 V, and the Pr.03-19 is invalid.
- When the setting is 1 or 2, the keypad displays the warning code “ANL”. It keeps blinking until the ACI signal is recovered.
- When the setting is 3, and the ACI terminal is disconnected, the keypad displays “ACE” error. It keeps blinking until the connection is recovered and the error is reset.
- When the motor drive stops, the warning condition does not continue to exist, so the warning disappears.

03-20 Multi-function Output 1 (AFM1)
03-23 Multi-function Output 2 (AFM2)

Default: 0

Settings 0–23

Function Chart

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>0</td><td>Output frequency (Hz)</td><td>Maximum frequency Pr.01-00 is regarded as 100%.</td></tr>
<tr><td>1</td><td>Frequency command (Hz)</td><td>Maximum frequency Pr.01-00 is regarded as 100%.</td></tr>
<tr><td>2</td><td>Motor speed (Hz)</td><td>Maximum frequency Pr.01-00 is regarded as 100%</td></tr>
<tr><td>3</td><td>Output current (rms)</td><td>(2.5 X rated current) is regarded as 100%</td></tr>
<tr><td>4</td><td>Output voltage</td><td>(2 X rated voltage) is regarded as 100%</td></tr>
<tr><td>5</td><td>DC bus Voltage</td><td>450V (900V)=100%</td></tr>
<tr><td>6</td><td>Power factor</td><td>-1.000–1.000=100%</td></tr>
<tr><td>7</td><td>Power</td><td>Rated power is regarded as 100%</td></tr>
<tr><td>9</td><td>AVI1 percentage</td><td>0–10 V / 0–20 mA / 4–20 mA =0–100%</td></tr>
<tr><td>10</td><td>ACI percentage</td><td>4–20 mA / 0–10 V / 0–20 mA =0–100%</td></tr>
<tr><td>11</td><td>AVI2 percentage</td><td>0–10 V = 0–100%</td></tr>
<tr><td>20</td><td>CANopen analog output</td><td>CANopen communication analog output
<table><tr><th>Terminal</th><th>Corresponding address</th></tr><tr><td>AFM1</td><td>2026-A1</td></tr><tr><td>AFM2</td><td>2026-A2</td></tr><tr><td>AO10</td><td>2026-AB</td></tr><tr><td>AO11</td><td>2026-AC</td></tr></table></td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>21</td><td>RS-485 analog output</td><td>For RS-485 (InnerCOM / Modbus) control output
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>26A0H</td></tr>
<tr><td>AFM2</td><td>26A1H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>22</td><td>Communication card analog output</td><td>Communication analog output (CMC-EIP01, CMC-PN01, CMC-DN01)
<table>
<tr><th>Terminal</th><th>Corresponding address</th></tr>
<tr><td>AFM1</td><td>26A0H</td></tr>
<tr><td>AFM2</td><td>26A1H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>23</td><td>Constant voltage output</td><td>Pr.03-32 and Pr.03-33 control voltage output level
0–100% of Pr.03-32 corresponds to 0–10 V of AFM1.
0–100% of Pr.03-33 corresponds to 0–10 V of AFM2.</td></tr>
</table>

03-21 Analog Output Gain 1 (AFM1)

03-24 Analog Output Gain 2 (AFM2)

Default: 100.0

Settings 0.0–500.0%

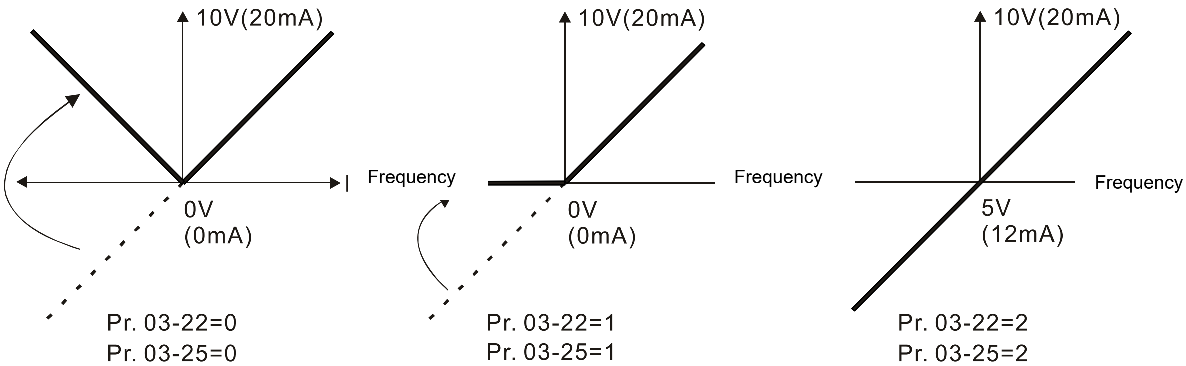
Adjusts the voltage level outputted to the analog meter from the analog signal (Pr.03-20) output terminal AFM of the drive.

03-22 Analog Output 1 in REV Direction (AFM1)

03-25 Analog Output 2 in REV Direction (AFM2)

Default: 0

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



Selections for the analog output direction

03-27 AFM2 Output Bias

Default: 0.00

Settings -100.00–100.00%

- Example 1, AFM2 0–10 V is set to the output frequency, the output equation is:
  10 V * (output frequency / Pr.01-00) * Pr.03-24 + 10 V * Pr.03-27
- Example 2, AFM2 0–20 mA is set to the output frequency, the output equation is:
  20 mA*(output frequency / Pr.01-00) * Pr.03-24 + 20 mA * Pr.03-27
- Example 3, AFM2 4–20 mA is set to the output frequency, the output equation is:
  4 mA+16 mA * (output frequency / Pr.01-00) * Pr.03-24 + 16 mA * Pr.03-27
- This parameter sets the corresponding voltage for the analog output 0.

03-28 AVI1 Terminal Input Selection

Default: 0

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

03-29 ACI Terminal Input Selection

Default: 0

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

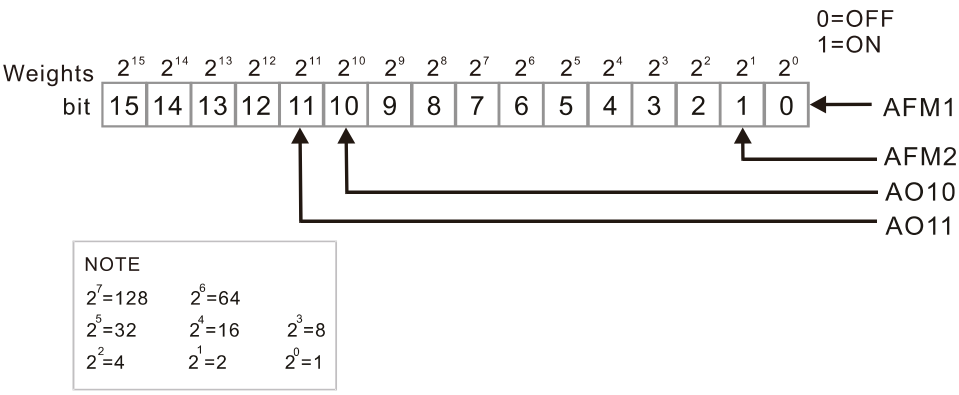
- When you change the input mode, verify that the external terminal switch (SW3, SW4) corresponds to the setting for Pr.03-28–Pr.03-29.

03-30 PLC Analog Output Terminal Status

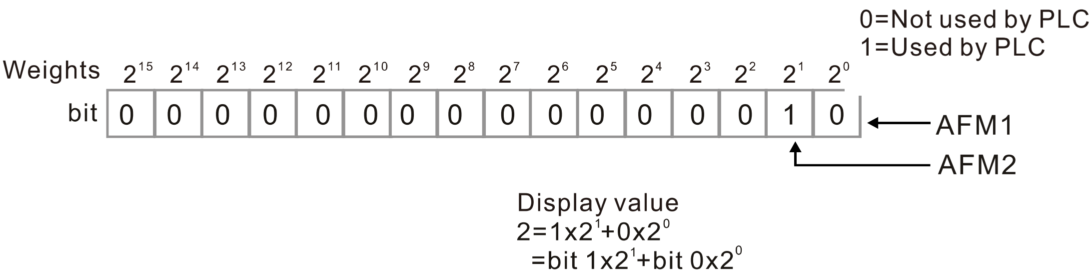
Default: Read only

Settings Monitor the status of PLC analog output terminals

- Pr.03-30 displays the external multi-function output terminal that used by PLC.



- For Example:
  When Pr.03-30 displays 0002h (hex), it means that AFM2 is used by PLC.



03-31 AFM2 Output Selection

03-34 AFM1 Output Selection

Default: 0

Settings 0: 0–20 mA output

1: 4–20 mA output

03-32 AFM1 DC Output Setting Level

03-33 AFM2 DC Output Setting Level

Default: 0.00

Settings 0.00–100.00%

- Pair with multi-function output: 23, Pr.03-32 and Pr.03-33 outputs constant AFM voltage.
- Set Pr.03-32 between 0–100.00% to correspond to 0–10 V of AFM1.
- Set Pr.03-33 between 0–100.00% to correspond to 0–10 V of AFM2.

03-35 AFM1 Filter Output Time

03-36 AFM2 Filter Output Time

Default: 0.01

Settings 0.00–20.00 sec.

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

Default: 0

Settings 0: AVI1

1: ACI

2: AVI2

03-45 AI Upper Level

Default: 50.00

Settings -100.00–100.00%

03-46 AI Lower Level

Default: 10.00

Settings -100.00–100.00%

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

03-50 Analog Input Curve Selection

Default: 7

Settings 0: Regular Curve

1: Three-point curve of AVI1

2: Three-point curve of ACI

3: Three-point curve of AVI 1& ACI

4: Three-point curve of AVI2

5: Three-point curve of AVI 1& AVI2
6: Three-point curve of ACI & AVI2
7: Three-point curve of AVI1 & ACI & AVI2

- Sets the calculation method for analog input.
- When Pr.03-50=0, all analog input signal is calculated by bias and gain.
- When Pr.03-50=1, AVI1 calculates by frequency and voltage / current (Pr.03-51–Pr.03-56), other analog input signal calculates by bias and gain.
- When Pr.03-50=2, ACI calculates by frequency and voltage / current (Pr.03-57–Pr.03-62), other analog input signal calculates by bias and gain.
- When Pr.03-50=3, AVI1 and ACI calculate by frequency and voltage / current (Pr.03-51–Pr.03-62), other analog input signal calculate by bias and gain.
- When Pr.03-50=4, AVI2 calculates by frequency and voltage (Pr.03-63–Pr.03-68), other analog input signal calculates by bias and gain.
- When Pr.03-50=5, AVI1 and AVI2 calculate by frequency and voltage / current (Pr.03-51–Pr.03-56 and Pr.03-63–Pr.03-68), other analog input signal calculate by bias and gain.
- When Pr.03-50=6, ACI and AVI2 calculate by frequency and voltage / current (Pr.03-57–Pr.03-68), other analog input signal calculates by bias and gain.
- When Pr.03-50=7, all analog input signal calculate by frequency and voltage / current (Pr.03-51–Pr.03-68).

03-51 AVI1 Lowest Point

Default: 0.00 / 0.00 / 4.00

Settings Pr.03-28=0, 0.00–10.00 V
Pr.03-28=1, 0.00–20.00 mA
Pr.03-28=2, 0.00–20.00 mA

03-52 AVI1 Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%

03-53 AVI1 Mid-Point

Default: 5.00 / 10.00 / 12.00

Settings Pr.03-28=0, 0.00–10.00 V
Pr.03-28=1, 0.00–20.00 mA
Pr.03-28=2, 0.00–20.00 mA

03-54 AVI1 Proportional Mid-Point

Default: 50.00

Settings -100.00–100.00%

03-55 AVI1 Highest Point

Default: 10.00 / 20.00 / 20.00

Settings Pr.03-28=0, 0.00–10.00 V

Pr.03-28=1, 0.00–20.00 mA

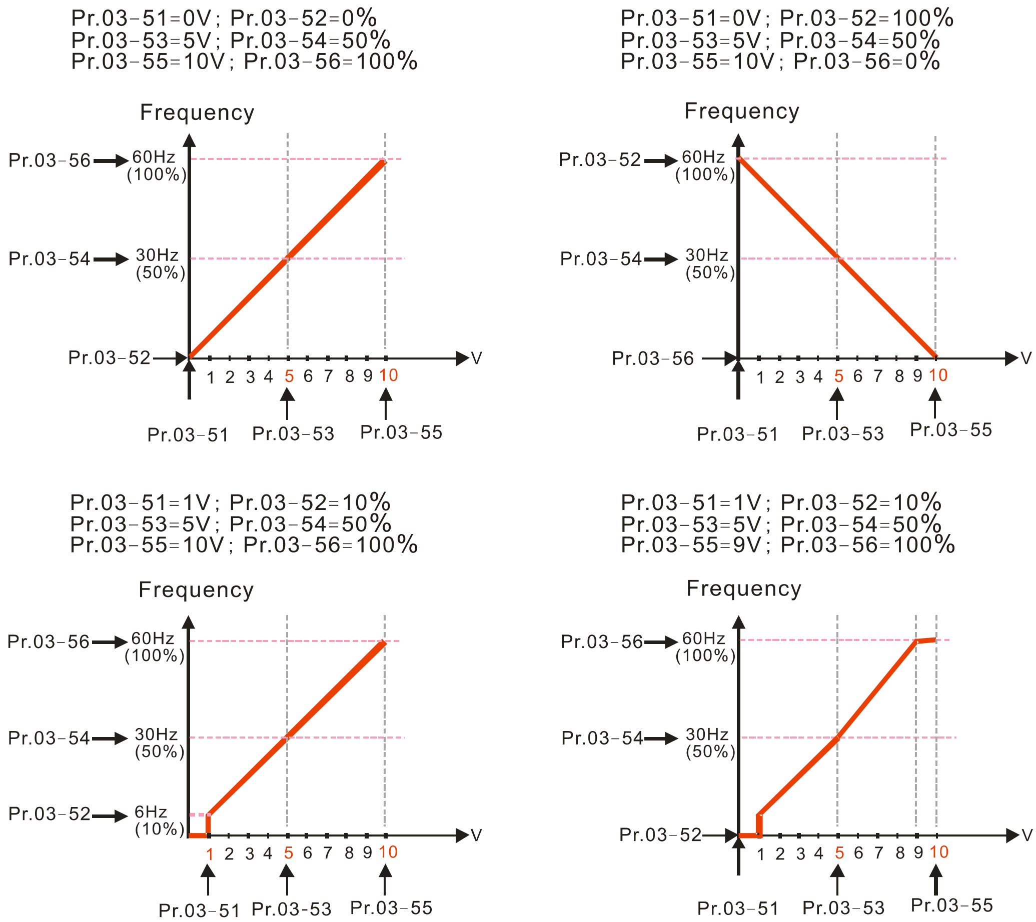
Pr.03-28=2, 0.00–20.00 mA

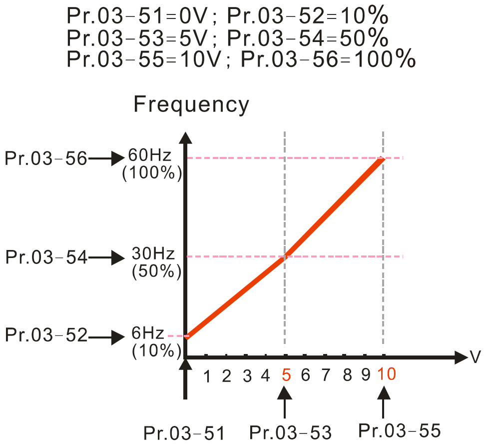
03-56 AVI1 Proportional Highest Point

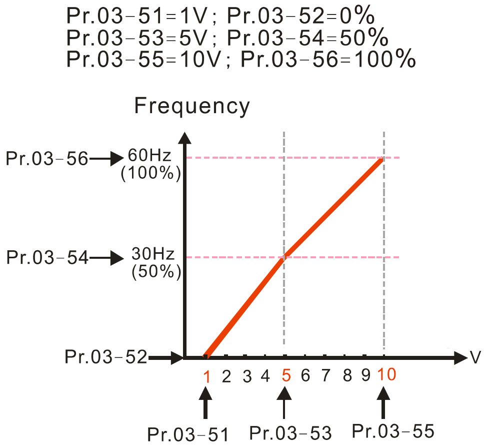
Default: 100.00

Settings -100.00–100.00%

- When Pr.03-28=0, AVI1 setting is 0–10 V and the unit is in voltage (V).
- When Pr.03-28≠0, AVI1 setting is 0–20 mA or 4–20 mA and the unit is in current (mA).
- When you set the analog input AVI1 to frequency command, 100% corresponds to Fmax (Pr.01-00 maximum operation frequency).
- The requirement for these there parameters (Pr.03-51, Pr.03-53 and Pr.03-55) is Pr.03-51 < Pr.03-53 < Pr.03-55. The values for three proportional points (Pr.03-52, Pr.03-54 and Pr.03-56) have no limits. Values between two points are calculated by a linear equation. The ACI and AVI2 are the same as AVI1.
- The output percentage is 0% when the AVI1 input value is lower than the lowest point setting. Example: Pr.03-51=1V, Pr.03-52=10%. The output is 0% when AVI1 input is lower than 1V. If the AVI1 input varies between 1V and 1.1V, the drive's output frequency is between 0% and 10%.







03-57 ACI Lowest Point

Default: 4.00 / 0.00 / 0.00

Settings Pr.03-29=0, 0.00–20.0 mA
Pr.03-29=1, 0.00–10.00 V
Pr.03-29=2, 0.00–20.00 mA

03-58 ACI Proportional Low Point

Default: 0.00

Settings -100.00–100.00%

03-59 ACI Mid-Point

Default: 12.00 / 5.00 / 10.00

Settings Pr.03-29=0, 0.00–20.00 mA
Pr.03-29=1, 0.00–10.00 V
Pr.03-29=2, 0.00–20.00 mA

03-60 ACI Proportional Mid-Point

Default: 50.00

Settings -100.00–100.00%

03-61 ACI Highest Point

Default: 20.00 / 10.00 / 20.00

Settings Pr.03-29=0, 0.00–20.00 mA
Pr.03-29=1, 0.00–10.00 V
Pr.03-29=2, 0.00–20.00 mA

03-62 ACI Proportional Highest Point

Default: 100.00

Settings -100.00–100.00%

- When Pr.03-29=1, ACI setting is 0–10 V and the unit is in voltage (V). When Pr.03-29≠1, ACI setting is 0–20 mA or 4–20 mA, and the unit is in current (mA).
- When you set the analog input ACI to frequency command, 100% corresponds to Fmax (Pr.01-00 maximum operation frequency).

- The requirement for these three parameters (Pr.03-57, Pr.03-59 and Pr.03-61) is Pr.03-57 < Pr.03-59 < Pr.03-61. The values for three proportional points (Pr.03-58, Pr.03-60 and Pr.03-62) have no limits. Values between two points are calculated by a linear equation.
- The output percentage is 0% when the ACI input value is lower than the lowest point setting.
  Example: Pr.03-57=2 mA; Pr.03-58=10%. The output becomes 0% when AVI1 input is lower than 2 mA. If the ACI input varies between 2 mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

03-63 Positive AVI2 Voltage Lowest Point

Default: 0.00

Settings 0.00–10.00 V

03-64 Positive AVI2 Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%

03-65 Positive AVI2 Voltage Mid-Point

Default: 5.00

Settings 0.00–10.00 V

03-66 Positive AVI2 Proportional Mid-Point

Default: 50.00

Settings -100.00–100.00%

03-67 Positive AVI2 Voltage Highest Point

Default: 10.00

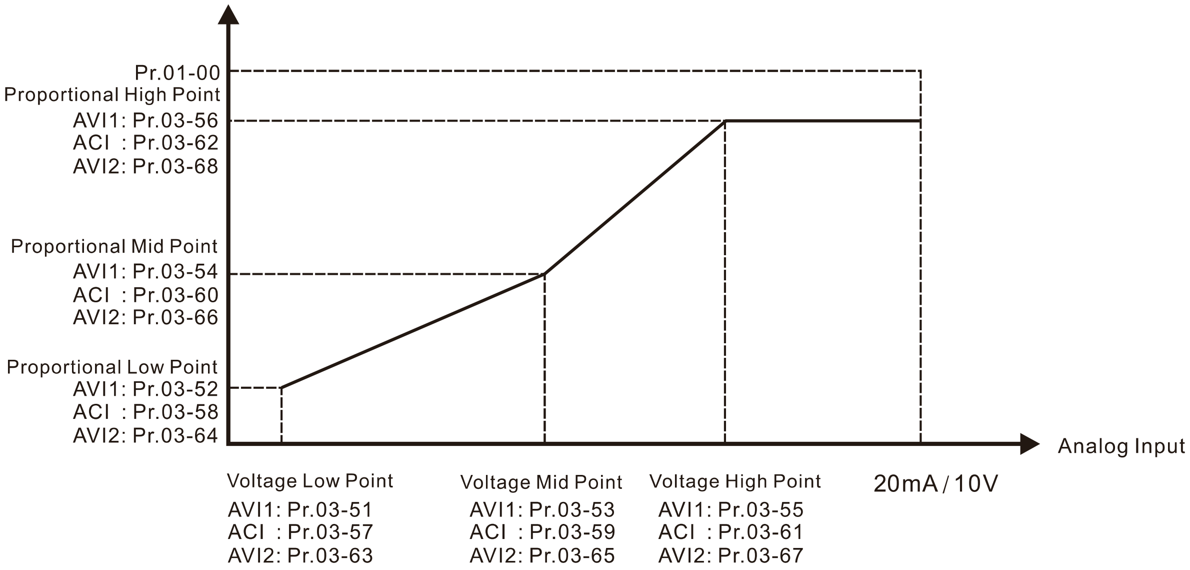
Settings 0.00–10.00 V

03-68 Positive AVI2 Proportional Highest Point

Default: 100.00

Settings -100.00–100.00%

- When you set the positive voltage AVI2 to the frequency command, 100% corresponds to Fmax (Pr.01-00 maximum operation frequency) and the motor runs in the forward direction.
- The requirement for these three parameters (Pr.03-63, Pr.03-65 and Pr.03-67) is Pr.03-63 < Pr.03-65 < Pr.03-67. The values for three proportional points (Pr.03-64, Pr.03-66 and Pr.03-68) have no limits. Values between two points are calculated by a linear equation.
- The output % will become 0% when the AVI2 input value is lower than low point setting.
  For example: Pr.03-63=1V; Pr.03-64=10%. The output will become 0% when the input is lower than 1 V. If the AVI input varies between 1 V and 1.1 V, the drive's output frequency oscillates between 0% and 10%.
- When AVI1 Selection (Pr.03-28) is 0–10 V, the setting ranges for Pr.03-51, Pr.03-53, and Pr.03-55 must be 0.00–10.00 or 0.00–20.00.
- When ACI Selection (Pr.03-29) is 0–10 V, the setting ranges for Pr.03-57, Pr.03-59 and Pr.03-61 must be 0.00–10.00 or 0.00–20.00.
- Set the analog input values at Pr.03-51–Pr.03-68 and the maximum operating frequency at Pr.01-00. The corresponding functions of open-loop control are shown as image below.


Pr.01-00
Proportional High Point
AVI1: Pr.03-56
ACI : Pr.03-62
AVI2: Pr.03-68
Proportional Mid Point
AVI1: Pr.03-54
ACI : Pr.03-60
AVI2: Pr.03-66
Proportional Low Point
AVI1: Pr.03-52
ACI : Pr.03-58
AVI2: Pr.03-64
Analog Input
Voltage Low Point
AVI1: Pr.03-51
ACI : Pr.03-57
AVI2: Pr.03-63
Voltage Mid Point
AVI1: Pr.03-53
ACI : Pr.03-59
AVI2: Pr.03-65
Voltage High Point
AVI1: Pr.03-55
ACI : Pr.03-61
AVI2: Pr.03-67
20mA / 10V

04 Multi-Step Speed Parameters

⌿ This parameter can be set during operation.

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

Default: 0.00

Settings 0.00–599.00 Hz

- Use the multi-function input terminals (refer to setting 1–4 of Pr.02-01–Pr.02-08 and Pr.02-26–Pr.02-31 Multi-function Input Command) to select the multi-step speed command (the maximum is 15th step speed). Pr.04-00 to Pr.04-14 set the multi-step speed frequency as shown in the following diagram.
- The external terminal/digital keypad/communication controls the RUN and STOP commands with Pr.00-21.
- You can set each multi-step speed between 0.00–599.00 Hz during operation.
- Explanation for the timing diagram of the multi-step speed and external terminals.

  The related parameter settings are:

  1. Pr.04-00–04-14: sets the 1st to 15th multi-step speed (to set the frequency of each step speed)
  2. Pr.02-01–02-08 and Pr.02-26–02-31: sets the multi-function input terminals (multi-step speed command 1–4)

  - Related parameters:

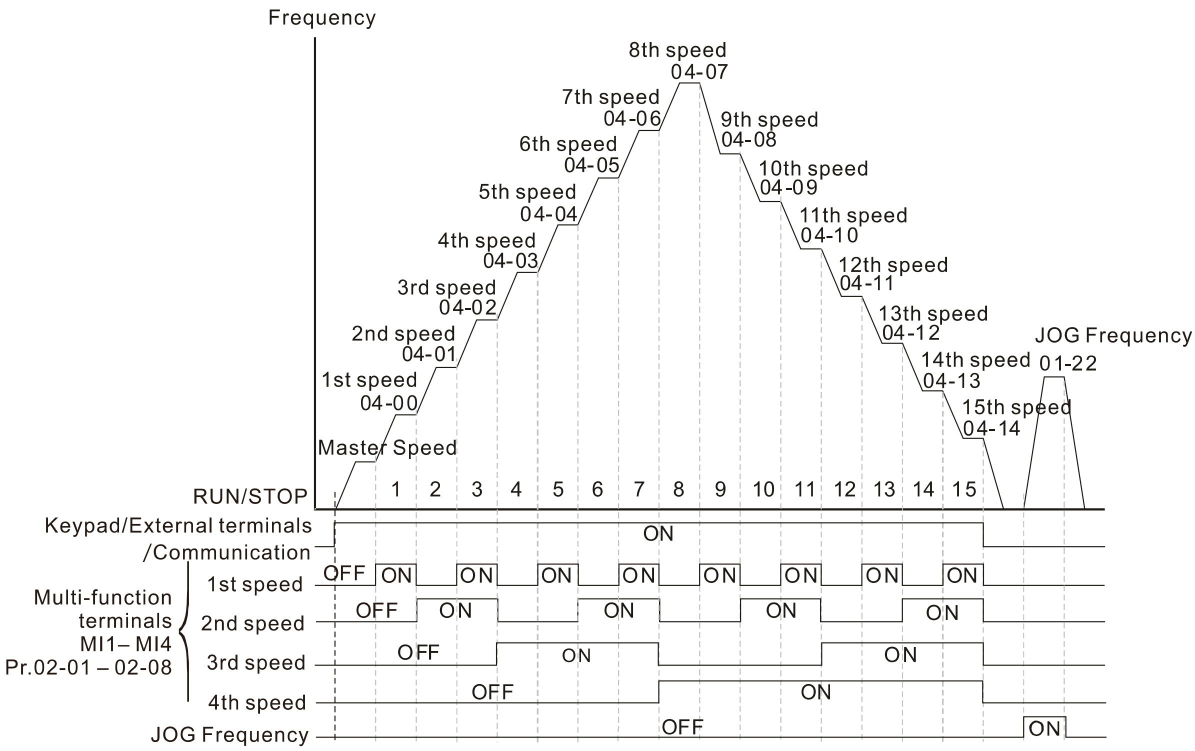
    Pr.01-22 JOG Frequency

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

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

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

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



Multi-speed via External Terminals

04-50	PLC Buffer 0
04-51	PLC Buffer 1
04-52	PLC Buffer 2
04-53	PLC Buffer 3
04-54	PLC Buffer 4
04-55	PLC Buffer 5
04-56	PLC Buffer 6
04-57	PLC Buffer 7
04-58	PLC Buffer 8
04-59	PLC Buffer 9
04-60	PLC Buffer 10
04-61	PLC Buffer 11
04-62	PLC Buffer 12
04-63	PLC Buffer 13
04-64	PLC Buffer 14
04-65	PLC Buffer 15
04-66	PLC Buffer 16
04-67	PLC Buffer 17
04-68	PLC Buffer 18
04-69	PLC Buffer 19

Default: 0

Settings 0–65535

You can combine the PLC buffer with the built-in PLC function for a variety of applications.

✓ 04-70	PLC Application Parameter 0
✓ 04-71	PLC Application Parameter 1
✓ 04-72	PLC Application Parameter 2
✓ 04-73	PLC Application Parameter 3
✓ 04-74	PLC Application Parameter 4
✓ 04-75	PLC Application Parameter 5
✓ 04-76	PLC Application Parameter 6
✓ 04-77	PLC Application Parameter 7
✓ 04-78	PLC Application Parameter 8
✓ 04-79	PLC Application Parameter 9
✓ 04-80	PLC Application Parameter 10
✓ 04-81	PLC Application Parameter 11
✓ 04-82	PLC Application Parameter 12
✓ 04-83	PLC Application Parameter 13
✓ 04-84	PLC Application Parameter 14
04-85	PLC Application Parameter 15
04-86	PLC Application Parameter 16
04-87	PLC Application Parameter 17
04-88	PLC Application Parameter 18
04-89	PLC Application Parameter 19
04-90	PLC Application Parameter 20
04-91	PLC Application Parameter 21
04-92	PLC Application Parameter 22
04-93	PLC Application Parameter 23
04-94	PLC Application Parameter 24
04-95	PLC Application Parameter 25
04-96	PLC Application Parameter 26
04-97	PLC Application Parameter 27
04-98	PLC Application Parameter 28
04-99	PLC Application Parameter 29

Default: 0

Settings 0–65535

📖 Pr.04-70–Pr.04-99 are user-defined parameters. You can combine these 30 PLC Application Parameters with the PLC programming for a variety of applications.

05 Motor Parameters

The following are abbreviations for different types of motors:

- IM: Induction motor
- PM: Permanent magnet synchronous AC motor
- IPM: Interior permanent magnet synchronous AC motor
- SPM: Surface permanent magnet synchronous AC motor

✔ This parameter can be set during operation.

05-00 Motor Parameter Auto-Tuning

Default: 0

Settings 0: No function
1: Rolling auto-tuning for induction motor (IM)
2: Static auto-tuning for induction motor (IM)
5: Rolling auto-tuning for PM (IPM / SPM)
13: Static auto-tuning for PM (IPM / SPM)

📖 Refer to Section 12-2 “Adjustment and Application” for more details of motor adjustment process.

05-01 Full-load Current for Induction Motor 1 (A)

Default: Depending on the model power

Settings Depending on the model power

📖 Sets this value according to the rated current of the motor as indicated on the motor nameplate.

📖 The default is 90% of the drive’s rated current.
Example: The rated current for a 7.5 HP (5.5 kW) is 25 A. The default is 22.5 A.
The setting range is between 2.5–30 A. (25*10%=2.5 A and 25*120%=30 A)

✔ 05-02 Rated Power for Induction Motor 1(kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

📖 Sets the rated power for motor 1. The default is the drive’s power value.

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

Default: Depending on the motor pole number

Settings 0–xxxx rpm (Depending on the motor pole number)
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

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

📖 Pr.01-01 and Pr.05-04 determine the maximum rotor speed for IM.
For example: Pr.01-01=20 Hz, Pr.05-04=2, according to the equation 120 x 20 Hz / 2 = 1200 rpm and take integers. Due to the slip of the IM, the maximum setting value for Pr.05-03 is 1199 rpm (1200 rpm – 1).

05-04 Number of poles for Induction Motor 1

Default: 4

Settings 2–64

- Sets the number poles for the motor (must be an even number).
- Set up Pr.01-01 and Pr.05-03 before setting up Pr.05-04 to make sure motor operates normally. Pr.01-01 and Pr.05-03 determine the maximum set up number poles for the IM.
  For example: Pr.01-01=20 Hz and Pr.05-03=39 rpm, according to the equation 120 x 20 Hz / 39 rpm=61.5 and take even number, the number of poles is 60. Therefore, Pr.05-04 can be set to the maximum of 60 poles.

05-05 No-load Current for Induction Motor 1 (A)

Default: Depending on the model power

Settings 0.0–Pr.05-01 default

- The default is 10–40% of motor rated current.
- For model with 110 kW and above, default setting is 20% of motor rated current.

05-06 Stator Resistance (Rs) for Induction Motor 1

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-07 Rotor Resistance (Rr) for Induction Motor 1

Default: 0.000

Settings 0.000–65.535 Ω

05-08 Magnetizing Inductance (Lm) for Induction Motor 1
05-09 Stator inductance (Lx) for Induction Motor 1

Default: 0.0

Settings 0.0–6553.5 mH

05-13 Full-load Current for Induction Motor 2 (A)

Default: Depending on the model power

Settings Depending on the model power

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

✓ 05-14 Rated Power for Induction Motor 2 (kW)

Default: Depending on the model power

Settings 0.00–655.35 kW

- Set the rated power for motor 2. The default is the drive's power value.

05-15 Rated Speed for Induction Motor 2 (rpm)

Default: Depending on the motor pole number

Settings 0–xxxx rpm (Depending on the motor pole number)
1710 (60 Hz 4 poles); 1410 (50 Hz 4 poles)

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

05-16 Number of Poles for Induction Motor 2

Default: 4

Settings 2–64

- Sets the number of poles for the motor (must be an even number).
- Set up Pr.01-35 and Pr.05-15 before setting up Pr.05-16 to make sure the motor operates normally. Pr.01-35 and Pr.05-15 determine the maximum set up number of poles.
  For example: Pr.01-35=20 Hz and Pr.05-15=39 rpm, according to the equation 120 x 20 Hz / 39 rpm=61.5 and take even number, the number of poles is 60. Therefore, Pr.05-16 can be set to the maximum of 60 poles.

05-17 No-load Current for Induction Motor 2 (A)

Default: Depending on the model power

Settings 0.00–Pr.05-13 default

- The default is 10–40% of motor rated current.
- For model with 110 kW and above, default setting is 20% of motor rated current.

05-18 Stator Resistance (Rs) for Induction Motor 2

Default: Depending on the model power

Settings 0.000–65.535 Ω

05-19 Rotor Resistance (Rr) for Induction Motor 2

Default: 0.000

Settings 0.000–65.535 Ω

05-20 Magnetizing Inductance (Lm) for Induction Motor 2
05-21 Stator Inductance (Lx) for Induction Motor 2

Default: 0.0

Settings 0.0–6553.5 mH

05-22 Induction Motor 1 / 2 Selection

Default: 1

Settings 1: Motor 1
2: Motor 2

- Sets the motor currently operated by the AC motor drive.

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

Default: 60.00

Settings 0.00–599.00 Hz

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

Default: 0

Settings 0: Disable

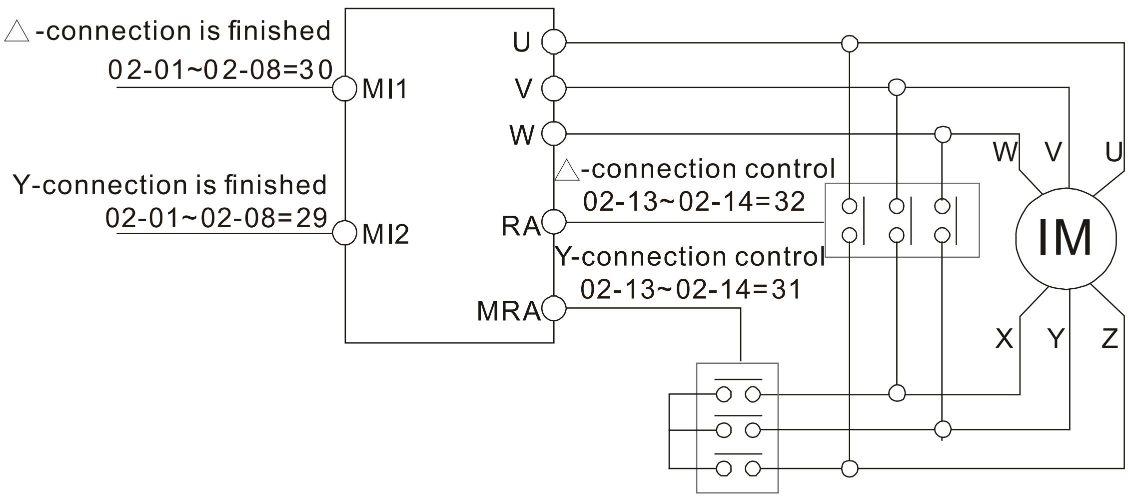
1: Enable

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

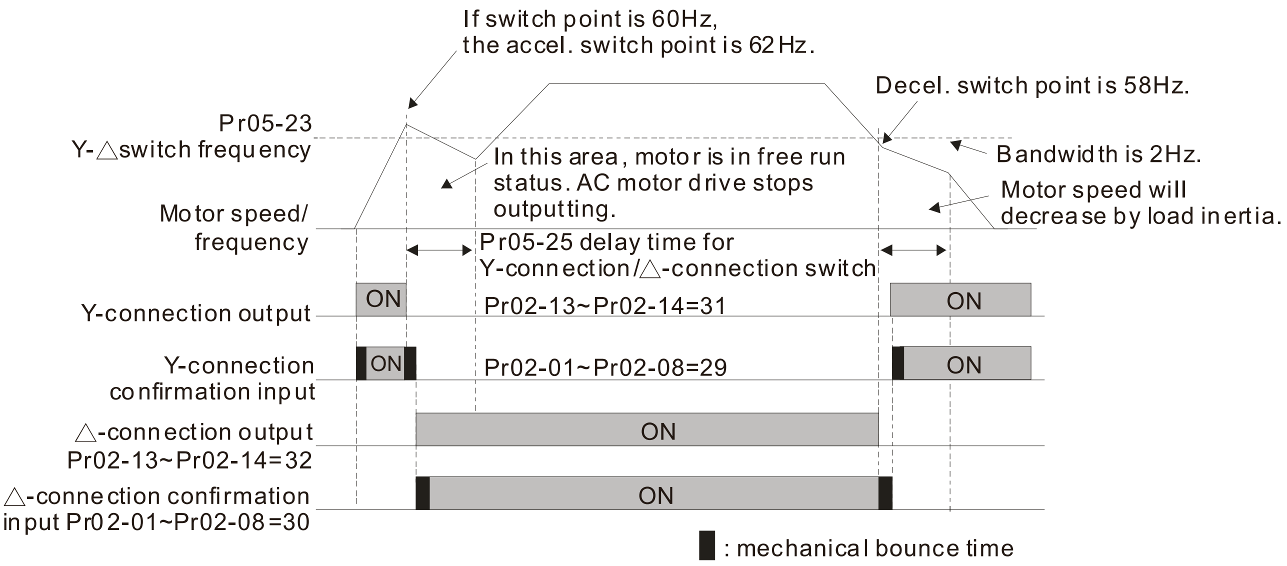
Default: 0.200

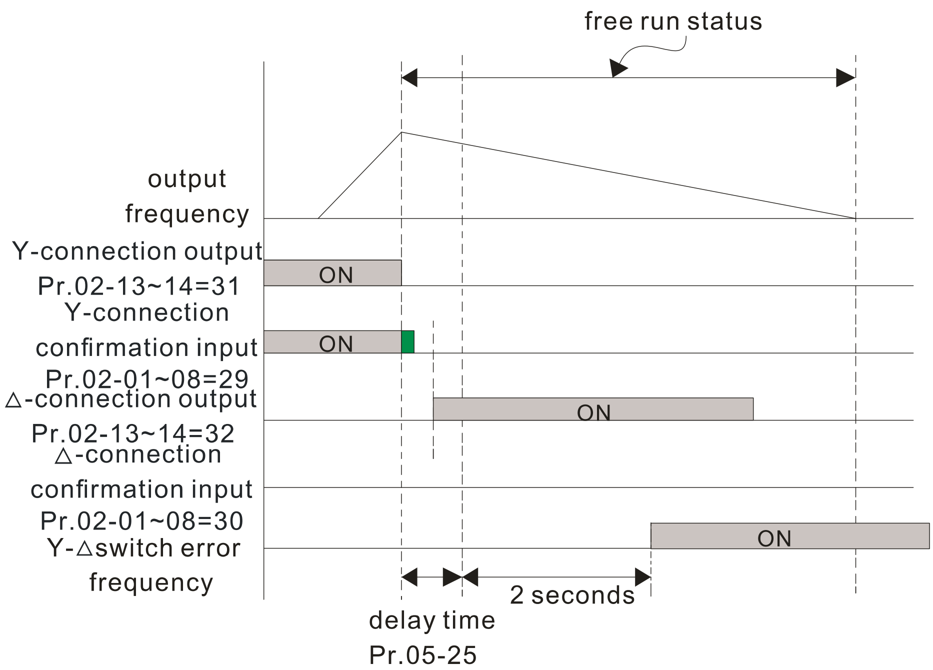
Settings 0.000–60.000 sec.

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



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





05-28 Accumulated Watt-hour for a Motor (W-hour)

Default: 0.0

Settings Read only

05-29 Accumulated Watt-hour for a Motor in Low Word (kW-hour)

Default: 0.0

Settings Read only

05-30 Accumulated Watt-hour for a Motor in High Word (MW-hour)

Default: 0

Settings Read only

- Pr.05-28–05-30 record the amount of power consumed by the motors. The accumulation begins when the drive is activated and the record is saved when the drive stops or turns OFF. The amount of consumed watts continues to accumulate when the drive is activated again. To clear the accumulation, set Pr.00-02 as 5 to return the accumulation record to 0.
- The accumulated total watts of the motor per hour = Pr.05-30 x 1000000 + Pr.05-29 x 1000 + Pr.05-28 Wh

Example: When Pr.05-30 = 76 MWh and Pr.05-29 = 150 kWh, Pr.05-28 = 400 Wh (or 0.4 kWh), the accumulated total kilowatts of the motor per hour = 76 x 1000000 + 150 x 1000 + 40 = 76150400Wh = 76150.4 kWh

05-31 Accumulated Motor Operation Time (Min)

Default: 0

Settings 0–1439

05-32 Accumulated Motor Operation Time (Day)

Default: 0

Settings 0–65535

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

05-33 Induction Motor (IM) or Permanent Magnet Synchronous AC Motor Selection

Default: 0

Settings 0: IM (Induction motor)

1: SPM (Surface permanent magnet synchronous AC motor)

2: IPM (Interior permanent magnet synchronous AC motor)

05-34 Full-load Current for a Permanent Magnet Synchronous AC Motor

Default: Depending on the model power

Settings Depending on the model power

Sets the full-load current for the motor according to motor's nameplate. The default is 90% of the drive's rated current.

For example: The rated current of a 7.5 HP (5.5 kW) is 25 A. The default is 22.5 A.

The setting range is between 2.5–30 A. (25*10%=2.5 A and 25*120%=30 A)

05-35 Rated Power for a Permanent Magnet Synchronous AC Motor

Default: Depending on the motor power

Settings 0.00–655.35 kW

Sets the rated power for the permanent magnet synchronous AC motor. The default is the drive's power value.

05-36 Rated speed for a Permanent Magnet Synchronous AC Motor

Default: 2000

Settings 0–65535 rpm

05-37 Pole number for a Permanent Magnet Synchronous AC Motor

Default: 10

Settings 0–65535

05-38 System Inertia for a Permanent Magnet Synchronous AC Motor

Default: Depending on the motor power

Settings 0.0–6553.5 kg-cm^2

Default values are as below:

Rated Power [kW]	0.4	0.75	1.5	2.2	3.7	5.5	7.5	9.3	11
Rotor Inertia [kg-cm^2]	1.2	3.0	6.6	15.8	25.7	49.6	82.0	121.6	177.0

Rated Power [kW]	14.1	18.2	27	33	40	46	54	Above 54
Rotor Inertia [kg-cm^2]	211.0	265.0	308.0	527.0	866.0	1082.0	1267.6	1515.0

05-39 Stator Resistance for a Permanent Magnet Synchronous AC Motor

Default: 0.000

Settings 0.000–65.535 Ω

05-40 Permanent Magnet Synchronous AC Motor Ld

Default: 0.00

Settings 0.00–655.35 mH

05-41 Permanent Magnet Synchronous AC Motor Lq

Default: 0.00

Settings 0.00–655.35 mH

✐ 05-43 Ke parameter for a Permanent Magnet Synchronous AC Motor

Default: 0

Settings 0–65535 (Unit: V/krpm)

- Ke parameter of a permanent magnet synchronous AC motor ($V_{phase, rms}$ / krpm).
- When Pr.05-00=5, the induction electromotive force Ke is measured according to the motor's actual operation.
- When Pr.05-00=13, the Ke is automatically calculated according to the motor power, current and rotor speed.

06 Protection Parameters

⚡ This parameter can be set during operation.

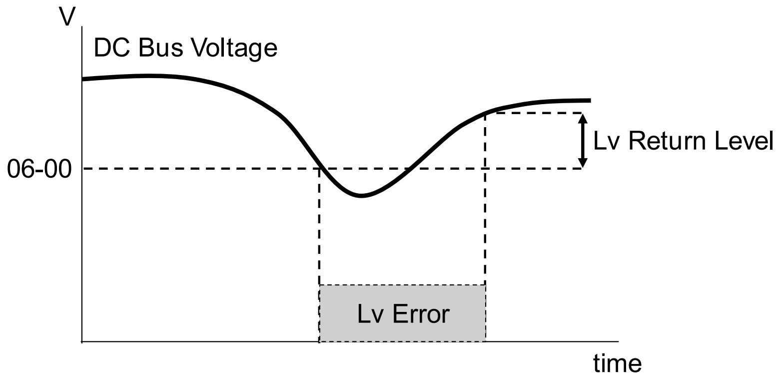
⚡ 06-00 Low Voltage Level

Default: 360.0

Settings 300.0–440.0 V_{DC}

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

Lv Return Level	460V
Frame A–D	60 V_{DC}



⚡ 06-01 Over-voltage Stall Prevention

Default: 760.0

Settings 0: Disabled
0.0–900.0 V_{DC}

- Setting Pr.06-01 to 0.0 disables the over-voltage stall prevention function (connected with braking unit or braking resistor). Use this setting when braking units or resistors are connected to the drive.
- Setting Pr.06-01 to a value > 0 enables the over-voltage stall prevention. This setting refers to the power supply system and loading. If the setting is too low, then over-voltage stall prevention is easily activated, which may increase the deceleration time.
- Related parameters: Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4, Pr.02-13–Pr.02-15 Multiple-function Output (Relay1–3) and Pr.06-02 Selection for Over-voltage Stall Prevention.

06-02 Selection for Stall Prevention

Default: 0

Settings 0: Traditional over-voltage and traditional over-current stall prevention
1: Smart over-voltage and traditional over-current stall prevention
2: Traditional over-voltage and smart over-current stall prevention
3: Smart over-voltage and smart over-current stall prevention

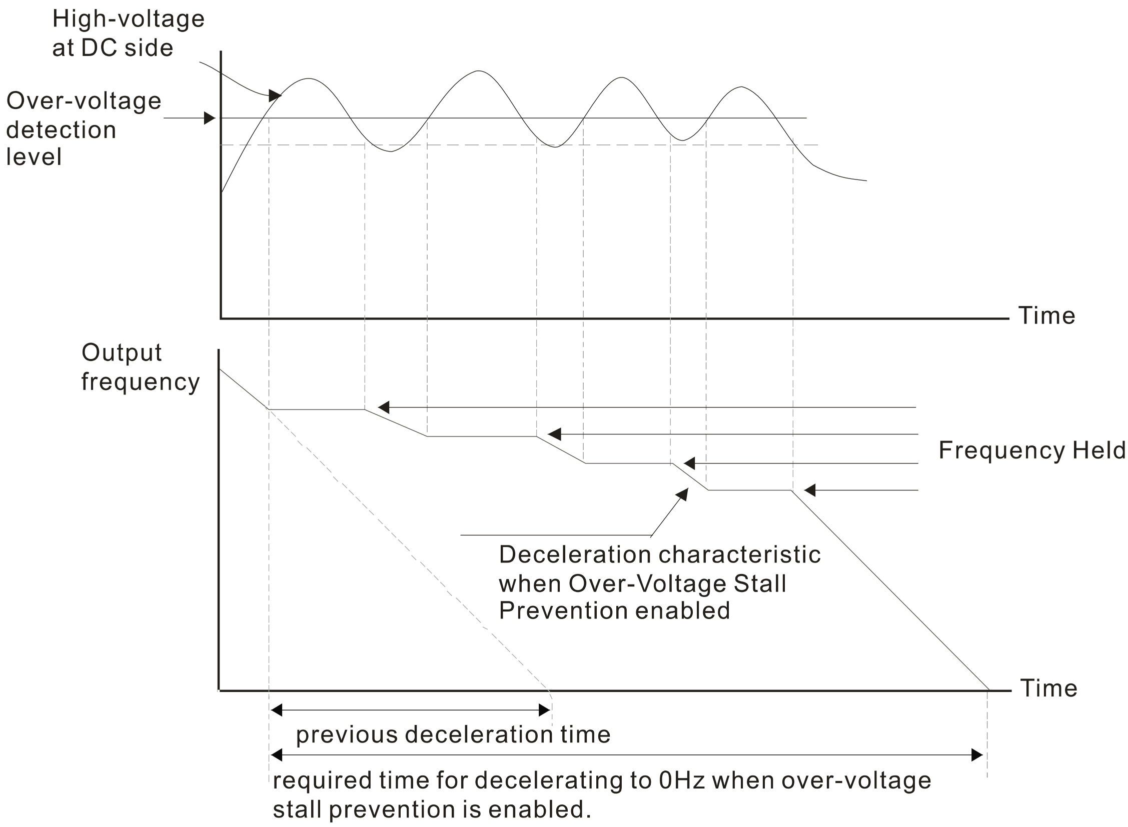
- A comparison between traditional stall prevention and smart stall prevention:

Type	Over-voltage			Over-current		
	Description	Action	Parameter	Description	Action	Parameter
Traditional	Frequency maintains during deceleration	Deceleration stops	Pr.06-01	Frequency maintains during acceleration	Acceleration stops	Pr.06-03
				Frequency decreases at constant speed	Frequency gradually decreases	Pr.06-04
Smart	Frequency increases during acceleration / deceleration / constant speed	Frequency gradually increases	Pr.06-01	Frequency decreases during acceleration / deceleration	Frequency gradually decreases	Pr.06-03
				Frequency decreases at constant speed	Frequency gradually decreases	Pr.06-04

- Pr.06-02 (Selection for stall prevention) can be used with Pr.01-49 (Regenerative energy restriction control method), but Pr.06-02 cannot work with Pr.01-44 (Auto-acceleration and auto-deceleration setting).
- When Pr.06-02 or Pr.01-49 is enabled (setting value > 0), Pr.01-44 (Auto-acceleration and auto-deceleration setting) automatically disables (setting value = 0) and cannot be set; when Pr.01-44 is enabled (setting value > 0), Pr.06-02 and Pr.01-49 automatically disable and cannot be set.
- If you use smart over-voltage or smart over-current stall prevention for industries that require fast response, you can decrease the deceleration time when needed.
- Related parameters:
  Pr.06-01 Over-voltage stall prevention, Pr.06-03 Over-current stall prevention during acceleration, Pr.06-04 Over-current stall prevention during operation, Pr.06-05 Acceleration / deceleration time selection for stall prevention at constant speed, Pr.01-12–01-19 Acceleration / Deceleration time 1–4, and Pr.02-13–02-15 Multi-function output (Relay 1–3).

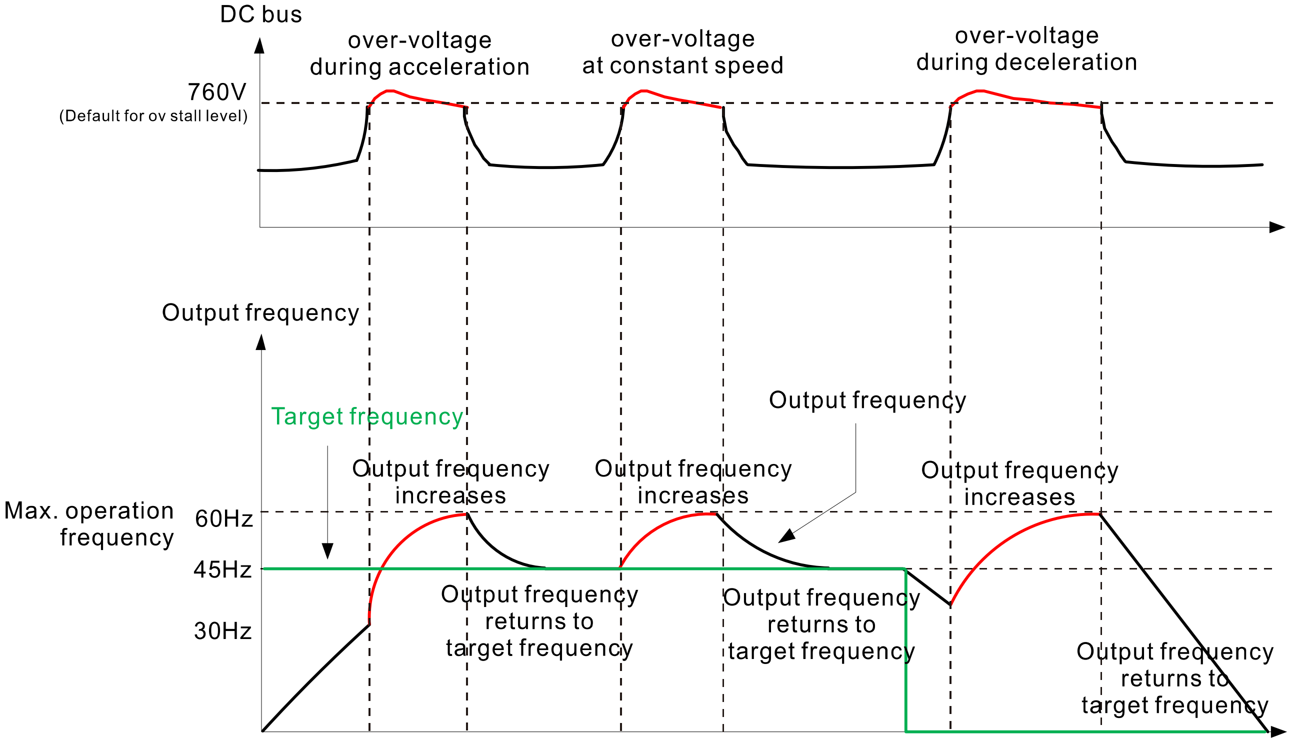
Traditional over-voltage stall prevention

- Used for uncertain load inertia. When it stops under normal load, the over-voltage does not occur during deceleration and fulfills the deceleration time setting. However, load regenerative inertia may occasionally increase and does not trip due to over-voltage when decelerating to stop. In this case, the drive automatically increases the deceleration time until it stops.
- Because of the motor load inertia, the motor may exceed the synchronous speed when the drive decelerates; in this case, the motor becomes generator. If the motor load inertia is larger, or the setting for drive's decelerating time is too small, the motor regenerates energy to the drive, and makes the DC bus voltage increase to the maximum allowable value. Thus, when traditional over-voltage stall prevention is enabled, the drive does not decelerate further and maintains the output frequency until the voltage drops below the setting value again.
- When the over-voltage stall prevention is enabled, the drive deceleration time is larger than the setting time.
- When there is a problem with the deceleration time, this function is disabled. See below for solution:
  1. Increase the deceleration time properly.
  2. Install a brake resistor (refer to Section 7-1 Brake Resistors and Brake Units Selection Chart for details) to dissipate the heat, that is, the electrical energy regenerating from the motor.



Smart over-voltage stall prevention

- Adopts closed-loop control and takes the setting for Pr.06-01 over-voltage stall prevention as target command during acceleration, deceleration and constant speed. When the DC bus voltage is higher than the stall prevention level, the controller increases the output frequency gradually according to closed-loop response until the DC bus voltage drops below the stall prevention level, and returns to target frequency based on the previous setting for deceleration time when the DC bus voltage is lower than the stall prevention level. If the DC bus voltage is still higher than the stall prevention level during the adjustment, the output frequency increases to the maximum operation frequency (Pr.01-00).

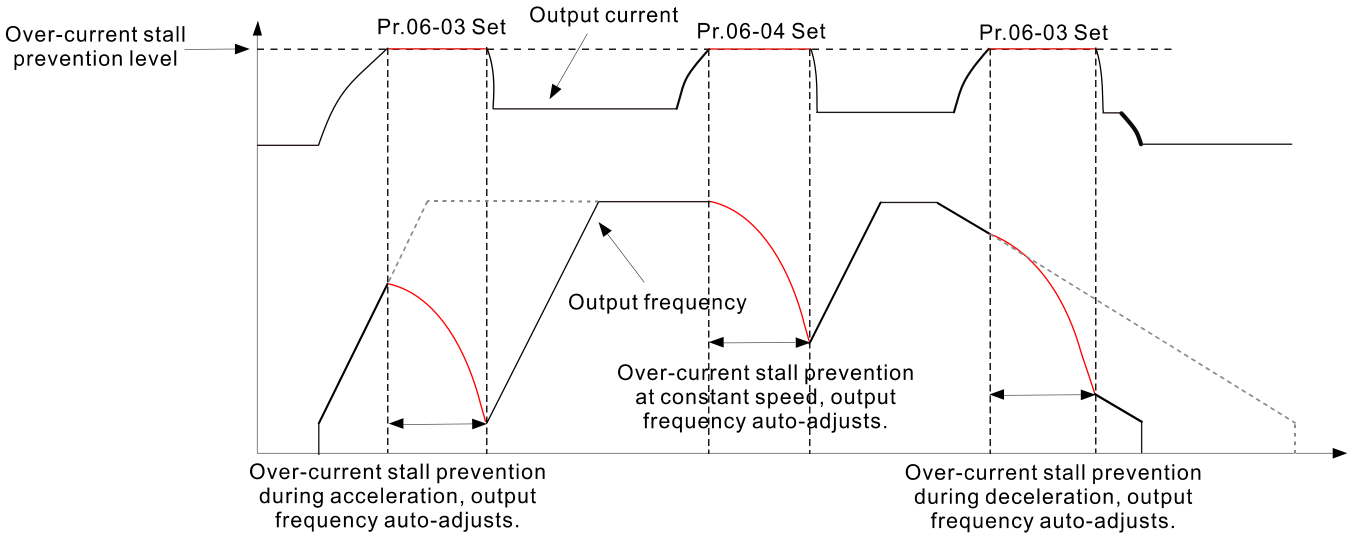


Traditional over-current stall prevention

- When the output current exceeds the over-current stall prevention level (Pr.06-03) during acceleration, the output frequency stops accelerating. The output frequency continues to accelerate when the output current drops below the stall prevention level to protect the drive.
- When the output current exceeds the over-current stall prevention during operation (Pr.06-04), the output frequency decreases according to the setting for acceleration / deceleration time selection for over-current stall prevention at constant speed (Pr.06-05). When the output current drops below the stall prevention level, the output frequency accelerates to the target frequency according to its previous set acceleration time.

Smart over-current stall prevention

- Adopts closed-loop control. It takes the setting for Pr.06-03 over-current stall prevention during acceleration as target command during acceleration and deceleration, and takes Pr.06-04 over-current stall prevention during operation as target command at constant speed. When the output current exceeds the stall prevention level, the controller decreases the output frequency gradually according to the closed-loop response until the current drops below the stall prevention level, and returns to target frequency based on the previous setting when the current is lower than the stall prevention level. If the output current is still higher than the stall prevention level during the adjustment, the output frequency decreases to the minimum output frequency at 0.5 Hz.



06-03 Over-current Stall Prevention during Acceleration

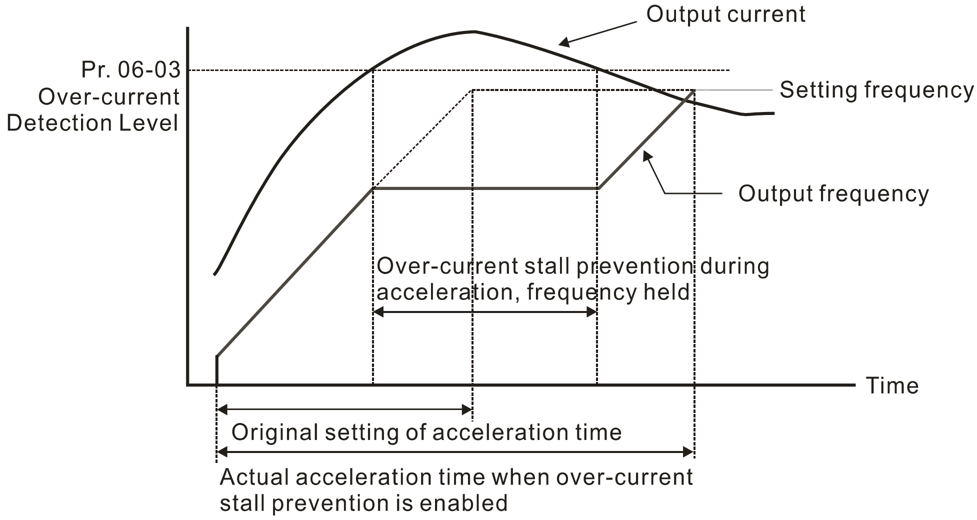
Default: 120

Settings Light load: 0–130% (100%: drive's rated current)

Normal load: 0–160% (100%: drive's rated current)

- This parameter only works in VF and SVC control modes.
- If the motor load is too large or the drive's acceleration time is too short, the output current of the drive may to too high during acceleration, and it may cause motor damage or trigger protection functions (oL or oc). Use this parameter to prevent these situations.
- During acceleration, the output current of the drive may increase abruptly and exceed the value of Pr.06-03. In this case, the drive stops accelerating and keeps the output frequency constant, and then continues to accelerate until the output current decreases.
- When you enable the over-current stall prevention, the drive's acceleration time is larger than the setting.
- When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the Pr.06-03 setting value.
- When you encounter any problem with the acceleration time, refer to the following guides for troubleshooting:
  1. Increase the acceleration time to a suitable value.
  2. Setting Pr.01-44 Auto Acceleration / Deceleration Setting to 1, 3 or 4 (auto-acceleration).

📖 Related parameters: Pr.01-12, Pr.01-14, Pr.01-16, Pr.01-18 Acceleration Time 1–4, Pr.01-44 Auto Acceleration / Deceleration Setting, Pr.02-13–02-15 Multi-function Output Relay1–3.



06-04 Over-current Stall Prevention during Operation

Default: 120

Settings Light load: 0–130% (100%: drive's rated current)

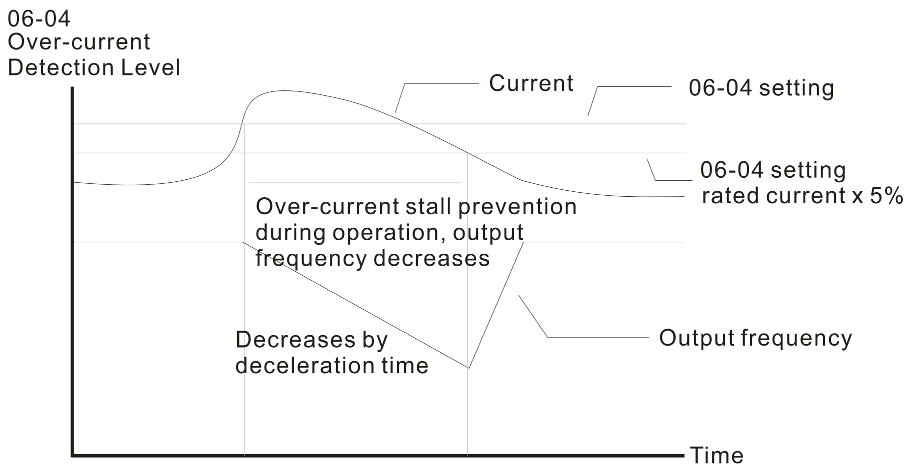
Normal load: 0–160% (100%: drive's rated current)

📖 This parameter only works in VF and SVC control modes.

📖 This is a protection for the drive to decrease output frequency automatically when the motor over-loads abruptly during constant motor operation.

📖 If the output current exceeds the setting value for Pr.06-04 when the drive is operating, the drive decreases output frequency (according to Pr.06-05) to prevent the motor from stalling.

If the output current is lower than the setting value for Pr.06-04, the drive accelerates (according to Pr.06-05) again to the setting frequency.



Over-current stall prevention during operation

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

Default: 0

Settings 0: By current acceleration / deceleration time

1: By the 1st acceleration / deceleration time

2: By the 2nd acceleration / deceleration time

3: By the 3rd acceleration / deceleration time

4: By the 4th acceleration / deceleration time
5: By automatic acceleration / deceleration

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

06-06 Over-torque Detection Selection (OT1)

Default: 0

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

06-09 Over-torque Detection Selection (OT2)

Default: 0

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

📖 When you set Pr.06-06 and Pr.06-09 to 1 or 3, a warning message displays, but there is not error record.

📖 When you set Pr.06-06 and Pr.06-09 to 2 or 4, a warning message displays and there is an error record.

06-07 Over-torque Detection Level (OT1)

Default: 120

Settings 10–200% (100% corresponds to the light-load rated current of the drive)

06-08 Over-torque Detection Level (OT1)

Default: 0.1

Settings 0.0–60.0 sec.

06-10 Over-torque Detection Level (OT2)

Default: 120

Settings 10–200% (100% corresponds to the light-load rated current of the drive)

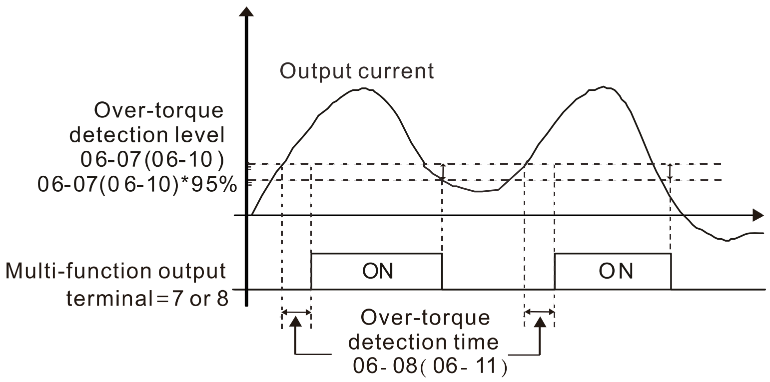
06-11 Over-torque Detection Time (OT2)

Default: 0.1

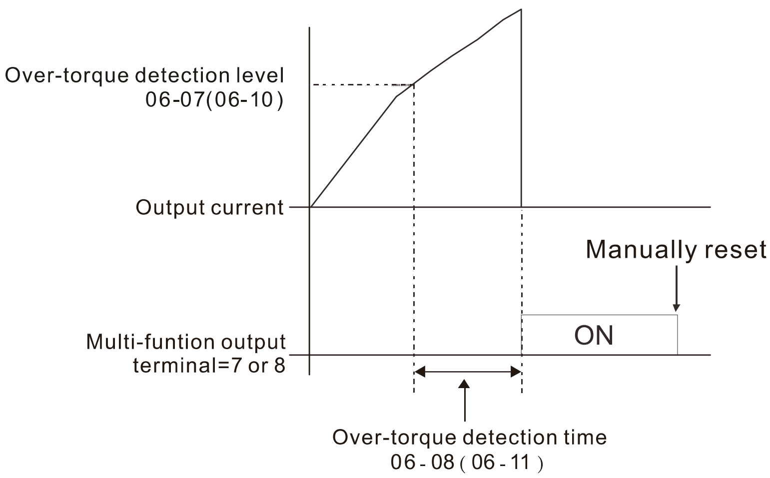
Settings 0.0–60.0 sec.

📖 When the output current exceeds the over-torque detection level (Pr.06-07 or Pr.06-10) and exceeds the over-torque detection time (Pr.06-08 or Pr.06-11), the over-torque detection follows the setting of Pr.06-06 and Pr.06-09.

- When you set Pr.06-06 or Pr.06-09 to 1 or 3, an ot1/ot2 warning displays while the drive keeps running. The warning remains on until the output current is smaller than 5% of the over-torque detection level.



- When you set Pr.06-06 or Pr.06-09 to 2 or 4, an ot1 / ot2 warning displays and the drive stops running after over-torque detection. The drive keeps running after you manually reset it.



06-13	Electronic Thermal Relay Selection (Motor 1)
06-27	Electronic Thermal Relay Selection (Motor 2)

Default: 2

Settings 0: Inverter motor (with external forced cooling)

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

2: Disable

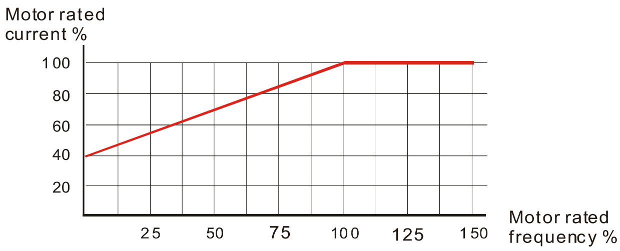
- Prevents self-cooled motor from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.
- Setting the parameter to 0 is suitable for an inverter motor (motor fan using independent power supply). For this kind of motor, there is no significant correlation between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

06-14 Electronic Thermal Relay Action Time 1 (Motor 1)
06-28 Electronic Thermal Relay Action Time 2 (Motor 2)

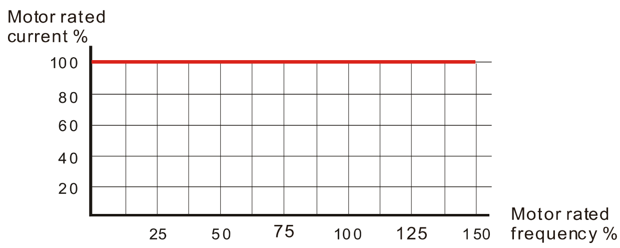
Default: 60.0

Settings 30.0–600.0 sec.

- Set the parameter to 150% of motor rated current and use with the setting of Pr.06-14 and Pr.06-28 to prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL1 / EoL2", and the motor free runs to stop.
- Use this parameter to set the action time of electronic thermal relay. It works based on the I^2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent motor from overheating.

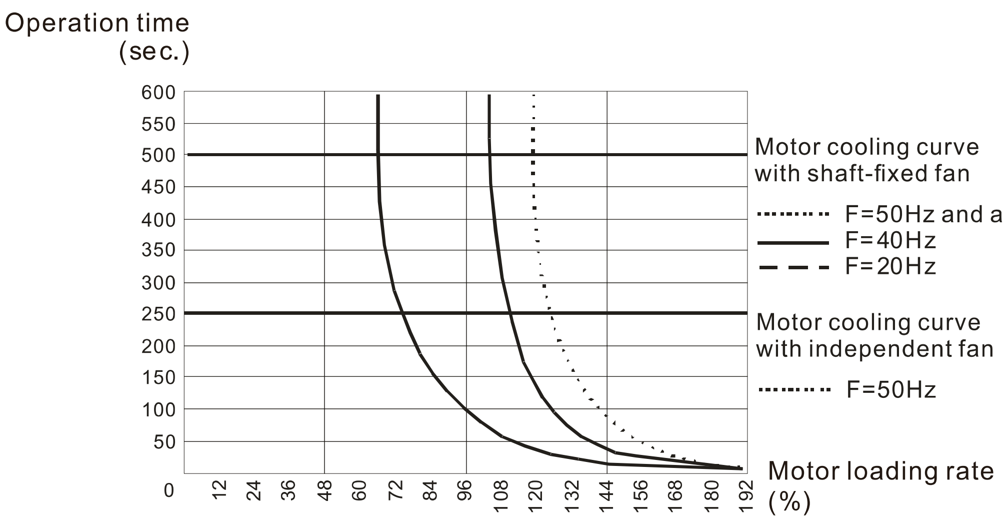


Motor cooling curve with shaft-fixed fan



Motor cooling curve with independent fan

- The action of electronic thermal relay depends on the setting for Pr.06-13 and Pr.06-27.
  1. Pr.06-13 or Pr.06-27 set to 0 (using inverter motor)：
     When the output current of motor drive is higher than 150% of motor rated current (refer to the motor cooling curve with independent fan), motor drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds Pr.06-14 or 06-28.
  2. Pr.06-13 or Pr.06-27 set to 1 (using standard motor)：
     When the output current of the drive is higher than 150% of the motor rated current (refer to the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds Pr.06-14 or 06-28
  3. If the Pr.05-01 is not set, the default is 90% of Pr.00-01 rated current of the drive.
- The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to following chart: (The motor cooling curve with shaft-fixed fan and motor cooling curve with independent fan F = 50 Hz are the same one.)



06-15 Heat Sink Over-heat (OH1) Warning

Default: 105.0

Settings 0.0–110.0°C

- If Pr.06-15 is set to 110°C, when the temperature reaches 110°C, the drive stops with an IGBT over-heat fault.
- For Frame C and above, when IGBT temperature is above Pr.06-15 minus 15°C, the cooling fan enhances performance to 100%; however, when IGBT temperature is below 35°C of Pr.06-15 and the temperature of CAP is below 10°C of oH2 over-heat warning (Pr.06-51), the cooling fan resets. The temperature 35°C is the criterion if Pr.06-15 is set below to 35°C.

06-16 Stall Prevention Limit Level (Weak Magnetic Area Current Stall Prevention Level)

Default: 50

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

- Sets the over-current stall prevention level when operation frequency is larger than Pr.01-01. This parameter only works during acceleration.
- Example: Pr.06-03 = 150%, Pr.06-04 = 100% and Pr.06-16 = 80%, when the operation frequency is larger than Pr.01-01, the over-current stall prevention level is as below:
  Over-current stall prevention level during acceleration = Pr.06-03 × Pr.06-16 = 150 × 80% = 120%.
  Over-current stall prevention level during operation = Pr.06-04 × Pr.06-16 = 100 × 80% = 80%
- Pr.06-16 is invalid when the over-current stall prevention activates according to Pr.06-04 at constant speed.

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

Settings

0: No fault record

1: Over-current during acceleration (ocA)

2: Over-current during deceleration (ocd)

3: Over-current during constant speed (ocn)

4: Ground fault (GFF)

5: IGBT short-circuit (occ)

6: Over-current at stop (ocS)

7: Over-voltage during acceleration (ovA)

8: Over-voltage during deceleration (ovd)

9: Over-voltage during constant speed (ovn)

10: Over-voltage at stop (ovS)

11: Low-voltage during acceleration (LvA)

12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (OrP)
16: IGBT over-heat (oH1)
17: Capacitance over-heat (oH2)
18: tH1o (TH1 open: IGBT over-heat protection error)
19: tH2o (TH2 open: capacitance over-heat protection error)
21: Drive over-load (oL)
22: Electronics thermal relay protection 1 (EoL1)
23: Electronics thermal relay protection 2 (EoL2)
24: Motor PTC overheat (oH3) (PTC / PT100)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Low current (uC)
30: Memory write-in error (cF1)
31: Memory read-out error (cF2)
33: U-phase current detection error (cd1)
34: V-phase current detection error (cd2)
35: W-phase current detection error (cd3)
36: Clamp current detection error (Hd0)
37: Over-current detection error (Hd1)
38: Over-voltage detection error (Hd2)
39: IGBT short-circuit detection error (Hd3)
40: Auto-tuning error (AUE)
41: PID feedback loss (AFE)
48: Analog current input loss (ACE)
49: External fault input (EF)
50: Emergency stop (EF1)
51: External Base Block (bb)
52: Password error (Pcod)
53: Software code error
54: Communication error (CE1)
55: Communication error (CE2)
56: Communication error (CE3)
57: Communication error (CE4)
58: Communication Time-out (CE10)
60: Brake transistor error (bF)
61: Y-connection / Δ-connection switch error (ydc)
62: Deceleration Energy Backup error (dEb)
63: Slip error (oSL)
64: Electromagnet switch error (ryF)

71: Watchdog
72: Channel 1 (STO1–SCM1) safety loop error (STL1)
73: External safety gate S1
74: FIRE mode output
76: Safety Torque Off (STO)
77: Channel 2 (STO2–SCM2) safety loop error (STL2)
78: Internal loop error (STL3)
79: U-phase output short-circuit (Uoc)
80: V-phase output short-circuit (Voc)
81: W-phase output short-circuit (Woc)
82: U-phase output phase loss (OPHL)
83: V-phase output phase loss (OPHL)
84: W-phase output phase loss (OPHL)
89: RoPd initial rotor position detection error
90: Inner PLC function is forced to stop
93: CPU error
99: TRAP CPU command error
101: CANopen software disconnect1 (CGdE)
102: CANopen software disconnect2 (CHbE)
103: CANopen synchronous error (CsyE)
104: CANopen hardware disconnect (CbFE)
105: CANopen index setting error (CidE)
106: CANopen slave station number setting error (CAdE)
107: CANopen index setting exceed limit (CFrE)
111: Internal communication overtime error (ictE)
142: Auto-tuning error 1 (no feedback current error) (AUE1)
143: Auto-tuning error 2 (motor phase loss error) (AUE2)
144: Auto-tuning error 3 (no-load current I_0 measuring error) (AUE3)
148: Auto-tuning error (leakage inductance Lsigma measuring error) (AUE4)

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

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

Default: 0

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

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

Fault Code	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: Phase loss protection (OrP)		●					
16: IGBT over-heat (oH1)			●				
17: Capacitance over-heat (oH2)			●				
18: tH1o (TH1 open)			●				
19: tH2o (TH2 open)			●				
21: Drive over-load (oL)			●				
22: Electronics thermal relay protection 1 (EoL1)			●				
23: Electronics thermal relay protection 2 (EoL2)			●				
24: Motor PTC overheat (oH3) (PTC / PT100)			●				
26: Over-torque 1 (ot1)			●				
27: Over-torque 2 (ot2)			●				
28: Low current (uC)	●						
30: Memory write-in error (cF1)				●			
31: Memory read-out error (cF2)				●			
33: U-phase current detection error (cd1)				●			
34: V-phase current detection error (cd2)				●			
35: W-phase current detection error (cd3)				●			
36: Clamp current detection error (Hd0)				●			
37: Over-current detection error (Hd1)				●			
38: Over-voltage detection error (Hd2)				●			
39: IGBT short-circuit detection error (Hd3)				●			
40: Auto tuning error (AUE)				●			
41: PID feedback loss (AFE)					●		
48: Analog current input loss (ACE)					●		
49: External fault input (EF)						●	
50: Emergency stop (EF1)						●	
51: External Base Block (bb)						●	
52: Password error (Pcod)				●			
53: Software code error				●			

Fault Code	bit0	bit1	bit2	bit3	bit4	bit5	bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
54: Communication error (CE1)							●
55: Communication error (CE2)							●
56: Communication error (CE3)							●
57: Communication error (CE4)							●
58: Communication Time-out (CE10)							●
60: Brake transistor error (bF)						●	
61: Y-connection/Δ-connection switch error (ydc)						●	
62: Deceleration Energy Backup Error (dEb)		●					
63: Slip error (oSL)						●	
64: Electromagnet switch error (ryF)						●	
72: Channel 1 (STO1–SCM1) safety loop error (STL1)				●			
73: External safety gate S1				●			
74: FIRE mode output						●	
76: Safety Torque Off (STO)				●			
77: Channel 2 (STO2–SCM2) safety loop error (STL2)				●			
78: Internal loop error (STL3)				●			
79: U-phase output short-circuit (Uoc)	●						
80: V-phase output short-circuit (Voc)	●						
81: W-phase output short-circuit (Woc)	●						
82: U-phase output phase loss (OPHL)	●						
83: V-phase output phase loss (OPHL)	●						
84: W-phase output phase loss (OPHL)	●						
90: Inner PLC function is forced to stop				●			
99: TRAP CPU command error				●			
101: CANopen software disconnect 1 (CGdE)							●
102: CANopen software disconnect 2 (CHbE)							●
103: CANopen synchronous error (CSyE)							●
104: CANopen hardware disconnect (CbFE)							●
105: CANopen index setting error (CIdE)							●
106: CANopen slave station number setting error (CAdE)							●
107: CANopen index setting exceed limit (CFrE)							●
111: Internal communication overtime error (ictE)							●

06-29 PTC Detection Selection / PT100 Motion

Default: 0

Settings 0: Warn and continue operation

1: Fault and ramp to stop

2: Fault and coast to stop

3: No warning

Sets the operation mode of a drive after you set Pr.06-29 to define PTC / PT100 / KTY84 detection.

06-30 PTC Level

Default: 50.0

Settings 0.0–100.0%

- Sets AVI1/ACI/AVI2 analog input function Pr.03-00–03-02 to 6 [Positive Temperature Coefficient (P.T.C.) thermistor input value].
- Use this to set the PTC level, the corresponding value for 100% is the analog input maximum value.

06-31 Frequency Command for Malfunction

Default: Read only

Settings 0.00–599.00 Hz

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

06-32 Output Frequency at Malfunction

Default: Read only

Settings 0.00–599.00 Hz

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

06-33 Output Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

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

06-34 DC Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

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

06-35 Output Current at Malfunction

Default: Read only

Settings 0.0–6553.5 Amp

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

06-36 IGBT Temperature at Malfunction

Default: Read only

Settings -3276.7–3276.7°C

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

06-37 Capacitance Temperature at Malfunction

Default: Read only

Settings -3276.7–3276.7°C

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

06-38 Motor Speed in rpm at Malfunction

Default: Read only

Settings -32767–32767 rpm

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

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

Default: Read only

Settings 0000h–FFFFh

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

Default: Read only

Settings 0000h–FFFFh

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

06-42 Drive Status at Malfunction

Default: Read only

Settings 0000h–FFFFh

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

06-44 STO Latch Selection

Default: 0

Settings 0: STO latch
1: STO no latch

- Pr.06-44=0: STO Alarm latch. After you clear the cause of the STO Alarm, use a Reset command to clear the STO Alarm.
- Pr.06-44=1: STO Alarm no latch. After you clear the cause of the STO Alarm, the STO Alarm clears automatically.
- All of STL1–STL3 errors are “Alarm Latch” mode (in STL1–STL3 mode, the Pr.06-44 function is no effective).

06-45 Treatment to Output Phase Loss (OPHL)

Default: 3

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

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

06-46 Detection Time of Output Phase Loss

Default: 0.500

Settings 0.000–65.535 sec.

06-47 Current Detection Level of Output Phase Loss

Default: 1.00

Settings 0.00–100.00%

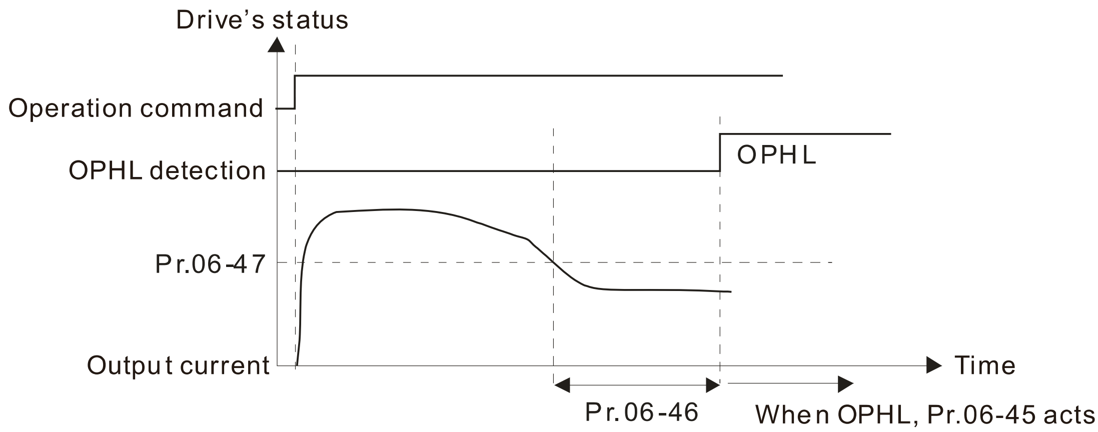
06-48 DC Brake Time of Output Phase Loss

Default: 0.000

Settings 0.000–65.535 sec.

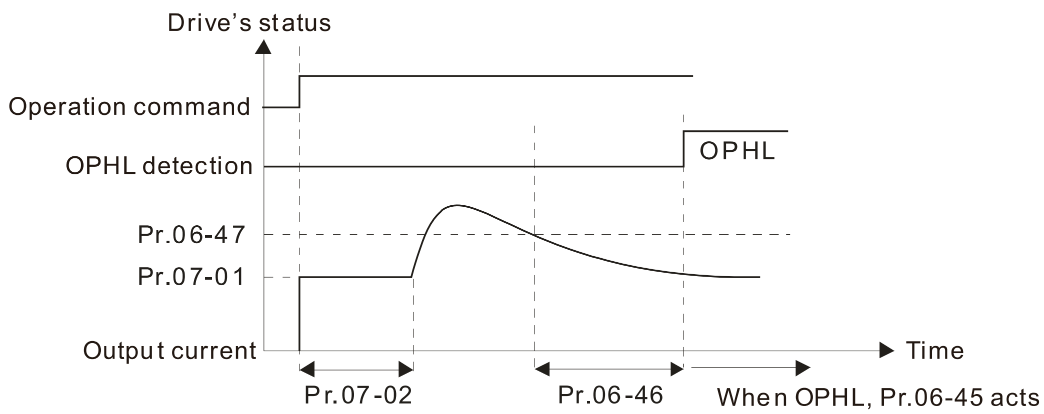
- Setting Pr.06-48 to 0 disables the OPHL detection function.
- Status 1: The drive is in operation

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



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

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

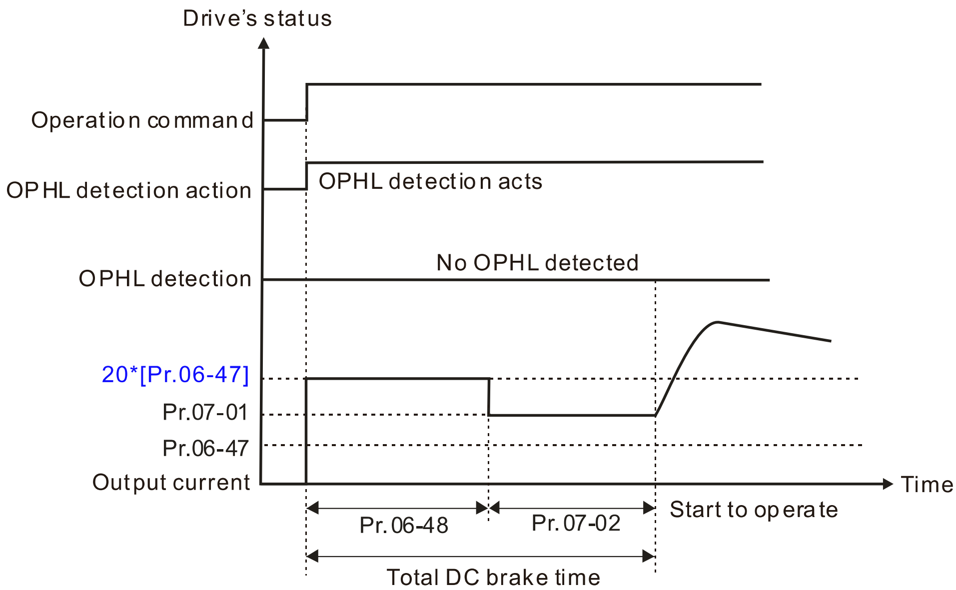


Status 3: The drive is in STOP; Pr.06-48≠0 ; Pr.07-02≠0

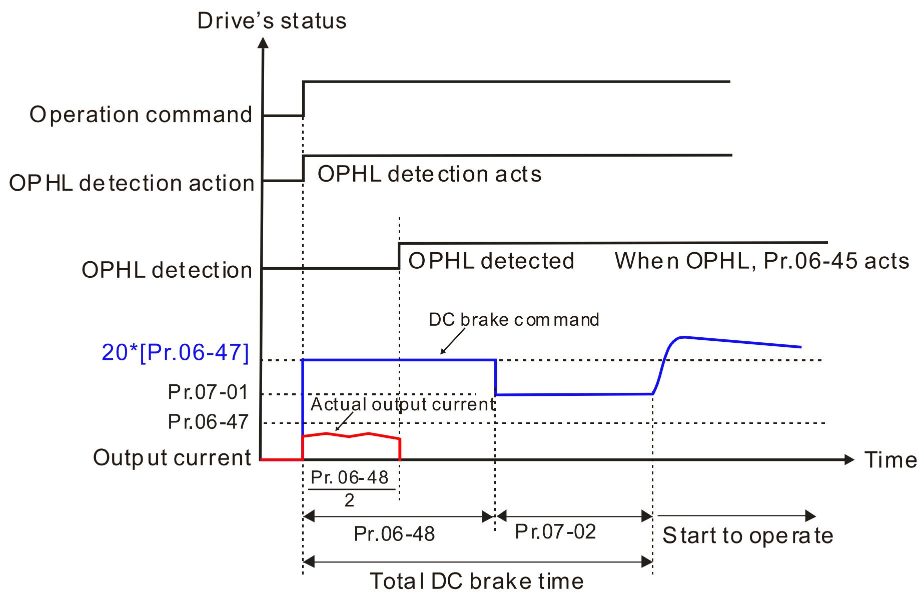
When the drive starts, it executes Pr.06-48 first, and then executes Pr.07-02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the Pr.06-47 setting value in Pr.06-48 setting time; the other is the Pr.07-02 setting value in Pr.07-01 setting time. Total DC brake time is T=Pr.06-48+Pr.07-02.

In this period, if an OPHL happens within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive start counting for half the time of Pr.06-48.

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



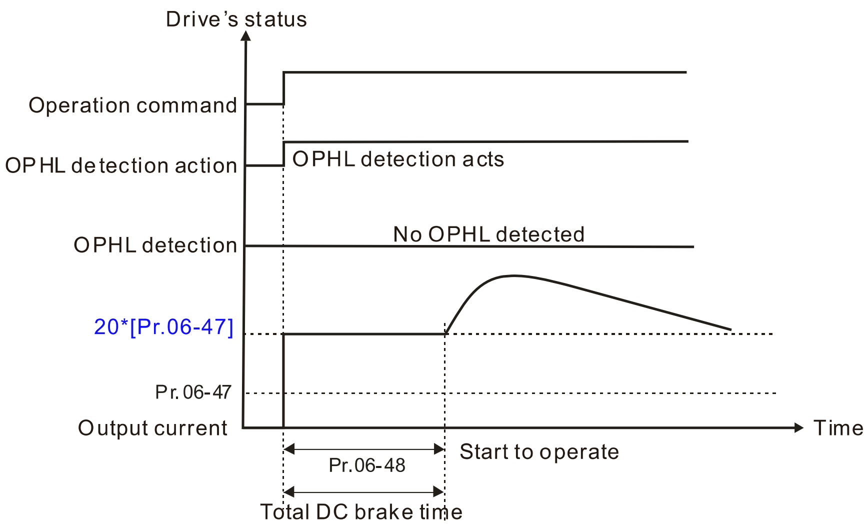
Status 3-2: Pr. 06-48≠0, Pr. 07-20≠0 (OPHL detected before operation)



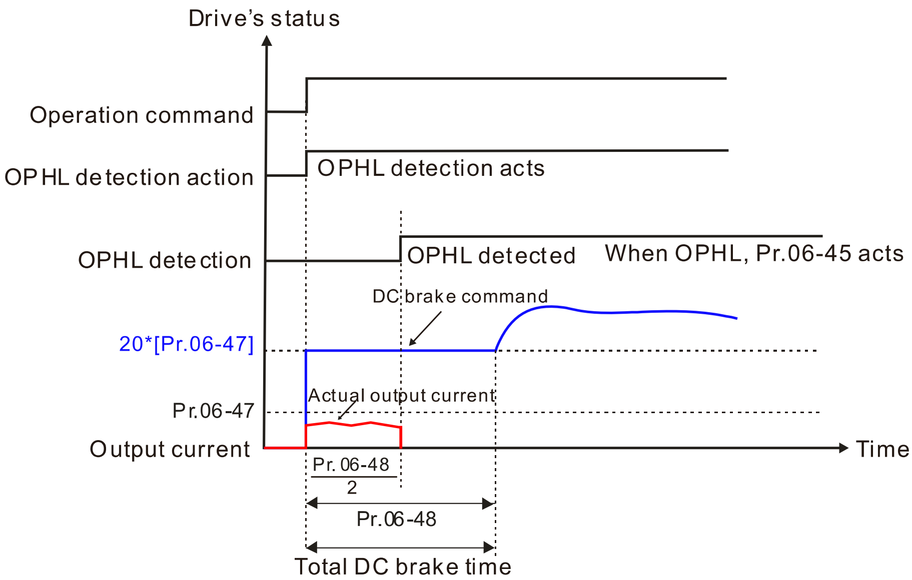
📖 Status 4: The drive is in STOP; Pr.06-48≠0 ; Pr.07-02=0

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

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



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



06-49 LvX Auto-Reset

Default: 0

Settings 0: Disable

1: Enable

06-50 Time for Input Phase Loss Detection

Default: 0.20

Settings 0.00–600.00 sec.

📖 Sets the time for input phase loss detection; setting 0.20 seconds means to check every 0.20 sec.

06-52 Ripple of Input Phase Loss

Default: 60.0

Settings 0.0–200.0 V_{DC}

- When the DC bus ripple is higher than Pr.06-52, and continues for Pr.06-50 plus 30 seconds, the drive triggers an OrP and acts according to the setting of Pr.06-53 to stop.
- In the time period Pr.06-50 plus 30 seconds, if the DC bus ripple is lower than Pr.06-52, the OrP protection counter restarts.

06-53 Treatment for the Detected Input Phase Loss (OrP)

Default: 0

Settings 0: Fault and ramp to stop
1: Fault and coast to stop

- When the DC bus ripple voltage lasts for Pr.06-50 ripple time, the drive activates the Input Phase Loss protection according to the Pr.06-53 settings:
  - DC bus ripple frequency ≤ 166 Hz
  - The amplitude is higher than Pr.06-52 setting [default 60 V]. It starts to count time after 20 consecutive times.
  - When the following conditions continue,ORP occurs.

(I)% is rated current percentage

(I)%	Actual seconds
50	432
75	225
120	60

- When any condition is not satisfied, the ORP protect function is recalculated.

06-55 Derating Protection

Default: 0

Settings 0: Constant rated current and limit carrier wave by load current and temperature
1: Constant carrier frequency and limit load current by setting carrier wave
2: Constant rated current (same as setting 0), but close current limit

- The maximum output frequency and its corresponded carrier frequency lower limit under each control mode:
  - VF, SVC: 599 Hz, 6K
- Setting 0:

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

Refer to the Section 9-4 “Derating Curve of Ambient Temperature” for the level of carrier frequency. Take VFD007FP4EA-52 in normal duty for example, ambient temperature 50°C, UL open-type, and independent installation. When the carrier frequency is set to 15 kHz, it corresponds to 72% of the rated output current. When the output current is higher than the value, it automatically decreases the carrier wave according to the ambient temperature, output current and overload time. At this time, the overload capacity of the drive is still 120% of the rated current.

📖 Setting 1:

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

Refer to Section 9-4 “Derating Curve of Ambient Temperature” for the derating level of the rated current. Take VFD007FP4EA-52 in normal duty for example, when the carrier frequency maintains at 15 kHz, the rated current decreases to 72%. The oL protection executes when the current is 120%*72%=86% for one minute; therefore, it must operate by the curve to keep the carrier frequency.

📖 Setting 2:

The protection method and action are the same as setting it to 0, but this disables the current limit when output current is the derating ratio x 160% of output current in normal load, and derating ratio x 130% of output current in light load. The advantage is that this can provide a higher starting output current when the carrier frequency setting is higher than the default. The disadvantage is that the carrier wave derates easily when it overloads.

📖 Use with settings for Pr.00-16 and Pr.00-17.

06-56 PT100 Voltage Level 1

Default: 5.000

Settings 0.000–10.000 V

06-57 PT100 Voltage Level 2

Default: 7.000

Settings 0.000–10.000 V

📖 Condition settings: Pr.06-57 > Pr.06-56.

06-58 PT100 Level 1 Frequency Protection

Default: 0.00

Settings 0.00–599.00 Hz

06-59 PT100 Activation Level 1 Protection Frequency Delay Time

Default: 60

Settings 0–6000 sec.

📖 PT100 operation instructions:

(1) Use voltage type analog input (AVI1, AVI2 and ACI voltage 0–10V) and select PT100 mode.

(2) Select one of the voltage type analog inputs below:

(a) AVI1(Pr.03-00=11)

(b) AVI2 (Pr.03-02=11)

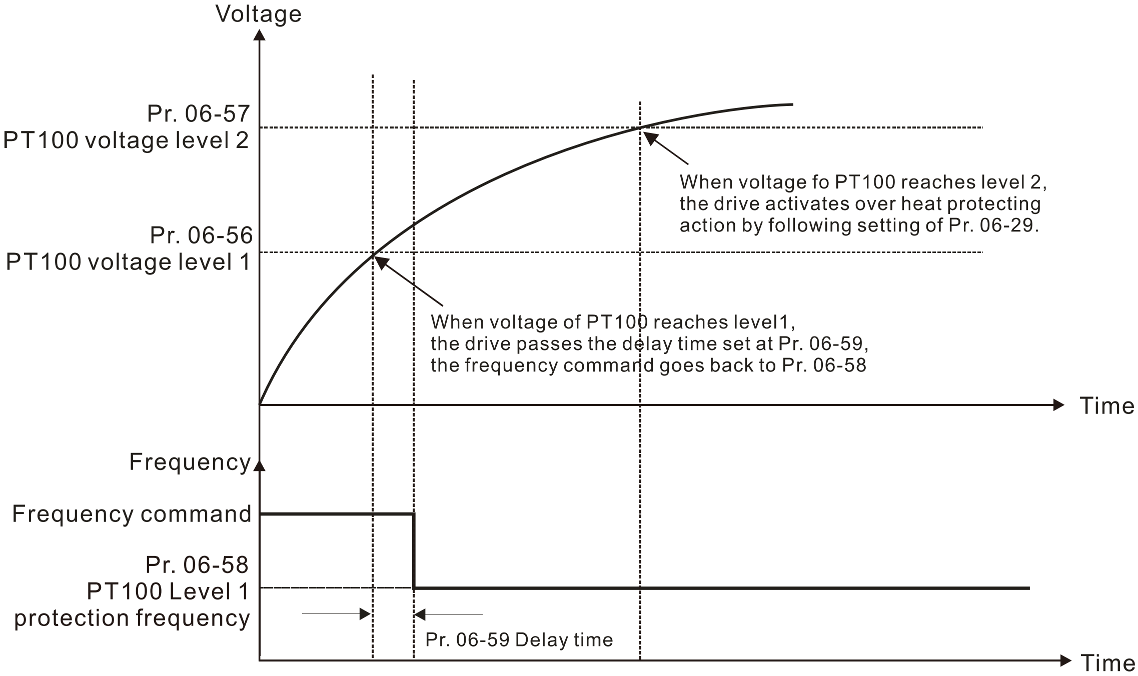
(c) ACI (Pr.03-01=11 and Pr.03-29=1).

(3) When selecting Pr.03-01=11 and Pr.03-29=1, you must switch SW4 to 0–10 V for the external I/O board.

(4) The AFM2 outputs constant voltage or current, the Pr.03-23=23. You must switch AFM2 SW2 to 0–20 mA for the external I/O board, and set AFM2 output level to 45% (Pr.03-33=45%) of 20 mA = 9 mA.

(5) Use Pr.03-33 to adjust the constant voltage or constant current of the AFM2 output, the setting range is 0–100.00%.

(6) There are two types of action levels for PT100. The diagram below shows the PT100 protecting action:



(7) PT100 wiring diagram:

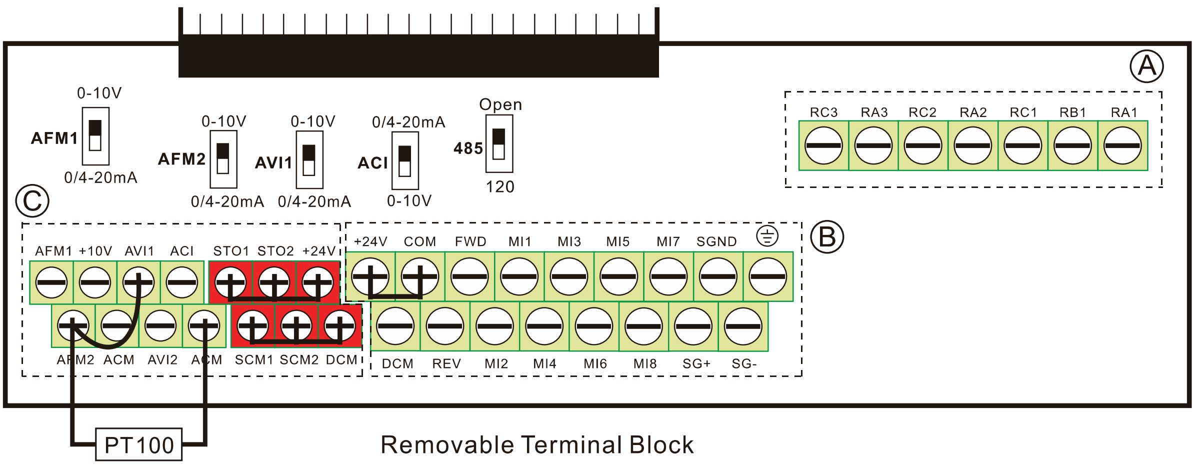


Figure 1

📖 When Pr.06-58=0.00 Hz, PT100 function is disabled.

Example:

When using PT100, if the motor temperature is higher than 135°C (275°F), the drive starts to count the delay time for auto-deceleration (Pr.06-59). The drive decreases the motor frequency to the setting for Pr.06-58 when it reaches the delay time count value. The drive operates at the frequency set for Pr.06-58 until the motor temperature is lower than 135°C (275°F). If the motor temperature is higher than 150°C (302°F), the drive automatically decelerates to STOP and displays the warning “oH3”.

Set up process:

1. Switch AFM2 to 0–20 mA on the I/O control terminal block. (Refer to Figure 1, PT100 wiring diagram)
2. Wiring (Refer to Figure 1, PT100 wiring diagram):
   Connect external terminal AFM2 to (+)
   Connect external terminal ACM to (-)
   Connect external terminals AFM2 and AVI1 to "short-circuit"
3. Set Pr.03-00=11 or Pr.03-23=23 or Pr.03-33=45% (9 mA).
4. Refer to the RTD temperature and resistance comparison table
   Temperature=135°C, resistance=151.71 Ω; input current: 9 mA, voltage: about 1.37 V_{DC}
   Temperature=150°C, resistance=157.33 Ω; input current: 9 mA, voltage: about 1.42 V_{DC}
5. When the RTD temperature is > 135°C, the drive decelerates to the specified operation frequency automatically. Then, Pr.06-56=1.37 and Pr.06-58=10 Hz. When Pr.06-58=0, it disables the specified operation frequency.
6. When the RTD temperature is > 150°C, the drive outputs a fault, decelerates to STOP, and displays the warning 'oH3'. Then, Pr.06-57=1.42 and Pr.06-29=1 (fault and ramp to stop).

✎ 06-60 Software Detection GFF Current Level

Default: 60.0

Settings 0.0–6553.5% (100% corresponds to the light-load rated current of the drive)

✎ 06-61 Software Detection GFF Filter Time

Default: 0.10

Settings 0.00–655.35 sec.

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

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

Default: Read only

Settings 0–65535 days

06-64 Operation Time for Fault Record 1 (Min)
06-66 Operation Time for Fault Record 2 (Min)
06-68 Operation Time for Fault Record 3 (Min)
06-70 Operation Time for Fault Record 4 (Min)

Default: Read only

Settings 0–1439 min

- If there is any malfunctions when the drive operates, Pr.06-17–Pr.16-22 record the malfunctions, and Pr.06-63–Pr.06-70 record the operation time for four sequential malfunctions. Check if there is any problem with the drive according to the interval of the recorded fault.

Example:

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

The second error: ocd occurs after another 1000 minutes.

The third error: ocn occurs after another 1000 minutes.

The fourth error: ocA occurs after another 1000 minutes.

The fifth error: ocd occurs after another 1000 minutes.

The sixth error: ocn occurs after 1000 minutes.

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

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

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

06-71 Low Current Setting Level

Default: 0.0

Settings 0.0–100.0 %

06-72 Low Current Detection Time

Default: 0.00

Settings 0.00–360.00 sec.

06-73 Low Current Action

Default: 0

Settings 0: No function

1: Fault and coast to stop

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

3: Warn and operation continue

- The drive operates according to the setting for Pr.06-73 when the output current is lower than the setting for Pr.06-71, and when the time of the low current exceeds the detection time for Pr.06-72. Use this parameter with the external multi-function output terminal 44 (for low current output).
- The low current detection function does not execute when the drive is in sleep or standby status.
- Sets Pr.06-71 low current level according to the drive's rated current, the equation is Pr.00-01

(drive's rated current) x Pr.06-71 (low current setting level)% = low current detection level (A). The drive changes the setting for Pr.00-01 (rated current) according to the setting for Pr.00-16 (load selection).

06-76 dEb Motion Offset

Default: 40.0

Settings 0.0–200.0 V_{DC}

06-80 Fire Mode

Default: 0.00

Settings 0: Disable
1: Operates in counter clockwise direction
2: Operates in clockwise direction

This parameter works with multi-input function terminal 58 or 59 and multi-output function terminal 53 and 54.
0: Fire mode is disabled.
1: When there is a fire, the motor operates in counter clockwise direction (U, V, W).
2: When there is a fire, the motor operates in clockwise direction (U, W, V).

06-81 Operating Frequency when Running Fire Mode

Default: 60.00

Settings 0.00–599.00 Hz

Sets the drive's frequency when the fire mode is enabled.

06-82 Enable Bypass on Fire Mode

Default: 0

Settings 0: Disable Bypass
1: Enable Bypass

06-83 Bypass Delay Time on Fire Mode

Default: 0.0

Settings 0.0–6550.0 sec.

06-84 Number of Times of Reset in Fire Mode

Default: 0

Settings 0–10

06-85 Length of Time of Reset in Fire Mode

Default: 60.0

Settings 0.0–6000.0 sec.

The settings for Pr.06-82 to Pr.06-85 determine whether to switch motors to operate under mains electricity when in fire mode.

06-86 Fire Mode Motion

Default: 0

Settings bit0: 0=Open Loop; 1=Close Loop (PID control)

bit1: 0=Manual reset fire mode; 1=Auto reset fire mode

0: Open loop control & manual reset fire mode

1: Close loop control & manual reset fire mode

2: Open loop control & auto reset fire mode

3: Close loop control & auto reset fire mode

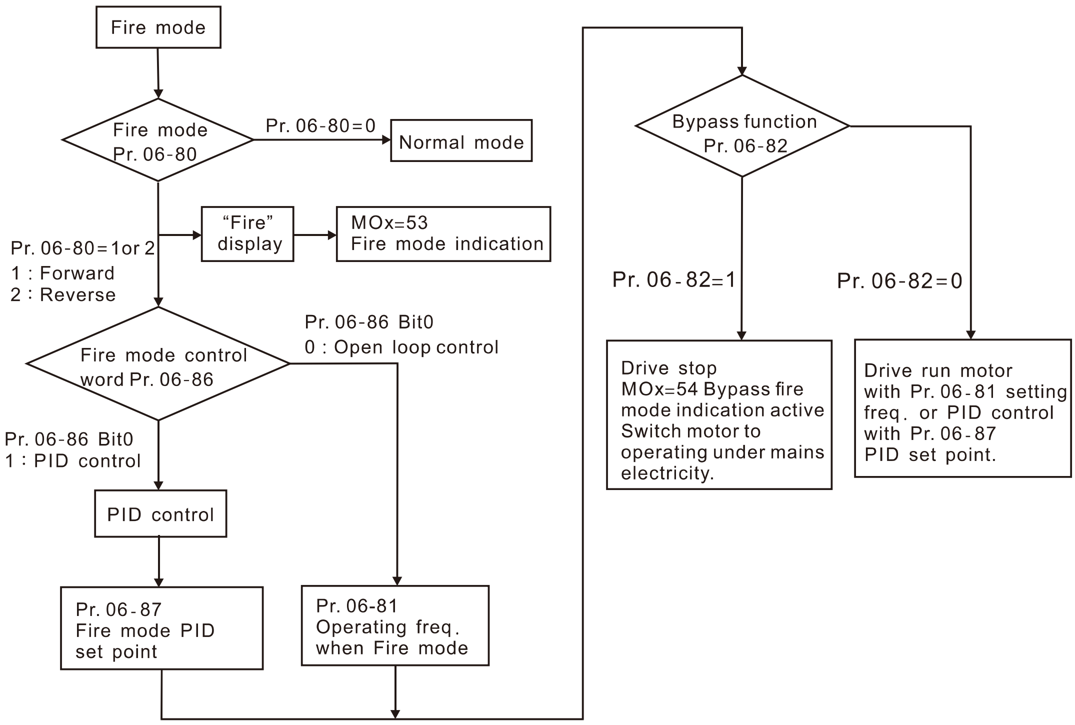
06-87 Fire Mode PID Set Point

Default: 0.00

Settings 0.00–100.00%

- Use Pr.06-87 as the Fire mode PID set point when setting the Pr.06-86 bit0=1.

Below diagram shows the sequence of fire mode operation. The operation mode will accord to the Pr.06-86 bit0 setting (bit0: 0=Open Loop; 1=Close Loop (PID control)).



The Fire mode operating procedure:

Pr.06-86 bit0=0: When setting Pr.06-80=1 or 2, and the multi-functional input terminals MIx=58 is ON, the drive enables the fire mode operation. The drive accelerates to the setting frequency for Pr.06-81, and the keypad KPC-CC01 displays a "Fire" warning. The drive outputs a RUN command for the fire mode when the multi-function output terminal MOx is set to 53. If you set Pr.06-82=1 to enable the Bypass function and the condition is established, the MOx=54 Bypass fire mode indicates action and switches the motor power to the mains power, then the drive stops.

Pr.06-86 bit0=1: When setting the Pr.06-80=1 or 2, and the multi-functional input terminals MIx=58 is ON, the drive enables the fire mode operation. The drive runs PID control with Pr.06-87 as PID set point, and the keypad KPC-CC01 displays a "Fire" warning. The drive outputs a RUN command for

the fire mode when the multi-function output terminal MOx is set to 53. If you set Pr.06-82=1 to enable the Bypass function and the condition is established, the MOx=54 Bypass fire mode indicates action and switches the motor power to the mains power, then the drive stops.
If an error occurs to the PID feedback signal, the drive switches to the open-loop control and runs according to the setting frequency for Pr.06-81.

Bypass function operating sequence:
Conditions are required to enable the Bypass function. When Pr.06-82 is set to 1, there is one of two conditions:

(1) When operating in fire mode, there is an error (as shown in the table below) and the fire alarm rings according to the time setting for Pr.06-83, and then the bypass function is enabled. MFO bypass indication is ON.
(2) When operating in fire mode, if there is an error on auto-reset and the number of times to auto-reset remains zero or the fire alarm rings according to the time setting for Pr.06-83, then the bypass function is enabled. MFO bypass indication is ON. If the auto-reset is successful before the bypass function is enabled, the bypass delay counter returns to zero to wait for next trigger.

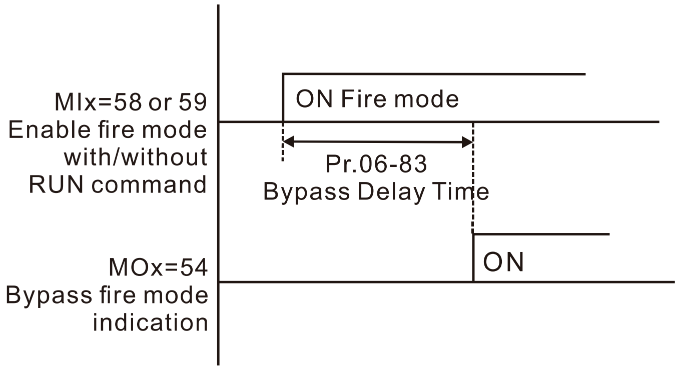


Table 1: Error detection under Normal mode, Fire mode and Bypass function in Fire mode. (V means detectable)

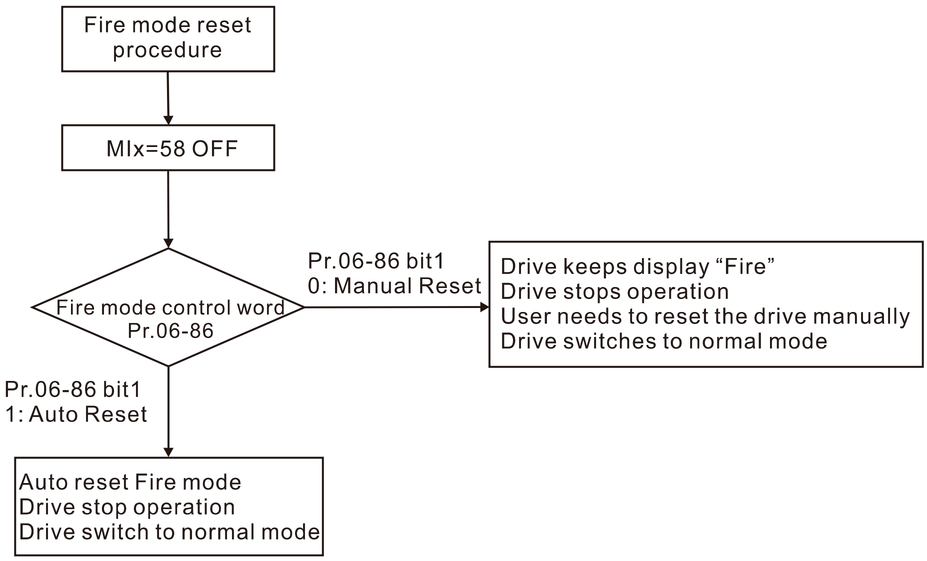
Code	Error name	Normal mode	Fire Mode	Enable bypass function
1	Over-current during acceleration (ocA)	V(RS)	V(able to auto-reset)	V
2	Over-current during deceleration (ocd)	V(RS)	V(able to auto-reset)	V
3	Over-current during constant speed (ocn)	V(RS)	V(able to auto-reset)	V
4	Ground Fault (GFF)	V	V(able to auto-reset)	V
5	IGBT short circuit (occ)	V(RS)	V(able to auto-reset)	V
6	Over-current during stop (ocS)	V(RS)	V(able to auto-reset)	V
7	Over-voltage during acceleration (ovA)	V(RS)	V(able to auto-reset)	V
8	Over-voltage during deceleration (ovd)	V(RS)	V(able to auto-reset)	V
9	Over-voltage during constant speed (ovn)	V(RS)	V(able to auto-reset)	V
10	Over-voltage during stop (ovS)	V(RS)	V(able to auto-reset)	V
11	Low-voltage during acceleration (LvA)	V	Not-detectable	Not-detectable
12	Low-voltage during deceleration (Lvd)	V	Not-detectable	Not-detectable
13	Low-voltage during constant speed (Lvn)	V	Not-detectable	Not-detectable
14	Low-voltage during Stop (LvS)	V	Not-detectable	Not-detectable
15	Input phase loss (OrP)	V	V(able to auto-reset)	V
16	Over-heat 1 (oH1)	V	V(able to auto-reset)	V
17	Over-heat 2 (oH2)	V	V(able to auto-reset)	V
18	Thermistor 1 open (tH1o)	V	V(able to auto-reset)	V
19	Thermistor 2 open (tH2o)	V	V(able to auto-reset)	V

Code	Error name	Normal mode	Fire Mode	Enable bypass function
21	Over-load (oL) (150% 1Min, Inverter)	V	Not-detectable	Not-detectable
22	Motor 1 over load (EoL1)	V	Not-detectable	Not-detectable
23	Motor 2 over load (EoL2)	V	Not-detectable	Not-detectable
24	Over heat 3 (oH3)	V	V(able to auto-reset)	V
26	Over torque 1 (ot1)	V	Not-detectable	Not-detectable
27	Over torque 2 (ot2)	V	Not-detectable	Not-detectable
28	Low current (uC)	V	Not-detectable	Not-detectable
30	EEPROM write error (cF1)	V	Not-detectable	Not-detectable
31	EEPROM read error (cF2)	V	V	Not-detectable
33	U phase current sensor detection error (cd1)	V	V	Not-detectable
34	V phase current sensor detection error (cd2)	V	V	Not-detectable
35	W phase current sensor detection error (cd3)	V	V	Not-detectable
36	Clamp current detection error (Hd0)	V	V	Not-detectable
37	Over-current detection error (Hd1)	V	V	Not-detectable
38	Over-voltage detection error (Hd2)	V	V	Not-detectable
39	IGBT short-circuit detection error (Hd3)	V	V	Not-detectable
40	Auto-tuning error (AUE)	V	Not-detectable	Not-detectable
41	PID feedback loss (AFE)	V	Not-detectable	Not-detectable
48	Analog current input loss (ACE)	V	Not-detectable	Not-detectable
49	External fault (EF)	V	Not-detectable	Not-detectable
50	Emergency stop (EF1)	V	Not-detectable	Not-detectable
51	External base block (bb)	V	Not-detectable	Not-detectable
52	Password error (Pcod)	V	Not-detectable	Not-detectable
53	Firmware version error	V	V	Not-detectable
54	Communication error 1 (CE1)	V	Not-detectable	Not-detectable
55	Communication error 2 (CE2)	V	Not-detectable	Not-detectable
56	Communication error 3 (CE3)	V	Not-detectable	Not-detectable
57	Communication error 4 (CE4)	V	Not-detectable	Not-detectable
58	Communication time-out (CE10)	V	Not-detectable	Not-detectable
60	Braking transistor error (bF)	V	Not-detectable	Not-detectable
61	Y-Delta connected Error (ydc)	V	Not-detectable	Not-detectable
62	Deceleration Energy Backup error (dEb)	V	Not-detectable	Not-detectable
63	Slip error (oSL)	V	Not-detectable	Not-detectable
64	Electromagnet switch error (ryF)	V	Not-detectable	Not-detectable
71	Watchdog	Not detectable	Not-detectable	Not-detectable
72	Channel 1 (STO1–SCM1) safety loop error (STL1)	V	V	Not-detectable
73	External safety gate S1	V	V	Not-detectable
74	Fire Mode output (Fire)	V	V(keeps on operating)	V(keeps on operating)
76	Safety Torque Off (STO)	V	V	Not-detectable
77	Channel 2 (STO2–SCM2) internal hardware error (STL2)	V	V	Not-detectable
78	Channel 1 and Channel 2 internal hardware error (STL3)	V	V	Not-detectable
79	Uoc (U-phase output short-circuit)	V	Not-detectable	Not-detectable
80	Voc (V-phase output short-circuit)	V	Not-detectable	Not-detectable
81	Woc (W-phase output short-circuit)	V	Not-detectable	Not-detectable
82	U-phase output phase loss (OPHL)	V	V(able to auto-reset)	V
83	V-phase output phase loss (OPHL)	V	V(able to auto-reset)	V

Code	Error name	Normal mode	Fire Mode	Enable bypass function
84	W-phase output phase loss (OPHL)	V	V(able to auto-reset)	V
89	RoPd initial rotor position detection error	V	V	V
90	Inner PLC function is forced to stop (FStp)	V	Not-detectable	Not-detectable
93	CPU error	Not detectable	Not-detectable	Not-detectable
99	CPU Trap error (TRAP)	V	V	Not-detectable
101	CANopen software disconnect 1 (CGdE)	V	Not-detectable	Not-detectable
102	CANopen software disconnect 2 (ChbE)	V	Not-detectable	Not-detectable
103	CANopen synchronous error (CSYE)	V	Not-detectable	Not-detectable
104	CANopen hardware disconnect (CbFE)	V	Not-detectable	Not-detectable
105	CANopen index setting error (CidE)	V	Not-detectable	Not-detectable
106	CANopen slave station number setting error (CAdE)	V	Not-detectable	Not-detectable
107	CANopen index setting exceed limit (CfrE)	V	Not-detectable	Not-detectable
111	InrCOM Internal communication overtime error	V	Not-detectable	Not-detectable
142	Auto-tuning error 1 (no feedback current error) (AUE1)	Not detectable	Not-detectable	Not-detectable
143	Auto-tuning error 2 (motor phase loss error) (AUE2)	Not detectable	Not-detectable	Not-detectable
144	Auto-tuning error 3 (no-load current I_0 measuring error) (AUE3)	Not detectable	Not-detectable	Not-detectable
148	Auto-tuning error 4 (leakage inductance Lsigma measuring error) (AUE4)	Not detectable	Not-detectable	Not-detectable

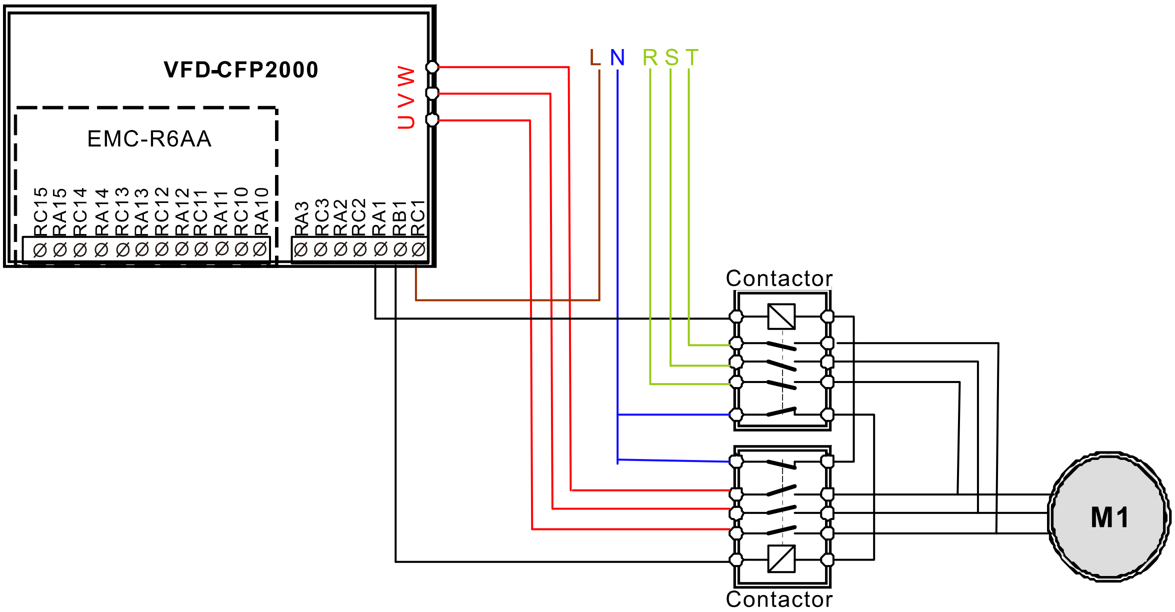
The Fire mode reset procedure:

When the terminal MIx=58 changes from ON to OFF, the drive starts to run “fire mode reset procedure”, and determines whether to “Manual reset” or “Auto reset” fire mode according to the selection of Pr.06-86 bit1.



Wiring Diagram:

1. When AC power is ON, RB1 and RC1 are ON, and RA1 and RC1 are OFF.
2. When operating in fire mode and bypass indication function is disabled, RB1 and RC1 are ON, and the motor is driven by the drive.
3. When operating in fire mode and bypass indication function is enabled, RA1 and RC1 are ON, and the motor runs under mains electricity.



- When in fire mode, the running direction of the drive is based on Pr.06-08=1 (FWD) or Pr.06-80=2 (REV). Other running direction commands are invalid and Pr.00-23 Motor Operating Direction is not available when in fire mode.
- When in fire mode, all keypad command are ignored, including RUN, STOP, JOG and direction commands.
- When in fire mode, all RS-485 communication commands are ignored, including RUN, STOP, JOG and direction commands.
- When in fire mode, B.B. and EF are not activated, including external terminal B.B, communication B.B, external terminal EF, communication EF and external terminal EF1). Any activated B.B. is automatically invalid, including external terminal B.B. and communication B.B., and the drive executes speed tracking.
- When in fire mode, activated EF and EF1 are automatically invalid, including external terminals EF & EF1 and communication EF).
- When in fire mode, the JOG command is not available (JOG command source: keypad, external terminals and communications). Any operating JOG command is automatically invalid.
- When in fire mode, the Acceleration / Deceleration Speed Inhibit function is not available. Any activated acceleration / deceleration speed inhibition is automatically invalid.
- When in fire mode, If you set Pr.06-86 to bit0=0 (open-loop control), the drive does not execute parameter group 08 PID function. Any operating PID function is automatically invalid.
- When in fire mode, the Hand-Off-Auto function is not available, including multi-function output terminals.
- When in fire mode, the drive does not execute the circulative control function, and all circulating control function parameters are cleared. The circulative control function is automatically invalid when in fire mode.
- When in fire mode, the drive does not execute the sleep function.
- When in fire mode, the drive does not execute the DC brake function. Any operating DC brake is automatically invalid when in fire mode.

- When in fire mode, the drive does not execute over-current stall prevention function. Any operating over-current stall prevention is automatically invalid when in fire mode.
- When in fire mode, over-torque detection function is not available.
- When in fire mode, oL1/oL2 detection function is not available.
- When in fire mode, abnormal communication (CE10, CE1, CE2, CE3 and CE4) detection is not available.
- The cd1, cd2, cd3 and Hd0, Hd1, Hd2, Hd3 are boot check and cannot be cleared. The above errors cannot be cleared when in fire mode. The drive does not operate when in fire mode.
- Lv protection is not activated when in fire mode, so the drive keeps running or runs until the power is lost. If the Lv error occurs before the fire mode warning, clear the Lv error to operate the drive.
- If bypass fire mode indication (MOx=54) is activated, reboot the drive and deactivate the fire mode to turn off this terminal output.
- When in fire mode, the output stop function is not available.
- When in fire mode, the skip frequency function is not available.
- When in fire mode, the operating frequency for Pr.06-81 cannot be larger than Pr.01-00 Maximum Output Frequency. If Pr.06-81 > Pr.01-00, the maximum frequency is automatically set to Pr.01-00.

07 Special Parameters

⚡ This parameter can be set during operation.

⚡ 07-00 Software Brake Level

Default: 740.0

Settings 700.0–900.0 V_{DC}

- Sets the brake transistor level for the DC bus voltage. Choose a suitable brake resistor to achieve the best deceleration. Refer to Section 7 Optional Accessories for information about brake resistors.
- This parameter is only valid for the models below 30 kW of 460V series.

⚡ 07-01 DC Brake Current Level

Default: 0

Settings 0–100%

- Sets the level of the DC brake current output to the motor during start-up and stop. When you set the DC brake current percentage, the rated current is regarded as 100%. Start with a low DC brake current level, and increase it slowly until the proper brake torque is reached. However, to avoid burning the motor, the DC brake current can NOT exceed the rated current. Do NOT use the DC brake for mechanical retention, otherwise, injury or accident may occur.
- The PM has the magnetic field itself, using the DC brake may possibly cause the motor run in a reverse direction, therefore, it is not recommended to use DC brake for PM.

⚡ 07-02 DC Brake Time at RUN

Default: 0.0

Settings 0.0–60.0 sec.

- The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. If you use the drive with the motor rotating, it may cause motor damage or trigger drive protection due to over-current. This parameter outputs DC current, generating torque to force the motor to stop to get a stable start before more operation. This parameter determines the duration of the DC brake current output to the motor when the drive start up. Setting this parameter to 0.0 disables the DC brake at start-up.
- The PM has the magnetic field itself, using the DC brake may possibly cause the motor run in a reverse direction, therefore, it is not recommended to use DC brake for PM. Use Pr.10-49 zero voltage command to force the motor decelerate or to stop.

⚡ 07-03 DC Brake Time at STOP

Default: 0.0

Settings 0.0–60.0 sec.

- The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. This parameter outputs DC current, generating torque to force the drive stop after the drive stops output to make sure that the motor stops.
- This parameter determines the duration of the DC brake current output to the motor when braking. To enable DC brake at STOP, set Pr.00-22 (Stop Method) to 0 (ramp to stop). The DC

brake is invalid when Pr.07-03 is set to 0.0.

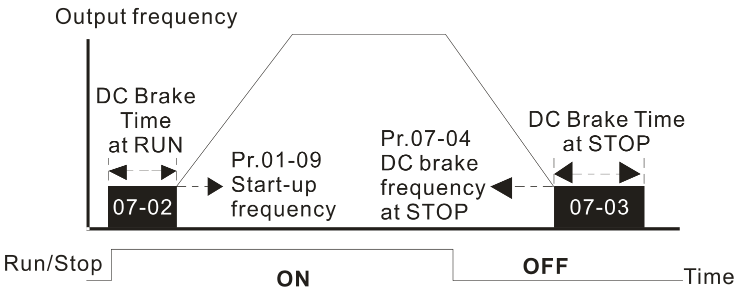
Related parameters: Pr.00-22 Stop Method, Pr.07-04 DC Brake Frequency at STOP.

07-04 DC Brake Frequency at STOP

Default: 0.00

Settings 0.00–599.00 Hz

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



DC Brake Time

- Use the DC brake before running the motor when the load is movable at stop, such as with fans and pumps. The motor is in free operating status and in unknown rotation direction before the drive start up. Execute the DC brake before you start the motor.
- Use DC brake at STOP when you need to brake the motor quickly or to control the positioning, such as with cranes or cutting machines.

07-05 Voltage Increasing Gain

Default: 100

Settings 1–200%

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

07-06 Restart after Momentary Power Loss

Default: 0

Settings 0: Stop operation

1: Speed tracking by speed before the power loss

2: Speed tracking by minimum output frequency

- Determines the operation mode when the drive restarts from a momentary power loss.
- The power system connected to the drive may power off momentarily due to many reasons. This function allows the drive to keep outputting after the power is repowered and does not cause the drive to stop.
- Setting 1: Frequency tracking begins before momentary power loss and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is a lot of inertia with little resistance on the motor load. For example, in equipment with a large inertia flywheel, there is NO need to wait until the flywheel stops completely after a restart to execute the operation command; therefore, it saves time.

- Setting 2: Frequency tracking starts from the minimum output frequency and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is little inertia and large resistance.
- This function is only valid when the RUN command is enabled.

07-07 Allowed Power Loss Duration

Default: 2.0

Settings 0.0–20.0 sec.

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

07-08 Base Block Time

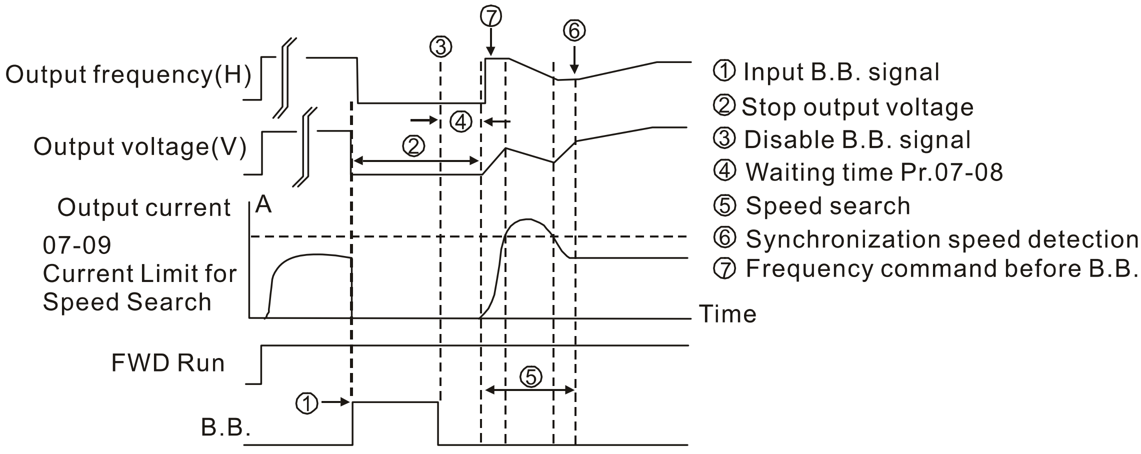
Default: Depending on the model power

Settings 0.0–5.0 sec. (Depending on the model power)

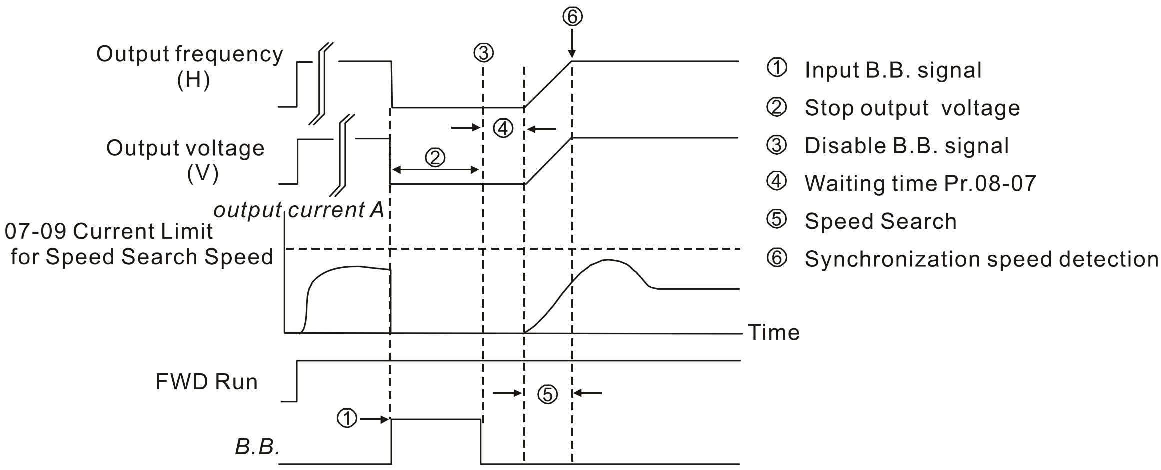
- When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by Pr.07-08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual regeneration voltage at the output side to decrease to 0V before activating the drive again.
- This parameter is not only for the B.B. time, but also is the re-start delay time after free run.
- The RUN command during a free run operation is memorized, and runs or stops with the last frequency command after the delay time.
- This delay time is only applicable in “Re-start after coast to stop” status, and does not limit ramp to stop. The coast to stop can be caused by various control command source, or by errors.
- Following table is the recommended setting for re-start delay time of each model power. You must set Pr. 07-08 according to this table (the default of each model power is based on this table as well).

kW	007	015	022	037	040	055	075	110	150
HP	1	2	3	5	5.5	7.5	10	15	20
Delay time (sec.)	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1

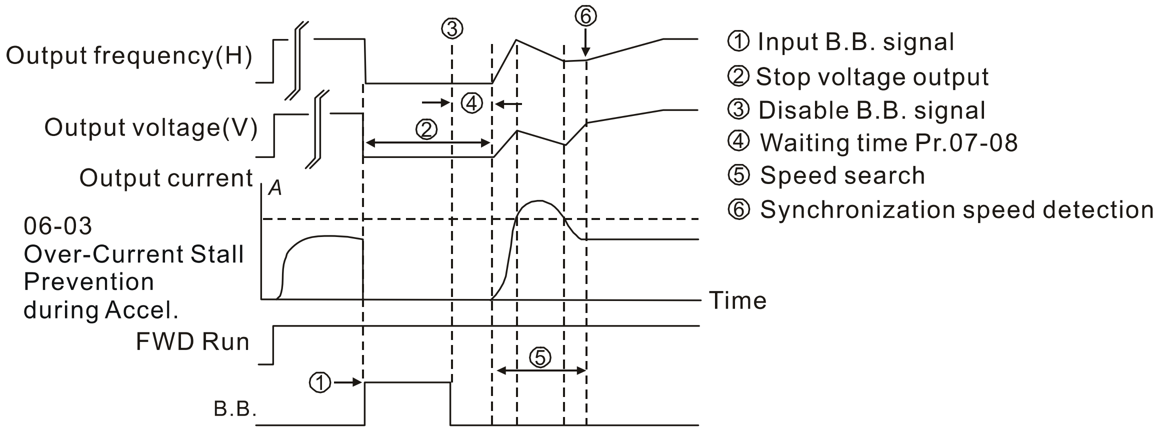
kW	185	220	300	370	450	550	750	900
HP	25	30	40	50	60	75	100	125
Delay time (sec.)	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8



B.B. Search with last output frequency downward timing chart



B.B. Search with minimum output frequency upward timing chart



B.B. Search with minimum output frequency upward timing chart

07-09 Current Limit for Speed Search

Default: 100

Settings 20–200% (100% corresponds to the light-load rated current of the drive)

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

07-10 Restart after Fault Action

Default: 0

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

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

07-11 Number of Times of Restart after Fault

Default: 0

Settings 0–10

- After fault (oc, ov, and occ) occurs, the AC motor drive can reset and restart automatically up to 10 times. When Pr.07-11 is set to 0, the auto-reset / restart function is disabled after fault. The drive re-starts according to the setting for Pr. 07-10.
- If the number of faults exceeds the Pr.07-11 setting, the drive does not restart and reset until you press "RESET" manually and execute the operation command again.

07-12 Speed Tracking during Start-up

Default: 0

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

- Speed tracking is suitable for punch, fans and other large inertia loads. For example, a mechanical punch usually has a large inertia flywheel, and the general stop method is coast to stop. If it needs to be restarted again, the flywheel may take 2–5 minutes or longer to stop. This parameter setting allows you to start the flywheel operating again without waiting until the flywheel stops completely.
- When using PM, Pr.07-12≠0, the speed tracking function is enabled. When Pr.07-12 = 1, 2 or 3, the output frequency converts to the actual rotor speed from zero-speed.

07-13 dEb Function Selection

Default: 0

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

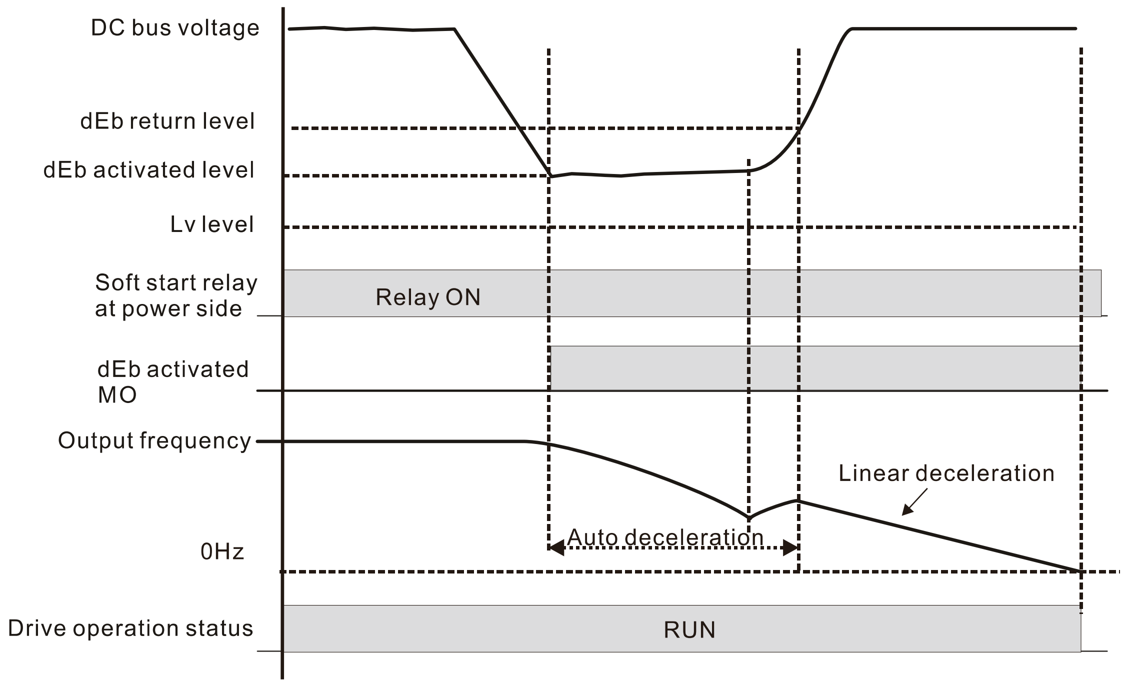
- dEb (Deceleration Energy Backup) lets the motor decelerates to stop when momentary power loss occurs. When the power loss is instantaneous, use this function to let the motor decelerate to zero speed. If the power recovers at this time, the drive restarts the motor after the dEb return time.
- Lv return level: Default value depends on the drive power model

  Frame A, B, C, D = Pr.06-00 + 60V

- Lv level: Default = Pr.06-00
- During dEb operation, other protection such as ryF, ov, oc, occ and EF may interrupt it, and these error codes are recorded.
- The STOP (RESET) command does not work during the dEb auto-deceleration, and the drive continues decelerating to stop. To make the drive coast to stop immediately, use another function (EF) instead.
- The B.B. function does not work when executing dEb. The B.B. function is enabled after the dEb function finishes.
- Even though the Lv warning does not display during dEb operation, if the DC bus voltage is lower than the Lv level, MOx = 10 (Low voltage warning) still operates.
- The following explains the dEb action:
  When the DC voltage drops below the dEb setting level, the dEb function start to work (soft start relay remains closed) and the drive executes auto-deceleration.

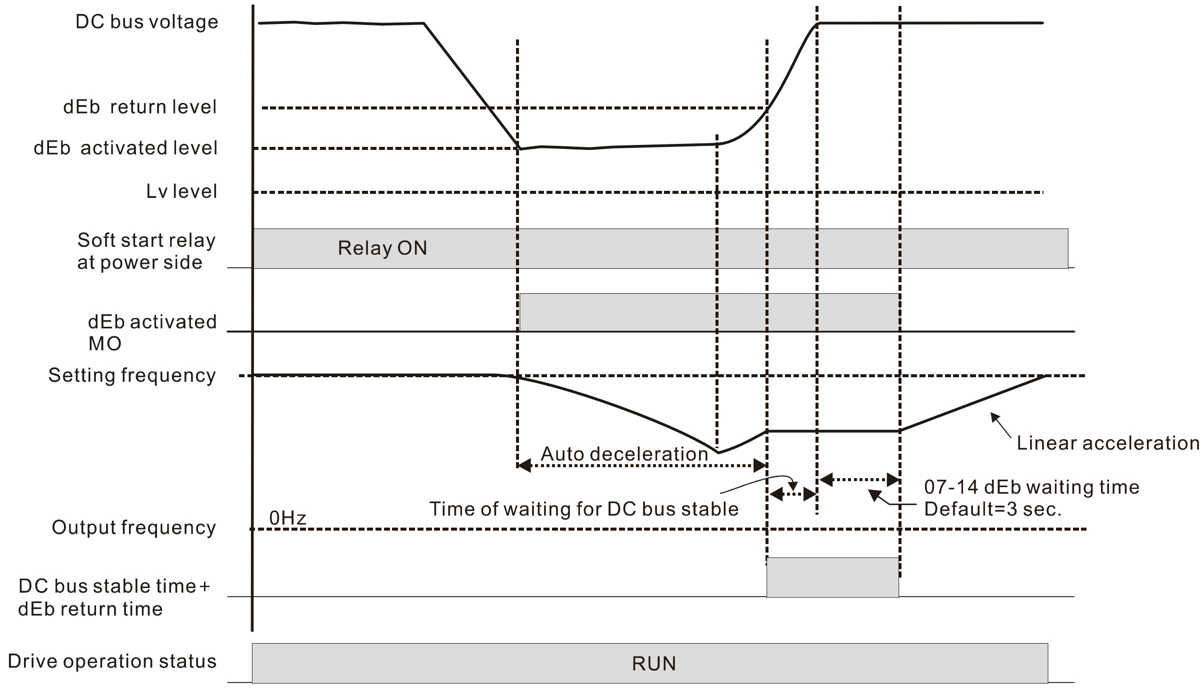
- Situation 1: Momentary power-loss, or power current too low and unstable, or power supply sliding down because of sudden heavy load.

  Pr.07-13=1, "dEb active, DC bus voltage returns, output frequency does not return" and power recovers. When the power recovers and DC bus voltage exceeds the dEb return level, the drive linearly decelerates to 0 Hz and stops. The keypad displays the "dEb" warning until you manually reset it, so that you can see the reason for the stop.



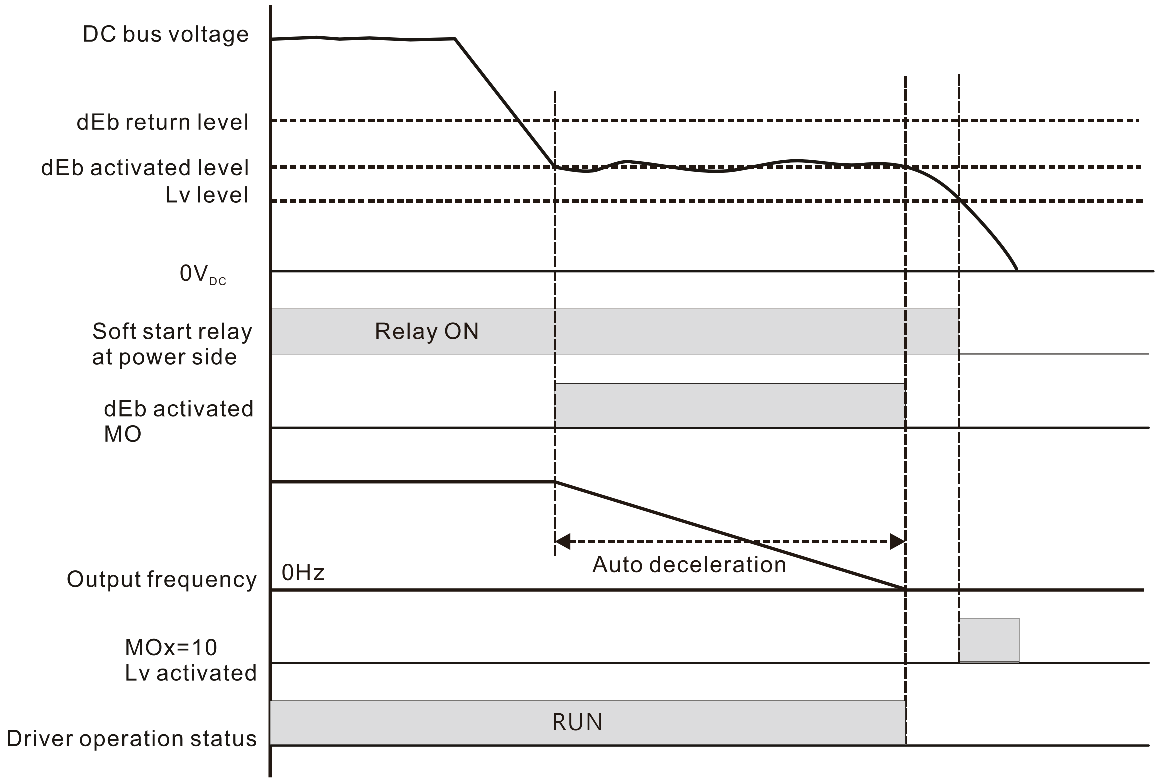
- Situation 2: Momentary power loss or power current too low and unstable, or power supply sliding down because of sudden heavy load.

  Pr.07-13=2 "dEb active, DC bus voltage returns, output frequency returns" and power recovers. During the dEb deceleration time (includes 0 Hz run), if the power recovers higher than dEb return level, the drive maintains the frequency for the set time of Pr.07-14 (default = 3 sec.) and then accelerates again. The dEb warning on the keypad clears automatically.



- Situation 3: Power supply unexpected shut down or power loss

  Pr.07-13=1 ”dEb active, DC bus voltage returns, the output frequency does not return” and the power does not recover. The keypad displays the “dEb” warning and stops after decelerating to the lowest running frequency. When the DC bus voltage is lower than the Lv level, the drive disconnects the soft start relay until the power completely runs out.



- Situation 4:

  Pr.07-13=2 “dEb active, DC bus voltage returns, the output frequency returns” and power does not recover. The drive decelerates to 0 Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level and the drive disconnects the soft-start relay. The keypad displays “dEb” warning until the drive completely runs out of power.

- Situation 5:

  Pr.07-13=2 "dEb low voltage control, when the speed is lower than 1/4 rated motor speed, DC bus voltage rises to 350 V_{DC} / 700 V_{DC}, the drive ramps to stop . The drive decelerates to 0 Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft-start relay. The soft start relay closes again after the power recovers and the DC bus voltage is higher than the Lv return level. When the DC bus voltage is higher than the dEb return level, the drive maintains the frequency for the set time of Pr.07-14 (default = 3 sec.) and starts to do accelerate linearly, and the dEb warning on the keypad cleared automatically.

- Situation 6: Pr. 07-13=4, dEb high-voltage control

  When dEb occurs, the DC bus voltage control level rises to 350 V_{DC} / 700 V_{DC} to ramp to stop. Even though the power recovers and the frequency does not return, dEb activates until the motor decelerates to 0 Hz.

  (1) When dEb activates, it sends dEb warning. When the output frequency reaches 0 Hz, the operation status is STOP and disables the dEb function, the dEb warning continues.

  (2) If power does not recover, the DC bus voltage drops until reaches the Lv level, the drive LvS error occurs (keypad displays LvS error that covers the dEb display), the Soft Start Relay will be OFF.

07-15 Dwell Time at Acceleration

Default: 0.00

Settings 0.00–600.00 sec.

07-16 Dwell Frequency at Acceleration

Default: 0.00

Settings 0.00–599.00 Hz

07-17 Dwell Time at Deceleration

Default: 0.00

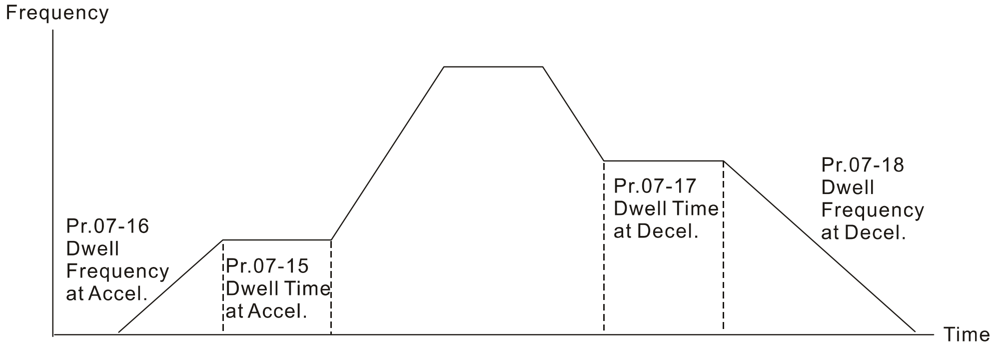
Settings 0.00–600.00 sec.

07-18 Dwell Frequency at Deceleration

Default: 0.00

Settings 0.00–599.00 Hz

- In the heavy load situation, Dwell can make stable output frequency temporarily.
- When the load is heavier, use Pr.07-15–Pr.07-18 to avoid ov or oc protection.



Dwell at acceleration / deceleration

07-19 Fan Cooling Control

Default: 0

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

- Use this parameter to control the fan.
- 0: Fan runs immediately when the drive power is turned ON.
- 1: Fan runs when AC motor drive runs. One minute after AC motor drives stops, the fan is OFF.
- 2: Fan runs when AC motor drive runs and stops immediately when AC motor drive stops.
- 3: Fan is ON when IGBT or CAP temperature > 60°C
  Fan is OFF when IGBT or CAP temperature < 40°C
- Setting 4: Fan is always OFF
- The control parameter for the applicable fan of each frame are as below:

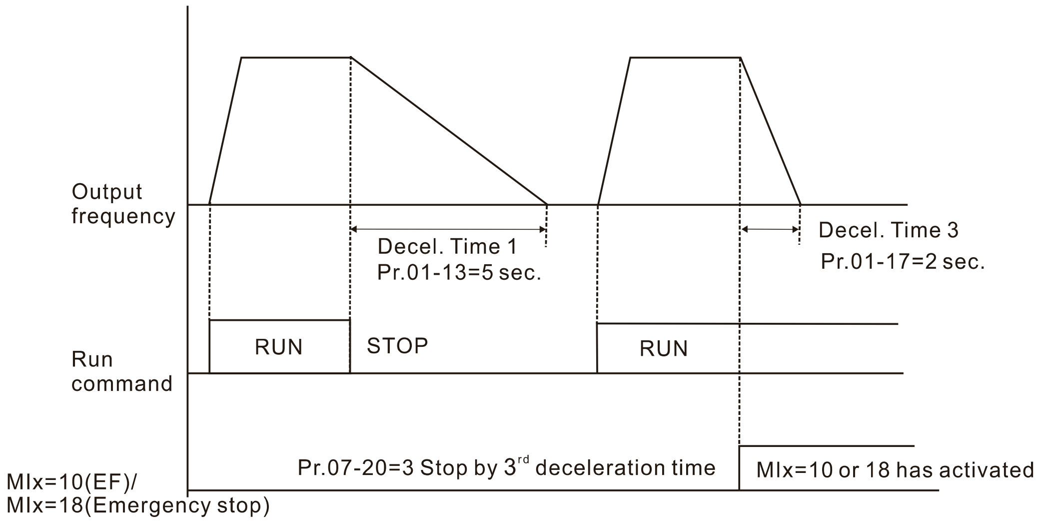
Frame	Heat Sink Fan	Capacitor Fan
A	Pr.07-19	No capacitor fan
B	Pr.07-19	Pr.07-19
C	Pr.07-19	Pr.07-19
D0	Pr.07-19	Pr.07-19
D	Pr.07-19	ON

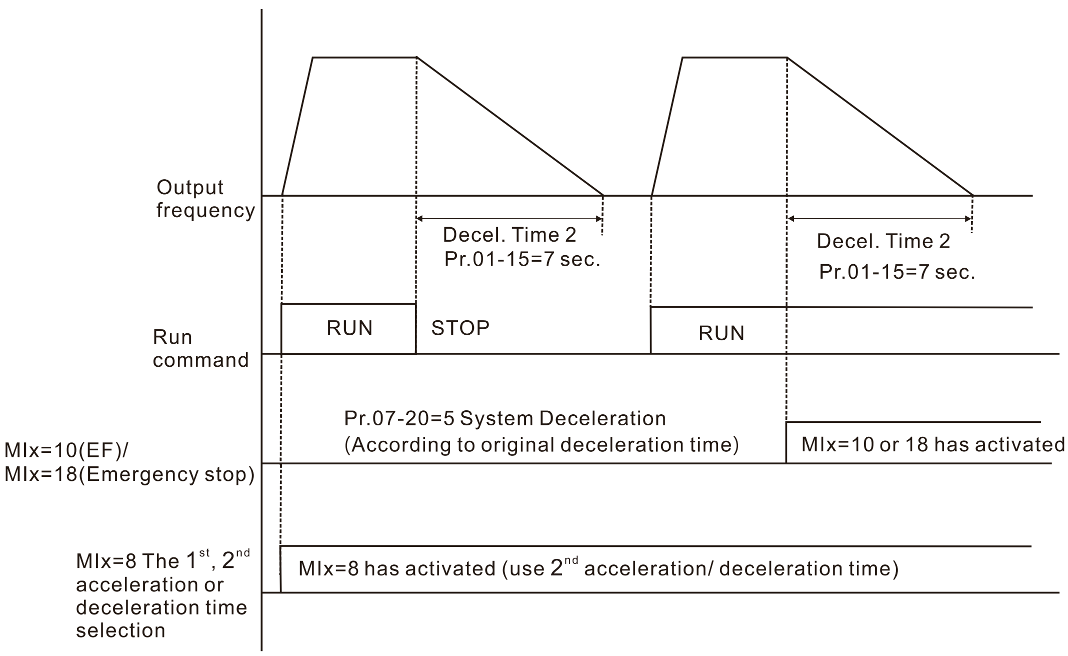
07-20 Emergency Stop (EF) & Force to Stop Selection

Default: 0

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

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





07-21 Automatic Energy-saving Selection

Default: 0

Settings 0: Disable

1: Enable

- When energy-saving is enabled, the motor acceleration and deceleration operate with full voltage. During constant speed operation, it automatically calculates the best voltage value according to the load power. This function is not suitable for fluctuating loads or loads which are nearly full during operation.
- When the output frequency is constant (that is, constant operation), the output voltage decreases automatically as the load decreases. Therefore, the drive operates with minimum multiplication of voltage and current (electric power).
- VF and SVC mode:
  Steady-speed: When output is light load, entry into the energy saving mode after 5 seconds.
  Return: When the drive is continuously adding loads, or in non-steady speed status.

07-22 Energy-saving Gain

Default: 100

Settings 10–1000%

- When Pr.07-21 is set to 1, use this parameter to adjust the energy-saving gain. The default is 100%. If the result is not satisfactory, adjust it by decreasing the setting value. If the motor oscillates, then increase the setting value.
- In certain applications such as high-speed spindles, the temperature rise in the motor is a major concern. When the motor is not in working state, reduce the motor current to a lower level. Reduce this parameter setting to meet this requirement.

07-23 Auto Voltage Regulation (AVR) Function

Default: 0

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

- The rated voltage of the motor is usually 200 V_{AC}–240 V_{AC} (380 V_{AC}–480 V_{AC}), 60Hz/50Hz and the input voltage of the AC motor drive may vary between 170 V_{AC}–264 V_{AC} (323 V_{AC}–528 V_{AC}), 50Hz/60Hz. Therefore, when the AC motor drive is used without AVR function, the output voltage is the same as the input voltage. When the motor runs at the voltage exceeding 12%–20% of the rated voltage, it causes higher temperature, damaged insulation, and unstable torque output, which result in losses due to shorter motor lifetime.
- The AVR function automatically regulates the output voltage of the AC motor drive to the motor rated voltage. For example, if the V/F curve is set at 200 V_{AC} / 50 Hz and the input voltage is at 200 V_{AC} to 264 V_{AC}, then the drive automatically reduces the output voltage to the motor to a maximum of 200 V_{AC} / 50 Hz. If the input voltage is at 170 V_{AC} to 200 V_{AC}, the output voltage to motor and input power are in direct proportion.
- 0: when the AVR function is enabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage does NOT change when the DC bus voltage changes.
- 1: when the AVR function is disabled, the drive calculates the output voltage according to the actual DC bus voltage. The DC bus voltage changes the output voltage, and may cause insufficient or over-current or shock.
- 2: the drive disables the AVR function when decelerating to stop, and may accelerate to brake.
- When the motor ramps to stop, the deceleration time is longer. When setting this parameter to 2 with auto acceleration/deceleration, the deceleration will be quicker.

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

Default: 0.500

Settings 0.001–10.000 sec.

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

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

Default: 0.100

Settings 0.001–10.000 sec.

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

07-26 Torque Compensation Gain (V/F Control Mode)

Default: 0

Settings IM: 0–10 (when Pr.05-33=0)
PM: 0–5000 (when Pr.05-33=1 or 2)

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

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

Default: 0.00
(1.00 in SVC mode)

Settings 0.00–10.00

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

motor rated slip x Pr.07-27 (Slip Compensation Gain) when the motor is at the rated load. If the actual speed ratio is slower than expected, increase the parameter setting value; otherwise, decrease the setting value.

07-29 Slip Deviation Level

Default: 0.0

Settings 0.0–100.0%

0: No detection

07-30 Over Slip Deviation Detection Time

Default:1.0

Settings 0.0–10.0 sec.

07-31 Over Slip Deviation Treatment

Default: 0

Settings 0: Warn and continue operation

1: Fault and ramp to stop

2: Fault and coast to stop

3: No warning

- The Pr.07-29 to Pr.07-31 set the allowable slip level / time and the over-slip treatment when the drive is running.

07-32 Motor Shock Compensation Factor

Default: 1000

Settings 0–10000

0: Disable

- If there are current wave motions in the motor in some specific area, setting this parameter can effectively improve this situation. When it is high frequency, set this parameter to 0. When the current wave motion occurs in low frequency and high-power, increase the value for Pr.07-32.)

07-33 Auto-restart Interval of Fault

Default: 60.0

Settings 0.0–6000.0 sec.

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

07-38 PMSVC Voltage Feedback Forward Gain

Default: 1.00

Settings 0.00–2.00

- Adjusts the PMSVC voltage feedback forward gain, and to meet the demand of rapid feedback application.
- Pr.07-38=1.00 means forward feedback = Ke * motor rotor speed
- Refer to Section 12-2 “PMSVC adjustment” for details.

✓ 07-50 PWM Fan Speed

Default: 60

Settings 60–100%

- For different application and environment, adjust the fan speed to expedite the heat dissipation of the drive.
- Default for 460V series (45 kW, 55 kW, 75 kW, 90 kW and 110 kW) is 80%; default for other series are 60%.
- 460V series: 22kW and above models are controlled by PWM fan speed control, and Pr.07-50 is available.

08 High-function PID Parameters

⚡ This parameter can be set during operation.

⚡ 08-00 Terminal Selection of PID Feedback

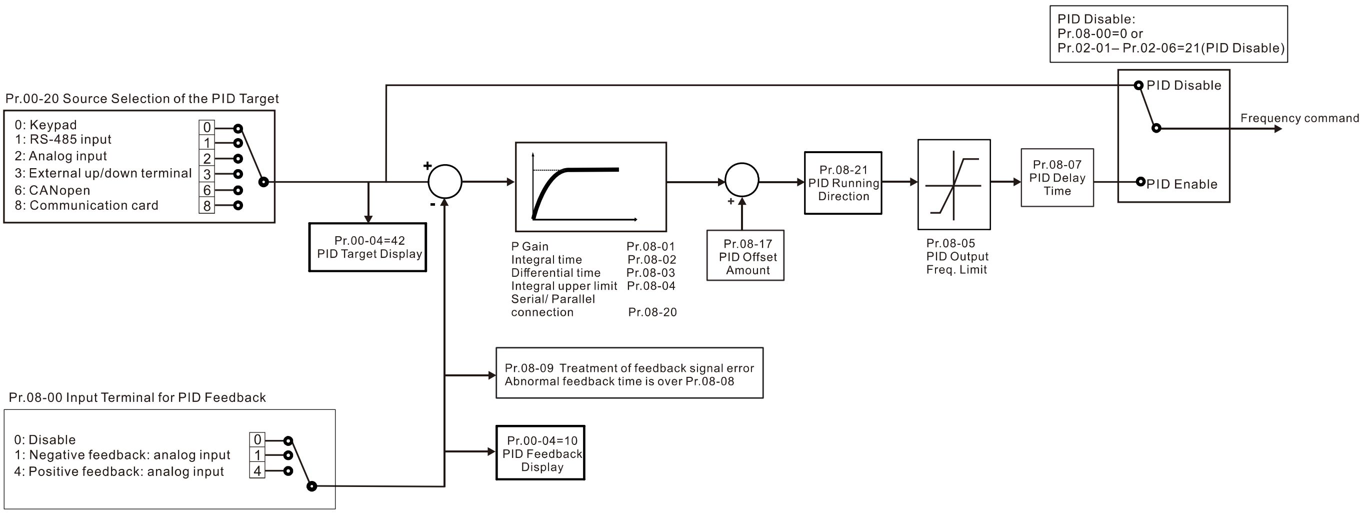
Default: 0

Settings 0: No function

1: Negative PID feedback: by analog input (Pr.03-00–03-02)

4: Positive PID feedback: by analog input (Pr.03-00–03-02)

- Pr.08-00≠0 enables the PID function.
- Negative feedback means:
  +target value – feedback. The detection value increases by increasing the output frequency.
- Positive feedback means:
  -target value + feedback. The detection value decreases by increasing the output frequency.
- When Pr.08-00≠7 neither ≠8, the input value is disabled. The value of the setting does not remain the same after the drive is OFF.
- Related applicable parameters: Pr.00-20, Pr.03-00–03-02
  When enable the PID function (Pr.08-00 ≠ 0), if Pr.00-20 is set to 2 “External analog input”, Pr.03-00–03-02 need to be set to 4 “PID target value” accordingly.



00-20 Master Frequency Command (AUTO) Source / Source Selection of the PID Target

Default: 0

Settings 0: Digital keypad

1: RS-485 serial communication

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

3: External UP/DOWN terminal

6: CANopen communication card

8: Communication card (does not include CANopen card)

03-00 Analog Input Selection (AVI1)

Default: 1

03-01 Analog Input Selection (ACI)

Default: 0

03-02 Analog Input Selection (AVI2)

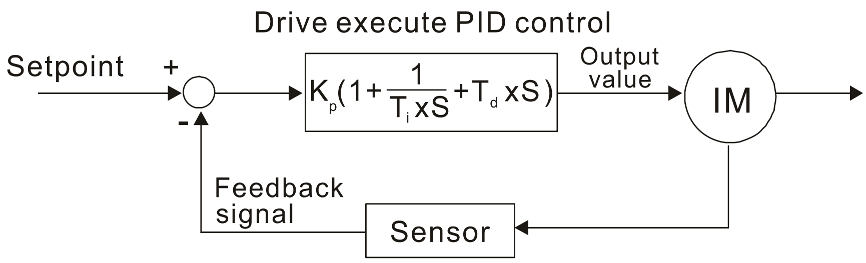
Default: 0

Settings 4: PID target value

Common applications for PID control

1. Flow control: Use a flow sensor to feedback the flow data and perform accurate flow control.
2. Pressure control: Use a pressure sensor to feedback the pressure data and perform precise pressure control.
3. Air volume control: Use an air volume sensor to feedback the air volume data to achieve excellent air volume regulation.
4. Temperature control: Use a thermocouple or thermistor to feedback temperature data for comfortable temperature control.
5. Speed control: Use a speed sensor or encoder to feedback motor shaft speed or input another machine speed as a target value for closed loop speed control of the master-slave operation. Pr.10-00 sets the PID set point source (target value).

PID control loop:



K_p: Proportional gain (P) T_i: Integral time (I) T_d: Derivative control (D) S: Operator

Concept of PID control

- Proportional gain (P):

  The output is proportional to input. With only proportional gain control, there is always a steady-state error.

  Adjustment: Turn off the Ti and Td, or remain Ti and Td in constant value, then adjust the proportional gain (P).

  Increase: Faster status feedback, but excessive adjustment will increase the overshoot.

  Decrease: Smaller overshoot, but excessive adjustment will slow down the transient response.

- Integral time(I):

  The controller output is proportional to the integral of the controller input. To eliminate the steady-state error, add an “integral part” to the controller. The integral time controls the relation between integral part and the error. The integral part increases over time even if the error is small. It gradually increases the controller output to eliminate the error until it is zero. This stabilizes the system without a steady-state error by using proportional gain control and integral time control.

Adjustment: The integral time (I) accumulates from the time difference, if the vibration cycle is longer than the setting for integral time, the integration enhances. Increase the integral time (I) to reduce the vibration.

Increase: Reduce the overshoot, excessive adjustment causes worse transient response.

Decrease: Faster transient response, but the transient time will be longer, and takes more time to achieve the steady state. Excessive adjustment causes larger overshoot.

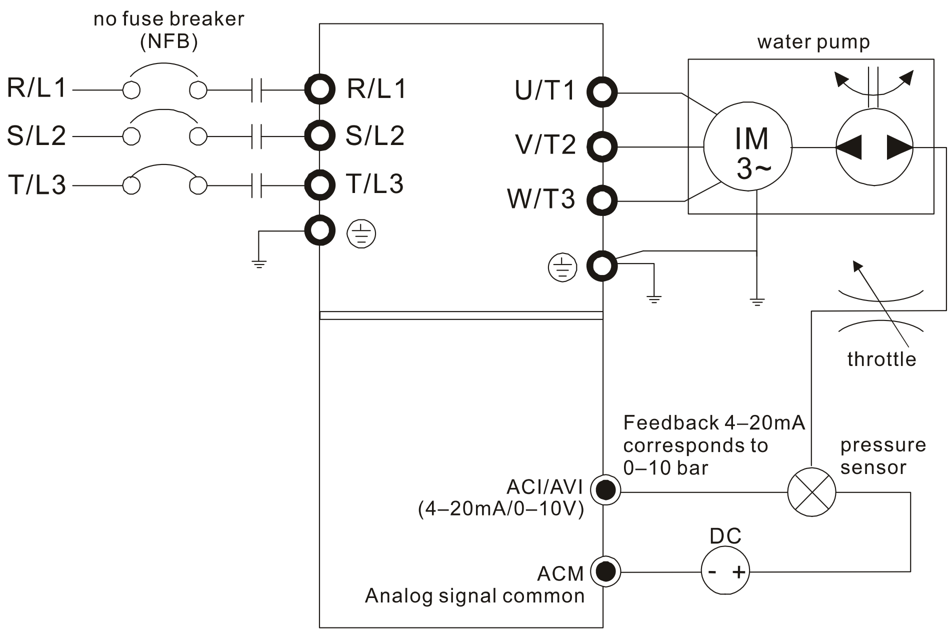
📖 Differential control (D):

The controller output is proportional to the differential of the controller input. During elimination of the error, oscillation or instability may occur. Use the differential control to suppress these effects by acting before the error. That is, when the error is near zero, the differential control should be zero. Use proportional gain (P) and differential control (D) to improve the system state during PID adjustment.

Adjustment: When the vibration cycle is shorter and continuous, it means that the differential time setting is too large, and causes excessive output. Decrease the setting of D gain to reduce the vibration. If the D gain is set to 0, adjust the PID control again.

Using PID control in a constant pressure pump feedback application:

Set the application's constant pressure value (bar) to be the set point of PID control. The pressure sensor sends the actual value as the PID feedback value. After comparing the PID set point and PID feedback, an error displays. The PID controller calculates the output by using proportional gain (P), integral time (I) and differential time (D) to control the pump. It controls the drive to use a different pump speed and achieves constant pressure control by using a 4–20 mA signal corresponding to 0–10 bar as feedback to the drive.



- Pr.00-04=10 (Display PID feedback (b) (%))
- Pr.01-12 Acceleration Time is set according to actual conditions.
- Pr.01-13 Deceleration Time is set according to actual conditions.
- Pr.00-21=0 to operate through the digital keypad
- Pr.00-20=0, the digital keypad controls the set point.
- Pr.08-00=1 (Negative PID feedback from analog input)
- ACI analog input Pr.03-01=5, PID feedback signal.
- Pr.08-01–08-03 is set according to actual conditions:
  If there is no vibration in the system, increase Pr.08-01 (Proportional Gain (P))
  If there is no vibration in the system, reduce Pr.08-02 (Integral Time (I))
  If there is no vibration in the system, increase Pr.08-03 (Differential Time (D))
- Refer to Pr.08-00–08-21 for PID parameter settings.

08-01 Proportional Gain (P)

Default: 1.0

Settings 0.0–100.0%

- When the setting is 1.0, Kp gain is 100%; if the setting is 0.5, Kp gain is 50%.
- Determines the deviation response of Proportional gain (P). Eliminates the system error; usually used to decrease the error and get faster response speed. It also reduces the steady-state error. But if you set the value too high, it may cause system oscillation and instability.
- If you set the other two gains (I and D) to zero, proportional control is the only effective parameter.

08-02 Integral Time (I)

Default: 1.00

Settings 0.00–100.00 sec.
0.00: No integral

- Use the integral controller to eliminate the error during stable system operation. The integral control does not stop working until the error is zero. The integral is affected by the integral time. The smaller the integral time, the stronger integral action. It is helpful to reduce overshoot and oscillation for a stable system. Accordingly, the speed to lower the steady-state error decreases. The integral control is often used with the other two controls for the PI controller or PID controller.
- Sets the integral time of the I controller. When the integral time is long, there is a small I controller gain, with slower response and slow external control. When the integral time is short, there is a large gain of I controller gain, with faster response and rapid external control.
- When the integral time is too short, it may cause system oscillation.
- Set integral time to 0.00 to disable Pr.08-02.

08-03 Differential Time (D)

Default: 0.00

Settings 0.00–1.00 sec.

- Use the differential controller to show the system error change, as well as to preview the change in this error. You can use the differential controller to eliminate the error in order to improve the system state. Using a suitable differential time can reduce overshoot and shorten adjustment time; however, the differential operation increases noise interference. Note that a too large differential causes more noise interference. In addition, the differential shows the change and the output is 0 when there is no change. Note that you cannot use the differential control independently. You must use it with the other two controllers for the PD controller or PID controller.

- Sets the D controller gain to determine the error change response. Using a suitable differential time reduces the P and I controllers overshoot to decrease the oscillation for a stable system. A differential time that is too long may cause system oscillation.
- The differential controller acts on the change in the error and cannot reduce the interference. Do not use this function when there is significant interference.

08-04 Upper limit of Integral Control

Default: 100.0

Settings 0.0–100.0%

- Defines an upper bound for the integral gain (I) and therefore limits the master frequency. The formula is: Integral upper bound = Maximum Output Frequency (Pr.01-00) x Pr.08-04 %.
- An excessive integral value causes a slow response due to sudden load changes and may cause motor stall or machine damage.

08-05 PID Output Command Limit

Default: 100.0

Settings 0.0–110.0%

- Defines the percentage of the output command limit during the PID control. The formula is Output Command Limit = Maximum Output Frequency (Pr.01-00 x Pr.08-05 %).

08-06 PID Feedback Value by Communication Protocol

Default: Read only

Settings -200.00%–200.00%

- Use communication to set the PID feedback value when the PID feedback input is set to communication (Pr.08-00 = 7 or 8).

08-07 PID Delay Time

Default: 0.0

Settings 0.0–35.0 sec.

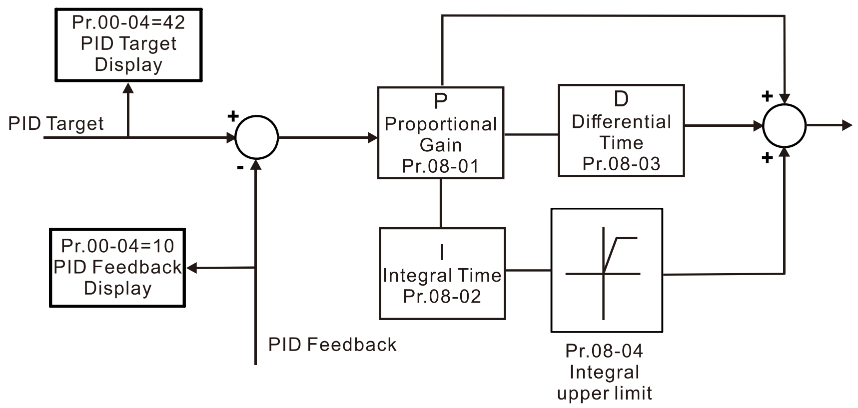
08-20 PID Mode Selection

Default: 0

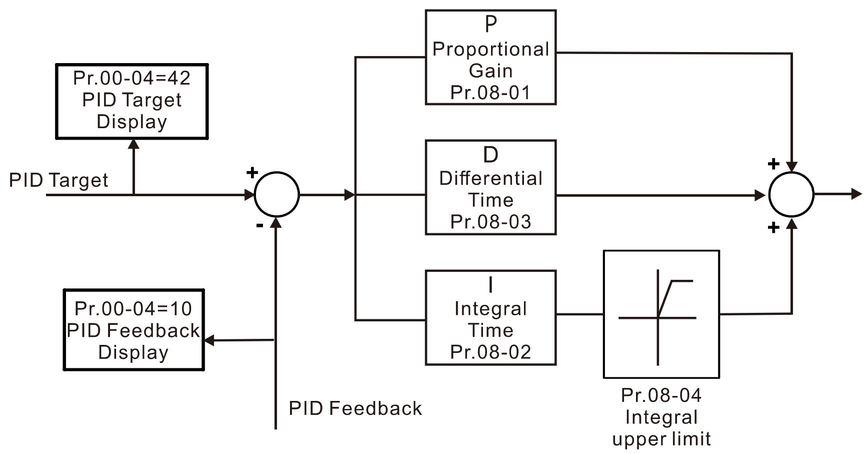
Settings 0: Serial connection
1: Parallel connection

- 0: Serial connection, use conventional PID control structure.
- 1: Parallel connection, the proportional gain, integral gain and derivative gain are independent. You can customize the P, I and D value to fit your application.
- Pr.08-20 determines the primary low pass filter time when in PID control. Setting a large time constant may slow down the drive's response rate.

- PID control output frequency is filtered with a primary low pass function. This function can filter a mix frequency. A long primary low pass time means the filter degree is high and a short primary low pass time means the filter degree is low.
- Inappropriate delay time setting may cause system error.
- PI Control:
  Controlled only by the P action, so the deviation cannot be entirely eliminated. In general, to eliminate residual deviations, use the P + I control. When you use the PI control, it eliminates the deviation caused by the targeted value changes and the constant external interferences. However, if the I action is too powerful, it delays the response when there is rapid variation. You can use the P action by itself to control the loading system with the integral components.
- PD Control:
  When deviation occurs, the system immediately generates an operation load that is greater than the load generated only by the D action to restrain the deviation increment. If the deviation is small, the effectiveness of the P action decreases as well. The control objects include applications with integral component loads, which are controlled by the P action only. Sometimes, if the integral component is functioning, the whole system may vibrate. In this case, use the PD control to reduce the P action's vibration and stabilize the system. In other words, this control is useful with no brake function's loading over the processes.
- PID Control:
  Use the I action to eliminate the deviation and the D action to reduce vibration; then combine this with the P action for the PID control. Use the PID method for a control process with no deviations, high accuracies and a stable system.
- Serial connection



- Parallel connection



08-08 Feedback Signal Detection Time

Default: 0.0

Settings 0.0–3600.0 sec.

- Pr.08-08 is valid only for ACI 4–20 mA.
- This parameter sets the detection time for abnormal PID feedback. Setting the detection time to 0.0 disables the detection function.

08-09 Feedback Signal Fault Treatment

Default: 0

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency

- This parameter is valid only for ACI 4–20 mA.
- AC motor drive acts when the analog PID feedback is abnormal.

08-10 Sleep Reference

Default: 0.00

Settings 0.00–599.00 Hz or 0–200.00%

- Determines the sleep frequency, and if the sleep time and the wake-up frequency are enabled or disabled. When Pr.08-10 = 0: disabled; when Pr.08-10 ≠ 0: enable.

08-11 Wake-up Frequency

Default: 0.00

Settings 0.00–599.00 Hz or 0–200.00%

- When Pr.08-18 = 0, the unit for Pr.08-10 and that for Pr.08-11 switch to frequency. The settings become 0.00–599.00 Hz.
- When Pr.08-18=1, the unit for Pr.08-10 and that for Pr.08-11 switch to percentage. The settings then switch to 0–200.00%.
- The percentage is based on the current command value, not the maximum value. For example, if the maximum value is 100 kg, and the current value is 30 kg, then if Pr.08-11=40%, the value is 12 kg.
- Pr.08-10 uses the same logic for calculation.

08-12 Sleep Time

Default: 0.0

Settings 0.0–6000.0 sec.

- When the frequency command is smaller than the sleep frequency and less than the sleep time, the frequency command is equal to the sleep frequency. However, the frequency command remains at 0.00 Hz until the frequency command becomes equal to or larger than the wake-up frequency.

08-13 PID Deviation Level

Default: 10.0

Settings 1.0–50.0%

08-14 PID Deviation Time

Default: 5.0

Settings 0.1–300.0 sec.

- When the PID control function is normal, it should calculate the value within a period of time that is close to the target value.
- Refer to the PID control diagram for details. When executing PID feedback control, if |PID reference target value – detection value| > Pr.08-13 PID deviation level and exceeds Pr.08-14 setting, it is judged as a PID control fault, and the multi-function output MOx = 15 (PID feedback error) activates.

08-15 PID Feedback Filter Time

Default: 5.0

Settings 0.1–300.0 sec.

08-16 PID Compensation Selection

Default: 0

Settings 0: Parameter setting (Pr.08-17)

1: Analog input

- 0: The setting for Pr.08-17 gives the PID compensation value.
- 1: Set the analog input (Pr.03-00–Pr.03-02) to 13, then the PID compensation value of analog input is displayed on Pr.08-17. At this time, Pr.08-17 is read only.

08-17 PID Compensation

Default: 0.0

Settings -100.0–100.0%

- The PID compensation value = maximum PID target value × Pr.08-17. For example, if the maximum operation frequency Pr.01-00=60.00 Hz, Pr.08-17=10.0%, the PID compensation value increases the output frequency 6.00 Hz. 60.00 Hz × 100.00% × 10.0% = 6.00 Hz

08-18 Sleep Mode Function Setting

Default: 0

Settings 0: Refer to PID output command

1: Refer to PID feedback signal

- 0: The unit for Pr.08-10 and that for Pr.08-11 switch to frequency. The settings then are between 0–599.00 Hz.
- 1: The unit for Pr.08-10 and that for Pr.08-11 switch to percentage. The settings then are between 0–200.00%.

08-19 Wake-up Integral Limit

Default: 50.0

Settings 0.0–200.0%

- The wake-up integral limit for the drive prevents suddenly running at high speed when the drive wakes up. The wake-up integral frequency limit = (Pr.01-00 × Pr.08-19%)
- Reduces the reaction time from sleep to wake-up.

08-21 Enable PID to Change the Operation Direction

Default: 0

Settings 0: Operation direction cannot be changed

1: Operation direction can be changed

08-22 Wake-up Delay Time

Default: 0.00

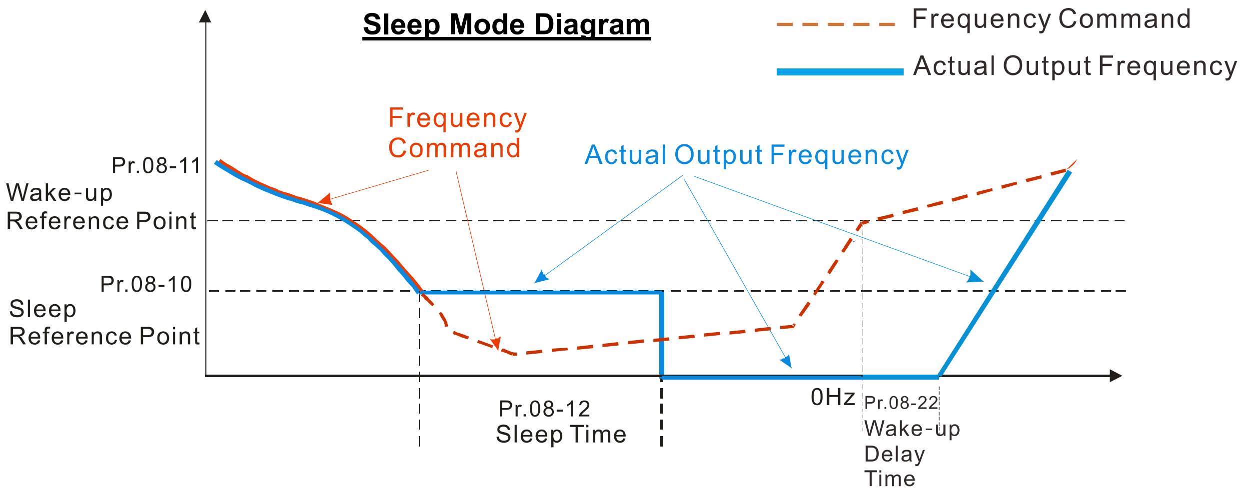
Settings 0.00–600.00 sec.

- Refer to Pr.08-18 for more information.
- There are three scenarios for sleep and wake-up frequency. Refer to following explanations:

1. Frequency Command (PID is not in use, Pr.08-00=0, only works in VF mode)

When the output frequency ≤ the sleep frequency, and the drive reaches the preset sleep time, then the drive is in sleep mode.

When the frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. When the drive reaches the wake-up delay time, the drive begins acceleration time to reach the frequency command value.

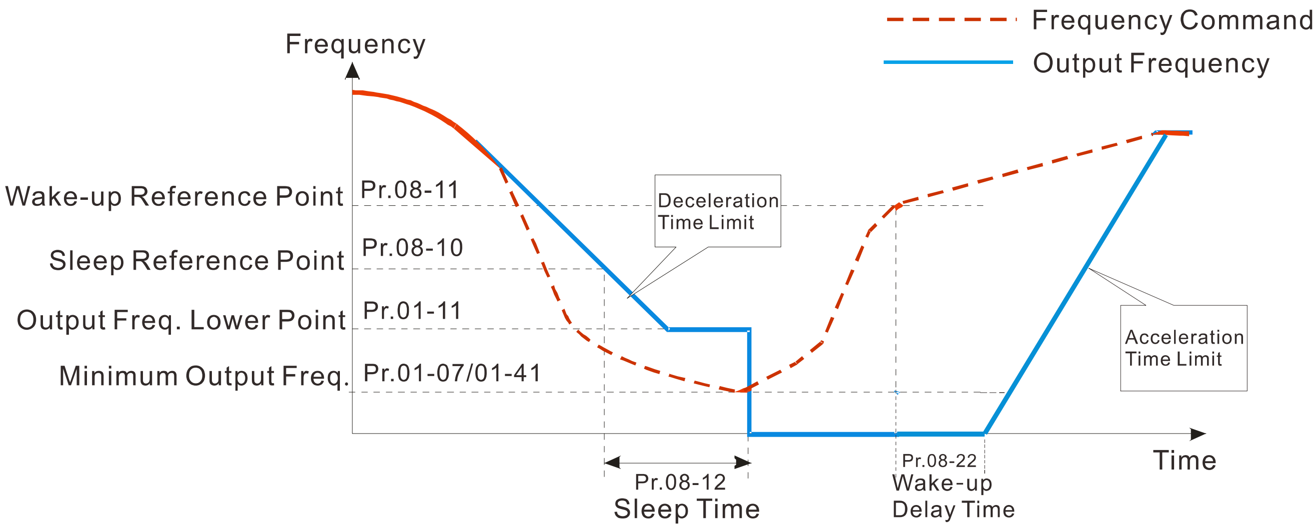


2. Frequency Command Calculation of the Internal PID (Use PID Pr.08-00≠0)

When the PID calculation reaches the sleep frequency, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, it goes directly to sleep mode (0 Hz). If the drive does not reach the sleep time, it remains at the lower limit (if there is a preset of lower limit), or it remains at the lowest output frequency set at Pr.01-07 and wait to reach the sleep time before it goes into sleep mode (0 Hz).

When the calculated frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts the acceleration time to reach the PID frequency command value.

Internal PID Calculation Frequency Command



3. PID Feedback Rate Percentage (Use PID, Pr.08-00 ≠ 0 and Pr.08-18=1)

When the PID feedback rate reaches the sleep level percentage, the drive starts to count the sleep time. The output frequency also decreases. If the drive exceeds the preset sleep time, it goes to sleep mode (0 Hz). If the drive does not reach the sleep time, it remains at the lower limit (if there is a preset of lower limit.), or it remains at the lowest output frequency set for Pr.01-07 and waits to reach the sleep time before going into sleep mode (0 Hz).

When the PID feedback value reaches the wake-up percentage, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts the acceleration time to reach the PID frequency command value.

Example 01: PID negative feedback

- Pr.08-10 must > Pr.08-11
- 30 kg is the reference
- Set the parameter:

Pr.03-00=5 (AVI1 is PID feedback)

Pr.08-00=1 (PID negative feedback: AVI1 simulation input function select)

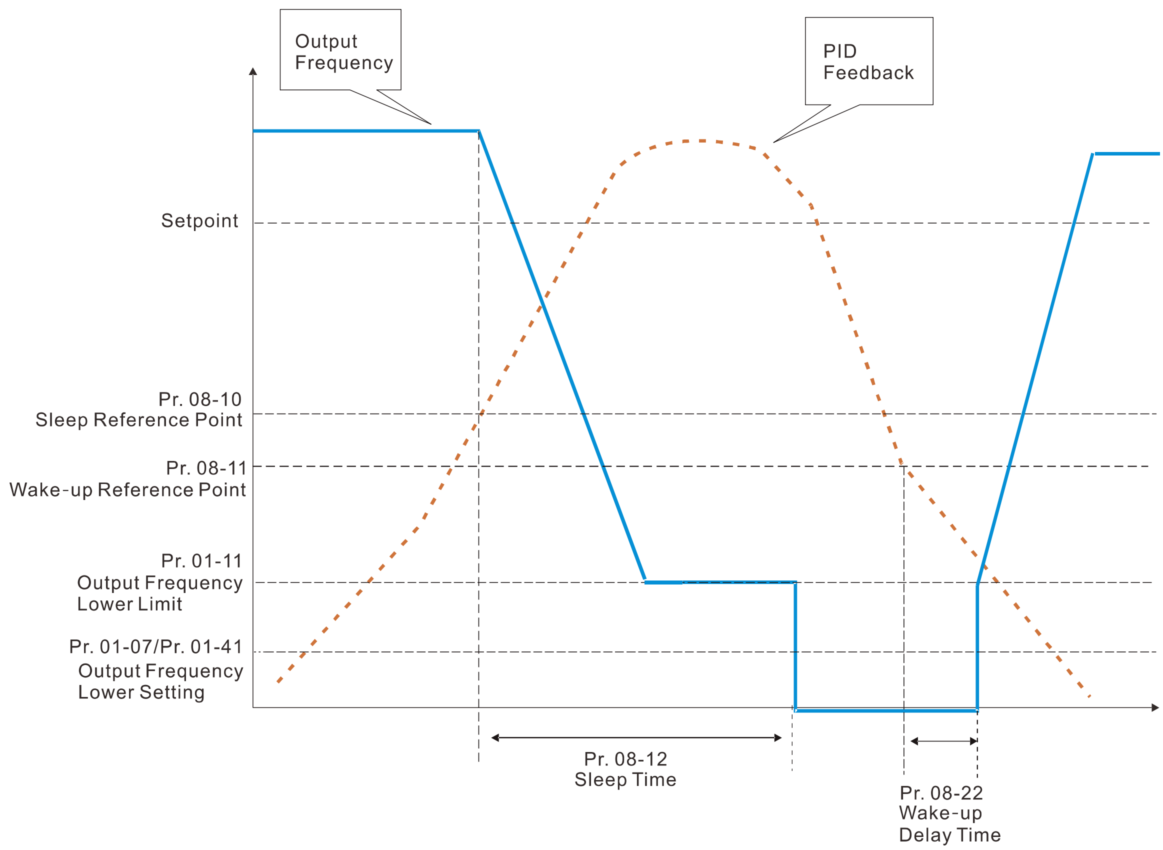
Pr.08-10=40% (Sleep reference: 12 kg = 40%*30 kg)

Pr.08-11=20% (Wake-up reference: 6 kg = 20% * 30 kg)

Case 01: If feedback >12kg, frequency decrease.

Case 02: If feedback < 6kg, frequency increase.

Area	PID Physical quantity
Sleep area	>12 kg, the drive goes into sleep, the motor goes into sleep
Excessive area	between 6 kg and 12 kg, the drive remains in current state
Wake-up area	< 6 kg, the drive wakes-up, the motor wakes-up



Example 02: PID positive feedback

- Pr.08-10 must < Pr.08-11
- 30 kg is the reference
- Set the parameter:

  Pr.03-00=5 (AVI1 is PID feedback)

  Pr.08-00=4 (PID positive feedback: AVI1 simulation input function select)

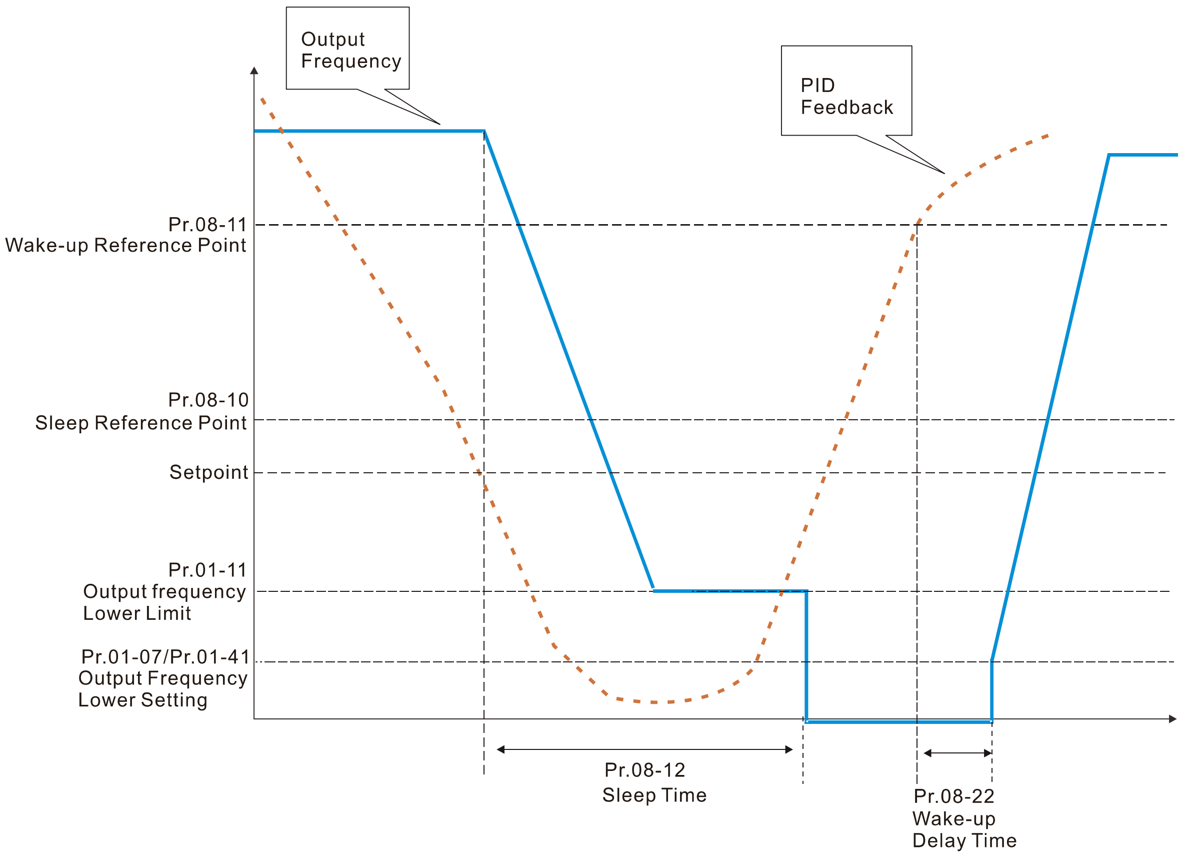
  Pr.08-10=110% (Sleep reference: 33 kg = 110% * 30 kg)

  Pr.08-11=120% (Wake-up reference: 36 kg = 120% * 30 kg)

  Case 01: If feedback <33kg, frequency decrease.

  Case 02: If feedback >36kg, frequency increase.

Area	PID Physical quantity
Sleep area	> 36 kg, the drive goes into sleep, the motor goes into sleep
Excessive area	between 33 kg and 36 kg, the drive remains in the current state
Wake-up area	< 33 kg, the drive wakes-up

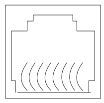


09 Communication Parameters

✓ The parameter can be set during the operation.

When using communication devices, connects AC drive with PC by using Delta IFD6530 or IFD6500.

8 ← 1



RS-485

Modbus RS-485
Pin 1~2,7,8: Reserved
Pin 3, 6: GND
Pin 4: SG-
Pin 5: SG+

✓ 09-00 COM1 Communication Address

Default: 1

Settings 1–254

📖 If RS-485 serial communication controls the AC motor drive, you must set the communication address for this drive in this parameter. Each AC motor drive's communication address must be different.

✓ 09-01 COM1 Transmission Speed

Default: 9.6

Settings 4.8–115.2 Kbps

📖 Sets the transmission speed of the computer and the drive.

📖 Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, 57.6 Kbps and 115.2 Kbps; otherwise, the transmission speed is set to the default 9.5 Kbps.

✓ 09-02 COM1 Transmission Fault Treatment

Default: 3

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

📖 Set the response for Modbus communication errors with the host. Set the detection time in Pr.09-03.

✓ 09-03 COM1 Time-out Detection

Default: 0.0

Settings 0.0–100.0 sec.

📖 Sets the communication transmission time-out.

✓ 09-04 COM1 Communication Protocol

Default: 1

Settings 1: 7, N, 2 (ASCII)
2: 7, E, 1 (ASCII)
3: 7, O, 1 (ASCII)
4: 7, E, 2 (ASCII)
5: 7, O, 2 (ASCII)
6: 8, N, 1 (ASCII)

7: 8, N, 2 (ASCII)
8: 8, E, 1 (ASCII)
9: 8, O, 1 (ASCII)
10: 8, E, 2 (ASCII)
11: 8, O, 2 (ASCII)
12: 8, N, 1 (RTU)
13: 8, N, 2 (RTU)
14: 8, E, 1 (RTU)
15: 8, O, 1 (RTU)
16: 8, E, 2 (RTU)
17: 8, O, 2 (RTU)

- Control by PC (Computer Link)
  When using the RS-485 serial communication interface, you must specify each drive's communication address in Pr.09-00. The computer then implements control using the drives' individual addresses.
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

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:

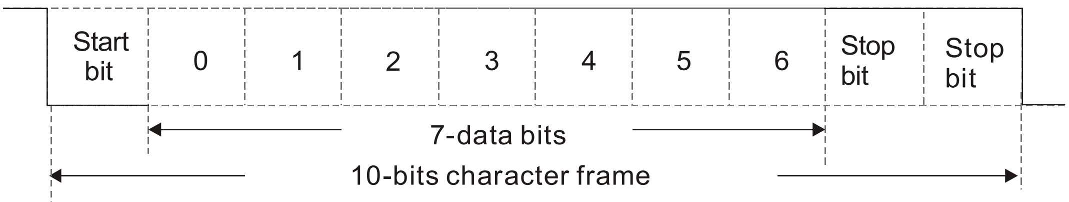
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

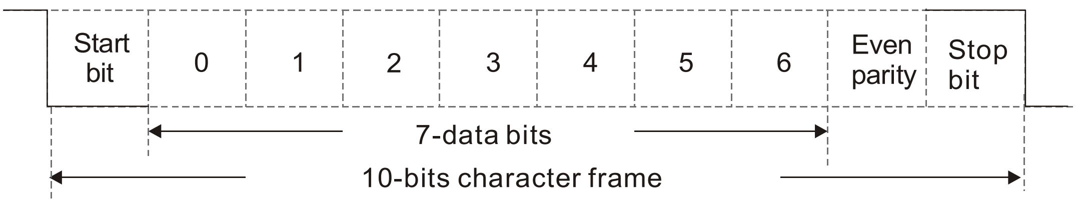
2. Data Format

10-bit character frame (For ASCII):

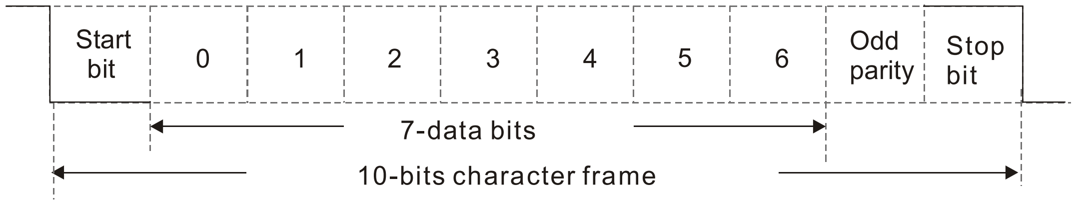
(7, N, 2)



(7, E, 1)

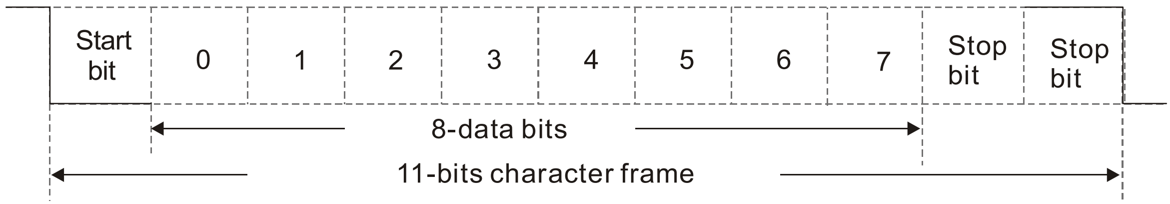


(7, O, 1)

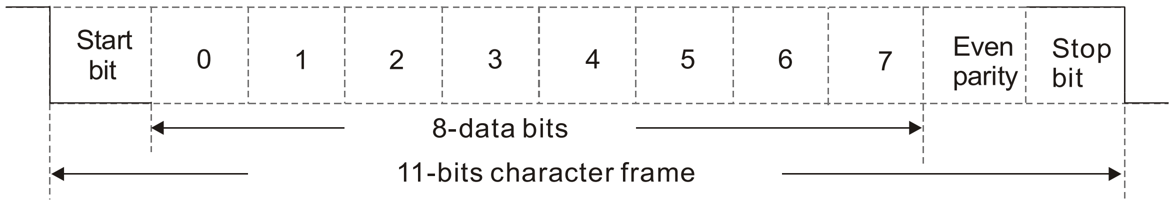


11-bit character frame (For RTU):

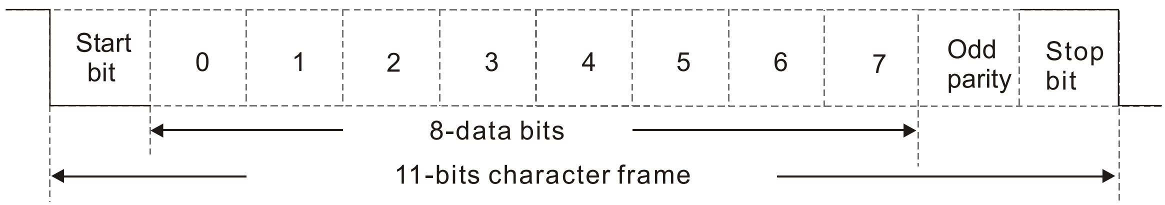
(8, N, 2)



(8, E, 1)



(8, O, 1)



3. Communication Protocol

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 consist of 2n ASCII codes
DATA 0	n ≤ 16, maximum of 32 ASCII codes
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 more than 10 ms
Address	Communication address: 8-bit address
Function	Command code: 8-bit command
DATA (n-1)	Contents of data: n × 8-bit data, n ≤ 16
…….	
DATA 0	
CRC Check Low	CRC checksum: one 16-bit checksum consists of 2 8-bit characters
CRC Check High	
END	Defined by a silent interval of more than 10 ms

- Communication Address (Address)

  00H: broadcast to all AC 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 register

  06H: write single register

  10H: write continuous multiple data

  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

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

06H: single write, write single data to 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

10H: write multiple registers (write multiple data to registers). The system can write up to 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'
	'B'
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'
	'9'
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 1	10H
Target register	04H
	00H
Number of register (Count by word)	00H
	02H
CRC Check Low	40H
CRC Check High	F8H

Check sum

ASCII mode:

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.

For example,

01H+03H+21H+02H+00H+02H=29H, the 2's-complement negation of 29H is D7H.

RTU mode:

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.

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

```
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
}
```

4. Address list

AC motor drive parameters (GGxx)

Modbus address	Function
GGnnH	GG is the parameter group, nn is the parameter number; for example, the address of Pr.04-10 is 040AH.

Control command (20xx)

<table>
<tr><th>Modbus address</th><th>R/W</th><th colspan="2">Function</th></tr>
<tr><td rowspan="30">2000H</td><td rowspan="30">RW</td><td rowspan="4">bit1–0</td><td>00B: No function</td></tr>
<tr><td>01B: Stop</td></tr>
<tr><td>10B: Run</td></tr>
<tr><td>11B: JOG + RUN</td></tr>
<tr><td>bit3–2</td><td>Reserved</td></tr>
<tr><td rowspan="4">bit5–4</td><td>00B: No function</td></tr>
<tr><td>01B: FWD</td></tr>
<tr><td>10B: REV</td></tr>
<tr><td>11B: Change direction</td></tr>
<tr><td rowspan="4">bit7–6</td><td>00B: 1st acceleration / deceleration</td></tr>
<tr><td>01B: 2nd acceleration / deceleration</td></tr>
<tr><td>10B: 3rd acceleration / deceleration</td></tr>
<tr><td>11B: 4th acceleration / deceleration</td></tr>
<tr><td rowspan="16">bit11–8</td><td>0000B: Master speed</td></tr>
<tr><td>0001B: 1st Step speed frequency</td></tr>
<tr><td>0010B: 2nd Step speed frequency</td></tr>
<tr><td>0011B: 3rd Step speed frequency</td></tr>
<tr><td>0100B: 4th Step speed frequency</td></tr>
<tr><td>0101B: 5th Step speed frequency</td></tr>
<tr><td>0110B: 6th Step speed frequency</td></tr>
<tr><td>0111B: 7th Step speed frequency</td></tr>
<tr><td>1000B: 8th Step speed frequency</td></tr>
<tr><td>1001B: 9th Step speed frequency</td></tr>
<tr><td>1010B: 10th Step speed frequency</td></tr>
<tr><td>1011B: 11th Step speed frequency</td></tr>
<tr><td>1100B: 12th Step speed frequency</td></tr>
<tr><td>1101B: 13th Step speed frequency</td></tr>
<tr><td>1110B: 14th Step speed frequency</td></tr>
<tr><td>1111B: 15th Step speed frequency</td></tr>
<tr><td>bit12</td><td>1: Enable bit6–11 function</td></tr>
<tr><td>bit15</td><td>Reserved</td></tr>
<tr><td>2001H</td><td>RW</td><td colspan="2">Frequency command (XXX.XX Hz)</td></tr>
<tr><td rowspan="4">2002H</td><td rowspan="4">RW</td><td>bit0</td><td>1: E.F. ON</td></tr>
<tr><td>bit1</td><td>1: Reset</td></tr>
<tr><td>bit2</td><td>1: Base block (B.B) ON</td></tr>
<tr><td>bit15–3</td><td>Reserved</td></tr>
</table>

Status monitor read only (21xx)

Modbus address	R/W	Function
2100H	R	High byte: Warn Code Low Byte: Error Code

Modbus address	R/W	Function	
2101H	R	bit1–0	AC motor drive operation status 00B: Drive stops 01B: Drive decelerating 10B: Drive standby 11B: Drive operating
		bit2	1：JOG Command
		bit4–3	Operation Direction 00B: FWD run 01B: From REV run to FWD run 10B: From FWD run to REV run 11B: REV run
		bit8	1: Master frequency controlled by communication interface
		bit9	1: Master frequency controlled by analog/external signal
		bit10	1: Operation command controlled by communication interface
		bit11	1: Parameter locked
		bit12	1: Enable to copy parameters from keypad
		bit15–13	Reserved
2102H	R	Frequency command (XXX.XX Hz)	
2103H	R	Output frequency (XXX.XX Hz)	
2104H	R	Output current (XX.XX A). When current is higher than 655.35, it shifts the decimal as (XXX.X A). The decimal can refer to High byte of 211F.	
2105H	R	DC bus Voltage (XXX.X V)	
2106H	R	Output voltage (XXX.X V)	
2107H	R	Current step number of multi-step speed operation	
2108H	R	Reserved	
2109H	R	Counter value	
210AH	R	Power factor angle (XXX.X)	
210CH	R	Actual motor speed (XXXXX rpm)	
210DH	R	Reserved	
210EH	R	Reserved	
210FH	R	Power output (X.XXX kW)	
2116H	R	Multi-function display (Pr.00-04)	
211BH	R	Maximum Operation Frequency (Pr.01-00) or Maximum User-defined Value (Pr.00-26) When Pr.00-26 is 0, this value is equal to Pr.01-00 setting When Pr.00-26 is not 0, and the command source is keypad, this value = Pr.00-24 * Pr.00-26 / Pr.01-00 When Pr.00-26 is not 0, and the command source is 485, this value = Pr.09-10 * Pr.00-26 / Pr.01-00	
211FH	R	High byte: decimal of current value (display)	

Status monitor read only (22xx)

Modbus address	RW	Function
2200H	R	Display output current (A). When current is higher than 655.35, it shifts the decimal as (XXX.X A). The decimal can refer to High byte of 211F.
2201H	R	Display counter value (c)
2202H	R	Actual output frequency (XXXXX Hz)
2203H	R	DC bus voltage (XXX.X V)
2204H	R	Output voltage (XXX.X V)
2205H	R	Power angle (XXX.X)

<table>
<tr><th>Modbus address</th><th>RW</th><th colspan="2">Function</th></tr>
<tr><td>2206H</td><td>R</td><td colspan="2">Display actual motor speed kW of U, V, W (XXXX.X kW)</td></tr>
<tr><td>2207H</td><td>R</td><td colspan="2">Display motor speed in rpm estimated by the drive or encoder feedback (XXXXX rpm)</td></tr>
<tr><td>2208H</td><td>R</td><td colspan="2">Display positive/negative output torque in %, estimated by the drive (XXX.X %)</td></tr>
<tr><td>2209H</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td>220AH</td><td>R</td><td colspan="2">PID feedback value after enabling PID function (XXX.XX %)</td></tr>
<tr><td>220BH</td><td>R</td><td colspan="2">Display signal of AVI1 analog input terminal, 0–10 V corresponds to 0.00–100.00% (1.) (see NOTE 2 in Pr.00-04)</td></tr>
<tr><td>220CH</td><td>R</td><td colspan="2">Display signal of ACI analog input terminal, 4–20 mA / 0–10 V corresponds to 0.00–100.00% (2.) (see NOTE 2 in Pr.00-04)</td></tr>
<tr><td>220DH</td><td>R</td><td colspan="2">Display signal of AVI2 analog input terminal, -10 V–10 V corresponds to -100.00–100% (3.) (see NOTE 2 in Pr.00-04)</td></tr>
<tr><td>220EH</td><td>R</td><td colspan="2">IGBT temperature of drive power module (XXX.X°C)</td></tr>
<tr><td>220FH</td><td>R</td><td colspan="2">The temperature of capacitance (XXX.X°C)</td></tr>
<tr><td>2210H</td><td>R</td><td colspan="2">The status of digital input (ON/OFF), refer to Pr.02-12
(see NOTE 3 in Pr.00-04)</td></tr>
<tr><td>2211H</td><td>R</td><td colspan="2">The status of digital output (ON/OFF), refer to Pr.02-18
(see NOTE 4 in Pr.00-04)</td></tr>
<tr><td>2212H</td><td>R</td><td colspan="2">The multi-step speed that is executing (S)</td></tr>
<tr><td>2213H</td><td>R</td><td colspan="2">The corresponding CPU pin status of digital input (d.)
(see NOTE 3 in Pr.00-04)</td></tr>
<tr><td>2214H</td><td>R</td><td colspan="2">The corresponding CPU pin status of digital output (O.)
(see NOTE 4 in Pr.00-04)</td></tr>
<tr><td>2215H</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td>2216H</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td>2217H</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td>2218H</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td>2219H</td><td>R</td><td colspan="2">Display times of counter overload (XXX.XX %)</td></tr>
<tr><td>221AH</td><td>R</td><td colspan="2">GFF (XXX.XX %)</td></tr>
<tr><td>221BH</td><td>R</td><td colspan="2">DC bus voltage ripples (XXX.X V)</td></tr>
<tr><td>221CH</td><td>R</td><td colspan="2">PLC register D1043 data (C)</td></tr>
<tr><td>221DH</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td>221EH</td><td>R</td><td colspan="2">User page displays the value in physical measure</td></tr>
<tr><td>221FH</td><td>R</td><td colspan="2">Output Value of Pr.00-05 (XXX.XX Hz)</td></tr>
<tr><td>2220H</td><td>R</td><td colspan="2">Number of motor turns when drive operates (saves when drive stops, and resets to zero when operating)</td></tr>
<tr><td>2221H</td><td>R</td><td colspan="2">Operating position of the motor (saves when drive stops, and resets to zero when operating)</td></tr>
<tr><td>2222H</td><td>R</td><td colspan="2">Fan speed of the drive (XXX %)</td></tr>
<tr><td>2223H</td><td>R</td><td colspan="2">Control mode of the drive 0: speed mode</td></tr>
<tr><td>2224H</td><td>R</td><td colspan="2">Carrier frequency of the drive (XXXX kHz)</td></tr>
<tr><td>2225H</td><td>R</td><td colspan="2">Reserved</td></tr>
<tr><td rowspan="4">2226H</td><td rowspan="4">R</td><td>Drive status bit1–0</td><td>00b: No direction
01b: Forward
10b: Reverse</td></tr>
<tr><td>bit3–2</td><td>01b: Drive ready
10b: Error</td></tr>
<tr><td>bit4</td><td>0b: Motor drive did not output
1b: Motor drive did output</td></tr>
<tr><td>bit5</td><td>0b: No alarm
1b: Alarm</td></tr>
<tr><td>2228H</td><td>R</td><td colspan="2">Reserve</td></tr>
</table>

Modbus address	RW	Function
2229H	R	kWh display (XXXX.X)
222AH	R	Reserve
222BH	R	Reserve
222CH	R	Reserve
222DH	R	Reserve
222EH	R	PID reference (XXX.XX %)
222FH	R	PID offset (XXX.XX %)
2230H	R	PID output frequency (XXX.XX Hz)
2231H	R	Hardware ID

Remote IO (26xx)

Modbus address	RW	Function
2600H	R	Each bit corresponds to different terminal input contact
2601H | 2639H	R	Reserved
2640H	RW	Each bit corresponds to different terminal output contact
2641H | 2659H	R	Reserved
2660H	R	AVI1 proportional value
2661H	R	ACI proportional value
2662H	R	AVI2 proportional value
2663H | 2664H	R	Reserved
266AH	R	Extension card AI10, 0.0–100.0% (EMC-A22A)
266BH	R	Extension card AI11, 0.0–100.0% (EMC-A22A)
266CH | 269FH	R	Reserved
26A0H	RW	AFM1 output proportional value
26A1H	RW	AFM2 output proportional value
26A3H	R	Reserved
26AAH	RW	Extension card AO10, 0.0–100.0% (EMC-A22A)
26ABH	RW	Extension card AO11, 0.0–100.0% (EMC-A22A)

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 (bit7) of 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.

Example:

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:

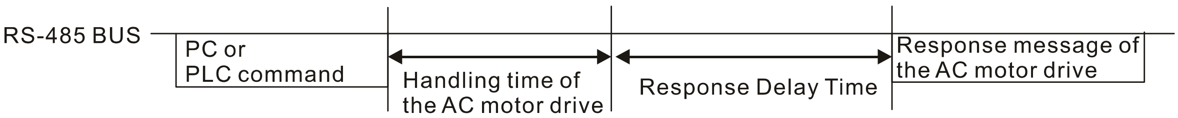
Exception code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Fail to execute this function code
10	Transformation for over-time duration

09-09 Communication Response Delay Time

Default: 2.0

Settings 0.0–200.0 ms

Sets the response delay time after the AC motor drive receives a communication command as shown in the following.



09-10 Communication Main Frequency

Default: 60.00

Settings 0.00–599.00 Hz

When you set Pr.00-20 to 1 (RS-485 serial communication), the AC motor drive saves the last frequency command into Pr.09-10 when there is abnormal power off or momentary power loss. After the drive reboots when power is restored, it checks the frequency in Pr.09-10 if no new frequency command is input. When a frequency command of RS-485 changes (the frequency command source must be set as Modbus), this parameter also changes.

09-11 Block Transfer 1
09-12 Block Transfer 2
09-13 Block Transfer 3
09-14 Block Transfer 4
09-15 Block Transfer 5
09-16 Block Transfer 6
09-17 Block Transfer 7

09-18 Block Transfer 8
09-19 Block Transfer 9
09-20 Block Transfer 10
09-21 Block Transfer 11
09-22 Block Transfer 12
09-23 Block Transfer 13
09-24 Block Transfer 14
09-25 Block Transfer 15
09-26 Block Transfer 16

Default: 0000

Settings 0–FFFFh

- There is a group of block transfer parameters available in the AC motor drive (Pr.09-11 to Pr.09-26). Using communication code 03H, you can store the parameters (Pr.09-11–Pr.09-26) that you want to read.
- For example: according to the Address List (as shown in the table below), Pr.01-42 is shown as 012A. Set Pr.09-11 to 012Ah (the minimum voltage of Pr.01-42 M2 is 2.0 V), and use Pr.09-11 (communication address 090B) to read the communication parameter, the read value is 2.0.

AC motor drive parameters	GGnnH	GG is the parameter group, nn is the parameter number; for example, the address of Pr.04-10 is 040AH.

09-30 Communication Decoding Method

Default: 1

Settings 0: Decoding Method 1 (20xx)
1: Decoding Method 2 (60xx)

		Decoding Method 1	Decoding Method 2
Source of Operation Control	Digital Keypad	Digital keypad controls the drive action regardless of decoding method 1 or 2.	
	External Terminal	External terminal controls the drive action regardless of decoding method 1 or 2.	
	RS-485	Refer to address: 2000h–20FFh	Refer to address: 6000h–60FFh
	CANopen	Refer to index: 2020-01h–2020-FFh	Refer to index: 2060-01h–2060-FFh
	Communication Card	Refer to address: 2000h–20FFh	Refer to address: 6000h–60FFh
	PLC	PLC commands controls the drive action regardless of decoding method 1 or 2.	

09-31 Internal Communication Protocol

Default: 0

Settings 1: BACnet
0: Modbus 485
-1: Internal Communication Slave 1
-2: Internal Communication Slave 2
-3: Internal Communication Slave 3
-4: Internal Communication Slave 4
-5: Internal Communication Slave 5

-6: Internal Communication Slave 6
-7: Internal Communication Slave 7
-8: Internal Communication Slave 8
-10: Internal Communication Master
-12: Internal PLC Control

📖 When it is defined as internal communication, refer to Section 16-10 for Main Control Terminal of Internal Communication.

📖 When it is defined as internal PLC control, refer to Section 16-12 for Remote IO Control Application (using MODRW).

09-33 PLC Command Force to 0

Default: 0000h

Setting bit0: Before PLC scan, set the PLC target frequency = 0

📖 Defines whether to clear the frequency command or speed command to 0 before the PLC scan time sequence.

09-35 PLC Address

Default: 2

Settings 1–254

09-36 CANopen Slave Address

Default: 0

Settings 0: Disable
0–127

09-37 CANopen Speed

Default 0

Settings 0: 1 Mbps
1: 500 Kbps
2: 250 Kbps
3: 125 Kbps
4: 100 Kbps (Delta only)
5: 50 Kbps

09-39 CANopen Warning Record

Default: Ready only

Settings bit0: CANopen Guarding Time-out
bit1: CANopen Heartbeat Time-out
bit2: CANopen SYNC Time-out
bit3: CANopen SDO Time-out
bit4: CANopen SDO Buffer Overflow
bit5: CANopen hardware disconnection warning (Can Bus Off)
bit6: Error protocol of CANOPEN
bit8: The setting values of CANopen indexes are fail
bit9: The setting value of CANopen address is fail
bit10: The checksum value of CANopen indexes is fail

09-40 CANopen Decoding Method

Default: 1

Settings 0: Disable (Delta-defined decoding method)

1: Enable (CANopen DS402 Standard protocol)

09-41 CANopen Communication Status

Default: Read only

Settings 0: Node Reset State

1: Com Reset State

2: Boot up State

3: Pre-operation State

4: Operation State

5: Stop State

09-42 CANopen Control Status

Default: Read only

Settings 0: Not ready for use state

1: Inhibit start state

2: Ready to switch on state

3: Switched on state

4: Enable operation state

7: Quick stop active state

13: Error reaction activation state

14: Error state

09-45 CANopen Master Function

Default: 0

Settings 0: Disable

1: Enable

09-46 CANopen Master Address

Default: 100

Settings 0–127

09-50 BACnet MS / TP Node Address

Default: 10

Settings 0–127

09-51 BACnet Baud Rate

Default: 38.4

Settings 9.6–76.8 Kbps

09-52 BACnet Device ID L

Default: 10

Settings 0–65535

09-53 BACnet Device ID H

Default: 0

Settings 0–63

09-55 BACnet Max Address

Default: 127

Settings 0–127

09-56 BACnet Password

Default: 0

Settings 0–65535

09-60 Identifications for Communication Card

Default: Read only

Settings 0: No communication card
1: DeviceNet Slave
2: Profibus-DP Slave
3: CANopen Slave / Master
4: Modbus-TCP Slave
5: EtherNet / IP Slave
8: BACnet IP
12: PROFINET

09-61 Firmware Version of Communication Card

Default: Read only

Settings Read only

09-62 Product Code

Default: Read only

Settings Read only

09-63 Error Code

Default: Read only

Settings Read only

09-70 Communication Card Address (for DeviceNet or PROFIBUS)

Default: 1

Settings DeviceNet: 0–63
Profibus-DP: 1–125

09-71 Communication Card Speed Setting (for DeviceNet)

Default: 2

Settings Standard DeviceNet:
0: 125 Kbps
1: 250 Kbps
2: 500 Kbps
3: 1 Mbps (Delta only)
Non standard DeviceNet : (Delta only)
0: 10 Kbps
1: 20 Kbps
2: 50 Kbps
3: 100 Kbps

4: 125 Kbps
5: 250 Kbps
6: 500 Kbps
7: 800 Kbps
8: 1 Mbps

09-72 Other Communication Card Speed Setting (for DeviceNet)

Default: 0

Settings 0: Standard DeviceNet
In this mode, the baud rate can only be 125 Kbps, 250 Kbps, and 500 Kbps in standard DeviceNet speed.
1: Nonstandard DeviceNet
In this mode, the baud rate of DeviceNet can be the same as that for CANopen (0–8).

- Use with Pr.09-71.
- Setting 0: The baud rate can only be set to 125 Kbps, 250 Kbps and 500 Kbps.
- Setting 1: The DeviceNet communication rate can be the same as that for CANopen (setting 0–8).

09-75 Communication Card IP Configuration (for Modbus TCP)

Default: 0

Settings 0: Static IP
1: DynamicIP (DHCP)

- Setting 0: Set the IP address manually.
- Setting 1: IP address is automatically set by the host controller.

09-76 Communication Card IP Address 1 (for Modbus TCP)
09-77 Communication Card IP Address 2 (for Modbus TCP)
09-78 Communication Card IP Address 3 (for Modbus TCP)
09-79 Communication Card IP Address 4 (for Modbus TCP)

Default: 0

Settings 0–65535

- Use Pr.09-76–09-79 with a communication card.

09-80 Communication Card Address Mask 1 (for Modbus TCP)
09-81 Communication Card Address Mask 2 (for Modbus TCP)
09-82 Communication Card Address Mask 3 (for Modbus TCP)
09-83 Communication Card Address Mask 4 (for Modbus TCP)

Default: 0

Settings 0–65535

09-84 Communication Card Gateway Address 1 (for Modbus TCP)
09-85 Communication Card Gateway Address 2 (for Modbus TCP)
09-86 Communication Card Gateway Address 3 (for Modbus TCP)

✎ 09-87 Communication Card Gateway Address 4 (for Modbus TCP)

Default: 0

Settings 0–65535

✎ 09-88 Communication Card Password (Low word) (for Modbus TCP)

✎ 09-89 Communication Card Password (High word) (for Modbus TCP)

Default: 0

Settings 0–99

✎ 09-90 Reset Communication Card (for Modbus TCP)

Default: 0

Settings 0: Disable

1: Reset, return to default

✎ 09-91 Additional Setting for the Communication Card (for Modbus TCP)

Default: 1

Settings bit0: Enable IP Filter

bit1: Enable internet parameters (1bit)

When IP address is set, this bit is enabled. After updating the communication card parameters, this bit changes to disabled.

bit2: Enable login password (1bit)

When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to disable.

09-92 Communication Card Status (for Modbus TCP)

Default: 0

Settings bit0: Enable password

When the communication card is set with a password, this bit is enabled. When the password is cleared, this bit is disabled.

10 Sensorless Motor Control Parameters

✎ This parameter can be set during operation.

✎ **10-31** I/F Mode, Current Command

Default: 40

Settings 0–150% of motor rated current

- Sets the current command for the drive in low speed area (low speed area: frequency command < Pr.10-39). When the motor stalls on heavy-duty start-up or forward / reverse with load, increase the parameter value. If the inrush current is too high and causes oc stall, then decrease the parameter value.

✎ **10-32** PM FOC Sensorless Speed Estimator Bandwidth

Default: 5.00

Settings 0.00–600.00 Hz

- Sets the speed estimator bandwidth. Adjust the parameter to change the stability and the accuracy of the motor speed.
- If there is low frequency vibration (the waveform is similar to the sine wave) during the process, then increase the bandwidth. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the bandwidth.

✎ **10-34** PM Sensorless Speed Estimator Low-pass Filter Gain

Default: 1.00

Settings 0.00–655.35

- Changes the response speed of the speed estimator.
- If there is low frequency vibration (the waveform is similar to the sine wave) during the process, then increase the gain. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the gain.

✎ **10-39** Frequency Point to Switch from I/F Mode to PM Sensorless Mode

Default: 20.00

Settings 0.00–599.00 Hz

- Sets the frequency for the switch point from low frequency to high frequency.
- If the switch point is too low, the motor does not generate enough back-EMF to let the speed estimator measure the rotor right position and speed, and causes stall and oc when running at the switch point frequency.
- If the switch point is too high, the active area of I/F is too wide, which generates more current and cannot save energy. If the current value for Pr.10-31 is too high, the high switch point makes the drive continue to output with the setting value for Pr.10-31.

10-40 Frequency Point to Switch from PM Sensorless Mode to I/F Mode

Default: 20.00

Settings 0.00–599.00 Hz

- Sets the switch point from high frequency to low frequency.
- If the switch point is too low, the motor does not generate enough back-EMF to let the speed estimator measure the rotor right position and speed when running at the switch point frequency.
- If the switch point is too high, the active area of I/F is too wide, which generates more current and cannot save energy. If the current value for Pr.10-31 is too high, the high switch point makes the drive continue to output with the setting value for Pr.10-31).

10-41 I/F Mode, Id Current Low-Pass Filter Time

Default: 0.2

Settings 0.0–6.0 sec.

- Sets the filter time for Pr.10-31. Smoothly increases the magnetic field to the current command setting value under the I/F mode.
- If you want to slowly increase the size of Id, increase the filter time to avoid a Step phenomenon occurs when starting current output. When decrease the filter time (minimum value is 0), the current rises faster, then a Step phenomenon occurs.

10-42 Initial Angle Detection Pulse Value

Default: 1.0

Settings 0.0–3.0 times of motor rated current

- This parameter is valid only when setting of Pr.10-53=2 or 3.
- The parameter influences the value of the pulse during the angle detection. The larger the pulse, the higher the accuracy of rotator's position. A larger pulse might cause oc.
- Increase the parameter when the running direction and the command are opposite during start-up. If oc occurs at start-up, then decrease the parameter.
- Refer to Section 12-2 Adjustment & Application for detailed motor adjustment procedure.

10-49 Zero Voltage Time while Start-up

Default: 0.000

Settings 0.000–60.000 sec.

- This parameter is valid only when the setting of Pr. 07-12 (Speed Tracking during Start-up) = 0.
- When the motor is in static status at the start-up, this increases the accuracy when estimating angles. In order to put the motor in static status, set the three-phase drive output to 0 V to the motor. The Pr.10-49 setting time is the length of time when three-phase output at 0 V.
- It is possible that even when you apply this parameter, the motor cannot go into the static state because of inertia or some external force. If the motor does not go into the static status in 0.2 seconds, increase the setting value appropriately.
- If Pr.10-49 is too high, the start-up time is longer. If it is too low, the braking performance is weak.

10-51 Injection Frequency

Default: 500

Settings 0–1200 Hz

- This parameter is a high frequency injection command in PM SVC control mode and usually you do not need to adjust it. If a motor's rated frequency (for example, 400 Hz) is too close to the frequency setting for this parameter (that is, the default is 500 Hz), it affects the accuracy of the angle detection. Refer to the setting for Pr.01-01 before you adjust this parameter.
- If the setting value for Pr.00-17 is lower than Pr.10-51*10, then increase the frequency of the carrier wave.
- Pr.10-51 is valid only when Pr.10-53 = 2.

10-52 Injection Magnitude

Default: 30.0

Settings 0.0–200.0 V

- The parameter is the magnitude command for the high frequency injection signal in PM SVC control mode.
- Increasing the parameter can increase the accuracy of the angle estimation, but the electromagnetic noise might be louder if the setting value is too high.
- The system uses this parameter after the motor auto-tunes parameters. This parameter influences the angle estimation accuracy.
- When the ratio of the salient pole (Lq/Ld) is lower, increase Pr.10-52 to make the angle detection more accurate.
- Pr.10-52 is valid only when Pr.10-53 = 2.

10-53 PM Initial Rotor Position Detection Method

Default: 0

Settings
0: Disable
1: Force attracting the rotor to zero degrees
2: High frequency injection
3: Pulse injection

- Set to 2 for IPM; set to 3 for SPM. If these settings cause problems, then set the parameter to "1".

11 Advanced Parameters

Group 11 Advanced parameters are reserved.

12 Pump Parameters

✓ This parameter can be set during operation.

12-00 Circulation Control

Default: 0

Settings 0: No operation
1: Fixed Time Circulation (by time)
2: Fixed Quantity Circulation
3: Fixed Quantity Control
4: Fixed Time Circulation + Fixed Quantity Circulation
5: Fixed Time Circulation + Fixed Quantity Control

- In this mode, the CFP2000 can control up to eight motors at a time. The total number of motors is determined by Pr.12-01. In accordance with the Fixed Time Circulation (Pr.12-02), you can adjust the switching time between Start and Stop for each motor. When an operating motor reaches the time setting for Pr.12-02, the CFP2000 stops that motor which according to the setting of Pr.00-22 Stop Method. After the delay time setting for Pr.12-03, next motor starts operating. See diagram below.

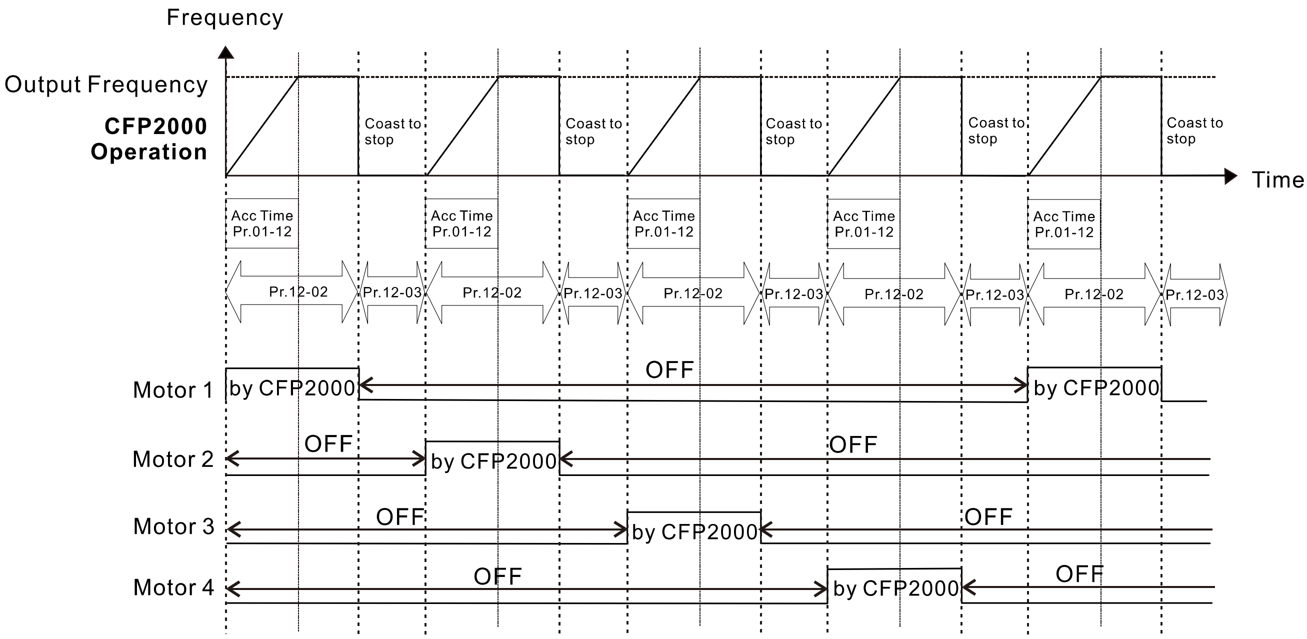


Diagram 12-1: Sequential Diagram of Fixed Time Circulation Free Running Mode (by time)

- Disable Motors' Output

Setting the multi-function input commands as Disable Motors' Output can stop the corresponding motors. The following table lists the settings:

Pr.02-01–Pr.02-06 =	60	61	62	63	64	65	66	67	68
Disable Motors' Output	ALL	1	2	3	4	5	6	7	8

When a motor's output is disabled, this motor coasts to stop.

📖 Wiring: Fixed Time Circulation (by time) can control up to eight motors. Diagram 12-2 shows an example of controlling four motors at the same time.

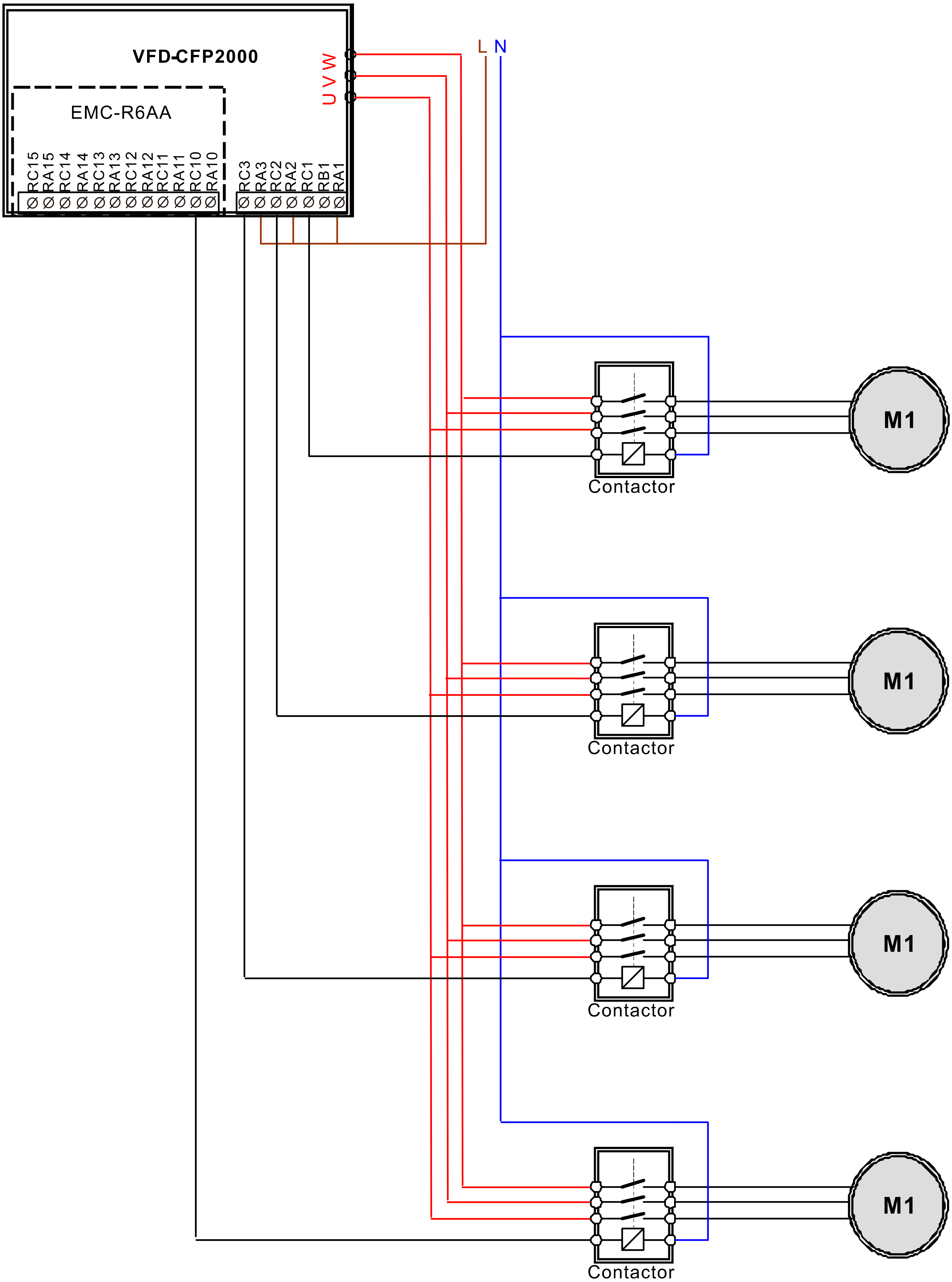


Diagram 12-2: Wiring

12-01 Number of Motors to be Connected

Default: 1

Settings 1–8

- Number of Motors: maximum of eight motors. After setting the number of connected motors, the multi-function output terminals automatically follow the setting as shown in the table below.

Pr.12-01	01	02	03	04	05	06	07	08
Pr.02-13	55	55	55	55	55	55	55	55
Pr.02-14		56	56	56	56	56	56	56
Pr.02-15			57	57	57	57	57	57
Pr.02-36				58	58	58	58	58
Pr.02-37					59	59	59	59
Pr.02-38						60	60	60
Pr.02-39							61	61
Pr.02-40								62

Table 1: Setting of Multi-function Output Terminal for Circulating Motors

12-02 Operating Time of Each Motor (minutes)

Default: 0

Settings 0–65500 minutes

- Sets the fixed time for circulation. If Pr.12-02 = 0, stop the timing. The currently running motors continue operating until a Stop command is given.

12-03 Delay Time due to the Acceleration (or the Increment) at Motor Switching (seconds)

Default: 1.0

Settings 0.0–3600.0 seconds

- Sets the delay time when switching motors. When the currently running motors reach the time setting for Pr.12-02, the CFP2000 uses the delay time setting for Pr.12-03 and then switches to run the next motors.

12-04 Delay Time due to the Deceleration (or the Decrement) at Motor Switching (seconds)

Default: 1.0

Settings 0.0–3600.0 seconds

- Sets the delay time when switching motors.

✓ 12-05 Delay time due to Fixed Quantity Circulation at Motor Switching (seconds)

Default: 10.0

Settings 0.0–3600.0 seconds

- Sets the fixed quantity circulation with PID

  Sequential Diagram

  In this mode, the CFP2000 can control up to four motors to increase flow quantity and pressure range control. When controlling the flow quantity, the motors are in parallel connection. When controlling the pressure range, the motors are in series connection.

To increase the flow quantity or pressure range, the CFP2000 increases the first motor's pressure from 0 Hz to the largest operating frequency. If the output frequency reaches the frequency setting for Pr.12-06 and delay time for Pr.12-05, the CFP2000 delays the time setting for Pr.12-03. CFP2000 then switches to the next motor to use mains electricity and delays the time setting for Pr.12-03 to run the next motor. If necessary, other motors are activated in sequence. See sequential diagram of 12-3 and 12-4.

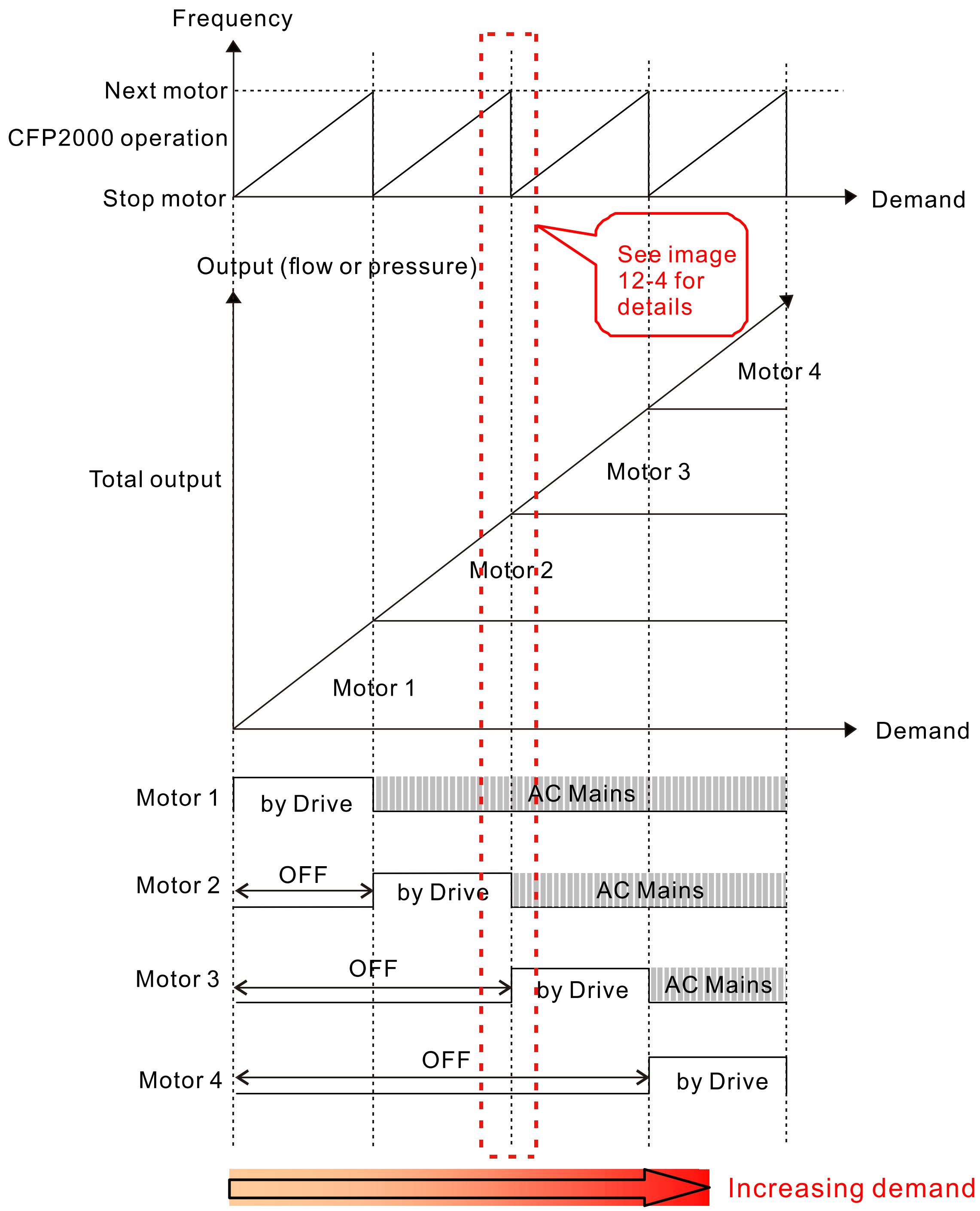


Diagram 12-3: Sequence of Fixed quantity circulation with PID – Increasing Demand

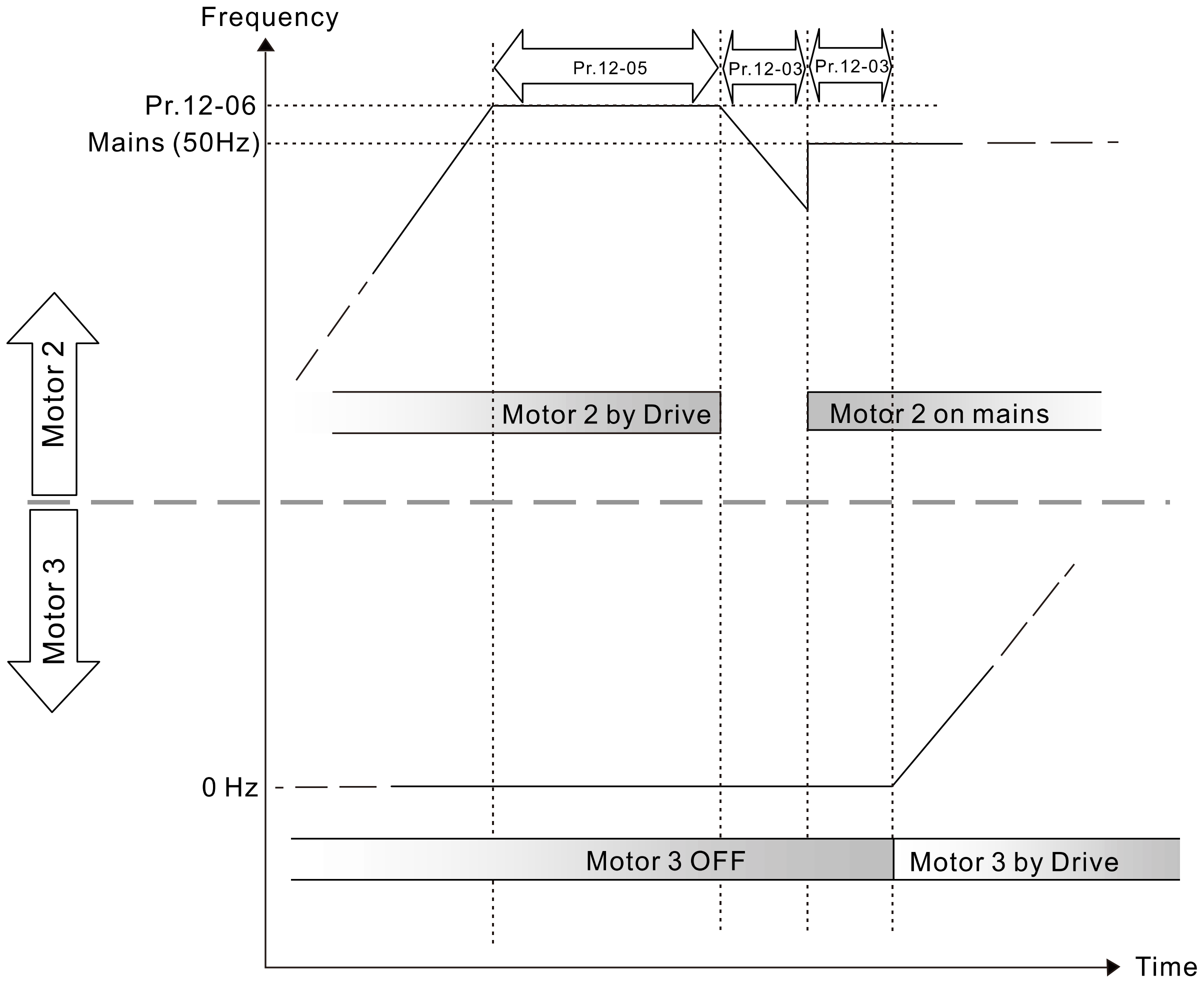


Diagram 12-4: Sequence of switching motors at Fixed Quantity Circulation with PID – Increasing Demands

However, if the decreasing demands for flow quantity and pressure are too big, the CFP2000 stops the current operating motors and waits for the delay time setting for Pr.12-04. It continues doing this until the last motor stops using mains electricity. See sequential diagram 12-5 and 12-6 below.

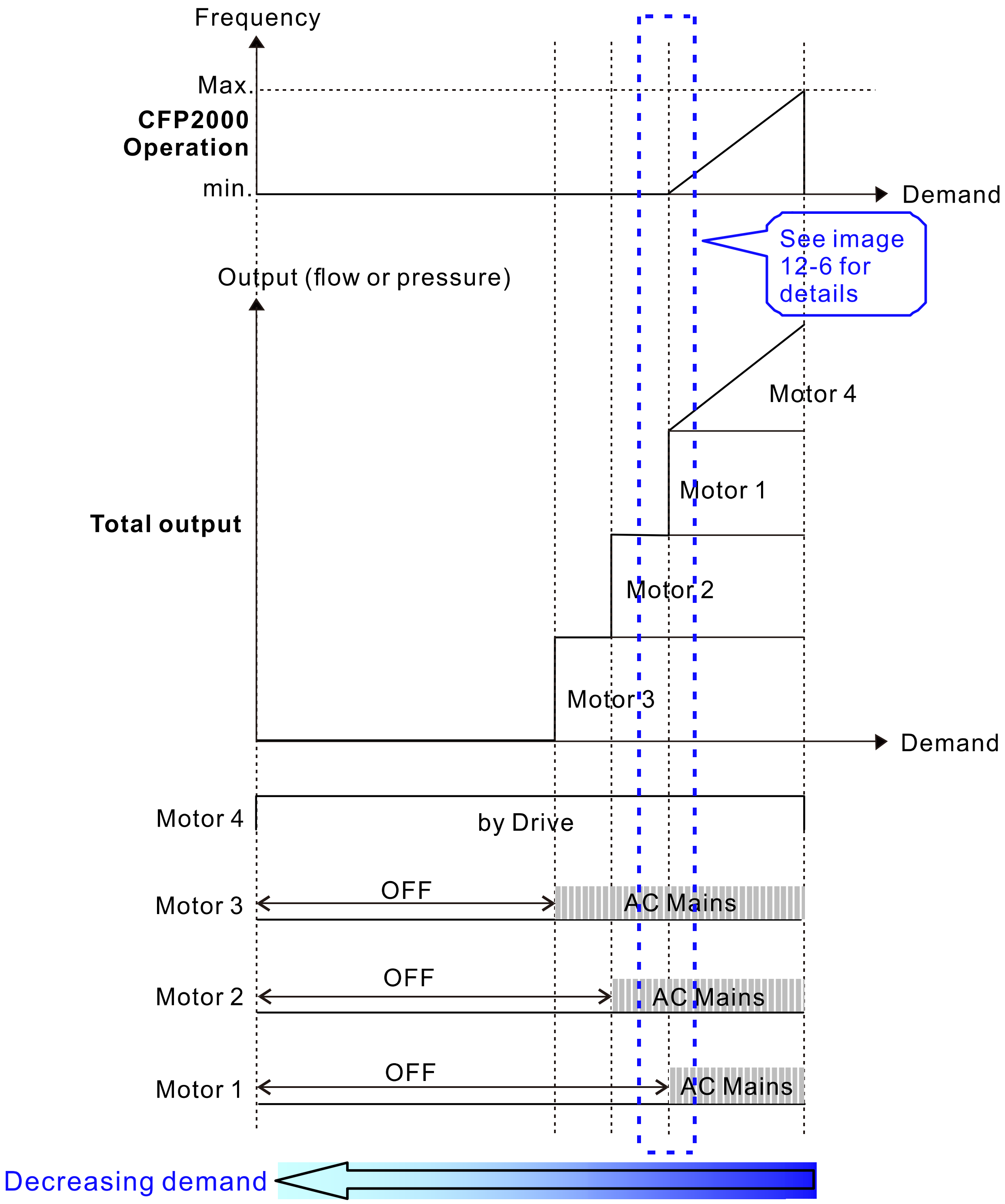


Diagram 12-5: Sequence of Fixed Quantity Circulation with PID – Decreasing Demands

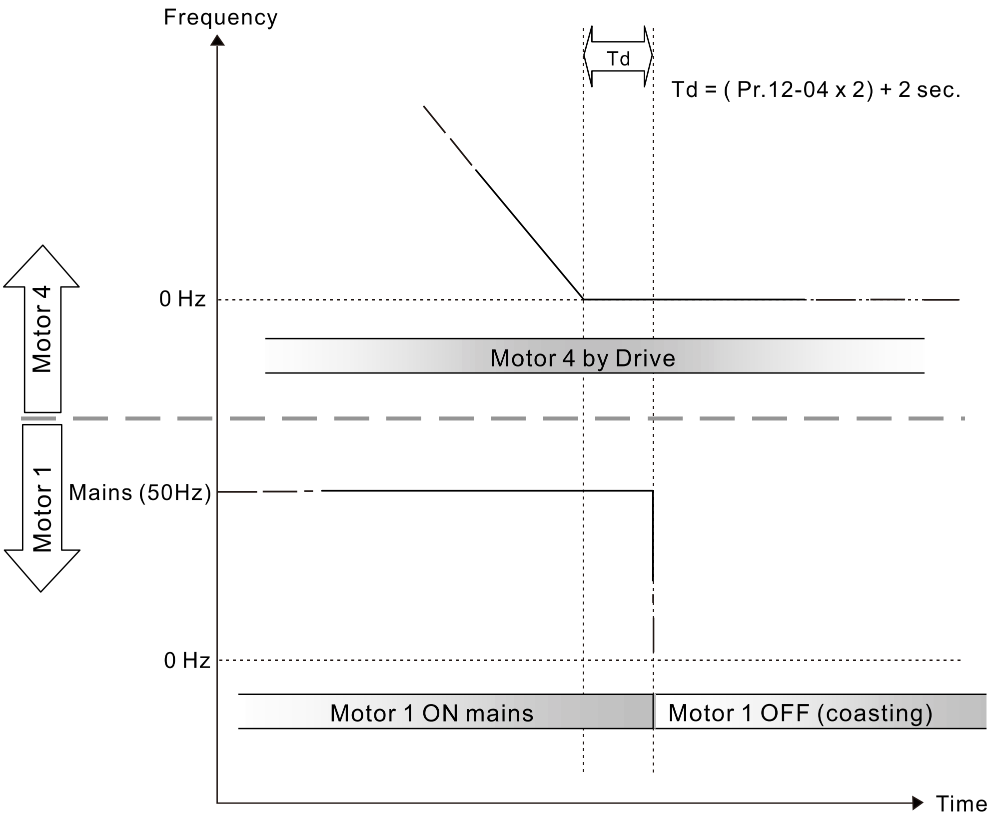


Diagram 12-6: Sequence of switching motors at Fixed Quantity Circulation with PID – Decreasing Demands

📖 Parameter Setting

<table>
<tr><th>Parameter setting</th><th>Description</th></tr>
<tr><td>Pr.12-00=2</td><td>Choose Fixed Quantity Circulation with PID</td></tr>
<tr><td>Pr.12-01=X</td><td>Number of Motors: maximum four motors. After you set the number of motors to be connected at the same time, the multi-function output terminals automatically follow the setting as shown in the table below.
<table>
<tr><td>Pr.12-01</td><td>01</td><td>01</td><td>02</td><td>02</td><td>03</td><td>03</td><td>04</td><td>04</td><td></td></tr>
<tr><td>Pr.02-13</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>Motor 1 by Drive</td></tr>
<tr><td>Pr.02-14</td><td></td><td>56</td><td>56</td><td>56</td><td>56</td><td>56</td><td>56</td><td>56</td><td>Motor 1 by Mains</td></tr>
<tr><td>Pr.02-15</td><td></td><td></td><td>57</td><td>57</td><td>57</td><td>57</td><td>57</td><td>57</td><td>Motor 2 by Drive</td></tr>
<tr><td>Pr.02-36</td><td></td><td></td><td></td><td>58</td><td>58</td><td>58</td><td>58</td><td>58</td><td>Motor 2 by Mains</td></tr>
<tr><td>Pr.02-37</td><td></td><td></td><td></td><td></td><td>59</td><td>59</td><td>59</td><td>59</td><td>Motor 3 by Drive</td></tr>
<tr><td>Pr.02-38</td><td></td><td></td><td></td><td></td><td></td><td>60</td><td>60</td><td>60</td><td>Motor 3 by Mains</td></tr>
<tr><td>Pr.02-39</td><td></td><td></td><td></td><td></td><td></td><td></td><td>61</td><td>61</td><td>Motor 4 by Drive</td></tr>
<tr><td>Pr.02-40</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>62</td><td>Motor 4 by Mains</td></tr>
</table>
Table 2: Setting of Multi-function Output Terminal on Circulating Motors</td></tr>
<tr><td>Pr.12-03=X</td><td>Delay Time due to the Acceleration (or the Increment) at Motor Switching (unit: sec.)</td></tr>
<tr><td>Pr.12-04=X</td><td>Delay Time due to the Deceleration (or the Decrement) at Motor Switching (unit: sec.)</td></tr>
<tr><td>Pr.12-05=X</td><td>Delay time while Fixed Quantity Circulation at Motor Switching with PID (unit: sec.)</td></tr>
<tr><td>Pr.12-06=X</td><td>Frequency when switching motors at Fixed Quantity Circulation (Hz)</td></tr>
<tr><td>Pr.12-09=X</td><td>Delay Time due to the Acceleration (or the Increment) at the next group of motor output.</td></tr>
</table>

📖 Disable Motor Output

Set the multi-function input commands to Disable Motors' Output can stop corresponding motors. The settings are:

Pr.02-01–Pr.02-06=	60	61	62	63	64	65	66	67	68
Disable Motor's Output	ALL	1	2	3	4	5	6	7	8

When a motor's output is disabled, this motor coasts to stop.

📖 Fixed Quantity Circulation with PID can control up to four motors. Diagram 12-7 below shows an example of controlling 4 motors.

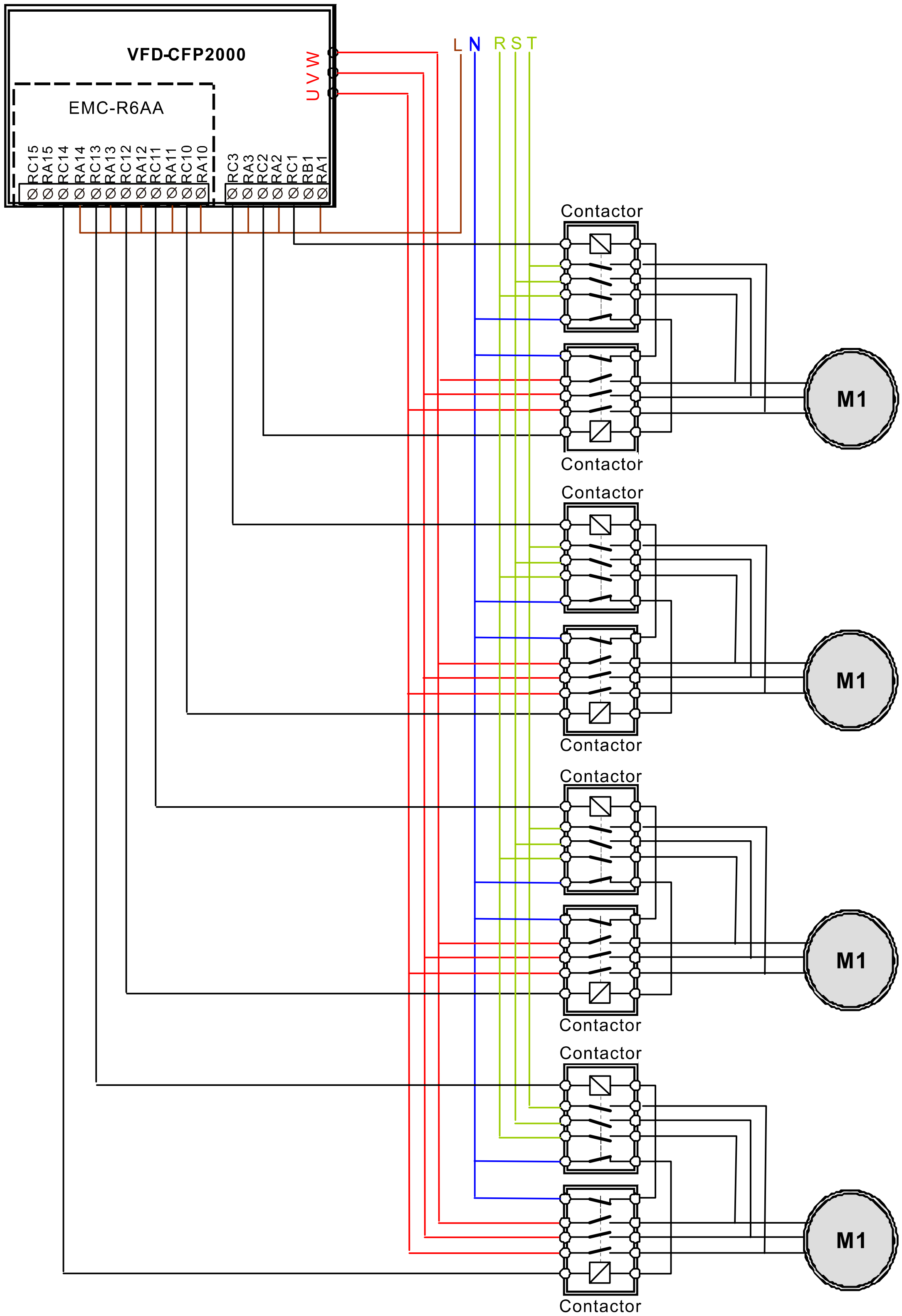


Diagram 12-7

✓ 12-06 Frequency when Switching Motors at Fixed Quantity Circulation (Hz)

Default: 60.00

Settings 0.0–599.00 Hz

Sets the drive's output frequency at which the system prepares to switch motors.

12-07 Action when Fixed Quantity Circulation Breaks Down

Default: 0

Settings 0: Turn off all output
1: Motors powered by mains electricity continues to operate

✓ 12-08 Frequency for Stopping Auxiliary Motor (Hz)

Default: 0.00

Settings 0.00–599.00 Hz

When the output frequency is smaller than the Pr.12-08 and remains at the time setting for Pr.12-04, the CFP2000 shuts down the motors one by one.

Fixed Quantity Control with PID

In this mode, the CFP2000 can control up to eight motors to increase flow quantity and pressure range control.

The CFP2000 connects directly to a main motor while the rest of the motors use mains electricity and are controlled by a relay. When controlling flow quantity, the motors are in parallel connection. When controlling pressure range, the motors are in series connection.

To increase the flow quantity or pressure range, the CFP2000 increases the main motor's pressure from 0 Hz to the largest operating frequency. If necessary, the CFP2000 switches the motors to use mains electricity in sequence. See sequential diagram 12-8 and 12-9.

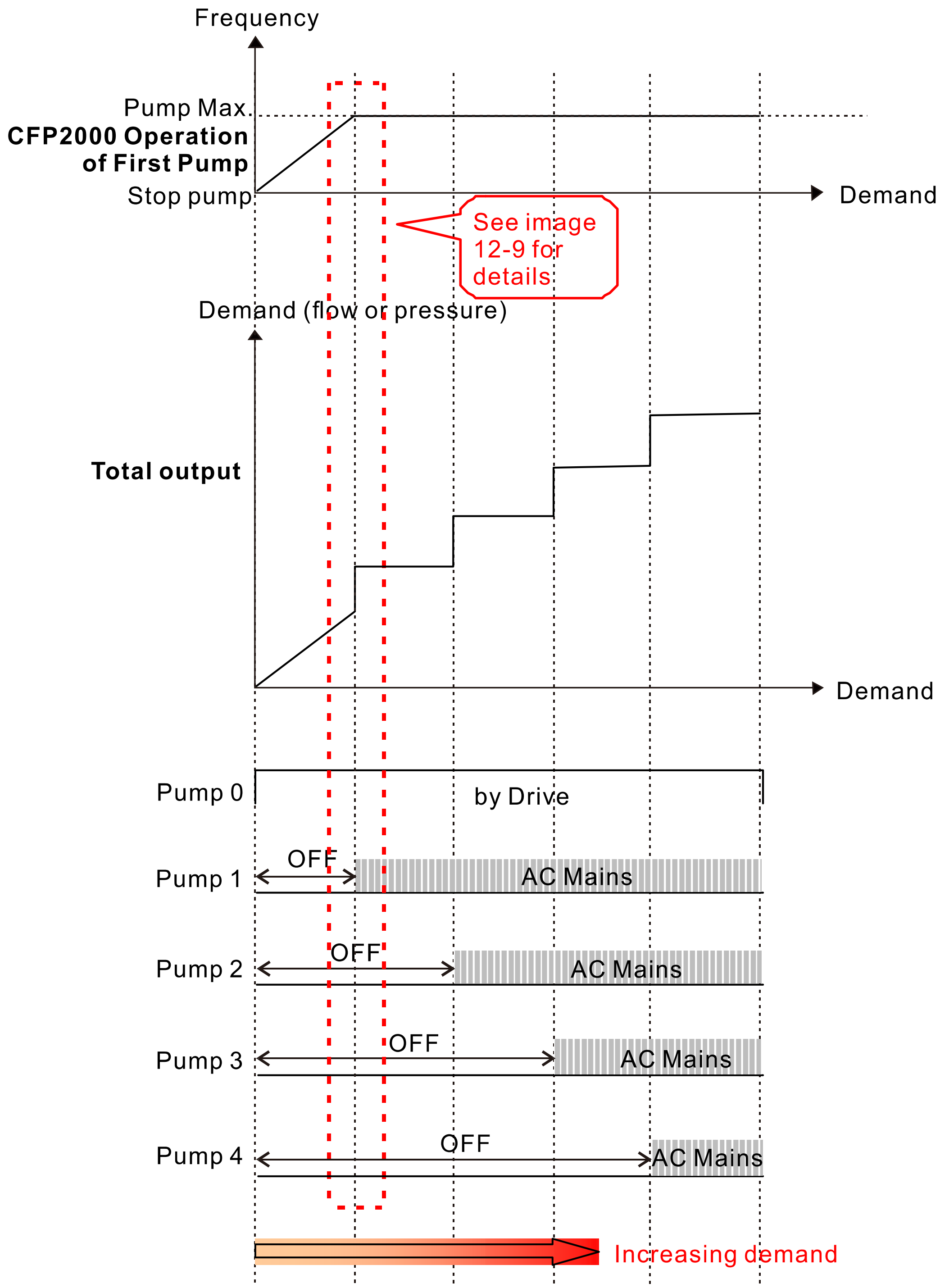


Diagram 12-8: Sequence of Fixed Quantity Control with PID – Increasing Demand

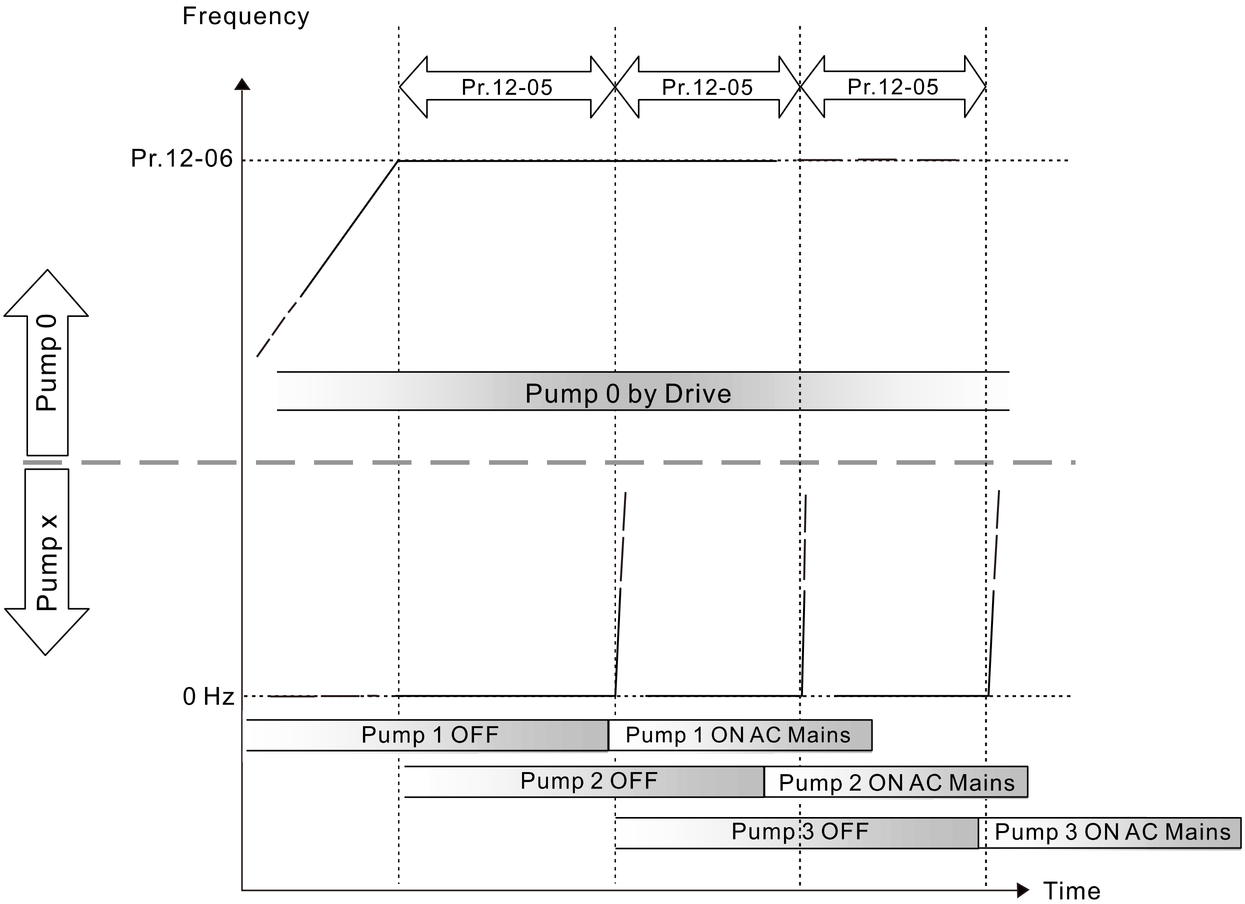


Diagram 12-9: Sequence of switching motors at Fixed Quantity Control with PID – Increasing Demand

However, if the flow quantity or pressure is too large, the CFP2000 stops, one by one, the motors use mains electricity until the CFP2000 decreases the main motor's frequency to 0 Hz. See Diagram 12-10 and Diagram 12-11.

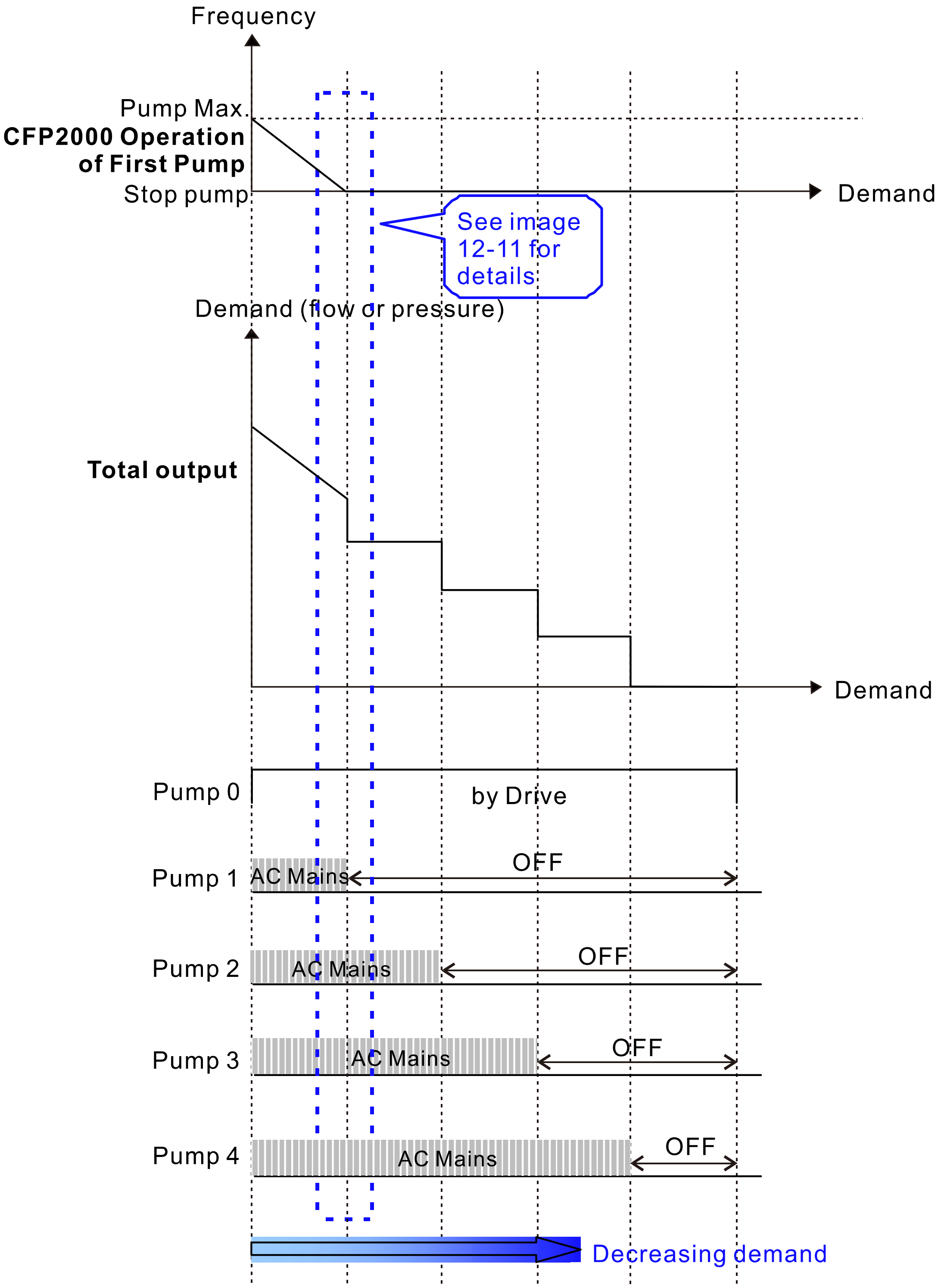


Diagram 12-10: Sequence of Fixed Quantity Control with PID – Decreasing Demand

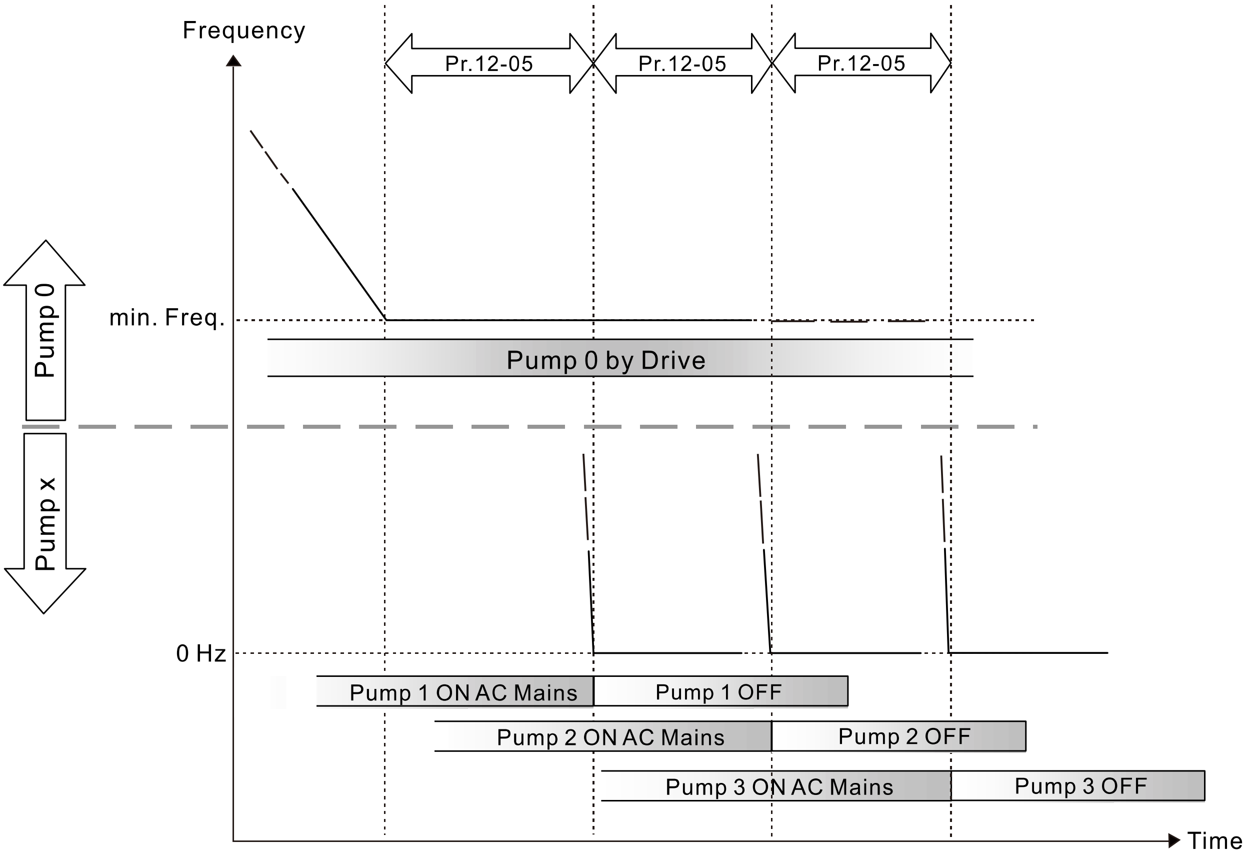


Diagram 12-11: Sequence of switching motors at Fixed Quantity Control with PID – Decreasing Demand

📖 Parameter setting:

<table>
<tr><th>Parameter Setting</th><th>Description</th></tr>
<tr><td>Pr.12-00=3</td><td>Choose Fixed Quantity Control</td></tr>
<tr><td>Pr.12-01=X</td><td>Number of Motors: maximum of eight motors. After you set the number of connected motors, the multi-function output terminals automatically follow the setting as shown in the table below.
<table>
<tr><td>Pr.12-01</td><td>01</td><td>02</td><td>03</td><td>04</td><td>05</td><td>06</td><td>07</td><td>08</td><td></td></tr>
<tr><td>Pr.02-13</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>55</td><td>Motor 1 by Mains</td></tr>
<tr><td>Pr.02-14</td><td></td><td>56</td><td>56</td><td>56</td><td>56</td><td>56</td><td>56</td><td>56</td><td>Motor 2 by Mains</td></tr>
<tr><td>Pr.02-15</td><td></td><td></td><td>57</td><td>57</td><td>57</td><td>57</td><td>57</td><td>57</td><td>Motor 3 by Mains</td></tr>
<tr><td>Pr.02-36</td><td></td><td></td><td></td><td>58</td><td>58</td><td>58</td><td>58</td><td>58</td><td>Motor 4 by Mains</td></tr>
<tr><td>Pr.02-37</td><td></td><td></td><td></td><td></td><td>59</td><td>59</td><td>59</td><td>59</td><td>Motor 5 by Mains</td></tr>
<tr><td>Pr.02-38</td><td></td><td></td><td></td><td></td><td></td><td>60</td><td>60</td><td>60</td><td>Motor 6 by Mains</td></tr>
<tr><td>Pr.02-39</td><td></td><td></td><td></td><td></td><td></td><td></td><td>61</td><td>61</td><td>Motor 7 by Mains</td></tr>
<tr><td>Pr.02-40</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>62</td><td>Motor 8 by Mains</td></tr>
</table>
Table 2: Setting of Multi-function Output Terminal on Circulating Motors</td></tr>
<tr><td>Pr.12-05=X</td><td>Delay time for Fixed Quantity Circulation at Motor Switching (seconds)</td></tr>
<tr><td>Pr.12-06=X</td><td>Frequency for switching motors at Fixed Quantity Circulation (Hz)</td></tr>
</table>

Disable Motor's Output

Set the multi-function input commands to Disable Motors' Output can stop the corresponding motors.

The settings are:

Pr.02-01–Pr.02-06=	60	61	62	63	64	65	66	67	68
Disable Motor's Output	ALL	1	2	3	4	5	6	7	8

When a motor's output is disabled, this motor coasts to stop.

Wiring: Fixed Quantity Control can control up to eight motors. Diagram 12-12 is an example of controlling four motors at the same time.

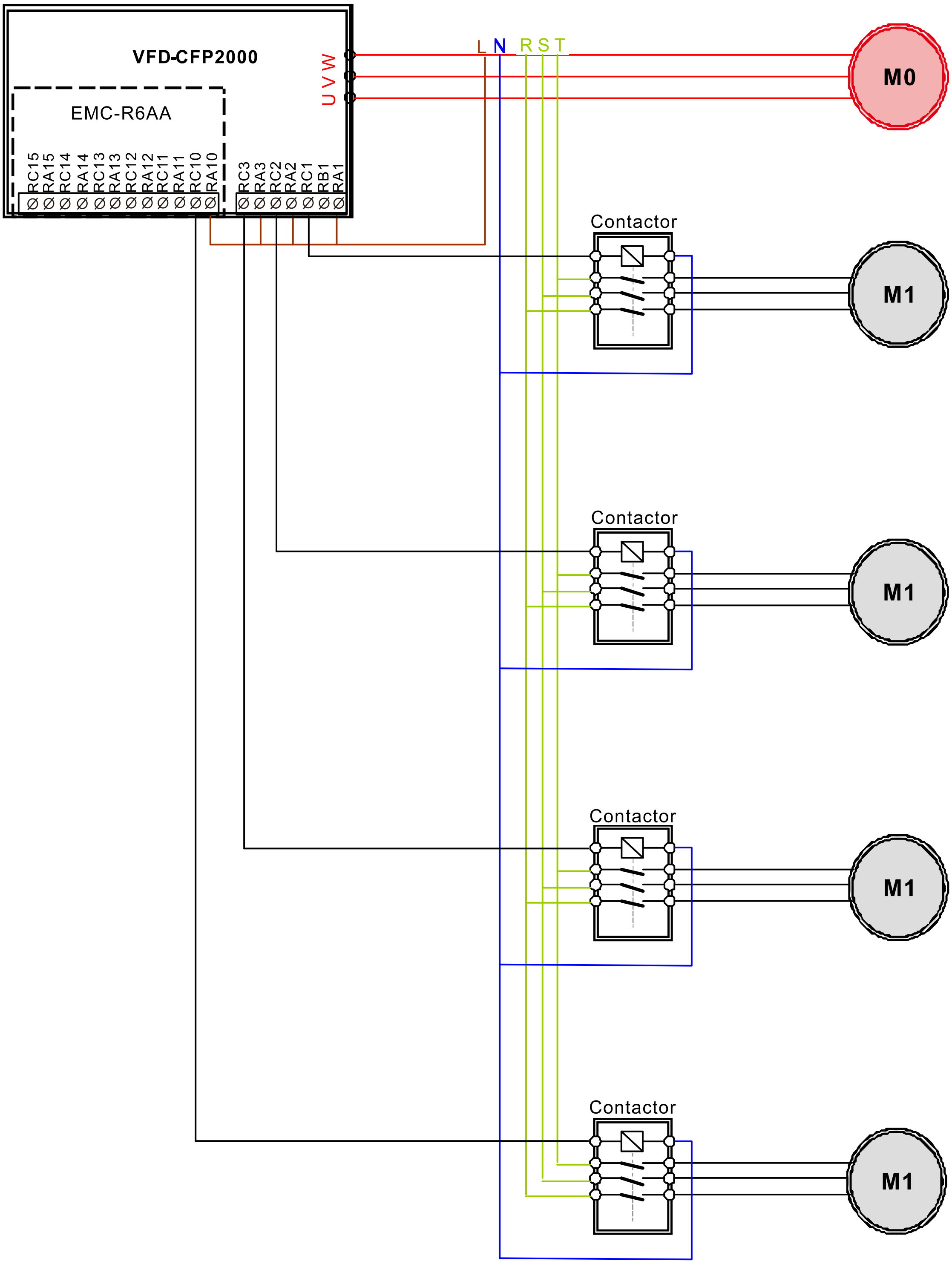


Diagram 12-12

📖 Fixed Time circulation and Fixed quantity circulation with PID

This mode combines Fixed Time Circulation and Fixed Quantity Circulation with PID. This is to prevent motors from becoming rusty if they are not in use for a long period of time. If some motors are not activated, set the fixed time circulation to run the motors one by one to make sure each of them is running.

If all the motors are running and the water pressure is sufficient, the fixed time circulation is not enabled. If motor 1 and motor 2 run to reach a balance in water pressure and the time reaches the setting for Pr.12-02, motor 1 runs without using mains electricity (runs by the motor drive) and motor 2 decelerates to stop.

When the motor 2 reaches the frequency setting at Pr.12-06 and the time setting for Pr.12-05, it separates from the motor drive (runs on mains electricity). When time reaches the setting for Pr.12-03, motor 2 runs using the mains electricity. Then when the time exceeds the setting for Pr.12-03, motor 3 is enabled by the motor drive. The time sequence Diagram 12-13 is shown as below.

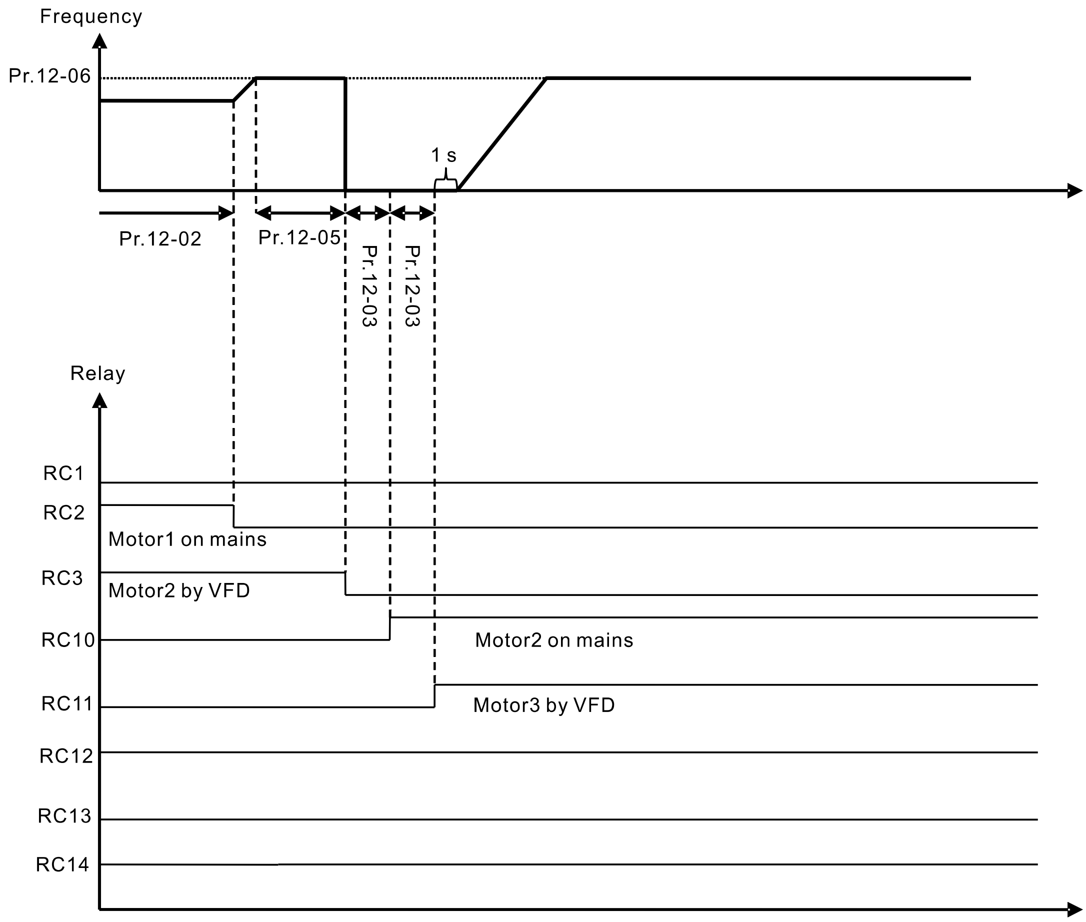


Diagram 12-13 Fixed Time Circulation and Fixed Quantity Control with PID

📖 Fixed Time Circulation and Fixed Quantity Control with PID

This mode combines Fixed Time Circulation and Fixed Quantity Control with PID. This is to prevent motors from becoming rusty if they are not in use for a long period of time. If some motors are not activated, set the fixed time circulation to run the motors one by one to make sure each of them is running.

When all the motors are running and water pressure is sufficient, the fixed time circulation is not enabled. If motor 1 and motor 2 run to reach a balance in water pressure and when the time reaches the setting for Pr.12-02, motor 1 runs without using mains electricity (run by the motor drive). When the time reaches the setting for Pr.12-03, motor 3 runs using mains electricity, and the operating time of each motor resets. Once it reaches the time setting for Pr.12-02 again, motor 2 runs without using mains electricity. Then when time reaches the setting for Pr.12-03, motor 4 runs using mains electricity. The time sequence Diagram 12-14 is as shown below

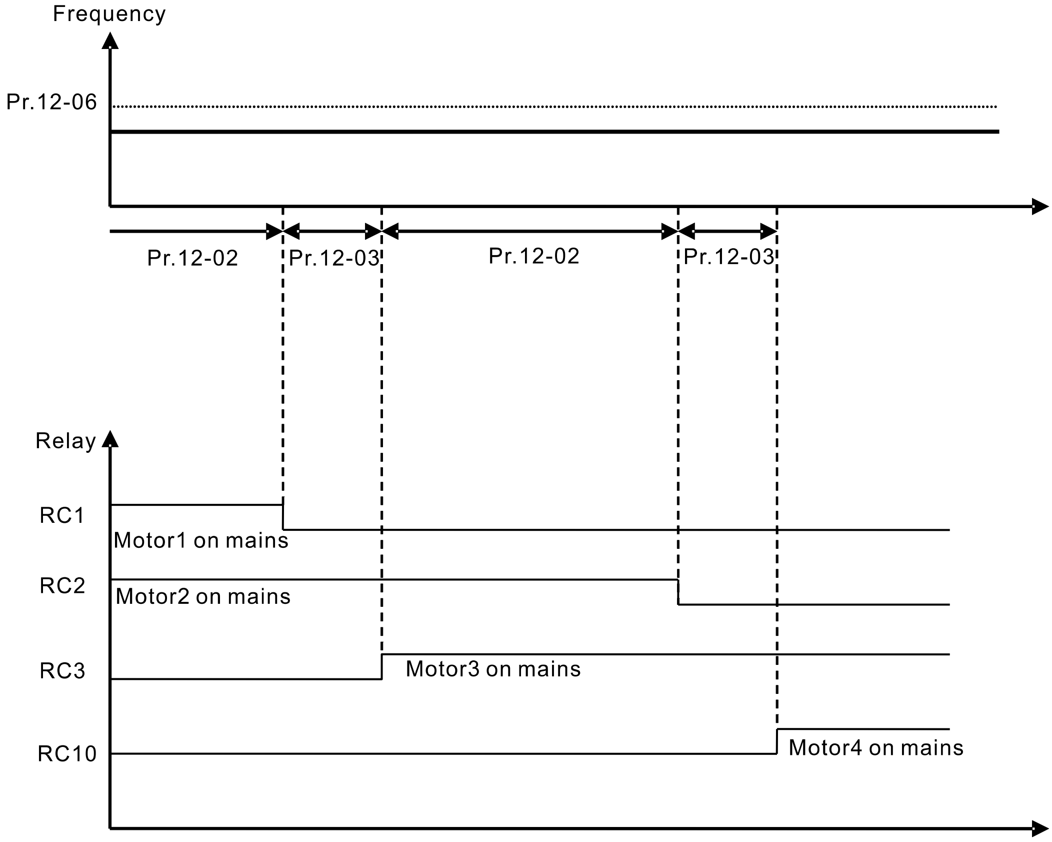


Diagram 12-14: Fixed Time Circulation under Fixed Amount Control Balance

12-09 Fixed Quantity Circulation Output Delay

Default: 1.0

Settings 1.0–3600.0 sec.

- Under Fixed Quantity Circulation (Increment) mode, the first motor of the drive switches to the supply mains through the setting time for Pr.12-03, then switches to the second motor through the setting delay time for Pr.12-09.

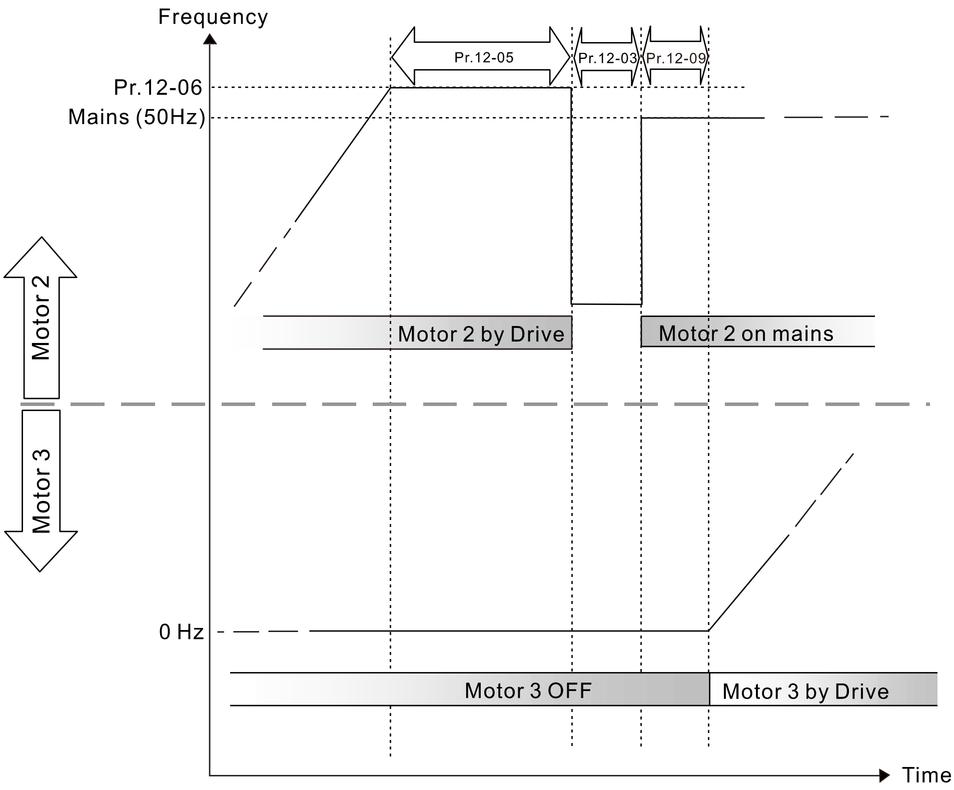


Diagram 12-15 Sequence of Fixed Quantity Circulation Output Delay

12 - 10 Motor 1 Operation Record (min. /sec.)
12 - 12 Motor 2 Operation Record (min. /sec.)
12 - 14 Motor 3 Operation Record (min. /sec.)
12 - 16 Motor 4 Operation Record (min. /sec.)
12 - 18 Motor 5 Operation Record (min. /sec.)
12 - 20 Motor 6 Operation Record (min. /sec.)
12 - 22 Motor 7 Operation Record (min. /sec.)
12 - 24 Motor 8 Operation Record (min. /sec.)

Default: Read only

Settings Read only

12 - 11 Motor 1 Operation Record (hour)
12 - 13 Motor 2 Operation Record (hour)
12 - 15 Motor 3 Operation Record (hour)
12 - 17 Motor 4 Operation Record (hour)
12 - 19 Motor 5 Operation Record (hour)
12 - 21 Motor 6 Operation Record (hour)
12 - 23 Motor 7 Operation Record (hour)
12 - 25 Motor 8 Operation Record (hour)

Default: Read only

Settings Read only

- These parameters record the operation time for Motor 1 to Motor 8. For examples, Pr.12-10 and Pr.12-11 both record the operation time for Motor 1. Pr.12-10 records the operation time in minutes and seconds, whereas Pr.12-11 records the operation time in hours. When Pr.12-10 displays 5959, it means the motor has operated for 59 minutes and 59 seconds. When the motor operates for an hour, Pr.12-11 displays 1 and Pr.12-10 displays 0.
- When circulation control Pr.12-00=1–5, the output frequency is > 0 Hz and output current is > 0 A, the motor operation time is recorded.
- When the record reaches the upper limit 65535 hours 59 minutes and 59 seconds, clear the motor operation time manually to keep tracking the operation status of each motor, and the service life of the motor.

Motor No. / Motor Operation Time	Hour	Min./Sec.	Clear Motor Operation Time
Motor 1	Pr.12-11 = 65535 ↓ 65535 hour	Pr.12-10 = 5959 ↓ 59 min.: 59 sec.	Pr.12-26=1
Motor 2	Pr.12-13	Pr.12-12	Pr.12-26=2
Motor 3	Pr.12-15	Pr.12-14	Pr.12-26=3
Motor 4	Pr.12-17	Pr.12-16	Pr.12-26=4
Motor 5	Pr.12-19	Pr.12-18	Pr.12-26=5
Motor 6	Pr.12-21	Pr.12-20	Pr.12-26=6
Motor 7	Pr.12-23	Pr.12-22	Pr.12-26=7
Motor 8	Pr.12-25	Pr.12-24	Pr.12-26=8
All motors	N/A	N/A	Pr.12-26=10

12-26 Clear Motor's Operation Time

Default: 0

Settings 0: No function

1: Clear operation time for motor 1

2: Clear operation time for motor 2

3: Clear operation time for motor 3

4: Clear operation time for motor 4

5: Clear operation time for motor 5

6: Clear operation time for motor 6

7: Clear operation time for motor 7

8: Clear operation time for motor 8

10: Clear operation time for all motors

- Clear the operation time for single motor or all motors as needed.
- 1: The operation time for Motor 1 returns to zero, including operation records in Pr.12-11 (hour) and Pr.12-10 (min. /sec.).
- 10: The operation time for Motor 1–8 (Pr.12-10–Pr.12-25) all return to zero.

12-27 Priority for Circulated Operation

Default: 0

Settings 0: Terminal order
1: Minimum operation time

- Terminal order: the multi-function output terminals corresponded to each circulation control mode (Pr.12-00=1–5).
- Minimum operation time: starts in the order from the motor with the minimum operating hours among all running motors.
- The minimum operation time is only applicable for operation time record under fixed time circulation mode (Pr.12-00=1), as listed in the circulation mode comparison table below.
- A comparison for each circulation mode

Function / Circulation Control Mode	Pr.12-00=1	Pr.12-00=2–5
Motor operation time record	v	v
Terminal order	v	v
Minimum operation time	v*	x

* When the drive resumes and starts running after stopping (or turning off) after operating for a period of time, the motor operates according to the minimum operation time. However, the first operating motor after resuming is the previous running motor before stop or turn-off. If you need to start the motors according to the minimum operation time in sequence immediately after resuming, close the minimum operation time (Pr.12-27=0) first and start (Pr.12-27=1) again.

- When Pr.12-00=1–5, the terminal order (Pr.12-27=0) is applicable for the operation time record under all the circulated control modes.
- When Pr.12-00=2–5, the terminal order (Pr.12-27=0) is the only available selection, and the minimum operation time (Pr.12-27=1) is invalid.
- When the minimum operation time (Pr.12-27=1) is enabled, the drive sorts the operation hours according to the amount of running motors at the moment, and then choose the motor that has the minimum operation hour to start after RUN command.

  As Example 1 below shows, the drive starts Motor 2, which having a minimum operation time among all eight motors.

  As Example 2 below shows, Motor 8 does not start though it has the minimum operation time, because only Motor 1 to Motor 5 are started. Moreover, if more than one motors have the same minimum operation hour, the number of the motor takes the priority. Therefore, Motor 3 starts rather than Motor 5.

Motor operation time-Example 1

Motor No. / Motor Status	Status	Operating Hour	Operating Min./ Sec.
Motor 1	ON	0	59 59
Motor 2	ON	0	12 12
Motor 3	ON	2	00 00
Motor 4	ON	0	43 11
Motor 5	ON	1	33 00

Motor 6	ON	3	50 05
Motor 7	ON	1	05 22
Motor 8	ON	10	20 21

Motor operation time-Example 2

Motor No. / Motor status	Status	Operating Hour	Operating Min./ Sec.
Motor 1	ON	0	59 59
Motor 2	ON	5	12 12
Motor 3	ON	0	33 00
Motor 4	ON	0	43 11
Motor 5	ON	0	33 00
Motor 6	OFF	3	50 05
Motor 7	OFF	1	05 22
Motor 8	OFF	0	00 01

13 Application Parameters by Industry

✓ This parameter can be set during operation.

13-00 Application Selection

Default: 0

Settings 0: Disabled

1: User-defined Parameter

2: Compressor IM

3: Fan

4: Pump

10: Air Handling Unit, AHU

- After you select the macro, some of the default values adjust automatically according to the application selection.
- Each setting varies with different application selection, and its value is different as well.
- Refer to Section 10-2 for more operation details.
- Group settings: 2: Compressor IM

The following table lists the relevant compressor application parameters.

Pr.	Explanation	Settings
00-11	Speed control mode	0: VF (IM V/F control)
00-16	Load selection	0: Light load
00-17	Carrier frequency	Default setting
00-20	Master frequency command source (AUTO) / Source selection of the PID target	2: External analog input
00-21	Operation command source (AUTO)	1: External terminals.
00-22	Stop method	0: Ramp to stop
00-23	Control of motor direction	1: Disable reverse
01-00	Maximum operation frequency	Default setting
01-01	Output frequency of motor 1	Default setting
01-02	Output voltage of motor 1	Default setting
01-03	Mid-point frequency 1 of motor 1	Default setting
01-04	Mid-point voltage 1 of motor 1	Default setting
01-05	Mid-point frequency 2 of motor 1	Default setting
01-06	Mid-point voltage 2 of motor 1	Default setting
01-07	Minimum output frequency of motor 1	Default setting
01-08	Minimum output voltage of motor 1	Default setting
01-11	Output frequency lower limit	20 (Hz)
01-12	Acceleration time 1	20 (s)
01-13	Deceleration time 1	20 (s)
03-00	Analog input selection (AVI1)	0: No function
03-01	Analog input selection (ACI)	1: Frequency command
05-01	Full-load current for induction motor 1 (A)	Default setting

Pr.	Explanation	Settings
05-03	Rated speed for induction motor 1 (rpm)	Default setting
05-04	Number of poles for induction motor 1	Default setting

📖 Group setting 03: Fan

The following table lists the relevant fan setting application parameters.

Pr.	Explanation	Settings
00-11	Speed control mode	0 (V/F control)
00-16	Load selection	0: Light load
00-17	Carrier frequency	Default setting
00-20	Master frequency command source (AUTO) / Source selection of the PID target	2: External analog input
00-21	Operation command source (AUTO)	1: External terminals.
00-22	Stop method	1: Coast to stop
00-23	Control of Motor Direction	1: Disable reverse
00-30	Master frequency command (HAND) source	0: Digital keypad
00-31	Operation command (HAND) source	0: Digital keypad
01-00	Maximum operation frequency	Default setting
01-01	Output frequency of motor 1	Default setting
01-02	Output voltage of motor 1	Default setting
01-03	Mid-point frequency 1 of motor 1	Default setting
01-04	Mid-point voltage 1 of motor 1	Default setting
01-05	Mid-point frequency 2 of motor 1	Default setting
01-06	Mid-point voltage 2 of motor 1	Default setting
01-07	Minimum output frequency of motor 1	Default setting
01-08	Minimum output voltage of motor 1	Default setting
01-10	Output frequency upper limit	50 (Hz)
01-11	Output frequency lower limit	35 (Hz
01-12	Acceleration time 1	15 (s)
01-13	Deceleration time 1	15 (s)
01-43	V/F curve selection	2: 2nd V/F curve
02-05	Multi-function input command 5 (MI5)	16: Rotating speed command from ACI
03-00	Analog input selection (AVI1)	1: Frequency command
03-01	Analog input selection (ACI)	1: Frequency command
03-28	AVI1 terminal input selection	0 (0–10 V)
03-29	ACI terminal input selection	1 (0–10 V)
03-31	AFM output selection	0 (0–10 V)
03-50	Analog input curve selection	1: three-point curve of AVI1
07-06	Restart after momentary power loss	2: Speed tracking by minimum output frequency
07-11	Number of times of restart after fault	5 (times)
07-33	Auto-restart interval of fault	60 (s)

📖 Group setting 04: Pump

The following table lists the relevant pump setting application parameters.

Pr.	Explanation	Settings
00-11	Speed control mode	0 (V/F mode)
00-16	Load selection	0: Light load
00-20	Master frequency command source (AUTO) / Source selection of the PID target	2: External analog input
00-21	Operation command source (AUTO)	1: External terminals.
00-23	Control of motor direction	1: Disable reverse
01-00	Maximum operation frequency	Default setting
01-01	Output frequency of motor 1	Default setting
01-02	Output voltage of motor 1	Default setting
01-03	Mid-point frequency 1 of motor 1	Default setting
01-04	Mid-point voltage 1 of motor 1	Default setting
01-05	Mid-point frequency 2 of motor 1	Default setting
01-06	Mid-point voltage 2 of motor 1	Default setting
01-07	Minimum output frequency of motor 1	Default setting
01-08	Minimum output voltage of motor 1	Default setting
01-10	Output frequency upper limit	50 (Hz)
01-11	Output frequency lower limit	35 (Hz)
01-12	Acceleration time 1	15 (s)
01-13	Deceleration time 1	15 (s)
01-43	V/F curve selection	2: 2nd V/F curve
07-06	Restart after momentary power loss	2: Speed tracking by minimum output frequency
07-11	Number of times of restart after fault	5 (times)
07-33	Auto-restart interval of fault	60 (s)

📖 Group setting 10: Air Handling Unit, AHU

The following table lists the relevant AHU setting application parameters.

Pr.	Explanation	Settings
00-04	Content of multi-function display	2
00-11	Speed control mode	0 (V/F control)
00-16	Load selection	0: Light load
00-20	Master frequency command source (AUTO) / Source selection of the PID target	2 or 0 (External analog input)
00-21	Operation command source (AUTO)	1 or 0 (External terminals)
00-22	Stop method	1: Coast to stop
00-23	Control of motor direction	1: Disable reverse
00-30	Master frequency command (HAND) source	0: Digital keypad
00-31	Operation command (HAND) source	0: Digital keypad

Pr.	Explanation	Settings
01-00	Maximum operation frequency	Default setting
01-01	Output frequency of motor 1	Default setting
01-02	Output voltage of motor 1	Default setting
01-07	Minimum output frequency of motor 1	Default setting
01-10	Output frequency upper limit	50 (Hz)
01-11	Output frequency lower limit	35 (Hz)
01-34	Zero-speed mode	2
01-43	V/F curve selection	2: 2nd V/F curve
02-05	Multi-function input command 5 (MI5)	16 or 17
02-13	Multi-function output 1 RLY1	11
02-14	Multi-function output 2 RLY2	1
03-00	Analog input selection (AVI1)	1
03-01	Analog input selection (ACI)	1: Frequency command
03-02	Analog input selection (AVI2)	1: Frequency command
03-28	AVI1 terminal input selection	0 (0–10 V)
03-29	ACI terminal input selection	1 (0–10 V)
03-20	Multi-function output 1 (AFM1)	0
03-23	Multi-function output 2（AFM2）	0
03-31	AFM1 current selection	0 or 1
03-34	AFM2 current selection	0 or 1
03-50	Analog input curve selection	4
07-06	Restart after momentary power loss	2 (Speed tracking by minimum output frequency)
07-11	Number of times of restart after fault	5 (times)
07-33	Auto-restart interval of fault	60 (s)

13-01
|
13-99 Application Parameter 1–99

Default: 0.00

Settings 0.00–655.35

14 Extension Card Parameter

✎ This parameter can be set during operation.

✎ **14-00** Extension Card Input Terminal Selection (AI10)

✎ **14-01** Extension Card Input Terminal Selection (AI11)

Default: 0

Settings 0: Disable

1: Frequency command

4: PID target value

5: PID feedback signal

6: Thermistor (PTC) input value

11: PT100 thermistor input value

13: PID compensation amount

- When the setting for Pr.14-00 and Pr.14-01 are the same, the AI10 is selected first.

✎ **14-08** Analog Input Filter Time (AI10)

✎ **14-09** Analog Input Filter Time (AI11)

Default: 0.01

Settings 0.00–20.00 sec.

- The input analog signal of terminal AI1 and AI2 often includes interferences, which will affect the stability of the control. Use these input delays to filter a noisy analog signal.
- When the setting for the time constant is too large, the control is stable but the control response is slow. When the setting for time constant is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting according to the control stability or the control response.

14-10 Analog Input 4–20 mA Signal Loss Selection (AI10)

14-11 Analog Input 4–20 mA Signal Loss Selection (AI11)

Default: 0

Settings 0: Disable

1: Continue operation at the last frequency

2: Decelerate to 0 Hz

3: Stop immediately and display ACE

- This parameter determines the treatment when the 4–20 mA signal is lost, when Pr.14-18 = 2, Pr.14-19 = 2.
- When the setting for Pr.14-18 or Pr.14-19 are 0 or 1, the voltage input to AVI and ACI terminal is 0–10 V or 4–20 mA. At this moment, Pr.14-10 and Pr.14-11 are invalid.
- Setting 1 or 2: Displays the warning code “ANL” on the keypad. It continues blinking until the lost ACI signal is recovered.
- When the motor drive stops, the warning condition does not continue to exist, so the warning disappears.

14-12 Extension Card Output Terminal Selection (AO10)

14-13 Extension Card Output Terminal Selection (AO11)

Default: 0

Settings 0–23

Refer to the function chart below for details setting.

Function Chart

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>0</td><td>Output frequency (Hz)</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>1</td><td>Frequency command (Hz)</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>2</td><td>Motor speed (Hz)</td><td>Maximum frequency Pr.01-00 is processed as 100%.</td></tr>
<tr><td>3</td><td>Output current (rms)</td><td>(2.5 x rated current) is processed as 100%</td></tr>
<tr><td>4</td><td>Output voltage</td><td>(2 x rated voltage) is processed as 100%</td></tr>
<tr><td>5</td><td>DC bus voltage</td><td>450V (900V)=100%</td></tr>
<tr><td>6</td><td>Power factor</td><td>-1.000–1.000=100%</td></tr>
<tr><td>7</td><td>Power</td><td>(2 x rated power) is processed as 100%</td></tr>
<tr><td>9</td><td>AVI1</td><td>0–10 V = 0–100%</td></tr>
<tr><td>10</td><td>ACI</td><td>4–20 mA = 0–100%</td></tr>
<tr><td>11</td><td>AVI2</td><td>-10–10 V = 0–100%</td></tr>
<tr><td>20</td><td>CANopen analog output</td><td>For CANopen communication analog output
<table><tr><th>Terminal</th><th>Corresponding address</th></tr><tr><td>AFM1</td><td>2026-A1</td></tr><tr><td>AFM2</td><td>2026-A2</td></tr><tr><td>AO10</td><td>2026-AB</td></tr><tr><td>AO11</td><td>2026-AC</td></tr></table></td></tr>
<tr><td>21</td><td>RS-485 analog output</td><td>For RS-485 (InnerCOM / Modbus) analog output
<table><tr><th>Terminal</th><th>Corresponding address</th></tr><tr><td>AFM1</td><td>26A0H</td></tr><tr><td>AFM2</td><td>26A1H</td></tr><tr><td>AO10</td><td>26AAH</td></tr><tr><td>AO11</td><td>26ABH</td></tr></table></td></tr>
<tr><td>22</td><td>Communication card analog output</td><td>For communication analog output (CMC-EIP01, CMC-PN01, CMC-DN01)
<table><tr><th>Terminal</th><th>Corresponding address</th></tr><tr><td>AFM1</td><td>26A0H</td></tr><tr><td>AFM2</td><td>26A1H</td></tr><tr><td>AO10</td><td>26AAH</td></tr><tr><td>AO11</td><td>26ABH</td></tr></table></td></tr>
<tr><td>23</td><td>Constant voltage output</td><td>Pr.14-20 and Pr.14-21 control voltage output level
0–100% of Pr.14-20 corresponds to 0–10 V of AO10.
0–100% of Pr.14-21 corresponds to 0–10 V of AO11.</td></tr>
</table>

14-14 Analog Output 1 Gain (AO10)

14-15 Analog Output 1 Gain (AO11)

Default: 100.0

Settings 0.0–500.0%

Adjusts the voltage level outputted to the analog meter from the analog signal (Pr.14-12, Pr.14-13) output terminal AFM of the drive.

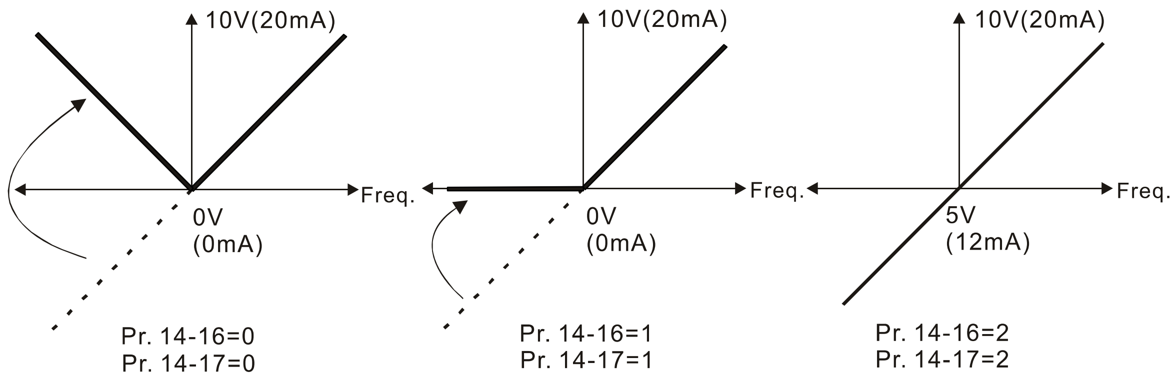
14-16 Analog Output 1 in REV Direction (AO10)

14-17 Analog Output 1 in REV Direction (AO11)

Default: 0

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

Determines the voltage reverse output when AO10 and AO11 are set as 0–10 V (Pr.14-36 = 0, Pr.14-37 = 0).



Analog Output Direction

14-18 Extension Card Input Selection (AI10)

Default: 0

Settings 0: 0–10 V (AVI10)
1: 0–20 mA (ACI10)
2: 4–20 mA (ACI10)

14-19 Extension Card Input Selection (AI11)

Default: 0

Settings 0: 0–10 V (AVI11)
1: 0–20 mA (ACI11)
2: 4–20 mA (ACI11)

When you change the input mode, verify that the switch position of external terminal (AI10, AI11) is correct.

14-20 AO10 DC Output Setting Level

14-21 AO11 DC Output Setting Level

Default: 0.00

Settings 0.00–100.00%

14-22 AO10 Filter Output Time

14-23 AO11 Filter Output Time

Default: 0.01

Settings 0.00–20.00 sec.

14-36 AO10 Output Selection

14-37 AO11 Output Selection

Default: 0

Settings 0: 0–10 V

1: 0–20 mA

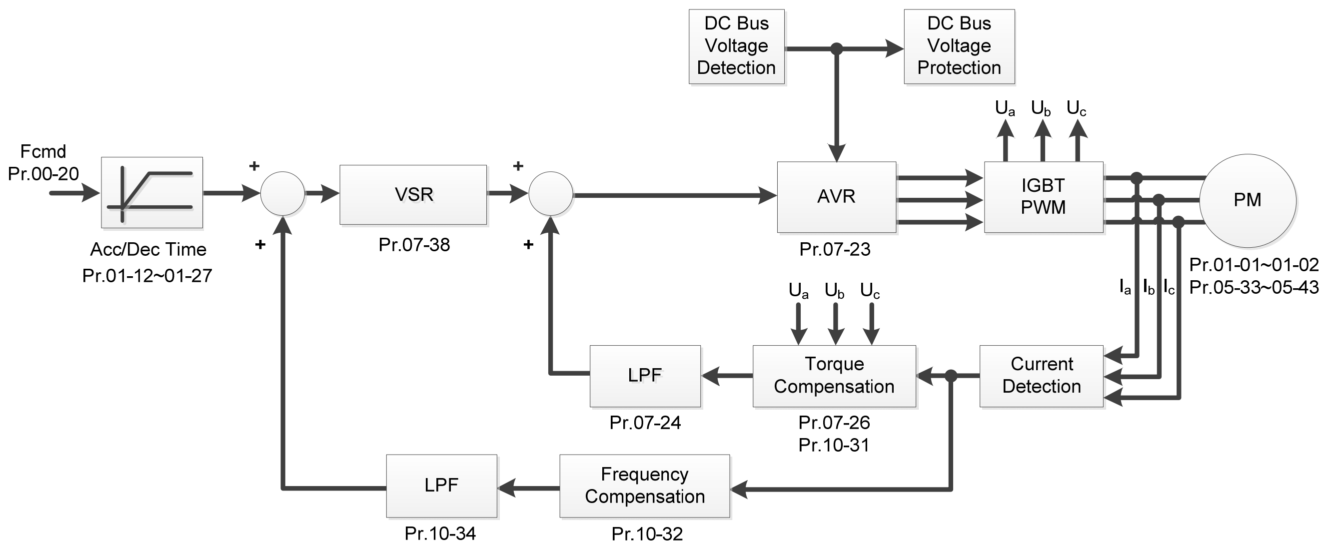
2: 4–20 mA

12-2 Adjustment & Application

Permanent Magnet Motor Space Vector Control (PM SVC) Pr.00-11=2

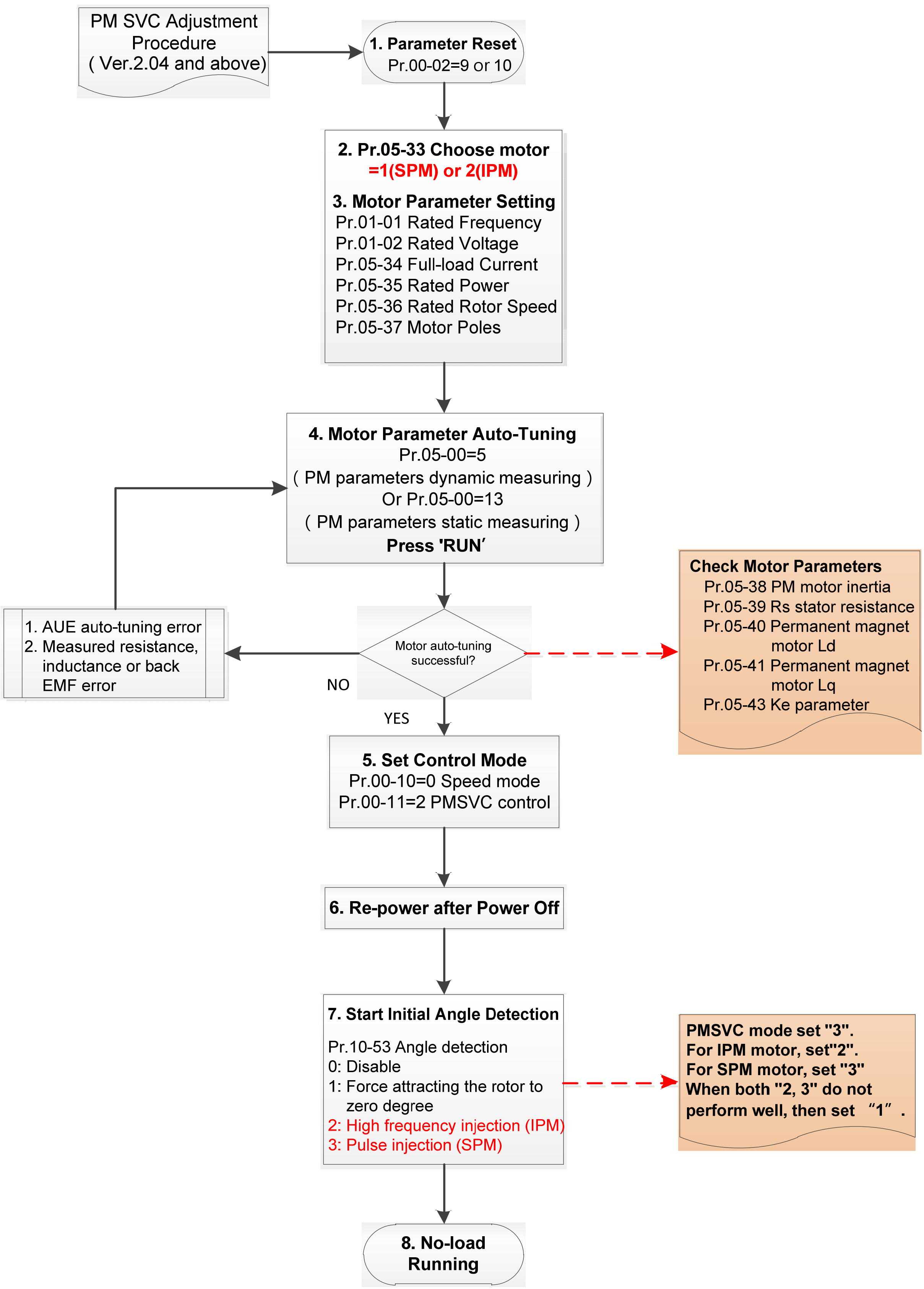
1. Control Diagram

   PM SVC control diagram



2. PM SVC Adjustment Procedure (※ the number marked on the procedure corresponds to the number of following adjustment explanations)

I. PM SVC motor parameters adjustment



📖 Basic Motor Parameters Adjustment

1. Parameter reset:

   Reset Pr.00-02=10 (60 Hz) to the default value.

2. Select PM motor type:

   Pr.05-33=1 (SPM) or 2 (IPM)

3. Motor nameplate parameter setting:

Parameter	Description
Pr.01-01	Rated frequency (Hz)
Pr.01-02	Rated voltage (V_{AC})
Pr.05-34	Rated current (A)
Pr.05-35	Rated power (kW)
Pr.05-36	Rated rotor speed (rpm)
Pr.05-37	Number of poles for the motor (poles)

4. PM parameter auto-tuning:

5. Set Pr.05-00=5 (Rolling auto-tuning for PM) or 13 (Static auto-tuning for PM) and press "RUN" key to finish motor auto-tuning, then you will get the following parameters:

Parameter	Description
Pr.05-39	Stator resistance for a permanent magnet motor (Ω)
Pr.05-40	Permanent magnet motor Ld (mH)
Pr.05-41	Permanent magnet motor Lq (mH)
Pr.05-43	Ke parameter of a permanent magnet motor ($V_{phase\ \cdot\ rms}$ / krpm) (When Pr.05-00=5, the Ke parameter is measured based on the actual motor rotation.) (When Pr.05-00=13, the Ke parameter is automatically calculated based on the motor power, current and rotor speed.)

   If an auto-tuning error (AUE) occurs, refer to Section 14 "Fault Codes and Descriptions" for further treatment.

AUE Error (code)	Description
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (Motor phase loss error)

6. Set control mode

   Control mode for the drive: Pr.00-10 = 0: Speed mode

   Control mode for the motor: Pr.00-11 = 2: PM SVC mode

7. Measure the initial magnetic pole angle of PM

   Set Pr.10-53 PM initial rotor position detection method

   0: Disable

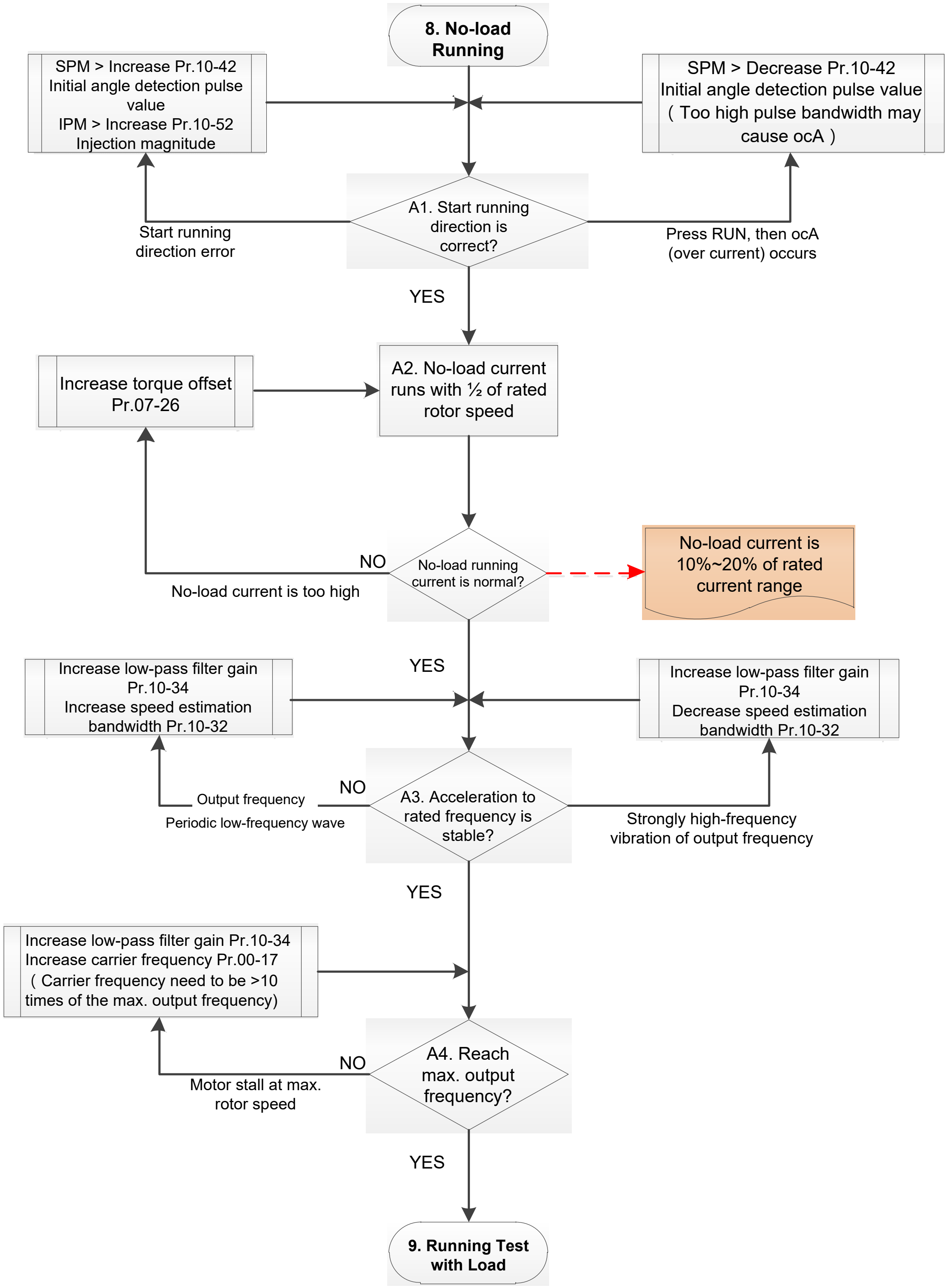
   1: Force attracting the rotor to zero degrees

   2: High frequency injection

   3: Pulse injection

   (Set to 2 for IPM; set to 3 for SPM. If these settings cause problems, then set the parameter to 1.)

II. PMSVC Adjustment for Operation without Load / with Light-load



📖 Adjustment for Operation with Light-load

8. Start the motor with no-load / light-load, and operates to 1/2 of the rated rotor speed

A1. Start operation direction:

a. If the start operation direction is wrong

SPM: increase the current proportion for Pr.10-42 (Initial angle detection pulse value) to improve the accuracy of the angle detection.

IPM: Increase the voltage for Pr.10-52 (Injection magnitude) to improve the accuracy of the angle detection.

b. If an ocA error occurs when pressing RUN to start the motor, decrease the current proportion for Pr.10-42 (Initial angle detection pulse value). An excessive pulse current may cause ocA error easily.

A2. Operates the motor in 1/2 of the rated rotor speed, adjust the no-load operating current

If the no-load operating current exceeds 20% of the rated current, increase Pr.07-26 (Torque compensation gain) and observe the no-load operating current.

A3. Accelerate to rated frequency and observe if the motor operates stably.

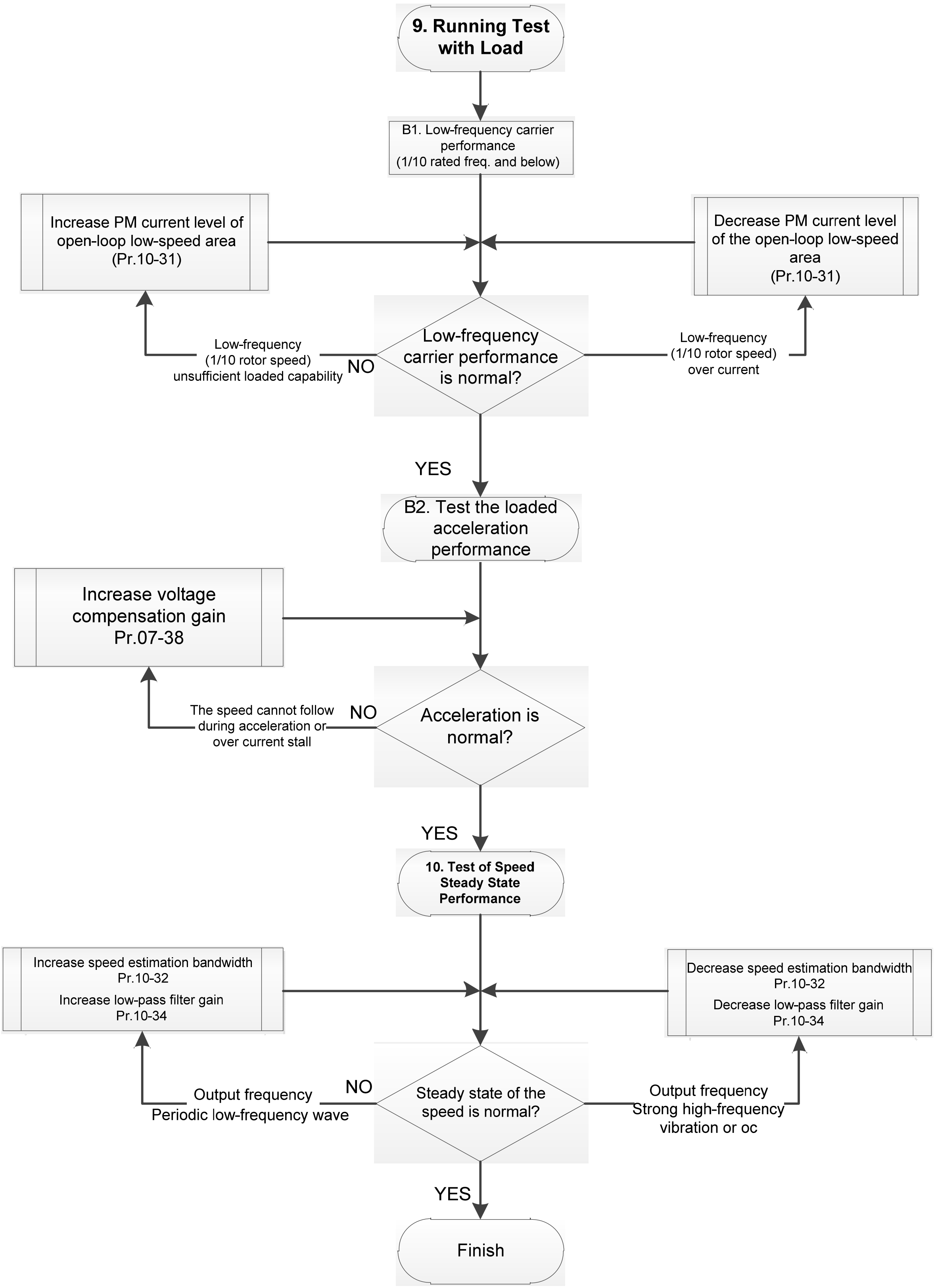
a. If the motor output rotor speed presents periodic low-frequency wave, increase Pr.10-34 (PM sensorless speed estimator low-pass filter gain), or increase Pr.10-32 (PM FOC sensorless speed estimator bandwidth).

b. If the output frequency reflects high-frequency vibration, decrease Pr.10-34 or decrease Pr.10-32.

A4. Accelerate the motor to the maximum rotor speed, and observe if it operates stably.

If the motor stalls when accelerating to the maximum rotor speed, then increase Pr.10-34 PM Sensorless Speed Estimator Low-pass Filter Gain, or increase Pr.00-17 Carrier Frequency (you must set the carrier frequency larger than 10 times of the maximum output frequency)

III. PM SVC Carrier Start-up Adjustment



📖 Heavy Load Operation Adjustment

9. Load operating test

B1. Low-frequency loading performance is below 1/10 of rated frequency:

a. If the low-frequency loading performance is insufficient, or the rotor speed is not smooth, increase Pr.10-31 (Current command of I/F mode).
b. If the low-frequency current is large, decrease Pr.10-31 (Current command of I/F mode).

B2. Test the with-load accelerating performance:

When the motor operates in 1/10 of rotor speed and above, if the speed cannot follow the acceleration time during accelerating, or the current stalls, increase Pr.07-38 (PMSVC voltage feedback forward gain).

10. Stability test at constant speed operation: if the motor operates stably at constant speed

a. If the motor output rotor speed presents periodic low-frequency wave, increase Pr.10-34 (PM sensorless speed estimator low-pass filter gain), or increase Pr.10-32 (PM FOC sensorless speed estimator bandwidth).
b. If the output frequency reflects high-frequency vibration, decrease Pr.10-34 or decrease Pr.10-32.

12-2-2-1 PMSVC Related Parameters

Refer to Section 12-1 Description of Parameter Settings for more details.

Parameter	Description	Unit	Default	Setting Range
Pr.07-24	Torque command filter time	sec.	0.500	0.001–10.000
Pr.07-26	Torque compensation gain	N/A	0	0–5000
Pr.07-38	PMSVC voltage feedback forward gain	N/A	1.00	0.00–2.00
Pr.10-31	I/F mode, current command	%	40	0–150
Pr.10-32	PM FOC sensorless speed estimator bandwidth	Hz	5.00	0.00–600.00
Pr.10-34	PM sensorless speed estimator low-pass filter gain	N/A	1.00	0.00–655.35
Pr.10-39	Frequency point to switch from I/F mode to PM sensorless mode	Hz	20.00	0.00–599.00
Pr.10-40	Frequency point to switch from PM sensorless mode to V/F mode	Hz	20.00	0.00–599.00
Initial Angle Estimating Parameters				
Pr.10-42	Initial angle detection pulse value	N/A	1.0	0.0–3.0
Pr.10-51	Injection frequency	Hz	500	0–1200
Pr.10-52	Injection magnitude	V	15.0 / 30.0	0.0–200.0
Pr.10-53	PM initial rotor position detection method 0: Disable 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	N/A	0	0–3

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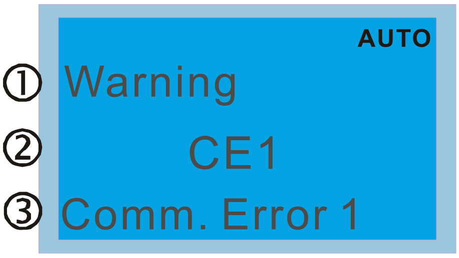
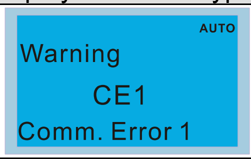
Chapter 13 Warning Codes



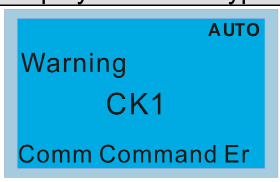
① Display error signal

② Abbreviate error code

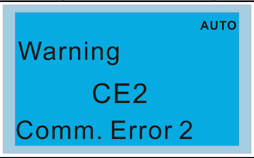
③ Display error description

ID No.	Display on LCD Keypad	Warning Name	Description
1		Communication error 1 (CE1)	RS-485 Modbus illegal function code

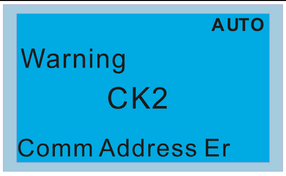
Action and Reset	
Action level	When the function code is not 03, 06, 10 and 63
Action time	Immediately act
Warning setting parameter	N/A
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct function code.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
Incorrect communication command from upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

Display on LCD Keypad	Warning Name	Description
	Communication command error 1 (CK1)	Keypad communication data, illegal function code (Keypad auto-detect this error and display it.)

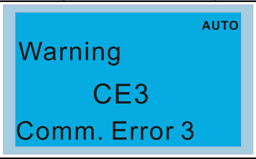
Action and Reset	
Action level	When the function code is not 03, 06, 10 and 63
Action time	Immediately act
Warning setting parameter	N/A
Reset method	Remove the keypad and then reconnect it to the motor drive.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
Incorrect communication command from keypad	Keypad and the motor drive don't communicate properly. It is recommended to remove the keypad and then reconnect it to the motor drive.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from keypad	Check if the Baud rate = 19200 bps. Format = RTU8, N, 2.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Display on LCD Keypad	Warning Name	Description
2		Communication error 2 (CE2)	RS-485 Modbus illegal data address

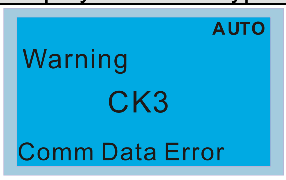
Action and Reset	
Action level	When the input data address is incorrect
Action time	Immediately act
Warning setting parameter	N/A
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct data address.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
Incorrect communication command from upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

Display on LCD Keypad	Warning Name	Description
	Communication address error (CK2)	Keypad communication data, illegal data address (Keypad auto-detect this error and display it.)

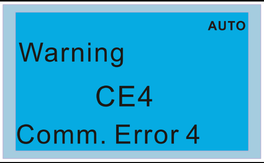
Action and Reset	
Action level	When the input data address is incorrect
Action time	Immediately act
Warning setting parameter	N/A
Reset method	Remove the keypad and then reconnect it to the motor drive.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
Incorrect communication command from keypad	Keypad and the motor drive don't communicate properly. It is recommended to remove the keypad and then reconnect it to the motor drive.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from keypad	Check if the Baud rate = 19200 bps. Format = RTU8, N, 2.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

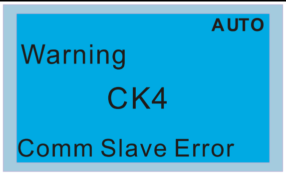
ID No.	Display on LCD Keypad	Warning Name	Description
3		Communication error 3 (CE3)	RS-485 Modbus illegal data value

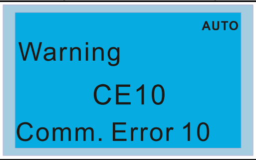
Action and Reset	
Action level	When the length of communication data is too long
Action time	Immediately act
Warning setting parameter	N/A
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct communication data value.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
Incorrect communication command from upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

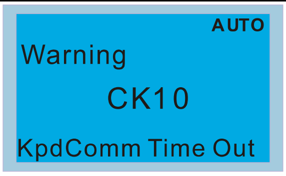
Display on LCD Keypad	Warning Name	Description
	Communication data error (CK3)	Keypad communication data, illegal data value (Keypad auto-detect this error and display it.)

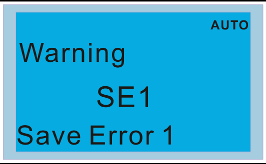
Action and Reset	
Action level	When the length of communication data is too long
Action time	Immediately act
Warning setting parameter	N/A
Reset method	Remove the keypad and then reconnect it to the motor drive.
Reset condition	Immediately reset
Record	N/A
Cause	**Corrective Actions**
Incorrect communication command from keypad	Keypad and the motor drive don't communicate properly. It is recommended to remove the keypad and then reconnect it to the motor drive.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from keypad	Check if the Baud rate = 19200 bps. Format = RTU8, N, 2.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

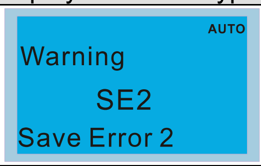
ID No.	Display on LCD Keypad	Warning Name	Description
4		Communication error 4 (CE4)	RS-485 Modbus data is written to read-only address
Action and Reset			
Action level		When the data is written to read-only address	
Action time		Immediately act	
Warning setting parameter		N/A	
Reset method		"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct written address of communication data.	
Reset condition		Immediately reset	
Record		N/A	
Cause		Corrective Actions	
Incorrect communication command from upper unit		Check if the communication command is correct.	
Malfunction caused by interference		Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
Different communication setting from the upper unit		Check if the setting for Pr.09-02 is the same as the setting for the upper unit.	
Disconnection or bad connection of the cable		Check the cable and replace it if is necessary.	

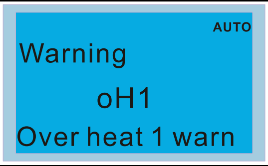
Display on LCD Keypad	Warning Name	Description
	Communication slave error (CK4)	Keypad communication data is written to read-only address. (Keypad auto-detect this error and display it.)
Action and Reset		
Action level	When the data is written to read-only address	
Action time	Immediately act	
Warning setting parameter	N/A	
Reset method	Remove the keypad and then reconnect it to the motor drive.	
Reset condition	Immediately reset	
Record	N/A	
Cause	Corrective Actions	
Incorrect communication command from keypad	Keypad and the motor drive don't communicate properly. It is recommended to remove the keypad and then reconnect it to the motor drive. If the problem persists after reconnecting the keypad, pay attention to the motor drive status. For example: Motor drive might reset to default setting during operation or while enabling PLC function.	
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
Different communication setting from keypad	Check if the Baud rate = 19200 bps. Format = RTU8, N, 2.	
Disconnection or bad connection of the cable	Check the cable and replace it if is necessary.	

<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>5</td><td>
</td><td>Communication error 10 (CE10)</td><td>RS-485 Modbus transmission time-out</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">When the communication time exceeds the detection time of Pr.09-03 communication time-out</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Setting for Pr.09-03</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">“Warning” occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the next communication packet.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">The upper unit does not transmit the communication command within Pr.09-03 setting time</td><td colspan="2">Check if the upper unit transmits the communication command within the setting time for Pr.09-03.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.</td></tr>
<tr><td colspan="2">Different communication setting from the upper unit</td><td colspan="2">Check if the setting for Pr.09-02 is the same as the setting for the upper unit.</td></tr>
<tr><td colspan="2">Disconnection or bad connection of the cable</td><td colspan="2">Check the cable and replace it if necessary.</td></tr>
</table>

<table>
<tr><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>
</td><td>Keypad communication time out (CK10)</td><td>Keypad communication data, transmission time-out
(Keypad auto-detect this error and display it.)</td></tr>
<tr><th colspan="3">Action and Reset</th></tr>
<tr><td>Action level</td><td colspan="2">When the communication time exceeds the detection time of Pr.09-03 communication time-out</td></tr>
<tr><td>Action time</td><td colspan="2">Setting for Pr.09-03</td></tr>
<tr><td>Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td>Reset method</td><td colspan="2">Remove the keypad and then reconnect it to the motor drive.</td></tr>
<tr><td>Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td>Record</td><td colspan="2">N/A</td></tr>
<tr><th>Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td>Incorrect communication command from keypad</td><td colspan="2">Keypad and the motor drive don’t communicate properly. It is recommended to remove the keypad and then reconnect it to the motor drive.</td></tr>
<tr><td>Malfunction caused by interference</td><td colspan="2">Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.</td></tr>
<tr><td>Different communication setting from keypad</td><td colspan="2">Check if the Baud rate = 19200 bps. Format = RTU8, N, 2.</td></tr>
<tr><td>Disconnection or bad connection of the cable</td><td colspan="2">Check the cable and replace it if necessary.</td></tr>
</table>

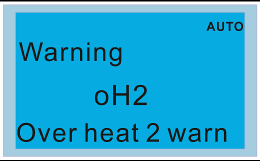
ID No.	Display on LCD Keypad	Warning Name	Description
7		Save error 1 (SE1)	Keypad COPY error 1: Keypad copy time-out
Action and Reset			
Action level	“SE1” warning occurs when the keypad does not transmit the COPY command to the drive, and does not transmit any data to the drive again in 10 ms at the time you copy the parameters to the drive.		
Action time	10 ms		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Communication connection error	SE1: The causes of error are mostly communication problems between the keypad and control board. Potential causes include communication signal interference and the unacceptable communication command to the Slave. Check if the error occurs randomly, or only occurs when copying certain parameters (the error displays on the upper right corner of the copy page). If you cannot clear the error, please contact Delta.		
Keypad error			
Control board error			

ID No.	Display on LCD Keypad	Warning Name	Description
8		Save error 2 (SE2)	Keypad COPY error 2: parameter writing error
Action and Reset			
Action level	“SE2” warning occurs when writing the parameters incorrectly at the time you copy parameters to the drive. For example, you copy the new firmware version with added parameters to the drive with old firmware version.		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Add new parameters to the new firmware version.	SE2: In this stage, the copied data has been transmitted to the Slave. The Slave compares and processes the copied data, and then saves the data to the Data ROM. During the process, the data error (should be attribution error) may occur, or the data cannot be saved to EEPROM. At this time, the warning occurs. It is suggested to check the status of Data ROM and remove the error causes first. If you cannot clear the error, please contact Delta.		
Malfunction caused by interference	Verify the wiring and grounding of the main circuit, control circuit and the encoder for effective anti-interference performance.		

ID No.	Display on LCD Keypad	Warning Name	Description
9		IGBT over-heating warning (oH1)	The AC motor drive detects over-heating of IGBT, and over the protection level of oH1 warning. (When Pr.06-15 is higher than the IGBT over-heating level, the drive shows oH1 error without displaying oH1 warning.)

Action and Reset	
Action level	Pr.06-15
Action time	"oH1" warning occurs when IGBT temperature is higher than Pr.06-15 setting value.
Warning setting parameter	N/A
Reset method	Auto-reset
Reset condition	The drive auto-resets when IGBT temperature is lower than oH1 warning level minus (–) 5°C
Record	N/A

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading	1. Decrease loading. 2. Decrease the carrier. 3. Replace with a drive with larger capacity.
The drive has run 100% or more of the rated output for a long time	Replace with a drive with larger capacity.

ID No.	Display on LCD Keypad	Warning Name	Description
10		Capacitor over-heat warning (oH2)	The drive has detected over heat of the capacitor

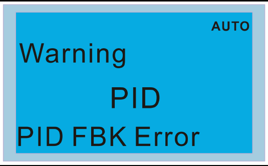
Action and Reset	
Action level	oH2 error level minus (–) 5°C
Action time	The oH2 warning occurs when the capacitor temperature is higher than oH2 warning level
Warning setting parameter	N/A
Reset method	Auto-reset
Reset condition	The drive auto-resets when the capacitor temperature is lower than oH2 error level minus (–) 10°C
Record	N/A

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponded loading	1. Decrease loading. 2. Decrease the carrier. 3. Replace with a drive with larger capacity.
The drive has run 100% or more of the rated output for a long time	Replace with a drive with larger capacity.
Unstable power	Install reactor(s).
The load changes frequently	Reduce the changes of the load.

oH1/ oH2 warning level

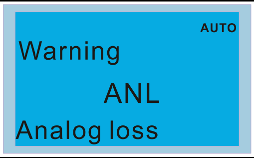
Model	oH1	oH2	oH warning oH1 warning = (Pr. 06-15)
VFD007FP4EA-41/52/52S	110	85	oH1 Warning = Pr.06-15 oH2 Warning = oH2 – 5
VFD015FP4EA-41/52/52S			
VFD022FP4EA-41/52/52S	100		
VFD037FP4EA-41/52/52S			
VFD040FP4EA-41/52/52S			
VFD055FP4EA-41/52/52S			
VFD075FP4EA-41/52/52S			
VFD110FP4EA-41/52/52S	105	90	
VFD150FP4EA-41/52/52S			
VFD185FP4EA-41/52/52S			
VFD220FP4EA-41/52/52S			
VFD300FP4EA-41/52/52S	110	97	
VFD370FP4EA-41/52/52S			
VFD450FP4EA-41/52/52S	100	90	
VFD550FP4EA-41/52/52S			
VFD750FP4EA-41/52/52S	95	85	
VFD900FP4EA-41/52/52S			

Unit: °C

ID No.	Display on LCD Keypad	Warning Name	Description
11		PID feedback error (PID)	PID feedback loss (warning for analog feedback signal; works only when PID enables)

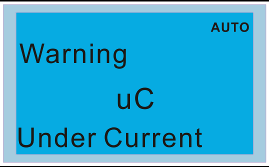
Action and Reset		
Action level		When the analog input is lower than 4mA (only detects analog input of 4–20mA)
Action time		Pr.08-08
Warning setting parameter		Pr.08-09 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency
Reset method	Auto	“Warning” occurs when Pr.08-09=0 or 3. The “Warning” automatically clears when the feedback signal is larger than 4mA.
	Manual	“Error” occurs when Pr.08-09=1 or 2. You must reset manually.
Reset condition		Immediately reset
Record		Records when Pr.08-09=1 or 2 (“Error”). Does not record when Pr.08-09=3 (“Warning”).

Cause	Corrective Actions
Loose or broken PID feedback wiring	Tighten the terminals again. Replace with a new cable.
Feedback device malfunction	Replace with a new feedback device.
Hardware error	If the PID error still occurs after checking all the wiring, return to the factory for repair.

ID No.	Display on LCD Keypad	Warning Name	Description
12		ACI analog signal loss (AnL)	Analog input current loss (including all analog 4–20mA signals)

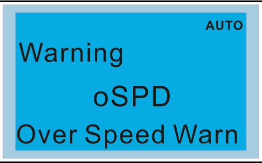
Action and Reset		
Action level		When the analog input is lower than 4mA (only detects analog input 4–20mA)
Action time		Immediately act
Warning setting parameter		Pr.03-19 0: Disable 1: Continue operation at the last frequency (warning, keypad displays ANL) 2: Decelerate to 0 Hz (warning, keypad displays ANL) 3: Stop immediately and display ACE
Reset method	Auto	“Warning” occurs when Pr.03-19=1 or 2. The “Warning automatically clears when the analog input signal is larger than 4 mA.
	Manual	“Error” occurs when Pr.03-19=3. You must reset manually.
Reset condition		Immediately reset
Record		Does not record when Pr.03-19=1 or 2 (“Warning”).

Cause	Corrective Actions
Loose or broken ACI wiring	Tighten the terminals again. Replace with a new cable.
External device error	Replace new device.
Hardware error	If the AnL error still occurs after checking all the wiring, return to the factory for repair.

ID No.	Display on LCD Keypad	Warning Name	Description
13		Under current (uC)	Low current

Action and Reset		
Action level	Pr.06-71	
Action time	Pr.06-72	
Warning setting parameter	Pr.06-73 0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by 2nd deceleration time 3: Warn and operation continue	
Reset method	Auto	"Warning" occurs when Pr.06-73=3. The "Warning" automatically clears when the output current is > (Pr.06-71+0.1A).
	Manual	"Error" occurs when Pr.06-73=1 and 2. You must reset manually.
Reset condition	Immediately reset	
Record	Does not record when Pr. 06-73=3 and uC displays "Warning".	

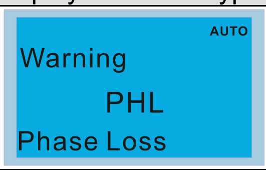
Cause	Corrective Actions
Broken motor cable	Exclude the connection issue of the motor and its load.
Improper setting for the low current protection	Set the proper settings for Pr.06-71, Pr.06-72 and Pr.06-73.
Low load	Check the loading status. Make sure the loading matches the motor capacity.

ID No.	Display on LCD Keypad	Warning Name	Description
17		Over speed warning (oSPd)	Over speed warning

Action and Reset	
Action level	The encoder feedback speed > Pr.10-10
Action time	Pr.10-11
Warning setting parameter	Pr.10-12=0 0: Warn and keep operation
Reset method	"Warning" automatically clears when the drive stops
Reset condition	"Warning" automatically clears when the drive stops
Record	N/A

Cause	Corrective Actions
Improper setting for Pr.10-25 FOC bandwidth of speed observer	Decrease setting value for Pr.10-25.
Improper bandwidth setting for ASR speed controller	Increase the bandwidth setting for ASR speed controller.
Incorrect motor parameter setting	Reset motor parameter and run parameter tuning.
Malfunction caused by interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.

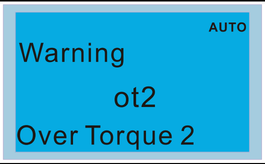
<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>18</td><td>
</td><td>Deviation Warning
(dAvE)</td><td>Over speed deviation warning</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Pr.10-13</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Pr.10-14</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">Pr.10-15=0
0: Warn and keep operation</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">“Warning” automatically clears when the drive stops</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">After the drive stops</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Improper parameter setting for the slip error</td><td colspan="2">Reset proper value for Pr.10-13 and Pr.10-14.</td></tr>
<tr><td colspan="2">Improper setting for ASR parameter and acceleration/ deceleration</td><td colspan="2">Reset ASR parameters.
Set proper accel./ decel. time.</td></tr>
<tr><td colspan="2">Accel./ Decel. time is too short</td><td colspan="2">Reset proper accel./ decel. time.</td></tr>
<tr><td colspan="2">Motor locked</td><td colspan="2">Remove the causes of motor locked.</td></tr>
<tr><td colspan="2">Mechanical brake is not released</td><td colspan="2">Check the active timing of the system.</td></tr>
<tr><td colspan="2">Incorrect parameter setting of torque limit
(Pr.06-12, Pr.11-17–20)</td><td colspan="2">Adjust to proper setting value.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>19</td><td>
</td><td>Phase loss
(PHL)</td><td>Input phase loss warning</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">One of the phases outputs less than Pr.06-47</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Pr.06-46</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">Pr.06-45=0
0: Warn and keep operation</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">“Warning” automatically clears when the drive stops</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">After the drive stops</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Phase loss of the input power</td><td colspan="2">Verify wiring of the main circuit.</td></tr>
<tr><td colspan="2">Single phase power input on a three-phase model</td><td colspan="2">Use the model with voltage that matches the power.</td></tr>
<tr><td colspan="2">The power voltage has changed</td><td colspan="2">If the power of main circuit works well, check if the MC of the main circuit is broken.
Cycle the power after verifying the power is normal. If PHL still occurs, return to the factory for repair.</td></tr>
<tr><td colspan="2">Loose wiring terminal of input power</td><td colspan="2">Tighten the terminal screws with the torque listed in the user manual.</td></tr>
<tr><td colspan="2">Check if the input cable of 3-phase power is broken</td><td colspan="2">Make sure the wiring is correct.
Replace the broken part of the cable.</td></tr>
<tr><td colspan="2">The voltage of input power has changed</td><td colspan="2">Check setting for Pr.06-50 (Time for Input Phase Loss Detection) and Pr.06-52 (Ripple of Input Phase Loss).</td></tr>
<tr><td colspan="2">Unbalance three-phase of the input power</td><td colspan="2">Check the status of 3-phase power.</td></tr>
</table>

ID No.	Display on LCD Keypad	Warning Name	Description
20		Over-torque 1 (ot1)	Over-torque 1 warning

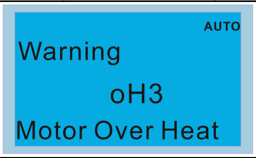
Action and Reset	
Action level	Pr.06-07
Action time	Pr.06-08
Warning setting parameter	Pr.06-06=1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
Reset method	When input current < (Pr.06-07 – 5%), the Ot1 warning automatically clears
Reset condition	When input current < (Pr.06-07 – 5%), the Ot1 warning automatically clears
Record	N/A

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.06-07 and Pr.06-08 again.
Mechanical error (e.g. mechanical lock due to over-torque)	Remove the causes of malfunction.
The load is too large	Decrease the loading. Replace with a motor with larger capacity.
Accel./ Decel. time and working cycle is too short	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time)
V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
The motor capacity is too small	Replace with a motor with larger capacity.
Over-load during low-speed operation	Decrease the loading during low-speed operation. Increase the motor capacity.
The torque compensation is too large	Adjust the torque compensation value (Pr.07-26 torque compensation gain) until the output current decreases and the motor does not stall.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display on LCD Keypad	Warning Name	Description
21		Over-torque (ot2)	Over-torque 2 warning

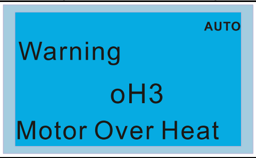
Action and Reset	
Action level	Pr.06-10
Action time	Pr.06-11
Warning setting parameter	Pr.06-09=1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
Reset method	When output current < (Pr.06-10 – 5%), the Ot2 warning automatically clears
Reset condition	When output current < (Pr.06-10 – 5%), the Ot2 warning automatically clears
Record	N/A

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.06-10 and Pr.06-11
Mechanical error (e.g. mechanical lock due to over-torque)	Remove the causes of malfunction.
The load is too large	Decrease the loading. Replace with a motor with larger capacity.
Accel./ Decel. time and working cycle is too short	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time)
V/F voltage is too high	Adjust the V/F curve (Motor 2, Pr.01-35–01-42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
The motor capacity is too small	Replace with a motor with larger capacity.
Over-load during low-speed operation	Decrease the loading during low-speed operation. Increase the motor capacity.
The torque compensation is too large	Adjust the torque compensation value (Pr.07-26 torque compensation gain) until the output current decreases and the motor does not stall.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display on LCD Keypad	Warning Name	Description
22_1		Motor over-heating (oH3) PTC	Motor over-heating warning. The AC motor drive detects the temperature inside the motor is too high

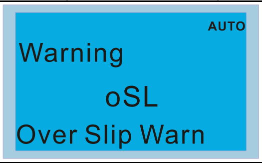
Action and Reset	
Action level	Pr.03-00=6 (PTC), PTC input level > Pr.06-30 (default=50%)
Action time	Immediately act
Warning setting parameter	Error treatment: Pr.06-29 0: Warn and keep operating 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When Pr.06-29=0 and when the temperature is ≦ Pr.06-30 level, the oH3 warning automatically clears. When Pr.06-29=0 (“Warning”), it automatically resets.
Reset method	When Pr.06-29=0, oH3 displays “Warning”. When the temperature is ≦ Pr.06-30 level, the oH3 warning automatically clears.
Reset condition	When the temperature is ≦ Pr.06-30 level, the oH3 warning automatically clears.
Record	N/A

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Decrease the loading. Replace with a motor with larger capacity.
Ambien temperature is too high	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low-speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity.
Accel./ Decel. time and working cycle is too short	Increase setting values for Pr.01-12–01-19 (accel./ decel. time).
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the PTC is properly set and wired	Check the connection between PTC thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Display on LCD Keypad	Warning Name	Description
22_2		Motor over-heating (oH3) PT100	Motor over-heating warning. The AC motor drive detects the temperature inside the motor is too high.

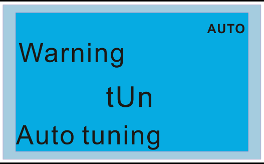
Action and Reset	
Action level	Pr.03-00=11 (PT100), PT100 input level > Pr.06-57 (default=7V)
Action time	Immediately act
Warning setting parameter	Error treatment: Pr.06-29 0: Warn and keep operating 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When Pr.06-29=0 and when the temperature is < Pr.06-56 level, the oH3 warning automatically clears. If the temperature is between Pr.06-56 and Pr.06-57, the frequency outputs according to the operating frequency setting for Pr.06-58.
Reset method	When Pr.06-29=0, oH3 displays "Warning". When the temperature is < Pr.06-56 level, the oH3 warning automatically clears.
Reset condition	When the temperature is < Pr.06-56 level, the oH3 warning automatically clears.
Record	N/A

Cause	Corrective Actions
Motor locked	Clear the motor lock status.
The load is too large	Decrease loading. Replace with a motor with larger capacity.
Ambien temperature is too high	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low-speed too long	Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity.
Accel./ Decel. time and working cycle is too short	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time).
V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
Check if the motor rated current matches the motor nameplate	Configure the correct rated current value of the motor again.
Check if the PT100 is properly set and wired	Check the connection between PT100 thermistor resistor and the heat protection.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.
Unbalance three-phase impedance of the motor	Replace the motor.
Harmonics is too high	Use remedies to reduce harmonics.

ID No.	Display on LCD Keypad	Warning Name	Description
24		Over slip warning (oSL)	Over slip warning. By using the maximum slip (Pr.10-29) as the base, when the drive outputs at constant speed, and the F>H or F<H exceeds Pr.07-29 level and Pr.07-30 setting time, 100% Pr.07-29 = Pr.10-29.

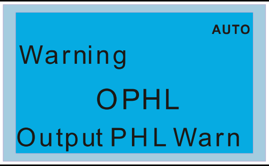
Action and Reset	
Action level	When the drive outputs at constant speed, and F>H or F<H exceeds the Pr.07-29 level
Action time	Pr.07-30
Warning setting parameter	Pr.07-31=0 Warning 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	When Pr.07-31=0 and when the drive outputs at constant speed, and F>H or F<H no longer exceeds the Pr.07-29 level, the oSL warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Check if the motor parameter is correct	Check the motor parameter.
The load is too large	Decrease the loading.
Check if the settings for Pr.07-29, Pr.07-30 and Pr.10-29 are properly set	Check the parameter settings for oSL protection.

ID No.	Display on LCD Keypad	Warning Name	Description
25		Auto tuning (tUn)	Parameter auto-tuning is processing. When running auto-tuning, the keypad displays “tUn”.

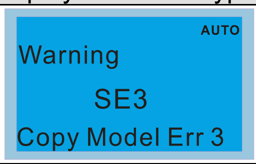
Action and Reset	
Action level	When running Pr.05-00 motor parameter auto-tuning, the keypad displays “tUn”.
Action time	N/A
Warning setting parameter	N/A
Reset method	When auto-tuning is finished and no error occurs, the warning automatically clears.
Reset condition	When auto-tuning is finished and no error occurs.
Record	N/A

Cause	Corrective Actions
The motor parameter is running auto-tuning	When the auto-tuning is finished, the warning automatically clears.

ID No.	Display on LCD Keypad	Warning Name	Description
28		Output phase loss (OPHL)	Output phase loss

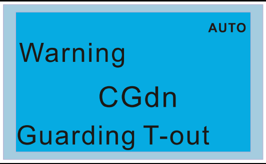
Action and Reset	
Action level	Pr.06-47
Action time	N/A
Warning setting parameter	Pr.06-45 0: Warn and keep operating 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	If Pr.06-45 is set to 0, the OPHL warning automatically clears after the drive stops.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable. Replace the cable.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, return to the factory for repair.
If capacity of the drive is larger than the motor	Choose the matches capacity of the drive and motor.

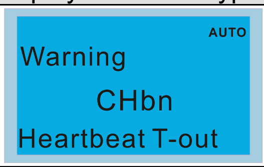
ID No.	Display on LCD Keypad	Warning Name	Description
30		Copy model error 3 (SE3)	Keypad COPY error 3: copy model error

Action and Reset	
Action level	"SE3" warning occurs when different drive identity codes are found during copying parameters.
Action time	Immediately act when the error is detected
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	N/A
Record	N/A

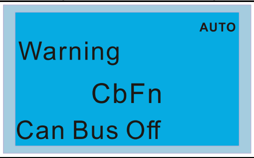
Cause	Corrective Actions
Keypad copy between different power range drives	It is mainly to prevent parameter copies between different HP/models.

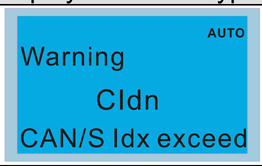
ID No.	Display on LCD Keypad	Warning Name	Description
36		CANopen guarding time-out (CGdn)	CANopen guarding time-out 1

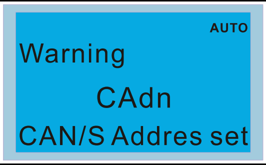
Action and Reset	
Action level	When CANopen Node Guarding detects that one of the slaves does not response, the CGdn error displays. The upper unit sets factor and time during configuration.
Action time	The time that upper unit sets during configuration
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	The upper unit sends a reset package to clear this fault.
Record	N/A
Cause	**Corrective Actions**
The guarding time is too short, or less detection times	Increase the guarding time (Index 100C) and detection times.
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.

ID No.	Display on LCD Keypad	Warning Name	Description
37		CANopen heartbeat error (CHbn)	CANopen heartbeat error

Action and Reset	
Action level	When CANopen Heartbeat detects that one of the slaves does not response, the CHbn error shows. The upper unit sets the confirming time of producer and consumer during configuration.
Action time	The upper unit sets the confirming time of producer and consumer during configuration.
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	The upper unit sends a reset package to clear this fault
Record	When Pr.00-21≠3, CHbn is a "Warning", and the warning is not recorded
Cause	**Corrective Actions**
The heartbeat time is too short	Increase heartbeat time (Index 1016)
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

ID No.	Display on LCD Keypad	Warning Name	Description
39		CANopen bus off error (CbFn)	CANopen BUS off error
Action and Reset			
Action level	Hardware	When CANopen card is not installed, CbFn fault will occur.	
	Software	When the master received wrong communication package, CbFn fault will occur. Too much interference on BUS When the CAN_H and CAN_L communication cable is short, the master receives wrong package, and CbFn fault occurs.	
Action time	Immediately act when the fault is detected		
Warning setting parameter	N/A		
Reset method	Manual Reset		
Reset condition	Cycle the power		
Record	When Pr.00-21≠3, CbFn is a “Warning”, and the warning is not recorded		
Cause	**Corrective Actions**		
Check if the CANopen card is installed	Make sure the CANopen card is installed.		
Check if the CANopen speed is correct	Reset CANopen speed (Pr.09-37)		
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.		
Communication cable is broken or bad connected	Check or replace the communication cable.		

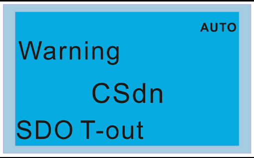
ID No.	Display on LCD Keypad	Warning Name	Description
40		CANopen index error (CIdn)	CANopen Index error
Action and Reset			
Action level	CANopen communication Index error		
Action time	Immediately act when the fault is detected		
Warning setting parameter	N/A		
Reset method	Manual Reset		
Reset condition	Upper unit sends a reset package to clear this fault		
Record	When Pr.00-21≠3, CIdn is a “Warning”, and the warning is not recorded		
Cause	**Corrective Actions**		
Incorrect setting of CANopen index	Reset CANopen Index (Pr.00-02=7)		

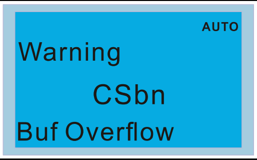
ID No.	Display on LCD Keypad	Warning Name	Description
41		CANopen station address error (CAdn)	CANopen station address error (only supports 1–127)

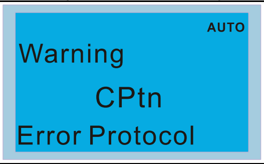
Action and Reset	
Action level	CANopen station address error
Action time	Immediately act when the fault is detected
Warning setting parameter	N/A
Reset method	Manual Reset
Reset condition	Pr.00-02=7
Record	When Pr.00-21≠3, CAdn is a "Warning", and the warning is not recorded
Cause	**Corrective Actions**
Incorrect setting of CANopen station address	1. Disable CANopen (Pr.09-36=0) 2. Reset CANopen (Pr.00-02=7) 3. Reset CANopen station address (Pr.09-36)

ID No.	Display on LCD Keypad	Warning Name	Description
42		CANopen memory error (CFrn)	CANopen memory error

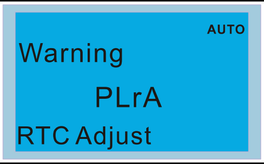
Action and Reset	
Action level	When the user update firmware version of the control board, the FRAM internal data will not be changed, then CFrn fault will occur.
Action time	Immediately act when the fault is detected
Warning setting parameter	N/A
Reset method	Manual Reset
Reset condition	Pr.00-02=7
Record	When Pr.00-21≠3, CFrn is a "Warning", and the warning is not recorded
Cause	**Corrective Actions**
CANopen internal memory error	1. Disable CANopen (Pr.09-36=0) 2. Reset CANopen (Pr.00-20=7) 3. Reset CANopen station address (Pr.09-36)

ID No.	Display on LCD Keypad	Warning Name	Description
43		CANopen SDO time-out (CSdn)	SDO transmission time-out (only shows on master station)
Action and Reset			
Action level	When the CANopen master transmits SDO command, and the Slave response "time-out", CSdn warning will occur.		
Action time	Immediately act when the fault is detected		
Warning setting parameter	N/A		
Reset method	When the master resends a SDO command and receives the response, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
Slave is not connected	Connect slave and CANopen BUS.		
The synchronize cycle is set too short	Increase the synchronization time (Index 1006)		
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.		
Disconnection or bad connection of the communication cable	Check the status of the cable, or replace the cable.		

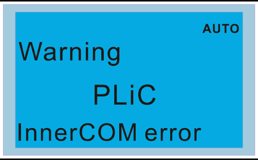
ID No.	Display on LCD Keypad	Warning Name	Description
44		CANopen SDO receives register overflow (CSbn)	CANopen SDO receives register overflow
Action and Reset			
Action level	The upper unit sends too much SDO and causes buffer overflow		
Action time	Immediately act when the fault is detected		
Warning setting parameter	N/A		
Reset method	The upper unit sends a reset package to clear the warning.		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
Too much SDO from the upper unit	Check if the master sends too much SDO command. Make sure the master sends SDO command according to the command format.		

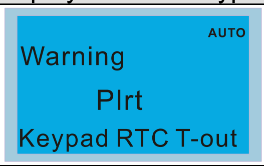
ID No.	Display on LCD Keypad	Warning Name	Description
46		CANopen format error (CPtn)	CANopen protocol format error

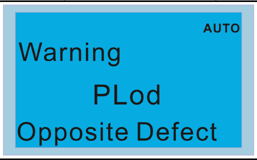
Action and Reset	
Action level	The slave detects that data from the upper unit cannot be recognized, and then shows CPtn warning
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	The upper unit sends a reset packet to clear the warning
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
The upper unit sends incorrect communication packet	Make sure the master sends the packet based on CANopen DS301 standard command format.

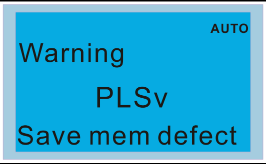
ID No.	Display on LCD Keypad	Warning Name	Description
47		RTC adjust (PLrA)	PLC (RTC) is not adjusted

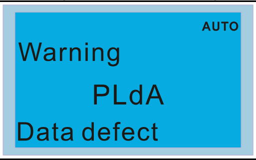
Action and Reset		
Action level	When using RTC function for PLC program, and PLC detects unreasonable RTC time, PLrA warning displays.	
Action time	Immediately displays when the fault is detected	
Warning setting parameter	N/A	
Reset method	Auto	Stops the PLC and runs again, the warning automatically clears
	Manual	Manual reset to clear this warning
Reset condition	Cycle the power	
Record	N/A	
Cause	**Corrective Actions**	
When using RTC function for PLC program, and the drive is power off over 7 days or KPC-CC01 does not connect to the drive for a long time, the RTC time is different with the internal calculated time when re-connect the keypad to the drive.	1. Stop the PLC program and restart it. 2. Adjust the RTC time and cycle the power.	
KPC-CC01 does not adjust the RTC time	Adjust the RTC time and cycle the power.	
PLC detects unreasonable RTC time	1. Stop the PLC program and restart it. 2. Cycle the power.	
Replace with a new KPC-CC01	1. Stop the PLC program and restart it. 2. Cycle the power.	

ID No.	Display on LCD Keypad	Warning Name	Description
48		InnerCOM error (PLiC)	InnerCOM error
Action and Reset			
Action level	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	N/A		
Reset condition	When InnerCOM is back to normal condition, the warning automatically clears		
Record	N/A		
Cause	Corrective Actions		
Communication cable is loose	Check the connection of the communication cable		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. It recommended to install terminal resistor(s) on the first and the last unit of the communication circuit.		

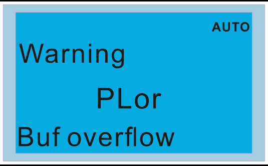
ID No.	Display on LCD Keypad	Warning Name	Description
49		Keypad RTC time-out (PLrt)	PLC (RTC) error
Action and Reset			
Action level	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	N/A		
Reset condition	Cycle the power		
Record	N/A		
Cause	Corrective Actions		
KPC-CC01 is not connected to the control board while using the RTC function	Do not remove the KPC-CC01 keypad while using RTC function.		

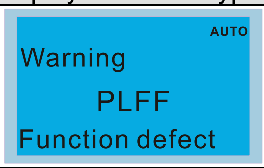
<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>50</td><td>
</td><td>PLC opposite defect
(PLod)</td><td>PLC download error warning</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">During PLC downloading, the program source code detects incorrect address (e.g. the address exceeds the range), then the PLod warning shows.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect component number is found when downloading the PLC program</td><td colspan="2">Use the correct component number.</td></tr>
</table>

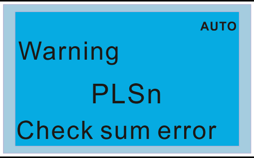
<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>51</td><td>
</td><td>PLC save memory error
(PLSv)</td><td>Data error during PLC operation</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">The program detects incorrect written address (e.g. the address has exceeds the range) during PLC operation, then the PLSv warning shows.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">An incorrect written address is detected during PLC operation</td><td colspan="2">Make sure the write-in address is correct and re-download the program.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>52</td><td>
</td><td>Data defect (PLdA)</td><td>Data error during PLC operation</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">The program detects incorrect write-in address when translating the program source code, then PLdA warning acts.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">During PLC operation, the external Modbus has written/read incorrect data to internal PLC program</td><td colspan="2">Check if the upper unit transmits the correct command</td></tr>
</table>

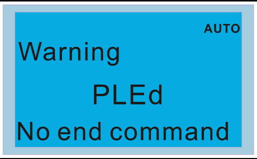
<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>53</td><td>
</td><td>Function defect (PLFn)</td><td>PLC download function code error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">The program detects incorrect command (unsupported command) during PLC downloading, then PLFn warning acts.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Unsupported command has used while downloading the program</td><td colspan="2">Check if the firmware of the drive is the old version. If yes, please contact Delta.</td></tr>
</table>

ID No.	Display on LCD Keypad	Warning Name	Description
54		PLC buffer overflow (PLor)	PLC register overflow
Action and Reset			
Action level	When PLC runs the last command and the command exceeds the maximum capacity of the program, the PLor warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	N/A		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
The program detects source code error during PLC operation	1. Disable PLC 2. Delete PLC program (Pr.00-02=6) 3. Enable PLC 4. Re-download PLC program		

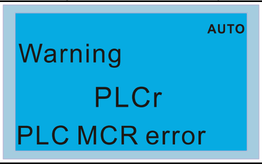
ID No.	Display on LCD Keypad	Warning Name	Description
55		Function defect (PLFF)	Function code error during PLC operation
Action and Reset			
Action level	The program detects incorrect command (unsupported command) during PLC operation, then PLFF warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
The PLC runs an incorrect command during operation	When starting the PLC function and there is no program in the PLC, the PLFF warning shows. This is a normal warning, please download the program.		

ID No.	Display on LCD Keypad	Warning Name	Description
56		Checksum error (PLSn)	PLC checksum error

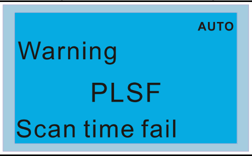
Action and Reset	
Action level	PLC checksum error is detected after power on, then PLSn warning shows
Action time	Immediately displays when the fault is detected
Warning setting parameter	NA
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
The program detects checksum error during PLC operation	1. Disable PLC 2. Remove PLC program (Pr.00-02=6) 3. Enable PLC 4. Re-download PLC program

ID No.	Display on LCD Keypad	Warning Name	Description
57		No end command (PLEd)	PLC end command is missing

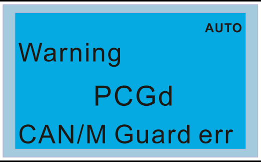
Action and Reset	
Action level	The “End” command is missing until the last command is executed, the PLEd warning shows
Action time	Immediately displays when the fault is detected
Warning setting parameter	NA
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
There is no “END” command during PLC operation	1. Disable PLC 2. Remove PLC program (Pr.00-02=6) 3. Enable PLC 4. Re-download PLC program

ID No.	Display on LCD Keypad	Warning Name	Description
58		PLC MCR error (PLCr)	PLC MCR command error
Action and Reset			
Action level	The MC command is detected during PLC operation, but there is no corresponded MCR command, then the PLCr warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The MC command is continuously used for more than 9 times	The MC command cannot be used continuously for 9 times. Check and reset the program, then re-download the program.		

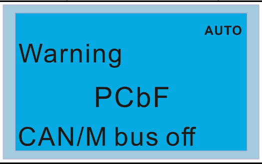
ID No.	Display on LCD Keypad	Warning Name	Description
59		PLC download fail (PLdF)	PLC download fail
Action and Reset			
Action level	PLC download fail due to momentary power loss during the downloading, when power is ON again, PLdF warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
PLC download is forced to stop, so the program write-in is incompleted	Check if there is any error in the program and re-download the PLC program		

ID No.	Display on LCD Keypad	Warning Name	Description
60		PLC scan time fail (PLSF)	PLC scan time exceeds the maximum allowable time

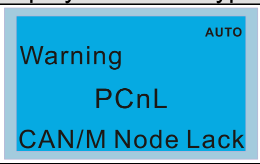
Action and Reset	
Action level	When the PLC scan time exceeds the maximum allowable time (400 ms), PLSF warning shows.
Action time	Immediately displays when the fault is detected
Warning setting parameter	NA
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
The PLC scan time exceeds the maximum allowable time (400ms)	Check if the source code is correct and re-download the program

ID No.	Display on LCD Keypad	Warning Name	Description
61		CAN/M guarding error (PCGd)	CANopen Master guarding error

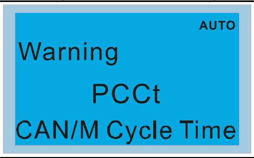
Action and Reset	
Action level	When CANopen Master Node Guarding detects that one of the Slaves does not response, the PCGd warning will display
Action time	Immediately displays when the fault is detected
Warning setting parameter	NA
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
Slave is not connected or CANopen BUS cable is not connected	Connect the Slave and CANopen BUS
Malfunction caused by interference	1. Verify wiring/grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

ID No.	Display on LCD Keypad	Warning Name	Description
62		CAN/M BUS off (PCbF)	CANopen Master BUS off

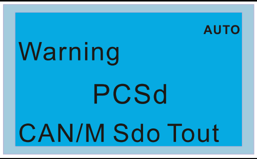
Action and Reset	
Action level	When the CANopen master detects error packets more than 255 during the BUS off detection, or when the CANopen card is not installed, the PCbF warning displays. If the BUS cable is not connected, the drive will not receive issues packet, and the PCbF warning will not display.
Action time	Immediately displays when the fault is detected
Warning setting parameter	NA
Reset method	Cycle the power
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
Malfunction caused by interference	1. Verify wiring/grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

ID No.	Display on LCD Keypad	Warning Name	Description
63		CAN/M node lack (PCnL)	CANopen Master node error

Action and Reset	
Action level	When the CANopen master configures different setting nodes from the actual nodes, the PCnL warning displays.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	When connect BUS to the original slave, or change the configured node numbers to meet the actual node quantity, the warning automatically clears.
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
The configured node quantity is different from the actual nodes	Connect BUS to the original slave, or change the configured node numbers to meet the actual node quantity
Communication cable is broken or bad connected	Check or replace the communication cable.

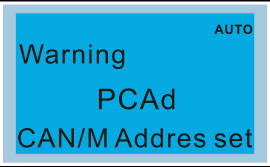
ID No.	Display on LCD Keypad	Warning Name	Description
64		CAN/M cycle time-out (PCCt)	CANopen Master cycle time-out
Action and Reset			
Action level		When the transmitted packet from CANopen master exceeds the maximum allowable quantity in a certain time, the PCCt warning displays.	
Action time		Immediately displays when the fault is detected	
Warning setting parameter		N/A	
Reset method		The warning automatically clears when changing the configuration and re-executing the program.	
Reset condition		N/A	
Record		N/A	
Cause		Corrective Actions	
When the transmitted packet from CANopen master exceeds the maximum allowable quantity in a certain time		Increase the time setting of D1090 synchronization cycle	

ID No.	Display on LCD Keypad	Warning Name	Description
65		CAN/M SDO over (PCSF)	CANopen Master SDO overflow
Action and Reset			
Action level		When the CANopen master transmits too much SDO that causes buffer overflow, the PCSF warning displays	
Action time		Immediately displays when the fault is detected	
Warning setting parameter		N/A	
Reset method		Cycle the power, or stop the PLC and run the PLC again	
Reset condition		N/A	
Record		N/A	
Cause		Corrective Actions	
Internal PLC transmits too much SDO at once		The PLC program needs to confirm receiving the SDO feedback data before sending another SDO command.	

ID No.	Display on LCD Keypad	Warning Name	Description
66		CAN/M SDO time-out (PCSd)	CANopen Master SDO time-out

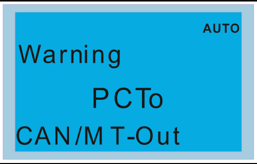
Action and Reset	
Action level	When the CANopen master sends a SDO command, and the BUS is too busy to transmit the command, PCSd warning displays.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	The warning automatically clears when the SDO transmits normally.
Reset condition	N/A
Record	N/A

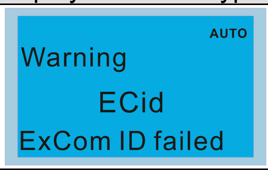
Cause	Corrective Actions
When the CANopen master transmits a SDO command, and does not receive feedback from the Slave within 1 sec.	Check if the Slave responds within 1 second.

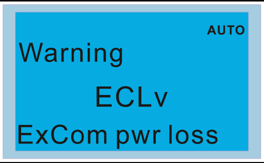
ID No.	Display on LCD Keypad	Warning Name	Description
67		CAN/M address error (PCAd)	CANopen Master station address error

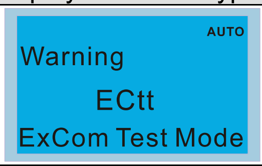
Action and Reset	
Action level	When the CANopen master detects an incorrect or repeated station address from the Slave, the PCAd warning displays.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	The warning automatically clears when reset the station address and run the program again.
Reset condition	N/A
Record	N/A

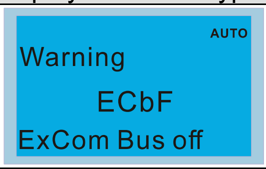
Cause	Corrective Actions
When the CANopen master detects an incorrect or repeated station address from the Slave	Set the correct slave station address.

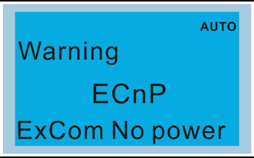
ID No.	Display on LCD Keypad	Warning Name	Description
68		CAN/M time-out (PCTo)	When the drive receives an incorrect packet, it means that there is interference or the command from the upper unit does not meet the CANopen command format.
Action and Reset			
Action level	N/A		
Action time	Immediately acts when receiving the command		
Warning setting parameter	N/A		
Reset method	The warning automatically clears after receives another normal packet		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Malfunction caused by interference	1. Verify wiring/grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.		
The command from the upper unit does not meet the CANopen format	Please contact Delta for further confirmation.		

ID No.	Display on LCD Keypad	Warning Name	Description
70		ExCom ID fail (ECid)	Duplicate MAC ID error Node address setting error
Action and Reset			
Action level	Duplicate setting of MAC ID Node address setting error		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Correct the setting and cycle the power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The setting address exceeds the range (0–63)	Check the address setting of the communication card (Pr.09-70)		
The speed setting exceeds the range	Standard: 0–2, non-standard: 0–7		
The address is duplicated with other nodes on the BUS	Reset the address		

ID No.	Display on LCD Keypad	Warning Name	Description
71		ExCom power loss (ECLv)	Low voltage of communication card
Action and Reset			
Action level	The 5V power that drive provides to communication card is to low		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Re-power		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
The 5V power that drive provides to communication card is to low	1. Switch the communication card to other CFP2000 drives and observe if there is ECLv warning shown. If yes, replace with a new communication card; if not, replace the drive. 2. Use another communication card to test if the ECLv warning has shown as well. If not, replace the card; if yes, replace the drive.		
The card is loose	Make sure the communication card is well inserted.		

ID No.	Display on LCD Keypad	Warning Name	Description
72		ExCom test mode (ECtt)	Communication card is in the test mode
Action and Reset			
Action level	Communication card is in the test mode		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Cycle the power and enter the normal mode		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
Communication command error	Cycle the power		

ID No.	Display on LCD Keypad	Warning Name	Description
73		ExCom Bus off (ECbF)	The communication card detects too much errors in the BUS, then enters the BUS-OFF status and stop communicating
Action and Reset			
Action level	When the drive detects BUS-off (for DeviceNet)		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Cycle the power		
Reset condition	N/A		
Record	N/A		
Cause	**Corrective Actions**		
Poor connection of the cable	Re-connect the cable		
Bad quality of the cable	Replace the cable		

ID No.	Display on LCD Keypad	Warning Name	Description
74		ExCom no power (ECnP)	There is no power supply on the DeviceNet

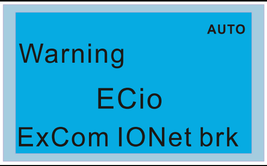
Action and Reset	
Action level	There is no power supply on the DeviceNet
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Re-power
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
The drive detects that DeviceNet has no power	Check if the cable and power is normal. If yes, return to the factory for repair.

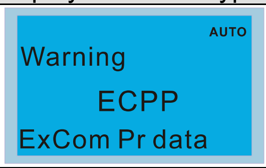
ID No.	Display on LCD Keypad	Warning Name	Description
75		ExCom factory defect (ECFF)	Factory default setting error

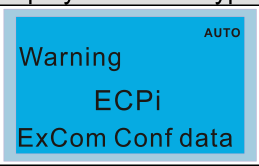
Action and Reset	
Action level	Factory default setting error
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Cycle the power
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
Factory default setting error	Use DCISoft to reset to the default value.

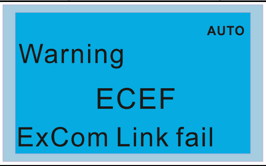
ID No.	Display on LCD Keypad	Warning Name	Description
76		ExCom inner error (ECiF)	Serious internal error

Action and Reset	
Action level	Internal memory saving error
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Cycle the power
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
Noise interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference. Cycle the power.
The memory is broken	Reset to the default value and check if the error still exists. If yes, replace the communication card.

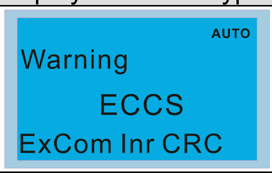
ID No.	Display on LCD Keypad	Warning Name	Description
77		ExCom IO Net break (ECio)	IO connection break off
Action and Reset			
Action level	IO connection between the communication card and the master is broken off		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The cable is loose	Re-install the cable		
Incorrect parameter setting for master communication	Check the setting for master communication parameter		

ID No.	Display on LCD Keypad	Warning Name	Description
78		ExCom Parameter data error (ECPP)	Profibus parameter data error
Action and Reset			
Action level	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The GSD file is incorrect	Get the correct GSD file from the software		

ID No.	Display on LCD Keypad	Warning Name	Description
79		ExCom configuration data error (ECPi)	Profibus configuration data error
Action and Reset			
Action level	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The GSD file is incorrect	Get the correct GSD file from the software		

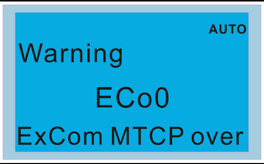
ID No.	Display on LCD Keypad	Warning Name	Description
80		Ethernet link fail (ECEF)	Ethernet cable is not connected
Action and Reset			
Action level	Hardware detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Ethernet cable is loose	Re-connect the cable		
Bad quality of Ethernet cable	Replace the cable		

ID No.	Display on LCD Keypad	Warning Name	Description
81		Communication time-out (ECto)	Communication time-out for communication card and the upper unit
Action and Reset			
Action level	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	N/A		
Reset condition	CMC-EC01: auto resets when the communication with the upper unit is back to normal		
Record	N/A		
Cause	Corrective Actions		
Communication card is not connected with the upper unit	Check if the connection of the communication cable is correct		
Communication error of the upper unit	Check if the communication of the upper unit is normal		

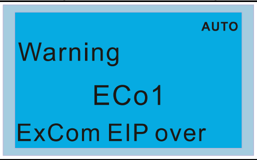
ID No.	Display on LCD Keypad	Warning Name	Description
82		Checksum error (ECCS)	Checksum error for communication card and the drive
Action and Reset			
Action level	Software detection		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
Noise interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.		

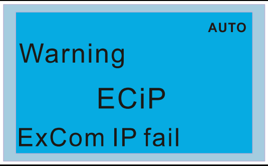
ID No.	Display on LCD Keypad	Warning Name	Description
83		Return defect (ECrF)	Communication card returns to the default setting

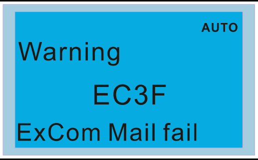
Action and Reset	
Action level	Communication card returns to the default setting
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A
Cause	**Corrective Actions**
Communication card is returning to default setting	No actions.

ID No.	Display on LCD Keypad	Warning Name	Description
84		Modbus TCP over (Eco0)	Modbus TCP exceeds maximum communication value

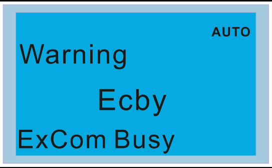
Action and Reset	
Action level	Hardware detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A
Cause	**Corrective Actions**
The Master communication value is more than the allowable quantity of the communication card	Reduce Master communication value
The upper unit is online without communicating, and does not break off the Modbus TCP link, causes occupy connection	Revise program of upper unit, the communication should be break off when it is not used for a long time
A new Modbus TCP connection is built every time when the upper unit is connected to the communication card, which caused occupy connection	Revise program of upper unit: use the same Modbus TCP connection when connected to the same communication card

ID No.	Display on LCD Keypad	Warning Name	Description
85		EtherNet/IP over (ECo1)	Ethernet/IP exceeds maximum communication value
Action and Reset			
Action level	Hardware detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
The Master communication value is more than the allowable quantity of the communication card	Reduce Master communication value		
The upper unit is online without communicating, and does not break off the Modbus TCP link, causes occupy connection	Revise program of upper unit, the communication should be break off when it is not used for a long time		
A new Modbus TCP connection is built every time when the upper unit is connected to the communication card, which caused occupy connection	Revise program of upper unit: use the same Modbus TCP connection when connected to the same communication card		

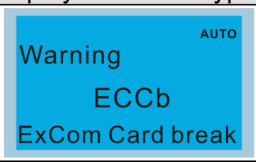
ID No.	Display on LCD Keypad	Warning Name	Description
86		IP fail (ECiP)	IP setting error
Action and Reset			
Action level	Software detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediate reset		
Record	N/A		
Cause	Corrective Actions		
IP conflict	Reset IP		
DHCP IP configuration error	MIS check if DHCP Server works normally		

ID No.	Display on LCD Keypad	Warning Name	Description
87		Mail fail (EC3F)	Mail warning: Alarm mail will be sent when the communication card establishes alarm conditions

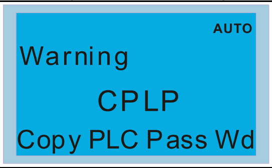
Action and Reset	
Action level	Communication card establishes alarm conditions
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A
Cause	**Corrective Actions**
Communication card establishes alarm conditions	No actions

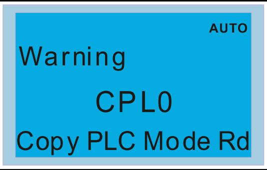
ID No.	Display on LCD Keypad	Warning Name	Description
88		ExCom busy (ECbY)	Communication card busy: too much packets are received

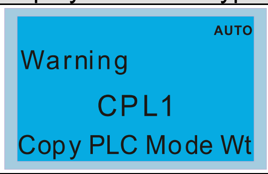
Action and Reset	
Action level	Software detection
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
Communication packets are too much for the communication card to process	Reduce communication packets

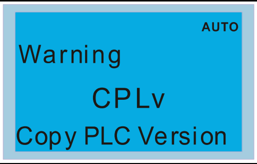
ID No.	Display on LCD Keypad	Warning Name	Description
89		ExCom card break (ECCb)	Communication card break off warning

Action and Reset	
Action level	Communication card break off
Action time	The time between communication card break off and ECCb displays: 1. EtherNet/IP: 3 sec. 2. Modbus TCP: 3 sec. 3. DeviceNet: 1 sec. 4. PROFIBUS: 1 sec. 5. EtherCAT: 0.1 sec.
Warning setting parameter	N/A
Reset method	Auto resets after communication card is re-installed
Reset condition	Immediately resets
Record	N/A
Cause	**Corrective Actions**
Communication card break off	Re-install communication card

ID No.	Display on LCD Keypad	Warning Name	Description
90		Copy PLC: password error (CPLP)	Copy PLC password error. When KPC-CC01 is processing PLC copy and the PLC password is incorrect, the CPLP warning shows.
Action and Reset			
Action level	PLC password is incorrect		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Directly resets		
Record	N/A		
Cause	Corrective Actions		
PLC password is incorrect	Reset and enter correct PLC password		

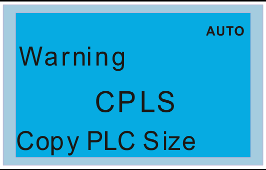
ID No.	Display on LCD Keypad	Warning Name	Description
91		Copy PLC: Read mode error (CPL0)	Copy PLC Read mode error
Action and Reset			
Action level	When copy PLC read mode with incorrect process		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Directly resets		
Record	N/A		
Cause	Corrective Actions		
When copy PLC read mode and the process is incorrect	Cycle the power and copy PLC read mode again		

ID No.	Display on LCD Keypad	Warning Name	Description
92		Copy PLC: Write mode (CPL1)	Copy PLC write mode error
Action and Reset			
Action level	Copy PLC write mode with incorrect process		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Directly resets		
Record	N/A		
Cause	Corrective Actions		
When copy PLC write mode and the process is incorrect	Cycle the power and copy PLC read mode again		

ID No.	Display on LCD Keypad	Warning Name	Description
93		Copy PLC: version error (CPLv)	Copy PLC version error. When non-CFP2000 built-in PLC is copied to CFP2000 drive, the CPLv warning shows

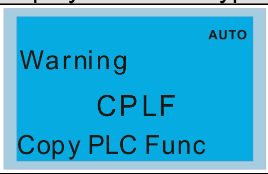
Action and Reset	
Action level	Software detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly resets
Record	N/A

Cause	Corrective Actions
Non-CFP2000 PLC program is copied to CFP2000	Check if the copied PLC program is for CFP2000. Use the correct CFP2000 PLC program.

ID No.	Display on LCD Keypad	Warning Name	Description
94		Copy PLC: size error (CPLS)	Copy PLC Capacity size error

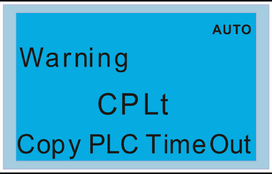
Action and Reset	
Action level	Software detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly resets
Record	N/A

Cause	Corrective Actions
The PLC copied to CFP2000 exceeds the allowable capacity	Check if the copied PLC program is for CFP2000 Use CFP2000 PLC program with correct capacity

ID No.	Display on LCD Keypad	Warning Name	Description
95		Copy PLC: PLC function (CPLF)	KPC-CC01 Copy PLC function should be executed when PLC is off

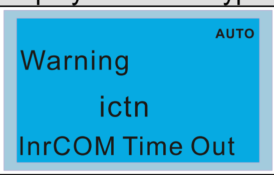
Action and Reset	
Action level	Software detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly resets
Record	N/A

Cause	Corrective Actions
PLC function is enabled when KPC-CC01 is running copy PLC	Disable PLC function first, then run the PLC copy function again

ID No.	Display on LCD Keypad	Warning Name	Description
96		Copy PLC: time-out (CPLt)	Copy PLC time out

Action and Reset	
Action level	Software detection
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Directly resets
Record	N/A

Cause	Corrective Actions
KPC-CC01 is removed while copying PLC program	The KPC-CC01 cannot be removed during the PLC copy process

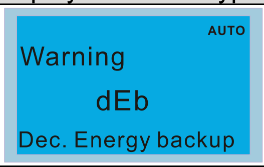
ID No.	Display on LCD Keypad	Warning Name	Description
101		InrCOM time-out (ictn)	Internal communication time-out

Action and Reset	
Action level	When Pr.09-31= (-1) – (-10) (no -9) and the internal communication between Master and Slave is abnormal, the ictn warning shows.
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Auto-reset
Reset condition	The warning automatically clears when the communication is back to normal condition
Record	N/A

Cause	Corrective Actions
Malfunction caused by interference	Verify wiring/grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication conditions with the upper unit	Check if the setting for Pr.09-02 is the same as the setting for upper unit
Communication cable break off or not connected well	Check the cable status or replace the cable

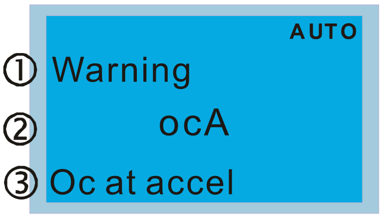
ID No.	Display on LCD Keypad	Warning Name	Description
105		Estimated speed reverse (SpdR)	Estimated speed is in a reverse direction with motor actual running direction

Action and Reset	
Action level	Software detection
Action time	Pr.10-09
Warning setting parameter	Pr.10-08 0: Warn and keep operation 1: Fault and coast to stop 2: Fault and ramp to stop
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A
Cause	**Corrective Actions**
The motor runs in reverse direction at start	Check if the motor is hold when started, or start the motor with speed source.
The difference between motor parameter measured Rr and Rs value is too large	Normally the Rr value of IM is Rs*0.7. If there is much difference of the measured value (e.g. Rr=Rs*0.3), proceed the motor parameter auto-tuning again.
Insufficient output torque is dragged to the reverse direction by the load.	Increase the current limit of Pr.06-12, so as to increase the output torque.

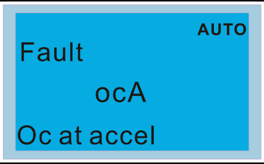
ID No.	Display on LCD Keypad	Warning Name	Description
123		Deceleration energy backup (dEb)	Deceleration energy backup

Action and Reset	
Action level	Software detection
Action time	N/A
Warning setting parameter	0: Disable 1: dEb with auto accel./decel., the output frequency will note return after power reply. 2: dEb with auto accel./decel., the output frequency will return after power reply. 3: dEb low-voltage control, then increase to 350 V_{DC} / 700 V_{DC} and decelerate to stop. 4: dEb high-voltage control of 350 V_{DC} / 700 V_{DC} and decelerate to stop
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A
Cause	**Corrective Actions**
Instantaneous power off or low voltage and unstable/ sudden heavy load of the power that cause the voltage drop	Check the power consumption
Unexpected power off	Check the power consumption

Chapter 14 Fault Codes and Descriptions

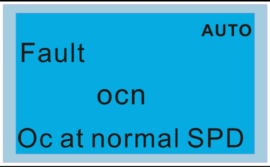


① Display error signal
② Abbreviate error code
③ Display error description

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th>Fault Descriptions</th></tr>
<tr><td>1</td><td></td><td>Over-current during acceleration (ocA)</td><td>Output current exceeds 2.4 times of rated current during acceleration.
When ocA occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocA error.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">240% of rated current</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Acceleration time is too short</td><td colspan="2">1. Increase the acceleration time
2. Increase the acceleration time of S curve
3. Set auto-acceleration and auto-deceleration parameter (Pr.01-44)
4. Set over-current stall prevention function (Pr.06-03)
5. Replace the drive with a larger capacity model.</td></tr>
<tr><td colspan="2">Short circuit at motor output due to poor insulation wiring</td><td colspan="2">Check the motor cable and remove causes of the short circuits, or replace the cable before turning on the power.</td></tr>
<tr><td colspan="2">Check for possible burnout or aging insulation of the motor</td><td colspan="2">Check the motor insulation value with megger. Replace the motor if the insulation is poor.</td></tr>
<tr><td colspan="2">The load is too large.</td><td colspan="2">Check if the output current during the whole working process exceeds the AC motor drive’s rated current. If yes, replace the AC motor drive with a larger capacity model.</td></tr>
<tr><td colspan="2">Impulsive change of the load</td><td colspan="2">Reduce the load or increase the capacity of AC motor drive.</td></tr>
<tr><td colspan="2">Use special motor or motor with larger capacity than the drive</td><td colspan="2">Check the motor capacity (the rated current on the motor’s nameplate should ≦ the rated current of the drive)</td></tr>
<tr><td colspan="2">Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive</td><td colspan="2">Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.</td></tr>
<tr><td colspan="2">V/F curve setting error</td><td colspan="2">Adjust V/F curve setting and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.</td></tr>
<tr><td colspan="2">Torque compensation is too large</td><td colspan="2">Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">The motor starts when in free run</td><td colspan="2">Enable the speed tracking during start-up of Pr.07-12.</td></tr>
<tr><td colspan="2">Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)</td><td colspan="2">Correct the parameter settings for speed tracking.
1. Start the speed tracking function.
2. Adjust the maximum current for Pr.07-09 speed tracking.</td></tr>
<tr><td colspan="2">Incorrect combination of control mode and used motor</td><td colspan="2">Check the settings for Pr.00-11 control mode:
1. For IM, Pr.00-11=0, 1, 2, 3, 5
2. For PM, Pr.00-11=4, 6, or 7</td></tr>
<tr><td colspan="2">The length of motor cable is too long</td><td colspan="2">Increase AC motor drive’s capacity.
Install AC reactor(s) on the output side (U/V/W).</td></tr>
</table>

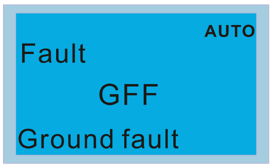
Cause	Corrective Actions
Hardware failure	The ocA occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V and W; DC- corresponds to U, V and W; ⏚ corresponds to U, V and W. If short circuit occur, return to the factory for repair.
Check if the setting for stall prevention is correct	Set the stall prevention to the proper value.

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th>Fault Descriptions</th></tr>
<tr><td>2</td><td>AUTO
Fault
ocd
Oc at decel</td><td>Over-current during deceleration (ocd)</td><td>Output current exceeds 2.4 times of rated current during deceleration.
When ocd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocd error.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">240% of rated current</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Deceleration time too short</td><td colspan="2">1. Increase the deceleration time
2. Increase the deceleration time of S-curve
3. Set auto-acceleration and auto-deceleration parameter (Pr.01-44)
4. Set over-current stall prevention function (Pr.06-03)
5. Replace the drive with a larger capacity model</td></tr>
<tr><td colspan="2">Check if the mechanical brake of the motor activates too early</td><td colspan="2">Check the action timing of the mechanical brake</td></tr>
<tr><td colspan="2">Short-circuit at motor output due to poor insulation wiring</td><td colspan="2">Check the motor cable and remove causes of the short circuits, or replace the cable before turning on the power.</td></tr>
<tr><td colspan="2">Check for possible burnout or aging insulation of the motor</td><td colspan="2">Check the motor insulation value with megger. Replace the motor if the insulation is poor.</td></tr>
<tr><td colspan="2">The load is too large</td><td colspan="2">Check if the output current during the whole working process exceeds the AC motor drive’s rated current. If yes, replace the AC motor drive with a larger capacity model.</td></tr>
<tr><td colspan="2">Impulsive change of the load</td><td colspan="2">Reduce the load or increase the capacity of AC motor drive.</td></tr>
<tr><td colspan="2">Use special motor or motor with larger capacity than the drive</td><td colspan="2">Check the motor capacity (the rated current on the motor’s nameplate should ≦ the rated current of the drive)</td></tr>
<tr><td colspan="2">Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive</td><td colspan="2">Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.</td></tr>
<tr><td colspan="2">V/F curve setting error</td><td colspan="2">Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.</td></tr>
<tr><td colspan="2">Torque compensation is too large</td><td colspan="2">Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">The length of motor cable is too long</td><td colspan="2">Increase AC motor drive’s capacity
Install AC reactor(s) on the output side (U/V/W)</td></tr>
<tr><td colspan="2">Hardware error</td><td colspan="2">The ocd occurs due to short circuit or ground fault at the output side of the drive.
Check for possible short circuits between terminals with the electric meter:
B1 corresponds to U, V and W; DC- corresponds to U, V and W; ⏚ corresponds to U, V and W.
If short circuits occur, return to the factory for repair.</td></tr>
<tr><td colspan="2">Check if the setting of stall prevention is correct</td><td colspan="2">Set the stall prevention to the proper value.</td></tr>
</table>

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
3		Over-current during steady operation (ocn)	Output current exceeds 2.4 times of the rated current during constant speed. When ocn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocn error.

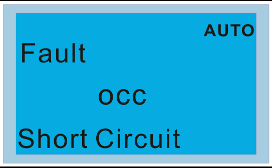
Action and Reset	
Action level	240% of rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
Short-circuit at motor output due to poor insulation wiring	Check the motor cable and remove causes of the short circuits, or replace the cable before turning on the power.
Check for possible shaft lock, burnout or aging insulation of the motor	Troubleshoot the motor shaft lock. Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Impulsive change of the load	Reduce the load or increase the capacity of AC motor drive.
Use special motor or motor with larger capacity than the drive	Check motor capacity (the rated current on the motor's nameplate should ≦ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Over-torque offset value too high	Adjust over-torque offset value (Refer to Pr.07-26 torque compensation gain), until the output current is reduced and not motor stall.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocn occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuit between terminals with the electric meter: B1 corresponds to U, V and W; DC- corresponds to U, V, and W; ⏚ corresponds to U, V, and W. If short circuits occur, return to the factory for repair.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
4		Ground fault (GFF)	When (one of) the output terminal(s) is grounded, short circuit current is larger than Pr.06-60 setting value, and the detection time is longer than Pr.06-61 time setting, GFF occurs. NOTE: the short circuit protection is provided for AC motor drive protection, not to protect the user.

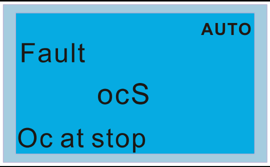
Action and Reset	
Action level	Pr.06-60 (Default = 60%)
Action time	Pr.06-61 (Default = 0.10 sec.)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared
Record	Yes

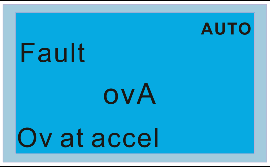
Cause	Corrective Actions
Motor burnout or aging insulation occurred	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Short circuit due to broken cable	Troubleshoot the short circuit. Replace the cable.
Larger stray capacitance of the cable and terminal ⏚	If the motor cable length exceeds 100 m, decrease the setting value for carrier frequency. Take remedies to reduce stray capacitance.
Malfunction caused by interference	Verify the grounding and wiring of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective sufficient anti-interference performance.
Hardware failure	Cycle the power after checking the status of motor, cable and cable length. If GFF still exists, return to the factory for repair.

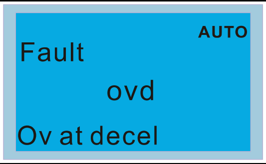
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
5		IGBT short circuit between upper bridge and lower bridge (occ)	Short-circuit is detected between upper bridge and lower bridge of the IGBT module

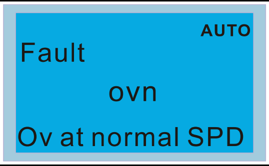
Action and Reset	
Action level	Hardware protection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
IGBT error	Check the motor wiring.
Short-circuit detecting circuit error	Cycle the power, if occ still exists, return to the factory for repair.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
6		Over-current at stop (ocS)	Over-current or hardware failure in current detection at stop. Cycle the power after ocS occurs. If the hardware failure occurs, the display shows cd1, cd2 or cd3.
Action and Reset			
Action level	240% of rated current		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset in 5 sec. after the fault is cleared		
Record	Yes		
Cause	Corrective Actions		
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.		
Hardware failure	Check if other error code such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
7		Over-voltage during acceleration (ovA)	DC bus over-voltage during acceleration. When ovA occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovA error.
Action and Reset			
Action level	820 V_{DC}		
Action time	Immediately act when DC bus voltage is higher than the level		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset only when DC bus voltage is lower than 90% of the over-voltage level		
Record	Yes		
Cause	Corrective Actions		
Acceleration is too slow (e.g. lifting load decreases acceleration time)	Decrease the acceleration time Use brake unit or DC bus Replace the drive with a larger capacity model.		
The setting for stall prevention level is smaller than no-load current	The setting for stall prevention level should be larger than no-load current		
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.		
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.		
Regenerative voltage of motor inertia	Use over-voltage stall prevention function (Pr.06-01) Use auto-acceleration and auto-deceleration setting (Pr.01-44) Use a brake unit or DC bus		
Acceleration time is too short	Check if the over-voltage warning occurs after acceleration stops. When the warning occurs, do the following: 1. Increase the acceleration time 2. Set Pr.06-01 over-voltage stall prevention 3. Increase setting value for Pr.01-25 S-curve acceleration arrival time 2		
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.		
Incorrect wiring of brake resistor or brake unit	Check the wiring of brake resistor and brake unit.		
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.		

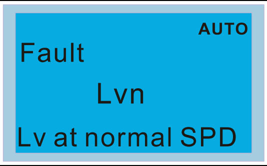
<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th>Fault Descriptions</th></tr>
<tr><td>8</td><td>
</td><td>Over-voltage during deceleration (ovd)</td><td>DC bus over-voltage during deceleration.
When ovd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovd error.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">820 V_{DC}</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act when DC bus voltage is higher than the level</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset only when DC bus voltage is lower than 90% of the over-voltage level</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Deceleration time is too short, causing too large regenerative energy of the load</td><td colspan="2">1. Increase the setting value of Pr.01-13, Pr.01-15, Pr.01-17 and Pr.01-19 (deceleration time)
2. Connect brake resistor, brake unit or DC bus on the drive.
3. Reduce the brake frequency.
4. Replace the drive with a larger capacity model.
5. Use S-curve acceleration/deceleration.
6. Use over-voltage stall prevention (Pr.06-01).
7. Use auto-acceleration and auto-deceleration (Pr.01-44).
8. Adjust braking level (Pr.07-01 or the bolt position of the brake unit).</td></tr>
<tr><td colspan="2">The setting for stall prevention level is smaller than no-load current</td><td colspan="2">The setting for stall prevention level should be larger than no-load current</td></tr>
<tr><td colspan="2">Power voltage is too high</td><td colspan="2">Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.</td></tr>
<tr><td colspan="2">ON/OFF switch action of phase-in capacitor in the same power system</td><td colspan="2">If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.</td></tr>
<tr><td colspan="2">Motor ground fault</td><td colspan="2">The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals.
Troubleshoot the ground fault.</td></tr>
<tr><td colspan="2">Incorrect wiring of brake resistor or brake unit</td><td colspan="2">Check the wiring of brake resistor or brake unit.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
</table>

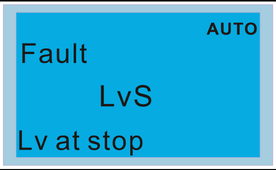
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
9		Over-voltage at constant speed (ovn)	DC bus over-voltage at constant speed. When ovn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovn error.
Action and Reset			
Action level		820 V_{DC}	
Action time		Immediately act when DC bus voltage is higher than the level	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset only when DC bus voltage is lower than 90% of over-voltage level	
Record		Yes	
Cause		Corrective Actions	
Impulsive change of the load		1. Connect brake resistor, brake unit or DC bus to the drive. 2. Reduce the load. 3. Replace to drive with a larger capacity model. 4. Adjust braking level (Pr.07-01 or bolt position of the brake unit).	
The setting for stall prevention level is smaller than no-load current		The setting of stall prevention level should be larger than no-load current	
Regenerative voltage of motor inertia		Use over-voltage stall prevention function (Pr.06-01) Use a brake unit or DC bus	
Power voltage is too high		Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.	
ON/OFF switch action of phase-in capacitor in the same power system		If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.	
Motor ground fault		The ground short-circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.	
Incorrect wiring of brake resistor or brake unit		Check the wiring of brake resistor or brake unit.	
Malfunction caused by interference		Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
10	AUTO Fault ovS Ov at stop	Over-voltage at stop (ovS)	Over-voltage at stop
Action and Reset			
Action level	820 V_{DC}		
Action time	Immediately act when DC bus voltage is higher than the level		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset only when DC bus voltage is lower than 90% of over-voltage level		
Record	Yes		
Cause	Corrective Actions		
Power voltage is too high	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.		
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit activates in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.		
Incorrect wiring of brake resistor or brake unit	Check the wiring of brake resistor or brake unit.		
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.		
Hardware failure in voltage detection	Check if other error code such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.		
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
11	AUTO Fault LvA Lv at accel	Low-voltage during acceleration (LvA)	DC bus voltage is lower than Pr.06-00 setting value during acceleration
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediately act when DC bus voltage is lower than Pr.06-00		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30V (Frame A–D)		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Power voltage changes	Adjust voltage to the power range of the drive		
Start up the motor with large capacity	Check the power system. Increase the capacity of power equipment.		
The load is too large	Reduce the load. Increase the drive capacity. Increase the acceleration time.		
DC bus	Install DC reactor(s).		
Check if there is short-circuit plate or any DC reactor installed between terminal +1 and +2	Connect short circuit plate or DC reactor between terminal +1 and +2. If the error still exists, return to the factory for repair.		

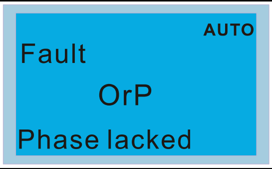
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
12	 	Low-voltage during deceleration (Lvd)	DC bus voltage is lower than Pr.06-00 setting value during deceleration
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediately act when DC bus voltage is lower than Pr.06-00		
Fault treatment parameter	NA		
Reset method	Manual reset		
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30V (Frame A–D)		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Power voltage changes	Adjust voltage to the power range of the drive.		
Start up the motor with large capacity	Check the power system. Increase the capacity of power equipment.		
Sudden load	Reduce the load. Increase the drive capacity.		
DC bus	Install DC reactor(s).		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
13	 	Low-voltage at constant speed (Lvn)	DC bus voltage is lower than Pr.06-00 setting value at constant speed
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediately act when DC bus voltage is lower than Pr.06-00		
Fault treatment parameter	NA		
Reset method	Manual reset		
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30V (Frame A–D)		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Power voltage changes	Adjust voltage to the power range of the drive		
Start up the motor with large capacity	Check the power system. Increase the capacity of power equipment.		
Sudden load	Reduce the load. Increase the drive capacity.		
DC bus	Install DC reactor(s).		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
14		Low-voltage at stop (LvS)	1. DC bus voltage is lower than Pr.06-00 setting value at stop 2. Hardware failure in voltage detection

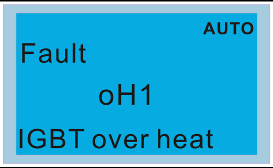
Action and Reset	
Action level	Pr.06-00 (Default = depending on the model)
Action time	Immediately act when DC bus voltage is lower than Pr.06-00
Fault treatment parameter	N/A
Reset method	Manual / auto: Frame A–D = Lv level + 60 V_{DC} + 500 ms
Reset condition	500 ms
Record	Yes

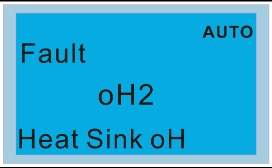
Cause	Corrective Actions
Power-off	Improve power supply condition.
Incorrect drive models	Check if the power specification matches the drive.
Power voltage changes	Adjust voltage to the power range of the drive. Cycle the power after checking the power. If LvS error still exists, return to the factory for repair.
Start up the motor with large capacity	Check the power system. Increase the capacity of power equipment.
DC bus	Install DC reactor(s).

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
15		Phase loss protection (OrP)	Phase loss of power input

Action and Reset	
Action level	DC bus is lower than Pr.07-00, and DC bus ripple is higher than Pr.06-52
Action time	N/A
Fault treatment parameter	Pr.06-53
Reset method	Manual reset
Reset condition	Immediately reset when DC bus is higher than Pr.07-00
Record	Yes

Cause	Corrective Actions
Phase loss of input power	Correctly install the wiring of the main circuit power.
Single phase power input to three-phase model	Choose the model whose power matches the voltage.
Power voltage changes	If the main circuit power works normally, verify the main circuit. Cycle the power after checking the power, if OrP error still exists, return to the factory for repair.
Loose wiring terminal of input power	Tighten the terminal screws according to the torque described in the user manual.
The input cable of three-phase power is cut off	Wire correctly. Replace the cut off cable.
Input power voltage changes too much	Verify the setting value for Pr.06-50 Time for Input Phase Loss Detection and Pr.06-52 Ripple of Input Phase Loss
Unbalanced three-phase of input power	Check the power three-phase status.

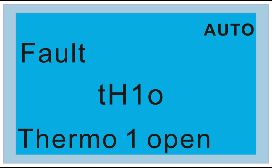
<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>16</td><td></td><td>IGBT overheating (oH1)</td><td colspan="2">IGBT temperature exceeds the protection level</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="3">Action level</td><td colspan="2">When Pr.06-15 is higher than the IGBT overheating protection level, oH1 error occurs instead of oH1 warning.</td></tr>
<tr><td colspan="3">Action time</td><td colspan="2">IGBT temperature exceeds the protection level for more than 100 ms, oH1 error occurs.</td></tr>
<tr><td colspan="3">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="3">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="3">Reset condition</td><td colspan="2">Reset only when IGBT temperature is lower than oH1 error level minus (-) 10°C</td></tr>
<tr><td colspan="3">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="3">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="3">Check if the ambient temperature or temperature inside the control cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.</td><td colspan="2">1. Check ambient temperature.
2. Regularly inspect the ventilation hole of the control cabinet.
3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings.
4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.</td></tr>
<tr><td colspan="3">Check if there is any obstruction on the heat sink or if the fan is running.</td><td colspan="2">Remove the obstruction or replace the cooling fan.</td></tr>
<tr><td colspan="3">Insufficient ventilation space</td><td colspan="2">Increase ventilation space of the drive.</td></tr>
<tr><td colspan="3">Check if the drive matches the corresponding load</td><td colspan="2">1. Reduce the load
2. Reduce the carrier
3. Replace the drive with a larger capacity model.</td></tr>
<tr><td colspan="3">The drive has run 100% or more than 100% of the rated output for a long time</td><td colspan="2">Replace the drive with a larger capacity model.</td></tr>
</table>

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th>Fault Descriptions</th></tr>
<tr><td>17</td><td>
</td><td>Heatsink overheating (oH2)</td><td>Capacitance temperature exceeds the protection level</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Refer to the table below for oH2 level of each models</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">When capacitance temperature exceeds the protection level for more than 100 ms, oH2 error occurs</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset when capacitance temperature is lower than oH2 error level minus (-) 10°C</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Check if the ambient temperature or temperature inside the control cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.</td><td colspan="2">1. Check ambient temperature.
2. Regularly inspect the ventilation hole of the control cabinet.
3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings.
4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.</td></tr>
<tr><td colspan="2">Check if there is any obstruction on the heat sink or if the fan is running.</td><td colspan="2">Remove the obstruction or replace the cooling fan.</td></tr>
<tr><td colspan="2">Insufficient ventilation space</td><td colspan="2">Increase ventilation space of the drive.</td></tr>
<tr><td colspan="2">Check if the drive matches the corresponding load</td><td colspan="2">1. Reduce the load
2. Reduce the carrier
3. Replace the drive with a larger capacity model.</td></tr>
<tr><td colspan="2">The drive has run 100% or more than 100% of the rated output for a long time</td><td colspan="2">Replace the drive with a larger capacity model.</td></tr>
<tr><td colspan="2">Unstable power</td><td colspan="2">Install reactor(s)</td></tr>
<tr><td colspan="2">Load changes frequently</td><td colspan="2">Reduce load changes</td></tr>
</table>

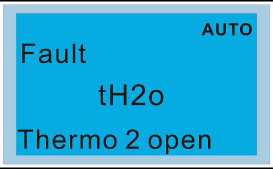
oH1/ oH2 warning level

<table>
<tr><th>Model</th><th>oH1</th><th>oH2</th><th>oH warning
oH1 warning = (Pr.06-15)</th></tr>
<tr><td>VFD007FP4EA-41/52/52S</td><td rowspan="2">110</td><td rowspan="7">85</td><td rowspan="17">oH1 Warning = Pr.06-15
oH2 Warning = oH2 – 5</td></tr>
<tr><td>VFD015FP4EA-41/52/52S</td></tr>
<tr><td>VFD022FP4EA-41/52/52S</td><td rowspan="5">100</td></tr>
<tr><td>VFD037FP4EA-41/52/52S</td></tr>
<tr><td>VFD040FP4EA-41/52/52S</td></tr>
<tr><td>VFD055FP4EA-41/52/52S</td></tr>
<tr><td>VFD075FP4EA-41/52/52S</td></tr>
<tr><td>VFD110FP4EA-41/52/52S</td><td rowspan="4">105</td><td rowspan="4">90</td></tr>
<tr><td>VFD150FP4EA-41/52/52S</td></tr>
<tr><td>VFD185FP4EA-41/52/52S</td></tr>
<tr><td>VFD220FP4EA-41/52/52S</td></tr>
<tr><td>VFD300FP4EA-41/52/52S</td><td rowspan="2">110</td><td rowspan="2">97</td></tr>
<tr><td>VFD370FP4EA-41/52/52S</td></tr>
<tr><td>VFD450FP4EA-41/52/52S</td><td rowspan="2">100</td><td rowspan="2">90</td></tr>
<tr><td>VFD550FP4EA-41/52/52S</td></tr>
<tr><td>VFD750FP4EA-41/52/52S</td><td rowspan="2">95</td><td rowspan="2">85</td></tr>
<tr><td>VFD900FP4EA-41/52/52S</td></tr>
</table>

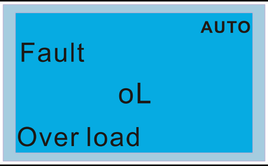
Unit: °C

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
18		IGBT temperature detection failure (tH1o)	IGBT hardware failure in temperature detection

Action and Reset	
Action level	NTC broken or wiring failure
Action time	When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH1o protection activates.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
Hardware failure	Wait for 10 minutes, and then cycle the power. Check if tH1o protection still exists. If yes, return to the factory for repair.

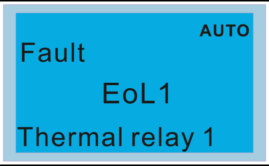
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
19		Capacitor hardware error (tH2o)	Hardware failure in capacitor temperature detection

Action and Reset	
Action level	NTC broken or wiring failure
Action time	When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH2o protection activates.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
Hardware failure	Wait for 10 minutes, and then cycle the power. Check if tH2o protection still exists. If yes, return to the factory for repair.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
21		Over load (oL)	The AC motor drive detects excessive drive output current. The overload capacity sustains for 1 minute when the drive outputs 120% of the drive's rated output current.

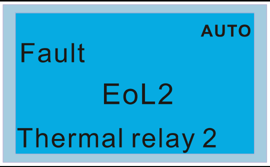
Action and Reset	
Action level	Based on over load curve and derating curve.
Action time	When the load is higher than the protection level and exceeds allowable time, the oL protection activates.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load
Accel./Decel. time or the working cycle are too short	Increase the setting value for Pr.01-12–01-19 (accel./decel time)
V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.
The capacity of the drive is too small	Replace the drive with a larger capacity model.
Overload during low-speed operation	Reduce the load during low-speed operation. Increase the drive capacity. Decrease the carrier frequency of Pr.00-17.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-26 Torque Compensation Gain) until the output current reduces and the motor does not stall.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Output phase loss	Check the status of three-phase motor. Check if the cable is broken or the screws are loose.
Input phase loss	Check if the motor three-phase impedance is equaled, or whether the screws are loosened.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
22		Electronics thermal relay 1 protection (EoL1)	Electronics thermal relay 1 protection. The drive coasts to stop once it activates.

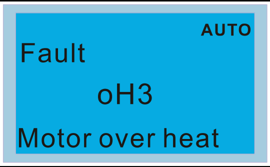
Action and Reset	
Action level	Start counting when output current > 105% of motor 1 rated current
Action time	Pr.06-14 (if the output current is larger than 105% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr.06-14)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load.
Accel./Decel. time or the working cycle is too short	Increase the setting values for Pr.01-12–01-19 (Accel./Decel. time)
V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.
Overload during low-speed operation. When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.
When using VFD dedicated motors, Pr.06-13=0 (electronic thermal relay selection motor 1 = inverter motor)	Pr.06-13=1 electronic thermal relay selection motor 1 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr.06-13=2 electronic thermal relay selection motor 1= disable, and install thermal relay on each motor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.
Motor fan error	Check the status of the fan, or replace the fan.
Unbalanced three-phase impedance of the motor	Replace the motor.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
23		Electronic thermal relay 2 protection (EoL2)	Electronic thermal relay 2 protection. The drive coasts to stop once it activates.

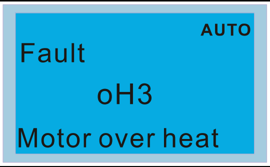
Action and Reset	
Action level	Start counting when output current > 105% of motor 2 rated current
Action time	Pr.06-28 (If the output current is larger than 105% of motor 2 rated current again within 60 sec., the counting time reduces and is less than Pr.06-28)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared
Record	Yes

Cause	Corrective Actions
The load is too large	Reduce the load
Accel./Decel. time or the working cycle are too short	Increase the setting values for Pr.01-12–01-19 (accel./decel. time)
V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection setting of Pr.01-43.
Overload during low-speed operation. When using general motor, even it operates below rated current, an overload may still occur during low-speed operation.	Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.
When using VFD dedicated motors, Pr.06-27=0 (electronic thermal relay selection motor 2 = 0 inverter motor)	Pr.06-27=1 Electronic thermal relay selection motor 2 = standard motor (motor with fan on the shaft).
Incorrect value of electronic thermal relay	Reset to the correct motor rated current.
The maximum motor frequency is set too low	Reset to the correct motor rated frequency.
One drive to multiple motors	Set Pr.06-27=2 Electronic thermal relay selection motor 2 = disable, and install thermal relay on each motor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.
Motor fan error	Check the status of the fan, or replace the fan.
Unbalanced three-phase impedance of the motor	Replace the motor.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
24_1		Motor overheating (oH3) PTC	Motor overheating (PTC) (Pr.03-00–Pr.03-02=6 PTC), when PTC input > Pr.06-30, the fault treatment acts according to Pr.06-29.

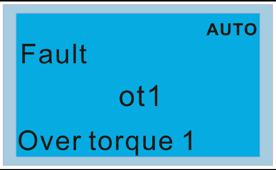
Action and Reset	
Action level	PTC input value > Pr.06-30 setting (Default = 50%)
Action time	Immediately act
Fault treatment parameter	Pr.06-29 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	When Pr.06-29=0, oH3 is a “Warning”. The “Warning” is automatically cleared. When Pr.06-29=1 or 2, oH3 is a “Fault”. You must reset manually.
Reset condition	Immediately reset
Record	When Pr.06-29=1 or 2, oH3 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Motor shaft lock	Remove the shaft lock.
The load is too large	Reduce the load. Increase the motor capacity.
Ambient temperature is too high	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operate at low-speed too long.	Decrease low-speed operation time. Replace the motor with a dedicated to VFD model. Increase the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–01-19 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate.	Reset to the correct motor rated current.
Check if the PTC is properly set and wired.	Check the connection between PTC thermistor and the heat protection.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics are too high.	Use remedies to reduce harmonics.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
24_2		Motor overheating (oH3) PT100	Motor overheating (PT100) (Pr.03-00–Pr.03-02=11 PT100). When PT100 input > Pr.06-57 (default = 7V), the fault treatment acts according to Pr.06-29.

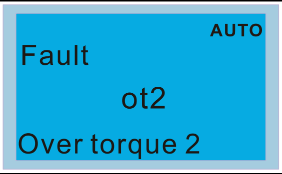
Action and Reset	
Action level	PT100 input value > Pr.06-57 setting (default = 7V)
Action time	Immediately act
Fault treatment parameter	Pr.06-29 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	When Pr.06-29=0 and the temperature < Pr.06-56, oH3 is automatically cleared. When Pr.06-29=1 or 2, oH3 is a “Fault”. You must reset manually.
Reset condition	Immediately reset
Record	When Pr.06-29=1 or 2, oH3 is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
Motor shaft lock	Remove the shaft lock.
The load is too large	Reduce the load. Increase the motor capacity.
Ambient temperature is too high	Change the installed place If there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operate at low-speed too long	Decrease low-speed operation time. Replace the motor with a dedicated to VFD model. Increase the motor capacity.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–Pr.01-19 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
Check if the motor rated current matches that on the motor nameplate.	Reset to the correct motor rated current.
Check if the PT100 is properly set and wired.	Check connection of PT100 thermistor.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics are too high	Use remedies to reduce harmonics.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
26		Over torque 1 (ot1)	When output current exceeds the over-torque detection level (Pr.06-07) and exceeds over-torque detection time (Pr.06-08), and when Pr.06-06 or Pr.06-09 is set to 2 or 4, the ot1 error displays.

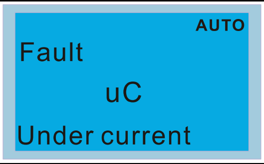
Action and Reset		
Action level	Pr.06-07	
Action time	Pr.06-08	
Fault treatment parameter	Pr.06-06 0: No function 1: Continue operation after Over-torque detection during constant speed operation 2: Stop after Over-torque detection during constant speed operation 3: Continue operation after Over-torque detection during RUN 4: Stop after Over-torque detection during RUN	
Reset method Reset condition	Auto	When Pr.06-06=1 or 3, ot1 is a “Warning”. The warning is automatically cleared when the output current < (Pr.06-07 – 5%)
	Manual	When Pr.06-06=2 or 4, ot1 is a “Fault”. You must reset manually.
Record	Immediately reset	
Active level	When Pr.06-06=2 or 4, ot1 is a “Fault”, and the fault is recorded.	

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr.06-07 and Pr.06-08
Mechanical failure (e.g. over-torque, mechanical lock)	Remove the causes of malfunction.
The load is too large	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–Pr.01-19 (accel./decel. time)
V/F voltage is too high	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Increase the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.
Improper parameter settings for speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
27		Over torque 2 (ot2)	When output current exceeds the over-torque detection level (Pr.06-10) and exceeds over-torque detection time (Pr.06-11), and when Pr.06-09 is set to 2 or 4, the ot2 error displays.

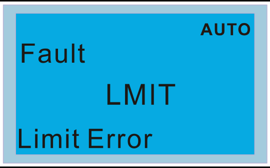
Action and Reset		
Action level	Pr.06-10	
Action time	Pr.06-11	
Fault treatment parameter	Pr.06-09 0: No function 1: Continue operation after Over-torque detection during constant speed operation 2: Stop after Over-torque detection during constant speed operation 3: Continue operation after Over-torque detection during RUN 4: Stop after Over-torque detection during RUN	
Reset method Reset condition	Auto	When Pr.06-09=1 or 3, ot2 is a "Warning". The warning is automatically cleared when the output current < (Pr.06-10 – 5%).
	Manual	When Pr.06-09=2 or 4, ot2 is a "Fault". You must reset manually.
Record	Immediately reset	
Active level	When Pr.06-09=2 or 4, ot2 is a "Fault", and the fault is recorded.	

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr.06-07 and Pr.06-08
Mechanical failure (e.g. over-torque, mechanical lock)	Remove the causes of malfunction.
The load is too large.	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time and working cycle are too short	Increase the setting values for Pr.01-12–01-19 (accel./decel. time).
V/F voltage is too high	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed).
The motor capacity is too small	Replace the motor with a larger capacity model.
Overload during low-speed operation	Decrease low-speed operation time. Increase the motor capacity.
Torque compensation is too large	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.
Improper parameter settings for speed tracking function (including restart at momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
28		Under current (uC)	Low current detection

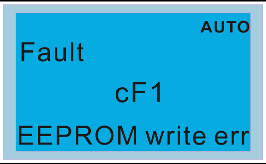
Action and Reset		
Action level	Pr.06-71	
Action time	Pr.06-72	
Fault treatment parameter	Pr.06-73 0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by 2nd deceleration time 3: Warn and operation continue	
Reset method Reset condition	Auto	When Pr.06-73=3, uC is a “Warning”. The warning is automatically cleared when the output current > (Pr.06-71+0.1A).
	Manual	When Pr.06-73=1 or 2, uC is a “Fault”. You must reset manually.
Record	Immediately reset	
Active level	When Pr.06-71=1 or 2, uC is a “Fault”, and the fault is recorded.	

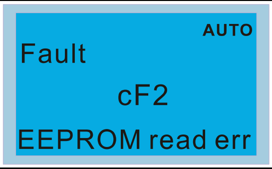
Cause	Corrective Actions
Motor cable disconnection	Troubleshoot the connection between the motor and the load.
Improper setting of low-current protection	Reset Pr.06-71, Pr.06-72 and Pr.06-73 to proper settings.
The load is too low	Check the load status. Check if the motor capacity matches the load.

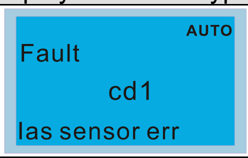
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
29		Limit Error (LMIT)	When MIx=45 (forward run limit) or MIx=44 (backward run limit) act during operation, LMIT error shows.

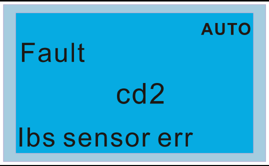
Action and Reset	
Action level	MIx=44 (backward run limit) or MIx=45(forward run limit)
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

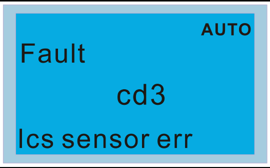
Cause	Corrective Actions
The limit ON/OFF switch is on incorrect position	Install the limit ON/OFF switch to correct position.
Deceleration time is too long, causing the motor cannot stop at limited position	Reduce deceleration time. Adjust setting values for brake level (Pr.07-01 or the insert position on the brake unit).
The motor cannot stop due to over-voltage stall prevention	Reset the over-voltage stall prevention.
Malfunction caused by interference	Verify wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

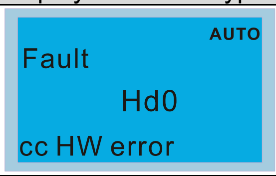
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
30		EEPROM write error (cF1)	Internal EEPROM cannot be programmed
Action and Reset			
Action level		Firmware internal detection	
Action time		cF1 acts immediately when the drive detects the fault	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		Yes	
Cause		Corrective Actions	
Internal EEPROM cannot be programmed		Press "RESET" key or reset the parameter to the default setting, if cF1 still exists, return to the factory for repair. Cycle the power, if cF1 still exists, return to the factory for repair.	

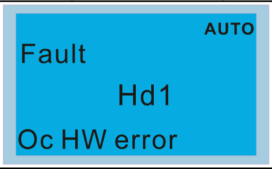
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
31		EEPROM read error (cF2)	Internal EEPROM cannot be read
Action and Reset			
Action level		Firmware internal detection	
Action time		cF2 acts immediately when the drive detects the fault	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		Yes	
Cause		Corrective Actions	
Internal EEPROM cannot be read		Press "RESET" key or reset the parameter to the default setting, if cF2 still exists, return to the factory for repair. Cycle the power, if cF2 error still exists, return to the factory for repair.	

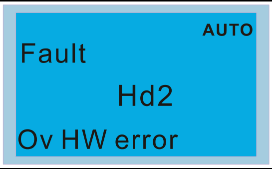
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
33		U-phase error (cd1)	U-phase current detection error when power is ON
Action and Reset			
Action level		Hardware detection	
Action time		cd1 acts immediately when the drive detects the fault	
Fault treatment parameter		N/A	
Reset method		Power-off	
Reset condition		N/A	
Record		Yes	
Cause		Corrective Actions	
Hardware failure		Cycle the power. If cd1 still exists, return to the factory for repair.	

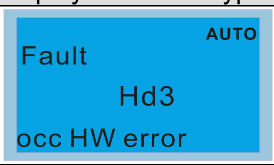
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
34		V-phase error (cd2)	V-phase current detection error when power ON
Action and Reset			
Action level	Hardware detection		
Action time	cd2 acts immediately when the drive detects the fault		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If cd2 still exists, return to the factory for repair.		

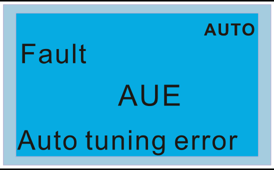
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
35		W-phase error (cd3)	W-phase current detection error when power ON
Action and Reset			
Action level	Hardware detection		
Action time	cd3 acts immediately when the drive detects the fault		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If cd3 still exists, return to the factory for repair.		

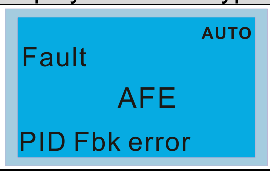
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
36		cc hardware failure (Hd0)	cc (current clamp) hardware protection error when power is ON
Action and Reset			
Action level	Hardware detection		
Action time	Hd0 acts immediately when the drive detects the fault		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If Hd0 still exists, return to the factory for repair.		

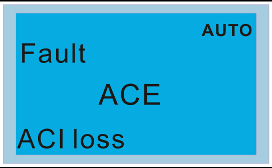
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
37		oc hardware error (Hd1)	oc hardware protection error when power is ON
Action and Reset			
Action level	Hardware detection		
Action time	Hd1 acts immediately when the drive detects the fault		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If Hd1 still exists, return to the factory for repair.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
38		ov hardware error (Hd2)	ov hardware protection error when power is ON
Action and Reset			
Action level	Hardware detection		
Action time	Hd2 acts immediately when the drive detects the fault		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If Hd2 still exists, return to the factory for repair.		

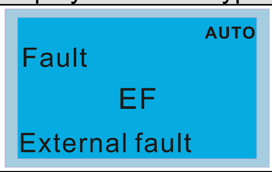
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
39		occ hardware error (Hd3)	Protection error of occ IGBT short-circuit detection when power is ON
Action and Reset			
Action level	Hardware detection		
Action time	Hd3 acts immediately when the drive detects the fault		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If Hd3 still exists, return to the factory for repair.		

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>40</td><td>
</td><td>Auto-tuning error (AUE)</td><td colspan="2">Motor auto-tuning error</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">Hardware detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Press “STOP” key during auto-tuning</td><td colspan="3">Re-execute auto-tuning.</td></tr>
<tr><td colspan="2">Incorrect motor capacity (too large or too small) and parameter setting</td><td colspan="3">Check motor capacity and related parameters.
Set the correct parameters, that is Pr.01-01–Pr.01-02.
Set Pr.01-00 larger than motor rated frequency.</td></tr>
<tr><td colspan="2">Incorrect motor wiring</td><td colspan="3">Check the wiring.</td></tr>
<tr><td colspan="2">Motor shaft lock</td><td colspan="3">Remove the cause of motor shaft lock.</td></tr>
<tr><td colspan="2">The electromagnetic contactor is ON at output side (U/V/W) of the drive</td><td colspan="3">Make sure the electromagnetic valve is OFF.</td></tr>
<tr><td colspan="2">The load is too large.</td><td colspan="3">Reduce the load.
Replace the motor with a larger capacity model.</td></tr>
<tr><td colspan="2">Accel./Decel. time is too short</td><td colspan="3">Increase the setting values for Pr.01-12–Pr.01-19 (Accel./Decel. time).</td></tr>
</table>

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>41</td><td>
</td><td>PID loss ACI (AFE)</td><td colspan="2">PID feedback loss (analog feedback signal is only valid when the PID function is enabled)</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">When the analog input < 4 mA (only detects 4–20 mA analog input)</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.08-08</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr.08-09
0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.08-09=3 or 4, AFE is a “Warning”. When the feedback signal is > 4mA, the ”Warning” is automatically cleared.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.08-09=1 or 2, AFE is a “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr.08-09=1 or 2, AFE is a “Fault”, and the fault is recorded; when Pr.08-09=3 or 4, AFE is a “Warning”, and the warning is not recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">PID feedback cable is loose or cut off</td><td colspan="3">Tighten the terminal.
Replace the cable with a new one.</td></tr>
<tr><td colspan="2">Feedback device failure</td><td colspan="3">Replace the device with a new one.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="3">Check all the wiring. If AFE fault still exists, return to the factory for repair.</td></tr>
</table>

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
48		ACI loss (ACE)	Analog input loss (including all the 4–20 mA analog signal)

Action and Reset		
Action level	When the analog input is < 4 mA (only detects 4–20 mA analog input)	
Action time	Immediately act	
Fault treatment parameter	Pr.03-19 0: Disable 1: Continue operation at the last frequency (warning, ANL is displayed on the keypad) 2: Decelerate to stop (warning, ANL is displayed on the keypad) 3: Stop immediately and display ACE	
Reset method	Auto	When Pr.03-19=1 or 2, ACE is a “Warning”. When analog input signal is > 4mA, the warning is automatically cleared.
	Manual	When Pr.03-19=3, ACE is a “Fault”. You must reset manually.
Reset condition	Immediately reset	
Record	When Pr.03-19=3, ACE is a “Fault”, and the fault is recorded.	
Cause	**Corrective Actions**	
ACI cable is loose or cut off	Tighten the terminal. Replace the cable with a new one.	
External device failure	Replace the device with a new one.	
Hardware failure	Check all the wiring. If ACE still exists, return to the factory for repair.	

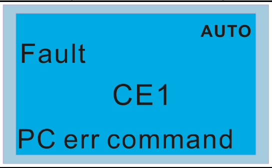
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
49		External fault (EF)	External fault. When the drive decelerates based on the setting of Pr.07-20, the EF fault displays on the keypad.

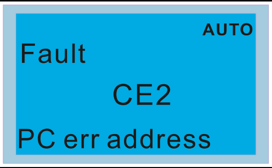
Action and Reset	
Action level	MIx=EF and the MI terminal is ON
Action time	Immediately act
Fault treatment parameter	Pr.07-20 0: Coast to stop 1: Stop by the 1st deceleration time 2: Stop by the 2nd deceleration time 3: Stop by the 3rd deceleration time 4: Stop by the 4th deceleration time 5: System deceleration 6: Automatic deceleration (Pr.01-46)
Reset method	Manual reset
Reset condition	Manual reset only after the external fault is cleared (terminal status is recovered)
Record	Yes
Cause	**Corrective Actions**
External fault	Press RESET key after the fault is cleared.

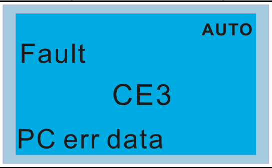
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
50	AUTO Fault EF1 Emergency stop	Emergency stop (EF1)	When the contact of MIx=EF1 is ON, the output stops immediately and displays EF1 on the keypad. The motor is in free running.
Action and Reset			
Action level		MIx=EF1 and the MI terminal is ON	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Manual reset only after the external fault is cleared (terminal status is recovered)	
Record		Yes	
Cause		Corrective Actions	
When MIx=EF1 activates		Verify if the system is back to normal condition, and then press “RESET” key to go back to the default.	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
51	AUTO Fault bb Base block	External base block (bb)	When the contact of MIx=bb is ON, the output stops immediately and displays bb on the keypad. The motor is in free running.
Action and Reset			
Action level		MIx=bb and the MI terminal is ON	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		The display “bb” is automatically cleared after the fault is cleared.	
Reset condition		N/A	
Record		No	
Cause		Corrective Actions	
When MIx=bb activates		Verify if the system is back to normal condition, and then press “RESET” key to go back to the default.	

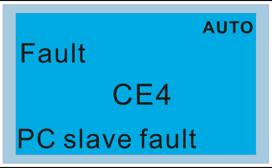
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
52	AUTO Fault Pcod Password error	Password is locked (Pcod)	Entering the wrong password three consecutive times
Action and Reset			
Action level		Entering the wrong password three consecutive times	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Power-off	
Record		Yes	
Cause		Corrective Actions	
Incorrect password input through Pr.00-07		1. Input the correct password after rebooting the motor drive. 2. If you forget the password, do the following steps: Step 1: Input 9999 and press ENTER. Step 2: Repeat step 1. Input 9999 and press ENTER. (You need to finish step 1 and step 2 within 10 seconds. If you don’t finish the two steps in 10 seconds, try again.) 3. The parameter settings return to the default when the “Input 9999” process is finished.	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
54		Illegal command (CE1)	Communication command is illegal
Action and Reset			
Action level	When the function code is not 03, 06, 10, or 63.		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	No		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

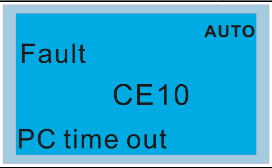
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
55		Illegal data address (CE2)	Data address is illegal
Action and Reset			
Action level	When the data address is correct.		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	No		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
56		Illegal data value (CE3)	Data value is illegal

Action and Reset	
Action level	When the data length is too long
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	No
Cause	**Corrective Actions**
Incorrect communication command from the upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

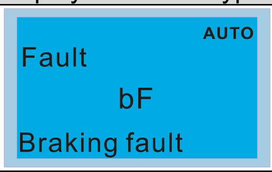
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
57		Data is written to read-only address (CE4)	Data is written to read-only address

Action and Reset	
Action level	When the data is written to read-only address.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	No
Cause	**Corrective Actions**
Incorrect communication command from the upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
58		Modbus transmission time-out (CE10)	Modbus transmission time-out occurs

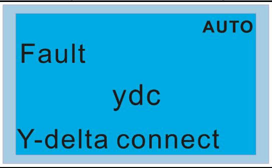
Action and Reset	
Action level	When the communication time exceeds the detection time for Pr.09-03 time-out.
Action time	Pr.09-03
Fault treatment parameter	Pr.09-02 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault and continue operation
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

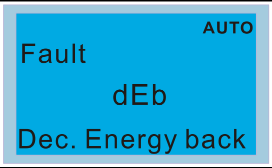
Cause	Corrective Actions
The upper unit does not transmit the communication command within Pr.09-03 setting time.	Check if the upper unit transmits the communication command within the setting time for Pr.09-03.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

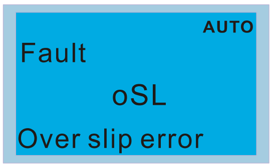
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
60		Brake transistor error (bF)	The brake transistor of the motor drive is abnormal. (for the models with built-in brake transistor)

Action and Reset	
Action level	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Hardware error	1. Press “RESET” key to go back to the default. If bF still exists, return to the factory for repair. 2. Power off the motor drive since the internal circuit is abnormal. Use a meter to check if it is short-circuit between B2 to DC-. If short-circuit exists, return to the factory for repair.
Malfunction caused by interference	Verify wiring/grounding of the main circuit to prevent interference.
Using the incorrect brake resistor	Check if the resistance value of the brake resistor matches to the drive.
Incorrect wiring of the brake resistor	Refer to the optional accessories instruction in chapter 7, and verify the wiring.

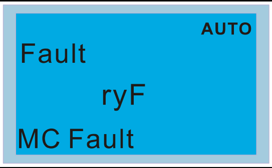
<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>61</td><td>
</td><td>Y-connection / Δ-connection switch error (ydc)</td><td colspan="2">An error occurs when Y-Δ switches</td></tr>
<tr><td colspan="5">Action and Reset</td></tr>
<tr><td colspan="2">Action level</td><td colspan="3">1. ydc occurs when the confirmation signals of Y-connection and Δ-connection are conducted at the same time.
2. If any of confirmation signals is not conducted within Pr.05-25, ydc occurs.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.05-25</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Can be reset only when the confirmation signal of Y-connection is conducted if it is Y-connection, or when the confirmation signal of Δ-connection is conducted if it is Δ-connection.</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><td colspan="2">Cause</td><td colspan="3">Corrective Actions</td></tr>
<tr><td colspan="2">The electromagnetic valve operates incorrectly during Y-Δ switch.</td><td colspan="3">Check if the electromagnetic valve works normally.
If not, replace it.</td></tr>
<tr><td colspan="2">Incorrect parameter setting</td><td colspan="3">Check if related parameters are all set up and set correctly.</td></tr>
<tr><td colspan="2">The wiring of Y-Δ switch function is incorrect</td><td colspan="3">Check the wiring.</td></tr>
</table>

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>62</td><td>
</td><td>Deceleration energy backup error (dEb)</td><td colspan="2">When Pr.07-13 is not 0, and the power is suddenly off, causing the DC bus voltage lower than the dEb action level, the dEb function acts and the motor ramps to stop. Then dEb displays on the keypad.</td></tr>
<tr><td colspan="5">Action and Reset</td></tr>
<tr><td colspan="2">Action level</td><td colspan="3">When Pr.07-13 is not 0, and the DC bus voltage is lower than the level of dEb.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.07-13=2 (dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored): dEb is automatically cleared.</td></tr>
<tr><td>Hand</td><td colspan="2">When Pr.07-13=1 (dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored): The drive stops when dEb acts and the rotation speed becomes 0 Hz, then the drive can be reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Auto: The fault is automatically cleared.
Hand: When the drive decelerates to 0 Hz.</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><td colspan="2">Cause</td><td colspan="3">Corrective Actions</td></tr>
<tr><td colspan="2">Unstable power source or the power is off</td><td colspan="3">Check the power system.</td></tr>
<tr><td colspan="2">There is any other large load operates in the power system</td><td colspan="3">1. Replace power system with a larger capacity.
2. Use a different power system from the large load system.</td></tr>
</table>

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
63		Over slip error (oSL)	On the basis of the maximum slip limit set via Pr.10-29, the speed deviation is abnormal. When the motor drive outputs at constant speed, F>H or F<H exceeds the level set via Pr.07-29, and it exceeds the time set via Pr.07-30, oSL shows. oSL occurs in induction motors only.

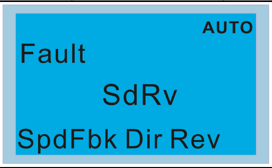
Action and Reset		
Action level	Pr.07-29 100% of Pr.07-29 = the maximum limit of the slip frequency (Pr.10-29)	
Action time	Pr.07-30	
Fault treatment parameter	Pr.07-31 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	
Reset method	Auto	Pr.07-31=0 is a warning. When the motor drive outputs at constant speed, and F>H or F<H does not exceed the level set via Pr.07-29 anymore, oSL warning will be cleared automatically.
	Hand	When Pr.07-31=1 or 2, oSL is an error, and it needs to reset manually.
Reset condition	Immediately reset	
Record	Pr.07-31=1 or 2, oSL is “Fault”, and will be recorded.	

Cause	Corrective Actions
Any of the motor parameters in parameter group 5 may be incorrect	Check the motor parameters
Overload	Decrease the load
Any of the setting value of Pr.07-29, 07-30, and 10-29 is improper	Check the setting of oSL protection function related parameters

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
64		Electric valve switch error (ryF)	Electric valve switch error when executing Soft Start

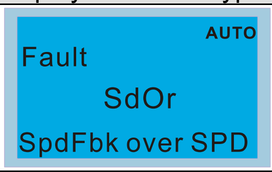
Action and Reset	
Action level	Hardware detection (Frame D and above)
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset when the electric valve switch is correctly closed
Record	Yes

Cause	Corrective Actions
The input power is abnormal	Check if the power is shut down during the drive operation. Check if the three-phase input power is normal.
Malfunction caused by interference	Verify the wiring/grounding of the main circuit to prevent interference.
Hardware failure	Cycle the power after checking the power. If ryF error still exists, return to the factory for repair.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
68		Reverse direction of the speed feedback (SdRv)	Rotating direction is different from the commanding direction detected by the sensorless

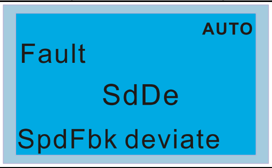
Action and Reset	
Action level	Software detection
Action time	Pr.10-09
Fault treatment parameter	Pr.10-08 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.10-08=1 or 2, SdRv is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
The setting of Pr.10-25 FOC bandwidth of speed observer is improper	Decrease the setting of Pr.10-25
The setting of motor parameter is incorrect	Reset the motor parameter and execute parameter tuning
The motor cable is abnormal or broken	Check if the cable is well functioned or replace the cable
A reverse force is exerted, or the motor runs in a reverse direction at start	Start speed tracking function (Pr.07-12)
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
69		Over speed rotation feedback (SdOr)	Over speed rotation detected by sensorless

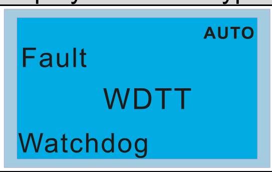
Action and Reset	
Action level	Pr.10-10
Action time	Pr.10-11
Fault treatment parameter	Pr.10-12 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.10-12=1 or 2, SdOr is a “Fault”, and the fault is recorded.

Cause	Corrective Actions
The setting of Pr.10-25 FOC bandwidth of speed observer is improper	Decrease the setting of Pr.10-25
The setting of ASR bandwidth of speed controller is improper	Increase the bandwidth of ASR speed controller
The setting of motor parameter is incorrect	Reset motor parameter and execute parameter tuning
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
70		Large deviation of speed feedback (SdDe)	A large deviation between the rotating speed and the command detected by the sensorless

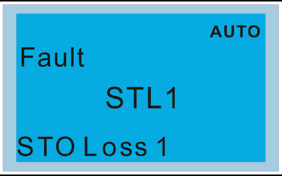
Action and Reset	
Action level	Pr.10-13
Action time	Pr.10-14
Fault treatment parameter	Pr.10-15 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.10-15=1 or 2, SdDe is a "Fault", and the fault is recorded.

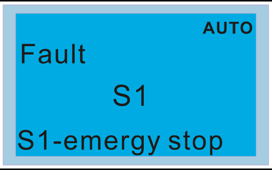
Cause	Corrective Actions
Improper parameter setting for abnormal rotating slip function	Reset proper setting for Pr.10-13 and Pr.10-14
Improper parameter setting for ASR and acceleration/deceleration	Reset ASR parameters Set proper acceleration/deceleration time
The acceleration/deceleration time is too short	Reset proper acceleration/deceleration time
Motor shaft lock	Remove the cause of motor shaft lock
The mechanical brake is not released	Verify the system action timeline
Incorrect parameter setting for torque limit (Pr.06-12, Pr.11-17 – 20)	Adjust the setting to proper value
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

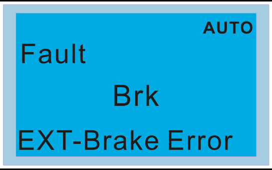
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
71		Watchdog (WDTT)	Watchdog error

Action and Reset	
Action level	Hardware detection
Action time	N/A
Fault treatment parameter	N/A
Reset method	Hardware failure, and cannot reset. Cycle the power.
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Hardware interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference. If the WDTT fault still exists, return to the factory for repair.

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>72</td><td></td><td>STO Loss 1 (STL1)</td><td colspan="2">STO1–SCM1 internal loop detection error</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">Hardware detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Hardware failure, and cannot reset. Cycle the power.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">STO1 and SCM1 short circuit lines are not connected</td><td colspan="3">Connect the short circuit line</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="3">After you make sure all the wiring is correct, if STOL fault still exists after cycling the power, please return to the factory for repair.</td></tr>
<tr><td colspan="2">Bad connection of the IO card</td><td colspan="3">Check if the PIN of IO card is broken.
Check if the IO card connects to the control board correctly, and if the screws are tightened well.</td></tr>
<tr><td colspan="2">The IO card does not match the version of the control board</td><td colspan="3">Contact local agent or Delta</td></tr>
</table>

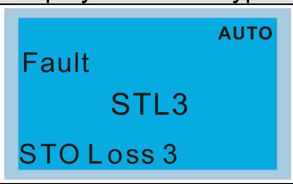
<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>73</td><td></td><td>Emergency stop for external safety (S1)</td><td colspan="2">Emergency stop for external safety</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">Hardware detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Reset only after S1 error is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">The switch action of S1 and SCM (OPEN)</td><td colspan="3">Reset the switch and cycle the power.</td></tr>
<tr><td colspan="2">S1 and SCM short circuit lines are not connected</td><td colspan="3">Re-connect the short circuit lines</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="3">Verify the wiring/grounding of the main circuit, control circuit and encoder to prevent interference.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="3">If S1 fault still exists after cycling the power, please return to the factory for repair.</td></tr>
<tr><td colspan="2">Poor connection of the IO card</td><td colspan="3">Check if the PIN of IO card is broken.
Check if the IO card connects to the control board correctly, and if the screws are tightened well.</td></tr>
<tr><td colspan="2">The IO card does not match the version of the control board</td><td colspan="3">Contact local agent or Delta</td></tr>
</table>

<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>75</td><td>
</td><td>External brake error (Brk)</td><td colspan="2">External mechanical brake error
The MO terminal is active when MOx=12, 42, 47 or 63, but the MIx=55 does not receive signal for mechanical brake action during the set time of Pr.02-56.</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">MIx=55 did not receive signal for the mechanical brake action during the set time of Pr.02-56.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.02-56</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="3">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Mechanical brake error</td><td colspan="3">Verify if the mechanical brake can work correctly.
Replace mechanical brake.</td></tr>
<tr><td colspan="2">Incorrect parameter setting</td><td colspan="3">If there is no brake-confirming signal to use, set Pr.02-56=0.</td></tr>
<tr><td colspan="2">Signal cable is loose or cut off</td><td colspan="3">Tighten the screws.
Replace the signal cable with a new one.</td></tr>
<tr><td colspan="2">The time of Pr.02-56 is set too short</td><td colspan="3">Increase the time setting of Pr.02-56</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="3">Verify the wiring/grounding of the main circuit, control circuit and encoder to prevent interference.</td></tr>
</table>

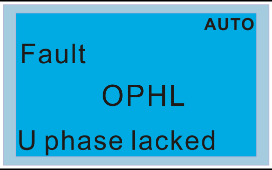
<table>
<tr><th>ID*</th><th>Display on LCD Keypad</th><th>Fault Name</th><th colspan="2">Fault Descriptions</th></tr>
<tr><td>76</td><td>
</td><td>STO (STO)</td><td colspan="2">Safety Torque Off function active</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">Hardware detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.06-44=1 and after STO error is cleared, it automatically resets.</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.06-44=0 and after STO error is cleared, reset it manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Reset only after STO error is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">The switch action of STO1/SCM1 and STO2/SCM2 (OPEN)</td><td colspan="3">Reset the switch (ON) and cycle the power</td></tr>
<tr><td colspan="2">Poor connection of the IO card</td><td colspan="3">Check if the PIN of IO card is broken.
Check if the IO card connects to the control board correctly, and if the screws are tightened well.</td></tr>
<tr><td colspan="2">The IO card does not match the version of the control board</td><td colspan="3">Contact local agent or Delta</td></tr>
</table>

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
77		STO Loss 2 (STL2)	STO2–SCM2 internal loop detection error

Action and Reset	
Action level	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Hardware failure, and cannot reset. Cycle the power.
Reset condition	N/A
Record	Yes
Cause	**Corrective Actions**
STO2 and SCM2 short circuit lines are not connected	Connect the short circuit lines
Hardware failure	After you make sure all the wiring is correct, if STL2 fault still exists after cycling the power, please return to the factory for repair.
Poor connection of the IO card	Check if the PIN of IO card is broken. Check if the IO card connects to the control board correctly, and if the screws are tightened well.
The IO card does not match the version of the control board	Contact local agent or Delta

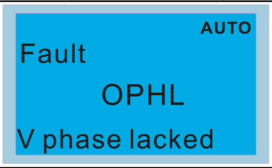
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
78		STO Loss 3 (STL3)	STO1–SCM1 and STO2–SCM2 internal loop detection error

Action and Reset	
Action level	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Hardware failure, and cannot reset. Cycle the power.
Reset condition	N/A
Record	Yes
Cause	**Corrective Actions**
STO1 and SCM1, or STO2 and SCM2 short circuit lines are not connected	Re-connect the short circuit lines
Hardware failure	After you make sure all the wiring is correct, if STL3 fault still exists after cycling the power, please return to the factory for repair.
Poor connection of the IO card	Check if the PIN of IO card is broken. Check if the IO card connects to the control board correctly, and if the screws are tightened well.
The IO card does not match the version of the control board	Contact local agent or Delta

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
82		Output phase loss U phase (OPHL)	U phase output phase loss

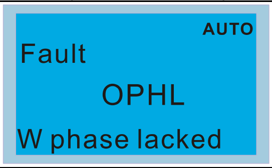
Action and Reset	
Action level	Pr.06-47
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first if there is DC braking function, and then use that of Pr.06-46.
Fault treatment parameter	Pr.06-45 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	Manual reset
Reset condition	Immediately reset
Record	Pr.06-45=1 or 2 is “Fault”, and will be recorded.

Cause	Corrective Actions
The three-phase impedance of motor is unbalanced	Replace the motor.
The motor is wired incorrectly	Check the cable condition. Replace the cable.
Using a single-phase motor	Choose a three-phase motor
The current sensor is damaged	Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, return the unit to the factory. Verify that the three-phase current is balanced via a current clamp meter. If it is balanced and the OPHL fault still exists, return the unit to the factory
The drive capacity is much larger than the motor capacity	Make sure the capacity of the drive and motor match to each other.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
83		Output phase loss V phase (OPHL)	V phase output phase loss

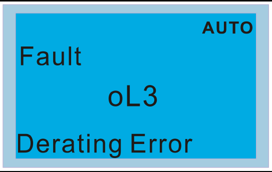
Action and Reset	
Action level	Pr.06-47
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46.
Fault treatment parameter	Pr.06-45 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.06-45=1 or 2, OPHL is a "Fault", and the fault is recorded.

Cause	Corrective Actions
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable and replace it if necessary.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL fault still exists, return to the factory for repair.
Check if the drive capacity is larger than the motor capacity	Choose the drive that matches the motor capacity

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
84		Output phase loss W phase (OPHL)	W phase output phase loss

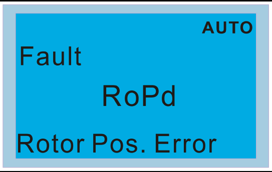
Action and Reset	
Action level	Pr.06-47
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46.
Fault treatment parameter	Pr.06-45 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
Reset method	Manual reset
Reset condition	Immediately reset
Record	When Pr.06-45=1 or 2, OPHL is a "Fault", and the fault is recorded.

Cause	Corrective Actions
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect	Check the cable and replace it if necessary.
Check if the motor is a single-phase motor	Choose a three-phase motor.
Check if the current sensor is broken	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL fault still exists, return to the factory for repair.
Check if the drive capacity is larger than the motor capacity	Choose the drive that matches the motor capacity

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
87		Overload protection at low frequency (oL3)	Low frequency and high current protection

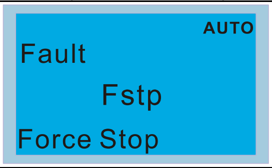
Action and Reset	
Action level	Software detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
The drive operates at a frequency below 15 Hz, and output current is too large.	1. Enhance the heat dissipation capacity for the cabinet. 2. Lower the carrier frequency (Pr.00-17). 3. Decrease the voltage settings that correspond to frequency below 15 Hz in the V/F curve. 4. Change Pr.00-11 to general control mode. 5. Replace the drive with a larger power model.

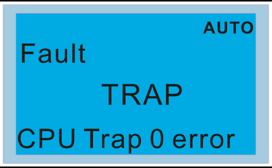
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
89		Rotor position detection error (RoPd)	Rotor position detection error protection

Action and Reset	
Action level	Reset the software
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

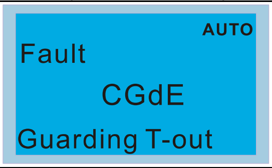
Cause	Corrective Actions
Check if the motor cable is abnormal or broken	Check or replace the cable.
Motor coil error	Replace the motor.
Hardware failure	IGBT broken. Return to the factory for repair.
Drive’s current feedback line error	Cycle the power. If RoPd still occurs during operation, return to the factory for repair.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
90		Force to stop (FStp)	Keypad forces PLC to Stop

Action and Reset	
Action level	When Pr.00-32=1, STOP button on the keypad is valid. When giving the STOP command during the PLC operation, FStp fault will active.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
Pr.00-32=1: keypad STOP button is valid	Check if it is necessary to set Pr.00-32=0, so the keypad STOP button is invalid.
Press STOP button during PLC operation	Verify the timing of STOP function.

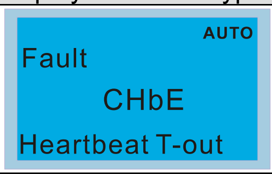
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
93		CPU error 0 (TRAP)	CPU crash

Action and Reset	
Action level	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Cannot reset, power off.
Reset condition	N/A
Record	Yes
Cause	**Corrective Actions**
Hardware interference	Verify the wiring of control circuit, and the wiring/grounding of the main circuit to prevent interference. If TRAP fault still exists, return to the factory for repair.
Hardware failure	Return to the factory for repair.
CPU is in an infinite loop	Cycle the power. If the TRAP fault still exists, return to the factory for repair.

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
101		CANopen guarding error (CGdE)	CANopen guarding error

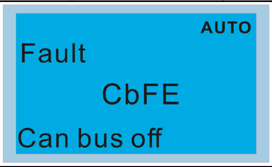
Action and Reset	
Action level	When CANopen Node Guarding detects that one of the slaves does not response, the CgdE fault will activate. The upper unit sets factor and time during configuration.
Action time	The time that upper unit sets during configuration
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	The upper unit sends a reset package to clear this fault
Record	Yes

Cause	Corrective Actions
The guarding time is too short, or less detection times	Increase the guarding time (Index 100C) and detection times
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

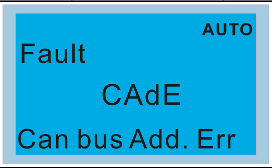
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
102		CANopen heartbeat error (ChbE)	CANopen heartbeat error

Action and Reset	
Action level	When CANopen Heartbeat detects that one of the slaves does not response, the ChbE fault will activate. The upper unit sets the confirming time of producer and consumer during configuration.
Action time	The confirming time that upper unit sets for producer and consumer during configuration.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	The upper unit sends a reset package to clear this fault
Record	Yes

Cause	Corrective Actions
The heartbeat time is too short	Increase heartbeat time (Index 100C)
Malfunction caused by interference	1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.
Communication cable is broken or bad connected	Check or replace the communication cable.

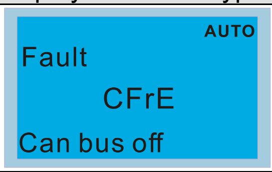
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
104		CANopen bus off error (CbFE)	CANopen bus off error
Action and Reset			
Action level		Hardware	When CANopen card is not installed, CbFE fault will occur.
		Software	When the master received wrong communication package, CbFE fault will occur. Too much interference on BUS When the CAN_H and CAN_L communication cable is short, the master will receive wrong package, and CbFE fault will occur.
Action level		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Cycle the power	
Record		Yes	
Cause		Corrective Actions	
Check if the CANopen card is installed		Make sure the CANopen card is installed.	
Check if the CANopen speed is correct		Reset CANopen speed (Pr.09-37)	
Malfunction caused by interference		1. Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2. Make sure the communication circuit is wired in series. 3. Use CANopen cable or add terminating resistance.	
Communication cable is broken or bad connected		Check or replace the communication cable.	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
105		CANopen index error (CidE)	CANopen index error
Action and Reset			
Action level		Software detection	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Upper unit sends a reset package to clear this fault	
Record		Yes	
Cause		Corrective Actions	
Incorrect setting of CANopen index		Reset CANopen Index (Pr.00-02=7)	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
106		CANopen station address error (CadE)	CANopen station address error (only supports 1–127)

Action and Reset	
Action level	Software detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset (Pr.00-02=7)
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Incorrect setting of CANopen station address	1. Disable CANopen (Pr.09-36=0) 2. Reset CANopen (Pr.00-02=7) 3. Reset CANopen station address (Pr.09-36)

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
107		CANopen memory error (CfrE)	CANopen memory error

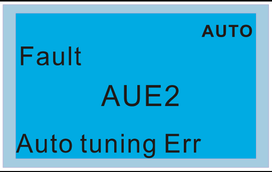
Action and Reset	
Action level	When the user update firmware version of the control board, the FRAM internal data will not be changed, and then CfrE fault will occur.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Pr.00-02=7
Record	Pr.00-21=3, the fault is recorded

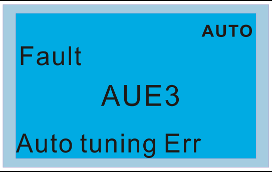
Cause	Corrective Actions
CANopen internal memory error	1. Disable CANopen (Pr.09-36=0) 2. Reset CANopen (Pr.00-02=7) 3. Reset CANopen station address (Pr.09-36)

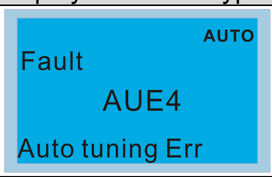
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
111	AUTO Fault ictE InrCom Time Out	InrCOM time-out error (ictE)	Internal communication time-out
Action and Reset			
Action level		Pr.09-31=-1 – -10 (there is no -9), when the internal communication between Slave and Master is abnormal, IctE fault will occur.	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Automatically reset after the internal communication is normal	
Reset condition		N/A	
Record		Yes	
Cause		Corrective Actions	
Malfunction caused by interference		Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
The communication condition is different with the upper unit		Verify the setting of Pr.09-02 is the same as the setting of upper unit.	
Communication cable is broken or bad connected		Check or replace the communication cable.	

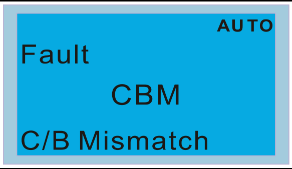
ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
112	AUTO Fault SfLK PMLess Shaft Lock	PMLess shaft lock (SfLK)	The drive has RUN command with output frequency, but the permanent magnetic motor does not turn.
Action and Reset			
Action level		Software detection	
Action time		3 sec.	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		Yes	
Cause		Corrective Actions	
Improper setting of the speed observer bandwidth		Increase the setting value.	
Motor shaft lock		Remove causes of the motor shaft lock.	
Motor error (e.g. demagnetization)		Replace the motor with a new one.	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
142	AUTO Fault AUE1 Auto tuning Err	Auto-tune error 1 (AUE1)	No feedback current error when motor parameter automatically detects
Action and Reset			
Action level		Software detection	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		Yes	
Cause		Corrective Actions	
Motor is not wired		Wire the motor correctly	
The electromagnetic contactor is used as an open state on the output side of the drive (U/V/W).		Verify that the electromagnetic valve is closed.	

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
143		Auto-tune error 2 (AUE2)	Motor phase loss error when motor parameter automatically detects
Action and Reset			
Action level	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
Incorrect motor wiring	Wire the motor correctly.		
Motor error	Check if the motor works normally.		
The electromagnetic contactor is used as an open state on the output side of the drive (U/V/W).	Verify that the three-phases of the electromagnetic valve are all closed.		
Motor U/V/W wire error	Check if the wires are broken.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
144		Auto-tune error 3 (AUE3)	No load current I_0 measurement error when motor parameter automatically detects.
Action and Reset			
Action level	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
Incorrect settings for the motor parameter (rated current)	Check the settings for Pr.05-01 / Pr.05-13 / Pr.05-34.		
Motor error	Check if the motor works normally.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
148		Auto-tune error 4 (AUE4)	Leakage inductance Lsigma measurement error when motor parameter automatically detects.
Action and Reset			
Action level	Software detection		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
Motor error	Check if the motor works normally.		
Incorrect setting of motor parameters (base frequency)	Check the setting of Pr.01-01.		

ID*	Display on LCD Keypad	Fault Name	Fault Descriptions
170		C/B mismatch (CBM)	Control board matching error

Action and Reset	
Action level	N/A
Action time	Acts when turning on the drive
Fault treatment parameter	N/A
Reset method	Cannot reset
Reset condition	Cannot reset
Record	Yes

Cause	Corrective Actions
Incorrect control board	Replace with the correct control board. If the CBM still exists, contact Delta for further confirmation.

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Chapter 15 CANopen Overview

The built-in CANopen function is a kind of remote control. You can control the AC motor drive by using CANopen protocol. CANopen is a CAN-based higher layer protocol. It provides standardized communication objects, including real-time data (Process Data Objects, PDO), configuration data (Service Data Objects, SDO) and special functions (Time Stamp, Sync message, and Emergency message). It also has network management data, including Boot-up message, NMT message, and Error Control message. Refer to CiA website http://www.can-cia.org/ for details. The content of this instruction sheet may be revised without prior notice. Please consult our distributors or download the most updated version at http://www.delta.com.tw/industrialautomation

Delta CANopen supporting functions:

- Support CAN2.0A Protocol;
- Support CANopen DS301 V4.02;
- Support DSP-402 V2.0.

Delta CANopen supporting services:

- PDO (Process Data Objects): PDO1–PDO4
- SDO (Service Data Object):
  Initiate SDO Download;
  Initiate SDO Upload;
  Abort SDO;
  SDO message can be used to configure the slave node and access the Object Dictionary in every node.
- SOP (Special Object Protocol):
  Support default COB-ID in Predefined Master/Slave Connection Set in DS301 V4.02;
  Support SYNC service;
  Support Emergency service.
- NMT (Network Management):
  Support NMT module control;
  Support NMT Error control;
  Support Boot-up.

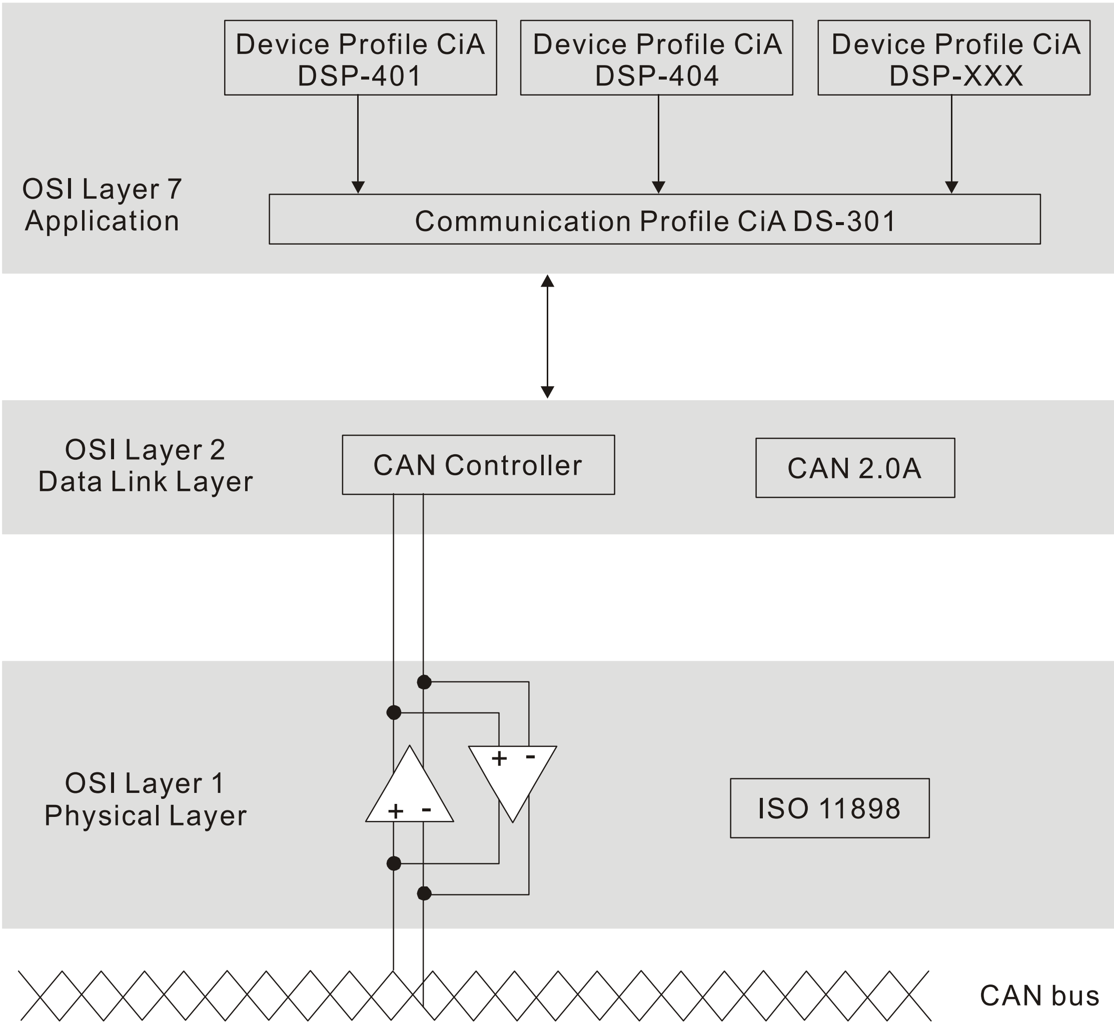
Delta CANopen not supporting service:

- Time Stamp service

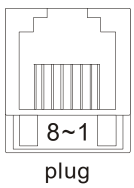
15-1 CANopen Overview

CANopen Protocol

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks, such as handling systems. Version 4.02 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover the application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA DS302), recommendations for cables and connectors (CiA DS303-1), SI units and prefix representations (CiA DS303-2).



RJ45 Pin Definition



PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground / 0V / V-
6	CAN_GND	Ground / 0V / V-

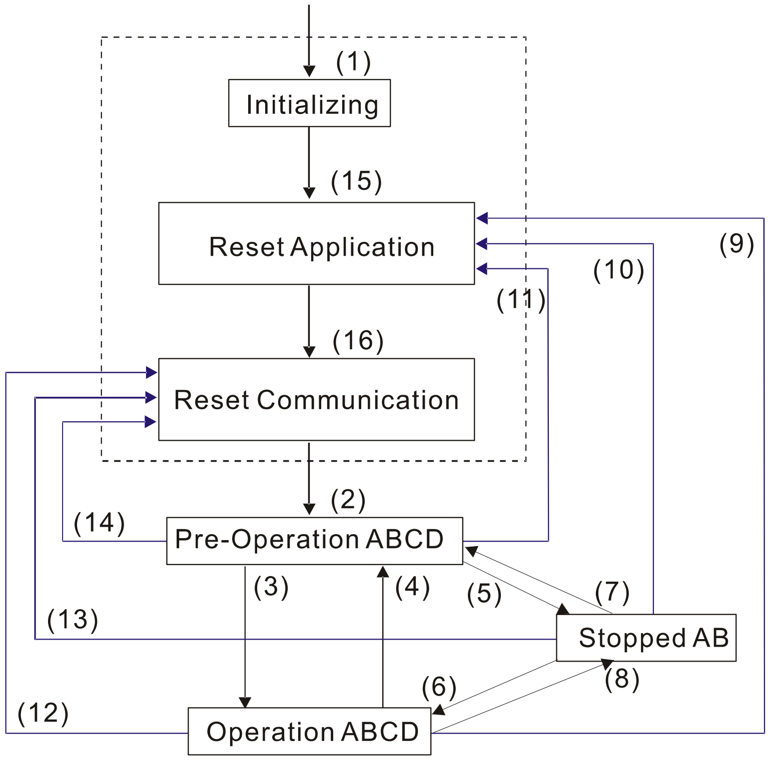
CANopen Communication Protocol

It has services as follows:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Object)
- EMCY (Emergency Object)

NMT (Network Management Object)

The Network Management (NMT) follows a Master/Slave structure for executing NMT service. A network has only one NMT master, and the other nodes are slaves. All CANopen nodes have a present NMT state, and NMT master can control the state of the slave nodes. Following shows the state diagram of a node:



(1) After power is applied, start in the auto-initialization state
(2) Automatically enter the pre-operational state
(3) (6) Start remote node
(4) (7) Enter pre-operational state
(5) (8) Stop remote node
(9) (10) (11) Reset node
(12) (13) (14) Reset communication
(15) Automatically enter the reset application state
(16) Automatically enter the reset communication state

A: NMT
B: Node Guard
C: SDO
D: Emergency
E: PDO
F: Boot-up

	Initializing	Pre-Operational	Operational	Stopped
PDO			○	
SDO		○	○	
SYNC		○	○	
Time Stamp		○	○	
EMCY		○	○	
Boot-up	○			
NMT		○	○	○

SDO (Service Data Objects)

Use SDO to access the Object Dictionary in every CANopen node using the Client / Server model. One SDO has two COB-ID (request SDO and response SDO) to upload or download data between two nodes. There is no data limit for SDOs to transfer data, but it must transfer data by segment when the data exceeds four bytes with an end signal in the last segment.

The Object Dictionary (OD) is a group of objects in a CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path in the OD is the index and sub-index; each object has a unique index in the OD, and has a sub-index if necessary.

PDO (Process Data Object)

PDO communication can be described by the producer / consumer model. Each node of the network listens to the messages of the transmission node and distinguishes whether the message has to be processed or not after receiving the message. A PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and an RxPDO. PDOs are transmitted in a non-confirmed mode. All transmission types are listed in the following table:

Type Number	PDO				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0		○	○		
1–240	○		○		
241–251	Reserved				
252			○		○
253				○	○
254				○	
255				○	

Type number 0 indicates the synchronous aperiodic message between two PDO transmissions.
Type number 1–240 indicates the number of SYNC message between two PDO transmissions.
Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.
Type number 253 indicates the data is updated immediately after receiving RTR.
Type number 254 indicates that Delta CANopen does not support this transmission format.
Type number 255 indicates the data is an asynchronous aperiodic transmission.

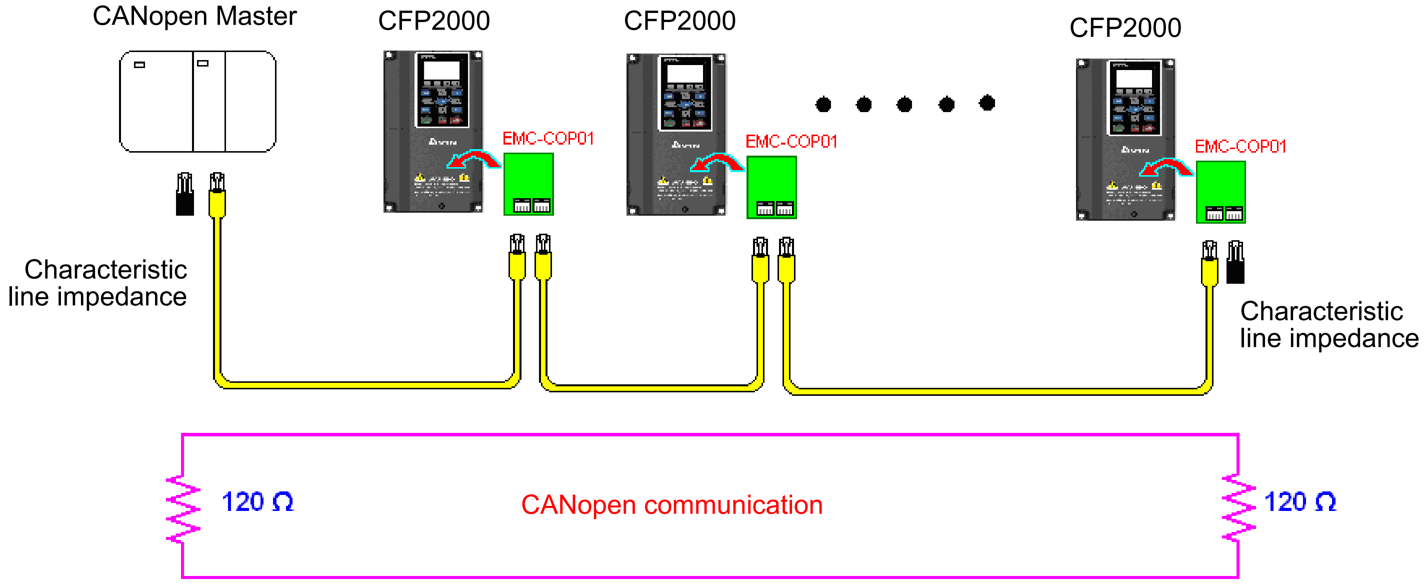
All PDO transmission data must be mapped to index via Object Dictionary.

EMCY (Emergency Object)

When errors occur inside the hardware, an emergency object is triggered. An emergency object is only sent when an error occurs. As long as there is nothing wrong with the hardware, there is no emergency object warning of an error message.

15-2 Wiring for CANopen

Use an external adapter card EMC-COP01 for CANopen wiring to connect CANopen to a CFP2000. The link uses a RJ45 cable. You must terminate the two farthest ends with 120 Ω terminating resistors as shown in the picture below.



15-3 CANopen Communication Interface Description

15-3-1 CANopen Control Mode Selection

There are two control modes for CANopen: the DS402 standard (Pr.09-40 set to 1) is the default, and the Delta's standard setting (Pr.09-40 set to 0). There are two control modes according to Delta's standard. One is the old control mode (Pr.09-30=0), this control mode can only control the motor drive under frequency control. The other mode is a new standard (Pr.09-30=1); this new control mode allows the motor drive to be controlled under multiple modes. The CFP2000 currently only supports speed mode. The following table shows the control mode definitions:

CANopen Control Mode Selection	Control Mode	
	Speed	
	Index	Description
DS402 standard Pr.09-40=1	6042-00	Target rotating speed (rpm)
	-----	-----
Delta Standard (Old definition) Pr.09-40=0 Pr.09-30=0	2020-02	Target rotating speed (Hz)
Delta Standard (New definition) Pr.09-40=0, Pr.09-30=1	2060-03	Target rotating speed (Hz)
	2060-04	Torque Limit (%)

CANopen Control Mode Selection	Operation Control	
	Index	Description
DS402 standard Pr.09-40=1	6040-00	Operation Command
	-----	-----
Delta Standard (Old definition) Pr.09-40=0, Pr.09-30=0	2020-01	Operation Command
Delta Standard (New definition) Pr.09-40=0, Pr.09-30=1	2060-01	Operation Command
	-----	-----

CANopen Control Mode Selection	Other	
	Index	Description
DS402 standard Pr.09-40=1	605A-00	Quick stop processing method
	605C-00	Disable operation processing method
Delta Standard (Old definition) Pr.09-40=1, Pr.09-30=0	-----	-----
Delta Standard (New definition) Pr.09-40=0, Pr.09-30=1	-----	-----
	-----	-----

You can use some indices in either DS402 or Delta's standard.
For example:

1. Index that are defined as RO attributes.
2. The corresponding index of available parameter groups: 2000-00–200B-XX)
3. Accelerating / Decelerating Index: 604F 6050
4. Control mode: Index: 6060

15-3-2 DS402 Standard Control Mode

15-3-2-1 Related set up for an AC motor drive (following the DS402 standard)

If you want to use the DS402 standard to control the motor drive, follow these steps:

1. Wire the hardware (refer to Section 15-2 Wiring for CANopen)
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control. (Run/stop, forward/reverse run…etc.)
3. Set the frequency source: set Pr.00-20 to 6. Choose the source of the frequency command from the CANopen setting.)
4. Set DS402 for the control mode: Pr.09-40=1
5. Set the CANopen station: set the CANopen station (range 1–127, 0 is to disable the CANopen slave function) with Pr.09-36. Note: set Pr.00-02=7 to reset if the station number error CAdE or CANopen memory error CFrE appears.
6. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 Mbps(0), 500 Kbps(1), 250 Kbps (2), 125 Kbps (3), 100 Kbps (4) and 50 Kbps (5))
7. Set the multiple input functions to Quick Stop, you can also choose enable or disable; the default setting is disabled. If it is necessary to enable the function, set MI terminal to 53 in one of the following parameter: Pr.02-01–Pr.02-08 or Pr.02-26–Pr.02-31. (Note: This function is available in DS402 only.)

15-3-2-2 The status of the motor drive (by following DS402 standard)

According to the DS402 definition, the motor drive is divided into 3 blocks and 9 statuses as described below.

3 blocks

1. Power Disable: Without PWM output
2. Power Enable: With PWM output
3. Fault: One or more errors have occurred.

9 status

1. Start: Power On
2. Not ready to switch on: The motor drive is initiating.
3. Switch On Disable: occurs when the motor drive finishes initiating.
4. Ready to switch on: warming up before running.
5. Switch On: the motor drive has the PWM output now, but the reference command is not effective.
6. Operation Enable: able to control normally.
7. Quick Stop Active: when there is a Quick Stop request, stop running the motor drive.
8. Fault Reaction Active: the motor drive detects conditions that might trigger error(s).
9. Fault: One or more errors have occurred in the motor drive.

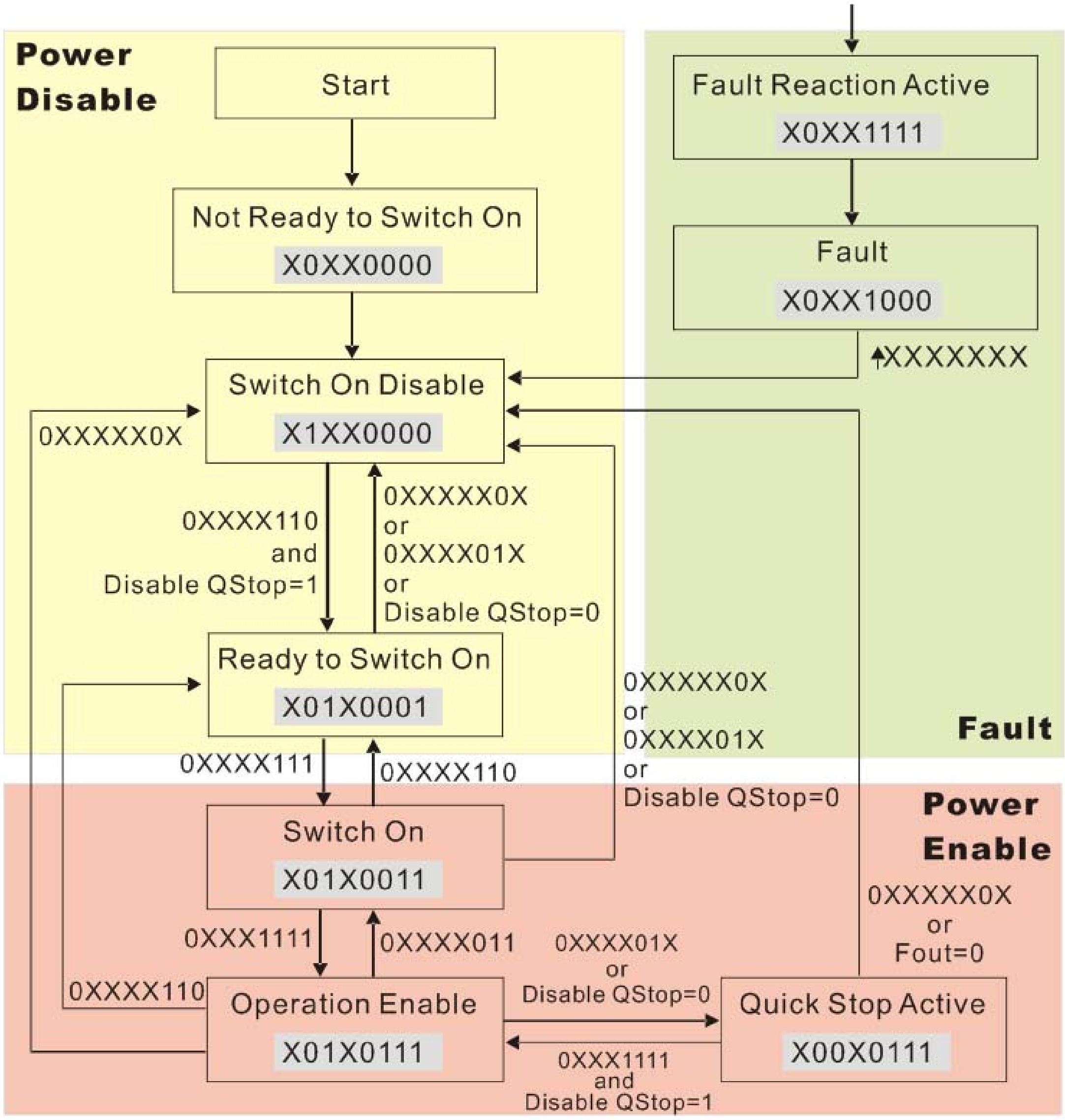
When the motor drive turns on and finishes the initiation, it remains in Ready to Switch On status. To control the operation of the motor drive, change to Operation Enable status. To do this, set the control word's bit0–bit3 and bit7 of the Index 6040H and pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described as below:

Index 6040

15–9	8	7	6–4	3	2	1	0
Reserved	Halt	Fault Reset	Operation	Enable operation	Quick Stop	Enable Voltage	Switch On

Index 6041

15–14	13–12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Operation	Internal limit active	Target reached	Remote	Reserved	Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on



Set command 6040=0xE, then set another command 6040 =0xF. Then you can switch the motor drive to Operation Enable. The Index 605A determines the lines from Operation Enable when the control mode changes from Quick Stop Active. When the setting value is 1–3, both lines are active, but when the setting value of 605A is not 1–3, once the motor drive is switched to Quick Stop Active, it is not be able to switch back to Operation Enable.

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	note
605Ah	0	Quick stop option code	2	RW	S16		No		0: disable drive function 1: slow down on slow down ramp 2: slow down on quick stop ramp 3: slow down on the current limit 5: slow down on slow down ramp and stay in QUICK STOP 6: slow down on quick stop ramp and stay in QUICK STOP 7: slow down on the current limit and stay in Quick stop

When the control section switches from Power Enable to Power Disable, use 605C to define parking method.

Index	Sub	Definition	Default	R/W	Size	Unit	PDO Map	Mode	note
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable of the drive function

15-3-2-3 Various mode control method (by following DS402 standard)

CFP2000 currently only supports speed control which is described as below:

Speed mode

1. Set CFP2000 to speed control mode: set Index6060 to 2.
2. Switch to Operation Enable mode: Set 6040=0xE, then set 6040 = 0xF.
3. Set the target frequency: Set target frequency of 6042, since the operation unit of 6042 is rpm, a transform is required:

$$n = f \times \frac{120}{p}$$

n: rotation speed (rpm) (rounds/minute)

P: motor's pole number (Pole)

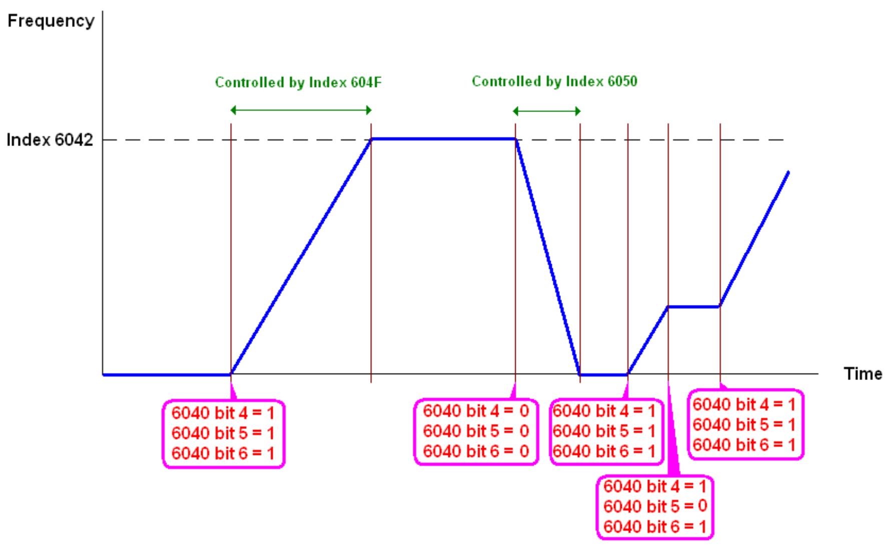
f: rotation frequency (Hz)

For example:

Set 6042H = 1500 (rpm), if the number of poles is 4 (Pr.05-04 or Pr.05-16), then the motor drive's operation frequency is 1500 / (120/4)=50 Hz. The 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter clockwise

4. To set acceleration and deceleration: Use 604F (Acceleration) and 6050 (Deceleration).
5. Trigger an ACK signal: in the speed control mode, the bit6–4 of Index 6040 needs to be controlled. It is defined as below:

	Index 6040			SUM
	bit6	bit5	bit4	
Speed mode (Index 6060=2)	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0 Hz.



NOTE 01: Read 6043 to get the current rotation speed. (Unit: rpm)

NOTE 02: Read bit10 of 6041 to find if the rotation speed has reached the targeting value. (0: Not reached; 1: Reached)

15-3-3 Using the Delta Standard (Old definition, only supports speed mode)

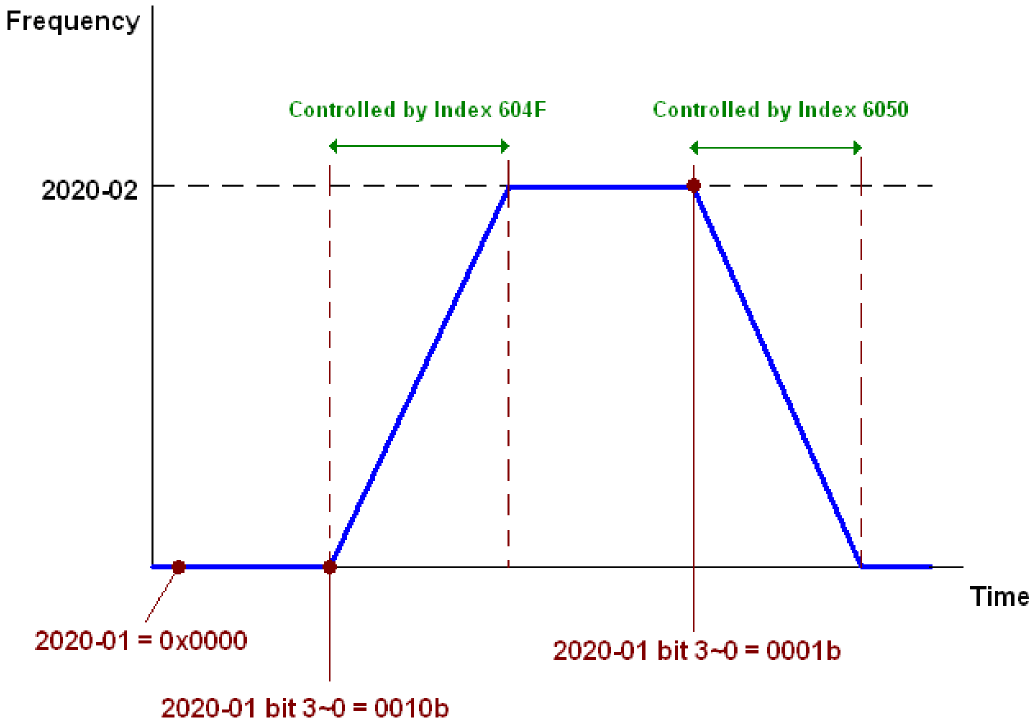
15-3-3-1 Various mode control method (Delta Old Standard)

Follow the steps below:

1. Wire the hardware (refer to Section 15-2 Wiring for CANopen)
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control. (Run/stop, forward/ reverse run…, etc.)
3. Set the frequency source: set Pr.00-20 to 6. Choose source for the frequency command from the CANopen setting.
4. Set Delta Standard (Old definition, only supports speed mode) as the control mode: Pr.09-40 = 0 and Pr.09-30 = 0.
5. Set the CANopen station: set Pr.09-36; the range is among 1–127. When Pr.09-36=0, the CANopen slave function is disabled. Note: If an error appears (CAdE or CANopen memory error) as you complete the station setting, set Pr.00-02=7 to reset.)
6. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 Mbps(0), 500 Kbps(1), 250 Kbps(2), 125 Kbps(3), 100 Kbps(4) and 50 Kbps(5))

15-3-3-2 By speed mode

1. Set the target frequency: Set 2020-02, the unit is Hz, with 2 decimal places. For example, 1000 is 10.00 Hz.
2. Operation control: set 2020-01 = 0002H for running, and set 2020-01 = 0001H for stopping.



15-3-4 Using Delta Standard (New definition)

15-3-4-1 Related set up for an AC motor drive (Delta New Standard)

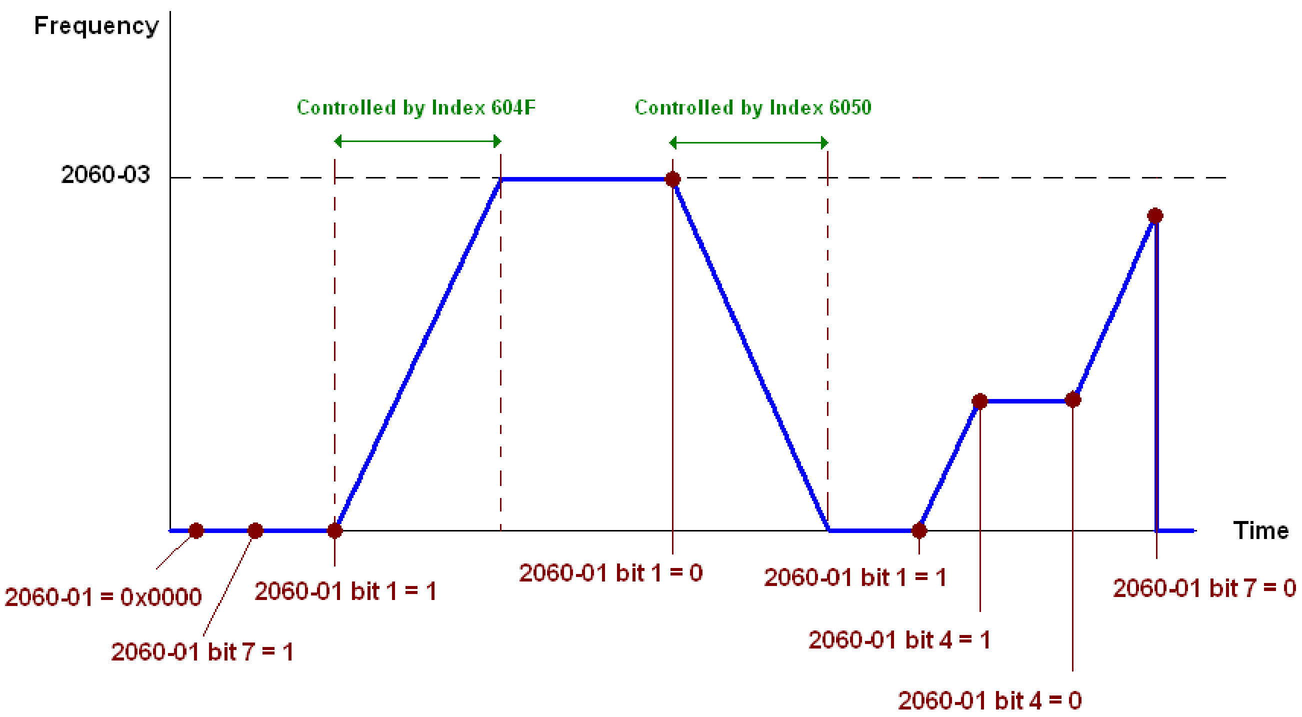
Follow the steps below:

1. Wire the hardware (refer to Section 15-2 Wiring for CANopen)
2. Set the operation source: set Pr.00-21 to 3 for CANopen communication card control. (Run/stop, forward/reverse run…, etc.)
3. Set the frequency source: set Pr.00-20 to 6. Choose the source of the frequency command from the CANopen setting.
4. Set Delta Standard (New definition) as the control mode: Pr.09-40 = 0 and Pr.09-30 = 1.
5. Set the CANopen station: set Pr.09-36; the range is among 1–127. When Pr.09-36=0, the CANopen slave function is disabled. Note: If an error appears (CAdE or CANopen memory error) as you complete the station setting, set Pr.00-02=7 to reset.)
6. Set the CANopen baud rate: set Pr.09-37 (CANBUS Baud Rate: 1 Mbps (0), 500 Kbps (1), 250 Kbps (2), 125 Kbps (3), 100 Kbps (4) and 50 Kbps(5)).

15-3-4-2 Various mode control method (Delta New Standard)

Speed Mode

1. Set CFP2000 to speed control mode: set Index6060 = 2.
2. Set the target frequency: set 2060-03, unit is Hz, with 2 decimal places. For example, 1000 is 10.00Hz.
3. Operation control: set 2060-01 = 008H for Server on, and set 2060-01 = 0081H for running.



NOTE01: Read 2061-05 to get the current position.

NOTE02: Read bit0 of 2061 to find if the position has reached to the target position. (0: Not reached, 1: Reached).

15-3-5 DI/ DO/ AI/ AO are controlled via CANopen

To control the DO/AO of the motor drive through CANopen, follow the steps below:

1. Define the DO to be controlled by CANopen. For example, set Pr.02-14=50 to control RY2.
2. Define the AO to be controlled by CANopen. For example, set Pr.03-23=20 to control AFM2.
3. Control the mapping index of CANopen. To control DO, use control Index2026-41. To control AO, you will need to control 2026-AX. To set RY2 as ON, set bit1 of Index 2026-41 =1, then RY2 outputs 1. To control AFM2 output = 50.00%, set Index 2026-A2 =5000, then AFM2 outputs 50%.

The following table shows the mapping of CANopen DI/ DO/ AI/ AO:

DI:

Terminal	Related Parameters	R/W	Mapping Index
FWD	==	RO	2026-01 bit0
REV	==	RO	2026-01 bit1
MI 1	==	RO	2026-01 bit2
MI 2	==	RO	2026-01 bit3
MI 3	==	RO	2026-01 bit4
MI 4	==	RO	2026-01 bit5
MI 5	==	RO	2026-01 bit6
MI 6	==	RO	2026-01 bit7
MI 7	==	RO	2026-01 bit8
MI 8	==	RO	2026-01 bit9
MI 10	==	RO	2026-01 bit10
MI 11	==	RO	2026-01 bit11
MI 12	==	RO	2026-01 bit12
MI 13	==	RO	2026-01 bit13
MI 14	==	RO	2026-01 bit14
MI 15	==	RO	2026-01 bit15

DO：

Terminal	Related Parameters	R/W	Mapping Index
RY1	Pr.02-13 = 51	RW	2026-41 bit0
RY2	Pr.02-14 = 51	RW	2026-41 bit1
RY3	Pr.02-15 = 51	RW	2026-41 bit2
MO10/RY10	Pr.02-36 = 51	RW	2026-41 bit5
MO11/RY11	Pr.02-37 = 51	RW	2026-41 bit6
RY12	Pr.02-38 = 51	RW	2026-41 bit7
RY13	Pr.02-39 = 51	RW	2026-41 bit8
RY14	Pr.02-40 = 51	RW	2026-41 bit9
RY15	Pr.02-41 = 51	RW	2026-41 bit10

AI：

Terminal	Related Parameters	R/W	Mapping Index
AVI1	==	RO	Value of 2026-61
ACI	==	RO	Value of 2026-62
AVI2	==	RO	Value of 2026-63

AO：

Terminal	Related Parameters	R/W	Mapping Index
AFM1	Pr.03-20 = 21	RW	Value of 26A0h
AFM2	Pr.03-23 = 21	RW	Value of 26A1h
AFM10	Pr.14-12 = 21	RW	Value of 26AAh
AFM11	Pr.14-13 = 21	RW	Value of 26ABh

15-4 CANopen Supporting Index

CFP2000 Index:

The parameter index corresponds as following in this example:

Index	**sub-Index**
2000H + Group	member+1

For example:

Pr.10-15 (Encoder Slip Error Treatment)

Group		**member**
10(0AH)	-	15(0FH)

Index = 2000H + 0AH = 200A

Sub Index = 0FH + 1H = 10H

CFP2000 Control Index:

Delta Standard Mode (Old definition)

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
2020H	0	Number	3	R	U8		
	1	Control word	0	RW	U16	bit1–0	00B: disable
							01B: stop
							10B: disable
							11B: JOG Enable
						bit3–2	Reserved
						bit5–4	00B: disable
							01B: Direction forward
							10B: Reverse
							11B: Switch Direction
						bit7–6	00B: 1^{st} step Accel. /Decel.
							01B: 2^{nd} step Accel. /Decel.
							10B: 3^{rd} step Accel. /Decel.
							11B: 4^{th} step Accel. /Decel.
						bit11–8	0000B: Master speed
							0001B: 1^{st} step speed
							0010B: 2^{nd} step speed
							0011B: 3^{rd} step speed
							0100B: 4^{th} step speed
							0101B: 5^{th} step speed
							0110B: 6^{th} step speed
							0111B: 7^{th} step speed
							1000B: 8^{th} step speed
							1001B: 9^{th} step speed
							1010B: 10^{th} step speed
							1011B: 11^{th} step speed
							1100B: 12^{th} step speed
							1101B: 13^{th} step speed
							1110B: 14^{th} step speed
							1111B: 15^{th} step speed
						bit12	1: Enable the function of bit6–11
						bit15	Reserved
	2	Freq. command (XXX.XX Hz)	0	RW	U16		
	3	Other trigger	0	RW	U16	bit0	1: E.F. ON

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
						bit1	1: Reset
						bit2	1: Base Block (B.B) ON
						bit15–3	Reserved
2021H	0	Number	10	R	U8		
	1	Error code	0	R	U16	High byte: Warn code Low byte: Error code	
	2	AC motor drive status	0	R	U16	bit1–0	00B: stop
							01B: decelerate to stop
							10B: waiting for operation command
							11B: in operation
						bit2	1: JOG command
						bit4–3	00B: run forward
							01B: switch from run in reverse to run forward
							10B: switch from run forward to run in reverse
							11B: run in reverse
						bit7–5	Reserved
						bit8	1: master frequency command controlled by communication interface
						bit9	1: master frequency command controlled by analog signal input
						bit10	1: operation command controlled by communication interface
						bit11	1: Parameter lock
						bit12	1: Enable the digital keypad copy parameter function
						bit15–13	Reserved
	3	Freq. command (XXX.XX Hz)	0	R	U16		
	4	Output freq. (XXX.XX Hz)	0	R	U16		
	5	Output current (XX.X A)	0	R	U16		
	6	DC bus voltage (XXX.X V)	0	R	U16		
	7	Output voltage (XXX.X V)	0	R	U16		
	8	The current segment run by the multi-segment speed command	0	R	U16		
	9	Reserved	0	R	U16		
	A	Display counter value (c)	0	R	U16		
	B	Display output power angle (XX.X°)	0	R	U16		
	C	Display output torque (XXX.X%)	0	R	U16		
	D	Display actual motor speed (rpm)	0	R	U16		
	10	Power output (X.XXX kWh)	0	R	U16		
	17	Multi-function display (Pr.00-04)	0	R	U16		
2022H	0	Reserved	0	R	U16		
	1	Display output current	0	R	U16		
	2	Display counter value	0	R	U16		
	3	Display actual output frequency (XXX.XX Hz)	0	R	U16		
	4	Display DC bus voltage (XXX.X V)	0	R	U16		

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	5	Display output voltage (XXX.X V)	0	R	U16		
	6	Display output power angle (XX.X°)	0	R	U16		
	7	Display output power in kW	0	R	U16		
	8	Display actual motor speed (rpm)	0	R	U16		
	9	Display estimate output torque (XXX.X%)	0	R	U16		
	B	Display PID feedback value after enabling PID function in % (To 2 decimal places)	0	R	U16		
	C	Display signal of AVI 1 analog input terminal, 0–10 V corresponds to 0–100% (To 2 decimal places)	0	R	U16		
	D	Display signal of ACI analog input terminal, 4–20 mA /0–10 V corresponds to 0–100% (To 2 decimal places)	0	R	U16		
	E	Display signal of AVI 2 analog input terminal, -10 V–10 V corresponds to -100–100% (To 2 decimal places)	0	R	U16		
	F	Display the IGBT temperature of drive power module in ºC	0	R	U16		
	10	Display the temperature of capacitance in ºC	0	R	U16		
	11	The status of digital input (ON/OFF), refer to Pr.02-12	0	R	U16		
	12	The status of digital output (ON/OFF), refer to Pr.02-18	0	R	U16		
	13	Display the multi-step speed that is executing	0	R	U16		
	14	The corresponding CPU pin status of digital input	0	R	U16		
	15	The corresponding CPU pin status of digital output	0	R	U16		
	1A	Display times of counter overload (0.00–100.00%)	0	R	U16		
	1B	Display GFF in %	0	R	U16		
	1C	Display DC bus voltage ripples (Unit: V_{DC})	0	R	U16		
	1D	Display PLC register D1043 data	0	R	U16		
	1E	Display Pole of Permanent Magnet Motor	0	R	U16		
	1F	User page displays the value in physical measure	0	R	U16		
	20	Output Value of Pr.00-05	0	R	U16		
	21	Number of motor turns when drive operates	0	R	U16		
	22	Operation position of motor	0	R	U16		
	23	Fan speed of the drive	0	R	U16		
	24	Control mode of the drive 0: speed mode	0	R	U16		
	25	Carrier frequency of the drive	0	R	U16		
	26	Reserved					
	27	Motor status					

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	2A	kWh display					
	2D	Motor actual position low-word					
	2E	Motor actual position high-word					
	2F	PID reference target					
	30	PID bias value					
	31	PID output frequency					

CANopen Remote IO mapping

Index	Sub	R/W	Definition
2026H	01h	R	Each bit corresponds to different terminal input contact
	03h–40h	R	Reserved
	41h	RW	Each bit corresponds to different terminal output contact
	42h–60h	R	Reserved
	61h	R	AVI1 proportional value
	62h	R	ACI proportional value
	63h	R	AVI2 proportional value
	64h–6Ah	R	Reserved
	6Bh	R	Extension card AI10, 0.0–100.0% (EMC-A22A)
	6Ch	R	Extension card AI11, 0.0–100.0% (EMC-A22A)
	6Dh–A0h	R	Reserved
	A1h	RW	AFM1 output proportional value
	A2h	RW	AFM2 output proportional value
	A3h–AAh	RW	Reserved
	ABh	RW	Extension card AO10, 0.0–100.0% (EMC-A22A)
	ACh	RW	Extension card AO11, 0.0–100.0% (EMC-A22A)

Index 2026-01	bit0	bit1	bit2	bit3	bit4	bit5	bit6	bit7	bit8	bit9	bit10	bit11	bit12	bit13	bit14	bit15
1	FWD	REV	MI1	MI2	MI3	MI4	MI5	MI6	MI7	MI8						
2											MI10	MI11	MI12	MI13	MI14	MI15
3											MI10	MI11	MI12	MI13		

1：Control broad I/O (Standard)

2：Add external card, EMC-D611A

3：Add external card, EMC-D42A

Index 2026-41	bit0	bit1	bit2	bit3	bit4	bit5	bit6	bit7	bit8	bit9	bit10	bit11	bit12	bit13	bit14	bit15
1	RY1	RY2		MO1	MO2											
2						MO10	MO11									
3						RY10	RY11	RY12	RY13	RY14	RY15					

1：Control broad I/O (Standard)

2：Add external card, EMC-D42A

3：Add external card, EMC-R6AA

Delta Standard Mode (New definition)

Index	sub	R/W	Size	Descriptions			Speed Mode
				bit	Definition	Priority	
2060h	00h	R	U8				
	01h	RW	U16	0	Ack	4	0: fcmd =0 1: fcmd = Fset (Fpid)
				1	Dir	4	0: FWD run command 1: REV run command
				2			
				3	Halt		0: drive run till target speed is attained 1: drive stop by deceleration setting
				4	Hold		0: drive run till target speed is attained 1: frequency stop at current frequency
				5	JOG		0: JOG OFF Pulse 1: JOG RUN
				6	QStop		Quick Stop
				7	Power		0:Power OFF 1:Power ON
				8	Reserved		
				9	Ext Cmd2	4	0->1: Absolute position cleared
				10–14	Reserved		
				15	RST	4	Pulse 1: Fault code cleared
	02h	RW	U16		Mode Cmd		0: Speed mode
	03h	RW	U16				Speed command (unsigned decimal)
	04h	RW	U16				
	05h	RW	S32				
	06h	RW					
	07h	RW	U16				
	08h	RW	U16				
2061h	01h	R	U16	0	Arrive		Frequency attained
				1	Dir		0: Motor FWD run 1: Motor REV run
				2	Warn		Warning
				3	Error		Error detected
				4			
				5	JOG		JOG
				6	QStop		Quick stop
				7	Power On		Switch ON
				15–8			
	02h	R					
	03h	R	U16				Actual output frequency
	04h	R					
	05h	R	S32				Actual position (absolute)
	06h	R					
	07h	R	S16				Actual torque

DS402 Standard

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	Note
6007h	0	Abort connection option code	2	RW	S16		Yes		0: No action 2: Disable Voltage 3: quick stop
603Fh	0	Error code	0	R0	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	R0	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	10000	RW	U32	1ms	Yes	vl	Unit must be: 100 ms, and check if the setting is 0.
6050h	0	vl slow down time	10000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	1000	RW	U32	1ms	Yes	vl	
605Ah	0	Quick stop option code	2	RW	S16		No		0: disable drive function 1: slow down on slow down ramp 2: slow down on quick stop ramp 5: slow down on slow down ramp and stay in QUICK STOP 6: slow down on quick stop ramp and stay in QUICK STOP
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable of the drive function
6060h	0	Mode of operation	2	RW	S8		Yes		2: Velocity Mode 4: Torque Profile Mode
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above

15-5 CANopen Fault Codes

AUTO
① Fault
② ocA
③ Oc at accel

① Display error signal
② Abbreviate error code
③ Display error description

* Refer to setting value of Pr.06-17–Pr.06-22.

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
1	AUTO Fault ocA Oc at accel	0001H	Over-current during acceleration	1	2213 H
2	AUTO Fault ocd Oc at decel	0002H	Over-current during deceleration	1	2213 H
3	AUTO Fault ocn Oc at normal SPD	0003H	Over-current during steady status operation	1	2214H
4	AUTO Fault GFF Ground fault	0004H	Ground fault. When one of the output terminals is grounded, the short circuit current is more than 50% of AC motor drive rated current. NOTE: The short circuit protection is provided for the AC motor drive protection, not to protect the user.	1	2240H
5	AUTO Fault occ Short Circuit	0005H	Short-circuit is detected between upper bridge and lower bridge of the IGBT module.	1	2250H
6	AUTO Fault ocS Oc at stop	0006H	Over-current at stop. Hardware failure in current detection	1	2314H
7	AUTO Fault ovA Ov at accel	0007H	Over-voltage during acceleration. Hardware failure in current detection	2	3210H
8	AUTO Fault ovd Ov at decel	0008H	Over-voltage during deceleration. Hardware failure in current detection.	2	3210H

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
9	AUTO Fault ovn Ov at normal SPD	0009H	DC bus over-voltage at constant speed	2	3210H
10	AUTO Fault ovS Ov at stop	000AH	Over-voltage at stop. Hardware failure in voltage detection	2	3210H
11	AUTO Fault LvA Lv at accel	000BH	DC bus voltage is less than Pr.06-00 during acceleration.	2	3220H
12	AUTO Fault Lvd Lv at decel	000CH	DC bus voltage is less than Pr.06-00 during deceleration.	2	3220H
13	AUTO Fault Lvn Lv at normal SPD	000DH	DC bus voltage is less than Pr.06-00 at constant speed.	2	3220H
14	AUTO Fault LvS Lv at stop	000EH	DC bus voltage is less than Pr.06-00 at stop	2	3220H
15	AUTO Fault OrP Phase lacked	000FH	Phase Loss Protection	2	3130H
16	AUTO Fault oH1 IGBT over heat	0010H	IGBT is overheated above the protection level 1–15 HP: 90°C 20–100 HP: 100°C	3	4310H
17	AUTO Fault oH2 Heat Sink oH	0011H	Heat sink overheat Heat sink temperature exceeds 90°C	3	4310H
18	AUTO Fault tH1o Thermo 1 open	0012H	IGBT over-heating protection error	3	FF00H
19	AUTO Fault tH2o Thermo 2 open	0013H	Temperature detection circuit error (capacity module) CAP NTC	3	FF01H

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
21	AUTO Fault oL Over load	0015H	Overload; the AC motor drive detects excessive drive output current. NOTE: The AC motor drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	1	2310H
22	AUTO Fault EoL1 Thermal relay 1	0016H	Electronic thermal relay 1 protection	1	2310H
23	AUTO Fault EoL2 Thermal relay 2	0017H	Electronic thermal relay 2 protection	1	2310H
24	AUTO Fault oH3 Motor over heat	0018H	Motor overheating : the AC motor drive internal temperature exceeds the setting for Pr.06-30 (PTC level)	3	FF20H
26	AUTO Fault ot1 Over torque 1	001AH	When the output current exceeds the over-torque detection level (Pr.06-07 or Pr.06-10) and exceeds Pr.06-08 or Pr.06-11; when Pr.06-06 or Pr.06-09 is set as 2 or 4, the keypad displays these two fault codes.	3	8311H
27	AUTO Fault ot2 Over torque 2	001BH		3	8311H
28	AUTO Fault uC Under current	001CH	Low current	1	8321H
29	AUTO Fault LMIT Limit Error	001DH	Home limit error	1	7320H
30	AUTO Fault cF1 EEPROM write err	001EH	Cannot program internal EEPROM	5	5530H
31	AUTO Fault cF2 EEPROM read err	001FH	Cannot read internal EEPROM	5	5530H
33	AUTO Fault cd1 Ias sensor err	0021H	U-phase current error	1	FF04H

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
34	AUTO Fault cd2 Ibs sensor err	0022H	V-phase current error	1	FF05H
35	AUTO Fault cd3 Ics sensor err	0023H	W-phase current error	1	FF06H
36	AUTO Fault Hd0 cc HW error	0024H	cc (current clamp) hardware error	5	FF07H
37	AUTO Fault Hd1 Oc HW error	0025H	oc hardware error	5	FF08H
38	AUTO Fault Hd2 Ov HW error	0026H	ov hardware error	5	FF09H
39	AUTO Fault Hd3 occ HW error	0027H	GFF hardware error	5	FF0AH
40	AUTO Fault AUE Auto tuning error	0028H	Motor parameters auto-tuning error	1	FF21H
41	AUTO Fault AFE PID Fbk error	0029H	PID loss (ACI)	7	FF22H
48	AUTO Fault ACE ACI loss	0030H	ACI loss (ACE)	1	FF25H
49	AUTO Fault EF External fault	0031H	External Fault; when the multi-function input terminals (EF) is active, the AC motor drive stops output.	5	9000H
50	AUTO Fault EF1 Emergency stop	0032H	Emergency stop; when the multi-function input terminals MI1 to MI6 are active, the AC motor drive stops output.	5	9000H

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
51	AUTO Fault bb Base block	0033H	External Base Block; when the multi-function input terminal (B.B.) is active, the AC motor drive stops output	5	9000H
52	AUTO Fault Pcod Password error	0034H	Keypad is locked after you enter the wrong password three times	5	FF26H
54	AUTO Fault CE1 PC err command	0036H	Modbus function code error (illegal function code)	4	7500H
55	AUTO Fault CE2 PC err address	0037H	Modus data address error [illegal data address (00H–254H)]	4	7500H
56	AUTO Fault CE3 PC err data	0038H	Modbus data error (illegal data value)	4	7500H
57	AUTO Fault CE4 PC slave fault	0039H	Modbus communication error (data is written to read-only address)	4	7500H
58	AUTO Fault CE10 PC time out	003AH	Modbus transmission time-out.	5	7500H
60	AUTO Fault bF Braking fault	003CH	Brake resistor fault	4	7110H
61	AUTO Fault ydc Y-delta connect	003DH	Y-connection / Δ-connection switch error	2	3330H
62	AUTO Fault dEb Dec. Energy back	003EH	Energy regeneration when decelerating	2	FF27H
63	AUTO Fault oSL Over slip error	003FH	Motor slip exceeds Pr.05-26 and Pr.05-27 setting	7	FF28H

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
64	AUTO Fault ryF MC Fault	0040H	Electric valve switch error	5	7110H
72	AUTO Fault STL1 STO Loss 1	0048H	STO1–SCM1 internal loop detection error	5	5441H
73	AUTO Fault S1 S1-emergy stop	0049H	Emergency stop for external safety	5	FF2AH
74	AUTO Fault Fire On Fire	004AH	Fire mode	7	FF2FH
75	AUTO Fault Brk EXT-Brake Error	004BH	External brake error	5	7110H
76	AUTO Fault STO STO	004CH	Safe torque off function active	5	5440H
77	AUTO Fault STL2 STO Loss 2	004DH	STO2–SCM2 internal loop detection error	5	5442H
78	AUTO Fault STL3 STO Loss 3	004EH	STO1–SCM1 and STO2–SCM2 internal loop detection error	5	5443H
79	AUTO Fault Uoc U phase oc	004FH	U-phase short circuit	1	FF2BH
80	AUTO Fault Voc V phase oc	0050H	V-phase short circuit	1	FF2CH
81	AUTO Fault Woc W phase oc	0051H	W-phase short circuit	1	FF2DH

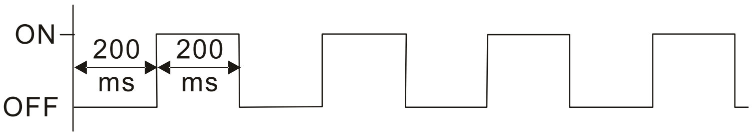
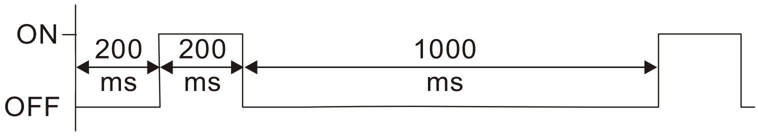
ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
82	AUTO Fault OPHL U phase lacked	0052H	Output phase loss 1 (Phase U)	2	2331H
83	AUTO Fault OPHL V phase lacked	0053H	Output phase loss 2 (Phase V)	2	2332H
84	AUTO Fault OPHL W phase lacked	0054H	Output phase loss 3 (Phase W)	2	2333H
90	AUTO Fault Fstp Force Stop	005AH	Force to stop	7	FF2EH
99	AUTO Fault TRAP CPU Trap Error	0063H	CPU trap error	7	6000H
101	AUTO Fault CGdE Guarding T-out	0065H	CANopen guarding error	4	8130H
102	AUTO Fault CHbE Heartbeat T-out	0066H	CANopen heartbeat error	4	8130H
104	AUTO Fault CbFE Can bus off	0068H	CANopen bus off error	4	8140H
105	AUTO Fault CIdE Can bus Index Err	0069H	CANopen index error	4	8110H
106	AUTO Fault CAdE Can bus Add. Err	006AH	CANopen station address error	4	0x8100
107	AUTO Fault CFrE Can bus off	006BH	CANopen memory error	4	0x8100

ID No.*	Display	Fault code	Description	CANopen fault register (bit0–7)	CANopen fault code
111	AUTO Fault ictE InrCom Time Out	006FH	InrCOM internal communication special error code	4	7500H
112	AUTO Fault SfLK PMLess Shaft Lock	0070H	PMLess shaft lock	7	FF31H

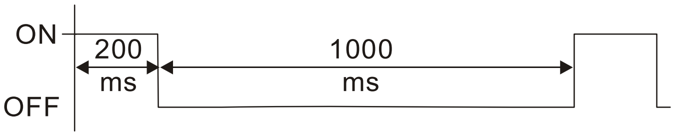
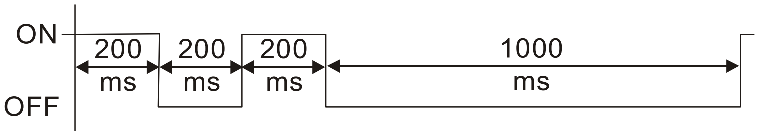
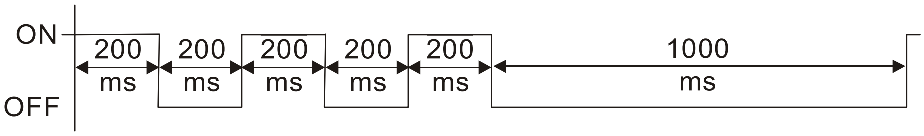
15-6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.

RUN LED:

LED status	Condition	CANopen State
OFF		Initial
Blinking		Pre-Operation
Single flash		Stopped
ON		Operation

ERR LED:

LED status	Condition/ State
OFF	No Error
Single flash	One Message fail 
Double flash	Guarding fail or heartbeat fail 
Triple flash	SYNC fail 
ON	Bus off 

Chapter 16 PLC Function Applications

16-1 PLC Summary

16-1-1 Introduction

The commands provided by the CFP2000's built-in PLC functions, including the ladder diagram editing tool WPLSoft, as well as the usage of basic commands and applications commands, chiefly retain the operating methods of Delta's PLC DVP series.

16-1-2 WPLSoft ladder diagram editing tool

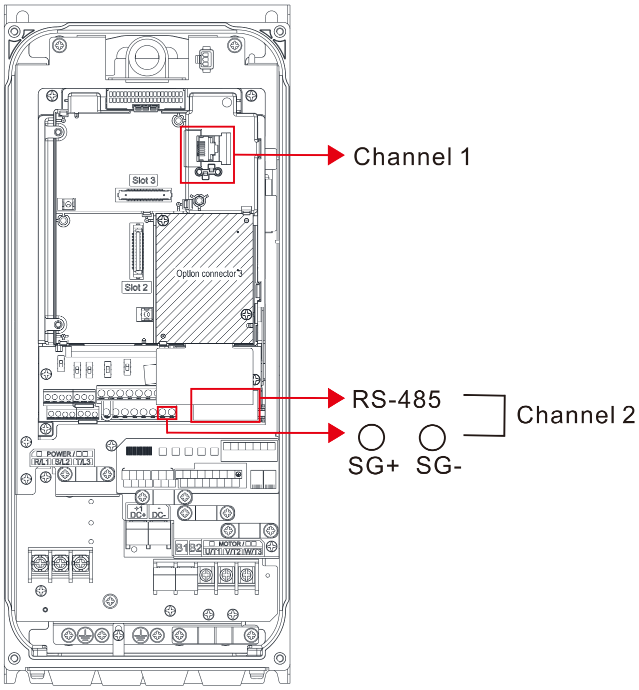
WPLSoft is Delta's program editing software for the DVP and CFP2000 programmable controllers in the Windows operating system environment. Apart from general PLC program design general Windows editing functions (such as cut, paste, copy, multiple windows, etc.), WPLSoft also provides many Chinese/English annotation editing and other convenience functions (such as registry editing, settings, file reading, saving, and contact graphic monitoring and settings, etc.).

The following basic requirements that need to install WPLSoft editing software:

Item	System requirements
Operating system	Windows 95/98/2000/NT/ME/XP
CPU	At least Pentium 90
Memory	At least 16MB (we recommend at least 32MB)
Hard drive	Hard drive capacity: at least 100MB free space One optical drive (for use in installing this software)
Display	Resolution: 640×480, at least 16 colors; it is recommended that the screen area be set at 800×600 pixels
Mouse	Ordinary mouse or Windows-compatible device
Printer	Printer with a Windows driver program
RS-485 port	Must have at least an RS-485 port to link to the PLC

16-2 Notes before PLC use

1. The PLC has a preset communications format of 7, N, 2, 9600, with node 2; the PLC node can be changed in Pr.09-35, but this address may not be the same as the drive's address setting of Pr.09-00.
2. The CFP2000 provides 2 communications serial ports that can be used to download PLC programs (see figure below). Channel 1 has a fixed communications format of 19200, 8, N, 2 RTU.



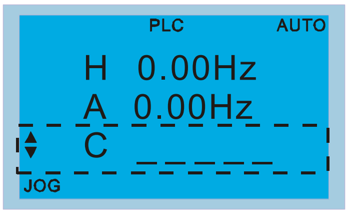
3. The client can simultaneously access data from the converter and internal PLC, which is performed through identification of the node. For instance, if the converter node is 1 and the internal PLC node is 2, then the client command will be
   01 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data in converter Pr.04-00.
   02 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data in internal PLC X0
4. The PLC program will be disabled when uploading / downloading programs.
5. Please note when using WPR commands to write in parameters, values may be modified up to a maximum of 10^9 times, otherwise a memory write error will occur. The calculation of modifications is based on whether the entered value has been changed. If the entered value is left unchanged, the modifications will not increase afterwards. But if the entered value is different from before, the number of modifications will increase by one. Those parameters listed below are exceptions, please proceed to the next page for details:

   - Pr.00-11 Speed control mode
   - Pr.01-12–Pr.01-19 Acceleration / Deceleration time 1–4
   - Pr.02-12 Multi-function input mode selection
   - Pr.02-18 Multi-function output direction
   - Pr.04-50–Pr.04-59 PLC buffer 0–9
   - Pr.08-04 Upper limit of integral control
   - Pr.08-05 PID output command limit

6. When Pr.00-04 is set as 28, the displayed value is the value of PLC register D1043 (see figure below):

   Keypad KPC-CC01

   Can display 0–65535

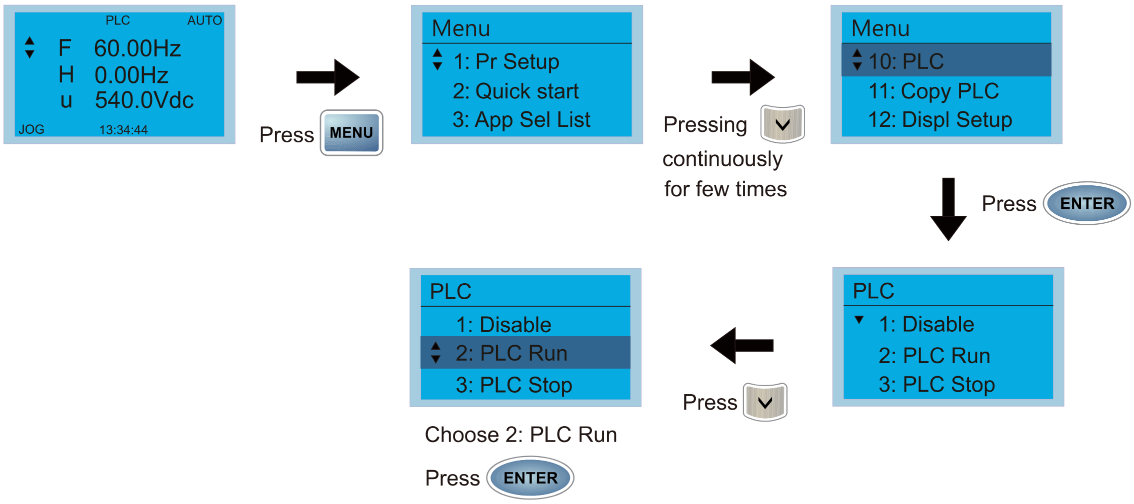
7. In the PLC Run and PLC Stop mode, the content 9 and 10 of Pr.00-02 cannot be set nor be reset to the default value.
8. The PLC can be reset to the default value when Pr.00-02 is set as 6.
9. The corresponding MI function will be disabled when the PLC writes to input contact X.
10. When the PLC controls converter operation, control commands will be entirely controlled by the PLC and will not be affected by the setting of parameter 00-21.
11. When the PLC controls converter frequency commands (FREQ commands), frequency commands will be entirely controlled by the PLC, and will not be affected by the setting of Pr.00-20 or the Hand ON/OFF configuration.
12. When the PLC controls the drive's operation, if the keypad Stop setting is valid, this will trigger an FStP error and cause stoppage.

16-3 Turn on

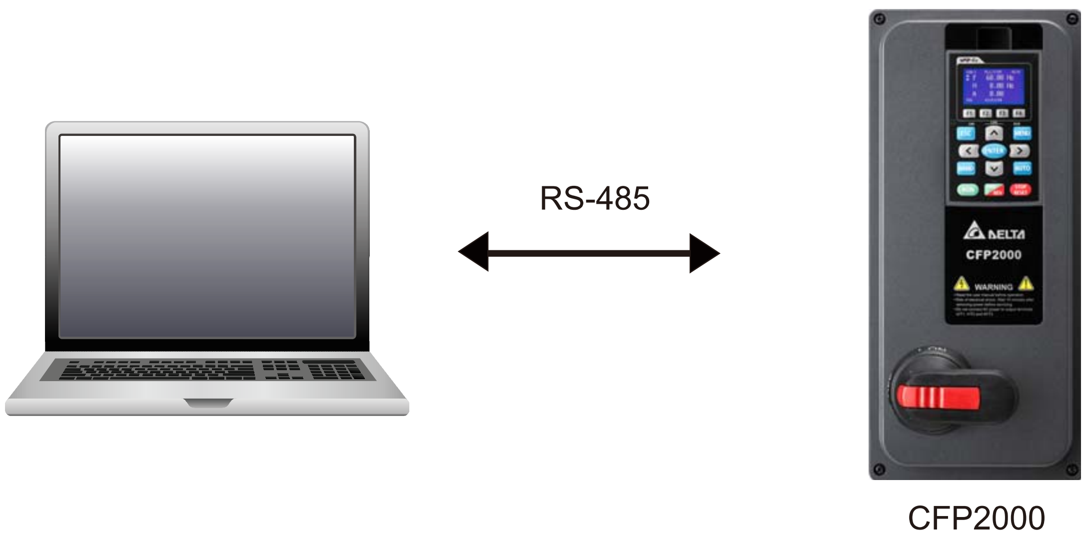
16-3-1 Connect to PC

Start operation of PLC functions in accordance with the following four steps

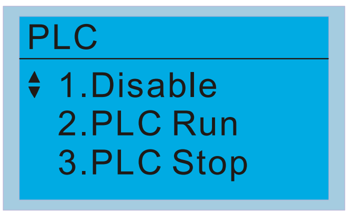
1. After pressing the Menu key and selecting 4: PLC on the KPC-CC01 digital keypad, press the Enter key (see figure below).



2. Wiring: Connect the drive's RJ45 communications interface to a PC via the RS-485



3. PLC function usage



- PLC functions are as shown in the figure on the left; select item 2 and implement PLC functions.

1: No function (Disable)

2: Enable PLC (PLC Run)

3: Stop PLC functions (PLC Stop)

- When the external multifunctional input terminals (MI1–MI8) are in PLC Mode select bit0 (51) or PLC Mode select bit1 (52), and the terminal contact is closed or open, it will compulsorily switch to the PLC mode, and keypad switching will be ineffective. Corresponding actions are as follows:

PLC mode Using KPC-CC01	PLC Mode select bit1(52)	PLC Mode select bit0 (51)
Disable	OFF	OFF
PLC Run	OFF	ON
PLC Stop	ON	OFF
Maintain previous state	ON	ON

NOTE

- When input/output terminals (FWD REV MI1–MI8, MI10–15, Relay1–3, RY10–RY15, MO10–MO11,) are included in the PLC program, these input / output terminals will only be used by the PLC. As an example, when the PLC program controls Y0 during PLC operation (PLC1 or PLC2), the corresponding output terminal relay (RA / RB / RC) will operate in accordance with the program. At this time, the multifunctional input/output terminal setting will be ineffective. Because these terminal functions are already being used by the PLC, the DI / DO / AO in use by the PLC can be determined by looking at Pr.02-52, Pr.02-53, and Pr.03-30.
- When the PLC's procedures use special register D1040, the corresponding AO contact AFM1 will be occupied, and AFM2 corresponding to special register D1045 will have the same situation.
- Pr.03-30 monitors the state of action of the PLC function analog output terminal; bit0 corresponds to the AFM1 action state, and bit1 corresponds to the AFM2 action state.

16-3-2 I/O device explanation

Input devices:

Serial No.	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
1	FWD	REV	MI1	MI2	MI3	MI4	MI5	MI6	MI7	MI8						
2											MI10	MI11	MI12	MI13	MI14	MI15
3											MI10	MI11	MI12	MI13		

1: Control I/O

2: Extension card: EMC-D611A (D1022=4)

3: Extension card: EMC-D42A (D1022=5)

Output devices:

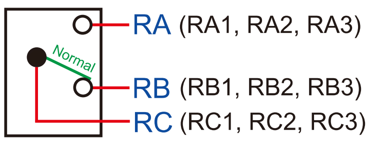
Serial No.	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17
1	RY1	RY2	RY3													
2						MO10	MO11									
3						RY10	RY11	RY12	RY13	RY14	RY15					

1: Control I/O

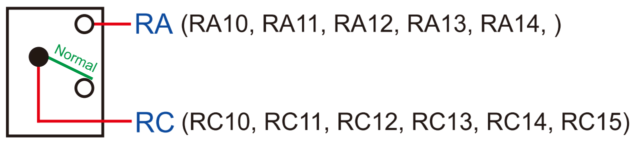
2: Extension card: EMC-D42A (D1022=5)

3: Extension card: EMC-R6AA (D1022=6)

RY1 / RY2 / RY3



RY10 / RY11 / RY12 / RY13 / RY14 / RY15



16-3-3 Installation WPLSoft

Download and install WPLSoft editing software in Delta's website: 
After completing installation, the WPLSoft program will be installed in the designated subfolder "C:\Program Files\Delta Industrial Automation\WPLSoft x.xx".

16-3-4 Program writing

Step 1: Click on the WPLSoft icon to start the editing software. (See figure 16-1)

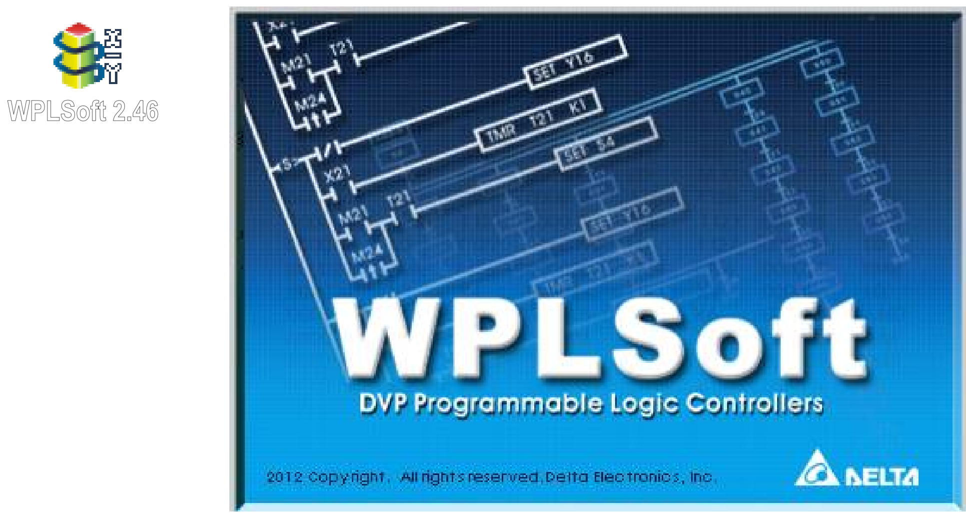


Figure 16-1 (Left: WPLSoft icon; Right: Start WPLSoft)

Step 2: The WPLSoft editing window appears (see figure 16-2 below). When running WPLSoft for the first time, before "New file" has been used, only the "File (F)," "Communications (C)," View (V)," "Options (O)," and "Help (H)" columns will appear on the function toolbar.

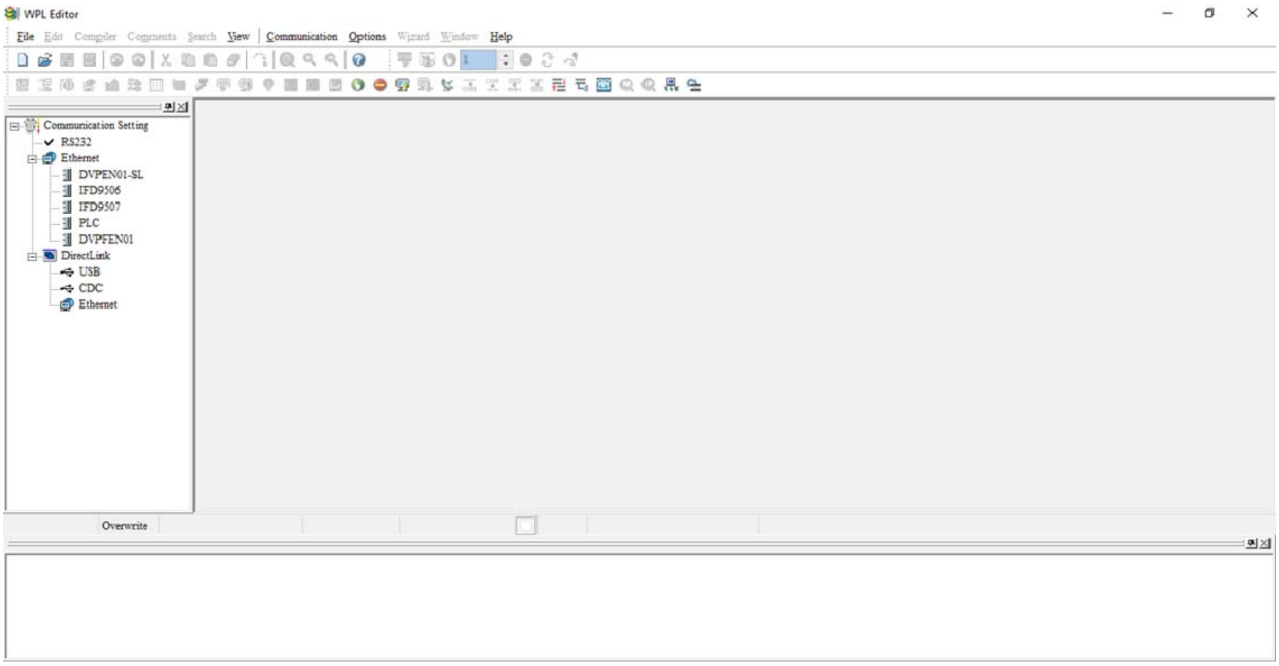


Figure 16-2

NOTE After running WPLSoft for the second time, the last file edited will open and be displayed in the editing window. The following figure 16-3 provides an explanation of the WPLSoft editing software window:

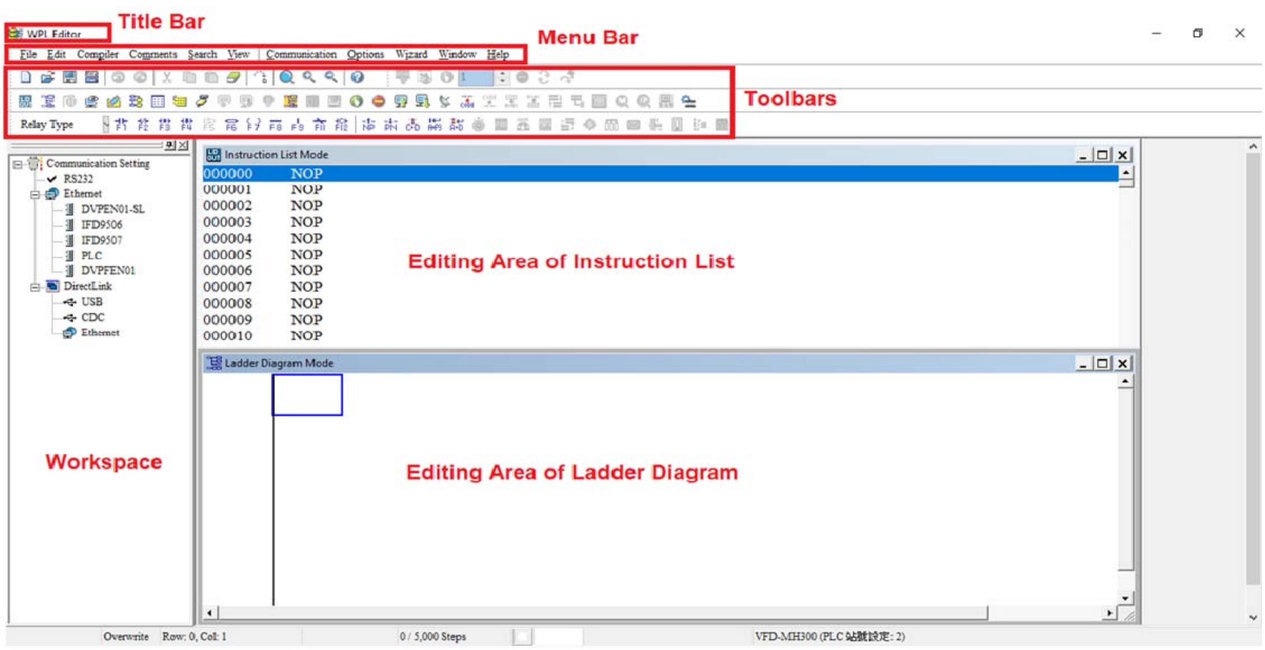


Figure 16-3

Step 3: Click on the icon on the toolbar: opens new file (Ctrl+N), see figure 16-4 below

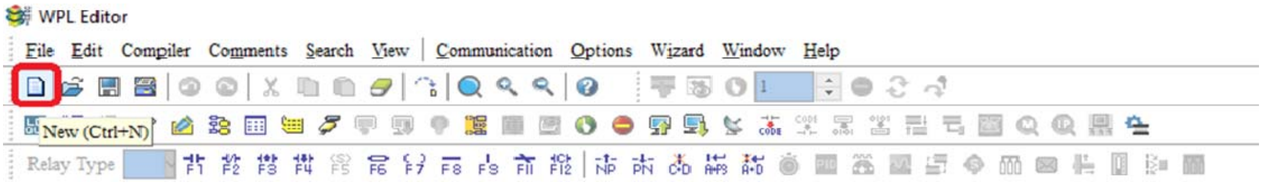


Figure 16-4

NOTE You can also find “New file (N) (Ctrl+N)” in the "File (F)", as shown in figure 16-5 below.

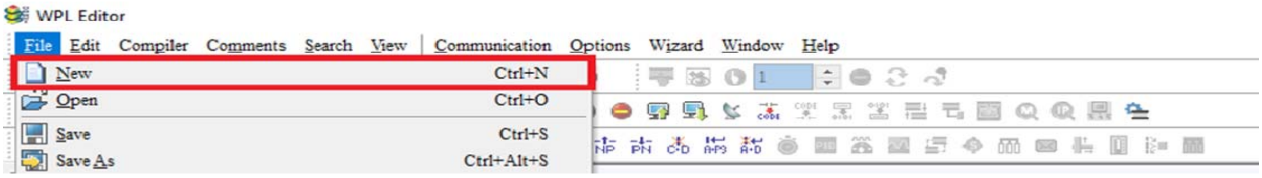


Figure 16-5

Step 4: The "Device settings" window will appear after clicking, see figure 16-6 below. You can now enter the project title and filename, and select the device and communication settings to be used.

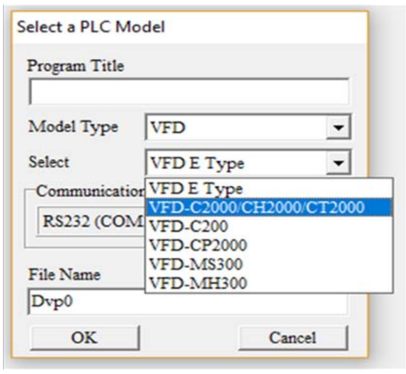


Figure 16-6

Communications settings: Perform settings in accordance with the desired communications method. See figure 16-7 below.

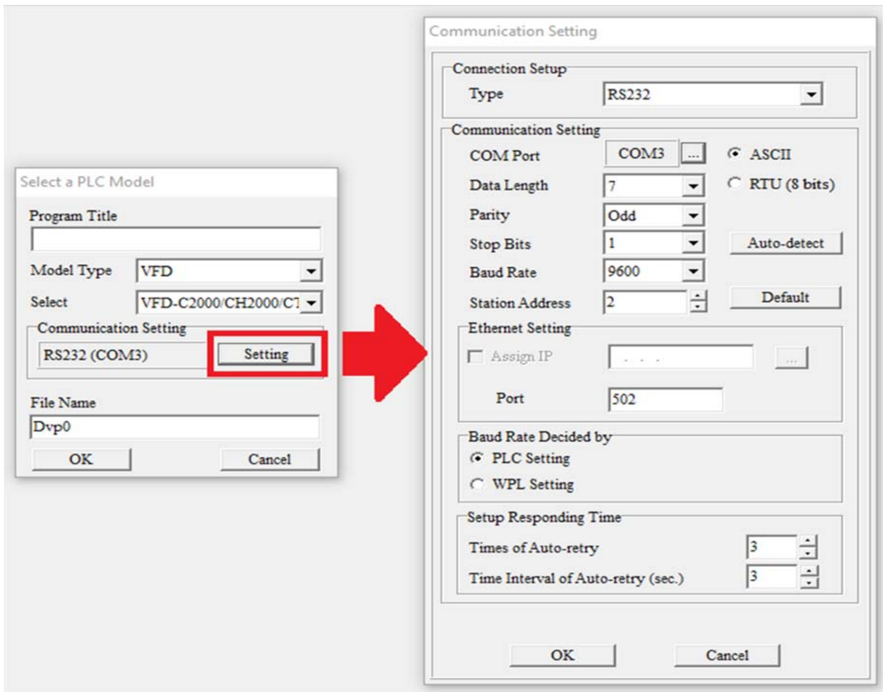


Figure 16-7

Step 5: Press Confirm after completing settings and begin program editing. There are two program editing methods; you can choose whether to perform editing in the command mode or the ladder diagram mode (see figure 16-8 below).

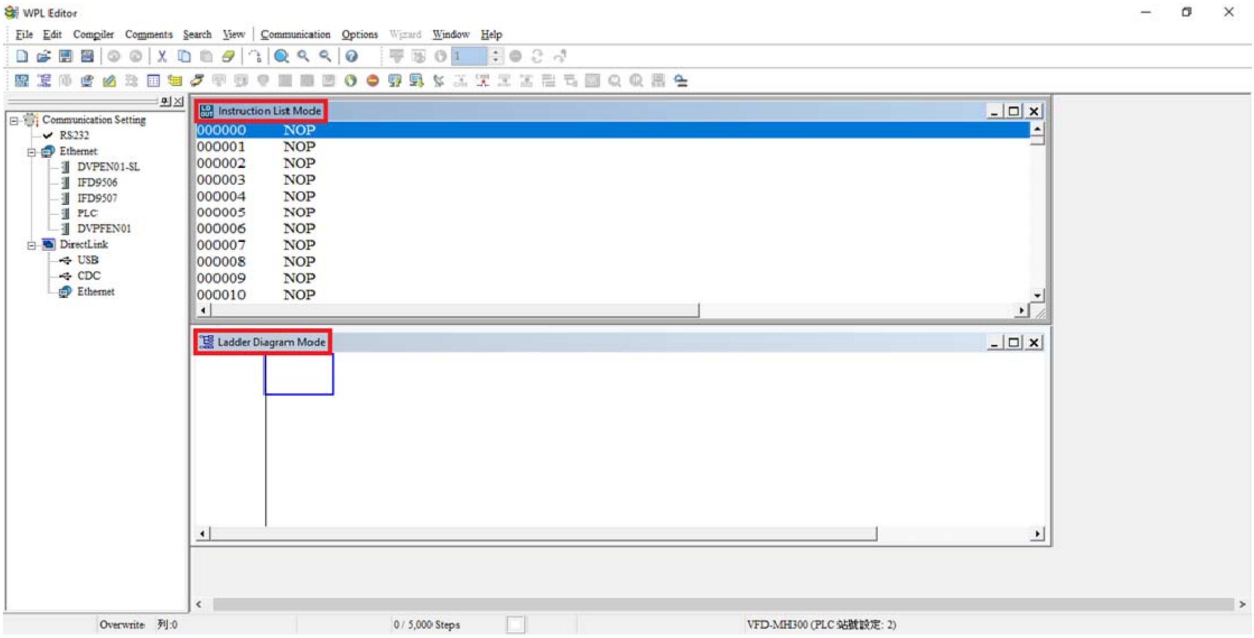


Figure 16-8

NOTE In ladder diagram mode, you can perform program editing using the buttons on the function icon row (see figure 16-9 below).

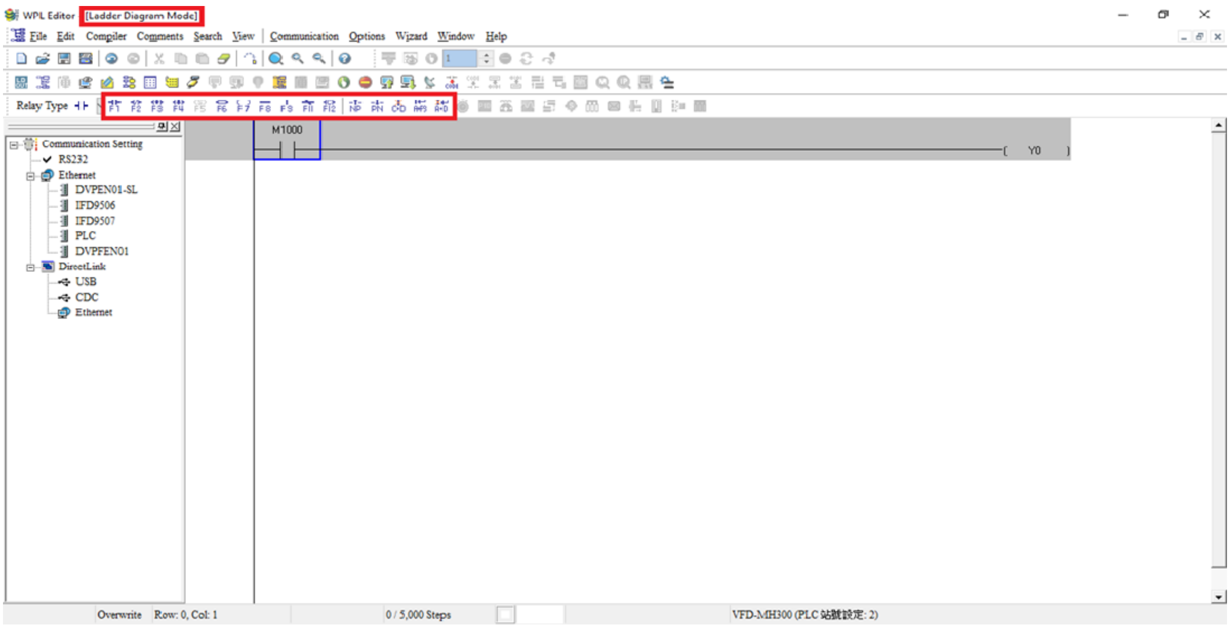


Figure 16-9

Basic Operation-Example

Input the ladder diagram as the figure below. The following steps can be operated through the mouse or function key (F1–F12) on the keyboard.

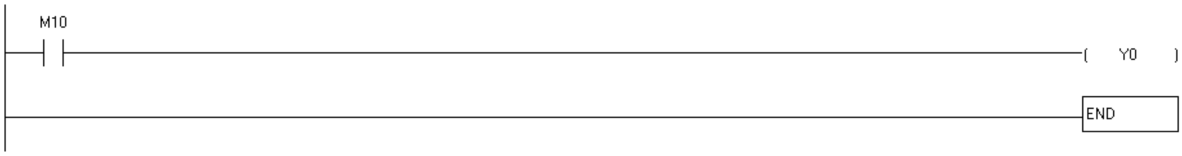


Figure 16-10

Step 1: The following screen will appear after a new file is established:

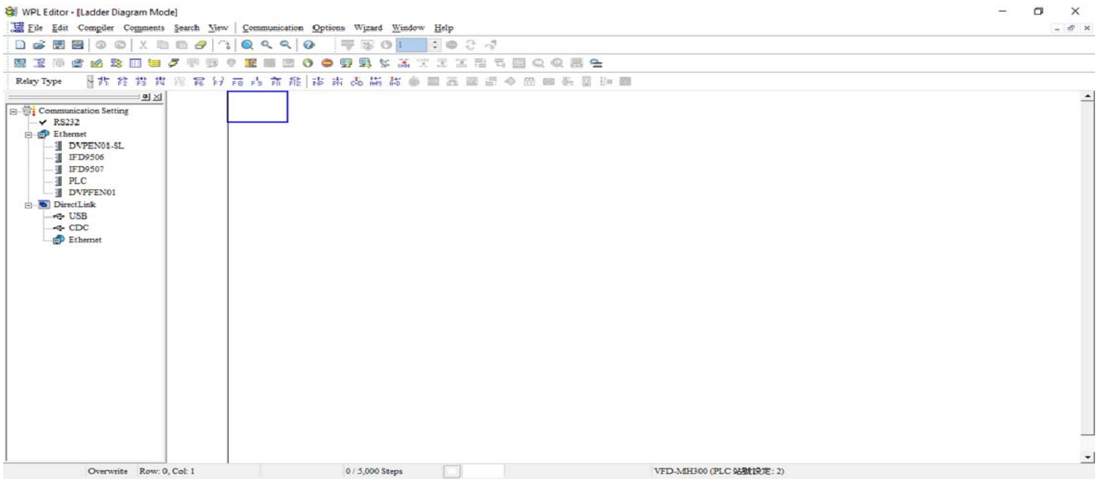


Figure 16-11

Step 2: Click on the always-open switch icon  or press the function key F1. After the name of the input device and the comment dialog box have appeared, the device name (such as "M"), device number (such as "10"), and input comments (such as "auxiliary contact") can be selected; press the OK button when finished (see figure 16-12 and 16-13 below).

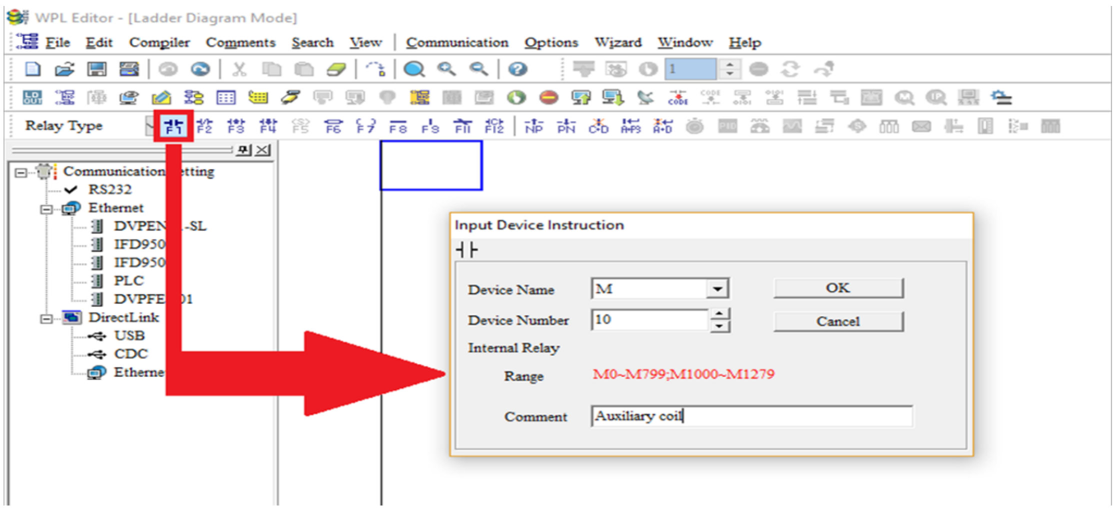


Figure 16-12

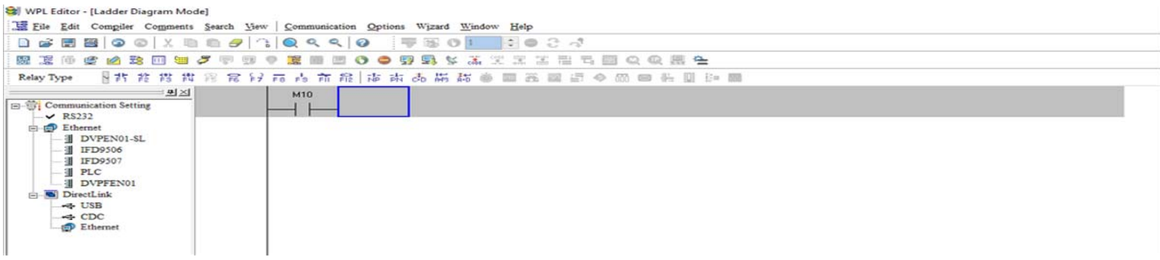


Figure 16-13

Step 3: Click on the output coil icon  or press function key F7. After the name of the input device and the comment dialog box have appeared, the device name (such as "Y"), device number (such as "0"), and input comments (such as "output coil") can be selected; press the OK button when finished (see figure 16-14 and 16-15 below).

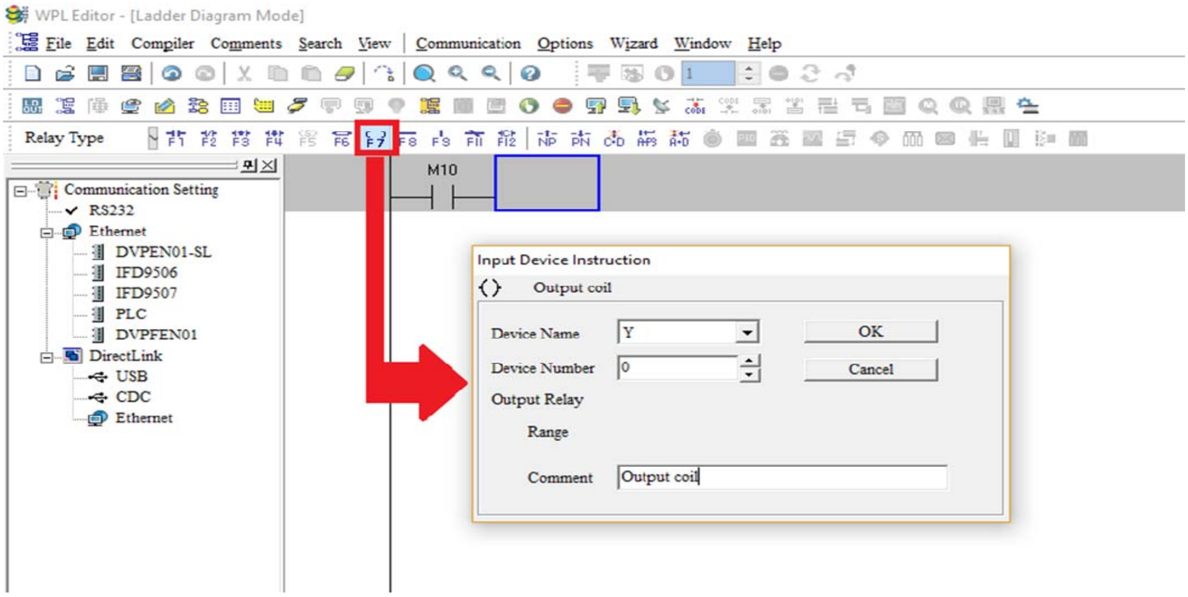


Figure 16-14

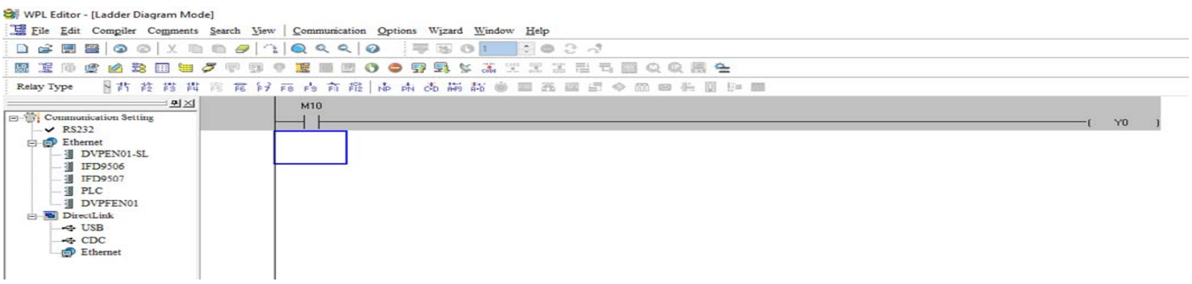


Figure 16-15

Step 4: Press “ENTER” button, when the “Input Instructions” window appears, key in “END” in the field and press the OK button (see figure 16-16 and 16-17 below).

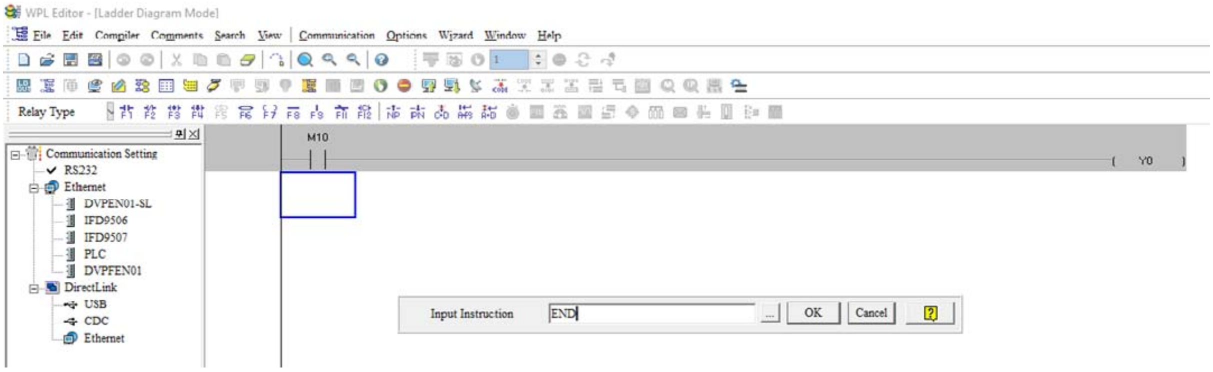


Figure 16-16

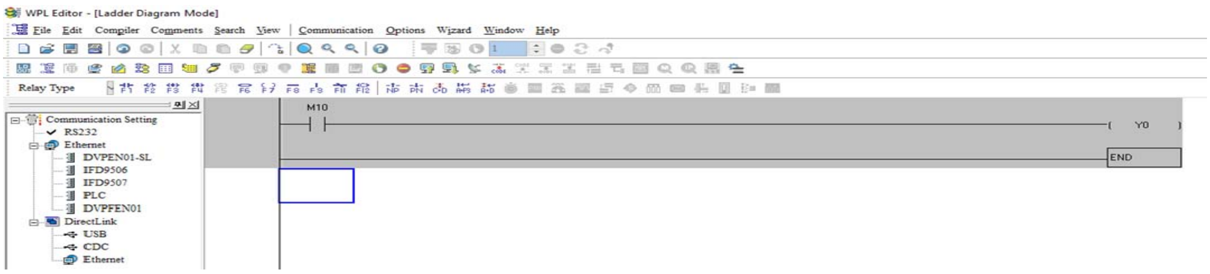
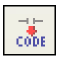


Figure 16-17

Step 5: Click on the  “Ladder diagram => Code” icon, which will compile the edited ladder diagram as a command program. After compiling, the number of steps will appear on the left side of the busbar (see figure 16-18 below).

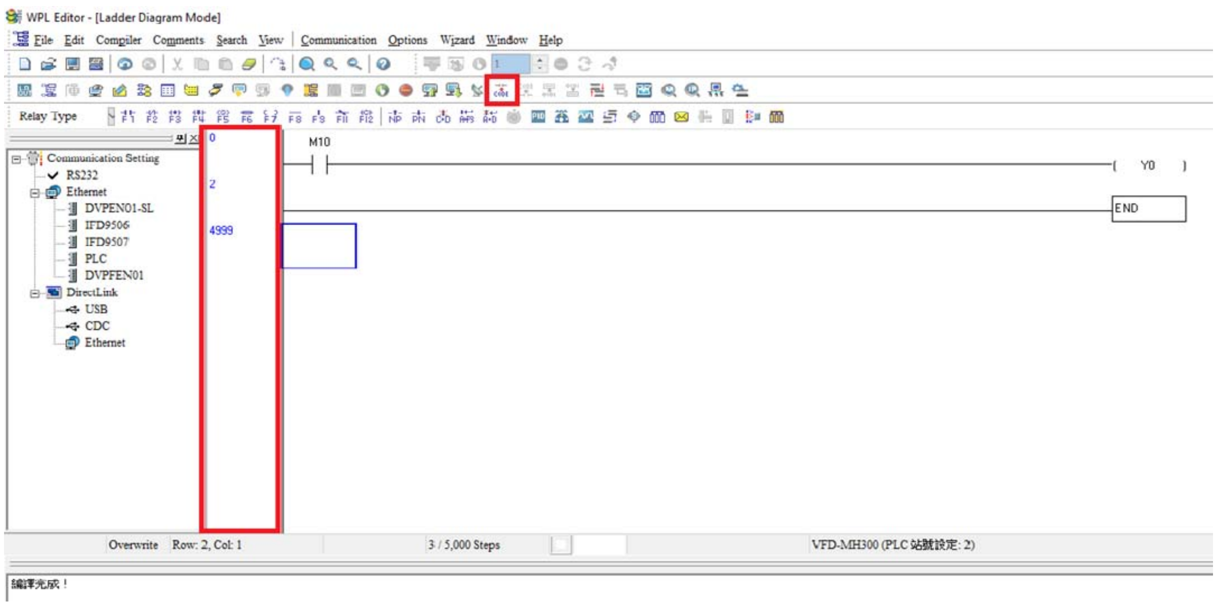


Figure 16-18

16-3-5 Program download

After inputting a program using WPLSoft, select compile  . After completing compilation, select the  to download a program. WPLSoft will perform program download with the online PLC in the communications format specified in communications settings.

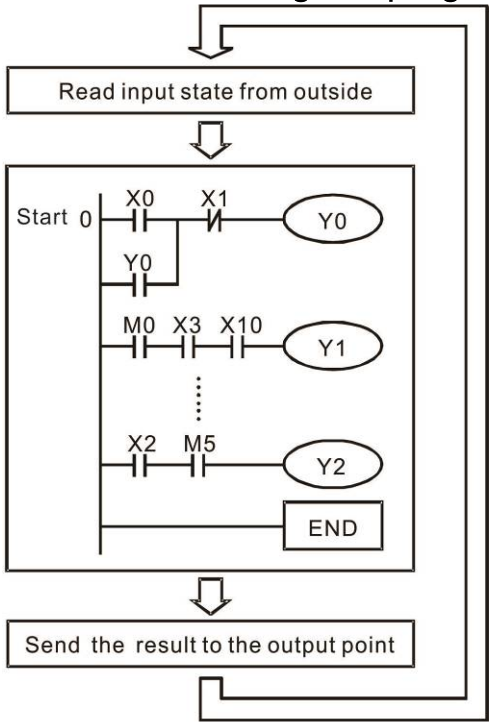
16-3-6 Program monitoring

While confirming that the PLC is in the Run mode, after downloading a program, click on  in the communications menu and select start ladder diagram control (see figure below)

16-4 Basic principles of PLC ladder diagrams

16-4-1 Schematic diagram of PLC ladder diagram program scanning

Output results are calculated on the basis of the ladder diagram configuration (internal devices will have real-time output before results are sent to an external output point)



Repeated implementation

16-4-2 Introduction to ladder diagrams

Ladder diagrams comprise a graphic language widely applied in automatic control, and employs common electrical control circuit symbols. After a ladder diagram editor has been used to create a ladder pattern, PLC program designed is completed. The use of a graphic format to control processes is very intuitive, and is readily accepted by personnel who are familiar with electrical control circuit technology. Many of the basic symbols and actions in a ladder diagram comprise commonly seen electrical devices in conventional automatic control power distribution panels, such as buttons, switches, relays, timers, and counters.

Internal PLC devices: The types and quantities of internal PLC devices vary in different brands of products. Although these internal devices use the same names as conventional electrical control circuit elements such as relays, coils, and contacts, a PLC does not actually contain these physical devices, and they instead correspond to basic elements in the PLC's internal memory (bits). For instance, if a bit is 1, this may indicate that a coil is electrified, and if that bit is 0, it will indicate that the coil is not electrified. An N.O. contact (Normal Open, or contact a) can be used to directly read the value of the corresponding bit, and an N.C. contact (Normal Close, or contact b) can be used to obtain the inverse of the bit's value. Multiple relays occupy multiple bits, and 8 bits comprise one byte; two bytes comprise one word, and two words comprise a double word. When multiple relays are processing at the same time (such as addition/ subtraction or displacement, etc.), a byte, word, or double word can be used. Furthermore, a PLC contains two types of internal devices: a timer and a counter. It not only has a coil, but can count time and numerical values. Because of this, when it is necessary to process some numerical values, these values are usually in the form of bytes, words, or double words.

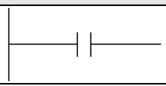
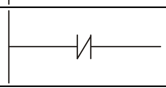
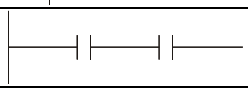
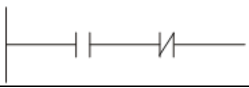
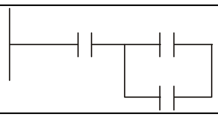
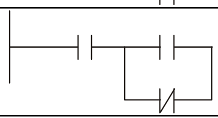
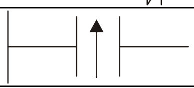
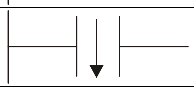
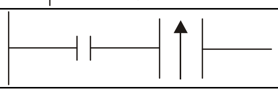
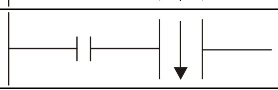
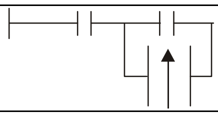
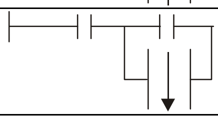
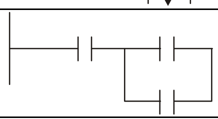
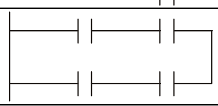
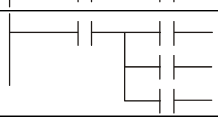
The various internal devices in a PLC all account for a certain quantity of storage units in the PLC's storage area. When these devices are used, the content of the corresponding storage area is red in the form of bits, bytes, or words.

Introduction to the basic internal devices in a PLC

Device type	Description of Function
Input Relay	An input relay constitutes the basic unit of storage in a PLC's internal memory corresponding to an external input point (which serves as a terminal connecting with an external input switch and receiving external input signals). It is driven by external input signals, to which it assigns values of 0 or 1. A program design method cannot change the input relay status, and therefore cannot rewrite the corresponding basic units of an input relay, and WPLSoft cannot be used to perform compulsory On/Off actions. A relay's contacts (contacts a and b) can be used an unlimited number of times. An input relay with no input signal must be left idle and cannot be used for some other purpose. ☑ Device indicated as: X0, X1, X7, X10, X11, etc. This device is expressed with the symbol "X," and a device's order is indicated with an octal number. Input point numbers are indicated in Section 16-8 I/O devices explanation.
Output Relay	An output relay constitutes the basic unit of storage in a PLC's internal memory corresponding to an external output point (which connects with an external load). It may be driven by an input relay contact, a contact on another internal device, or its own contacts. It uses one N.O. contact to connect with external loads or other contacts, and, like input contacts, can use the contact an unlimited number of times. An output relay with no input signal will be idle, but may be used an internal relay if needed. ☑ Device indicated as: Y0, Y1, Y7, Y10, Y11, etc. This device is expressed with the symbol "Y," and a device's order is indicated with an octal number. Output point numbers are indicated in Section 16-8 I/O devices explanation.
Internal Relay	Internal relays have no direct connection with the outside. These relays are auxiliary relays inside a PLC. Their function is the same as that of an auxiliary (central) relay in an electrical control circuit: Each auxiliary relay corresponding to a basic unit of internal storage; they can be driven by input relay contacts, output relay contacts, and the contacts of other internal devices. An internal auxiliary relay's contact can also be used an unlimited number of times. Internal relays have no outputs to outside, and must output via an output point. ☑ Device indicated as: M0, M1 to M799, etc. This device is expressed as the symbol "M," expressed, and its order is expressed as a decimal number.
Counter	A counter is used to perform counting operations. A count setting value (such as the number of pulses to be counted) must be assigned when a counter is used. A counter contains a coil, contact, and a counting storage device. When the coil goes from Off →to On, this indicates that the counter has an input pulse, and one is added to its count. There are 16 bits that can be employed by the user. ☑ Device indicated as: C0, C1 to C79, etc. This device is expressed as the symbol "C," expressed, and its order is expressed as a decimal number.
Timer	A timer is used to complete control of timing. The timer contains a coil, contact, and a time value register. When the coil is electrified, if the preset time is reached, the contact will be actuated (contact a will close, contact b will open), and the timer's fixed value be given by the set value. Timer has a regulated clock cycle (timing units: 100 ms). As soon as power to the coil is cut off, the contact will no longer be actuated (contact a will open, contact b will close), and the original timing value will return to zero.

Device type	Description of Function
	☑ Device indicated as: T0, T1 to T159, etc. The device is expressed as the symbol "T," and its order is expressed as a decimal number.
Data register	When a PLC is used to perform various types of sequence control and set time value and count value control, it most commonly perform data processing and numerical operations, and data registers are used exclusively for storage of data and various parameters. Each data register contains 16 bits of binary data, which means that it can store one word. Two data registers with adjacent numbers can be used to process double words. Device indicated as: D0, D1 to D399, etc. The device is expressed as the symbol "D," and its order is expressed as a decimal number.

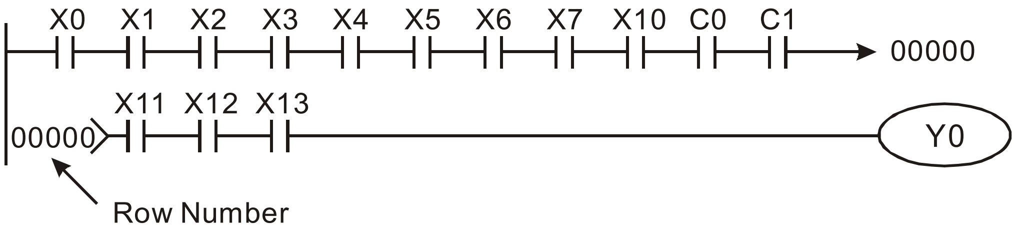
Ladder diagram images and their explanation

Ladder diagram structures	Explanation of commands	Command	Using Device
	NO switch, contact a	LD	X, Y, M, T, C
	NC switch, contact b	LDI	X, Y, M, T, C
	Series NO	AND	X, Y, M, T, C
	Series NC	ANI	X, Y, M, T, C
	Parallel NO	OR	X, Y, M, T, C
	Parallel NC	ORI	X, Y, M, T, C
	Positive edge-triggered switch	LDP	X, Y, M, T, C
	Negative edge-triggered switch	LDF	X, Y, M, T, C
	Positive edge-triggered series	ANDP	X, Y, M, T, C
	Negative edge-triggered series	ANDF	X, Y, M, T, C
	Positive edge-triggered parallel	ORP	X, Y, M, T, C
	Negative edge-triggered parallel	ORF	X, Y, M, T, C
	Block series	ANB	N/A
	Block parallel	ORB	N/A
	Multiple outputs	MPS MRD MPP	N/A

Ladder diagram structures	Explanation of commands	Command	Using Device
	Coil driven output commands	OUT	Y, M
	Some basic commands, applications commands	Some basic commands Applications commands	
	Inverted logic	INV	N/A

16-4-3 Overview of PLC ladder diagram editing

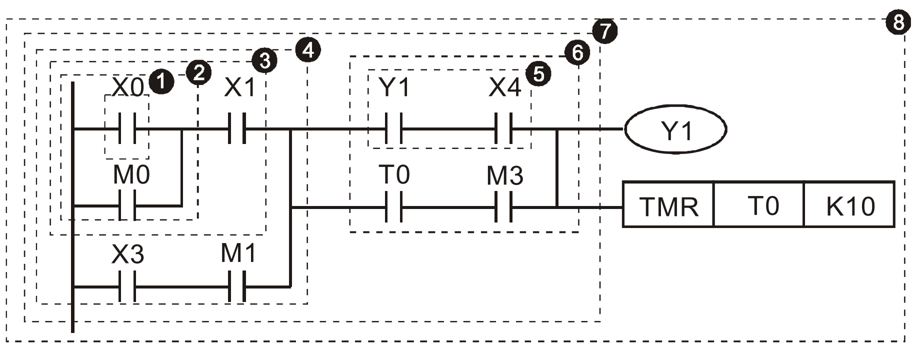
The program editing method begins from the left busbar and proceeds to the right busbar (the right busbar is omitted when editing using WPLSoft). Continue to the next row after completing each row; there is a maximum of 11 contacts on each row. If this is not sufficient, a continuous line will be will be generated to indicate the continued connection and more devices can be added. A continuous series of numbers will be generated automatically and identical input points can be used repeatedly. See figure below:



The ladder diagram programming method involves scanning from the upper left corner to the lower right corner. The coils and applications command computing box are handled in the output, and the ladder diagram is placed on the farthest right. Taking the figure below as an example, we can gradually analyze the procedural sequence of the ladder diagram. The number in the upper right corner gives the sequential order.

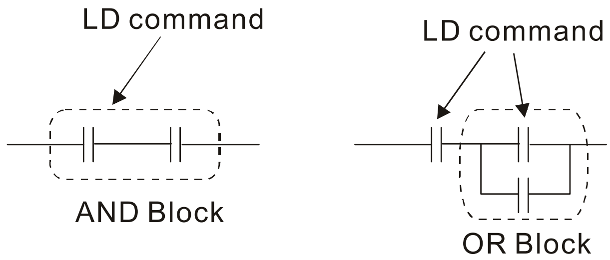
Explanation of command sequence

```
1   LD    X0
2   OR    M0
3   AND   X1
4   LD    X3
    AND   M1
    ORB
5   LD    Y1
    AND   X4
6   LD    T0
    AND   M3
    ORB
7   ANB
8   OUT   Y1
    TMR   T0    K10
```

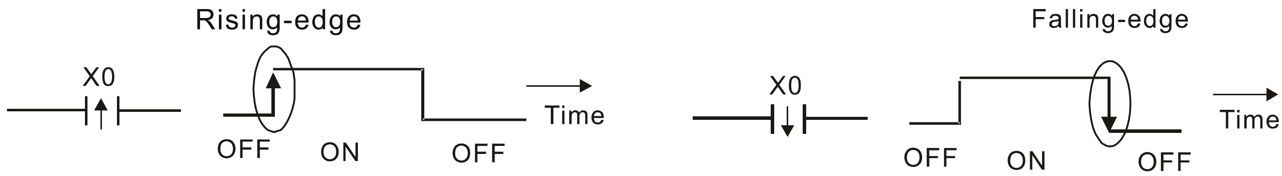


Explanation of basic structure of ladder diagrams

LD (LDI) command: An LD or LDI command is given at the start of a block.



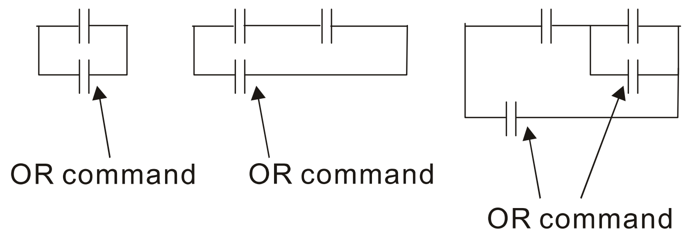
LDP and LDF have this command structure, but there are differences in their action state. LDP, LDF only act at the rising or falling edge of a conducting contact. (see figure below):



AND (ANI) command: A series configuration in which a single device is connected with one device or a block.

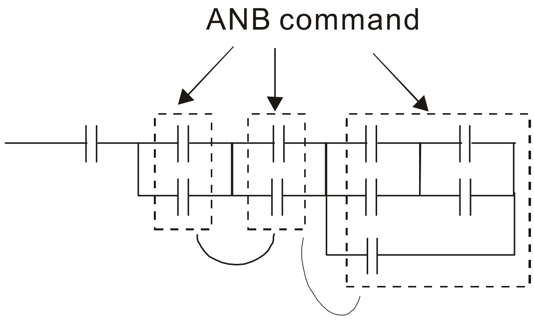
ANDP, ANDF also have structures like this, but their action occurs at the rising and falling edge.

OR (ORI) command: A single device is connected with one device or a block.

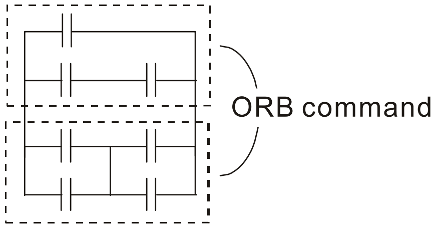


ORP, ORF also have identical structures, but their action occurs at the rising and falling edge.

ANB command: A configuration in which one block is in series with one device or block.



ORB command: A configuration in which one block is in parallel with one device or block.

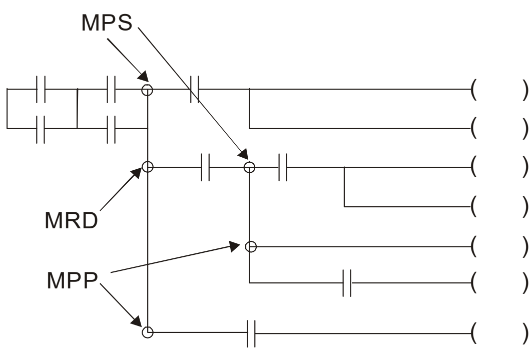


In the case of ANB and ORB operations, if a number of blocks are connected, they should be combined to form a block or network from the top down or from left to right.

MPS, MRD, MPP commands: Branching point memory for multiple outputs, enabling multiple, different outputs. The MPS command begins at a branching point, where the so-called branching point refers to the intersection of horizontal and vertical lines. We have to rely on the contact status along a single vertical line to determine whether the next contact can give a memory command. While each contact is basically able to give memory commands, in view of convenience and the PLC's capacity restrictions, this can be omitted from some places when converting a ladder diagram. The structure of the ladder diagram can be used to judge what kinds of contact memory commands are used.

MPS can be distinguished by use of the "┬" symbol; this command can be used consecutively for up to 8 times. The MRD command is read from branching point memory; because logic states along any one vertical line must be the same, in order to continue analysis of other ladder diagrams, the original contact status must be read.

MRD can be distinguished by use of the "├" symbol. The MPP command is read from the starting state of the uppermost branching point, and it is read from the stack (pop); because it is the final command along a vertical line, it indicates that the state of the vertical line can be concluded.
MPP can be distinguished by use of the "└" symbol. Although there should basically be no errors when using the foregoing analytical approach, the compiling program may sometimes omit identical state output, as shown in the following figure:



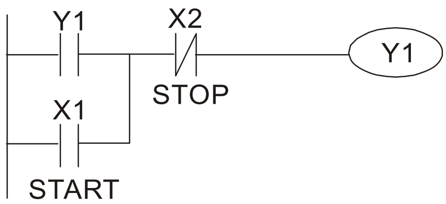
16-4-4 Commonly-used basic program design examples

Start, stop, and protection

Some applications may require a brief close or brief break using the buttons to start and stop equipment. A protective circuit, therefore, must be designed to maintain continued operation in these situations; this protective circuit may employ one of the following methods:

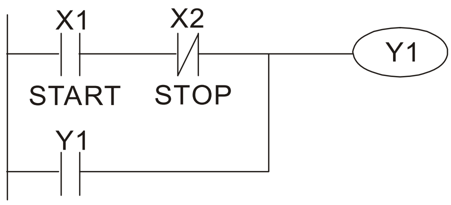
Example 1: Priority stop protective circuit

When the start N.O. contact X1=On, and the stop N.C. contact X2＝Off, Y1=On; if X2=On at this time, coil Y1 will no longer be electrified, and this is therefore referred to as priority stop.



Example 2: Priority start protective circuit

When start N.O. contact X1=On, and the stop N.C. contact X2=Off, Y1=On, and coil Y1 will be electrified and protected. At this time, if X2=On, coil Y1 will still protect the contact and continue to be electrified, and this is therefore priority start.

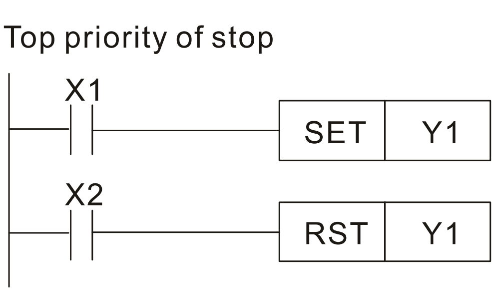


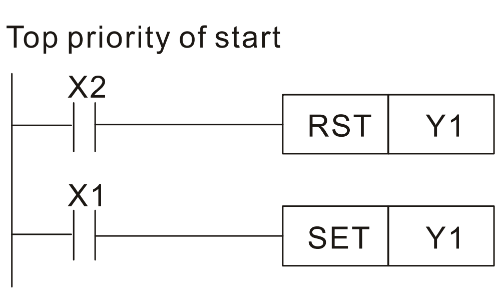
Example 3: Setting (SET) and reset (RST) command protective circuit

The following figure shows a protective circuit composed of RST and SET commands.

Priority stop occurs when the RST command is placed after the SET command. Because the PLC executes programs from the top down, at the end of the program, the state of Y1 will indicate whether coil Y1 is electrified. When X1 and X2 are both actuated, Y1 will lose power, and this is therefore priority stop.

Priority start occurs when the SET command is placed after the RST command. When X1 and X2 are both actuated, Y1 will be electrified, and this is therefore priority start.

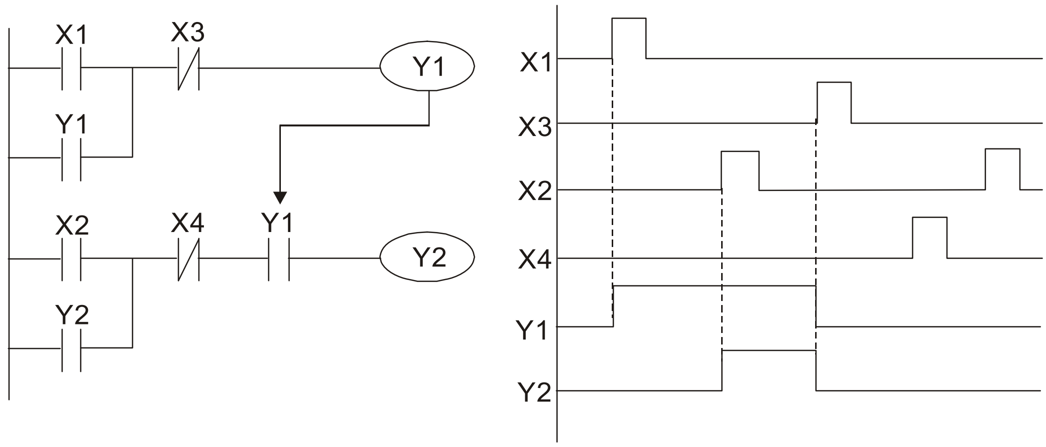




Commonly-used control circuits

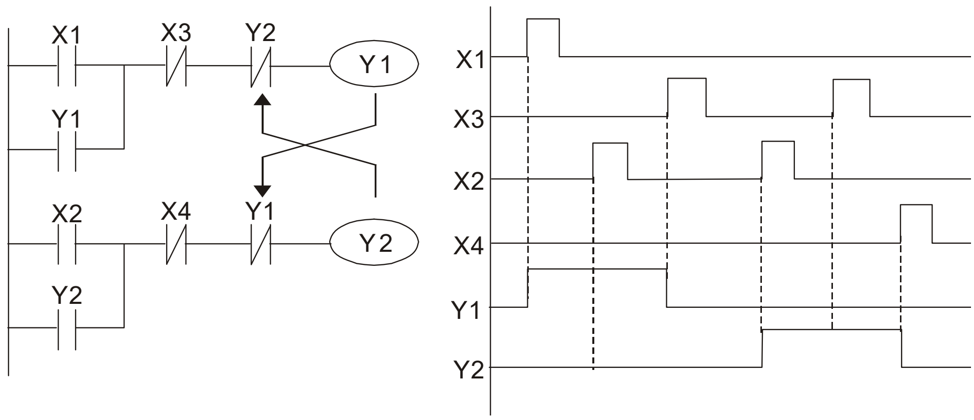
Example 4: Conditional control

X1 & X3 respectively start/stop Y1, and X2 & X4 respectively start/stop Y2. All of these have protective circuits. Because Y1's N.O. contact is series connected with Y2's circuit, it becomes an AND condition for the actuation of Y2. The action of Y1 is therefore a condition for the action of Y2, and Y1 must be actuated before Y2 can be actuated.



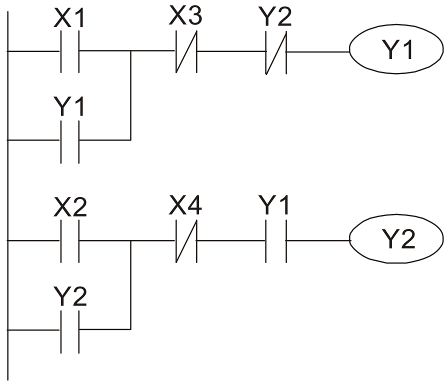
Example 5: Interlocking control

The figure below shows an interlocking control circuit. Depending on which of the start contacts X1, X2 is valid first, the corresponding output Y1 or Y2 will be actuated, and when one is actuated, the other will not be actuated. This implies that Y1 and Y2 cannot be actuated at the same time (interlocking effect). Even if both X1 and X2 are valid at the same time, because the ladder diagram program is scanned from the top down, it is impossible for Y1 and Y2 to be actuated at same time. This ladder diagram assigns priority only to Y1.



Example 6: Sequence control

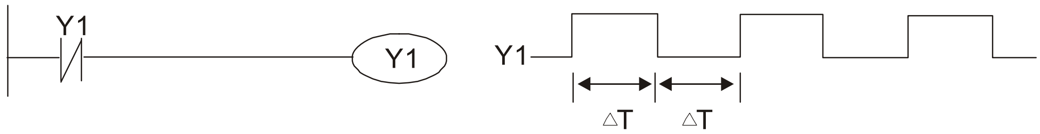
If the N.C. contact of Y2 in the interlocking control configuration of example 5 is put in series with the Y1 circuit, so that it is an AND condition for actuation of Y1 (see figure below), not only is Y1 a condition for the actuation of Y2 in this circuit, the actuation of Y2 will also stop the actuation of Y1. This configuration confirms the actuation order of Y1 and Y2.



Example 7: Oscillating circuit

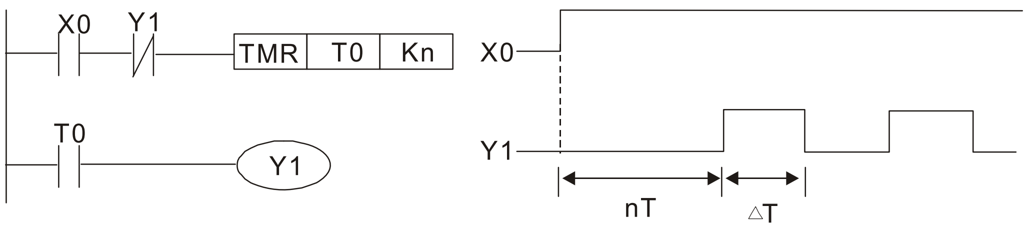
Oscillating circuit with a period of ΔT+ΔT

The figure below shows a very simple ladder diagram. When starting to scan the Y1 N.C. contact, because the Y1 coil has lost power, the Y1 N.C. contact will be closed. When the Y1 coil is then scanned, it will be electrified, and the output will be 1. When the Y1 N.C. contact is scanned in the scanning cycle, because Y1 coil is electrified, the Y1 N.C. contact will be open, the Y1 coil will then lose power, and the output will be 0. Following repeated scanning, the output of Y1 coil will have an oscillating waveform with a period of ΔT (On) +ΔT (Off).



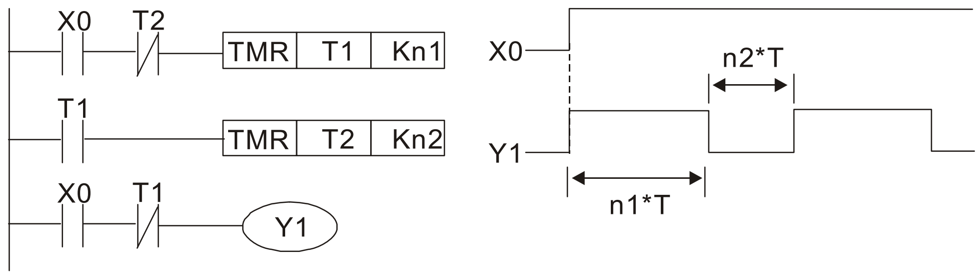
Oscillating circuit with a period of nT+ΔT

The program of the ladder diagram shown below uses timer T0 to control coil Y1's electrified time. After Y1 is electrified, it causes timer T0 to close during the next scanning cycle, which will cause the output from Y1 to have the oscillating waveform shown in the figure below. Here n is the timer's decimal setting value, and T is the clock cycle of the timer.



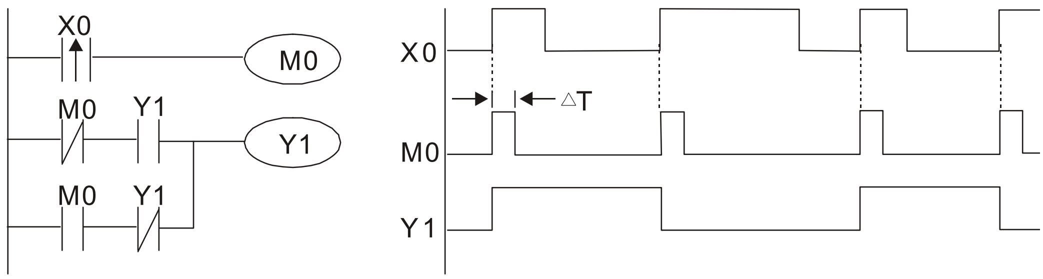
Example 8: Flashing circuit

The following figure shows an oscillating circuit of a type commonly used to cause an indicator light to flash or buzzers to buzz. It uses two timers to control the On and Off time of Y1 coil. Here n1, n2 are the timing set values of T1 and T2, and T is the clock cycle of the timer.



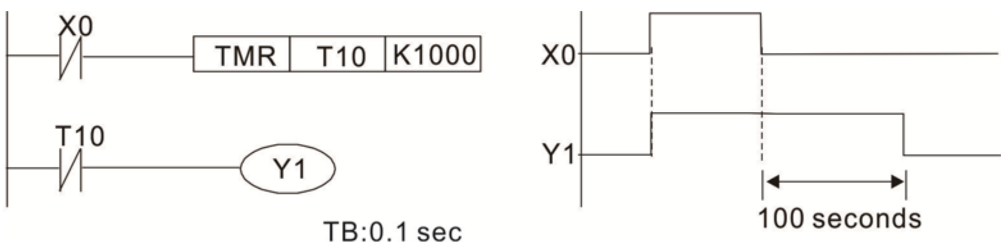
Example 9: Triggering circuit

In the figure below, a command consisting of the differential of the rising edge of X0 causes coil M0 to generate a single pulse for ΔT (length of one scanning cycle), and coil Y1 is electrified during this scanning cycle. Coil M0 loses power during the next scanning cycle, N.C. contact M0 and N.C. contact Y1 are both closed. This causes coil Y1 to stay in an electrified state until there is another rising edge in input X0, which again causes the electrification of coil M0 and the start of another scanning cycle, while also causing coil Y1 to lose power, etc. The sequence of these actions can be seen in the figure below. This type of circuit is commonly used to enable one input to perform two actions in alternation. It can be seen from the time sequence in the figure below that when input X0 is a square wave signal with a period of T, the output of coil Y1 will be a square wave signal with a period of 2T.

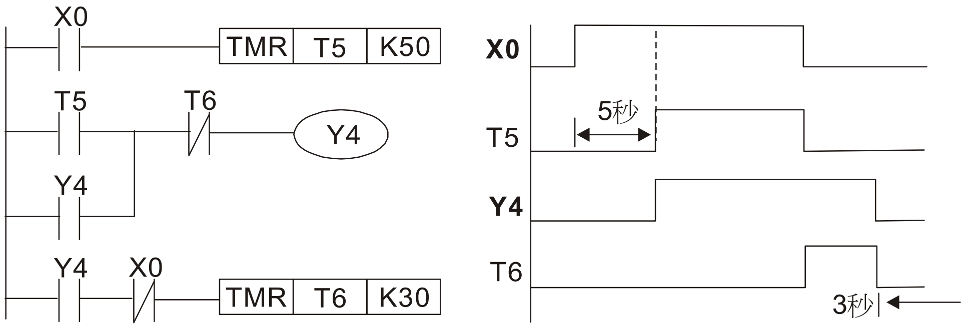


Example 10: Delay circuit

When input X0 is On, because the corresponding N.C. contact will be Off, the timer T10 will be in no power status, and output coil Y1 will be electrified. T10 will receive power and begin timing only after input X0 is Off, and output coil Y1 will be delayed for 100 sec. (K1000*0.1 sec. =100 sec.) before losing power; please refer to the sequence of actions in the figure below.

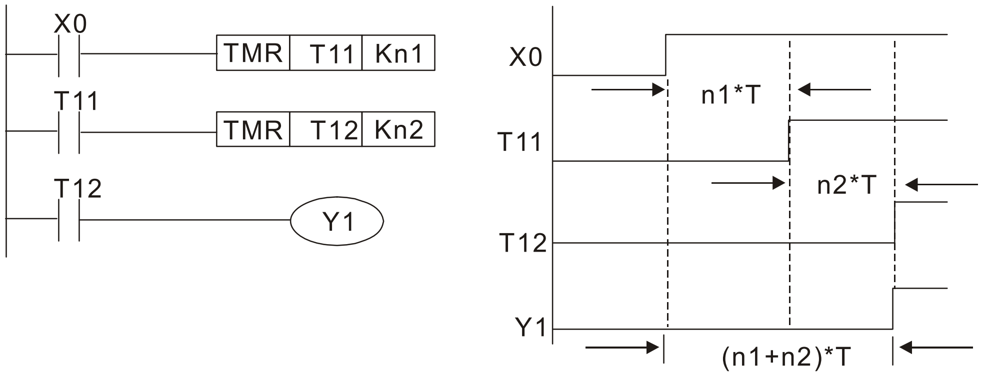


Example 11: The open / close delay circuit is composed of two timers; output Y4 will have a delay whether input X0 is On or Off.



Example 12: Extended timing circuit

In the circuit in the figure on the left, the total delay time from the moment input X0 closes to the time output Y1 is electrified is (n1+n2)*T, where T is the clock cycle. Timers: T11, T12; clock cycle: T.



16-5 Various PLC device functions

Item	Specifications	Notes
Algorithmic control method	Program stored internally, alternating back-and-forth scanning method	
Input / output control method	When it starts again after ending (after execution to the END command), the input/output has an immediate refresh command	
Algorithmic processing speed	Basic commands (several μs);	Applications command (1-several tens of μs)
Programming language	Command + ladder diagram	
Program capacity	10000 steps	
Input / output terminal	Input (X): 10, output (Y): 3	This number of contacts constitutes CFP2000 input/output contacts; other devices have different correspondences

Type	Device	Item		Range		Function
Relay bit form	X	External input relay		X0–X17, 16 points, octal number	Total 32 points	Corresponds to external input point
	Y	External output relay		Y0–Y17, 16 points, octal number		Corresponds to external output point
	M	Auxiliary Relay	General Use	M0–M799, 800 points	Total 880 points	Contact can switch On/Off within the program
			Special purpose	M1000–M1079, 80 points		
	T	Timer	100ms timer	T0–T159, 160 points	Total 160 points	Timers referred to by the TMR command; contact of the T with the same number will go On when the time is reached
	C	Counter	16-bit counter, general use	C0–C79, 80 points	Total 80 points	Counter referred to by the CNT command; contact of the C with the same number will go On when the count is reached
Register word data	T	Current timer value		T0–T159, 160 points		The contact will be On when the time is reached
	C	Current counter value		C0–C79, 16-bit counter 80 points		The counter contact will come On when the count is reached
	D	Data Register	Used to maintain power Off	D0–D399, 400 points	Total 1400 points	Used as data storage memory area
			Special purpose	D1000–D1199, 200 points D2000–D2799, 800 points		
Constant	K	Decimal	Single-byte	Setting Range: K-32,768–K32,767		
			Double-byte	Setting Range: K-2,147,483,648–K2,147,483,647		
	H	Hexadecimal	Single-byte	Setting Range:H0000–HFFFF		
			Double-byte	Setting Range: H00000000–HFFFFFFFF		
Serial communications port (program write/read)				RS-485/keypad port		
Input/output				Built-in three analog inputs and two analog outputs		
Function expansion module			Optional Accessories	EMC-D42A; EMC-R6AA; EMC-D611A		
Communication Expansion Module			Optional Accessories	EMC-COP01 (CANopen)		

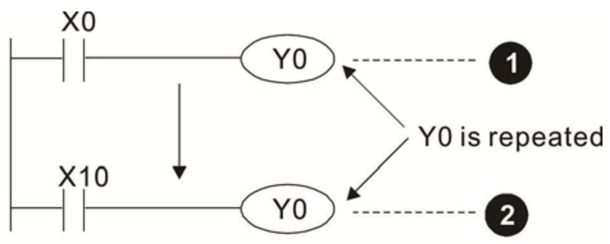
16-5-1 Introduction to device functions

Input/output contact functions

Input contact X functions: Input contact X is connected with an input device, and reads input signals entering the PLC. The number of times that contact a or b of input contact X used in the program is not subject to restrictions. The ON/OFF state of input contact X will change as the input device switches ON and OFF; a peripheral device (WPLSoft) cannot be used to force contact X On or Off.

Output contact Y functions

The job of output contact Y is to send an ON/OFF signal to drive the load connected with output contact Y. Output contacts consist of two types: relays and transistors. While number of times that contact a or b of each output contact Y used in the program is not subject to restrictions, it is recommended that the number of output coil Y be used only once in a program, otherwise the right to determine the output state when the PLC performs program scanning will be assigned to the program's final output Y circuit.



The output of Y0 will be decided by circuit ❷ , i.e. decided by On/Off of X10.

Numerical value, constant [K]/ [H]

Constant	Single-byte	K	Decimal	K-32,768–K32,767
	Double-byte			K-2,147,483,648–K2,147,483,647
	Single-byte	H	Hexadecimal	H0000–HFFFF
	Double-byte			H00000000–HFFFFFFFF

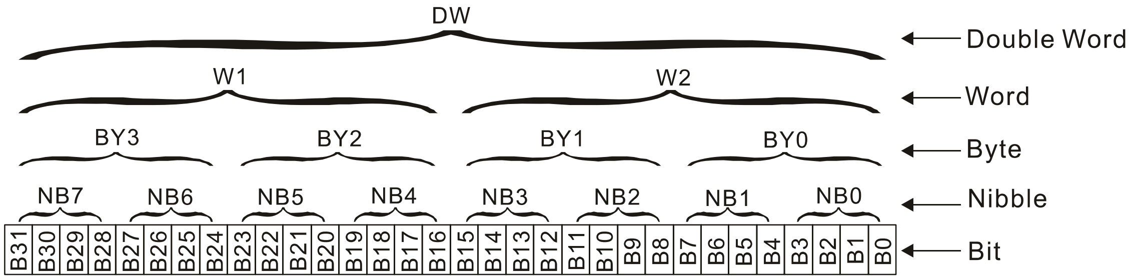
The PLC can use five types of numerical values to implement calculations based on its control tasks; the following is an explanation of the missions and functions of different numerical values.

Binary Number, BIN

The PLC's numerical operations and memory employ binary numbers. Binary nibbles and relevant terms are explained as follows:

bit	bits are the fundamental units of binary values, and have a state of either 1 or 0
Nibble	Comprised of a series of 4 bits (such as b3–b0); can be used to express a one-nibble decimal number 0–9 or hexadecimal number: 0–F.
Byte	Comprised of a series of two nibbles (i.e. 8 bits, b7–b0); can express a hexadecimal number: 00–FF.
Word	Comprised of a series of two bytes (i.e. 16 bits, b15–b0); can express a hexadecimal number with four nibbles: 0000–FFFF.
Double Word	Comprised of a series of two words (i.e. 32 bits, b31–b0); can express a hexadecimal number with eight nibbles: 00000000–FFFFFFFF

Relationship between bits, digits, nibbles, words, and double words in a binary system (see figure below):



Octal Number, OCT

The external input and output terminals of a DVP-PLC are numbered using octal numbers

Example: External input: X0–X7, X10–X17… (Device number table);

External output: Y0–Y7, Y10–Y17… (Device number table)

Decimal Number, DEC

Decimal numbers are used for the following purposes in a PLC system:

☑ The setting values of timer T or counter C, such as TMR C0 K50. (K constant)

☑ The numbers of devices including M, T, C, or D, such as M10 or T30. (device number)

☑ Used as an operand in an application command, such as MOV K123 D0. (K constant)

Binary Code Decimal, BCD

Uses one nibble or 4 bits to express the data in a decimal number; a series of 16 bits can therefore express a decimal number with 4 nibbles. Chiefly used to read the input value of a fingerwheel numerical switch input or output a numerical value to a seven-segment display driver.

Hexadecimal Number, HEX

Applications of hexadecimal numbers in a PLC system: Used as operands in application commands, such as MOV H1A2B D0. (H constant)

Constant K

Decimal numbers are usually prefixed with a "K" in a PLC system, such as K100. This indicates that it is a decimal number with a numerical value of 100.

Exceptions: K can be combined with bit device X, Y, M, or S to produce data in the form of a nibble, byte, word, or double word, such as in the case of K2Y10 or K4M100. Here K1 represents a 4-bit combination, and K2-K4 variously represent 8-, 12-, and 16-bit combinations.

Constant H

Hexadecimal numbers are usually prefixed with the letter "H" in a PLC system, such as in the case of H100, which indicates a hexadecimal number with a numerical value of 100.

Functions of auxiliary relays

Like an output relay Y, an auxiliary relay M has an output coil and contacts a and b, and the number of times they can be used in a program is unrestricted. Users can use an auxiliary relay M to configure the control circuit, but cannot use it to directly drive an external load. Auxiliary relays have the following two types of characteristics:

Ordinary auxiliary relays: Ordinary auxiliary relays will all revert to the Off state if a power outage occurs while the PLC is running, and will remain in the Off state if power is again turned down.

Special purpose auxiliary relays: Each special purpose auxiliary relay has its own specific use. Do not use any undefined special purpose auxiliary relays.

Timer functions

Timers take 100 ms as their timing units. When the timing method is an upper time limit, when the current timer value = set value, power will be sent to the output coil. Timer setting values consist of decimal K values, and the data register D can also serve as a setting value.

Actual timer setting time = timing units * set value

Counter features

Item	16-bit counter
Type	General Type
CT Direction:	Score:
Setting	0–32,767
Designation of set value	Constant K or data register D
Change in current value	When the count reaches the set value, there is no longer a count
Output contact	When the count reaches the set value, the contact comes On and stays On
Reset	The current value reverts to 0 when an RST command is executed, and the contact reverts to Off
Contact actuation	All are actuated after the end of scanning

Counter functions

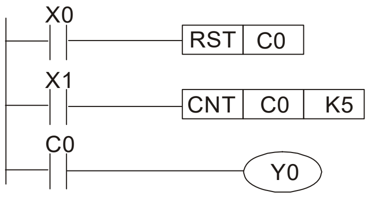
When a counter's counting pulse input signal goes OFF→ON, if the counter's current value is equal to the set value, the output coil will become ON. The setting value will be a decimal K values, and the data register D can also serve as a setting value.

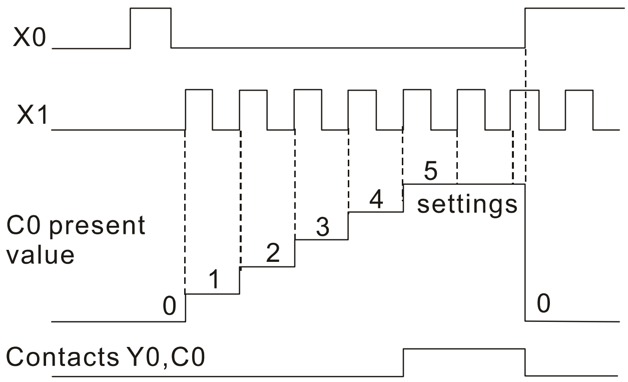
16-bit counter C0–C79:

- ☑ 16-bit counter setting range: K0–K32,767. (when K0 and K1 are identical, the output contact will immediately be ON during the first count.)
- ☑ The current counter value will be cleared from an ordinary counter when power is shut off to the PLC.
- ☑ If the MOV command or WPLSoft is used to transmit a value greater than the set value to the C0 current value register, when the next X1 goes from OFF→ON, the C0 counter contact will change to On, and the current value will change to the set value.
- ☑ A counter's setting value may be directly set using a constant K or indirectly set using the value in register D (not including special data registers D1000–D1199 or D2000–D2799).
- ☑ If the set value employs a constant K, it may only be a positive number; the set value may be either a positive or a negative number if the value in data register D is used. The current counter value will change from 32,767 to -32,768 as the count continues to accumulate.

Example

```
LD      X0
RST     C0
LD      X1
CNT     C0   K5
LD      C0
OUT     Y0
```





1. When X0=On and the RST command is executed, the current value of C0 will revert to 0, and the output contact will revert to Off.
2. When X1 changes from Off→On, the current value of the counter will execute an increase (add one).
3. When the count of counter C0 reaches the set value K5, the contact C0 will come On, and the current value of C0＝ set value =K5. Afterwards, signal C0 triggered by X1 cannot be received, and the current value of C0 will remain K5.

16-5-2 Introduction to special relay functions (special M)

R/W items: RO: read only function; RW: read and write function

Special M	Description of Function	R/W *
M1000	Operates monitor NO contact (contact a). NO while RUN, contact a. This contact is On while in the RUN state.	RO
M1001	Operates monitor NC contact (contact b). NC while RUN, contact b. This contact is Off while in the RUN state.	RO
M1002	Initiates a forward (the instant RUN is On) pulse. Initial pulse, contact a. Produces a forward pulse the moment RUN begins; its width = scan cycle	RO
M1003	Initiates a reverse (the instant RUN is Off) pulse. Initial pulse, contact a. Produces a reverse pulse the moment RUN ends; the pulse width = scan cycle	RO
M1004	Reserved	RO
M1005	Driver malfunction instructions	RO
M1006	Converter has no output	RO
M1007	Driver direction FWD(0)/REV(1)	RO
M1008 | M1010	--	--
M1011	10 ms clock pulse, 5 ms On/5 ms Off	RO
M1012	100 ms clock pulse, 50 ms On / 50 ms Off	RO
M1013	1 sec. clock pulse, 0.5s On / 0.5s Off	RO
M1014	1 min. clock pulse, 30s On / 30s Off	RO
M1015	Frequency attained (when used together with M1025)	RO
M1016	Parameter read/write error	RO
M1017	Parameter write successful	RO
M1018	--	--
M1019	--	--
M1020	Zero flag	RO
M1021	Borrow flag	RO
M1022	Carry flag	RO
M1023	Divisor is 0	RO
M1024	--	--
M1025	Drive frequency = set frequency (ON) Drive frequency =0(OFF)	RW
M1026	Drive operating direction FWD(OFF)/REV(ON)	RW
M1027	Drive Reset	RW
M1028	--	--
M1029	--	--
M1030	--	--
M1031	Compulsory setting of the current PID integral value equal to D1019 (0 change, 1 valid)	RW
M1032	Compulsory definition of FREQ command after PID control	RW
M1033	--	--
M1034	Initiates CANopen real-time control	RW
M1035	Initiates internal communications control	RW
M1036	Ignore calendar error	RW
M1037	--	--
M1038	--	--
M1039	--	--
M1040	Excitation (Servo On)	RW
M1041	--	--
M1042	Quick stop	RW
M1043	--	--
M1044	Pause (Halt)	RW

Special M	Description of Function	R/W *
M1045 | M1047	--	--
M1048	--	--
M1049	--	--
M1050	--	--
M1051	--	--
M1052	Lock frequency (lock, frequency locked at the current operating frequency)	RW
M1053	--	--
M1054	--	--
M1055	--	--
M1056	Excitation ready (Servo On Ready)	RO
M1057	--	--
M1058	On Quick Stopping	RO
M1059	CANopen Master setting complete	RO
M1060	CANopen Currently initializing slave station	RO
M1061	CANopen Slave station initialization failure	RO
M1062	--	--
M1063	--	--
M1064	--	--
M1065	Read/write CANOpen data time out	RO
M1066	Read/write CANopen data complete	RO
M1067	Read/write CANopen data successful	RO
M1068	Calendar calculation error	RO
M1069	--	--
M1070	--	--
M1071	--	--
M1072 | M1075	--	--
M1076	Calendar time error or refresh time out	RO
M1077	485 Read/write complete	RO
M1078	485 Read-write error	RO
M1079	485 Communications time out	RO
M1090	OFF (refer to parameter descriptions for Pr.00-29)	RO
M1091	HAND (refer to parameter descriptions for Pr.00-29)	RO
M1092	AUTO (refer to parameter descriptions for Pr.00-29)	RO
M1100	LOCAL (refer to parameter descriptions for Pr.00-29)	RO
M1101	REMOTE (refer to parameter descriptions for Pr.00-29)	RO
M1168	SMOV BCD and BIN mode switch	RW
M1260	PLC PID1 Enable	RW
M1262	PLC PID1 Positive integral value limit	RW
M1270	PLC PID2 Enable	RW
M1272	PLC PID2 Positive integral value limit	RW

16-5-3 Introduction to special register functions (special D)

Special D	Description of Function	R/W *
D1000	--	--
D1001	Device system program version	RO
D1002	Program capacity	RO
D1003	Total program memory content	RO
D1004 | D1009	--	--
D1010	Current scan time (units: 0.1 ms)	RO
D1011	Minimum scan time (units: 0.1 ms)	RO
D1012	Maximum scan time (units: 0.1 ms)	RO
D1013 | D1017	--	--
D1018	Current integral value	RO
D1019	Compulsory setting of PID I integral	RW
D1020	Output frequency (0.00–600.00 Hz)	RO
D1021	Output current (####.# A)	RO
D1022	AI AO DI DO Expansion card number 0: No extension card 4: AC input card (6 in) (EMC-D611A) 5: Digital I/O Card (4 in 2 out) (EMC-D42A) 6: Relay card(6 out) (EMC-R6AA) 11: Analog I/O card (2 in 2 out) (EMC-A22A)	RO
D1023	Communication expansion card number 0: No extension card 1: DeviceNet Slave (CMC-DN01) 2: Profibus-DP Slave (CMC-PD01) 3: CANopen Slave (EMC-COP01) 4: Modbus-TCP Slave 5: EtherNet/IP Slave (CMC-EIP01) 12: PROFINET Slave (CMC-PN01)	RO
D1024 | D1026	--	--
D1027	PID calculation frequency command (frequency command after PID calculation)	RO
D1028	AVI1value (0.00–100.00%)	RO
D1029	ACI value (0.0–100.00%)	RO
D1030	AVI2 value (0.00–100.00%)	RO
D1031	C series: extension card AI10 (0.0–100.0%)	RO
D1032	C series: extension card AI11 (0.0–100.0%)	RO
D1033 | D1035	--	--
D1036	Servo error bit	RO
D1037	Drive output frequency	RO
D1038	DC bus voltage	RO
D1039	Output voltage	RO
D1040	Analog output value AFM1 (-100.00–100.00%)	RW
D1041	C series: extension card AO10 (0.0–100.0%)	RW
D1042	C series: extension card AO11 (0.0–100.0%)	RW
D1043	Can be user-defined (will be displayed on panel when Pr.00-04 is set as 28; display method is C xxx)	RW
D1044	--	-
D1045	Analog output value AFM2 (-100.00–100.00%)	RW

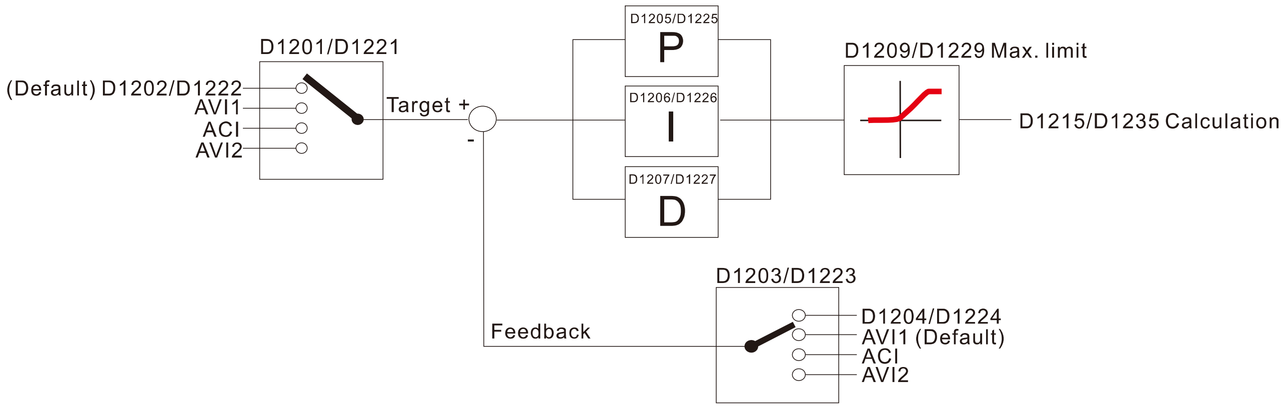
Special D	Description of Function	R/W *
D1046 | D1049	--	--
D1050	Actual Operation Mode 0: Speed	RO
D1051	--	--
D1052	--	--
D1053	--	--
D1054	--	--
D1055	--	--
D1056	--	--
D1057	--	--
D1058	--	--
D1059	--	--
D1060	Operation Mode setting 0: Speed	RW
D1061	485 COM1 communications time out time (ms)	RW
D1062	Torque command (torque limit in speed mode)	RW
D1063	Year (Western calendar) (display range 2000-2099) (must use KPC-CC01)	RO
D1064	Week (display range 1-7) (must use KPC-CC01)	RO
D1065	Month (display range 1-12) (must use KPC-CC01)	RO
D1066	Day (display range 1-31) (must use KPC-CC01)	RO
D1067	Hour (display range 0-23) (must use KPC-CC01)	RO
D1068	Minute (display range 0-59) (must use KPC-CC01)	RO
D1069	Second (display range 0-59) (must use KPC-CC01)	RO
D1100	Target frequency	RO
D1101	Target frequency (must be operating)	RO
D1102	Reference frequency	RO
D1103	--	--
D1104	--	--
D1105	--	--
D1106	--	--
D1107	π(Pi) Low word	RO
D1108	π(Pi) High word	RO
D1109	Random number	RO
D1110	Internal node communications number (set number of slave stations to be controlled)	RW
D1111	--	--
D1112	--	--
D1113	--	--
D1114	Numbering of the operating motors: 1: Motor 1 2: Motor 2	RO
D1115	Internal node synchronizing cycle (ms)	RO
D1116	Internal node error (bit0 = Node 0, bit1 = Node 1,…bit7 = Node 7)	RO
D1117	Internal node online correspondence (bit0 = Node 0, bit1 = Node 1,…bit7 = Node 7)	RO
D1118	--	--
D1119	--	--
D1120	Internal node 0 control command	RW
D1121	Internal node 0 mode	RW
D1122	Internal node 0 reference command L	RW
D1123	Internal node 0 reference command H	RW
D1124	--	--
D1125	--	--

Special D	Description of Function	R/W *
D1126	Internal node 0 status	RO
D1127	Internal node 0 reference status L	RO
D1128	Internal node 0 reference status H	RO
D1129	--	--
D1130	Internal node 1 control command	RW
D1131	Internal node 1 mode	RW
D1132	Internal node 1 reference command L	RW
D1133	Internal node 1 reference command H	RW
D1134	--	--
D1135	--	--
D1136	Internal node 1 status	RO
D1137	Internal node 1 reference status L	RO
D1138	Internal node 1 reference status H	RO
D1139	--	--
D1140	Internal node 2 control command	RW
D1141	Internal node 2 mode	RW
D1142	Internal node 2 reference command L	RW
D1143	Internal node 2 reference command H	RW
D1144	--	--
D1145	--	--
D1146	Internal node 2 status	RO
D1147	Internal node 2 reference status L	RO
D1148	Internal node 2 reference status H	RO
D1149	--	--
D1150	Internal node 3 control command	RW
D1151	Internal node 3 mode	RW
D1152	Internal node 3 reference command L	RW
D1153	Internal node 3 reference command H	RW
D1154	--	--
D1155	--	--
D1156	Internal node 3 status	RO
D1157	Internal node 3 reference status L	RO
D1158	Internal node 3 reference status H	RO
D1159	--	--
D1160	Internal node 4 control command	RW
D1161	Internal node 4 mode	RW
D1162	Internal node 4 reference command L	RW
D1163	Internal node 4 reference command H	RW
D1164	--	--
D1165	--	--
D1166	Internal node 4 status	RO
D1167	Internal node 4 reference status L	RO
D1168	Internal node 4 reference status H	RO
D1169	--	--
D1170	Internal node 5 control command	RW
D1171	Internal node 5 mode	RW
D1172	Internal node 5 reference command L	RW
D1173	Internal node 5 reference command H	RW
D1174	--	RW
D1175	--	--
D1176	Internal node 5 status	--
D1177	Internal node 5 reference status L	RO
D1178	Internal node 5 reference status H	RO
D1179	--	--
D1180	Internal node 6 control command	RW

Special D	Description of Function	R/W *
D1181	Internal node 6 mode	RW
D1182	Internal node 6 reference command L	RW
D1183	Internal node 6 reference command H	RW
D1184	--	--
D1185	--	--
D1186	Internal node 6 status	RO
D1187	Internal node 6 reference status L	RO
D1188	Internal node 6 reference status H	RO
D1189	--	--
D1190	Internal node 7 control command	RW
D1191	Internal node 7 mode	RW
D1192	Internal node 7 reference command L	RW
D1193	Internal node 7 reference command H	RW
D1194	--	--
D1195	--	--
D1196	Internal node 7 status	RO
D1197	Internal node 7 reference status L	RO
D1198	Internal node 7 reference status H	RO
D1199	--	--

Special D	Description of Function	Default	R/W*
D1200	PID1 mode: 0: Basic mode	0	RW
D1201	PID1 target selection: 0: Refer to D1202 1: AVI1 2: ACI 3: AVI2	0	RW
D1202	PID1 target value (0.00%–100.00%)	5000	RW
D1203	PID1 feedback selection 0: Refer to D1204 1: AVI1 2: ACI 3: AVI2	1	RW
D1204	PID1 feedback value (0.00%–100.00%)	0	RW
D1205	PID1 P value (decimal point 2)	10	RW
D1206	PID1 I value (decimal point 2)	1000	RW
D1207	PID1 D value (decimal point 2)	0	RW
D1209	Max. limit of PID1	10000	RW
D1215	Counting value of PID1 (decimal point 2)	0	RO
D1220	PID2 mode: 0: Basic mode	0	RW
D1221	PID2 target selection: 0: Refer to D1202 1: AVI1 2: ACI 3: AVI2	0	RW
D1222	PID2 target value (0.00%–100.00%)	5000	RW
D1223	PID2 feedback selection 0: Refer to D1204 1: AVI1 2: ACI 3: AVI2	1	RW
D1224	PID2 feedback value (0.00%–100.00%)	0	RW

Special D	Description of Function	Default	R/W*
D1225	PID1 P value (decimal point 2)	10	RW
D1226	PID2 I value (decimal point 2)	1000	RW
D1227	PID2 D value (decimal point 2)	0	RW
D1229	Max. limit of PID2	10000	RW
D1235	Counting value of PID2 (decimal point 2)	0	RO



The following is CANopen Master's special D (can be written in only with PLC in Stop state)

※ CFP2000 does not have torque and position mode. As CANopen master, however, CFP2000 can issue torque and position commands to CANopen slaves.

n=0–7

Special D	Description of Function	PDO Map	Power off Memory	Default:	R/W
D1070	Channel opened by CANopen initialization (bit0=Machine code0 ....)	NO	NO	0	R
D1071	Error channel occurring in CANopen initialization process (bit0=Machine code0 ....)	NO	NO	0	R
D1072	Reserved	-	-		-
D1073	CANopen break channel (bit0=Machine code0 ....)	NO	NO		R
D1074	Error code of master error 0: No error 1: Slave station setting error 2: Synchronizing cycle setting error (too small)	NO	NO	0	R
D1075	Reserved	-	-		-
D1076	SDO error message (main index value)	NO	NO		R
D1077	SDO error message (secondary index value)	NO	NO		R
D1078	SDO error message (error code)	NO	NO		R
D1079	SDO error message (error code)	NO	NO		R
D1080	Reserved	-	-		-
D1081 | D1086	Reserved	-	-		-
D1087 | D1089	Reserved	-	-		-
D1090	Synchronizing cycle setting	NO	YES	4	RW
D1091	Sets slave station On or Off (bit0–bit7 correspond to slave stations number 0–7)	NO	YES	FFFFH	RW
D1092	Delay before start of initialization	NO	YES	0	RW
D1093	Break time detection	NO	YES	1000ms	RW
D1094	Break number detection	NO	YES	3	RW
D1095 | D1096	Reserved	-	-		-

Special D	Description of Function	PDO Map	Power off Memory	Default:	R/W
D1097	Corresponding real-time transmission type (PDO) Setting range: 1–240	NO	YES	1	RW
D1098	Corresponding real-time receiving type (PDO) Setting range: 1–240	NO	YES	1	RW
D1099	Initialization completion delay time Setting range: 1 to 60000 sec	NO	YES	15 sec.	RW
D2000+100*n	Station number n of slave station Setting range: 0–127 0: No CANopen function	NO	YES	0	RW

The CFP2000 supports 8 slave stations under the CANopen protocol; each slave station occupies 100 special D locations; stations are numbered 1–8, total of 8 stations.

Explanation of slave station number

Slave station no. 1	D2000 D2001 | D2099	Node ID Slave station no. 1 torque restrictions | Address 4(H) corresponding to receiving channel 4
Slave station no. 2	D2100 D2101 | D2199	Node ID Slave station no. 2 torque restrictions | Address 4(H) corresponding to receiving channel 4
Slave station no. 3	D2200 D2201 | D2299	Node ID Slave station no. 3 torque restrictions | Address 4(H) corresponding to receiving channel 4
	⇩	
Slave station no. 8	D2700 D2701 | D2799	Node ID Slave station no. 8 torque restrictions | Address 4(H) corresponding to receiving channel 4

1. The range of n is 0–7
2. ●Indicates PDOTX, ▲Indicates PDORX; unmarked special D can be refreshed using the CANFLS command

Special D	Description of Function	Default:	R/W
D2000+100*n	Station number n of slave station Setting range: 0–127 0: No CANopen function	0	RW
D2002+100*n	Manufacturer code of slave station number n (L)	0	R
D2003+100*n	Manufacturer code of slave station number n (H)	0	R
D2004+100*n	Manufacturer's product code of slave station number n (L)	0	R
D2005+100*n	Manufacturer's product code of slave station number n (H)	0	R

Basic definitions

Special D	Description of Function	Default:	CAN Index	PDO Default:				R/W
				1	2	3	4	
D2006+100*n	Communications break handling method of slave station number n	0	6007H-0010H					RW
D2007+100*n	Error code of slave station number n error	0	603FH-0010H					R
D2008+100*n	Control word of slave station number n	0	6040H-0010H	●		●	●	RW
D2009+100*n	Status word of slave station number n	0	6041H-0010H	▲		▲	▲	R
D2010+100*n	Control mode of slave station number n	2	6060H-0008H					RW
D2011+100*n	Actual mode of slave station number n	2	6061H-0008H					R

Velocity Control

Slave station number n=0–7

Special D	Description of Function	Default:	CAN Index	PDO Default:				R/W
				1	2	3	4	
D2001+100*n	Torque restriction on slave station number n	0	6072H-0010H					RW
D2012+100*n	Target speed of slave station number n	0	6042H-0010H	●				RW
D2013+100*n	Actual speed of slave station number n	0	6043H-0010H	▲				R
D2014+100*n	Error speed of slave station number n	0	6044H-0010H					R
D2015+100*n	Acceleration time of slave station number n	1000	604FH-0020H					R
D2016+100*n	Deceleration time of slave station number n	1000	6050H-0020H					RW

20XXH correspondences: MI / MO / AI / AO

Slave station number n=0–7

Special D	Description of Function	Default:	CAN Index	PDO Default:				R/W
				1	2	3	4	
D2026+100*n	MI status of slave station number n	0	2026H-0110H		▲			RW
D2027+100*n	MO setting of slave station number n	0	2026H-4110H		●			RW
D2028+100*n	AI1 status of slave station number n	0	2026H-6110H		▲			RW
D2029+100*n	AI2 status of slave station number n	0	2026H-6210H		▲			RW
D2030+100*n	AI3 status of slave station number n	0	2026H-6310H		▲			RW
D2031+100*n	AO1 status of slave station number n	0	2026H-A110H		●			RW
D2032+100*n	AO2 status of slave station number n	0	2026H-A210H		●			RW
D2033+100*n	AO3 status of slave station number n	0	2026H-A310H		●			RW

PDO reflection length setting:

Special D	Description of Function	Default:	R/W
D2034+100*n	Real-time transmission setting of slave station number n	000AH	RW
D2067+100*n	Real-time reception setting of slave station number n	0000H	RW

16-5-4 PLC Communication address

Device	Range	Type	Address (Hex)
X	00–37 (Octal)	bit	0400–041F
Y	00–37 (Octal)	bit	0500–051F
T	00–159	bit/word	0600–069F
M	000–799	bit	0800–0B1F
M	1000–1079	bit	0BE8–0C37
C	0–79	bit/word	0E00–0E47
D	00–399	word	1000–118F
D	1000–1198	word	13E8–144B
D	2000–2799	word	17D0–1AEF

Command code that can be used

Function Code	Description of Function	Function target
01	Coil status read	Y, M, T, C
02	Input status read	X, Y, M, T, C
03	Read single unit of data	T, C, D
05	Compulsory single coil status change	Y, M, T, C
06	Write single unit of data	T, C, D
0F	Compulsory multiple coil status change	Y, M, T, C
10	Write multiple units of data	T, C, D

NOTE

When PLC functions have been activated, the CFP2000 can match PLC and driver parameters; this method employs different addresses and driver (default station number is 1, PLC sets station number as 2).

16-6 Introduction to the Command Window

16-6-1 Overview of basic commands

Ordinary commands

Command code	Function	OPERAND	Execution speed (us)
LD	Load contact a	X, Y, M, T, C	0.8
LDI	Load contact b	X, Y, M, T, C	0.8
AND	Connect contact a in series	X, Y, M, T, C	0.8
ANI	Connect contact b in series	X, Y, M, T, C	0.8
OR	Connect contact a in parallel	X, Y, M, T, C	0.8
ORI	Connect contact b in parallel	X, Y, M, T, C	0.8
ANB	Series circuit block	N/A	0.3
ORB	Parallel circuit block	N/A	0.3
MPS	Save to stack	N/A	0.3
MRD	Stack read (pointer does not change)	N/A	0.3
MPP	Read stack	N/A	0.3

Output command

Command code	Function	OPERAND	Execution speed (us)
OUT	Drive coil	Y, M	1
SET	Action continues (ON)	Y, M	1
RST	Clear contact or register	Y, M, T, C, D	1.2

Timer, counter

Command code	Function	OPERAND	Execution speed (us)
TMR	16-bit timer	T-K or T-D commands	1.1
CNT	16-bit counter	C-K or C-D (16-bit)	0.5

Main control command

Command code	Function	OPERAND	Execution speed (us)
MC	Common series contact connection	N0–N7	0.4
MCR	Common series contact release	N0–N7	0.4

Contact rising edge/falling edge detection command

Command code	Function	OPERAND	Execution speed (us)
LDP	Start of forward edge detection action	X, Y, M, T, C	1.1
LDF	Start of reverse edge detection action	X, Y, M, T, C	1.1
ANDP	Forward edge detection series connection	X, Y, M, T, C	1.1
ANDF	Reverse edge detection series connection	X, Y, M, T, C	1.1
ORP	Forward edge detection parallel connection	X, Y, M, T, C	1.1
ORF	Reverse edge detection parallel connection	X, Y, M, T, C	1.1

Upper/lower differential output commands

Command code	Function	OPERAND	Execution speed (us)
PLS	Upper differential output	Y, M	1.2
PLF	Lower differential output	Y, M	1.2

Stop command

Command code	Function	OPERAND	Execution speed (us)
END	Program conclusion	N/A	0.2

Other commands

Command code	Function	OPERAND	Execution speed (us)
NOP	No action	N/A	0.2
INV	Inverse of operation results	N/A	0.2
P	Index	P	0.3

16-6-2 Detailed explanation of basic commands

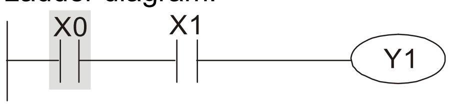
Command	Function					
LD	Load contact a					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The LD command is used for contact a starting at the left busbar or contact a starting at a contact circuit block; its function is to save current content and save the acquired contact status in the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	**X0**	Load Contact a of X0
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

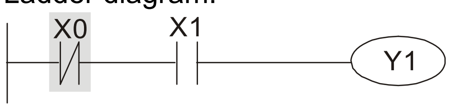
Command	Function					
LDI	Load contact b					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The LDI command is used for contact b starting at the left busbar or contact b starting at a contact circuit block; its function is to save current content and save the acquired contact status in the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LDI	**X0**	Load Contact b of X0
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

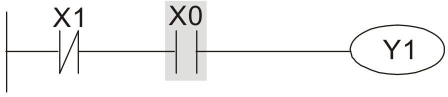
Command	Function					
AND	Connect contact a in series					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The AND command is used to create a series connection to contact a; first reads current status of the designated series contact and logical operation results before contact in order to perform "AND" operation; saves results in cumulative register.

Example

Ladder diagram:



Command code:		Description:
LDI	X1	Load Contact b of X1
AND	**X0**	Create series connection to contact a of X0
OUT	Y1	Drive Y1 coil

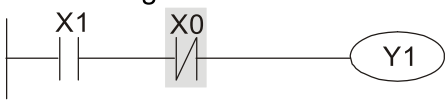
Command	Function					
ANI	Connect contact b in series					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The ANI command is used to create a series connection to contact b; its function is to first read current status of the designated series contact and logical operation results before contact in order to perform "AND" operation; saves results in cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X1	Load Contact a of X1
ANI	**X0**	Create series connection to contact b of X0
OUT	Y1	Drive Y1 coil

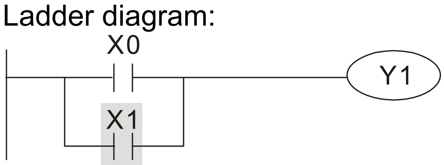
Command	Function					
OR	Connect contact a in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The OR command is used to establish a parallel connection to contact a; its function is to first read current status of the designated series contact and logical operation results before contact in order to perform "OR" operation; saves results in cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
OR	**X1**	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

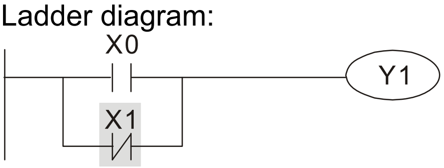
Command	Function					
ORI	Connect contact b in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The ORI command is used to establish a parallel connection to contact b; its function is to first read current status of the designated series contact and logical operation results before contact in order to perform "OR" operation; saves results in cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
ORI	**X1**	Create series connection to contact b of X1
OUT	Y1	Drive Y1 coil

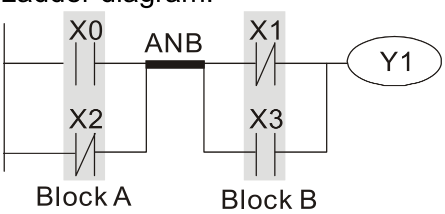
Command	Function
ANB	Series circuit block
Operand	N/A

Explanation

ANB performs an "AND" operation on the previous saved logic results and the current cumulative register content.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
ORI	X2	Establish parallel connection to contact b of X2
LDI	X1	Load Contact b of X1
OR	X3	Establish parallel connection to contact a of X3
ANB		Series circuit block
OUT	Y1	Drive Y1 coil

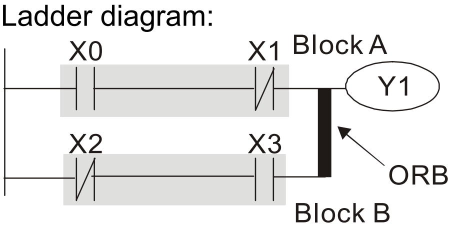
Command	Function
ORB	Parallel circuit block
Operand	N/A

Explanation

ORB performs an "OR" operation on the previous saved logic results and the current cumulative register content.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
ANI	X1	Establish parallel connection to contact b of X1
LDI	X2	Load Contact b of X2
AND	X3	Establish parallel connection to contact a of X3
ORB		Parallel circuit block
OUT	Y1	Drive Y1 coil

Command	Function
MPS	Save to stack
Operand	N/A

Explanation: Save current content of cumulative register to the stack. (Add one to stack pointer)

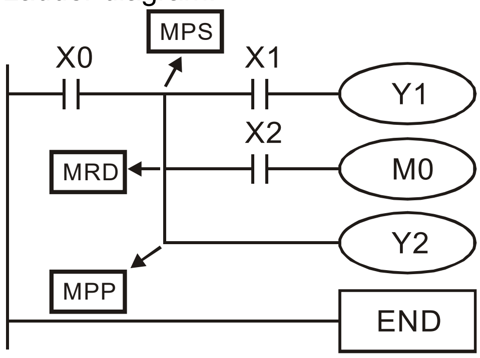
Command	Function
MRD	Read stack (pointer does not change)
Operand	N/A

Explanation: Reads stack content and saves to cumulative register. (Stack pointer does not change)

Command	Function
MPP	Read stack
Operand	N/A

Explanation: Retrieves result of previously-save logical operation from the stack, and saves to cumulative register. (Subtract one from stack pointer)

Example: Ladder diagram:



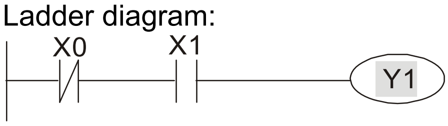
Command code:		Description:
LD	X0	Load Contact a of X0
MPS		Save to stack
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil
MRD		Read stack (pointer does not change)
AND	X2	Create series connection to contact a of X2
OUT	M0	Drive M0 coil
MPP		Read stack
OUT	Y2	Drive Y2 coil
END		Program conclusion

Command	Function					
OUT	Drive coil					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation: Outputs result of logical operation before OUT command to the designated element.
Coil contact action:

Result:	Out command		
	Coil	Access Point:	
		Contact a (N.O.)	Contact b (N.C.)
FALSE	Off	Not conducting	Conducting
TRUE	On	Conducting	Not conducting

Example: Ladder diagram:



Command code:		Description:
LD	X0	Load Contact b of X0
AND	X1	Establish parallel connection to contact a of X1
OUT	**Y1**	Drive Y1 coil

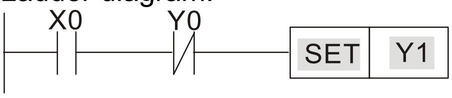
Command	Function					
SET	Action continues (ON)					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation

When the SET command is driven, the designated element will be set as On, and will be maintained in an On state, regardless of whether the SET command is still driven. The RST command can be used to set the element as Off.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
ANI	Y0	Establish parallel connection to contact b of Y0
SET	**Y1**	Action continues (ON)

Command	Function					
RST	Clear contact or register					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	✓	✓	✓

Explanation

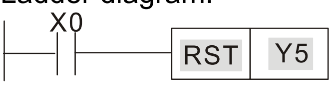
When the RST command is driven, the action of the designated element will be as follows:

Element	Mode
Y, M	Both coil and contact will be set as Off.
T, C	The current timing or count value will be set as 0, and both the coil and contact will be set as Off.
D	The content value will be set as 0.

If the RST command has not been executed, the status of the designated element will remain unchanged.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
RST	**Y5**	Clear contact or register

Command	Function	
TMR	16-bit timer	
Operand	T-K	T0–T159, K0–K32,767
	T-D	T0–T159, D0–D399

Explanation

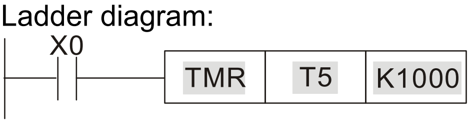
When the TMR command is executed, the designated timer coil will be electrified, and the timer will begin timing. The contact's action will be as follows when the timing value reaches the designated set value (timing value >= set value):

N.O. (Normally Open) contact	Closed
N.C. (Normally Close) contact	Open

If the RST command has not been executed, the status of the designated element will remain unchanged.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
TMR	T5 K1000	T5 timer Set value as K1000

Command	Function	
CNT	16-bit counter	
Operand	C-K	C0–C79, K0–K32,767
	C-D	C0–C79, D0–D399

Explanation

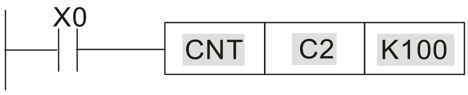
When the CNT command is executed from OFF→ON, this indicates that the designated counter coil goes from no power → electrified, and 1 will be added to the counter's count value; when the count reaches the designated value (count value = set value), the contact will have the following action:

N.O. (Normally Open) contact	Closed
N.C. (Normally Close) contact	Open

After the count value has been reached, the contact and count value will both remain unchanged even if there is continued count pulse input. Please use the RST command if you wish to restart or clear the count.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
CNT	**C2 K100**	C2counter Set value as K100

Command	Function
MC/MCR	Connect/release a common series contact
Operand	N0–N7

Explanation

MC is the main control initiation command, and any commands between MC and MCR will be executed normally. When the MC command is OFF, any commands between MC and MCR will act as follows:

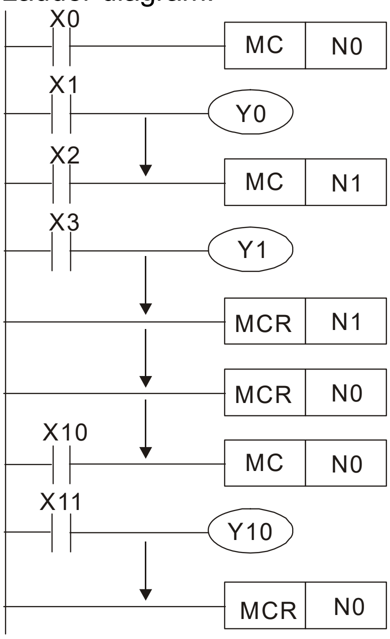
Determination of commands	Description
Ordinary timer	The timing value will revert to 0, the coil will lose power, and the contact will not operate
Counter	The coil will lose power, and the count value and contact will stay in their current state
Coil driven by OUT command	None receive power
Elements driven by SET, RST commands	Will remain in their current state
Applications commands	None are actuated

MCR is the main control stop command, and is placed at the end of the main control program. There may not be any contact commands before the MCR command.

The MC-MCR main control program commands support a nested program structure with a maximum only 8 levels; use in the order N0-N7, please refer to the following program:

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
MC	**N0**	Connection of N0 common series contact
LD	X1	Load Contact a of X1
OUT	Y0	Drive Y0 coil
:		
LD	X2	Load Contact a of X2
MC	**N1**	Connection of N1 common series contact
LD	X3	Load Contact a of X3
OUT	Y1	Drive Y1 coil
:		
MCR	**N1**	Release N1 common series contact
:		
MCR	**N0**	Release N0 common series contact
:		
LD	X10	Load Contact a of X10
MC	**N0**	Connection of N0 common series contact
LD	X11	Load Contact a of X11
OUT	Y10	Drive Y10 coil
:		
MCR	**N0**	Release N0 common series contact

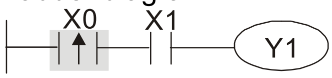
Command	Function					
LDP	Start of forward edge detection action					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The LDP command has the same usage as LD, but its action is different; its function is to save current content, while also saving the detected state of the rising edge of the contact to the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LDP	**X0**	Start of X0 forward edge detection action
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

Remark

Please refer to the function specifications table for each device in series for the scope of usage of each operand.

A rising edge contact will be TRUE after power is turned on if the rising edge contact is On before power is turned on to the PLC.

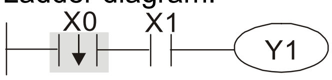
Command	Function					
LDF	Start of reverse edge detection action					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The LDF command has the same usage as LD, but its action is different; its function is to save current content while also saving the detected state of the falling edge of the contact to the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LDF	**X0**	Start of X0 reverse edge detection action
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

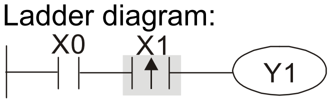
Command	Function					
ANDP	Forward edge detection series connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation

The ANDP command used for a contact rising edge detection series connection.

Example

Ladder diagram:

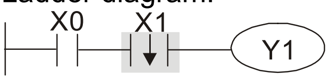


Command code:		Description:
LD	X0	Load Contact a of X0
ANDP	**X1**	X1 Forward edge detection series connection
OUT	Y1	Drive Y1 coil

Command	Function					
ANDF	Reverse edge detection series connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation: The ANDF command is used for a contact falling edge detection series connection.

Example: Ladder diagram:

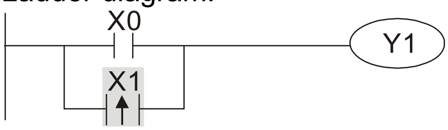


Command code:		Description:
LD	X0	Load Contact a of X0
ANDF	**X1**	X1 Reverse edge detection series connection
OUT	Y1	Drive Y1 coil

Command	Function					
ORP	Forward edge detection parallel connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation: The ORP command is used for a contact rising edge detection parallel connection.

Example: Ladder diagram:

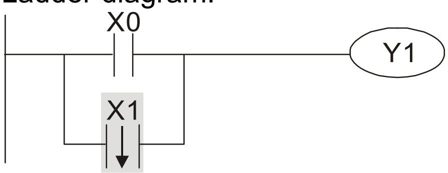


Command code:		Description:
LD	X0	Load Contact a of X0
ORP	**X1**	X1 Forward edge detection parallel connection
OUT	Y1	Drive Y1 coil

Command	Function					
ORF	Reverse edge detection parallel connection					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

Explanation: The ORF command is used for contact falling edge detection parallel connection.

Example: Ladder diagram:

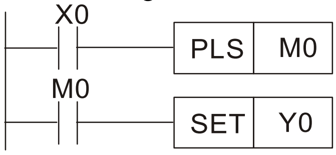


Command code:		Description:
LD	X0	Load Contact a of X0
ORF	**X1**	X1 Reverse edge detection parallel connection
OUT	Y1	Drive Y1 coil

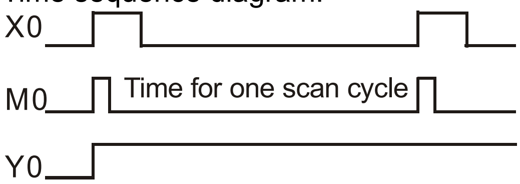
Command	Function					
PLS	Upper differential output					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation Upper differential output commands. When X0=OFF→ON (positive edge-triggered), the PLS command will be executed, and M0 will send one pulse, with a pulse length consisting of one scanning period.

Example Ladder diagram:



Time sequence diagram:

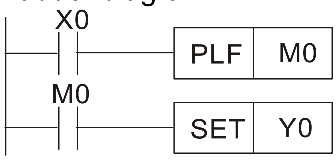


Command code:		Description:
LD	X0	Load Contact a of X0
PLS	**M0**	M0 Upper differential output
LD	M0	Load Contact a of M0
SET	Y0	Y0 Action continues (ON)

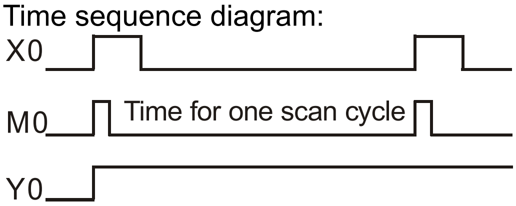
Command	Function					
PLF	Lower differential output					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation Lower differential output command. When X0= On→Off (negative edge-triggered), the PLF command will be executed, and M0 will send one pulse, with pulse length consisting of one scanning period.

Example Ladder diagram:



Time sequence diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
PLF	**M0**	M0 Lower differential output
LD	M0	Load Contact a of M0
SET	Y0	Y0 Action continues (ON)

Command	Function
END	Program conclusion
Operand	N/A

Explanation An END command must be added to the end of a ladder diagram program or command program. The PLC will scan from address 0 to the END command, and will return to address 0 and begins scanning again after execution.

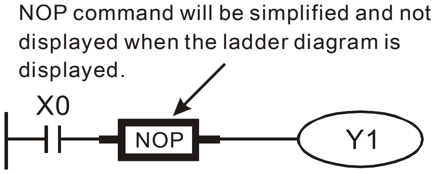
Command	Function
NOP	No action
Operand	N/A

Explanation

The command NOP does not perform any operation in the program. Because execution of this command will retain the original logical operation results, it can be used in the following situation: the NOP command can be used to replace a command that is deleted without changing the program length.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact b of X0
NOP		No action
OUT	Y1	Drive Y1 coil

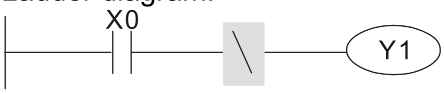
Command	Function
INV	Inverse of operation results
Operand	N/A

Explanation

Saves the result of the logic inversion operation prior to the INV command in the cumulative register.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
INV		Inverse of operation results
OUT	Y1	Drive Y1 coil

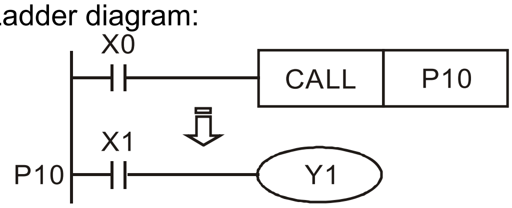
Command	Function
P	Index
Operand	P0–P255

Explanation

Pointer P is used to subprogram call command API 01 CALL. Use does not require starting from zero, but the number cannot be used repeatedly, otherwise an unpredictable error will occur.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
CALL	P10	Call command CALL to P10
:		
P10		Pointer P10
LD	X1	Load Contact a of X1
OUT	Y1	Drive Y1 coil

16-6-3 Overview of application commands

Classification	API	Command code 16 bit	Command code 32 bit	P command	Function	STEPS 16bit	STEPS 32bit
Circuit control	01	CALL	–	✓	Call subprogram	3	–
	02	SRET	–	–	Conclusion of subprogram	1	–
	06	FEND	–	–	Conclusion of main program	1	–
Send comparison	10	CMP	DCMP	✓	Compares set output	7	13
	11	ZCP	DZCP	✓	Range comparison	9	17
	12	MOV	DMOV	✓	Data movement	5	9
	13	SMOV	DSMOV	✓	Nibble movement	11	21
	15	BMOV	–	✓	Send all	7	–
Four logical operations	18	BCD	DBCD	✓	BIN to BCD transformation	5	9
	19	BIN	DBIN	✓	BCD to BIN transformation	5	9
	20	ADD	DADD	✓	BIN addition	7	13
	21	SUB	DSUB	✓	BIN subtraction	7	13
	22	MUL	DMUL	✓	BIN multiplication	7	13
	23	DIV	DDIV	✓	BIN division	7	13
	24	INC	DINC	✓	BIN add one	3	5
	25	DEC	DDEC	✓	BIN subtract one	3	5
Rotational displacement	30	ROR	DROR	✓	Right rotation	5	–
	31	ROL	DROL	✓	Left rotation	5	–
Data Process	40	ZRST	–	✓	Clear range	5	-
	41	DECO	DDECO	✓	Decoder	7	13
	42	ENCO	DENCO	✓	Encoder	7	13
	43	SUM	DSUM	✓	ON bit number	5	9
	44	BON	DBON	✓	ON bit judgement	7	13
	49	–	DFLT	✓	BIN whole number → binary floating point number transformation	–	9
Floating point operation	110	–	DECMP	✓	Comparison of binary floating point numbers	–	13
	111	–	DEZCP	✓	Comparison of binary floating point number range	–	17
	116	–	DRAD	✓	Angle → Radian	–	9
	117	–	DDEG	✓	Radian → Angle	–	9
	120	–	DEADD	✓	Binary floating point number addition	–	13
	121	–	DESUB	✓	Binary floating point number subtraction	–	13
	122	–	DEMUL	✓	Binary floating point number multiplication	–	13
	123	–	DEDIV	✓	Binary floating point number division	–	13
	124	–	DEXP	✓	Binary floating point number obtain exponent	–	9
	125	–	DLN	✓	Binary floating point number obtain logarithm	–	9
	127	–	DESQR	✓	Binary floating point number find square root	–	9
	129	INT	DINT	✓	Binary floating point number → BIN whole number transformation	–	9
	130	–	DSIN	✓	Binary floating point number SIN operation	–	9
	131	–	DCOS	✓	Binary floating point number COS operation	–	9
	132	–	DTAN	✓	Binary floating point number TAN operation	–	9

<table>
<tr><th rowspan="2">Classification</th><th rowspan="2">API</th><th colspan="2">Command code</th><th rowspan="2">P command</th><th rowspan="2">Function</th><th colspan="2">STEPS</th></tr>
<tr><th>16 bit</th><th>32 bit</th><th>16bit</th><th>32bit</th></tr>
<tr><td rowspan="3"></td><td>133</td><td>–</td><td>DASIN</td><td>✓</td><td>Binary floating point number ASIN operation</td><td>–</td><td>9</td></tr>
<tr><td>134</td><td>–</td><td>DACOS</td><td>✓</td><td>Binary floating point number ACOS operation</td><td>–</td><td>9</td></tr>
<tr><td>135</td><td>–</td><td>DATAN</td><td>✓</td><td>Binary floating point number ATAN operation</td><td>–</td><td>9</td></tr>
<tr><td rowspan="3">Floating point operation</td><td>136</td><td>–</td><td>DSINH</td><td>✓</td><td>Binary floating point number SINH operation</td><td>–</td><td>9</td></tr>
<tr><td>137</td><td>–</td><td>DCOSH</td><td>✓</td><td>Binary floating point number COSH operation</td><td>–</td><td>9</td></tr>
<tr><td>138</td><td>–</td><td>DTANH</td><td>✓</td><td>Binary floating point number TANH operation</td><td>–</td><td>9</td></tr>
<tr><td>Other</td><td>147</td><td>SWAP</td><td>DSWAP</td><td>✓</td><td>Exchange the up/down 8 bits</td><td>3</td><td>5</td></tr>
<tr><td>Communication</td><td>150</td><td>MODRW</td><td>–</td><td>✓</td><td>Modbus read/write</td><td>7</td><td>–</td></tr>
<tr><td rowspan="5">Calendar</td><td>160</td><td>TCMP</td><td>–</td><td>✓</td><td>Compare calendar data</td><td>11</td><td>–</td></tr>
<tr><td>161</td><td>TZCP</td><td>–</td><td>✓</td><td>Compare calendar data range</td><td>9</td><td>–</td></tr>
<tr><td>162</td><td>TADD</td><td>–</td><td>✓</td><td>Calendar data addition</td><td>7</td><td>–</td></tr>
<tr><td>163</td><td>TSUB</td><td>–</td><td>✓</td><td>Calendar data subtraction</td><td>7</td><td>–</td></tr>
<tr><td>166</td><td>TRD</td><td>–</td><td>✓</td><td>Calendar data read</td><td>3</td><td>–</td></tr>
<tr><td rowspan="2">GRAY code</td><td>170</td><td>GRY</td><td>DGRY</td><td>✓</td><td>BIN→GRY code transformation</td><td>5</td><td>9</td></tr>
<tr><td>171</td><td>GBIN</td><td>DGBIN</td><td>✓</td><td>GRY code →BIN transformation</td><td>5</td><td>9</td></tr>
<tr><td rowspan="9">Contact form logical operation</td><td>215</td><td>LD&</td><td>DLD&</td><td>–</td><td>Contact form logical operation LD#</td><td>5</td><td>9</td></tr>
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<tr><td>217</td><td>LD^</td><td>DLD^</td><td>–</td><td>Contact form logical operation LD#</td><td>5</td><td>9</td></tr>
<tr><td>218</td><td>AND&</td><td>DAND&</td><td>–</td><td>Contact form logical operation AND#</td><td>5</td><td>9</td></tr>
<tr><td>219</td><td>ANDI</td><td>DANDI</td><td>–</td><td>Contact form logical operation AND#</td><td>5</td><td>9</td></tr>
<tr><td>220</td><td>AND^</td><td>DAND^</td><td>–</td><td>Contact form logical operation AND#</td><td>5</td><td>9</td></tr>
<tr><td>221</td><td>OR&</td><td>DOR&</td><td>–</td><td>Contact form logical operation OR#</td><td>5</td><td>9</td></tr>
<tr><td>222</td><td>OR|</td><td>DOR|</td><td>–</td><td>Contact form logical operation OR#</td><td>5</td><td>9</td></tr>
<tr><td>223</td><td>OR^</td><td>DOR^</td><td>–</td><td>Contact form logical operation OR#</td><td>5</td><td>9</td></tr>
<tr><td rowspan="18">Contact form compare command</td><td>224</td><td>LD＝</td><td>DLD＝</td><td>–</td><td>Contact form compare LD※</td><td>5</td><td>9</td></tr>
<tr><td>225</td><td>LD＞</td><td>DLD＞</td><td>–</td><td>Contact form compare LD※</td><td>5</td><td>9</td></tr>
<tr><td>226</td><td>LD＜</td><td>DLD＜</td><td>–</td><td>Contact form compare LD※</td><td>5</td><td>9</td></tr>
<tr><td>228</td><td>LD＜＞</td><td>DLD＜＞</td><td>–</td><td>Contact form compare LD※</td><td>5</td><td>9</td></tr>
<tr><td>229</td><td>LD＜＝</td><td>DLD＜＝</td><td>–</td><td>Contact form compare LD※</td><td>5</td><td>9</td></tr>
<tr><td>230</td><td>LD＞＝</td><td>DLD＞＝</td><td>–</td><td>Contact form compare LD※</td><td>5</td><td>9</td></tr>
<tr><td>232</td><td>AND＝</td><td>DAND＝</td><td>–</td><td>Contact form compare AND※</td><td>5</td><td>9</td></tr>
<tr><td>233</td><td>AND＞</td><td>DAND＞</td><td>–</td><td>Contact form compare AND※</td><td>5</td><td>9</td></tr>
<tr><td>234</td><td>AND＜</td><td>DAND＜</td><td>–</td><td>Contact form compare AND※</td><td>5</td><td>9</td></tr>
<tr><td>236</td><td>AND＜＞</td><td>DAND＜＞</td><td>–</td><td>Contact form compare AND※</td><td>5</td><td>9</td></tr>
<tr><td>237</td><td>AND＜＝</td><td>DAND＜＝</td><td>–</td><td>Contact form compare AND※</td><td>5</td><td>9</td></tr>
<tr><td>238</td><td>AND＞＝</td><td>DAND＞＝</td><td>–</td><td>Contact form compare AND※</td><td>5</td><td>9</td></tr>
<tr><td>240</td><td>OR＝</td><td>DOR＝</td><td>–</td><td>Contact form compare OR※</td><td>5</td><td>9</td></tr>
<tr><td>241</td><td>OR＞</td><td>DOR＞</td><td>–</td><td>Contact form compare OR※</td><td>5</td><td>9</td></tr>
<tr><td>242</td><td>OR＜</td><td>DOR＜</td><td>–</td><td>Contact form compare OR※</td><td>5</td><td>9</td></tr>
<tr><td>244</td><td>OR＜＞</td><td>DOR＜＞</td><td>–</td><td>Contact form compare OR※</td><td>5</td><td>9</td></tr>
<tr><td>245</td><td>OR＜＝</td><td>DOR＜＝</td><td>–</td><td>Contact form compare OR※</td><td>5</td><td>9</td></tr>
<tr><td>246</td><td>OR＞＝</td><td>DOR＞＝</td><td>–</td><td>Contact form compare OR※</td><td>5</td><td>9</td></tr>
</table>

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16bit	32bit
Floating point contact form	275	–	FLD＝	–	Floating point number contact form compare LD※	–	9
	276	–	FLD＞	–	Floating point number contact form compare LD※	–	9
	277	–	FLD＜	–	Floating point number contact form compare LD※	–	9
Compare command	278	–	FLD＜＞	–	Floating point number contact form compare LD※	–	9
	279	–	FLD＜＝	–	Floating point number contact form compare LD※	–	9
	280	–	FLD＞＝	–	Floating point number contact form compare LD※	–	9
	281	–	FAND＝	–	Floating point number contact form compare AND※	–	9
	282	–	FAND＞	–	Floating point number contact form compare AND※	–	9
	283	–	FAND＜	–	Floating point number contact form compare AND※	–	9
	284	–	FAND＜＞	–	Floating point number contact form compare AND※	–	9
	285	–	FAND＜＝	–	Floating point number contact form compare AND※	–	9
	286	–	FAND＞＝	–	Floating point number contact form compare AND※	–	9
	287	–	FOR＝	–	Floating point number contact form compare OR※	–	9
	288	–	FOR＞	–	Floating point number contact form compare OR※	–	9
	289	–	FOR＜	–	Floating point number contact form compare OR※	–	9
	290	–	FOR＜＞	–	Floating point number contact form compare OR※	–	9
	291	–	FOR＜＝	–	Floating point number contact form compare OR※	–	9
	292	–	FOR＞＝	–	Floating point number contact form compare OR※	–	9
Driver special command	139	RPR	–	✓	Read servo parameter	5	–
	140	WPR	–	✓	Write servo parameter	5	–
	141	FPID	–	✓	Driver PID control mode	9	–
	142	FREQ	–	✓	Driver torque control mode	7	–
	261	CANRX	–	✓	Read CANopen slave station data	9	–
	264	CANTX	–	✓	Write CANopen slave station data	9	–
	265	CANFLS	–	✓	Refresh special D corresponding to CANopen	3	–
	320	ICOMR	DICOMR	✓	Internal communications read	9	17
	321	ICOMW	DICOMW	✓	Internal communications write	9	17
	323	WPRA	–	–	RAM write in drive parameters	5	–

16-6-4 Detailed explanation of applications commands

API				
01	CALL	P	S	Call subprogram

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Notes on operand usage:
The S operand can designate P
CFP2000 series device: The S operand can designate P0-P63

16-bit command (3 STEP)

CALL	Continuous execution type	CALLP	Pulse execution type

32-bit command

—	—	—	—

Flag signal: none

Explanation

- **S**：Call subprogram pointer.
- Write the subprogram after the FEND command.
- The subprogram must end after the SRET command.
- Refer to the FEND command explanation and sample content for detailed command functions.

API				
02	SRET	P	–	Conclusion of subprogram

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D

Notes on operand usage:
No operand
A contact-driven command is not needed

16-bit command (1 STEP)

FEND	Continuous execution type	—	—

32-bit command

—	—	—	—

Flag signal: none

Explanation

- A contact-driven command is not needed. Automatically returns next command after CALL command
- Indicates end of subprogram. After end of subprogram, SRET returns to main program, and executes next command after the original call subprogram CALL command.
- Refer to the FEND command explanation and sample content for detailed command functions.

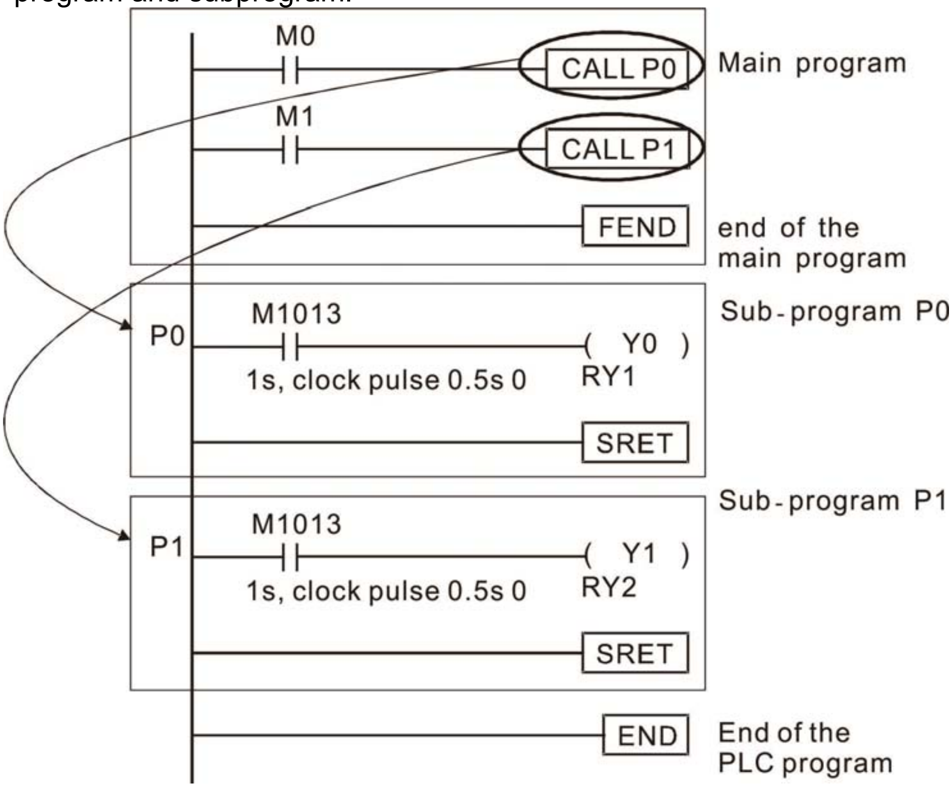
API		FEND		–	Conclusion a main program
06					

	Bit device				Word device						16-bit command (1 STEP)			
	X	Y	M	K	H	KnX	KnY	KnM	T	C	FEND	Continuous execution type	–	–
Notes on operand usage: No operand A contact-driven command is not needed											32-bit command – – – – Flag signal: none			

Explanation

- This command indicates the end of the main program. It is the same as the END command when the PLC executes this command.
- The CALL command program must be written after the FEND command, and the SRET command added to the end of the subprogram.
- When using the FEND command, an END command is also needed. However, the END command must be placed at the end, after the main program and subprogram.

CALL command process



API					
10	D	CMP	P	S1 S2 D	Compares set output

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D		*	*								

Notes on operand usage:
The operand D occupies three consecutive points

16-bit command (7 STEP)

CMP	Continuous execution type	CMPP	Pulse execution type

32-bit command (13 STEP)

DCMP	Continuous execution type	DCMPP	Pulse execution type

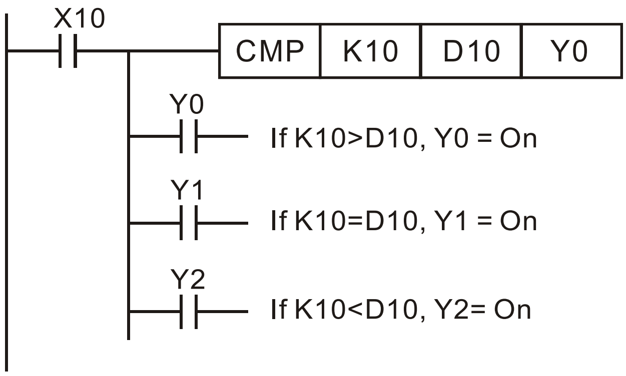
Flag signal: none

Explanation

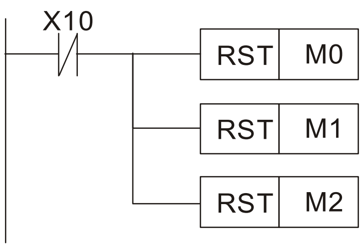
- S1: Compare value 1. S2: Compare value 2. D: Results of comparison.
- Compares the size of the content of operand S1 and S2; the results of comparison are expressed in D.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

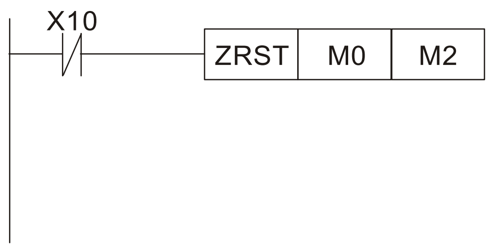
Example

- When the designated device is Y0, it automatically occupies Y0, Y1 and Y2.
- When X10=On, the CMP command executes, and Y0, Y1 or Y2 will be On. When X10=Off, the CMP command will not execute, and the state of Y0, Y1 and Y2 will remain in the state prior to X10=Off.
- If ≥, ≤, or ≠ results are needed, they can be obtained via series/parallel connections of Y0-Y2.



- To clear results of comparison, use the RST or ZRST command.





API					
11	D	**ZCP**	P	(S1) (S2) (S) (D)	Range comparison

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S				*	*	*	*	*	*	*	*
D		*	*								

Notes on operand usage:
The content value of operand S1 is less than the content value of S2 operand
The operand D occupies three consecutive points

16-bit command (9 STEP)

ZCP	Continuous execution type	ZCPP	Pulse execution type

32-bit command (17 STEP)

DZCP	Continuous execution type	DZCPP	Pulse execution type

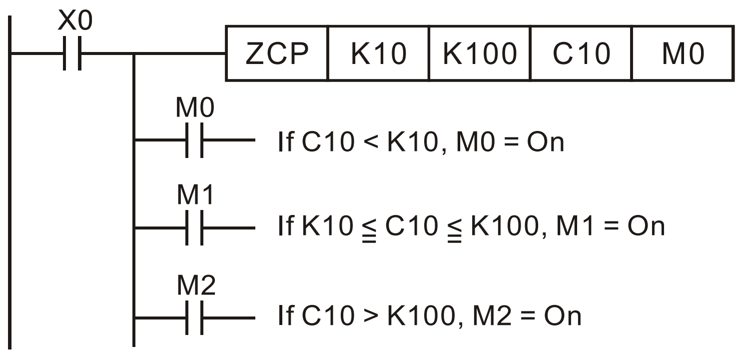
Flag signal: none

Explanation

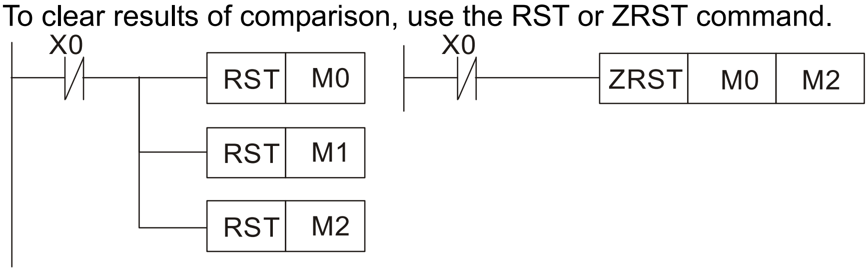
- (S1): Lower limit of range comparison. (S2): Upper limit of range comparison. (S) : Comparative value. (D): Results of comparison.
- When the comparative value (S) is compared with the lower limit (S1) and upper limit (S2), the results of comparison are expressed in (D).
- When lower limit (S1) > upper limit (S2), the command will use the lower limit (S1) to perform comparison with the upper and lower limit.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

Example

- When the designated device is M0, it automatically occupies M0, M1 and M2.
- When X0=On, the ZCP command executes, and M0, M1 or M2 will be On. When X0=Off, the ZCP command will not execute, and the state of M0, M1 or M2 will remain in the state prior to X0=Off.
- If ≥, ≤, or ≠ results are needed, they can be obtained via series/parallel connections of M0-M2.



- To clear results of comparison, use the RST or ZRST command.



API					
12	D	MOV	P	S D	Data movement

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

MOV	Continuous execution type	MOVP	Pulse execution type

32-bit command (9 STEP)

DMOV	Continuous execution type	DMOVP	Pulse execution type

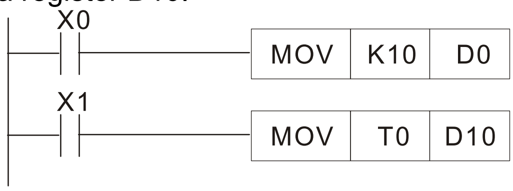
Flag signal:

Explanation

- S: Data source. D: Destination of data movement.
- When this command is executed, the content of S content will be directly moved to D. When the command is not executed, the content of D will not change.

Example

- When X0=Off, the content of D10 will not change; if X0=On, the value K10 will be sent to data register D10.
- When X1=Off, the content of D10 will not change; if X1=On, the current value of T0 will be sent to data register D10.



API 13	D	SMOV	P	S m1 m2 D n	Nibble movement

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (11 STEP)

MOV	Continuous execution type	SMOVP	Pulse execution type

32-bit command (21 STEP)

DSMOV	Continuous execution type	DSMOVP	Pulse execution type

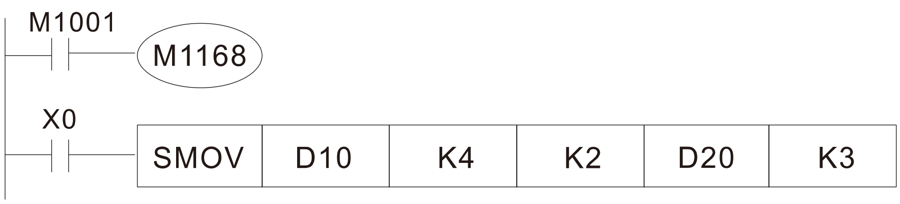
Flag signal: M1168

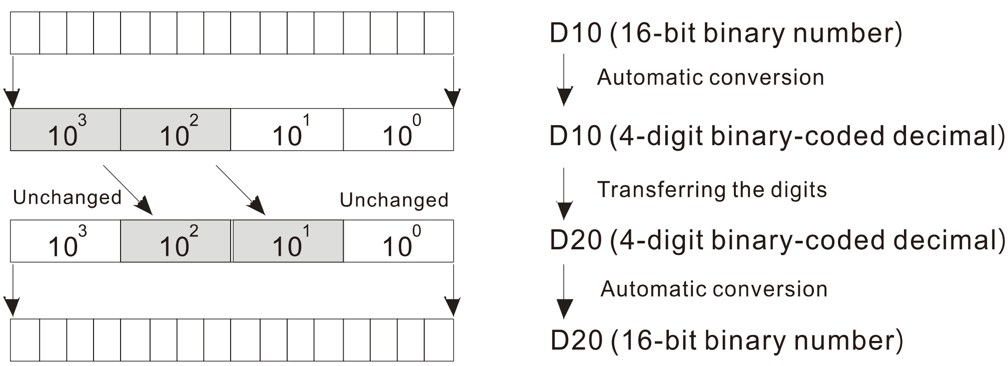
Explanation

- S: Data source. m1: The data source transfers starting bit number. m2 : The data source transfers individual bit number. D: Transfer destination. n Transferring starting bit number of the destination.
- BCD mode (M1168 = Off):
  SMOV enables and operates BCD under this mode, the operation is similar to the way SMOV operates decimal numbers. The command copies specific bit number of arithmetic element S (S is a 4-figure decimal number), and sends the bit number to arithmetic element D (D is also a 4-figure decimal number). The current data on the target register will be covered.
- m_1 range: 1–4
- m_2 range: 1–m_1 (m_2 cannot be larger than m_1)
- n range: m_2–4 (n cannot be smaller than m_2)

Example 1

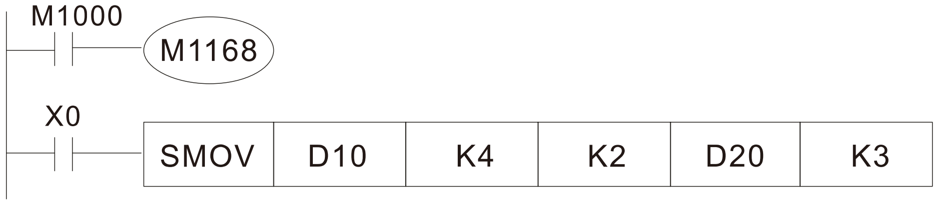
- When M1168 = Off (BCD mode), X0 is ON, the instruction transfers two digits of the decimal number starting from the fourth digit of the decimal number (the digit in the thousands place of the decimal number) in D10 to the two digits of the decimal number starting from the third digit of the decimal number (the digit in the hundreds place of the decimal number) in D20. After the instruction is executed, the digits in the thousands place of the decimal number (10^3) and the ones place of the decimal number (10^0) in D20 are unchanged.

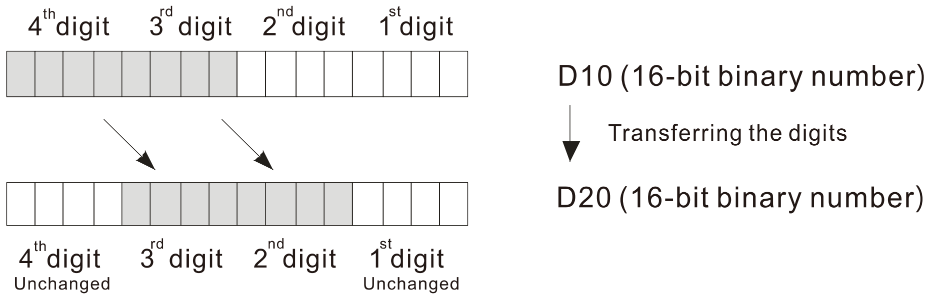




Example 2

- When M1168 is On (BIN mode), and the SMOV command is executed, D10 and D20 do not change in BCD mode, but send 4 digits as a unit in BIN mode.





API				
15	BMOV	P	(S) (D) (n)	Send all

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*
n				*	*				*	*	

Notes on operand usage:
n operand scope n ＝ 1 to 512

16-bit command (7 STEP)

BMOV	Continuous execution type	BMOVP	Pulse execution type

32-bit command

–	–	–	–

Flag signal: none

Explanation

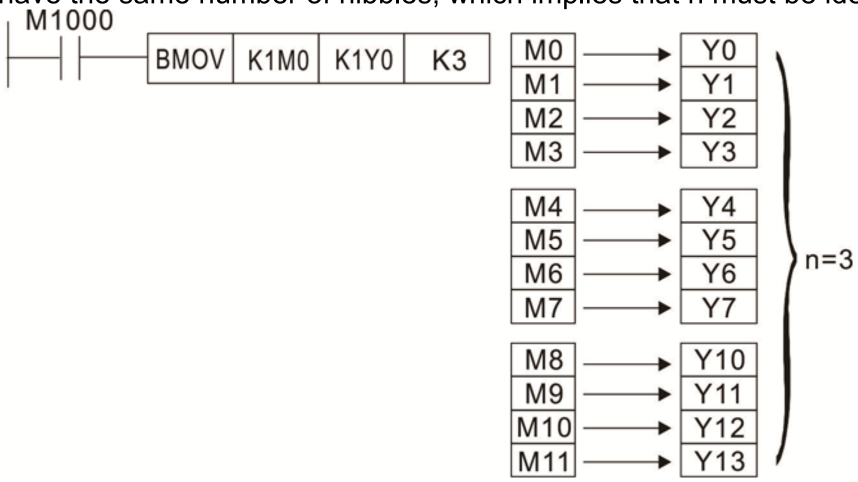
- (S): Initiate source device. (D): Initiate destination device. (n): Send block length.
- The content of n registers starting from the initial number of the device designated by (S) will be sent to the n registers starting from the initial number of the device designated by (n); if the number of points referred to (n) exceeds the range used by that device, only points within the valid range will be sent.

Example 1

- When X10=On, the content of registers D0–D3 will be sent to the four registers D20 to D23.

Example 2

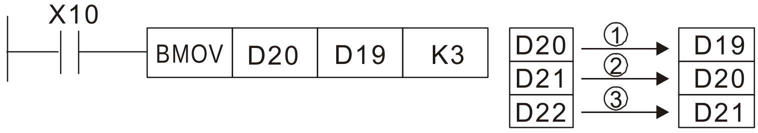
- If the designated bit devices KnX, KnY, and KnM are sent, (S) and (D) must have the same number of nibbles, which implies that n must be identical.



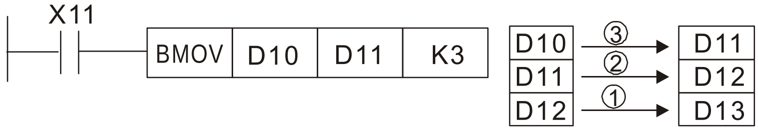
Example 3

- In order to prevent overlap between the transmission addresses of two operands, which would cause confusion, make sure that the addresses designated by the two operands have different sizes, as shown below:

When (S) > (D), send in the order ①→② →③.



When (S) < (D), send in the order ③→② →①.



API					
18	D	BCD	P	(S) (D)	BIN to BCD transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

BCD	Continuous execution type	BCDP	Pulse execution type

32-bit command (9 STEP)

DBCD	Continuous execution type	DBCDP	Pulse execution type

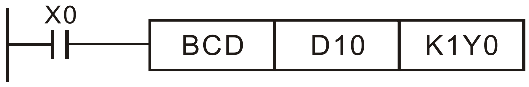
Flag signal: none

Explanation

- (S): Data source. (D): Destination of data movement.
- The content of data source (S) (BIN value, 0–9999) executes BCD transformation and saves in (D).
- Arithmetic elements S and D use the F device, it can only use 16-bit command.

Example

- When X0 is ON, and the BIN value of D10 is transformed to BCD value, the digit is saved in 4-bit element of K1Y0 (Y0–Y3).



- If D10 = 001E (Hex) = 0030 (Decimal), the executed result will be Y0–Y3=0000 (BIN).

API					
19	D	**BIN**	P	S D	BCD to BIN transformation

	Bit device			Word device						
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

BIN	Continuous execution type	BINP	Pulse execution type

32-bit command (9 STEP)

DBIN	Continuous execution type	DBINP	Pulse execution type

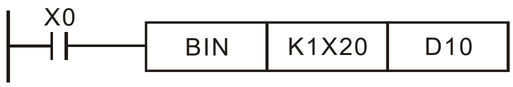
Flag signal: none

Explanation

- S: Data source. D: Transformation result.
- The content of data source S (BCD: 0–9,999) executes BIN transformation and saves in D.
- Valid number range of the data source S: BCD (0–9,999), DBCD (0–99,999,999).

Example

- When X0 is ON, and the BCD value of K1X20 is transformed to BIN value, the result saves in D10.



Remark

- When PLC reads a BCD type switch-off from the outside, it has to use the BIN command to transform the read data to BIN value, then saves the value into PLC.

API	D	ADD	P	S1 S2 D	BIN addition
20					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (7 STEP)

ADD	Continuous execution type	ADDP	Pulse execution type

32-bit command (13 STEP)

DADD	Continuous execution type	DADDP	Pulse execution type

Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag
Please refer to the following supplementary explanation

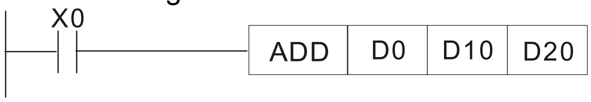
Explanation

- S1: Augend. S2: Addend. D: Sum.
- Using two data sources: The result of adding S1 and S2 using the BIN method will be stored in D.
- The highest bit of any data is symbolized as bit 0 indicating (positive) 1 indicating (negative), enabling the use of algebraic addition operations. (for instance: 3+(-9)=-6)
- Flag changes connected with the addition.

1. When calculation results are 0, the zero flag M1020 will be On.
2. When calculation results are less than –32,768, the borrow flag M1021 will be On.
3. When calculation results are greater than 32,767, the carry flag M1022 will be On.

Example

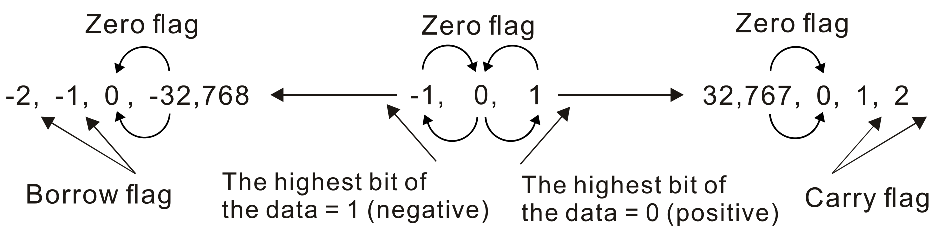
- 16-bit BIN addition: When X0=On, the result of the content of addend D0 plus the content of augend D10 will exist in the content of D20.



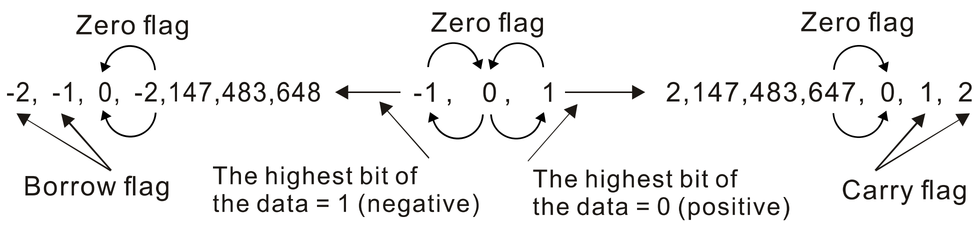
Remark

- Relationship between flag actions and negative/positive numbers:

16-bit:



32-bit:



API				
21	D	**SUB**	P	S1 S2 D — BIN subtraction

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (7 STEP)

SUB	Continuous execution type	SUBP	Pulse execution type

32-bit command (13 STEP)

DSUB	Continuous execution type	DSUBP	Pulse execution type

Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag
Please refer to the following supplementary explanation

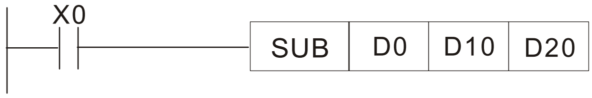
Explanation

- S1: Minuend. S2: Subtrahend. D: Difference.
- Using two data sources: The result of subtraction of S1 and S2 using the BIN method is stored in D.
- The highest bit of any data is symbolized as bit 0 indicating (positive) 1 indicating (negative), enabling the use of algebraic subtraction operations.
- Flag changes connected with subtraction.

1. When calculation results are 0, the zero flag M1020 will be On.
2. When calculation results are less than –32,768, the borrow flag M1021 will be On.
3. When calculation results are greater than 32,767, the carry flag M1022 will be On.

Example

- 16-bit BIN subtraction: When X0=On, the content of D10 is subtracted from the content of D0, and the difference is stored in D20.



API					
22	D	MUL	P	S1 S2 D	BIN multiplication

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
The 16-bit command operand D will occupy 2 consecutive points

16-bit command (7 STEP)

MUL	Continuous execution type	MULP	Pulse execution type

32-bit command (13 STEP)

DMUL	Continuous execution type	DMULP	Pulse execution type

Flag signal: none

Explanation

- S1: Multiplicand. S2: Multiplier. D: Product.
- Using two data sources: When S1 and S2 are multiplied using the BIN method, the product is stored in D.

16-bit BIN multiplication operation:

$$\underbrace{\text{b15.........b0}}_{S1} \times \underbrace{\text{b15.........b0}}_{S2} = \underbrace{\text{b31.........b16}}_{D+1}\underbrace{\text{b15.............b0}}_{D}$$

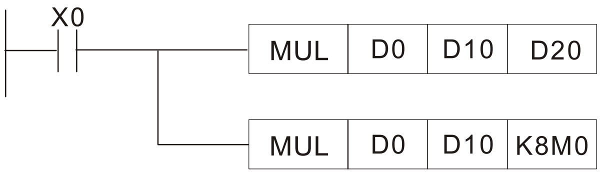
b15 is a symbol bit　b15 is a symbol bit　b31 is a symbol bit (b15 of D+1)

Symbol bit = 0 refers to a positive value
Symbol bit = 1 refers to a negative vlalue

When D is a bit device, K1–K4 can be designated as a hexadecimal number, which will occupy 2 consecutive units.

Example

- When 16-bit DO is multiplied by 16-bit D10, the result will be a 32-bit product; the upper 16 bits will be stored in D21, and the lower 16 bits will be stored in D20. Whether the bit at the farthest left is Off or On will indicate the sign of the result.



API 23	D	DIV	P	S1 S2 D	BIN division

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
The 16-bit command operand D will occupy 2 consecutive points

16-bit command (7 STEP)

DIV	Continuous execution type	DIVP	Pulse execution type

32-bit command (13 STEP)

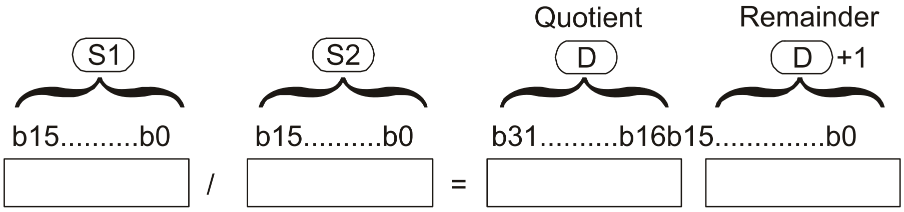
DDIV	Continuous execution type	DDIVP	Pulse execution type

Flag signal: none

Explanation

- S1: Dividend. S2: Divisor. D: Quotient and remainder.
- Using two data sources: The quotient and remainder will be stored in D when S1 and S2 are subjected to division using the BIN method. The sign bit for S1, S2 and D must be kept in mind when performing a 16-bit operation.

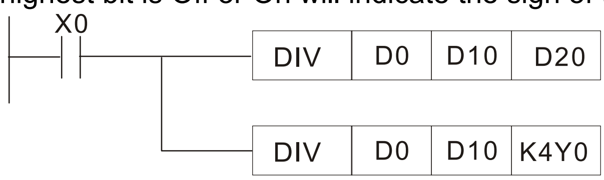
16-bit BIN division:



If D is a bit device, K1–K4 can be designated 16 bits, which will occupy 2 consecutive units and yield the quotient and remainder.

Example

- When X0=On, the quotient resulting from division of dividend D0 by divisor D10 will be placed in D20, and the remainder will be placed in D21. Whether the highest bit is Off or On will indicate the sign of the result.



API					
24	D	INC	P	D	BIN add one

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (3 STEP)

INC	Continuous execution type	INCP	Pulse execution type

32-bit command (5 STEP)

DINC	Continuous execution type	DINCP	Pulse execution type

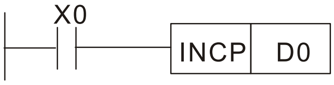
Flag signal: none

Explanation

- D: Destination device.
- If a command is not the pulse execution type, when the command is executed, the program will add 1 to the content of device D for each scanning cycle.
- This command is ordinarily used as a pulse execution type command (INCP).
- During 16-bit operation, 32,767 +1 will change the value to -32,768. During 32 bit operation, 2,147,483,647 +1 will change the value to -2,147,483,648.

Example

- When X0=Off→On, 1 is automatically added to the content of D0.



API				
25	D	DEC	P	D	BIN subtract one

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*			

Notes on operand usage: none

16-bit command (3 STEP)

DEC	Continuous execution type	DECP	Pulse execution type

32-bit command (5 STEP)

DDEC	Continuous execution type	DDECP	Pulse execution type

Flag signal: none

Explanation

- D: Destination device.
- If a command is not the pulse execution type, when the command is executed, the program will add 1 to the content of device D for each scanning cycle.
- This command is ordinarily used as a pulse execution type command (DECP).
- During 16-bit operation, -32,768 -1 will change the value to 32,767. During 32 bit operation, -2,147,483,648 -1 will change the value to 2,147,483,647.

Example

- When X0=Off→On, 1 is automatically subtracted from the content of D0.

API					
30	D	ROR	P	(D) (n)	Right rotation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*
n				*	*						

Notes on operand usage:
Only K4 (16-bit) will be valid if the operand D is designated as KnY or KnM.
n operand n=K1-K16 (16-bit)

16-bit command (5 STEP)

ROR	Continuous execution type	RORP	Pulse execution type

32-bit command (9 STEP)

DROR	Continuous execution type	DRORP	Pulse execution type

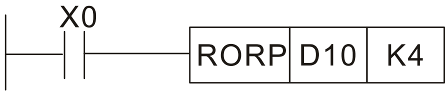
Flag signal: M1022 Carry flag

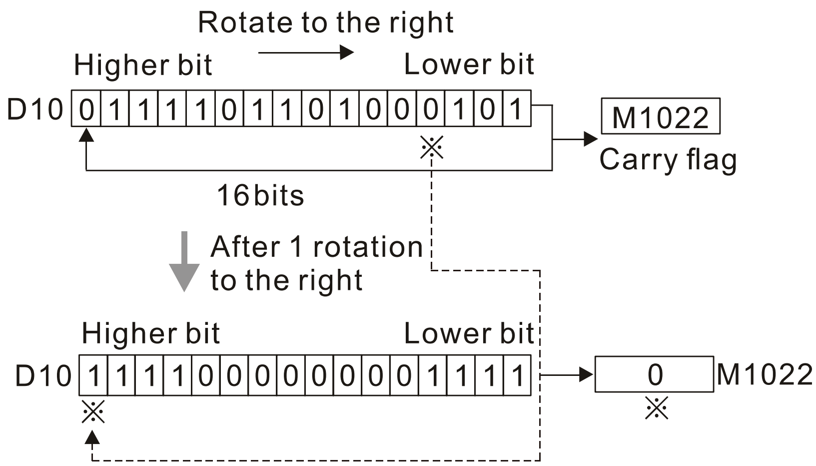
Explanation

- (D): Device to be rotated. (n): Number of bits for one rotation.
- Rotate the device designated by (D) to the right (n) bits.
- This command is ordinarily used as a pulse execution type command (RORP).

Example

- When X0=Off→On, 4 of the 16 bits in D10 specify a right rotation; the content of the bit indicated with * (see figure below) will be sent to the carry flag signal M1022.





API	D	ROL	P	D n	Left rotation
31					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*
n				*	*						

Notes on operand usage:
Only K4 (16-bit) will be valid if the operand D is designated as KnY or KnM.
n operand n=1 to 16 (16-bit)

16-bit command (5 STEP)

ROL	Continuous execution type	ROLP	Pulse execution type

32-bit command (9 STEP)

DROL	Continuous execution type	DROLP	Pulse execution type

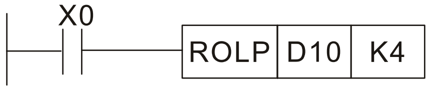
Flag signal: M1022 Carry flag

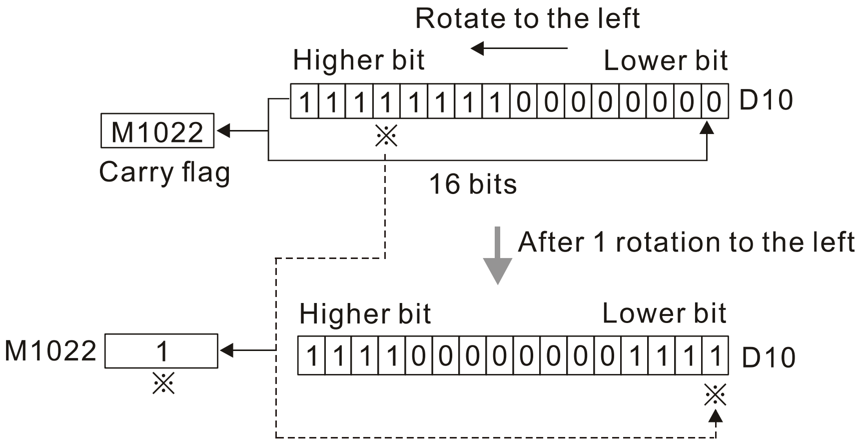
Explanation

- D: Device to be rotated. n: Number of bits for one rotation.
- Rotates the device designated by D to the left n bits.
- This command is ordinarily used as a pulse execution type command (ROLP).

Example

- When X0=Off→On, 4 of the 16 bits in D10 specify a left rotation; the content of the bit indicated with * (see figure below) will be sent to the carry flag signal M1022.





API				
40		ZRST P	D1 D2	Clear range

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D1		*	*						*	*	*
D2		*	*						*	*	*

Notes on operand usage:
Number of operand D_1 operand ≤ number of operand D_2
Operands D_1, D_2 must designate the same type of device
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

ZRST	Continuous execution type	ZRSTP	Pulse execution type

32-bit command

–	–	–	–

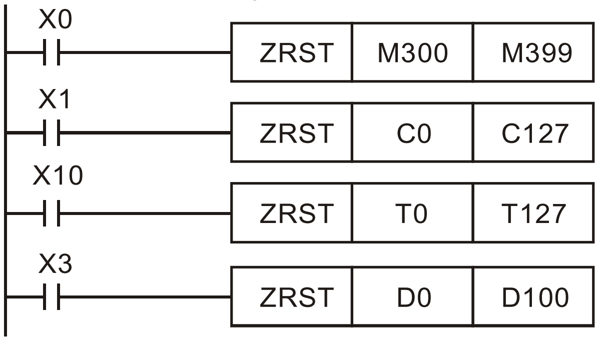
Flag signal: none

Explanation

- **D_1**: Clear range's initial device. **D_2**: Clear range's final device.
- When the number of operand D_1 > number of operand D_2, only the operand designated by D_2 will be cleared.

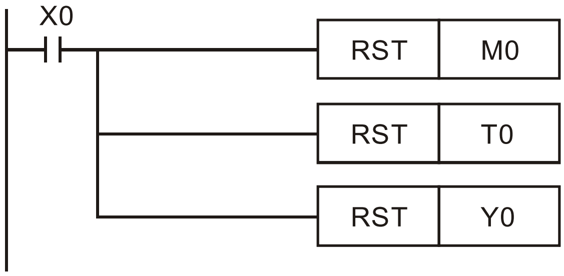
Example

- When X0 is On, auxiliary relays M300–M399 will be cleared and changed to Off.
- When X1 is On, 16-bit counters C0–C127 will all be cleared. (Writes 0, and clears and changes contact and coil to Off).
- When X10 is On, timer T0–T127 will all be cleared. (Writes 0, and clears and changes contact and coil to Off).
- When X3 is On, the data in data registers D0–D100 will be cleared and set as 0.



Remark

- Devices can independently use the clear command (RST), such as bit device Y, M and word device T, C, D.



API 41	D	DECO	P	(S) (D) (n)	Decoder

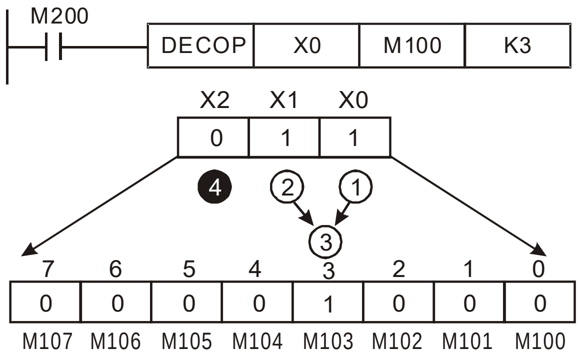
	Bit device			Word device								16-bit command (7 STEP)			
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	DECO	Continuous execution type	DECOP	Pulse execution type
S	*	*	*	*	*				*	*	*				
D		*	*				*	*	*	*	*	32-bit command (13 STEP)			
n				*	*							DDECO	Continuous execution type	DDECOP	Pulse execution type
Notes on operand usage: none												Flag signal: none			

Explanation

- (S): Decoding source device. (D): Device that saves the decoding result. (n): Length of decoding bit.
- Decodes with the lower “n” bit, and saves the length of “2^n” bit in D.
- This command usually uses pulse execution type command (DECOP).
- When D is the bit device, n = 1–8, when D is the word device, n = 1–4.

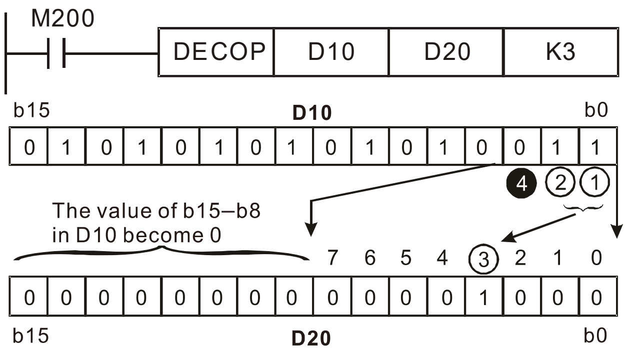
Example 1

- When Dis the bit device, the valid range of n is 0< **n** ≦8. If n = 0 or n > 8, a fault will occur.
- When n = 8, the maximum decoding will be 2^8 = 256 points.
- When M200 switches from Off to On, the content of X0–X2 is decoded to M100–M107.
- If S = 3, M103 (the third digit starting from M100) = On.
- When the command is executed, M200 turns to Off. The ones that are decoded and outputted act as usual.



Example 2

- When D is word device, the valid range of n is 0< **n** ≦4. If n = 0 or n > 4, the fault occurs.
- When n = 4, the maximum decoding will be 2^4 = 16 points.
- When M200 switches from Off to On, the content of D10 (b2–b0) is decoded to D20 (b7–b0). The unused digits (b15–b8) of D20 become 0.
- The lower 3 digits of D10 are decoded and saved in the lower 8 digits of D20, the upper 8 digits are 0.
- When the command is executed, M200 turns to Off. The ones that are decoded and outputted act as usual.



API					
42	D	ENCO	P	S D n	Encoder

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S	*	*	*						*	*	*
D							*	*	*	*	*
n				*	*						

Notes on operand usage: none

16-bit command (7 STEP)

ENCO	Continuous execution type	ENCOP	Pulse execution type

32-bit command (13 STEP)

DENCO	Continuous execution type	DENCOP	Pulse execution type

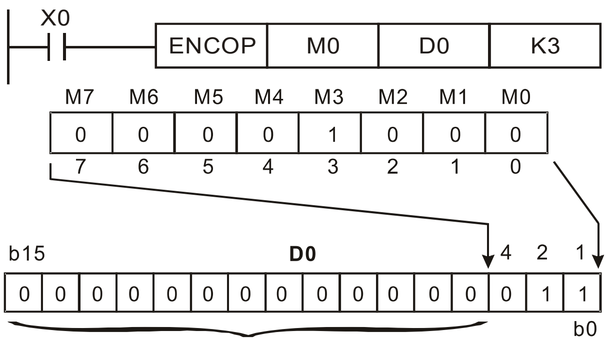
Flag signal: none

Explanation

- S: Encoding source device. D: Device that saves the encoding result. n: Length of encoding bit.
- Encodes the data of lower "2^n" bit length from encoding source device S, and saves the encoding result in D.
- If multiple digits of encoding source device are 1, the command will process the first digit starting from high digit.
- This command usually uses pulse execution type command (ENCOP).
- When S is the bit device, n = 1–8, when S is the word device, n = 1–4.

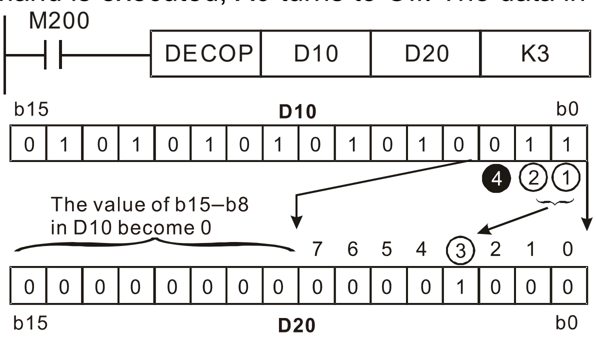
Example 1

- When S is the bit device, the valid range of n is 0< **n** ≦8. If n = 0 or n > 8, a fault will occur.
- When n = 8, the maximum decoding will be 2^8 = 256 points.
- When X0 switches from Off to On, the content of 2^3 digit (M0–M7) is encoded and saved in the lower 3 digits (b2–b0). The unused digits (b15–b3) in D0 become 0.
- When the command is executed, X0 turns to Off. The data in D is unchanged.



Example 2

- When S is word device, the valid range of n is 0< **n** ≦4. If n = 0 or n > 4, the fault occurs.
- When n = 4, the maximum decoding will be 2^4 = 16 points.
- When X0 switches from Off to On, 2^3 digit data of D10 (b0–b7) is encoded and saved in the lower 3 digits (b2–b0) of D20. The unused digits (b15–b3) of D20 become 0. (b8–b15 in D10 are invalid data)
- When the command is executed, X0 turns to Off. The data in D is unchanged.



API 43	D	SUM	P	(S) (D)	ON bit number

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D									*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

SUM	Continuous execution type	SUMP	Pulse execution type

32-bit command (9 STEP)

DSUM	Continuous execution type	DSUMP	Pulse execution type

Flag signal: M1020

Explanation

- (S): Source device. (D): Destination of saving counter values.
- The total amount of all digits that is “1” in S will be saved in D.
- D will use 2 registers when use the 32-bit command.
- Arithmetic elements S and D use F device, and can only use 16-bit command.
- If there is no bit is ON, the flag signal M1020 will be ON.

Example

- When M200 = On, the total amount of content “1” digit in D0’s 16-bit command will be saved in D2.

0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0

D0

3

D2

API				
44	D	BON	P	S D n	ON bit judgement

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D		*	*						*	*	*
n				*	*						

Notes on operand usage: none

16-bit command (7 STEP)			
BON	Continuous execution type	BONP	Pulse execution type

32-bit command (9 STEP)			
DBON	Continuous execution type	DBONP	Pulse execution type

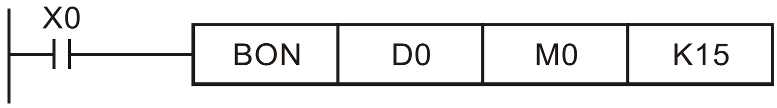
Flag signal: none

Explanation

- S: Source device. D: Destination of saving judging result. n: assign judged digit (numbering from 0)
- The status of specific digit from source device is shown on target position.
- Arithmetic element S uses F device, and can only use the 16-bit command.
- The valid range of arithmetic element n: n = 0–15 (16-bit), n = 0–31 (32-bit).

Example

- When X0 = On, if the 15th digit of D0 is “1”, M0 is On. If it is “0”, M0 is Off.
- When X0 turns to Off, M0 remains previous status.



b15 … b0

0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=Off

D0

b15 … b0

1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=On

D0

API					
49	D	FLT	P	S D	BIN whole number → binary decimal transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S		*	*						*	*	*
D		*	*						*	*	*

Notes on operand usage: Please refer to the function specifications table for each device in series for the scope of device usage
The operand D will occupy 2 consecutive points

16-bit command

FLT	Continuous execution type	FLTP	Pulse execution type

32-bit command (9steps)

DFLT	Continuous execution type	DFLTP	Pulse execution type

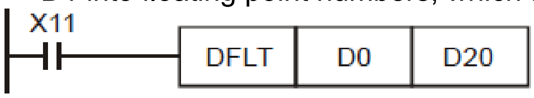
Flag signal: none

Explanation

- **S**: Transformation source device. **D**: Device storing transformation results.
- Transforms BIN whole number into a binary decimal value.

Example

- When X11 is On, converts the whole number of values corresponding to D0 and D1 into floating point numbers, which are placed in D20 and D21.



API					
110	D	ECMP	P	(S1) (S2) (D)	Comparison of binary floating point numbers

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
The operand D occupies three consecutive points
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (13 STEP)

DECMP	Continuous execution type	DECMPP	Pulse execution type

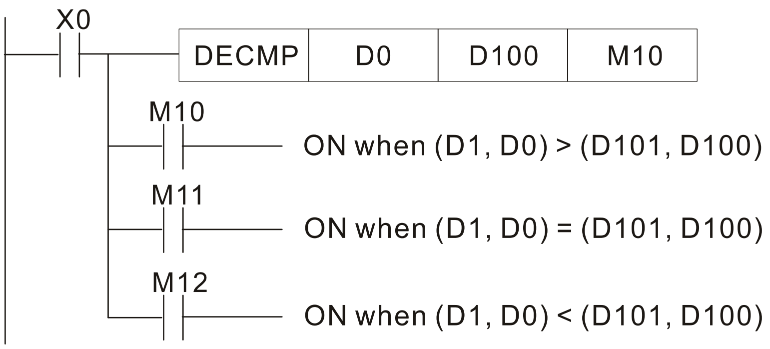
Flag signal: none

Explanation

- **S_1**: Comparison of binary floating point numbers value 1. **S_2**: Comparison of binary floating point numbers value 2. **D**: Results of comparison, occupies 3 consecutive points.
- When binary floating point number 1 is compared with comparative binary floating point number 2, the result of comparison (>, =, <) will be expressed in **D**.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command will transform the constant to a binary floating-point number for the purpose of comparison.

Example

- When the designated device is M10, it will automatically occupy M10–M12.
- When X0=On, the DECMP command executes, and one of M10–M12 will be On. When X0=Off, the DECMP command will not execute, and M10–M12 will remain in the X0=Off state.
- If results in the form of ≥, ≤, or ≠ are needed, they can be obtained by series and parallel connection of M10-M12.
- Please use the RST or ZRST command to clear the result.



API					
111	D	EZCP	P	S1 S2 S D	Comparison of binary floating point number range

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S				*	*						*
D		*	*								

Notes on operand usage:
The operand D occupies three consecutive points
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (17 STEP)

DEZCP	Continuous execution type	DEZCP P	Pulse execution type

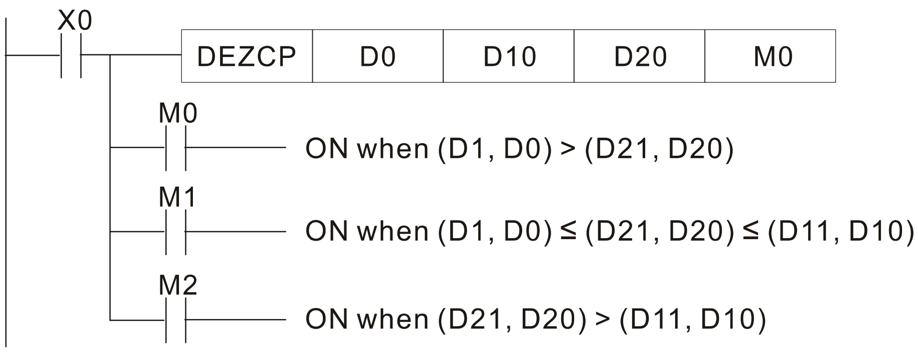
Flag signal: none

Explanation

- S_1: Lower limit of binary floating point number in range comparison. S_2: Upper limit of binary floating point number in range comparison. **S**: Comparison of binary floating point numerical values. **D**: Results of comparison, occupies 3 consecutive points.
- Comparison of binary floating point numerical value **S** with binary floating point number lower limit value S_1 and binary floating point number upper limit value S_2; the results of comparison are expressed in **D**.
- **If the source operand** S_1 or S_2 designates a constant K or H, the command will transform the constant to a binary floating-point number for the purpose of comparison.
- When the lower limit binary floating point number S_1 is greater than the upper limit binary floating point number S_2, a command will be issued to perform comparison with the upper and lower limits using the binary floating point number lower limit value S_1.

Example

- When the designated device is M0, it will automatically occupy M0–M2.
- When X0=On, the DEZCP command will be executed, and one of M0–M2 will be On. When X0=Off, the EZCP command will not execute, and M0–M2 will continue in the X0=Off state.
- Please use the RST or ZRST command to clear the result.



API					
116	D	RAD	P	S D	Angle → Radian

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DRAD	Continuous execution type	DRADP	Pulse execution type

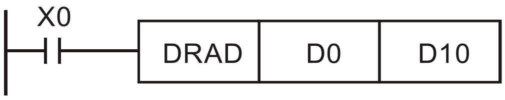
Flag signal: none

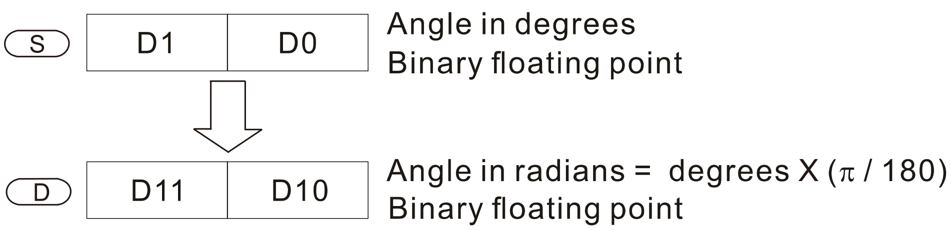
Explanation

- **S**: data source (angle). **D**: result of transformation (radian).
- Uses the following formula to convert angles to radians.
- Radian ＝Angle × (π/180)

Example

- When X0=On, the angle of the designated binary floating point number (D1, D0) will be converted to radians and stored in (D11, D10), with the content consisting of a binary floating point number.





API		Mnemonic		Operands	Function
117	D	DEG	P	S D	Radian → Angle

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

DDEG	Continuous execution type	DDEGP	Pulse execution type

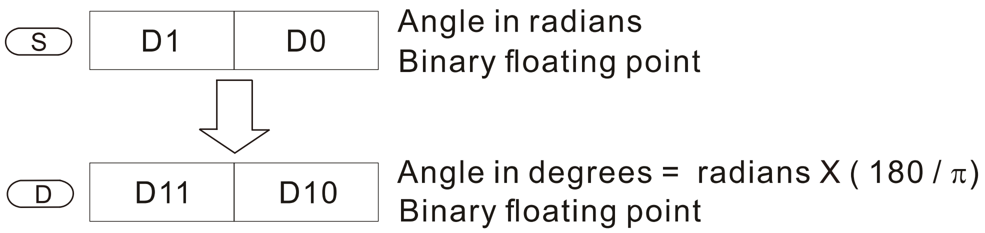
Flag signal: none

Explanation

- **S**: data source (radian). **D**: results of transformation (angle).
- Uses the following formula to convert radians to an angle.
- Angle ＝Radian × (180/π)

Example

- When X0=On, angle of the designated binary floating point number (D1, D0) in radians will be converted to an angle and stored in (D11, D10), with the content consisting of a binary floating point number.



API					
120	D	EADD	P	S1 S2 D	Adding binary floating point numbers

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DEADD	Continuous execution type	DEADDP	Pulse execution type

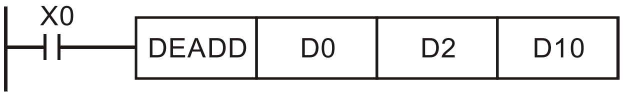
Flag signal: none

Explanation

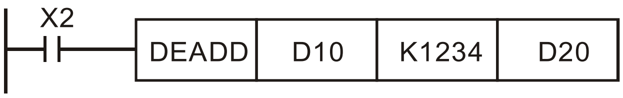
- S_1: augend. S_2: addend. **D**: sum.
- When the content of the register designated by S_2 is added to the content of the register designated by S_1, and the result is stored in the register designated by **D**. Addition is performed entirely using binary floating-point numbers.
- **If the source operand S_1** or S_2 designates a constant K or H, the command will transform that constant into a binary floating point number for use in addition.
- **In the situation when S_1** and S_2 designate identical register numbers, if a "continuous execution" command is employed, when conditional contact is On, the register will perform addition once during each scan. Pulse execution type commands (DEADDP) are generally used under ordinary circumstances.

Example

- When X0=On, a binary floating point number (D1, D0) will be added to a binary floating point number (D3, D2), and the results stored in (D11, D10).



- When X2 =On, a binary floating point number (D11, D10) will be added to K1234 (which has been automatically converted to a binary floating-point number), and the results stored in (D21, D20).



API					
121	D	ESUB	P	S1 S2 D	Subtraction of binary floating point numbers

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (13 STEP)

DESUB	Continuous execution type	DESUBP	Pulse execution type

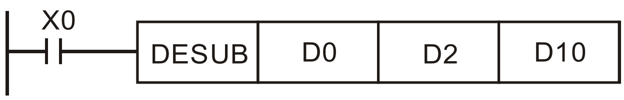
Flag signal: none

Explanation

- S_1: minuend. S_2: subtrahend. **D**: difference.
- When the content of the register designated by S_2 is subtracted from the content of the register designated by S_1, the difference will be stored in the register designated by **D**; subtraction is performed entirely using binary floating-point numbers.
- **If the source operand S_1** or S_2 designates a constant K or H, the command will transform that constant into a binary floating point number for use in subtraction.
- **In the situation when S_1** and S_2 designate identical register numbers, if a "continuous execution" command is employed, when conditional contact is On, the register will perform addition once during each scan. Pulse execution type commands (DESUBP) are generally used under ordinary circumstances.

Example

- When X0=On, a binary floating point number (D1, D0) will be subtracted to a binary floating point number (D3, D2), and the results stored in (D11, D10).



- When X2 =On, the binary floating point number (D1, D0) will be subtracted from K1234 (which has been automatically converted to a binary floating-point number), and the results stored in (D11, D10).

API 122	D	EMUL	P	S1 S2 D	Multiplication of binary floating point numbers

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (13 STEP)

DEMUL	Continuous execution type	DEMULP	Pulse execution type

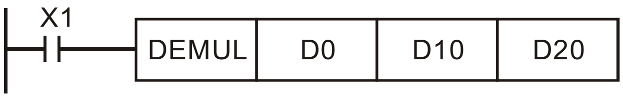
Flag signal: none

Explanation

- **S₁**: multiplicand. **S₂**: multiplier. **D**: product.
- When the content of the register designated by **S_1** is multiplied by the content of the register designated by **S_2**, the product will be stored in the register designated by **D**; multiplication is performed entirely using binary floating-point numbers.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command will transform that constant into a binary floating point number for use in multiplication.
- **In the situation when S_1** and **S_2** designate identical register numbers, if a "continuous execution" command is employed, when conditional contact is On, the register will perform multiplication once during each scan. Pulse execution type commands (DEMULP) are generally used under ordinary circumstances.

Example

- When X1=On, the binary floating point number (D1, D0) will be multiplied by the binary floating point number (D11, D10), and the product will be stored in the register designated by (D21, D20).



- When X2 =On, the binary floating point number (D1, D0) will be multiplied from K1234 (which has been automatically converted to a binary floating-point number), and the results stored in (D11, D10).

API					
123	D	EDIV	P	S1 S2 D	Division of binary floating point numbers

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (13 STEP)

DEDIV	Continuous execution type	DEDIVP	Pulse execution type

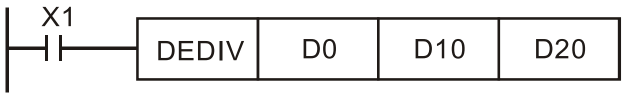
Flag signal: none

Explanation

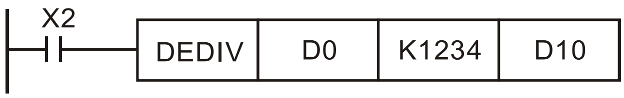
- **S₁**: dividend. **S₂**: divisor. **D**: quotient and remainder.
- When the content of the register designated by **S_1** is divided by the content of the register designated by **S_2**, the quotient will be stored in the register designated by **D**; division is performed entirely using binary floating-point numbers.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command will transform that constant into a binary floating point number for use in division.

Example

- When X1=On, the binary floating point number (D1, D0) will be divided by the binary floating point number (D11, D10), and the quotient stored in the register designated by (D21, D20).



- When X2 =On, the binary floating point number (D1, D0) will be divided by K1,234 (which has been automatically converted to a binary floating-point number), and the results stored in (D11, D10).



API					
124	D	EXP	P	S D	Binary floating point number obtain exponent

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DEXP	Continuous execution type	DEXPP	Pulse execution type

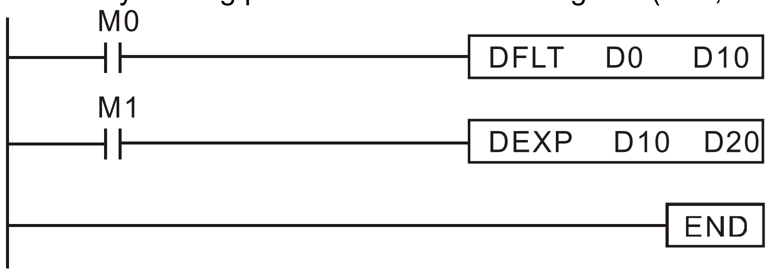
Flag signal: none

Explanation

- **S**: operation source device. **D**: operation results device.
- Taking e =2.71828 as a base, **S** is the exponent in the EXP operation.
- [**D** +1，**D**]=EXP〔**S +1**，**S**〕
- Valid regardless of whether the content of **S** has a positive or negative value. The designated register D must have a 32-bit data format. This operation is performed using floating-point numbers, and **S** must therefore be converted to a floating point number.
- Content of operand **D** =e^{S} ; e=2.71828, **S** is the designated source data

Example

- When M0 is On, the value of (D1, D0) will be converted to a binary floating point number, which will be stored in register (D11, D10).
- When M1 is On, the EXP operation is performed on the exponent of (D11, D10); its value is a binary floating point number stored in register (D21, D20).



API 125	D	LN	P	S D	Binary floating point number obtain logarithm

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DLN	Continuous execution type	DLNP	Pulse execution type

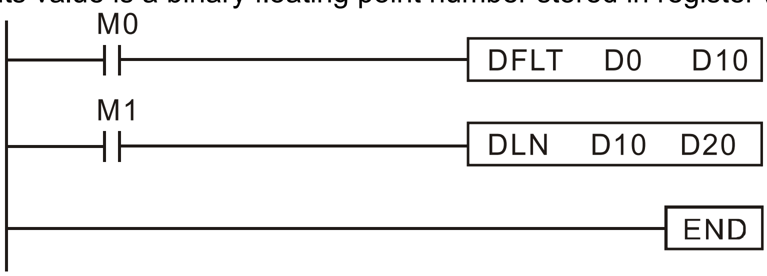
Flag signal: none

Explanation

- **S**: operation source device. **D**: operation results device.
- Taking e =2.71828 as a base, **S** is the exponent in the EXP operation.
- [**D** +1，**D**]=EXP［**S +1**，**S**］
- Valid regardless of whether the content of **S** has a positive or negative value. The designated register D must have a 32-bit data format. This operation is performed using floating-point numbers, and **S** must therefore be converted to a floating point number.
- Content of operand **D** =e^{S} ; e=2.71828， **S** is the designated source data

Example

- When M0 is On, the value of (D1, D0) will be converted to a binary floating point number, which will be stored in register (D11, D10).
- When M1 is On, the EXP operation is performed on the exponent of (D11, D10); its value is a binary floating point number stored in register (D21, D20).



API 127	D	ESQR	P	S D	Binary floating point number find square root

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command
– – – –

32-bit command (9 STEP)

DESQR	Continuous execution type	DESQRP	Pulse execution type

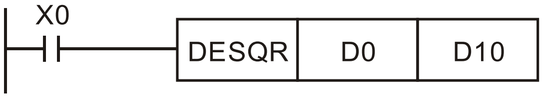
Flag signal: none

Explanation

- **S**: source device for which square root is desired **D**: result of finding square root.
- When the square root is taken of the content of the register designated by **S**, the result is temporarily stored in the register designated by **D**. Taking square roots is performed entirely using binary floating-point numbers.
- If the source operand **S** refers to a constant K or H, the command will transform that constant into a binary floating point number for use in the operation.

Example

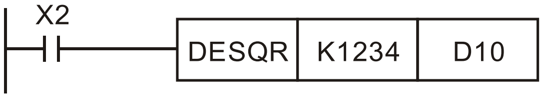
- When X0=On, the square root is taken of the binary floating point number (D1, D0), and the result is stored in the register designated by (D11, D10).



$$\sqrt{(D1 \cdot D0)} \longrightarrow (D11 \cdot D10)$$

Binary floating point   Binary floating point

- When X2 =On, the square root is taken of K1,234 (which has been automatically converted to a binary floating-point number), and the results stored in (D11, D10).



API					
129	D	INT	P	S D	Binary floating point number → BIN whole number transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S											*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

INT	Continuous execution type	INTP	Pulse execution type

32-bit command (9 STEP)

DINT	Continuous execution type	DINTP	Pulse execution type

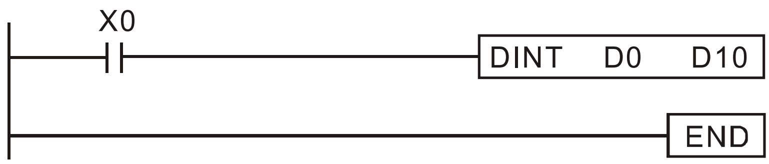
Flag signal: none

Explanation

- **S**: the source device to be transformed. **D**: results of transformation.
- The content of the register designated by **S** is transformed from a binary floating point number format into a BIN whole number, and is temporarily stored in **D**. The BIN whole number floating point number will be discarded.
- The action of this command is the opposite of that of command API 49 (FLT).

Example

- When X0=On, the binary floating point number (D1, D0) is transformed into a BIN whole number, and the result is stored in (D10); the BIN whole number floating point number will be discarded.



API					
130	D	SIN	P	S D	Binary floating point number SIN operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

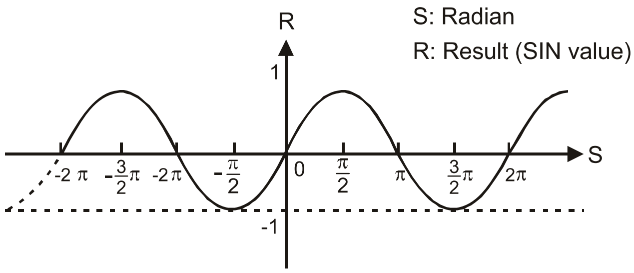
DSIN	Continuous execution type	DSINP	Pulse execution type

Flag signal: none

Explanation

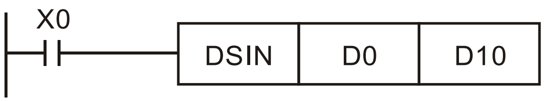
- **S**: the designated source value. **D**: the SIN value result.
- **S** is the designated source in radians.
- The value in radians (RAD) is equal to (angle ×π/180).
- The SIN obtained from the source value designated by **S** is stored in **D**.

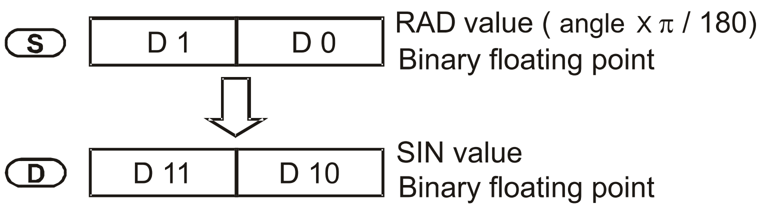
The following figure displays the relationship between the arc and SIN results:



Example

- When X0=On, the SIN value of the designated binary floating point number (D1, D0) in radians (RAD) will be stored in (D11, D10), with the content consisting of a binary floating point number.





API					
131	D	COS	P	S D	Binary floating point number COS operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

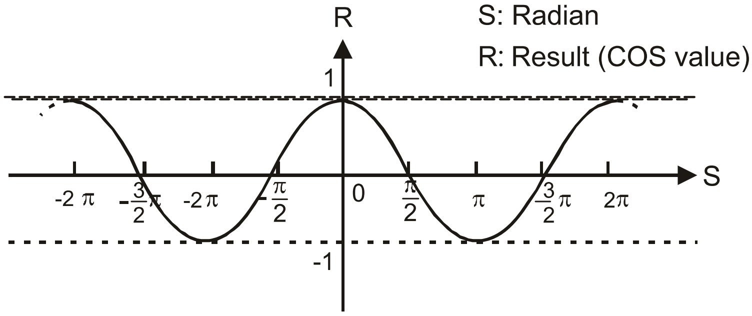
DCOS	Continuous execution type	DCOSP	Pulse execution type

Flag signal: none

Explanation

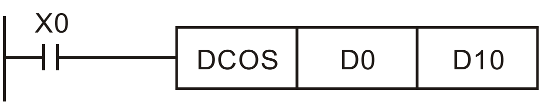
- **S**: the designated source value. **D**: the COS value result.
- The source designated by S can be given as radians or an angle; this is decided by flag M1018.
- When M1018=Off, the operation is in radians mode, where the radians (RAD) value is equal to (angle ×π/180).
- When M1018=On, the operation is in the angle mode, where the angular range is 0°≤ angle <360°.
- When calculation results yield 0, M1020=On.
- The COS obtained from the source value designated by **S** is stored in **D**.

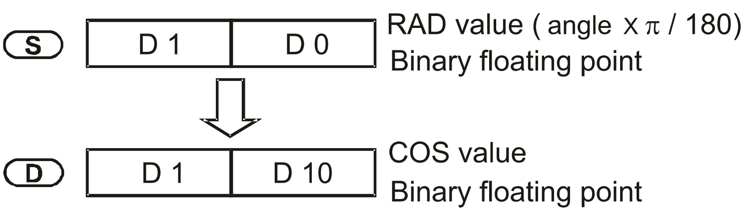
The following figure displays the relationship between the arc and SIN results:



Example

- When X0=On, the COS value of the designated binary floating point number (D1, D0) in radians will be stored in (D11, D10), with the content consisting of a binary floating point number.





API 132	D	TAN	P	(S) (D)	Binary floating point number TAN operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

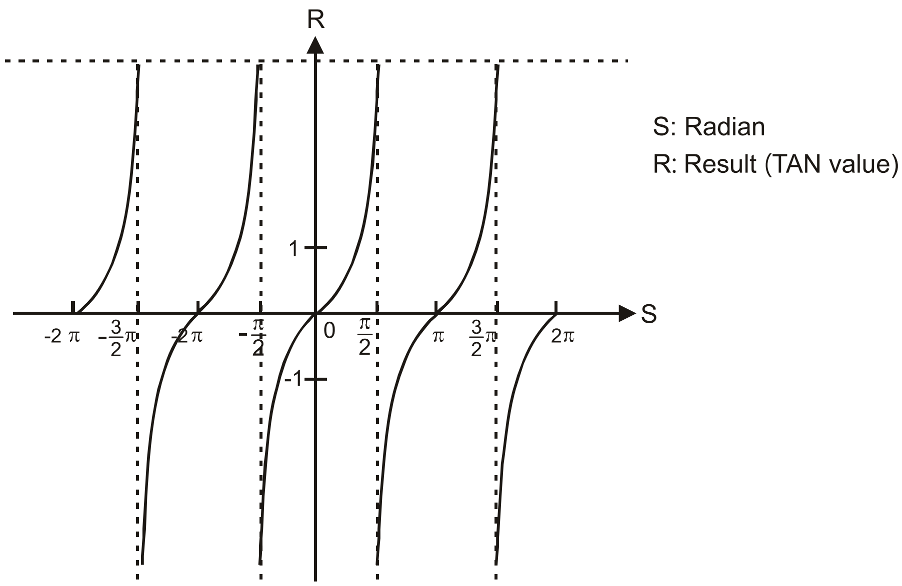
DTAN	Continuous execution type	DTANP	Pulse execution type

Flag signal: none

Explanation

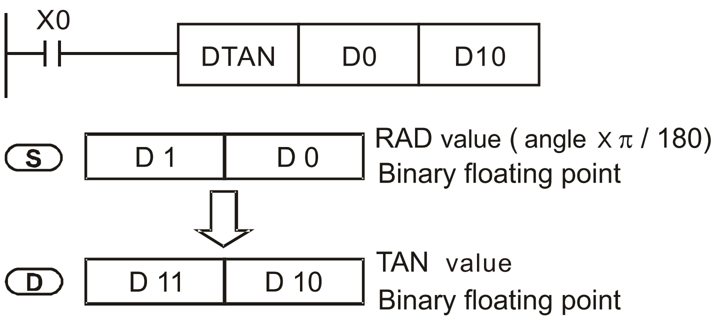
- **S**: the designated source value. **D**: the TAN value result.
- The source designated by **S** can be given as radians or an angle; this is decided by flag M1018.
- When M1018=Off, the operation is in radians mode, where the radians (RAD) value is equal to (angle ×π/180).
- When M1018=On, the operation is in the angle mode, where the angular range is 0°≤ angle <360°.
- When calculation results yield 0, M1020=On.
- The TAN obtained from the source value designated by **S** is stored in **D**.

The following figure displays the relationship between the arc and SIN results:



Example

- When X0=On, the TAN value of the designated binary floating point number (D1, D0) in radians (RAD) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API		Mnemonic		Operands	Function
133	D	ASIN	P	S D	Binary floating point number ASIN operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command			
–	–	–	–

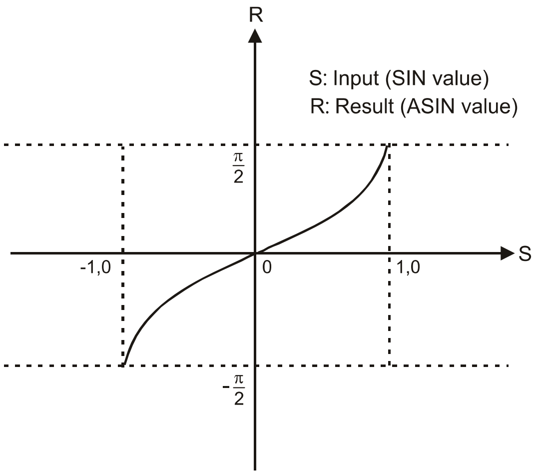
32-bit command (9 STEP)			
DASIN	Continuous execution type	DASINP	Pulse execution type

Flag signal: none

Explanation

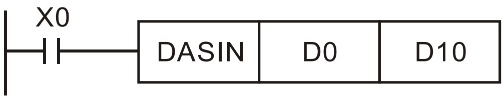
- **S**: the designated source (binary floating point number). **D**: the ASIN value result.
- ASIN value $=\sin^{-1}$

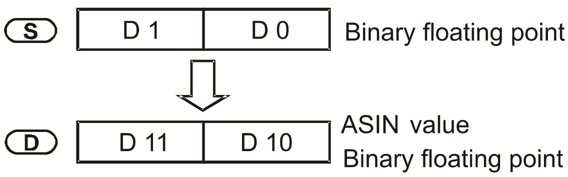
The figure below shows the relationship between input data and result:



Example

- When X0=On, the ASIN value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.





API 134	D	ACOS	P	(S) (D)	Binary floating point number ACOS operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

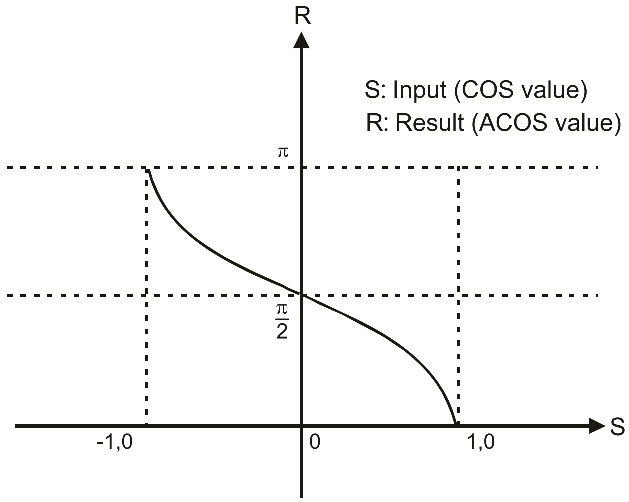
DACOS	Continuous execution type	DACOSP	Pulse execution type

Flag signal: none

Explanation

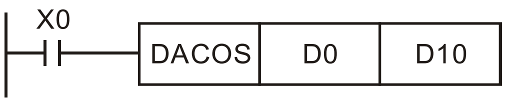
- **S**: the designated source (binary floating point number). **D**: the ACOS value result.
- ACOS value $=\cos^{-1}$

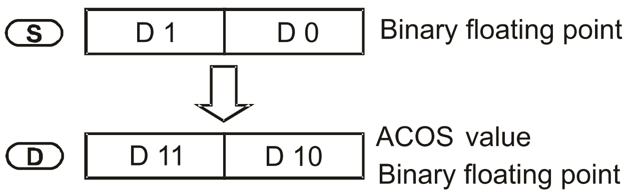
The figure below shows the relationship between input data and result:



Example

- When X0=On, the ACOS value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.





API 135	D	ATAN	P	S D	Binary floating point number ATAN operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

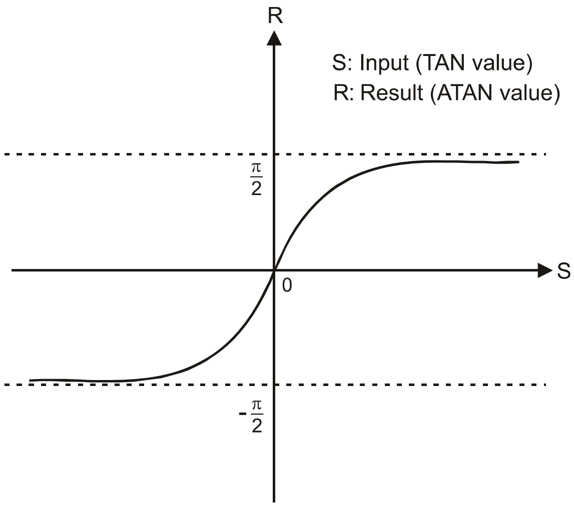
DATAN	Continuous execution type	DATANP	Pulse execution type

Flag signal: none

Explanation

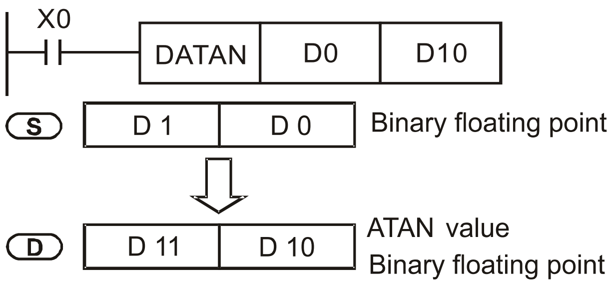
- **S**: the designated source (binary floating point number). **D**: the ATAN value result.
- ATAN value $=\tan^{-1}$

The figure below shows the relationship between input data and result:



Example

- When X0=On, the TAN value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API					
136	D	SINH	P	S D	Binary floating point number SINH operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DSINH	Continuous execution type	DSINHP	Pulse execution type

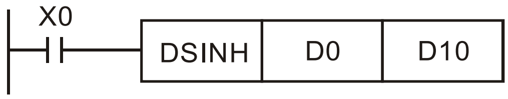
Flag signal: none

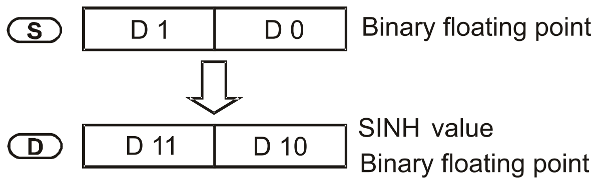
Explanation

- **S**: the designated source (binary floating point number). **D**: the SINH value result.
- SINH value =$(e^{s}-e^{-s})/2$

Example

- When X0=On, the SINH value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.





API 137	D	COSH	P	S D	Binary floating point number COSH operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DCOSH	Continuous execution type	DCOSHP	Pulse execution type

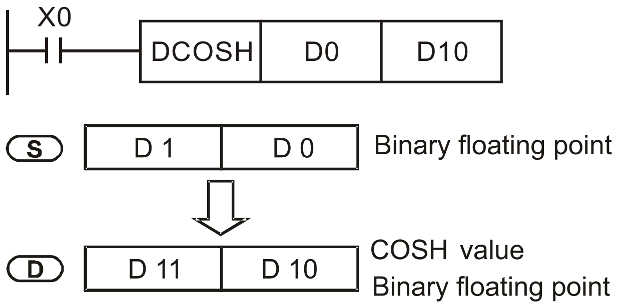
Flag signal: none

Explanation

- **S**: the designated source (binary floating point number). **D**: the COSH value result.
- COSH value $=(e^{s}+e^{-s})/2$

Example

- When X0=On, the COSH value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API					
138	D	TANH	P	(S) (D)	Binary floating point number TANH operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

DTANH	Continuous execution type	DTANHP	Pulse execution type

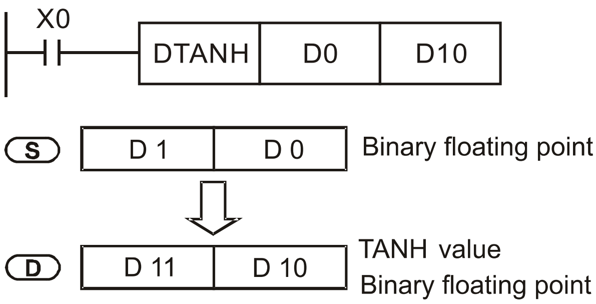
Flag signal: none

Explanation

- **S**: the designated source (binary floating point number). **D**: the TANH value result.
- tanh value $=(e^{s}-e^{-s})/(e^{s}+e^{-s})$

Example

- When X0=On, the TANH value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API 147	D	SWAP	P	(S)	Exchange the up/down 8 bits

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*

Notes on operand usage: none

16-bit command (3 STEP)

SWAP Continuous execution type SWAPP Pulse execution type

32-bit command (5 STEP)

DSWAP Continuous execution type DSWAPP Pulse execution type

Flag signal: none

Explanation

- (S): The device that going to exchange its up/down 8 bits.
- When using 16-bit command, the upper 8-bit and lower 8-bit exchange.
- When using 32-bit command, the contents of upper 8-bit and lower 8-bit of the 2 registers exchange.
- This command usually uses pulse execution type (SWAPP, DSWAPP)

API				
150	MODRW P	S1 S2 S3 S n		Modbus data read/write

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
S											*
n				*	*						*

16-bit command (5 STEP)

MODRW Continuous execution type MODRW P Pulse execution type

32-bit command

— — — —

Flag signal: M1077 M1078 M1079

Explanation

- S1: online device address. S2: communications function code. S3: address of data to read/write. S: register for data to be read/written is stored. N: length of data to be read/written.
- COM1 must be defined as controlled by the PLC (set Pr.09-31 = -12) before using this command, and the corresponding communications speed and format must also be set (set Pr.09-01 and Pr.09-04). S2: communications function code. Currently only supports the following function code; the remaining function code cannot be executed.

Function	Description
H 02	Input read
H 03	Read word
H 06	Write single word
H 0F	Write multiple coils
H10	Write single word

- After executing this command, M1077, M1078 and M1079 will be immediately changed to 0.
- As an example, when CFP2000 must control another converter and PLC, if the converter has a station number of 10 and the PLC has a station number of 20, see the following example:

Control slave device converter

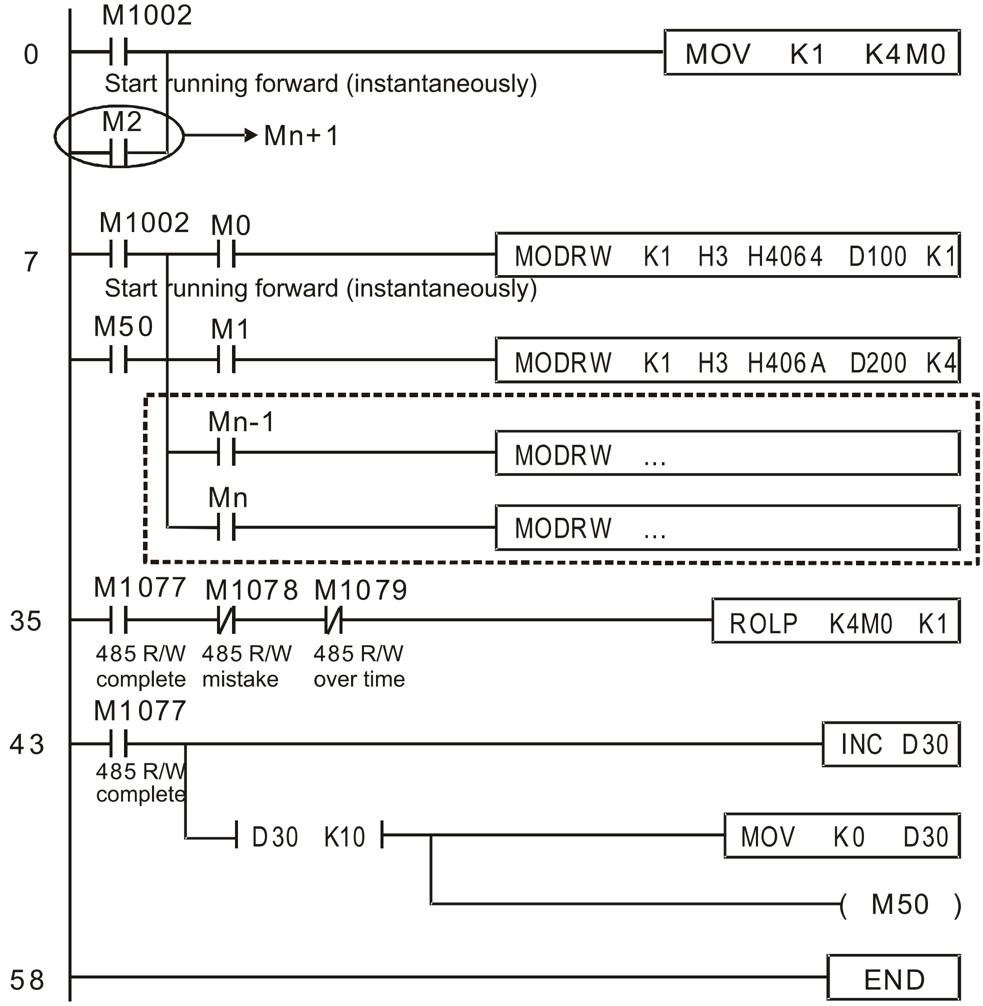
Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length
1	Reads 4 sets of data comprising the converter slave device Pr.01-00 to Pr.01-03, and saves the read data in D0 to D3	K10	H3	H100	D0	K4
2	Reads 3 sets of data comprising the converter slave device addresses H2100 to H2102, and saves the read data in D5 to D7	K10	H3	H2100	D5	K3
3	Reads 3 sets of data comprising the converter slave device Pr.05-00 to Pr.05-03, and writes the values as D10 to D12	K10	H10	H500	D10	K3
4	Writes 2 sets of data comprising the converter slave device addresses H2000 to H2001, and writes the values as D15 to D16	K10	H10	H2000	D15	K2

PLC controlling slave device

Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length:
1	Reads 4 sets of data comprising the PLC slave device's X0 to X3 state, and saves the read data in bits 0 to 3 of D0	K20	H2	H400	D0	K4
2	Reads 4 sets of data comprising the PLC slave device's Y0 to Y3 state, and saves the read data in bits 0 to 3 of D1	K20	H2	H500	D1	K4
3	Reads 4 sets of data comprising the PLC slave device's M0 to M3 state, and saves the read data in bits 0 to 3 of D2	K20	H2	H800	D2	K4
4	Reads 4 sets of data comprising the PLC slave device's T0 to T3 state, and saves the read data in bits 0 to 3 of D3	K20	H2	H600	D3	K4
5	Reads 4 sets of data comprising the PLC slave device's C0 to C3 state, and saves the read data in bits 0 to 3 of D4	K20	H2	HE00	D4	K4
6	Reads 4 sets of data comprising the PLC slave device's T0 to T3 count value, and saves the read data of D10 to D13	K20	H3	H600	D10	K4
7	Reads 4 sets of data comprising the PLC slave device's C0 to C3 count value, and saves the read data of D20 to D23	K20	H3	HE00	D20	K4
8	Reads 4 sets of data comprising the PLC slave device's D0 to D3 count value, and saves the read data of D30 to D33	K20	H3	H1000	D30	K4
9	Writes 4 sets of the PLC slave device's Y0 to Y3 state, and writes the values as bits 0 to 3 of D1	K20	HF	H500	D1	K4
10	Writes 4 sets of the PLC slave device's M0 to M3 state, and writes the values as bits 0 to 3 of D2	K20	HF	H800	D2	K4
11	Writes 4 sets of the PLC slave device's T0 to T3 state, and writes the values as bits 0 to 3 of D3	K20	HF	H600	D3	K4
12	Writes 4 sets of the PLC slave device's C0 to C3 state, and writes the values as bits 0 to 3 of D4	K20	HF	HE00	D4	K4
13	Writes 4 sets of the PLC slave device's T0 to T3 state, and writes the values of D10 to D13	K20	H10	H600	D10	K4
14	Writes 4 sets of the PLC slave device's C0 to C3 state, and writes the values of D20 to D23	K20	H10	HE00	D20	K4
15	Writes 4 sets of the PLC slave device's D0 to D3 state, and writes the values of D30 to D33	K20	H10	H1000	D30	K4

Example

- Will trigger M0 On when the PLC begins to operate, and sends instruction to execute one MODRW command.
- After receiving the slave device's response, if the command is correct, it will execute one ROL command, which will cause M1 to be On.
- After receiving the slave device's response, will trigger M50 = 1 after a delay of 10 PLC scanning cycles, and then execute one MODRW command.
- After again receiving the slave device's response, if the command is correct, it will execute one ROL command, and M2 will change to On at this time (and M2 can be defined as a repeat of M); K4M0 will change to K1, and only M0 will remain 1. Transmission can proceed in a continuous cycle. If you wish to add a command, merely add the desired command in the empty frame, and change repeat M to Mn+1.



API		TCMP	P	S1 S2 S3 S D	Comparison of calendar data
160					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S3				*	*	*	*	*	*	*	*
S									*	*	*
D		*	*								

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (11 STEP)

TCMP	Continuous execution type	TCMPP	Pulse execution type

32-bit command

—	—	—	—

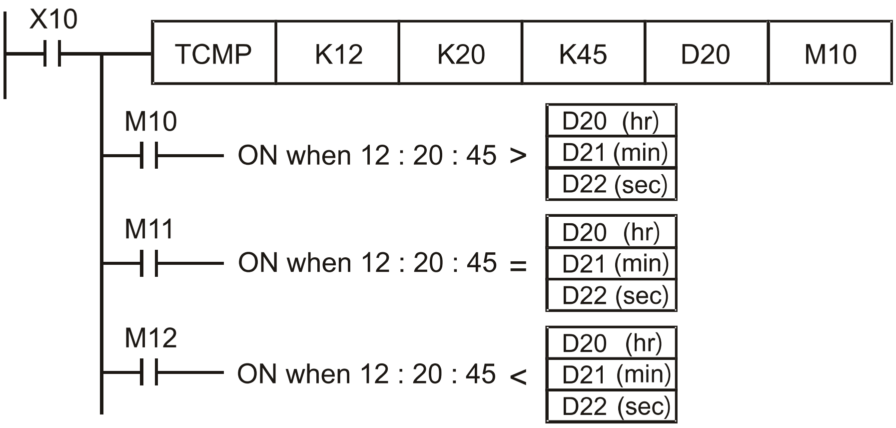
Flag signal: none

Explanation

- **S_1**: Sets the hours of the comparison time, setting range is "K0–K23." **S_2**: Sets the minutes of the comparison time, setting range is "K0–K59." **S_3**: Sets the seconds of the comparison time, setting range is "K0–K59." **S**: current calendar time. **D**: Results of comparison.
- Compares the time in hours, minutes, and seconds set in **S_1–S_3** with the current calendar time in hours, minutes, and seconds, with the results of comparison expressed in **D**.
- **S** The hour content of the current calendar time is "K0–K23." **S** +1 comprises the minutes of the current calendar time, and consists of "K0–K59." **S** +2 comprises the seconds of the current calendar time, and consists of "K0–K59."
- The current calendar time designated by **S** is usually compared using the TCMP command after using the TRD command to read the current calendar time. If the content value of **S** exceeds the range, this is considered an operating error, the command will not execute, and M1068=On.

Example

- When X10=On, the command will execute, and the current calendar time in D20–D22 will be compared with the preset value of 12:20:45; the results will be displayed in M10–M12. When X10 On→Off, the command will not be executed, but the On/Off status prior to M10–M12 will be maintained.
- If results in the form of ≥, ≤, or ≠ are needed, they can be obtained by series and parallel connection of M10–M12.



API		Mnemonic		Operands	Function
161		TZCP	P	S1 S2 S D	Comparison of calendar data

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*
S									*	*	*
D		*	*								

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (9 STEP)

TZCP	Continuous execution type	TZCPP	Pulse execution type

32-bit command

–	–	–	–

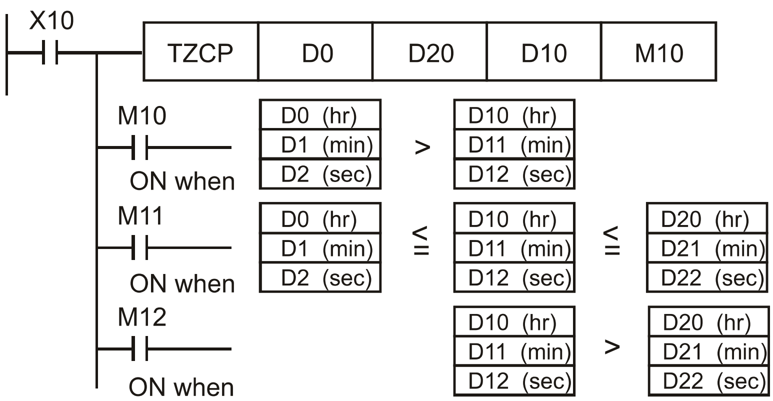
Flag signal: none

Explanation

- S_1: Sets the lower limit of the comparison time. S_2: Sets the upper limit of the comparison time. **S**: current calendar time. **D**: Results of comparison.
- Performs range comparison by comparing the hours, minutes, and seconds of the current calendar time designated by **S** with the lower limit of the comparison time set as S_1 and the upper limit of the comparison time set as S_2, and expresses the results of comparison in **D**.
- S_1, S_1 +1, S_1 +2: Sets the hours, minutes, and seconds of the lower limit of the comparison time.
- S_2, S_2 +1, S_2 +2: Sets the hours, minutes, and seconds of the upper limit of the comparison time.
- **S**, **S** +1, **S** +2: The hours, minutes, and seconds of the current calendar time
- The D0 designated by the **S** listed in this program is usually obtained by comparison using the TZCP command after using the TRD command in advance to read the current calendar time. If the value of S_1, S_2, or **S** exceeds the range, this is considered an operating error, the command will not execute, and M1068=On.
- When the current time **S** is less than the lower limit value S_1 and **S** is less than the upper limit value S_2, **D** will be On. When the current time **S** is greater than the lower limit value S_1 and **S** is greater than the upper limit value S_2, **D** +2 will be On; **D** +1 will be On under other conditions.

Example

- When X10=On, the TZCP command executes, and one of M10-M12 will be On. When X10=Off, the TZCP command will not execute, and M10-M12 will remain in the X10=Off state.



API		TADD	P	S1 S2 D	Calendar data addition
162					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*
D									*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (7 STEP)

TADD	Continuous execution type	TADDP	Pulse execution type

32-bit command

—	—	—	—

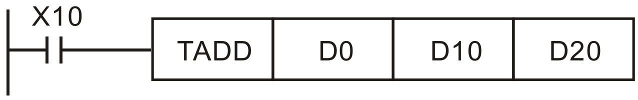
- Flag signal: M1020 Zero flag
  M1022 Carry flag
  M1068 Calendar error

Explanation

- S_1: time addend. S_2: time augend. **D**: time sum.
- The calendar data in hours, minutes, and seconds designated by S_2 is added to the calendar data in hours, minutes, and seconds designated by S_1, and the result is stored as hours, minutes, and seconds in the register designated by **D**.
- If the value of S_1 or S_2 exceeds the range, this is considered an operating error, the command will not execute, M1067, M1068=On, and D1067 will record the error code 0E1A (HEX).
- If the results of addition are greater than or equal to 24 hours, carry flag M1022=On, and **D** will display the results of addition minus 24 hours.
- If the results of addition are equal to 0 (0 hours, 0 minutes, 0 seconds), zero flag M1020=On.

Example

- When X10=On, the TADD command will be executed, and the calendar data in hours, minutes, and seconds designated by D0 to D2 will be added to the calendar data in hours, minutes, and seconds designated by D10 to D12, and the results are stored as a total number of hours, minutes, and seconds in the registers designated by D20 to D22.



S1		+	S2		→	D	
D0	8(hr)		D10	6(hr)		D20	14(hr)
D1	10(min)		D11	40(min)		D21	50(min)
D2	20(sec)		D12	6(sec)		D22	26(sec)
8 : 10 : 20			6 : 40 : 6			14 : 50 : 26	

API 163	TSUB P	S1 S2 D	Calendar data subtraction

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*
D									*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (7 STEP)

TSUB	Continuous execution type	TSUBP	Pulse execution type

32-bit command

–	–	–	–

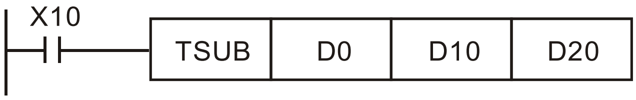
- Flag signal: M1020 Zero flag
  M1022 Carry flag
  M1068 Calendar error

Explanation

- S_1: time minuend. S_2: time augend. **D**: time sum.
- Subtracts the calendar data in hours, minutes, and seconds designated by S_2 from the calendar data in hours, minutes, and seconds designated by S_1, and the result is temporarily stored as hours, minutes, and seconds in the register designated by **D**.
- If the value of S_1 or S_2 exceeds the range, this is considered an operating error, the command will not execute, M1067, M1068=On, and D1067 will record the error code 0E1A (HEX).
- If subtraction results in a negative number, borrow flag M1021=On, and the result of that negative number plus 24 hours will be displayed in the register designated by **D**.
- If the results of subtraction are equal to 0 (0 hours, 0 minutes, 0 seconds), zero flag M1020=On.

Example

- When X10=On, the TADD command will be executed, and the calendar data in hours, minutes, and seconds designated by D10 to D12 will be subtracted from the calendar data in hours, minutes, and seconds designated by D0 to D2, and the results are stored as a total number of hours, minutes, and seconds in the registers designated by D20 to D22.



D0	20(hr)	–	D10	14(hr)	→	D20	5(hr)
D1	20(min)		D11	30(min)		D21	49(min)
D2	5(sec)		D12	8(sec)		D22	57(sec)

20 : 20 : 5   14 : 30 : 8   5 : 49 : 57

API				
166	TRD	P	(D)	Calendar data read

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D									*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (3 STEP)

TRD	Continuous execution type	TRDP	Pulse execution type

32-bit command

–	–	–	–

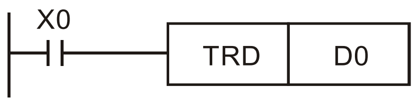
- Flag signal: none

Explanation

- **S₁**: time minuend. **S₂**: time augend. **D**: time sum.
- **D**: device used to store the current calendar time after reading.
- The EH/EH2/SV/EH3/SV2/SA/SX/SC main units have a built-in calendar clock, and the clock provides seven sets of data comprising year, week, month, day, hour, minute, and second stored in D1063 to D1069. The TRD command function allows program designers to directly read the current calendar time into the designated seven registers.
- D1063 only reads the two right digits of the Western calendar year.

Example

- When X0=On, the current calendar time is read into the designated registers D0 to D6.
- In D1064, 1 indicates Monday, 2 indicates Tuesday, and so on, with and 7 indicating Sunday.



Special D	Item	Content		General D	Item
D1063	Year (Western)	00–99	→	D0	Year (Western)
D1064	Weeks	1–7	→	D1	Weeks
D1065	Month	1–12	→	D2	Month
D1066	Day	1–31	→	D3	Day
D1067	Hour	0–23	→	D4	Hour
D1068	Minute	0–59	→	D5	Minute
D1069	Second	0–59	→	D6	Second

API					
170	D	GRY	P	S D	BIN→GRAY code transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

GRY	Continuous execution type	GRYP	Pulse execution type

32-bit command (9 STEP)

DGRY	Continuous execution type	DGRYP	Pulse execution type

- Flag signal: none

Explanation

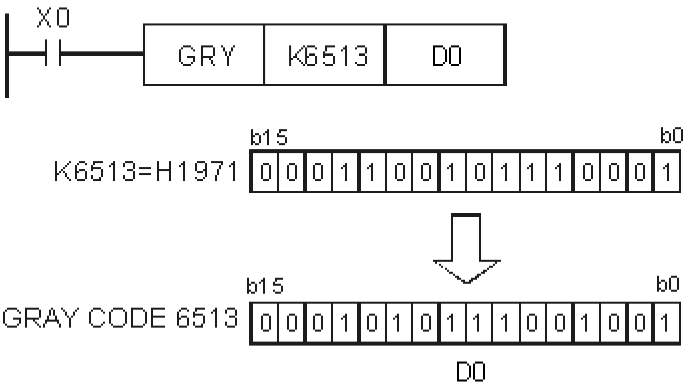
- **S**: source device. **D**: device storing GRAY code.
- Transforms the content value (BIN value) of the device designated by **S** to GRAY code, which is stored in the device designated by **D**.
- The valid range of **S** is as shown below; if this range is exceeded, it will be considered an error, and the command will not execute.

16-bit command: 0–32,767

- 32-bit command: 0–2,147,483,647

Example

- When X0=On, the constant K6513 will be transformed to GRAY code and stored in D0.



API 171	D	GBIN	P	(S) (D)	GRAY code →BIN transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

GBIN	Continuous execution type	GBINP	Pulse execution type

32-bit command (9 STEP)

DGBIN	Continuous execution type	DGBINP	Pulse execution type

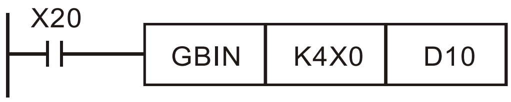
- Flag signal: none

Explanation

- **S**: source device used to store GRAY code. **D**: device used to store BIN value after transformation.
- The GRAY code corresponding to the value of the device designated by **S** is transformed into a BIN value, which is stored in the device designated by **D**.
- This command will transform the value of the absolute position encoder connected with the PLC's input and (this encoder usually has an output value in the form of GRAY code) into a BIN value, which is stored in the designated register.
- The valid range of **S** is as shown below; if this range is exceeded, it will be considered an error, and the command will not execute.
- 16-bit command: 0–32,767
- 32-bit command: 0–2,147,483,647

Example

- When X20=On, the GRAY code of the absolute position encoder connected with input points X0 to X17 will be transformed into BIN value and stored in D10.



K4X0

	X17															X0
GRAY CODE 6513	0	0	0	1	0	1	0	1	1	1	0	0	1	0	0	1

⇩

	b15															b0
H1971=K6513	0	0	0	1	1	0	0	1	0	1	1	1	0	0	0	1

API				
215–217	D	LD#	S1 S2	Contact form logical operation LD#

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: # : &、|、^

Please refer to the function specifications table for each device in series for the range of device usage

16-bit command (5 STEP)

LD#	Continuous execution type	—	—

32-bit command (9 STEP)

DLD#	Continuous execution type	—	—

Flag signal: none

Explanation

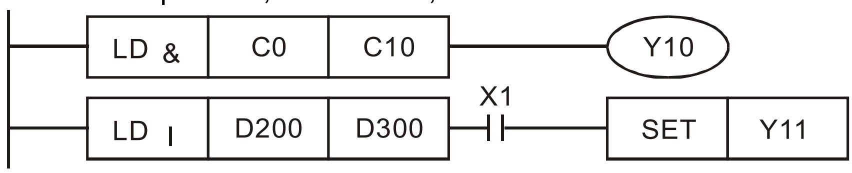
- **S1**: data source device 1. **S2**: data source device 2.
- This command performs comparison of the content of **S1** and **S2**; when the result of comparison is not 0, this command will be activated, but this command will not be activated when the result of comparison is 0.
- The LD#This command can be used while directly connected with the busbar

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
215	LD&	**D**LD&	S_1 & S_2 $\neq 0$	S_1 & S_2 $= 0$
216	LD|	**D**LD|	S_1 | S_2 $\neq 0$	S_1 | S_2 $= 0$
217	LD^	**D**LD^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $= 0$

- &: logical AND operation.
- |: logical OR operation.
- ^: logical XOR operation.

Example

- When the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y10=On.
- When the content of D200 and D300 is subjected to the logical OR operation, and the result is not equal to 0, and X1=On, Y11=On and remains in that state.



API	D	AND#	S1 S2	Contact form logical operation AND#
218–220				

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: # : & 、| 、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

AND#	Continuous execution type	–	–

32-bit command (9 STEP)

DAND#	Continuous execution type	–	–

Flag signal: none

Explanation

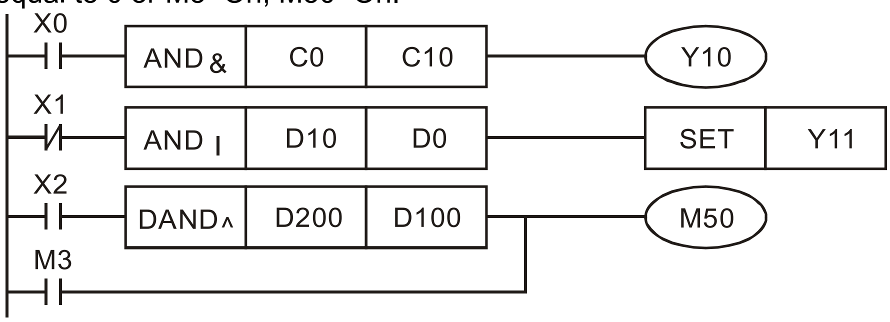
- S_1: data source device 1. S_2: data source device 2.
- This command performs comparison of the content of S_1 and S_2; when the result of comparison is not 0, this command will be activated, but this command will not be activated when the result of comparison is 0.
- The AND# command is an operation command in series with the contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
218	AND&	DAND&	S_1 & S_2 $\neq 0$	S_1 & S_2 $= 0$
219	AND|	DAND|	S_1 | S_2 $\neq 0$	S_1 | S_2 $= 0$
220	AND^	DAND^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $= 0$

- &: logical AND operation.
- |: logical OR operation.
- ^: logical XOR operation.

Example

- When X0=On and the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y10=On.
- When X1=Off and D10 and D0 is subjected to the logical OR operation, and the result is not equal to 0, Y11=On and remains in that state.
- When X2 =On and the content of the 32-bit register D200 (D201) and 32-bit register D100 (D101) is subjected to the logical XOR operation, and the result is not equal to 0 or M3=On, M50=On.



API					
221–223	D	OR#		S1 S2	Contact form logical operation OR#

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: # : &、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

OR#	Continuous execution type	–	–

32-bit command (9 STEP)

DOR#	Continuous execution type	–	–

Flag signal: none

Explanation

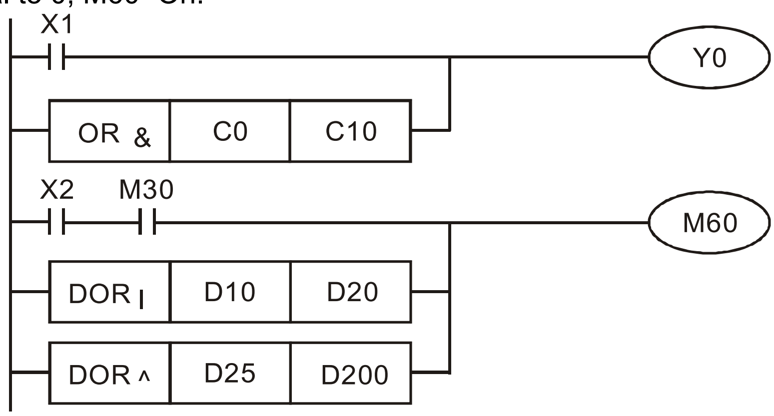
- S_1: data source device 1. S_2: data source device 2.
- This command performs comparison of the content of S_1 and S_2; when the result of comparison is not 0, this command will be activated, but this command will not be activated when the result of comparison is 0.
- The OR# command is an operation command in series with the contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
221	OR&	DOR&	S_1 & S_2 $\neq 0$	S_1 & S_2 $= 0$
222	OR|	DOR|	S_1 | S_2 $\neq 0$	S_1 | S_2 $= 0$
223	OR^	DOR^	S_1 ^ S_2 $\neq 0$	S_1 ^ S_2 $= 0$

- &: logical AND operation.
- |: logical OR operation.
- ^: logical XOR operation.

Example

- When X1=On or the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y0=On.
- When X2 and M30 are both equal to On, or the content of 32-bit register D10 (D11) and 32-bit register D20 (D21) is subjected to the logical OR operation, and the result is not equal to 0, or the content of the 32-bit counter C235 and the 32-bit register D200 (D201) is subjected to the logical XOR operation, and the result is not equal to 0, M60=On.



API 224–230	D	LD※	(S1) (S2)	Contact form compare LD*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※ : =、>、<、<>、≦、≧

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

LD※	Continuous execution type	–	–

32-bit command (9 STEP)

DLD※	Continuous execution type	–	–

Flag signal: none

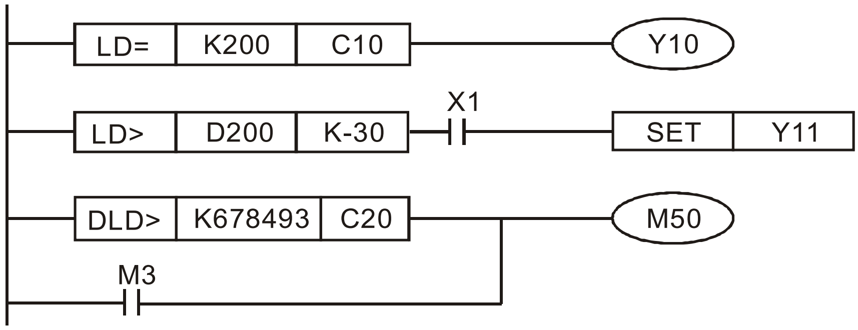
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking API 224 (LD=) as an example, this command will be activated when the result of comparison is "equal," and will not be activated when the result is "unequal."
- The LD* can be used while directly connected with the busbar

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
224	LD＝	DLD＝	$S_1 = S_2$	$S_1 \neq S_2$
225	LD＞	DLD＞	$S_1 > S_2$	$S_1 \leqq S_2$
226	LD＜	DLD＜	$S_1 < S_2$	$S_1 \geqq S_2$
228	LD＜＞	DLD＜＞	$S_1 \neq S_2$	$S_1 = S_2$
229	LD＜＝	DLD＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
230	LD＞＝	DLD＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When the content of C10 is equal to K200, Y10=On.
- When the content of D200 is greater than K-30, and X1=On, Y11=On and remains in that state.



API 232–238	D	AND※		S1 S2	Contact form compare AND*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※ : = 、> 、< 、<> 、≦ 、≧

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

AND※	Continuous execution type	–	–

32-bit command (9 STEP)

DAND※	Continuous execution type	–	–

Flag signal: none

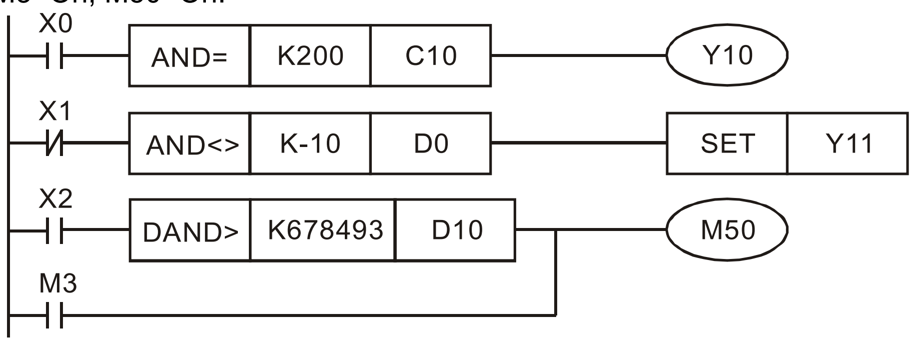
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking API 232 (AND=) as an example, when the result of comparison is equal, this command will be activated; when the result of comparison is unequal, this command will not be activated.
- The AND* command is a comparison command in series with a contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
232	AND＝	DAND＝	$S_1 = S_2$	$S_1 \neq S_2$
233	AND＞	DAND＞	$S_1 > S_2$	$S_1 \leqq S_2$
234	AND＜	DAND＜	$S_1 < S_2$	$S_1 \geqq S_2$
236	AND＜＞	DAND＜＞	$S_1 \neq S_2$	$S_1 = S_2$
237	AND＜＝	DAND＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
238	AND＞＝	DAND＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When X0=On and the current value of C10 is also equal to K200, Y10=On.
- When X1=Off and the content of register D0 is not equal to K-10, Y11=On and remains in that state.
- When X2 =On and the content of the 32-bit register D0 (D11) is less than 678,493, or M3=On, M50=On.



API	D	OR※		(S1) (S2)	Contact form compare OR*
240–246					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※ : =、>、<、<>、≦、≧

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

OR※	Continuous execution type	–	–

32-bit command (9 STEP)

DOR※	Continuous execution type	–	–

Flag signal: none

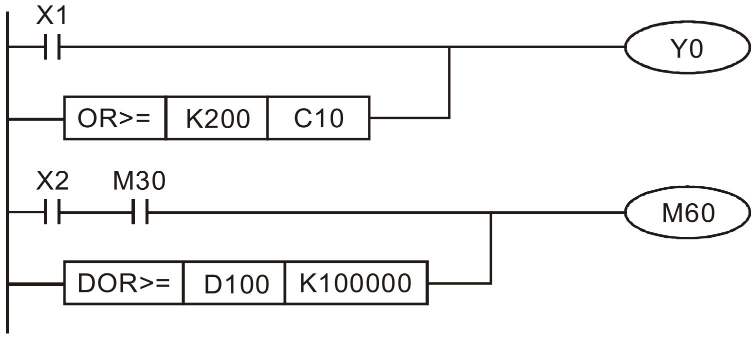
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking API 240 (OR=) as an example, when the result of comparison is equal, this command will be activated; when the result of comparison is unequal, this command will not be activated.
- The OR* command is a compare command in parallel with a contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
240	OR＝	DOR＝	$S_1 = S_2$	$S_1 \neq S_2$
241	OR＞	DOR＞	$S_1 > S_2$	$S_1 \leqq S_2$
242	OR＜	DOR＜	$S_1 < S_2$	$S_1 \geqq S_2$
244	OR＜＞	DOR＜＞	$S_1 \neq S_2$	$S_1 = S_2$
245	OR＜＝	DOR＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
246	OR＞＝	DOR＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When X0=On and the current value of C10 is also equal to K200, Y10=On.
- When X1=Off and the content of register D0 is not equal to K-10, Y11=On and remains in that state.
- When X2 =On and the content of the 32-bit register D0 (D11) is less than 678,493, or M3=On, M50=On.



API				
275–280	FLD※	S1	S2	Floating point number contact form compare LD*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: # : & 、| 、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

FLD※	Continuous execution type	–	–

Flag signal: none

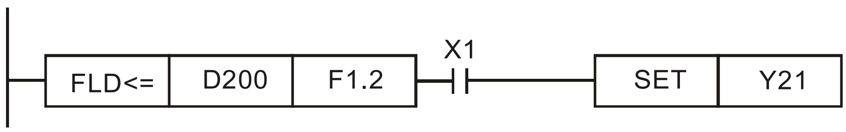
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking "FLD=" as an example, if the result of comparison is "equal," this command will be activated; but it will not be activated when the result is "unequal."
- The FLD* command can directly input floating point numerical values (for instance: F1.2) to the S_1, S_2 operands, or store floating-point numbers in register D for use in operations.
- This command can be used while directly connected with the busbar

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
275	FLD=	$S_1 = S_2$	$S_1 \neq S_2$
276	FLD>	$S_1 > S_2$	$S_1 \leqq S_2$
277	FLD<	$S_1 < S_2$	$S_1 \geqq S_2$
278	FLD<>	$S_1 \neq S_2$	$S_1 = S_2$
279	FLD<=	$S_1 \leqq S_2$	$S_1 > S_2$
280	FLD>=	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When the floating point number of register D200 (D201) is less than or equal to F1.2, and X1 activated, contact Y21 will be activated and remain in that state.



API 281–286		FAND※		(S1) (S2)	Floating point number contact form compare AND*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ＃：&、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

FAND※	Continuous execution type	–	–

Flag signal: none

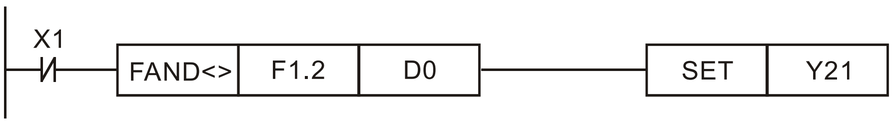
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking "FAND=" as an example, if the result of comparison is "equal," this command will be activated; but it will not be activated when the result is "unequal."
- The FAND* command can directly input floating point numerical values (for instance: F1.2) to the S_1, S_2 operands, or store floating-point numbers in register D for use in operations.
- This command can be used while directly connected with the busbar

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
281	FAND=	$S_1 = S_2$	$S_1 \neq S_2$
282	FAND>	$S_1 > S_2$	$S_1 \leqq S_2$
283	FAND<	$S_1 < S_2$	$S_1 \geqq S_2$
284	FAND<>	$S_1 \neq S_2$	$S_1 = S_2$
285	FAND<=	$S_1 \leqq S_2$	$S_1 > S_2$
286	FAND>=	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When X1=Off, and the floating point number in register D100 (D101) is not equal to F1.2, Y21=On and remains in that state.



API			
287–292	FOR※	(S1) (S2)	Floating point number contact form compare OR*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: # : & 、| 、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

FOR※	Continuous execution type	–	–

Flag signal: none

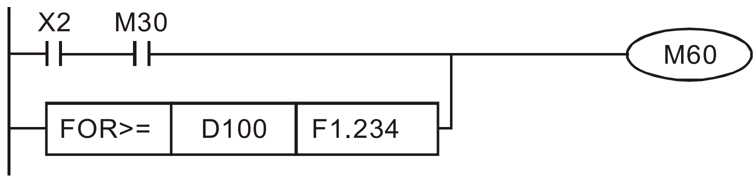
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking "FOR=" as an example, if the result of comparison is "equal," this command will be activated; but it will not be activated when the result is "unequal."
- The FOR* command can directly input floating point numerical values (for instance: F1.2) to the S_1, S_2 operands, or store floating-point numbers in register D for use in operations.
- This command can be used while directly connected with the busbar

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
287	FOR=	$S_1 = S_2$	$S_1 \neq S_2$
288	FOR>	$S_1 > S_2$	$S_1 \leqq S_2$
289	FOR<	$S_1 < S_2$	$S_1 \geqq S_2$
290	FOR<>	$S_1 \neq S_2$	$S_1 = S_2$
291	FOR<=	$S_1 \leqq S_2$	$S_1 > S_2$
292	FOR>=	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When X2 and M30 are both equal to "On," or the floating point number in register D100 (D101) is greater than or equal to F1.234, M60=On.



16-6-5 Detailed explanation of driver special applications commands

API					
139		RPR	P	S1 S2	Read servo parameter

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2											*

Notes on operand usage: none

16-bit command (5 STEP)

RPR	Continuous execution type	RPRP	Pulse execution type

32-bit command

—	—	—	—

Flag signal: none

Explanation

■ S1: Parameter address of data to be read. S2: Register where data to be read is stored.

API					
140		WPR	P	S1 S2	Write servo parameter

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*

Notes on operand usage: none

16-bit command (5 STEP)

WPR	Continuous execution type	WPRP	Pulse execution type

32-bit command

—	—	—	—

Flag signal: none

Explanation

■ S1: Data to write to specified page. S2: Parameter address of data to be written.

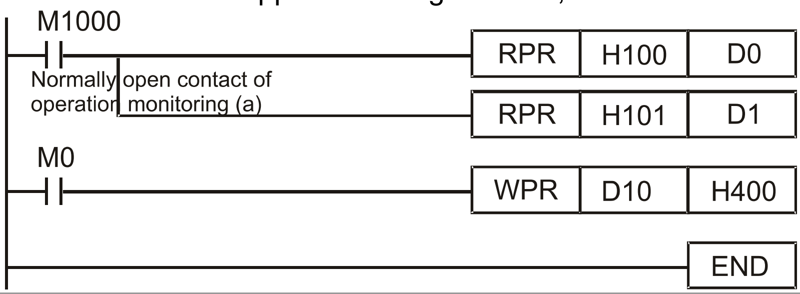
Example

■ When the data in the CFP2000 driver's parameter H01.00 is read and written to D0, data from H01.01 will be read and written to D1.

■ When M0=On, the content of D10 will be written to the CFP2000 driver parameter 04-00 (first speed of multiple speed levels).

■ When the parameter has been written successfully, M1017=On.

■ The CFP2000's WPR command does not support writing to the 20XX address, but the RPR command supports reading of 21XX, 22XX.



Recommendation Take care when using the WPR command. When writing parameters, because most parameters are recorded as they are written, these parameters may only be revised 109 times; a memory write error may occur if parameters are written more than 10^9 times.

Because the following commonly-used parameters have special processing, there are **no** restrictions on the number of times they may be written.

Pr.00-11: Speed mode selection

Pr.00-27: User-defined value

Pr.01-12: Acceleration time 1

Pr.01-13: Deceleration time 1

Pr.01-14: Acceleration time 2
Pr.01-15: Deceleration time 2
Pr.01-16: Acceleration time 3
Pr.01-17: Deceleration time 3
Pr.01-18: Acceleration time 4
Pr.01-19: Deceleration time 4

Pr.02-12: Select MI Conversion Time mode:
Pr.02-18: Select MO Conversion Time mode:

Pr.04-50–Pr.04-69: PLC register parameter 0–19

Pr.08-04: Upper limit of integral
Pr.08-05: PID output upper limit

Pr.10-17: Electronic gear A
Pr.10-18: Electronic gear B

Calculation of the number of times written is based on whether the written value is modified. For instance, writing the same value 100 times at the same time counts as writing only once.
When writing a PLC program, if unsure of usage of the WPR command, we recommend that you use the WPRP command.

API 141		FPID	P	S1 S2 S3 S4	Driver PID control mode

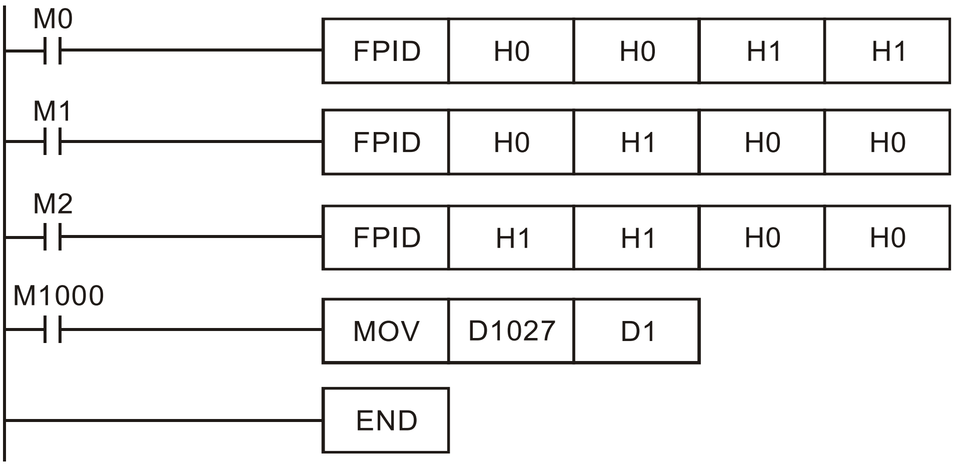
	Bit device			Word device								16-bit command (9 STEP)
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	FPID: Continuous execution type; FPIDP: Pulse execution type
S1				*	*						*	32-bit command
S2				*	*						*	– – – –
S3				*	*						*	
S4				*	*						*	
Notes on operand usage: none												Flag signal: none

Explanation

- S1: PID reference target value input terminal select. S2: PID function proportional gain P. S3: PID function integral time I. S4: PID function differential time D.
- The FPID command can directly control the driver's feedback control of PID parameter Pr.08-00 PID reference target value input terminal selection, Pr.08-01 proposal gain P, Pr.08-02 integral time I, and Pr.08-03 differential time D.

Example

- When M0=On, the set PID reference target value input terminal selection is 0 (no PID function), the PID function proportional gain P is 0, the PID function integral time I is 1 (units: 0.01 sec.), and the PID function differential time D is 1 (units: 0.01 sec.).
- When M1=On, the set PID reference target value input terminal selection is 0 (no PID function), the PID function proportional gain P is 1 (units: 0.01), the PID function integral time I is 0, and the PID function differential time D is 0.
- When M2=On, the set PID reference target value input terminal selection is 1 (target frequency input is controlled from the digital keypad), the PID function proportional gain P is 1 (units: 0.01), the PID function integral time I is 0, and the PID function differential time D is 0.
- D1027: Frequency command after PID operation.



API					
142		FREQ	P	S1 S2 S3	Driver speed control mode

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*

Notes on operand usage: none

16-bit command (7 STEP)

FREQ	Continuous execution type	FREQP	Pulse execution type

32-bit command

–	–	–	–

Flag signal: M1015

Explanation

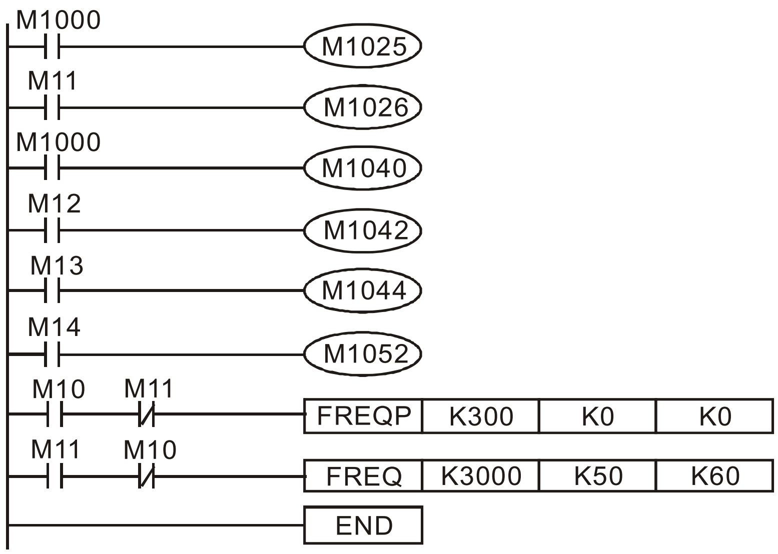
- S1: Frequency command. S2: Acceleration time. S3: Deceleration time
- S2, S3: In acceleration/deceleration time settings, the number of decimal places is determined by the definitions of Pr.01-45.

Example
When Pr.01-45=0: units of 0.01 sec.
The setting of 50 for S2 (acceleration time) in the ladder diagram below implies 0.5 sec, and the S3 (deceleration time) setting of 60 implies 0.6 sec

- The FREQ command can control driver frequency commands, and acceleration and deceleration time; it also uses special register control actions, such as:
  M1025: Control driver RUN(On)/STOP(Off) (RUN requires Servo On (M1040 On) to be effective)
  M1026: Control driver operating direction FWD(Off)/REV(On)
  M1040: Control Servo On/Servo Off.
  M1042: Trigger quick stop (ON)/does not trigger quick stop (Off).
  M1044: Pause (On)/release pause (Off)
  M1052: Lock frequency (On)/release lock frequency (Off)

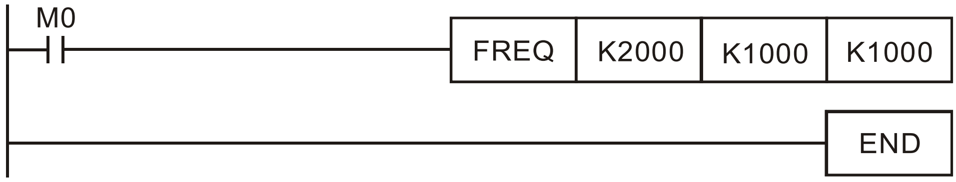
Example

- M1025: Driver RUN (On) / STOP (Off), M1026: driver operating direction FWD (Off) / REV (On). M1015: frequency reached.
- When M10=On, sets the driver frequency command K300 (3.00 Hz), with an acceleration/deceleration time of 0.
  When M11=On, sets the driver frequency command K3000 (30.00 Hz), with an acceleration time of 50 (0.5 sec.) and deceleration time of 60 (0.6 sec.). (When Pr.01-45=0)
- When M11=Off, the drive frequency command will now change to 0



- Pr.09-33 are defined on the basis of whether the reference commands have been cleared before PLC operation.
  bit0: Prior to PLC scanning procedures, whether the target frequency has been cleared is 0. (This will be written to the FREQ command when the PLC is ON).

Example: When using r to write a program



If we force M0 to be 1, the frequency command will be 20.00 Hz; but when M0 is set as 0, there will be a different situation.

Case 1: When the bit0 of Pr.09-33 is 0, and M0 is set as 0, the frequency command remains at 20.00 Hz.

Case 2: When the bit0 of Pr.09-33 is 1, and M0 is set as 0, the frequency command changes to 0.00 Hz.

The reason is that when the Pr.09-33 bit0 is 1 prior to the PLC scanning procedures, the frequency will firstly revert to 0.

When the Pr.09-33 bit0 is 0, the frequency will not revert to 0.

API	CANRX P	(S1) (S2) (S3) (D)	Read CANopen slave station data
261			

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						
S2				*	*						
S3				*	*						
D									*	*	*

Notes on operand usage: none

16-bit command (9 STEP)

CANRX	Continuous execution type	CANRX P	Pulse execution type

32-bit command

–	–	–	–

Flag signal

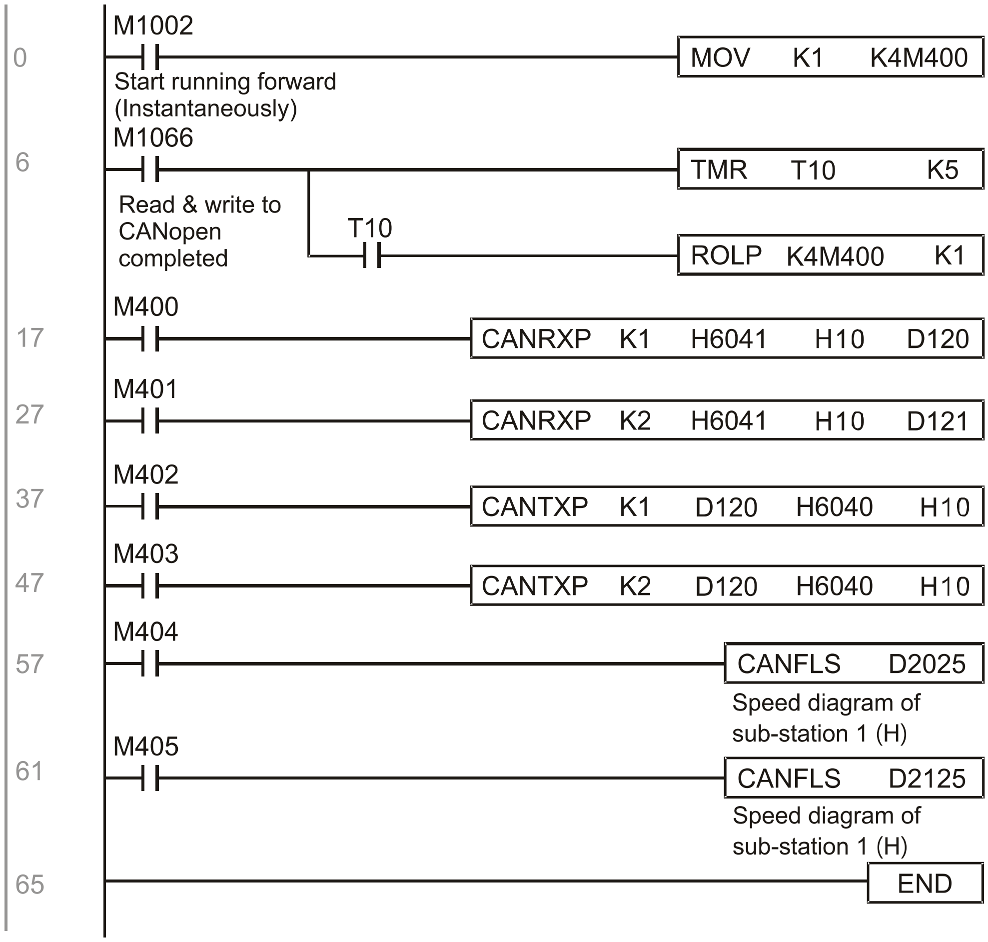
Explanation

- (S1): Slave station number. (S2): Main index. (S3): Subindex+bit length. (D): Preset address.
- The CANRX command can read the index of the corresponding slave station. When it is executed, it will send the SDO message format to the slave station. M1066 and M1067 will both be 0 at that time, and M1066 will be set as 1 after reading. If the slave station gives the correct response, it will write the value to the preset register, and set M1067 as 1. If the slave station has a response error, M1067 will be set as 0, and an error message will be recorded to D1076 to D1079.

Example

M1002: When the PLC runs, the command will be triggered once and will set K4M400 = K1

Afterwards, each time M1066 is 1, it will switch to a different message.



API					
264		CANTX	P	(S1) (S2) (S3) (S4)	Write CANopen slave station data

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						
S2				*	*				*	*	*
S3				*	*						
S4				*	*						

Notes on operand usage: none

16-bit command (9 STEP)

CANTX	Continuous execution type	CANTXP	Pulse execution type

32-bit command

–	–	–	–

Flag signal

Explanation

- (S1): Slave station number. (S2): Address to be written. (S3): Main index. (S4): Subindex+bit length.
- The CANTX command can write a value to the index of the corresponding slave station. When it is executed, it will send the SDO message format to the slave station. M1066 and M1067 will both be 0 at that time, and M1066 will be set as 1 after reading. If the slave station gives the correct response, it will write the value to the preset register, and set M1067 as 1. If the slave station has a response error, M1067 will be set as 0, and an error message will be recorded to D1076 to D1079.

API					
265		CANFLS	P	(D)	Refresh special D corresponding to CANopen

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D				*	*						

Notes on operand usage: none

16-bit command (3 STEP)

CANFLS	Continuous execution type	CANFLSP	Pulse execution type

32-bit command

–	–	–	–

Flag signal

Explanation

- (D): Special D to be refreshed.
- The CANFLS command can refresh special D commands. When is a read only attribute, executing this command will send a message equivalent to that of CANRX to the slave station, and the number of the slave station will be transmitted back and refreshed to this special D. When there is a read/write attribute, executing this command will send a message equivalent to that of CANTX to the slave station, and the value of this special D will be written to the corresponding slave station.
- When M1066 and M1067 are both 0, and M1066 is set as 1 after reading, if the slave station gives a correct response, the value will be written to the designated register, and M1067 will be set as 1. If the slave station's response contains an error, then M1067 will be set as 0, and an error message will be recorded to D1076-D1079.

API					
320	D	ICOMR	P	(S1)(S2)(S3)(D)	Internal communications read

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
D				*	*						*

Notes on operand usage: none

16-bit command (9 STEP)

ICOMR	Continuous execution type	ICOMRP	Pulse execution type

32-bit command (17 STEP)

DICOMR	Continuous execution type	DICOMRP	Pulse execution type

Flag signal: M1077 M1078 M1079

Explanation

(S1): Selection of slave device. (S2): Device selection (0: converter, 1: internal PLC). (S3): Read address. (D): Saving target.

- The ICOMR command can obtain the slave station's converter and the internal PLC's register value.

API				
321	D	ICOMW	P	S1 S2 S3 D	Internal communications write

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
D				*	*						*

Notes on operand usage: none

16-bit command (9 STEP)

ICOMW	Continuous execution type	ICOMWP	Pulse execution type

32-bit command (17 STEP)

DICOMW	Continuous execution type	DICOMWP	Pulse execution type

Flag signal: M1077 M1078 M1079

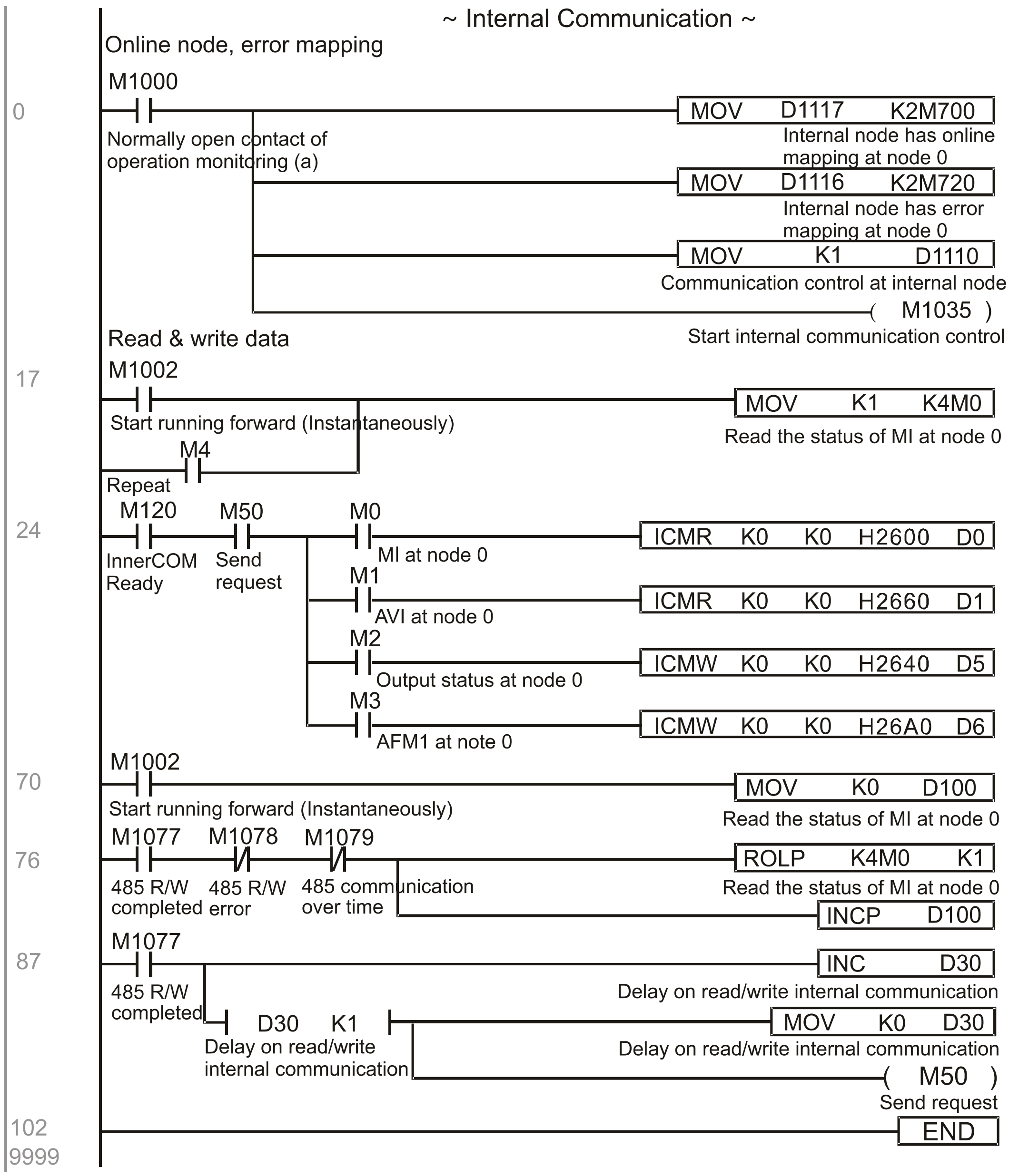
Explanation

S1: Selection of slave device. S2: Device selection (0: converter, 1: internal PLC). S3: Read address. D: Saving target.

- The ICOMW command write a value to the slave station's converter and the internal PLC's register.

Example

Please refer to the following example:



API				
323	WPRA	P	S1 S2	Drive parameters write-in

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*

Notes on operand usage: none

16-bit command (5 STEP)

WORA	Continuous execution type	WORAP	Pulse execution type

32-bit command

-	-	-	-

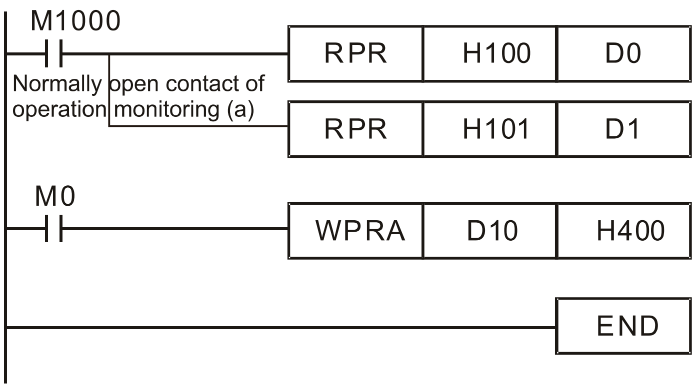
Flag signal: none

Explanation

S1: Data that is going to write in S2: Parameter address of the write-in data

Example

- Read the data of CFP2000 drive's parameter H01.00 and write into D0, read data of H01.01 and write into D1.
- When M0 is ON, write the content of D10 into CFP2000 drive's Pr.04-00 (1st step speed frequency).
- When parameter writes-in successfully, M1017 is ON.
- The WPR command does not support the write-in of 20XX address, but the RPR command supports the read-out of 21XX and 22XX.



Recommendation

- When WPRA executes, the data is only written into the RAM area, and will get back to previous record when the power is off.

16-7 Error display and handling

Code	ID	Description	Recommended handling approach
PLrA	47	RTC time check	Turn power on and off when resetting the keypad time
PLrt	49	incorrect RTC mode	Turn power on and off after making sure that the keypad is securely connected
PLod	50	Data writing memory error	Check whether the program has an error and download the program again
PLSv	51	Data write memory error during program execution	Restart power and download the program again
PLdA	52	Program transmission error	Try uploading again; if the error persists, sent to the manufacturer for service
PLFn	53	Command error while downloading program	Check whether the program has an error and download the program again
PLor	54	Program exceeds memory capacity or no program	Restart power and download the program again
PLFF	55	Command error during program execution	Check whether the program has an error and download the program again
PLSn	56	Check code error	Check whether the program has an error and download the program again
PLEd	57	Program has no END stop command	Check whether the program has an error and download the program again
PLCr	58	MC command has been used continuously more than nine times	Check whether the program has an error and download the program again
PLdF	59	Download program error	Check whether the program has an error and download again
PLSF	60	PLC scan time excessively long	Check whether the program code has a writing error and download again

16-8 CANopen Master control applications

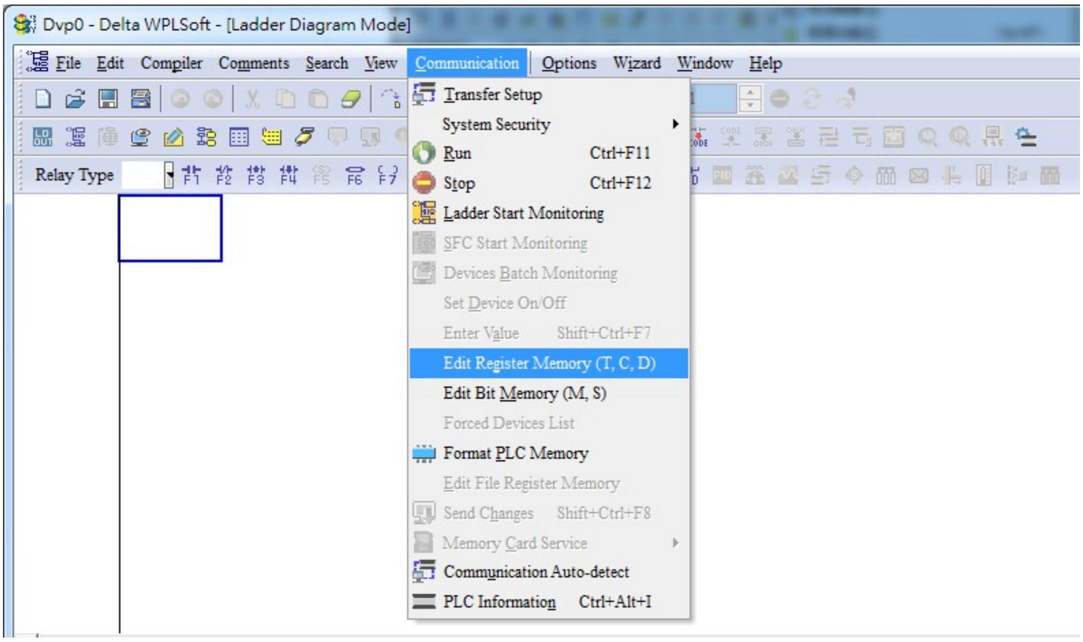
Control of a simple multi-axis application is required in certain situations. If the device supports the CANopen protocol, a CFP2000 can serve as the master in implementing simple control (speed control). The setting method comprises the following seven steps:

Step 1: Activating CANopen Master functions

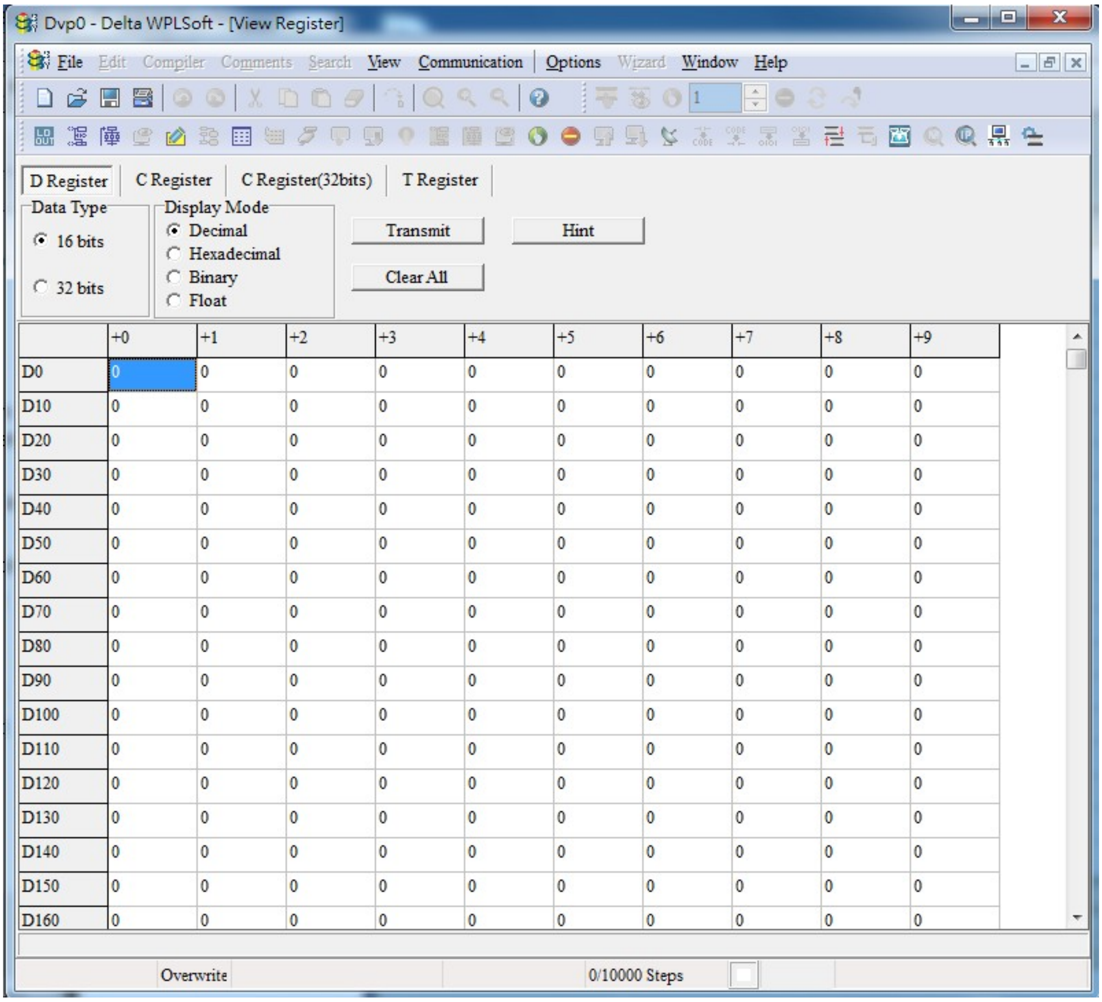
1. Pr.09-45=1 (initiates Master functions); restart power after completing setting, the status bar on the KPC-CC01 digital keypad will display "CAN Master".
2. Pr.00-02=6 reset PLC (please note that this action will reset the program and PLC registers to the default values)
3. Turn power off and on again.
4. Use the KPC-CC01 digital keypad to set the PLC control mode as **"PLC Stop"** (if a newly-introduced driver is used, the blank internal PLC program will cause a PLFF warning code to be issued).

Step 2: Master memory settings

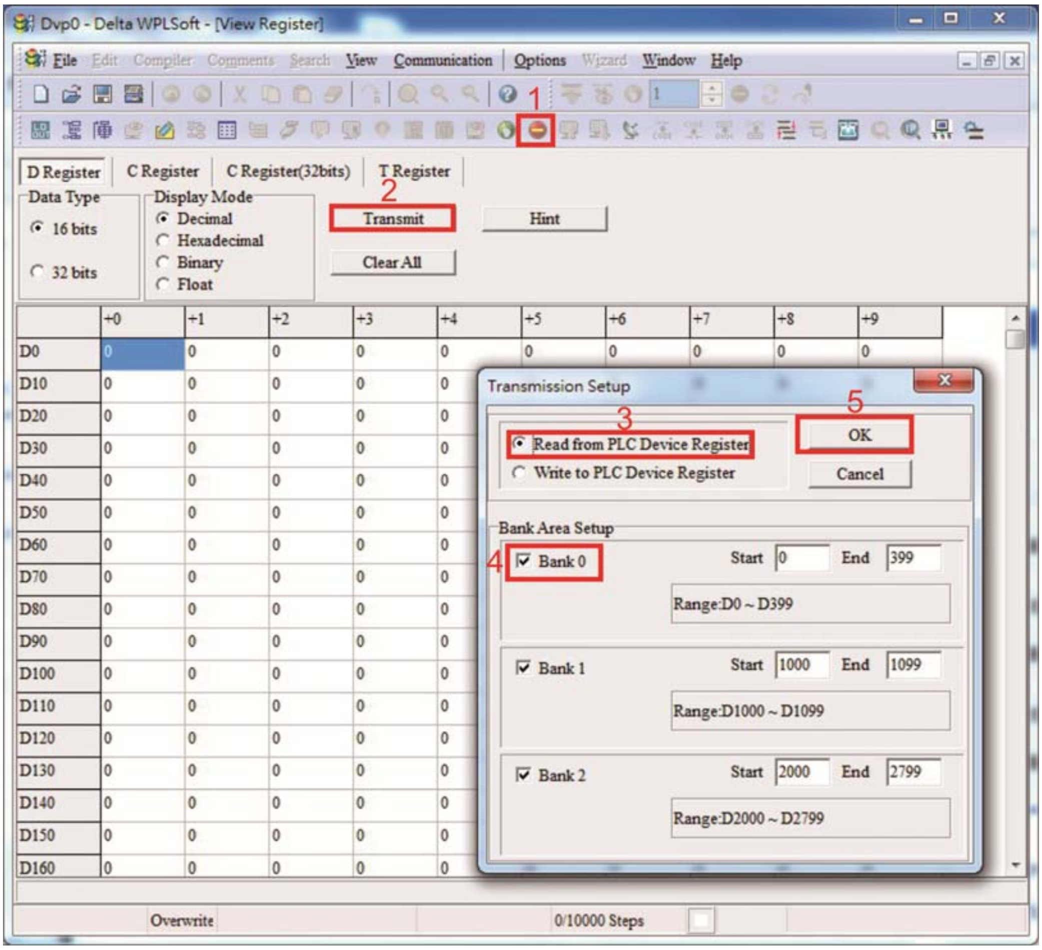
1. After connecting the 485 communications cable, use WPL Soft to set the PLC **status** as Stop (if the PLC mode has been switched to the **"PLC Stop"** mode, the PLC **status** should already be Stop)
2. Set the address and corresponding station number of the slave station to be controlled. For instance, if it is wished to control two slave stations (a maximum of 8 stations can be controlled simultaneously), and the station numbers are 21 and 22, it is only necessary to set D2000 and D2100 as 20 and 21, and then set D2200, D2300, D2400, D2500, D2600, and D2700 as 0. The setting method involves use of the PLC's WPL editing software WPL as follows:
   - Open WPL and implement **communications > register edit (T C D)** function



- After leaving the PLC register window, the register setting screen will appear, as shown below:



If there is a new PLC program and no settings have yet been made, you can read default data from the converter, and merely edit it to suit the current application. If settings have already been made, however, the special D in the CANopen area will display the saved status (the CANopen D area is located at D1090 to D1099 and D2000 to D2799). Assuming it is a new program, we will first read the default data from the converter; check the communications format if there is no communications link (the default PLC station number is 2, 9600, 7N2, ASCII). Perform the following steps: 1. Switch the PLC to Stop status; 2. Press the transmit button; 3. click on read memory after exiting the window; 4. Ignore D0-D399; and 5. click on the confirm button.)



After reading the data, it is necessary to perform some special D settings. Before proceeding, we will first introduce the special D implications and setting range. The CANopen Master's special D range is currently D1070 to D1099 and D2000 to D2799; this range is divided into 3 blocks:

The first block is used to display CANopen's current status, and has a range of D1070 to D1089; the second block is used for CANopen's basic settings, and has a range of D1090 to D1099; the third block is the slave station mapping and control area, and has a range of D2000 to D2799;
These areas are therefore introduced as follows:

The first contains the current CANopen status display:
When the master initializes a slave station, we can find out from D1070 whether configuration of the slave device has been completed; we can find out whether an error occurred in the configuration process from D1071 and whether the configuration is inappropriate from D1074.
After entering normal control, we can find out whether the slave device is offline from D1073. In addition, we can check the slave device's read/write information using the CANRX, CANTX, and CANFLS commands; error information can be obtained from D1076 to D1079 if there has been a read/write failure.

Special D	Description of Function	R/W
D1070	Channel opened by CANopen initialization (bit0=Machine code0 …….)	R
D1071	Error channel occurring in CANopen initialization process (bit0=Machine code0 …….)	R
D1072	Reserved	-

Special D	Description of Function	R/W
D1073	CANopen break channel (bit0=Machine code0 …….)	R
D1074	Error code of master error 0: No error 1: Slave station setting error 2: Synchronizing cycle setting error (too small)	R
D1075	Reserved	-
D1076	SDO error message (main index value)	R
D1077	SDO error message (secondary index value)	R
D1078	SDO error message (error code L)	R
D1079	SDO error message (error code H)	R

The second area is for basic CANopen settings: (the PLC must have **stopped** when this area is used to make settings)

We must set the information exchange time for the master and slave station,

Special D	Description of Function	Default:	R/W
D1090	Synchronizing cycle setting	4	RW

Use D1090 to perform settings; setting time relationships include:

$$\text{Sync time} \geq \frac{1M}{\text{Rate}} * \frac{N}{4}$$

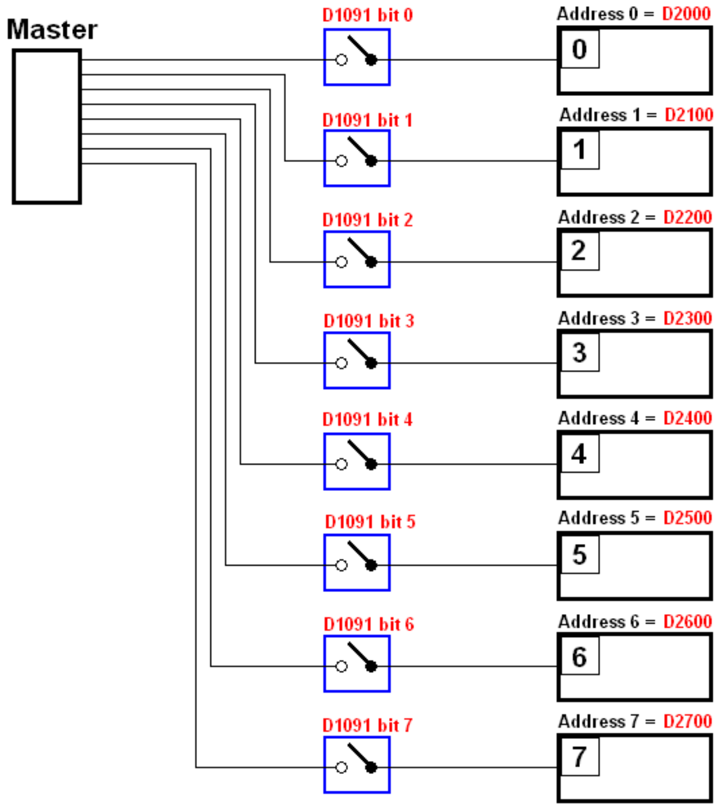
N: TXPDO + RXPDO

For instance, when communications speed is 500Kbps, TXPDO + RXPDO have 8 sets, and synchronizing time will require more than 4 ms

We must also define how many slave stations will be open. D1091 is the channel for defining station opening, and D2000+100*n is the station number defining this channel. See the detailed explanation below.

Slave station number **n**=0-7

Special D	Description of Function	R/W
D1091	Sets slave station On or Off (bit0–bit 7 correspond to slave stations number 0–7)	RW
D2000+100***n**	Slave station number	RW



If slave devices have a slow start-up, the master can delay for a short time before performing slave station configuration; this time delay can be set via D1092.

Special D	Description of Function	Default:	R/W
D1092	Delay before start of initialization	0	RW

With regard to slave device initialization, a delay time can be set to judge whether failure has occurred. If the communications speed is relatively slow, the delay time can be adjusted to judge whether initialization has been completed, which will ensure that there is time to perform slave device initialization.

Special D	Description of Function	Default:	R/W
D1099	Initialization completion delay time Setting range: 1 to 60000 sec.	15 sec.	RW

After communication is successful, the system must detect whether there is a break in communications with the slave station. D1093 is used to set detection time, and D1094 sets the number of consecutive errors that will trigger a break error.

Special D	Description of Function	Default:	R/W
D1093	Break time detection	1000ms	RW
D1094	Break number detection	3	RW

The packet type transmitted by PDO is set before establishing normal communications and generally does not require adjustment.

Special D	Description of Function	Default:	R/W
D1097	Corresponding real-time transmission type (PDO) Setting range: 1–240	1	RW
D1098	Corresponding real-time receiving type (PDO) Setting range: 1–240	1	RW

The third block is the slave station mapping and control area.

CANopen provides a PDO method to perform mapping of the master and slave station memory, and enables the master to directly access read/write data in a certain memory area. The master will automatically perform data exchange with the corresponding slave device, and the read/write values can be seen directly from the special D area after real-time exchange (M1034 = 1 time) has been established. The CFP2000 currently supports real-time mapping of four PDOs, and there are two types of PDO RXPDO (reads slave device information) and TXPDO (writes to slave device). In addition, in order to facilitate control, the CFP2000 cannot perform mapping of commonly used registers; the following is an overview of the current PDO mapping situation:

TX PDO			
PDO2 (Remote I/O)		PDO1 (Speed)	
Description	Special D	Description	Special D
Slave device DO	D2027+100*n	Controller word	D2008+100*n
Slave device AO1	D2031+100*n	Target speed	D2012+100*n
Slave device AO2	D2032+100*n		
Slave device AO3	D2033+100*n		

RXPDO			
PDO2 (Remote I/O)		PDO1 (Speed)	
Description	Special D	Description	Special D
Slave device DI	D2026+100*n	Mode word	D2009+100*n
Slave device AI1	D2028+100*n	Actual frequency	D2013+100*n
Slave device AI2	D2029+100*n		
Slave device AI3	D2030+100*n		

Because usage requires only simple to open the corresponding PDO, where TXPDO employs D2034+100*n settings and RXPDO employs D2067+100*n settings.

These two special D areas are defined as follows:

	PDO2		PDO1	
Default definition	Remote I/O		Speed	
bit	7	6–4	3	2–0
Definition	En	Length:	En	Length:

En: indicates whether PDO is used

Length: indicates mapping of several variables

In a simple example, if we wish to control a CFP2000 slave device and cause it to operate in speed mode, we only have to make the following settings:

D2034+100*n =000Ah

Length	TX PDO			
	PDO2		PDO1	
	Description	Special D	Description	Special D
1	Slave device DO	D2027+100*n	Controller word	D2008+100*n
2	Slave device AO1	D2031+100*n	Target speed	D2012+100*n
3	Slave device AO2	D2032+100*n		
4	Slave device AO3	D2033+100*n		

	PDO2		PDO1	
Definition	Remote I/O		Speed	
bit	7	6–4	3	2–0
Definition	0	0	1	2

D2067+100*n =000Ah

Length	TX PDO			
	PDO2		PDO1	
	Description	Special D	Description	Special D
1	Slave device DI	D2026+100*n	Controller word	D2009+100*n
2	Slave device AI1	D2028+100*n	Actual frequency	D2013+100*n
3	Slave device AI2	D2029+100*n		
4	Slave device AI3	D2030+100*n		

	PDO2		PDO1	
Definition	Remote I/O		Speed	
bit	7	6–4	3	2–0
Definition	0	0	1	2

Switch the PLC to Run after completing settings. Now wait for successful initialization of CANopen (M1059 = 1 and M1061 = 0), and then initiate CANopen memory mapping (M1034 = 1). The control word and frequency command will now automatically refresh to the corresponding slave device (D2008+n*100 and D2012+n*100), and the slave device's status word and currently frequency will also be automatically sent back to the master station (D2009+n*100 and D2013+n*100). This also illustrates how the master can handle these tasks through read/write operations in the special D area.

Furthermore, it should be noted that the remote I/O of PDO2 can obtain the slave device's current DI and AI status, and can also control the slave device's DO and AO status. Nevertheless, after introducing a fully automatic mapping special D, the CFP2000 CANopen master also provides additional information refreshes. For instance, while in speed mode, acceleration/deceleration settings may have been refreshed. The special D therefore also stores some seldom-used real-time information, and these commands can be refreshed using the CANFLS command. The following is the CFP2000's current CANopen master data conversion area, which has a range of D2001+100*n - D2033+100*n, as shown below:

1. The range of n is 0-7
2. ●Indicates PDOTX, ▲Indicates PDORX; unmarked special D can be refreshed using the CANFLS command

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2000+100*n	Station number n of slave station Setting range: 0–127 0: No CANopen function	0			RW
D2002+100*n	Manufacturer code of slave station number n (L)	0			R
D2003+100*n	Manufacturer code of slave station number n (H)	0			R
D2004+100*n	Manufacturer's product code of slave station number n (L)	0			R
D2005+100*n	Manufacturer's product code of slave station number n (H)	0			R

Basic definitions

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2006+100*n	Communications break handling method of slave station number n	0			RW
D2007+100*n	Error code of slave station number n error	0			R
D2008+100*n	Control word of slave station number n	0	●		RW
D2009+100*n	Status word of slave station number n	0	▲		R
D2010+100*n	Control mode of slave station number n	2			RW
D2011+100*n	Actual mode of slave station number n	2			R

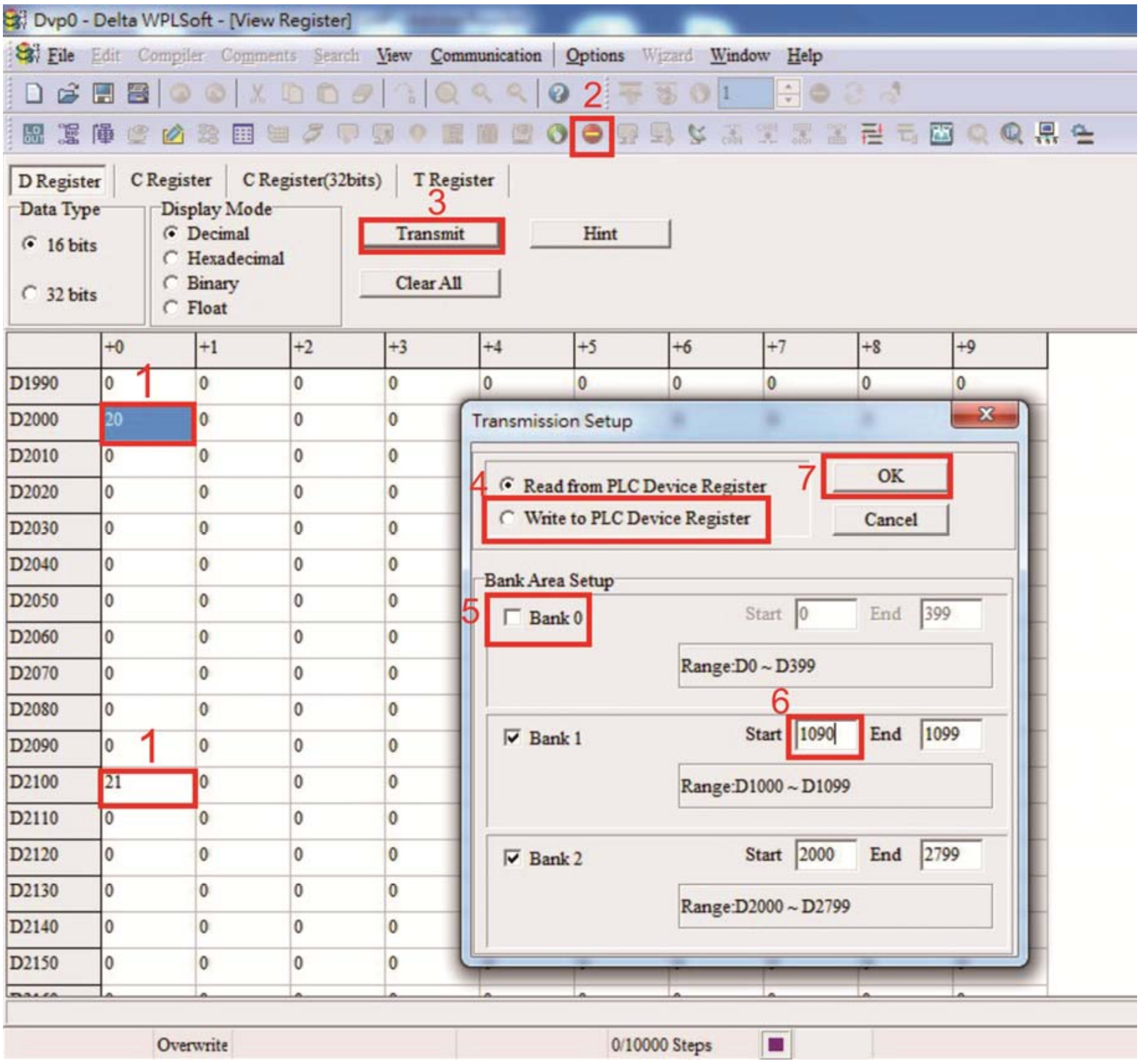
Velocity Control

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2001+100*n	Torque restriction on slave station number n	0			RW
D2012+100*n	Target speed of slave station number n (rpm)	0	●		RW
D2013+100*n	Actual speed of slave station number n (rpm)	0	▲		R
D2014+100*n	Error speed of slave station number n (rpm)	0			R
D2015+100*n	Acceleration time of slave station number n (ms)	1000			RW
D2016+100*n	Deceleration time of slave station number n (ms)	1000			RW

Remote I/O

Special D	Description of Function	Default	PDO Default		R/W
			1	2	
D2026+100*n	MI status of slave station number n	0		▲	R
D2027+100*n	MO setting of slave station number n	0		●	RW
D2028+100*n	AI1 status of slave station number n	0		▲	R
D2029+100*n	AI2 status of slave station number n	0		▲	R
D2030+100*n	AI3 status of slave station number n	0		▲	R
D2031+100*n	AO1 setting of slave station number n	0		●	RW
D2032+100*n	AO2 setting of slave station number n	0		●	RW
D2033+100*n	AO3 setting of slave station number n	0		●	RW

After gaining an understanding of special D definitions, we return to setting steps. After entering the values corresponding to D1090 to D1099, D2000+100*n, D2034+100*n and D2067+100*n, we cannot begin to perform downloading, which is performed in accordance with the following steps: (1. D2000 and D2100 are set as 20 and 21, and D2200, D2300, D2400, D2500, D2600, and D2700 are set as 0; if a setting of 0 causes problems, D1091 can be set as 3, and slave stations 2 to 7 can be closed. 2. Switch PLC to Stop status. 3. Press the transmit button. 4. Click on write memory after exiting the window. 5. Ignore D0–D399. 6. Change the second range to D1090–D1099. 7. Click on Confirm.)



- Another method can be used to set D1091: Determine which of slave stations 0 to 7 will not be needed, and set the corresponding bits to 0. For instance, if it is not necessary to control slave stations 2, 6 and 7, merely set D1091 = 003B, and the setting method is the same as described above: Use WPL to initiate **communications > use register edit (T C D)** function to perform settings.

Step 3: Set the master's communications station number and communications speed

- ☑ When setting the master's station number (Pr.09-46, default is set as 100), make sure not to use the same number as a slave station.
- ☑ Set the CANopen communications speed (Pr.09-37); regardless of whether the driver is defined as a master or slave station, the communications speed is set via this parameter.

Step 4: Write program code

Real-time access: Can directly read/write to or from the corresponding D area.

Non real-time access:

Read command:

Use the CANRX command for reading. M1066 will be 1 when reading is complete; M1067 will be 1 if reading is successful, and M1067 will be 0 if an error has occurred.

Write command:

Use the CANTX command for writing. M1066 will be 1 when writing is complete; M1067 will be 1 if writing is successful, and M1067 will be 0 if an error has occurred.

Refresh command:

Use CANFLS command to refresh (if there are RW attributes, the master will write to the slave station; if there are RO attributes, the slave station will return the read values to the master); M1066 will be 1 if refresh has been completed; M1067 will be 1 if refresh is successful, and M1067 will be 0 if an error has occurred.

NOTE

When using CANRX, CANTX or CANFLS, internal implementation commands will wait until M1066 is completed before executing the next CANRX, CANTX or CANFLS.

Afterwards, download program to the driver (Please note that the PLC's default communications format is ASCII 7N2 9600, and the station number is 2. The WPL must therefore be modified, and the WPL setting pathway is **settings > communications settings**)

Step 5: Set the slave stations' station numbers, communications speed, control source, and command source

Delta's CFP2000 and EC series devices currently support the CANopen communications interface driver, and the corresponding slave station numbers and communications speed parameters are as follows:

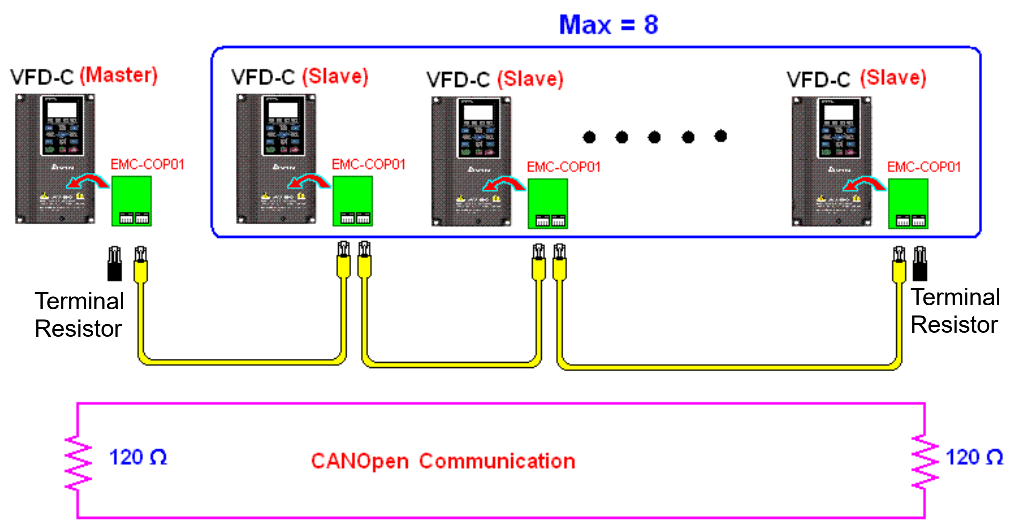
	Corresponding device parameters		Value	Definition
	CFP2000	E-C		
Slave station address	Pr.09-36	Pr.09-20	0	Disable CANopen hardware interface
			1–127	CANopen Communication address
Communication speed	Pr.09-37	Pr.09-21	0	1 Mbps
			1	500 Kbps
			2	250 Kbps
			3	125 Kbps
			4	100 Kbps
			5	50 Kbps

Delta's A2 Servo currently supports the CANopen communications interface, and the corresponding slave station numbers and communications speed parameters are as follows:

	Corresponding device parameters	Value	Definition
	A2		
Slave station address	Pr.03-00	1–127	CANopen Communication address
Communication speed	Pr.03-01 bit8–11 XRXX	R= 0	125 Kbps
		R= 1	250 Kbps
		R= 2	500 Kbps
		R= 3	750 Kbps
		R= 4	1 Mbps
Control/command source	Pr.01-01	B	

Step 6: Connect hardware wiring

When performing wiring, note the head and tail terminal resistance; connection methods are as follows:



Step 7: Initiate control

After a program has been written and downloaded, switch the PLC mode to Run. Merely turn power to master and slave stations off and then on again.

Refer to CANMasterTest 1 vs. 2 driver.dvp

Example:

CFP2000 driver one-to-two control

Step 1: Activating CANopen Master functions

- ☑ Pr.09-45=1 (initiates Master functions); restart power after completing setting, the status bar on the KPC-CC01 digital keypad will display "CAN Master".
- ☑ Pr.00-02=6 reset PLC (please note that this action will reset the program and PLC registers to the default values)
- ☑ Turn power off and on again.
- ☑ Use the KPC-CC01 digital keypad to set the PLC control mode as "PLC Stop" (if a newly-introduced driver is used, the blank internal PLC program will cause a PLFF warning code to be issued).

Step 2: Master memory correspondences

- ☑ Enable WPL
- ☑ Use keypad set PLC mode as Stop (PLC 2)
- ☑ WPL read D1070 to D1099, D2000 to D2799
- ☑ Set D2000=10 D2100=11
- ☑ Set D2100 2200 2300 2400 2500 2600 2700=0
- ☑ Download D2000 to D2799 settings

Step 3: Set the master's communications station number and communications speed

- ☑ When setting the master's station number (Pr.09-46, default is set as 100), make sure not to use the same number as a slave station.
- ☑ Set the CANopen communications speed as 1M (Pr.09-37=0); regardless of whether the driver is defined as a master or slave station, the communications speed is set via this parameter.

Step 4: Write program code

Real-time access: Can directly read/write to or from the corresponding D area.

Non real-time access:

Read command:

Use the CANRX command for reading. M1066 will be 1 when reading is complete; M1067 will be 1 if reading is successful, and M1067 will be 0 if an error has occurred.

Write command:

Use the CANTX command for writing. M1066 will be 1 when writing is complete; M1067 will be 1 if writing is successful, and M1067 will be 0 if an error has occurred.

Refresh command:

Use CANFLS command to refresh (if there are RW attributes, the master will write to the slave station; if there are RO attributes, the slave station will return the read values to the master); M1066 will be 1 if refresh has been completed; M1067 will be 1 if refresh is successful, and M1067 will be 0 if an error has occurred.

NOTE

When using CANRX, CANTX or CANFLS, internal implementation commands will wait until M1066 is completed before executing the next CANRX, CANTX or CANFLS.

Afterwards, download program to the driver (Please note that the PLC's default communications format is ASCII 7N2 9600, and the station number is 2. The WPL must therefore be modified, and the WPL setting pathway is **settings > communications settings**)

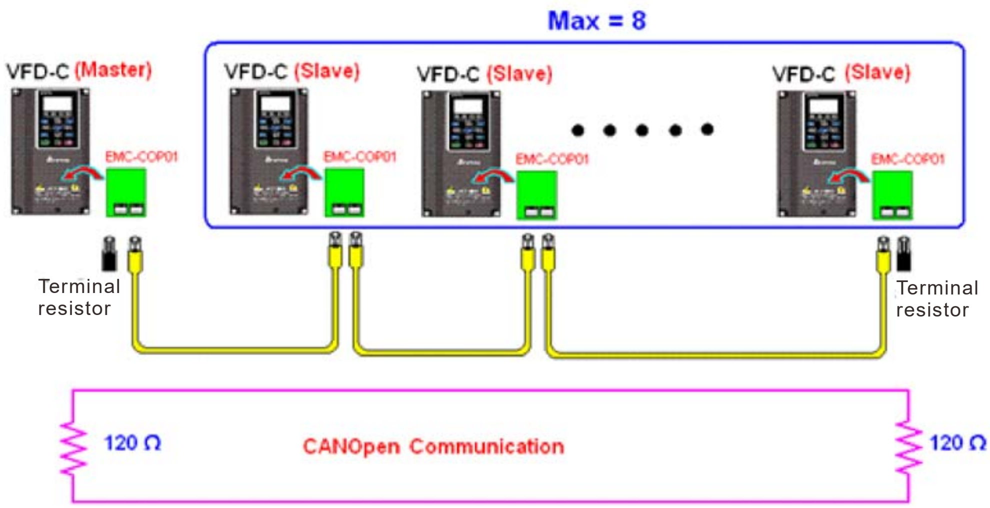
Step 5: Set the slave stations' station numbers and communications speed

Slave station no. 1: Pr.09-37 = 0 (Speed 1M)   Pr.09-36=10 (Node ID 10)

Slave station no. 2: Pr.09-37 = 0 (Speed 1M)   Pr.09-36=10 (Node ID 11)

Step 6: Connect hardware wiring

When performing wiring, note the head and tail terminal resistance; connection methods are as follows:



Step 7: Initiate control

After a program has been written and downloaded, switch the PLC mode to Run. Merely turn power to master and slave stations off and then on again.

Refer to CANMasterTest 1 vs. 2 driver.dvp

16-9 Explanation of various PLC speed mode controls

Speed mode supports SVC control. Under the speed mode of SVC control, it cannot be performed successfully unless finish motor parameter auto tuning ahead of time.

Control methods and settings are explained as follows:

Speed control:

Register table for speed mode:

Control special M

Special M	Description of Function	Attributes
M1025	Driver frequency = set frequency (ON)/driver frequency =0 (OFF)	RW
M1026	Driver operating direction FWD(OFF)/REV(ON)	RW
M1040	Hardware power (Servo On)	RW
M1042	Quick stop	RW
M1044	Pause (Halt)	RW
M1052	Lock frequency (lock, frequency locked at the current operating frequency)	RW

Status special M

Special M	Description of Function	Attributes
M1015	Frequency attained (when used together with M1025)	RO
M1056	Servo On Ready	RO
M1058	On Quick Stopping	RO

Control special D

Special D	Description of Function	Attributes
D1060	Mode setting (speed mode is 0)	RW

Status special D

Special D	Description of Function	Attributes
D1037	Converter output frequency (0.00–600.00)	RO
D1050	Actual operating mode (speed mode is 0)	RO

Speed mode control commands:

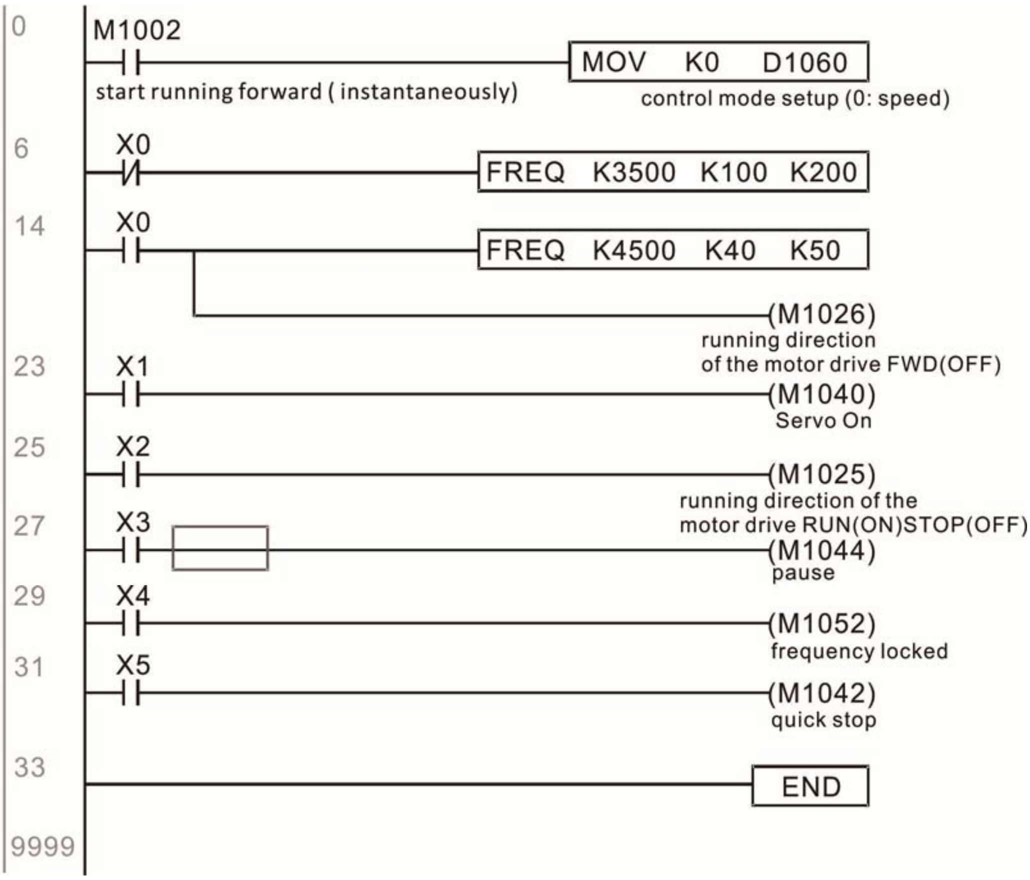
FREQ (P)	S1	S2	S3
	Target speed	The first acceleration time setting	The first deceleration time setting

Example of speed mode control:

Before performing speed control, if the SVC control method is used, setting of electromechanical parameters must first be completed.

1. Setting D1060 = 0 will shift the converter to the speed mode (default).
2. Use the FREQ command to control frequency, acceleration time, and deceleration time.
3. Set M1040 = 1, the driver will now be excited, but the frequency will be 0.
4. Set M1025 = 1, the driver frequency command will now jump to the frequency designated by FREQ, and acceleration/deceleration will be controlled on the basis of the acceleration time and deceleration time specified by FREQ.
5. M1052 can be used to lock the current operating frequency.
6. M1044 can be used to temporarily pause operation, and the deceleration method will comply with deceleration settings.

7. M1042 can be used to perform quick stop, and deceleration will be as quick as possible without giving rise to an error. (There may still be a jump error if the load is too large.)
8. Control user rights: M1040(Servo ON) > M1042(Quick Stop) >M1044(Halt) >M1052(LOCK)



16-10 Internal communications main node control

The protocol has been developed in order to facilitate the use of 485 instead of CANopen in certain application situations. The 485 protocol offers similar real-time characteristics as CANopen; this protocol can only be used on the CP2000, CFP2000 and CT2000 devices. The maximum number of slave devices is 8.

Internal communications have a master-slave structure. The initiation method is very simple:

Slave device:

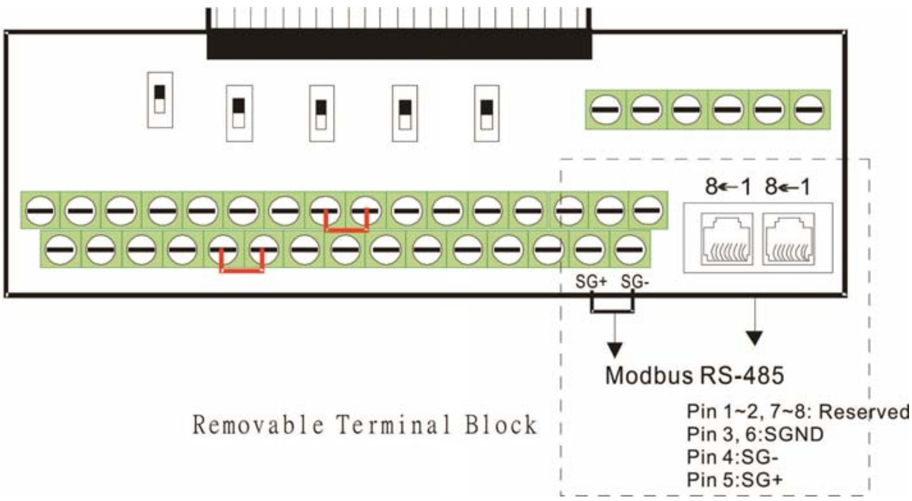
Set Pr.09-31 = -1 to -8 in order to access 8 nodes, and set Pr.00-20 = 1 to define the control source as 485 and access the reference sources that must be controlled, namely speed command (Pr.00-21 = 2). This will complete slave device settings. (PLC functions do not need to be activated)

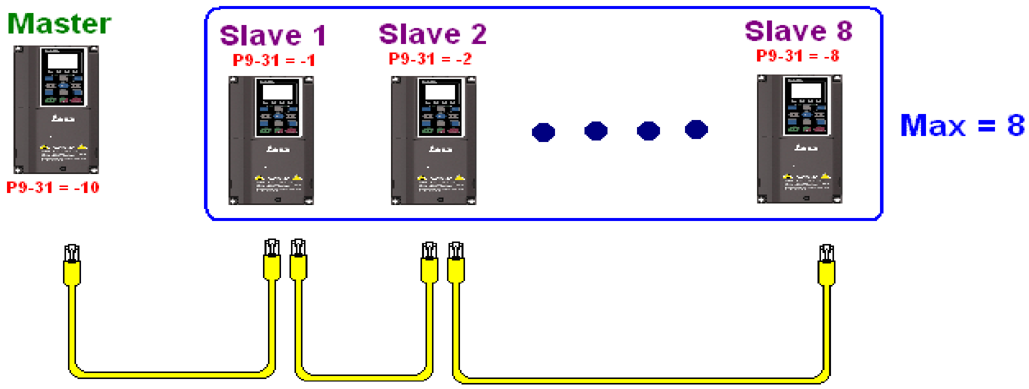
System:

Setting the master is even simpler; it is only necessary to set Pr.09-31 = -10, and enable the PLC.

Hardware wiring:

The master and slave stations are connected via the 485 serial port. The CFP2000 provide two types of 485 serial port interfaces, see the figure below: (please refer to Section 06 Control terminals concerning detailed terminal connections)





Master programming: In a program, D1110 can be used to define a slave station to be controlled (1–8, if set as 0, can jump between 8 stations). Afterwards, M1035 is set as 1, and the memory positions of the master and slave stations will correspond. At this time, it is only necessary to send commands to the correlation slave station address to control that station. The following is a register table connected with internal communications:

Control special M

Special M	Description of Function	Attributes
M1035	Initiates internal communications control	RW

Control special D

Special D	Description of Function	Attributes
D1110	Internal node communications number 1–8 (set the station number of the slave station to be controlled)	RW

Special D	Description of Function				Attributes
	Definition	bit	User rights	Speed mode	
D1120 + 10*N	Internal node N control command	0	4	Command functions	RW
		1	4	Reverse rotation requirements	
		2	4	-	
		3	3	Temporary pause	
		4	4	Frequency locking	
		5	4	JOG	
		6	2	Quick Stop	
		7	1	Servo ON	
		11–8	4	Speed interval switching	
		13–12	4	Deceleration time change	
		14	4	Enable bit13–8	
		15	4	Clear error code	
D1121 + 10*N	Internal node N control mode			0	RW
D1122 + 10*N	Internal node N reference command L			Speed command (no number)	RW
D1123 + 10*N	Internal node N reference command H			-	RW

※ N = 0–7

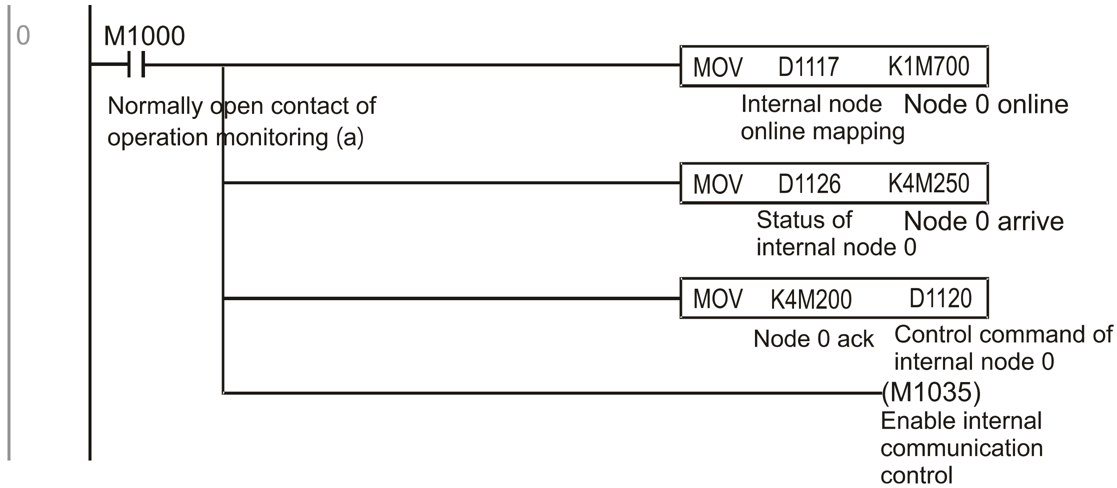
Status special D

Special D	Description of Function	Attributes
D1115	Internal node synchronizing cycle (ms)	RO
D1116	Internal node error (bit0 = slave device 1, bit1 = slave device 2,…bit7 = slave device 8)	RO
D1117	Internal node online correspondence (bit0 = slave device 1, bit1 = slave device 2,…bit7 = slave device 8)	RO

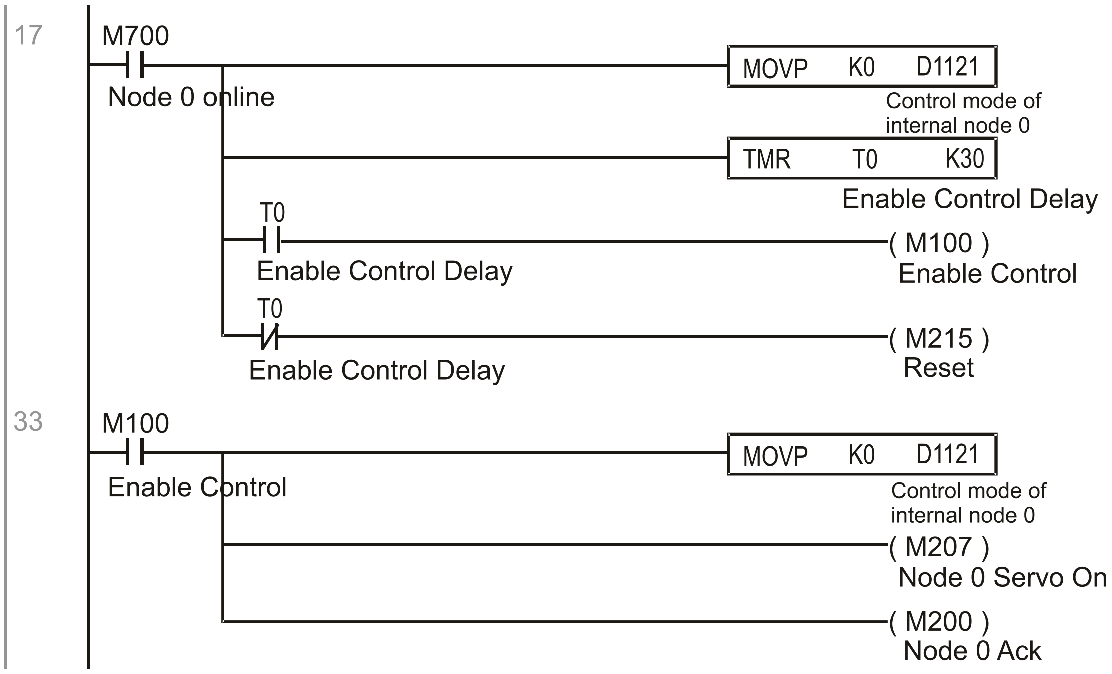
Special D	bit	Description of Function Speed mode	Attributes
D1126 + 10*N	0	Frequency command arrival	RO
	1	Clockwise	
		Counterclockwise:	
	2	Warning	
	3	Error	
	5	JOG	
	6	Quick Stop	
	7	Servo ON	
D1127 + 10*N		Actual frequency	RO
D1128 + 10*N		-	

※ N = 0–7

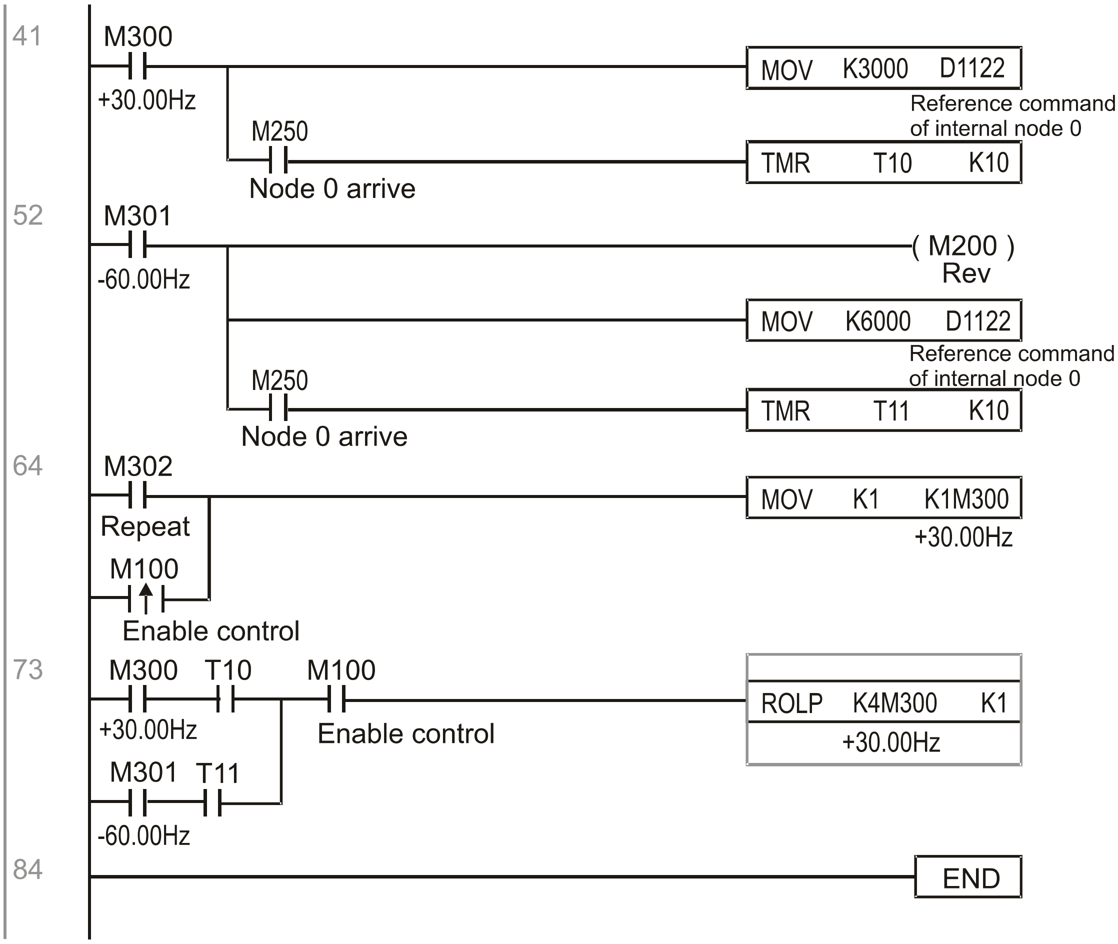
Example: Assume it is desired to control slave station 1 operation at frequencies of 30.00 Hz and 60.00 Hz, status, and online node correspondences:



When it is judged that slave station 1 is online, delay 3 sec. and begin control



It is required slave station 1 maintain forward rotation at 30.00 Hz for 1 sec., and maintain reverse rotation at 60.00 Hz for 1 sec., and repeat this cycle continuously.



16-11 Modbus remote IO control applications (use MODRW)

The CFP2000's internal PLC supports 485 read/write functions, which can be realized using the MODRW command. However, the 485 serial port must be defined as available for the PLC's 485 use before writing a program, and the Pr.09-31 must be set as -12. After completing settings, the standard functions defined by 485 can be used to implement read/write commands at other stations. Communications speed is defined by Pr.09-01, the communications format is defined by Pr.09-04, and the PLC's current station number is defined by Pr.09-35. The CFP2000 currently supports the functions read coil (0x01), read input (0x02), read register (0x03), write to single register (0x06), write to several coils (0x0F), and write to several registers (0x10). Explanations and the usage of these functions are provided as follows:

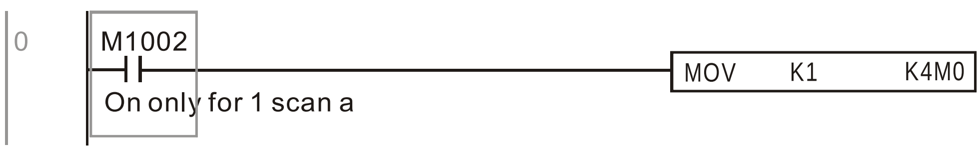
MODRW command					General meaning	Slave device is Delta's PLC meaning	Slave device is Delta's converter meaning
S1	S2	S3	S4	S5			
Node ID	Command	Address	Return: D area	Length:			
K3	H01	H500	D0	K18	Read coil (Bit)	Read 18 bits of data corresponding to slave station 3 PLC Y0 to Y21. This data is stored by bit 0 to 15 of this station's D0 and bit 0 to bit 3 of D1.	Does not support this function
K3	H02	H400	D10	K10	Read input (Bit)	Read 10 bits of data corresponding to slave station 3 PLC X0 to X11. This data is stored by bit 0 to 9 of this station's D10.	Does not support this function
K3	H03	H600	D20	K3	Read register (word)	Read 3 words of data corresponding to slave station 3 PLC T0 to T2. This data is stored by D20 to D22.	Read 3 words of data corresponding to slave station 3 converter parameters 06-00 to 06-02. This data is stored by D20 to D22
K3	H06	H610	D30	XX	Write to single register (word)	Write slave station 3 PLC's T16 to this station's D30 value	Write slave station 3 converter 06 to 16 parameter to this station's D30 value
K3	H0F	H509	D40	K10	Write to multiple coils (Bit)	Write slave station 3 PLC's Y11 to Y22 to bit 0 to 9 of D40.	Does not support this function
K3	H10	H602	D50	K4	Write to multiple registers (word)	Write slave station 3 PLC's T2 to T5 to D50 to D53	Write slave station 3 converter 06-02 to 06-05 parameters to this station's D50 to D53

※ XX indicates doesn't matter

After implementing MODRW, the status will be displayed in M1077 (485 read/write complete), M1078 (485 read/write error), and M1079 (485 read/write time out). M1077 is defined so as to immediately revert to 0 after the MODRW command has been implemented. However, any of three situations—a report of no error, a data error report, or time out with no report—will cause the status of M1077 to change to On.

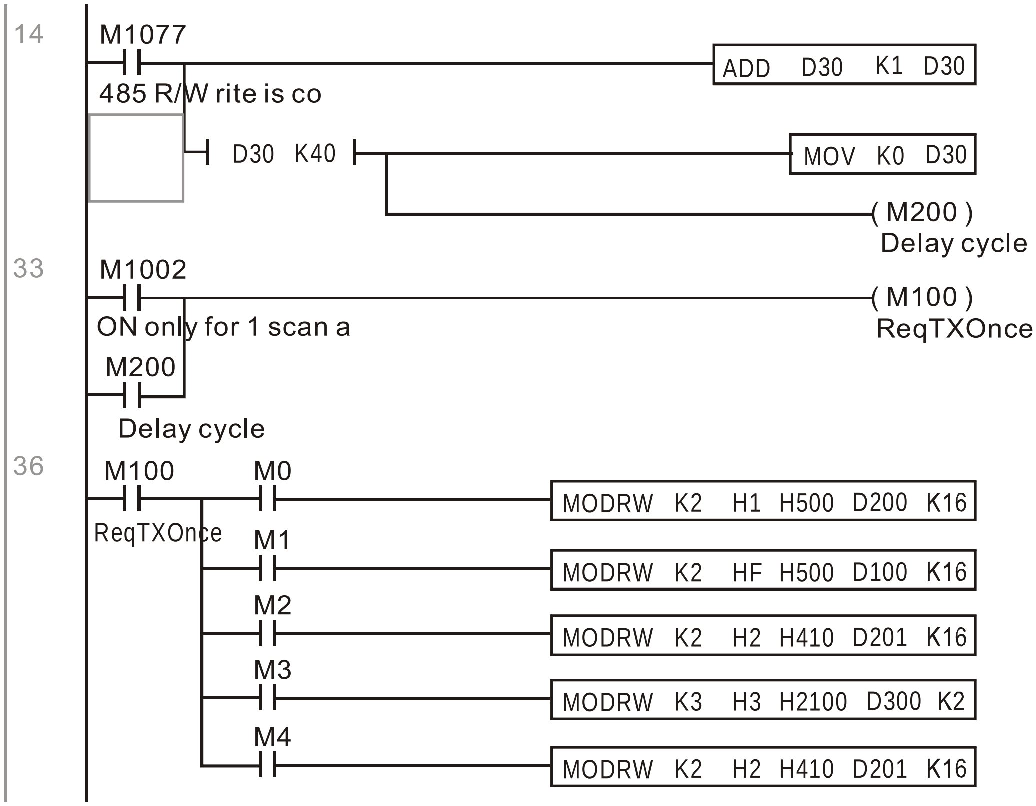
Example program: Testing of various functions

At the start, will cause the transmitted time sequence to switch to the first data unit.

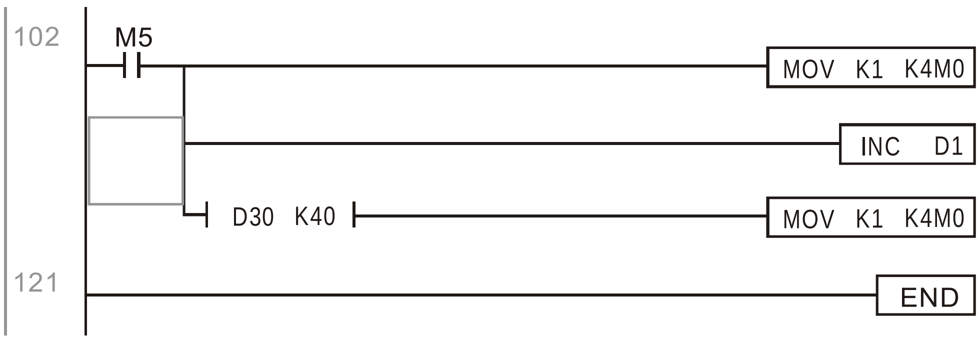


When the reported message indicates no error, it will switch to the next transmitted command

If time out occurs or an error is reported, the M1077 will change to On. At this time, after a delay of 30 scanning cycles, it will re-issue the original command once



It will repeat after sending all commands



Practical applications:

Actual use to control the RTU-485 module.

Step 1: Set the communications format. Assume that the communications format is 115200, 8,N,2, RTU

CFP2000：The default PLC station number is set as 2 (Pr.09-35)

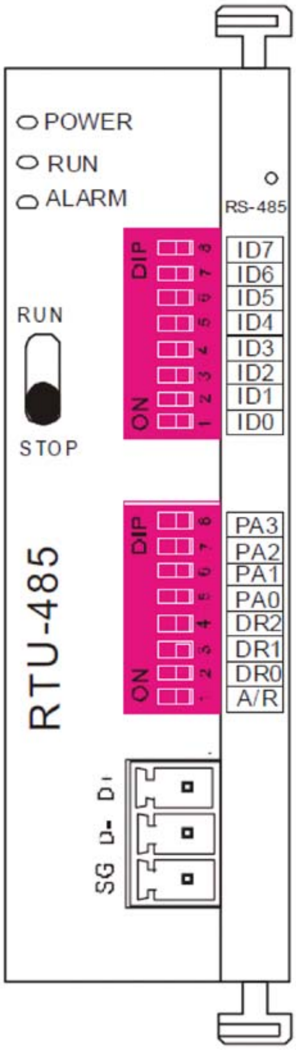
Pr.09-31=-12 (COM1 is controlled by the PLC), Pr.09-01=115.2 (The communications speed is 115200)

Pr.09-04=13 (The format is 8,N,2, RTU)

RTU485: The station number = 8 (give example)

ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
0	0	0	0	1	0	0	0

PA3	PA2	PA1	PA0	DR2	DR1	DR0	A/R
1	0	0	0	1	1	1	0



Communication station #:
ID0~ ID7 are defined as 2^0, 2^1, 2^2…2^6, 2^7

Communication protocol

PA3	PA2	PA1	PA0	A/R	Communication Protocol
OFF	OFF	OFF	OFF	ON	7,E,1 · ASCII
OFF	OFF	OFF	ON	ON	7,O,1 · ASCII
OFF	OFF	ON	OFF	ON	7,E,2 · ASCII
OFF	OFF	ON	ON	ON	7,O,2 · ASCII
OFF	ON	OFF	OFF	ON	7,N,2 · ASCII
OFF	ON	OFF	ON	ON	8,E,1 · ASCII
OFF	ON	ON	OFF	ON	8,O,1 · ASCII
OFF	ON	ON	ON	ON	8,N,1 · ASCII
ON	OFF	OFF	OFF	ON	8,N,2 · ASCII
OFF	ON	OFF	ON	OFF	8,E,1 · RTU
OFF	ON	ON	OFF	OFF	8,O,1 · RTU
OFF	ON	ON	ON	OFF	8,N,1 · RTU
ON	OFF	OFF	OFF	OFF	8,N,2 · RTU

DR2	DR1	DR0	Communicaton Speed
OFF	OFF	OFF	1,200 bps
OFF	OFF	ON	2,400 bps
OFF	ON	OFF	4,800 bps
OFF	ON	ON	9,600 bps
ON	OFF	OFF	19,200 bps
ON	OFF	ON	38,400 bps
ON	ON	OFF	57,600 bps
ON	ON	ON	115,200 bps

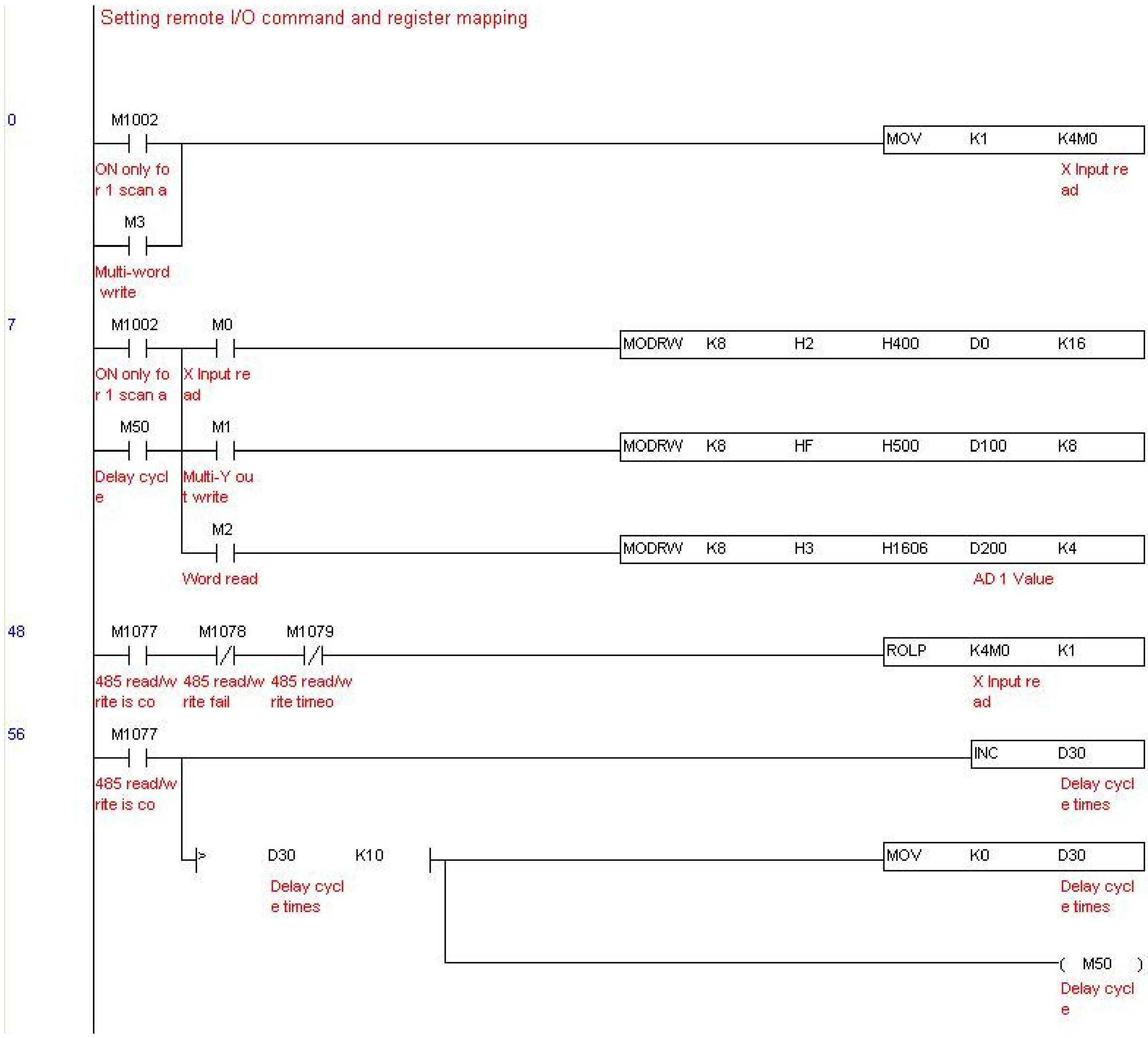
Step 2: Install control equipment. We sequentially connect a DVP16-SP (8 IN 8 OUT), DVP-04AD (4 channels AD), DVP02DA (2 channels DA), and DVP-08ST (8 switches) to the RTU485.

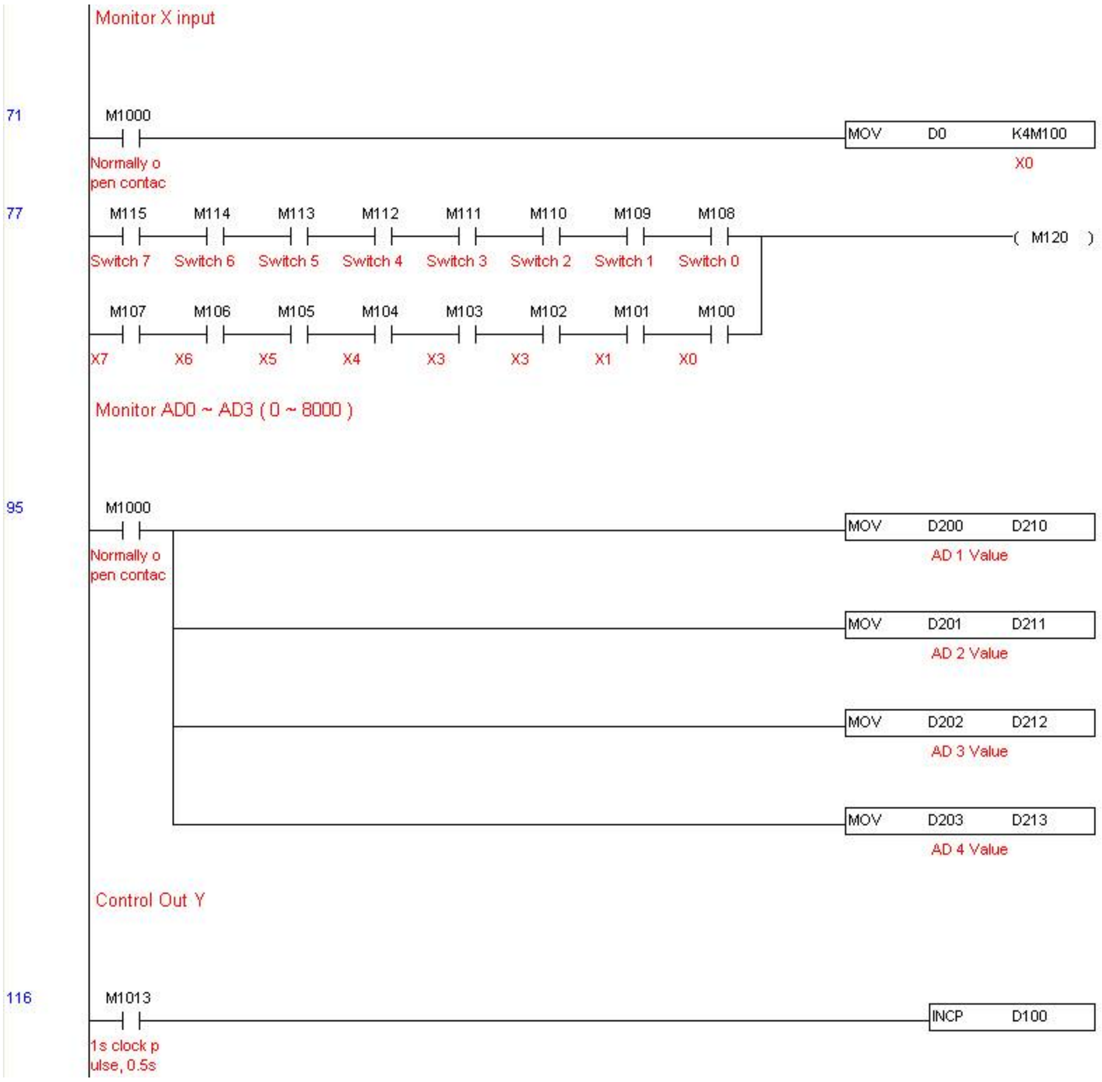
The following corresponding locations can be obtained from the RTU485's configuration definitions:

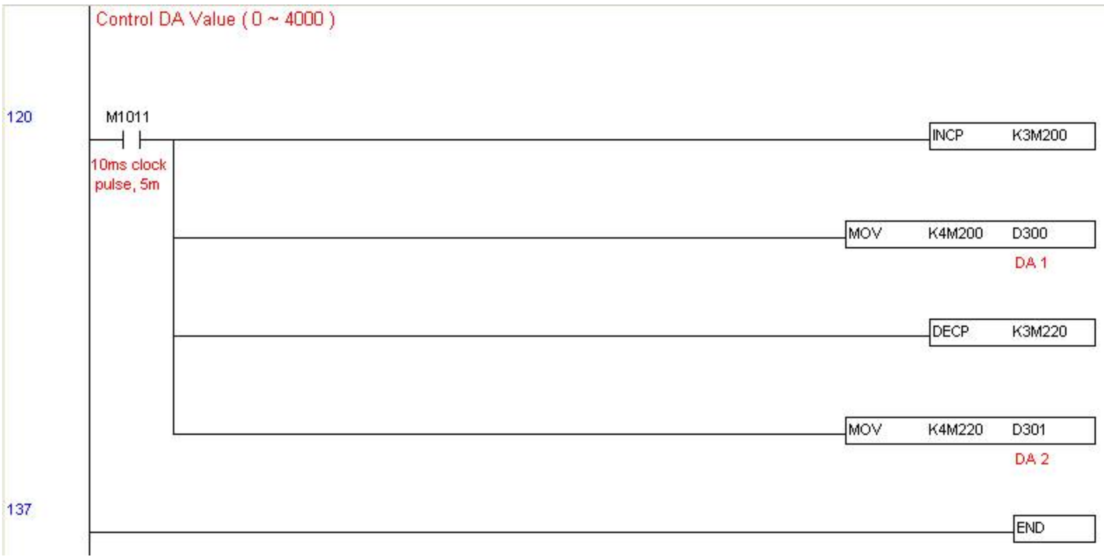
Module	Terminals	485 Address
DVP16-SP	X0–X7	0400H–0407H
	Y0–Y7	0500H–0507H
DVP-04AD	AD0–AD3	1600H–1603H
DVP02DA	DA0–DA1	1640H–1641H
DVP-08ST	Switch 0–7	0408H–040FH

Step 3: Physical configuration

Step 4: Write to PLC program

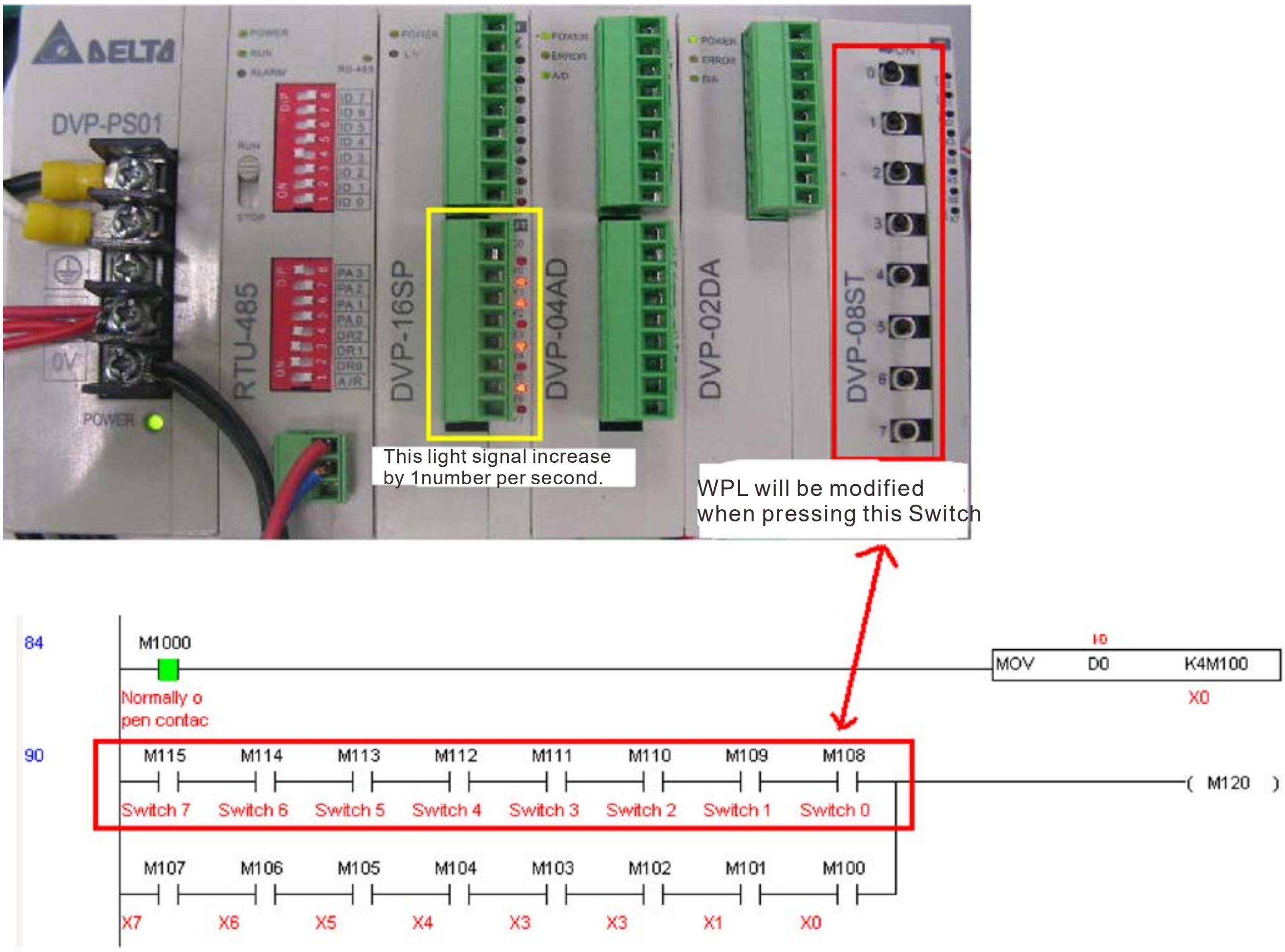



Monitor X input
71
M1000
Normally o
pen contac
MOV D0 K4M100
X0
77
M115 M114 M113 M112 M111 M110 M109 M108
Switch 7 Switch 6 Switch 5 Switch 4 Switch 3 Switch 2 Switch 1 Switch 0
(M120)
M107 M106 M105 M104 M103 M102 M101 M100
X7 X6 X5 X4 X3 X3 X1 X0
Monitor AD0 ~ AD3 (0 ~ 8000)
95
M1000
Normally o
pen contac
MOV D200 D210
AD 1 Value
MOV D201 D211
AD 2 Value
MOV D202 D212
AD 3 Value
MOV D203 D213
AD 4 Value
Control Out Y
116
M1013
1s clock p
ulse, 0.5s
INCP D100

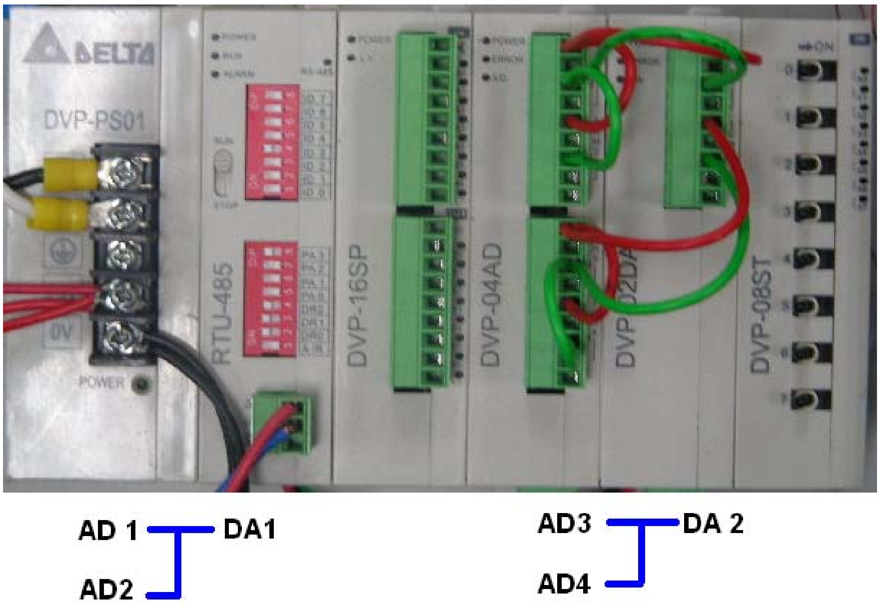

Control DA Value (0 ~ 4000)
120
M1011
10ms clock
pulse, 5m
INCP K3M200
MOV K4M200 D300
DA 1
DECP K3M220
MOV K4M220 D301
DA 2
137
END

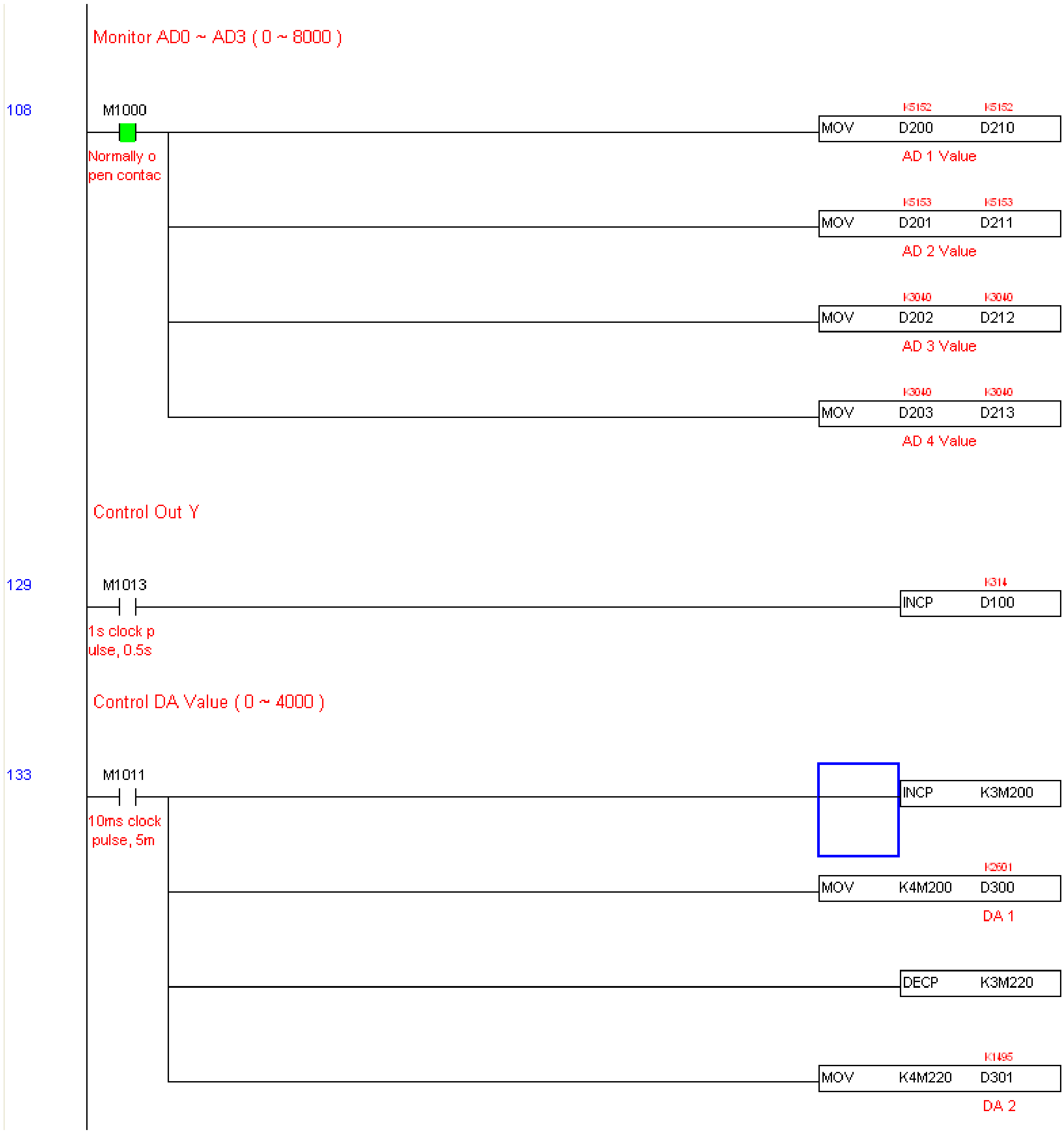
Step 5: Actual testing situation:

I/O testing: When the switch is activated, it can be discovered that the display corresponds to M115 - M108. Furthermore, it can be seen that one output point light is added every 1 sec. (the display uses a binary format)



AD DA testing: It can be discovered that D200 and D201 are roughly twice of the D300, and continue to increase progressively. For their part, the D202 and D203 are roughly twice of the D301, and continue to decrease progressively.




Monitor AD0 ~ AD3 (0 ~ 8000)
108
M1000
Normally o
pen contac
MOV D200 D210
K5152 K5152
AD 1 Value
MOV D201 D211
K5153 K5153
AD 2 Value
MOV D202 D212
K3040 K3040
AD 3 Value
MOV D203 D213
K3040 K3040
AD 4 Value
Control Out Y
129
M1013
1s clock p
ulse, 0.5s
INCP D100
K314
Control DA Value (0 ~ 4000)
133
M1011
10ms clock
pulse, 5m
INCP K3M200
MOV K4M200 D300
K2501
DA 1
DECP K3M220
MOV K4M220 D301
K1495
DA 2

16-12 Calendar functions

Keypad (KPC-CC01) should be connected, or the CFP2000 cannot be used. Currently-support commands include TCMP (comparison of calendar data), TZCP (calendar data range comparison), TADD (calendar data addition), TSUB (calendar data subtraction), and TRD (calendar reading). Please refer to the explanation of relevant commands and functions for the usage of these commands.

In real applications, the internal PLC can judge whether calendar function have been activated; if they have been activated, calendar warning codes may be displayed in some situations. The basis for whether a calendar function has been activated is whether the program has written the calendar time (D1063 to D1069) in connection with the foregoing calendar commands or programs.

The calendar's time display is currently assigned to D1063 to D1069, and is defined as follows:

Special D	Item	Content	Attributes
D1063	Year (Western)	20xx (2000–2099)	RO
D1064	Weeks	1–7	RO
D1065	Month	1–12	RO
D1066	Day	1–31	RO
D1067	Hour	0–23	RO
D1068	Minute	0–59	RO
D1069	Second	0–59	RO

Calendar-related special M items are defined as follows:

Special D	Item	Attributes
M1068	Calendar time error	RO
M1076	Calendar time error or refresh time out	RO
M1036	Ignore calendar warning	RW

*When a program writes to the commands TCMP, TZCP, TADD, or TSUB, if it is discovered that a value exceeds the reasonable range, M1026 will be 1.

*When the keypad display is PLra (RTC correction warning) or PLrt (RTC time out warning), M1076 will be ON.

*When M1036 is 1, the PLC will ignore the calendar warning.

Calendar trigger warning code is defined as follows:

Warning	Description	Reset approach	Whether it affects PLC operation
PLra	Calendar time correction	Requires power restart	Will not have any effect
PLrt	Calendar time refresh time out	Requires power restart	Will not have any effect

*When the PLC's calendar functions are operating, if the keypad is replaced with another keypad, it will jump to PLra.

*When it is discovered at startup that the keypad has not been powered for more than 7 days, or the time is wrong, PLra will be triggered.

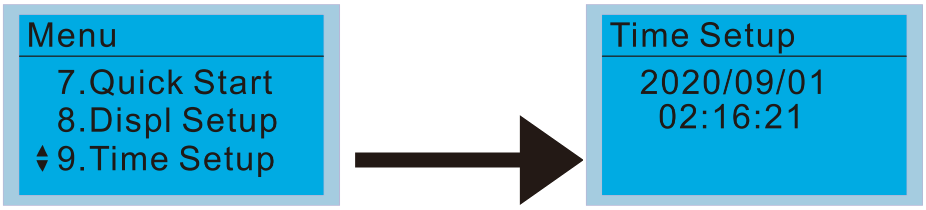
*When it is discovered that the CFP2000 has no keypad in 10 sec. after start up, PLrt will be triggered.

*If the keypad is suddenly pulled out while the calendar is operating normally, and is not reconnected in 1 minute, PLrt will be triggered.

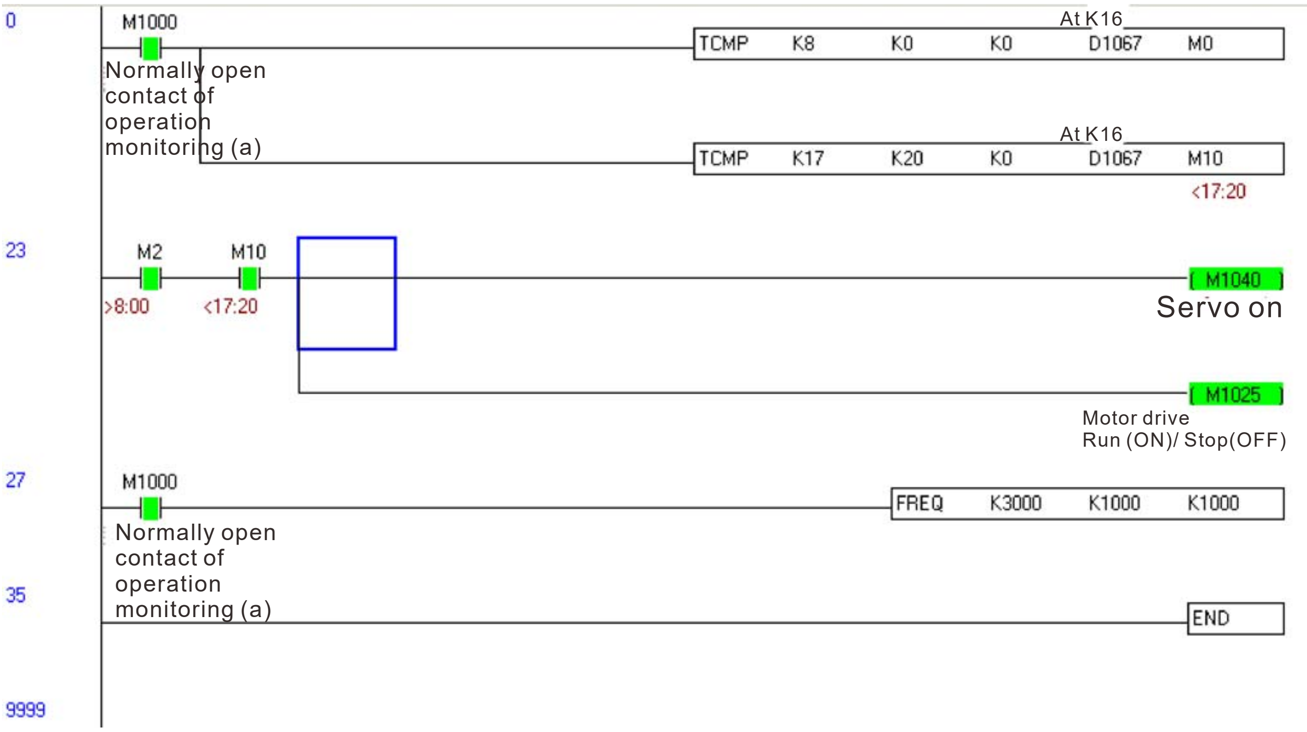
Practical applications:

We will perform a demo of simple applications.

We first correct the keypad time. After pressing Menu on the keypad, select the 9th time setting option. After selection, set the current time.



We set converter on during the period of 8:00–17:20, which allows us to write the following example



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Chapter 17 Introduction to BACnet

1. About BACnet:

BACnet is an ASHRAE communication protocol for **b**uilding **a**utomation and **c**ontrol **net**works. (ASHRAE: **A**merican **S**ociety of **H**eating, **R**efrigerating and Air-Conditioning **E**ngineers, Inc.). CFP2000's BACnet is based on version 2004.

BACnet's regulations are related to several kinds of physical layers' interfaces. The physical layer built inside CFP2000 is achieved via MS/TP interface.

The BACnet of CFP2000 supports a device type called B-ASC. B-ASC supports six types of services such as DS-RP-B, DS-RPM-B, DS-WP-B, DM-DDB-B, DM-DOB-B and DM-DCC-B.

2. CFP2000 BACnet-Object and Property:

In CFP2000, BACnet supports 3 object types: Device, AnalogValue (AV) and BinaryValue (BV). In each object type, we have the following table to show the Properties list:

Property ID		Object Type		
		Device	Analog Value	Binary Value
#4	ACTIVE TEXT			V
#11	APDU_TIMEOUT	V		
#12	APPLICATION_SOFTWARE_VERSION	V		
#28	DESCRIPTION	V	V	V
#30	DEVICE ADDRESS BINDING	V	V	
#36	EVENT STATE		V	V
#44	FIRMWARE_REVISION	V		
#46	INACTIVE TEXT			V
#62	MAX_APDU_LENGTH_ACCEPTED	V		
#63	MAX_INFO_FRAMES	V		
#64	MAX_MASTER	V		
#70	MODEL_NAME	V		
#73	NUMBER_OF_APDU_RETRIES	V		
#75	OBJECT_IDENTIFIER	V *1	V	V
#76	OBJECT_LIST	V		
#77	OBJECT_NAME	V *1	V	V
#79	OBJECT_TYPE	V	V	V
#81	OUT OF SERVICE		V	V
#85	PRESENT VALUE		V *2	V *2
#87	PRIORITY ARRAY		V *3	V *3
#96	PROTOCOL_OBJECT_TYPES_SUPPORTED	V		

Property ID		Object Type		
		Device	Analog Value	Binary Value
#97	PROTOCOL_SERVICES_SUPPORTED	V		
#98	PROTOCOL_VERSION	V		
#104	RELINQUISH DEFAULT		V *3	V *3
#107	SEGMENTATION_SUPPORTED	V		
#111	STATUS FLAGS		V	V
#112	SYSTEM_STATUS	V		
#117	UNITS		V	
#120	VENDOR_IDENTIFIER	V		
#121	VENDOR_NAME	V		
#139	PROTOCOL_REVISION	V		
#155	DATABASE_REVISION	V		

*1. The Object_ID and Object_Name Properties of Device are writeable.

*2. The Present_Value Property of some AV and BV objects is commandable.

*3. Only Commandable objects support Priority_Array and Relinquish_Default.

The AV objects, we have commandable and readonly cases.

- Commendable case: We can use Write_Service to access the Present_Value property of commandable AV objects. Thus, the commandable AV objects are linking to the Control_Word and Pr_Word in CFP2000.
- Readonly case: We can use Read_Service to access the Present_Value property of readonly AV objects. Thus, these readonly AV objects are linking to the Status_Word in CFP2000.

The BV objects, we also have commandable and readonly cases.

- Commandable case: We can use Write_Service to access the Present_Value property of commendable BV objects. Thus, the commandable BV objects are linking to the Control_Bit in CFP2000.
- Readonly case: We can use Read_Service to access the Present_Value property of readonly BV objects. Thus, these readonly BV objects are linking to the Status_Bit in CFP2000.

2.1 Commandable Analog Value Object

In CFP2000, we have AV_000–AV_026 supporting commandable Present_Value property. For these AV_Objects, we also can use (Multi) Read_Service to access Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description	Unit
AV 000	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 001	RW	FreqRefValue	Frequency Reference Value	UNITS_HERTZ
AV 002	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 003	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 004	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 005	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 006	RW	Reserved	Reserved	UNITS_NO_UNITS

Object Number	R/W	Object Name	Object Description	Unit
AV 007	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 008	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 009	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 010	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 011	RW	(P9-11 map set)	AV11 will modify data which is P9-11 mapping to	Depends
AV 012	RW	(P9-12 map set)	AV12 will modify data which is P9-12 mapping to	Depends
AV 013	RW	(P9-13 map set)	AV13 will modify data which is P9-13 mapping to	Depends
AV 014	RW	(P9-14 map set)	AV14 will modify data which is P9-14 mapping to	Depends
AV 015	RW	(P9-15 map set)	AV15 will modify data which is P9-15 mapping to	Depends
AV 016	RW	(P9-16 map set)	AV16 will modify data which is P9-16 mapping to	Depends
AV 017	RW	(P9-17 map set)	AV17 will modify data which is P9-17 mapping to	Depends
AV 018	RW	(P9-18 map set)	AV18 will modify data which is P9-18 mapping to	Depends
AV 019	RW	(P9-19 map set)	AV19 will modify data which is P9-19 mapping to	Depends
AV 020	RW	(P9-20 map set)	AV20 will modify data which is P9-20 mapping to	Depends
AV 021	RW	(P9-21 map set)	AV21 will modify data which is P9-21 mapping to	Depends
AV 022	RW	(P9-22 map set)	AV22 will modify data which is P9-22 mapping to	Depends
AV 023	RW	(P9-23 map set)	AV23 will modify data which is P9-23 mapping to	Depends
AV 024	RW	(P9-24 map set)	AV24 will modify data which is P9-24 mapping to	Depends
AV 025	RW	(P9-25 map set)	AV25 will modify data which is P9-25 mapping to	Depends
AV 026	RW	(P9-26 map set)	AV26 will modify data which is P9-26 mapping to	Depends

2.2 Status (Readonly) Analog Value Object

In CFP2000, we have AV_027–AV_068 with readonly Present_Value property. For these AV_Objects, we do NOT have Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description	Unit
AV 027	R	Reserved	Reserved	UNITS_NO_UNITS
AV 028	R	Reserved	Reserved	UNITS_NO_UNITS
AV 029	R	Reserved	Reserved	UNITS_NO_UNITS
AV 030	R	Reserved	Reserved	UNITS_NO_UNITS
AV 031	R	Output frequency	Display output frequency (Hz)	UNITS_HERTZ
AV 032	R	Reserved	Reserved	UNITS_NO_UNITS
AV 033	R	Reserved	Reserved	UNITS_NO_UNITS
AV 034	R	Reserved	Reserved	UNITS_NO_UNITS
AV 035	R	Output torque (%)	Display output torque (%)	UNITS_PERCENT
AV 036	R	Reserved	Reserved	UNITS_NO_UNITS
AV 037	R	Reserved	Reserved	UNITS_NO_UNITS
AV 038	R	Reserved	Reserved	UNITS_NO_UNITS
AV 039	R	Status word	Display status word,made from BV16–BV31	UNITS_NO_UNITS

Object Number	R/W	Object Name	Object Description	Unit
AV 040	R	Reserved	Reserved	UNITS_NO_UNITS
AV 041	R	Driver type code	Driver type code	UNITS_NO_UNITS
AV 042	R	Warn code	Warn code	UNITS_NO_UNITS
AV 043	R	Error code	Error code	UNITS_NO_UNITS
AV 044	R	Output current	Display output current (Amp)	UNITS_AMPERES
AV 045	R	DC-bus voltage	Display DC bus voltage (Volt)	UNITS_VOLTS
AV 046	R	Output Voltage	Display output voltage of U, V, W (Volt)	UNITS_VOLTS
AV 047	R	Count Value	Display counter value of TRG terminal	UNITS_NO_UNITS
AV 048	R	Power Angle	Display output power angle of U, V, W	UNITS_POWER_FACTOR
AV 049	R	Output Power	Display actual output power of U, V, W (kW)	UNITS_KILOWATTS
AV 050	R	IGBT temperature	Display the IGBT temperature	UNITS_DEGREES_CELSIUS
AV 051	R	Temperature of driver	Display the temperature of capacitance	UNITS_DEGREES_CELSIUS
AV 052	R	Real carry frequency	Display real carrier frequency of the drive (kHz)	UNITS_KILOHERTZ
AV 053	R	PID feedback value	Display PID feedback value (%)	UNITS_PERCENT
AV 054	R	Overload rate	Display overload condition (%)	UNITS_PERCENT
AV 055	R	Ground fail detect level	Display GND fail detect level (%)	UNITS_PERCENT
AV 056	R	DC bus ripple	Display DC bus voltage ripples (Volt)	UNITS_VOLTS
AV 057	R	Fan Speed	Fan speed of the drive (%)	UNITS_PERCENT
AV 058	R	Output speed(rpm)	Output speed(rpm)	UNITS_REVOLUTIONS_PER_MINUTE
AV 059	R	KW per Hour	kW per Hour	UNITS_KILOWATTS
AV 060	R	Multi-speed switch	Real multi-speed switch	UNITS_NO_UNITS
AV 061	R	AVI1 input value	0–10 V corresponds to 0–100%	UNITS_PERCENT
AV 062	R	ACI input value	4–20 mA / 0–10 V corresponds to 0–100%	UNITS_PERCENT
AV 063	R	AVI2 input value	0 V–10 V corresponds to 0–100%	UNITS_PERCENT
AV 064	R	Digital input status	Refer to Pr.02-12	UNITS_NO_UNITS
AV 065	R	Digital output status	Refer to Pr.02-18	UNITS_NO_UNITS
AV 066	R	CPU pin status of DI	Corresponding CPU pin status of digital input	UNITS_NO_UNITS
AV 067	R	CPU pin status of DO	Corresponding CPU pin status of digital output	UNITS_NO_UNITS
AV 068	R	PLC D1043 value	PLC D1043 value	UNITS_NO_UNITS

2.3 Commandable Binary Value Object

In CFP2000, we have BV_000–BV_015 supporting commandable Present_Value property. For these BV_Objects, we also can use (Multi) Read_Service to access Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description
BV 000	RW	ACTIVE CMD	(0)FreqCmd=0;(1)FreqCmd=FreqRefValue
BV 001	RW	FWD/REV CMD	(0)Forward; (1)Reverse
BV 002	RW	Reserved	Reserved
BV 003	RW	HALT CMD	(0)None;(1)RampDown to 0 Hz.
BV 004	RW	LOCK CMD	(0)None;(1)OutputFreq stays at current frequency
BV 005	RW	Reserved	Reserved
BV 006	RW	QSTOP CMD	(0)None;(1)Force driver quick stop
BV 007	RW	ServoPower CMD	(0)PowerOff(free run to stop);(1)PowerOn
BV 008	RW	Reserved	Reserved
BV 009	RW	Reserved	Reserved
BV 010	RW	Reserved	Reserved
BV 011	RW	Reserved	Reserved
BV 012	RW	Reserved	Reserved
BV 013	RW	Reserved	Reserved
BV 014	RW	Reserved	Reserved
BV 015	RW	RESET	RESET:(0)Do nothing;(1)Reset fault

2.4 Status (Readonly) Binary Value Object

In CFP2000, we have BV_016–BV_031 with readonly Present_Value property. For these BV_Objects, we do NOT have Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description
BV 016	R	ARRIVE STATE	(0)Not yet;(1)Arrive (OutputFreq=FreqCmd)
BV 017	R	FWD/REV STATE	(0)Forward;(1)Reverse
BV 018	R	WARN STATE	(0)No Warn;(1)Occur Warn
BV 019	R	ERROR STATE	(0)No Error;(1)Occur Error
BV 020	R	Reserved	Reserved
BV 021	R	Reserved	Reserved
BV 022	R	QSTOP STATE	(0)No QSTOP;(1)Occur QSTOP
BV 023	R	ServoPower STATE	(0)PowerOff(free run to stop);(1)PowerOn
BV 024	R	Reserved	Reserved
BV 025	R	Reserved	Reserved
BV 026	R	Reserved	Reserved
BV 027	R	Reserved	Reserved

Object Number	R/W	Object Name	Object Description
BV 028	R	Reserved	Reserved
BV 029	R	Reserved	Reserved
BV 030	R	Reserved	Reserved
BV 031	R	Reserved	Reserved

3. Steps to setup the Parameters about BACnet in CFP2000

Related to BACnet function in CFP2000, We have to configure 2 parts of parameters
Part1. Setup parameters related to Communication at Pr_Group9.
Part2. Setup parameters related to System_Parameter at Pr_Group0.

Part1. Pr_Group9, Communication.

1-1. Set Pr.09-31 =1, BACnet is enabled, then the COM1_Port will be accessed by BACnet. When this is set, the COM1_Port communication format will be changed to RTU 8, N, 1.
(Note: The HW Pins of COM1_Port are shared by RJ45 and RS-485. When BACnet is enabled, BACnet will access the COM1_Port, that also means we can **NOT** have Modbus, PLC connections, VFDSoft and VFD Explorer by COM1_Port).

1-2. Set Pr.09-50, Default = 10, BACnet's MS/TP station number 0–127

1-3. Set Pr.09-51, Default = 38400, BACnet communication baud rate, 9600, 19200, 38400 or 76800 bps.

1-4. Set Pr.09-52 and Pr.09-53, the default setting of Device Object_Identifier is 0x000A (Pr.09-52=10, Pr.09-53=00). Device Object_Identifier is the combination of Pr.09-52 and Pr.09-53, thus the setting range can be 0–4194303.
For example, Pr.09-53=12(0x0C) and Pr.09-52 =3456(0x0D80), then the device Identifier's value =12*65536+3456 =789888(0x0C0D80).

1-5. Set Pr.09-55, Default =127, the highest allowable address for master nodes on the same MS/TP network. CFP2000 base on this setting to know the Max search range.

1-6. Set Pr.09-56, setup the BACnet password. If setup is successful, the keypad will display 8888.

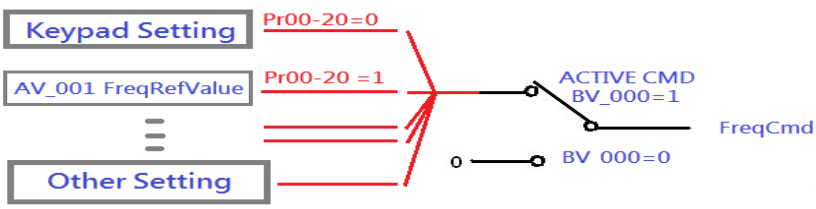
Part2. Pr_Group0, System Parameter.

2-1. Set Pr.00-20 =1, that means the source of the Frequency command is from RS-485 Interface (accessed by BACnet).

2-2. Set Pr.00-21 =2, that means the source of the Operation command is from RS-485 Interface (accessed by BACnet).

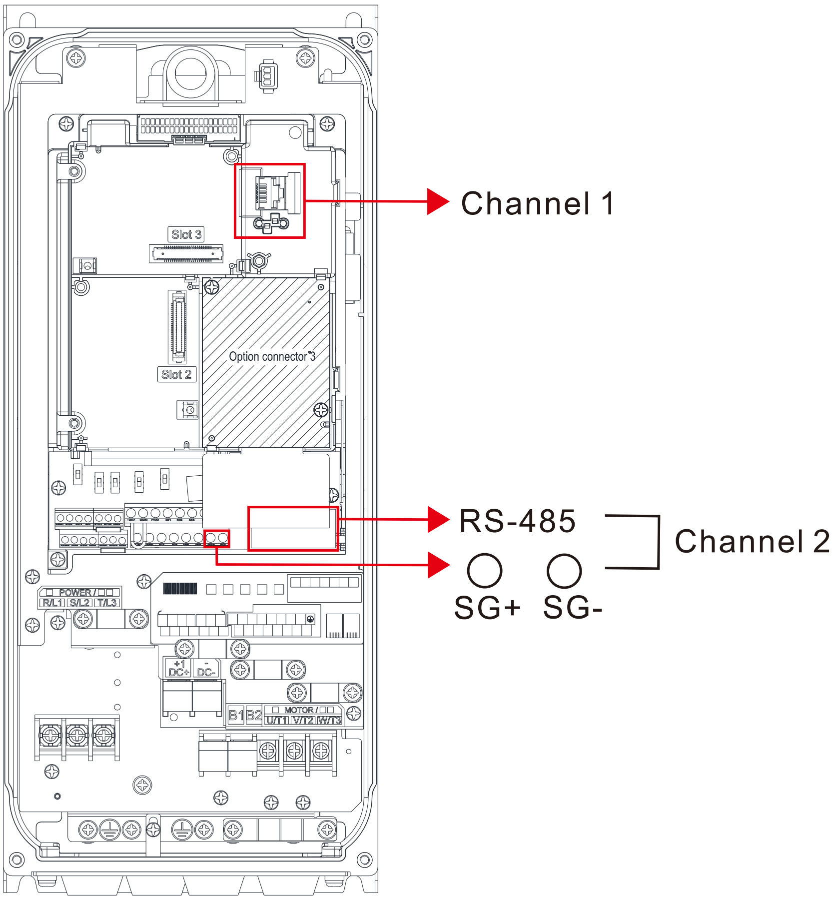
Here is a simple example:

After setting up the 2 parts of Pr, we can enable the BACnet function in CFP2000. Thus, we can access some BACnet objects to make the CFP2000 driving motor Run or Stop.
Step1. Write_Service on AV_001, Present_Value =60.0 ➔ Setup Frequency Reference Value.
Step2. Write_Service on BV_007, Present_Value =Active. ➔ Setup Servo Power CMD.
Step3. Write_Service on BV_000, Present_Value =Active. ➔ Setup Active CMD.
Step4. Read_Service on AV_031, Present_Value ➔ User can know the Output frequency.



PS. In CFP2000, based on different Pr setting or IO setting, we can make FreqCmd with different source of Reference Value. Please check the usage of Keypad, Pr and IO setting for more detail information.

- Connection of the communication cable as shown in the below diagram.
  Please note that HW Pins of COM1_Port are shared by RJ45 and RS-485. That means user can use RJ45_cable or RS-485_lines to access the COM1_Port.
  When BACnet is enabled, COM1_Port will be dominated by BACnet function. Under this condition, user will not be able to have Modbus VFD Soft, VFD Explorer or PLC function on COM1_Port.



BACnet Protocol Implementation Conformance Statement

Date：July 24, 2014

Vendor Name: Delta Electronics, Inc.

Product Name: CFP2000

Product Model Number: VFD-CFP2000

Applications Software Version: Ver 01.04- yyyymm **Firmware Revision:** Ver 01.04 **BACnet Protocol Revision:** 7

Product Description:

Delta VFD-CFP2000 is a Variable Frequency AC motor Drive with BACnet embedded.

In VFD-CFP2000, the BACnet connection is by MS/TP, RS-485-based. VFD-CFP2000 provides a BACnet communication function that permits it as a server and supports BIBBs defined by the BACnet B-ASC. VFD-CFP2000 BACnet provides the capability to control and monitor the VFD-CFP2000 machine.

BACnet Standardized Device Profile (Annex L):

☐ **BACnet Operator Workstation (B-OWS)_**

☐ **BACnet Building Controller (B-BC)**

☐ **BACnet Advanced Application Controller (B-AAC)_**

■ **BACnet Application Specific Controller (B-ASC)**

☐ **BACnet Smart Sensor (B-SS)**

☐ **BACnet Smart Actuator (B-SA)**

List all BACnet Interoperability Building Blocks Supported (Annex K):

Data Sharing BIBBs

Data Sharing-ReadProperty-B (DS-RP-B)

Data Sharing-WriteProperty-B (DS-WP-B)

Data Sharing-ReadPropertyMultiple-B (DS-RPM-B)

Device and Network Management BIBBs

Device Management-Dynamic Device Binding-B (DM-DDB-B)

Device Management-Dynamic Object Binding-B (DM-DOB-B)

Device Management-DeviceCommunicationControl-B (DM-DCC-B)

Segmentation Capability:

☐ Segmented requests supported Window Size ____________________

☐ Segmented responses supported Window Size ________________

Standard Object Types Supported:

Analog Value

Binary Value

Device

Object instantiation is static. Refer to table at end of this document for object details.

Data Link Layer Options:

☐ BACnet IP, (Annex J)

☐ BACnet IP, (Annex J), Foreign Device

☐ ISO 8802-3, Ethernet (Clause 7)

☐ ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)

☐ ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s) ____________

■ MS/TP master (Clause 9), baud rate(s): 9600, 19200, 38400, 76800

☐ MS/TP slave (Clause 9), baud rate(s): ________

☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):______

☐ Point-To-Point, modem, (Clause 10), baud rate(s): _____

☐ LonTalk, (Clause 11), medium: __________

☐ Other: _________

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐Yes ■No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.

☐ Annex H, BACnet Tunneling Router over IP

☐ BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ANSI X3.4	☐ IBM™/Microsoft™ DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

____

____

____

____

The Properties of Objects

Property ID		Object Type		
		Device	Analog Value	Binary Value
#4	ACTIVE TEXT			V
#11	APDU_TIMEOUT	V		
#12	APPLICATION_SOFTWARE_VERSION	V		
#28	DESCRIPTION	V	V	V
#30	DEVICE ADDRESS BINDING	V	V	
#36	EVENT STATE		V	V
#44	FIRMWARE_REVISION	V		
#46	INACTIVE TEXT			V
#62	MAX_APDU_LENGTH_ACCEPTED	V		
#63	MAX_INFO_FRAMES	V		
#64	MAX_MASTER	V		
#70	MODEL_NAME	V		
#73	NUMBER_OF_APDU_RETRIES	V		
#75	OBJECT_IDENTIFIER	**V *1**	V	V
#76	OBJECT_LIST	V		
#77	OBJECT_NAME	**V *1**	V	V
#79	OBJECT_TYPE	V	V	V
#81	OUT OF SERVICE		V	V
#85	PRESENT VALUE		**V *2**	**V *2**
#87	PRIORITY ARRAY		V *3	V *3
#96	PROTOCOL_OBJECT_TYPES_SUPPORTED	V		
#97	PROTOCOL_SERVICES_SUPPORTED	V		
#98	PROTOCOL_VERSION	V		
#104	RELINQUISH DEFAULT		V *3	V *3
#107	SEGMENTATION_SUPPORTED	V		
#111	STATUS FLAGS		V	V
#112	SYSTEM_STATUS	V		
#117	UNITS		V	
#120	VENDOR_IDENTIFIER	V		
#121	VENDOR_NAME	V		
#139	PROTOCOL_REVISION	V		
#155	DATABASE_REVISION	V		

*1. The Object_ID and Object_Name Properties of Device are writeable.

*2. The Present_Value Property of some AV and BV objects are commandable.

*3. Only Commandable objects support Priority_Array and Relinquish_Default.

- ## Commandable Analog Value Object

In VFD-CFP2000, we have AV_000–AV_026 supporting commandable Present_Value property. In these AV_Objects, we also can use (Multi) Read_Service to access Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description	Unit
AV 000	RW	AV_000_Reserved	Reserved	UNITS_NO_UNITS
AV 001	RW	AV_001_FreqRefValue	Frequency Reference Value	UNITS_HERTZ
AV 002	RW	AV_002_Reserved	Reserved	UNITS_NO_UNITS
AV 003	RW	AV_003_Reserved	Reserved	UNITS_NO_UNITS
AV 004	RW	AV_004_Reserved	Reserved	UNITS_NO_UNITS
AV 005	RW	AV_005_Reserved	Reserved	UNITS_NO_UNITS
AV 006	RW	AV_006_Reserved	Reserved	UNITS_NO_UNITS
AV 007	RW	AV_007_Reserved	Reserved	UNITS_NO_UNITS
AV 008	RW	AV_008_Reserved	Reserved	UNITS_NO_UNITS
AV 009	RW	AV_009_Reserved	Reserved	UNITS_NO_UNITS
AV 010	RW	AV_010_Reserved	Reserved	UNITS_NO_UNITS
AV 011	RW	AV_011_P9-11 map set= -----	AV11 will modify data which is P9-11 mapping to	Depends
AV 012	RW	AV_012_P9-12 map set= -----	AV12 will modify data which is P9-12 mapping to	Depends
AV 013	RW	AV_013_P9-13 map set= -----	AV13 will modify data which is P9-13 mapping to	Depends
AV 014	RW	AV_014_P9-14 map set= -----	AV14 will modify data which is P9-14 mapping to	Depends
AV 015	RW	AV_015_P9-15 map set= -----	AV15 will modify data which is P9-15 mapping to	Depends
AV 016	RW	AV_016_P9-16 map set= -----	AV16 will modify data which is P9-16 mapping to	Depends
AV 017	RW	AV_017_P9-17 map set= -----	AV17 will modify data which is P9-17 mapping to	Depends
AV 018	RW	AV_018_P9-18 map set= -----	AV18 will modify data which is P9-18 mapping to	Depends
AV 019	RW	AV_019_P9-19 map set= -----	AV19 will modify data which is P9-19 mapping to	Depends
AV 020	RW	AV_020_P9-20 map set= -----	AV20 will modify data which is P9-20 mapping to	Depends
AV 021	RW	AV_021_P9-21 map set= -----	AV21 will modify data which is P9-21 mapping to	Depends
AV 022	RW	AV_022_P9-22 map set= -----	AV22 will modify data which is P9-22 mapping to	Depends
AV 023	RW	AV_023_P9-23 map set= -----	AV23 will modify data which is P9-23 mapping to	Depends
AV 024	RW	AV_024_P9-24 map set= -----	AV24 will modify data which is P9-24 mapping to	Depends
AV 025	RW	AV_025_P9-25 map set= -----	AV25 will modify data which is P9-25 mapping to	Depends
AV 026	RW	AV_026_P9-26 map set= -----	AV26 will modify data which is P9-26 mapping to	Depends

Status (Readonly) Analog Value Object

In VFD-CFP2000, we have AV_027–AV_068 with readonly Present_Value property. In these AV_Objects, we do NOT have Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description	Unit
AV 027	R	AV_027_Reserved	Reserved	UNITS_NO_UNITS
AV 028	R	AV_028_Reserved	Reserved	UNITS_NO_UNITS
AV 029	R	AV_029_Reserved	Reserved	UNITS_NO_UNITS
AV 030	R	AV_030_Reserved	Reserved	UNITS_NO_UNITS
AV 031	R	AV_031_Output frequency	Display output frequency (Hz)	UNITS_HERTZ
AV 032	R	AV_032_Reserved	Reserved	UNITS_NO_UNITS
AV 033	R	AV_033_Reserved	Reserved	UNITS_NO_UNITS
AV 034	R	AV_034_Reserved	Reserved	UNITS_NO_UNITS
AV 035	R	AV_035_Output torque (%)	Display output torque (%)	UNITS_PERCENT
AV 036	R	AV_036_Reserved	Reserved	UNITS_NO_UNITS
AV 037	R	AV_037_Reserved	Reserved	UNITS_NO_UNITS
AV 038	R	AV_038_Reserved	Reserved	UNITS_NO_UNITS
AV 039	R	AV_039_Status word	Display status word,made from BV16–BV31	UNITS_NO_UNITS
AV 040	R	AV_040_Reserved	Reserved	UNITS_NO_UNITS
AV 041	R	AV_041_Driver type code	Driver type code	UNITS_NO_UNITS
AV 042	R	AV_042_Warn code	Warn code	UNITS_NO_UNITS
AV 043	R	AV_043_Error code	Error code	UNITS_NO_UNITS
AV 044	R	AV_044_Output current	Display output current (Amp)	UNITS_AMPERES
AV 045	R	AV_045_DC bus voltage	Display DC bus voltage (Volt)	UNITS_VOLTS
AV 046	R	AV_046_Output Voltage	Display output voltage of U, V, W (Volt)	UNITS_VOLTS
AV 047	R	AV_047_Count Value	Display counter value of TRG terminal	UNITS_NO_UNITS
AV 048	R	AV_048_Power Angle	Display output power angle of U, V, W	UNITS_POWER_FACTOR
AV 049	R	AV_049_Output Power	Display actual output power of U, V, W (kW)	UNITS_KILOWATTS
AV 050	R	AV_050_IGBT temperature	Display the IGBT temperature	UNITS_DEGREES_CELSIUS
AV 051	R	AV_051_Temperature of driver	Display the temperature of capacitance	UNITS_DEGREES_CELSIUS
AV 052	R	AV_052_Real carry frequency	Display real carrier frequency of the drive (kHz)	UNITS_KILOHERTZ
AV 053	R	AV_053_PID feedback value	Display PID feedback value (%)	UNITS_PERCENT
AV 054	R	AV_054_Overload rate	Display overload condition (%)	UNITS_PERCENT
AV 055	R	AV_055_Ground fail detect level	Display GND fail detect level (%)	UNITS_PERCENT
AV 056	R	AV_056_DC bus ripple	Display DC bus voltage ripples (Volt)	UNITS_VOLTS
AV 057	R	AV_057_Fan Speed	Fan speed of the drive (%)	UNITS_PERCENT
AV 058	R	AV_058_Output speed (rpm)	Output speed (rpm)	UNITS_REVOLUTIONS_PER_MINUTE

Object Number	R/W	Object Name	Object Description	Unit
AV 059	R	AV_059_kW per Hour	kW per Hour	UNITS_KILOWATTS
AV 060	R	AV_060_Multi-speed switch	Real multi-speed switch	UNITS_NO_UNITS
AV 061	R	AV_061_AVI1 input value	0–10 V corresponds to 0–100%	UNITS_PERCENT
AV 062	R	AV_062_ACI input value	4–20 mA / 0–10 V corresponds to 0–100%	UNITS_PERCENT
AV 063	R	AV_063_AVI2 input value	0 V–10 V corresponds to 0–100%	UNITS_PERCENT
AV 064	R	AV_064_Digital input status	Refer to Pr.02-12	UNITS_NO_UNITS
AV 065	R	AV_065_Digital output status	Refer to Pr.02-18	UNITS_NO_UNITS
AV 066	R	AV_066_CPU pin status of DI	Corresponding CPU pin status of digital input	UNITS_NO_UNITS
AV 067	R	AV_067_CPU pin status of DO	Corresponding CPU pin status of digital output	UNITS_NO_UNITS
AV 068	R	AV_068_PLC D1043 value	PLC D1043 value	UNITS_NO_UNITS

- **Commandable Binary Value Object**

  In VFD-CFP2000, we have BV_000–BV_015 supporting commandable Present_Value property. In these BV_Objects, we also can use (Multi) Read_Service to access Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description
BV 000	RW	BV_000_ACTIVE CMD	(0)FreqCmd=0;(1)FreqCmd=FreqRefValue
BV 001	RW	BV_001_FWD/REV CMD	(0)Forward; (1)Reverse
BV 002	RW	BV_002_Reserved	Reserved
BV 003	RW	BV_003_HALT CMD	(0)None;(1)RampDown to 0Hz.
BV 004	RW	BV_004_LOCK CMD	(0)None;(1)OutputFreq stays at current frequency
BV 005	RW	BV_005_Reserved	Reserved
BV 006	RW	BV_006_QSTOP CMD	(0)None;(1)Force driver quick stop
BV 007	RW	BV_007_ServoPower CMD	(0)PowerOff(free run to stop);(1)PowerOn
BV 008	RW	BV_008_Reserved	Reserved
BV 009	RW	BV_009_Reserved	Reserved
BV 010	RW	BV_010_Reserved	Reserved
BV 011	RW	BV_011_Reserved	Reserved
BV 012	RW	BV_012_Reserved	Reserved
BV 013	RW	BV_013_Reserved	Reserved
BV 014	RW	BV_014_Reserved	Reserved
BV 015	RW	BV_015_RESET	RESET:(0)Do nothing;(1)Reset fault

- **Status (Readonly) Binary Value Object**

In VFD-CFP2000, we have BV_016–BV_031 with readonly Present_Value property. In these BV_Objects, we do NOT have Priority_Array and Relinquish_Default properties.

Object Number	R/W	Object Name	Object Description
BV 016	R	BV_016_ARRIVE STATE	(0)Not yet;(1)Arrive (OutputFreq=FreqCmd)
BV 017	R	BV_017_FWD/REV STATE	(0)Forward;(1)Reverse
BV 018	R	BV_018_WARN STATE	(0)No Warn;(1)Occur Warn
BV 019	R	BV_019_ERROR STATE	(0)No Error;(1)Occur Error
BV 020	R	BV_020_Reserved	Reserved
BV 021	R	BV_021_Reserved	Reserved
BV 022	R	BV_022_QSTOP STATE	(0)No QSTOP;(1)Occur QSTOP
BV 023	R	BV_023_ServoPower STATE	(0)PowerOff(free run to stop);(1)PowerOn
BV 024	R	BV_024_Reserved	Reserved
BV 025	R	BV_025_Reserved	Reserved
BV 026	R	BV_026_Reserved	Reserved
BV 027	R	BV_027_Reserved	Reserved
BV 028	R	BV_028_Reserved	Reserved
BV 029	R	BV_029_Reserved	Reserved
BV 030	R	BV_030_Reserved	Reserved
BV 031	R	BV_031_Reserved	Reserved

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Chapter 18 Safe Torque Off Function

18-1 The Drive Safety Function Failure Rate

Item	Definition	Standard	Performance
STO	Safe Torque Off	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

18-2 Safe Torque Off Terminal Function Description

The Safe Torque Off function is to cut off the power supply to motor through the hardware, thereby the motor could not produce torque.

The STO function controls the motor current driving signal through two hardware circuits respectively, and thus cut off the inverter power module output in order to achieve the status of safety stop.

Operation Principle Description as following table 1:

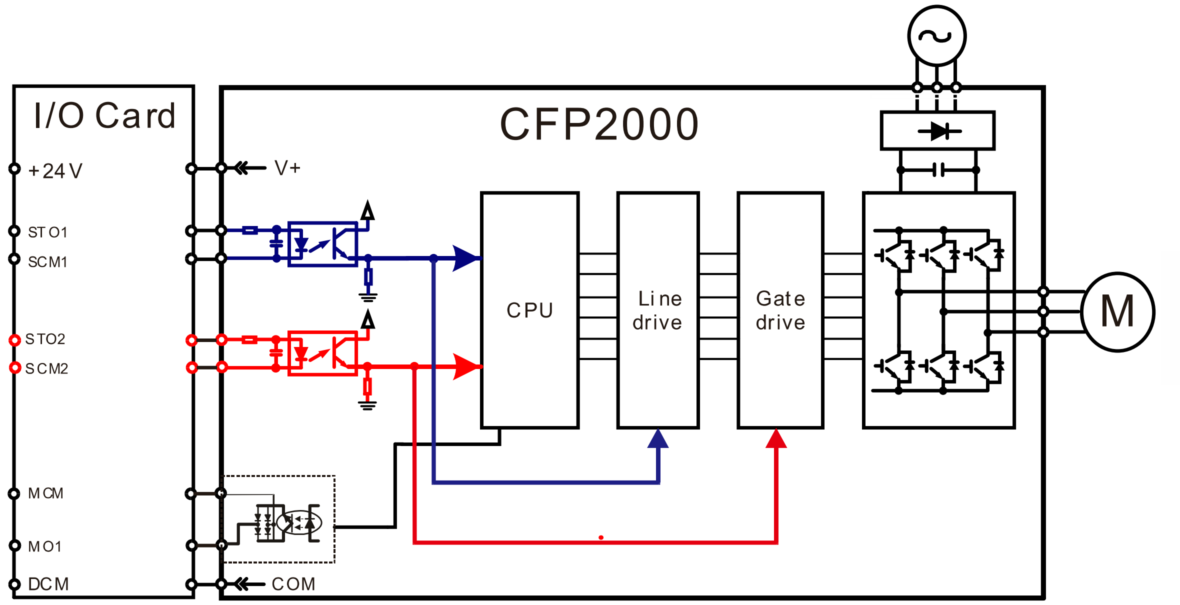
Table 1: Terminal operation description

Signal	Channel	Photo-coupler status			
STO signal	STO1–SCM1	ON (High)	ON (High)	OFF (Low)	OFF (Low)
	STO2–SCM2	ON (High)	OFF (Low)	ON (High)	OFF (Low)
Driver Output status		Ready	STL2 mode (Torque output off)	STL1 mode (Torque output off)	STO mode (Torque output off)

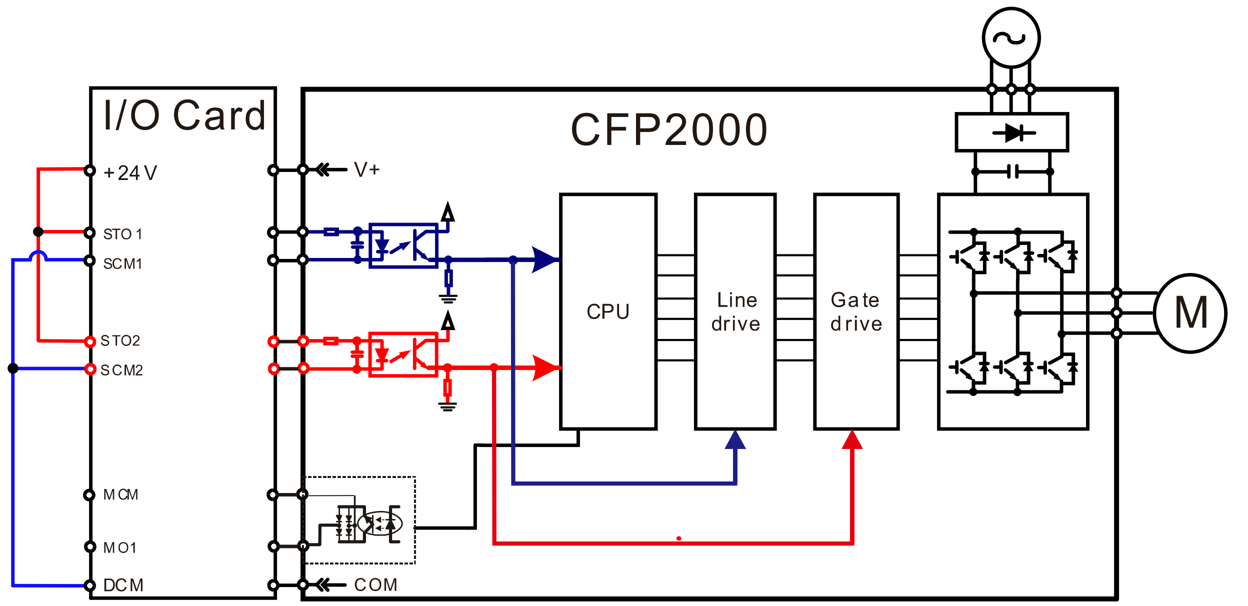
- 🕮 STO means Safe Torque Off
- 🕮 STL1–STL3 means Safe Torque Off hardware abnormal.
- 🕮 STL3 means STO1–SCM1 and STO2–SCM2 internal circuit detected abnormal.
- 🕮 STO1–SCM1 ON (High): means STO1–SCM1has connected to a +24 V_{DC} power supply.
- 🕮 STO2–SCM2 ON (High): means STO2–SCM2 has connected to a +24 V_{DC} power supply.
- 🕮 STO1–SCM1 OFF (Low): means STO1–SCM1hasn’t connected to a +24 V_{DC} power supply.
- 🕮 STO2–SCM2 OFF (Low): means STO2–SCM2hasn’t connected to a +24 V_{DC} power supply.

18-3 Wiring diagram

18-3-1Internal STO circuit as below:

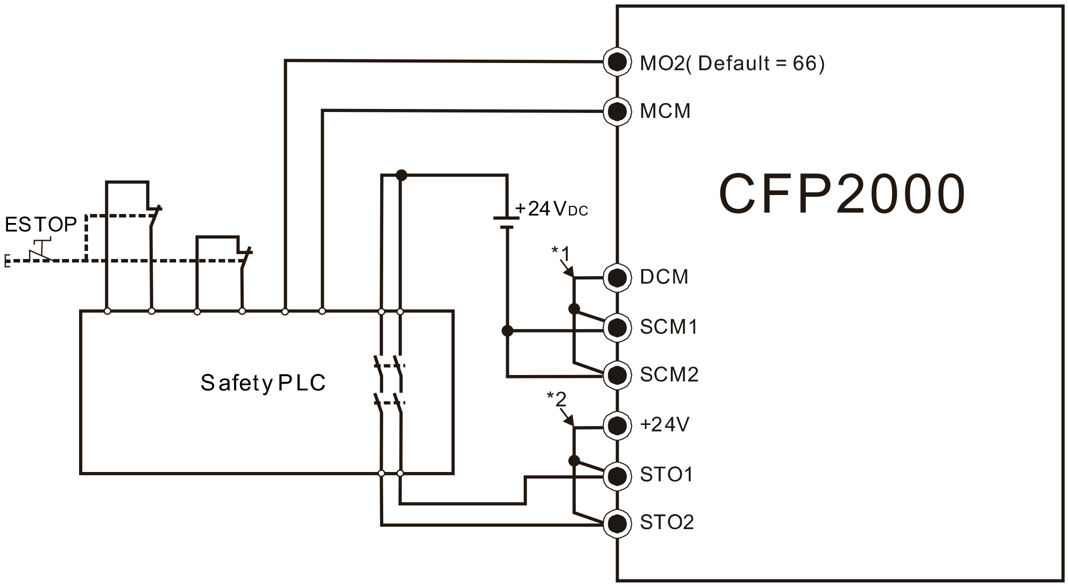


18-3-2 In the figure below, the default setting for +24V-STO1-STO2 and SCM1-SCM2-DCM is short circuit:



18-3-3 The control loop wiring diagram:

1. Remove the shot-circuit of +24V-STO1-STO2 and DCM-SCM1-SCM2.
2. The wiring as below diagram. The ESTOP switch must at Close status in normal situation and drive will be able to Run.
3. STO mode, switch ESTOP open. Drive output stop and keypad display STO.



NOTE

*1: Factory short-circuit of DCM-SCM1-SCM2. Remove the short-circuit to use the Safety function.
*2: Factory short-circuit of +24V-STO1-STO2. Remove the short-circuit to use the Safety function.

18-4 Parameter

06-44 STO Alarm Latch

Default: 0

Settings 0：STO latch
1：STO no latch

- Pr.06-44=0 STO latch: after the reason of STO alarm is cleared, you need a Reset command to clear STO alarm.
- Pr.06-44=1 STO no latch: after the reason of STO alarm is cleared, the STO alarm will be cleared automatically.
- The STL1–STL3 error are all “Alarm latch” mode (in STL1–STL3 mode, the Pr.06-44 function is no effective).

02-13 Multi-function Output 1 (Relay1)

Default: 11

02-14 Multi-function Output 2 (Relay2)

Default: 1

02-15 Multi-function Output 3 (Relay3)

Default: 66

Settings
66: SO output logic A
68: SO output logic B

Settings	Functions	Descriptions
66	SO output logic A	Safety Output Normal Open
68	SO output logic B	Safety Output Normal Close

- CFP2000 default Pr.02-15 (Relay3) = 66(N.O.) and Multi-function Output setting item adds two new functions: 66 and 68.

Drive status	Safety Output status	
	N.O. (MOx=66)	N.C. (MOx=68)
Normal run	Open	Close
STO	Close	Open
STL1–STL3	Close	Open

00-04 Content of Multi-function Display

Default: 3

Settings 45: Hardware ID

18-5 Operating Sequence Description

18-5-1 Normal operation status

As shown in Figure 1: When the STO1–SCM1 and STO2–SCM2=ON (no STO function is needed), the drive executes “Operating” or “Output Stop” according to the RUN/STOP command.

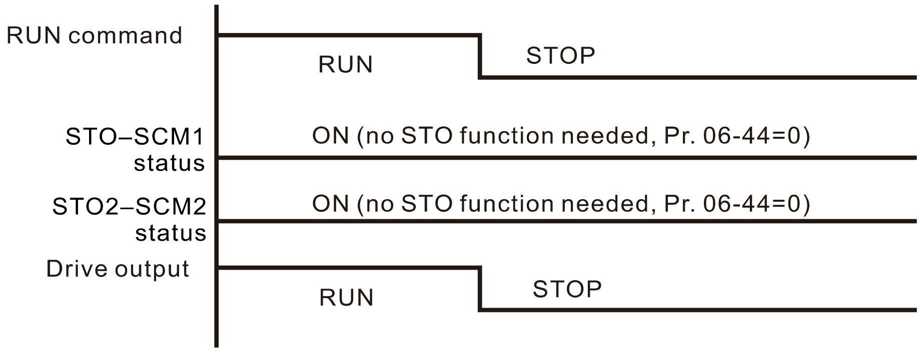


Figure 1

18-5-2-1 STO, Pr.06-44=0, Pr.02-35=0

As shown in Figure 4: When both of STO1–SCM1 and STO2–SCM2 channel have turned off during operating, the STO function enables and the drive stops output regardless of Run command is ON or OFF status.

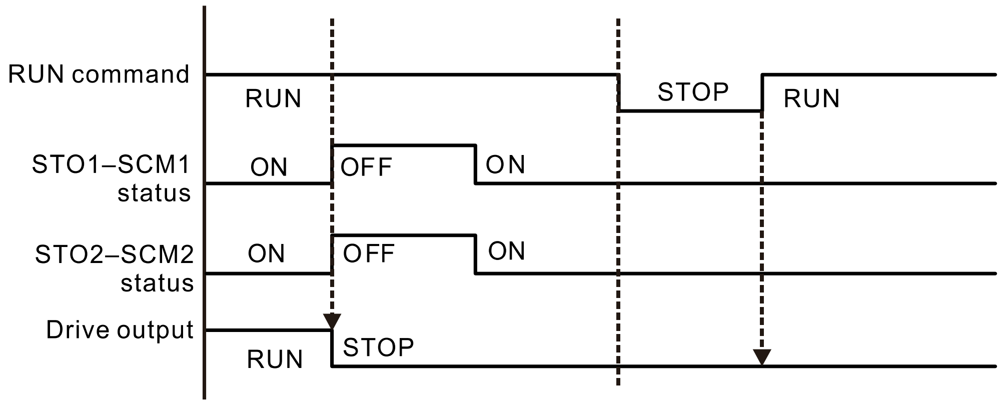


Figure 2

18-5-2-2 STO, Pr.06-44=0, Pr.02-35=1

As shown in Figure 3: the same as figure 2. However, due to the setting for Pr.02-35 is 1, if the operating command still exists after the Reset command, the drive will immediately execute the run command again.

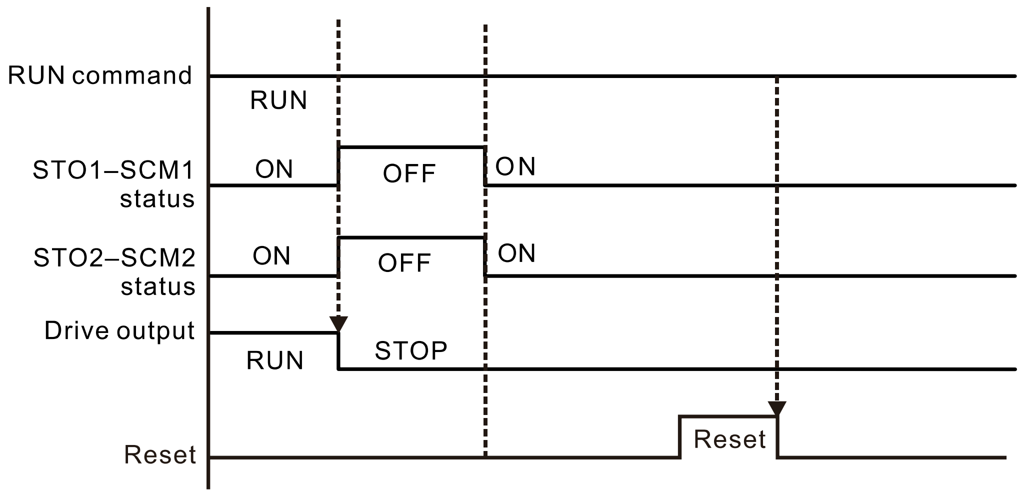


Figure 3

18-5-3 STO, Pr.06-44=1 STO Alarm no latch

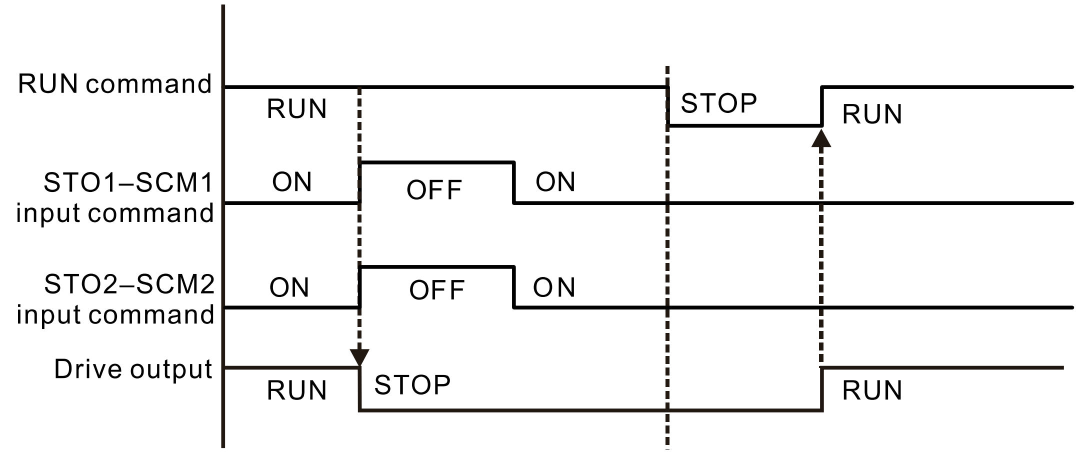


Figure 4

18-5-4 STL1

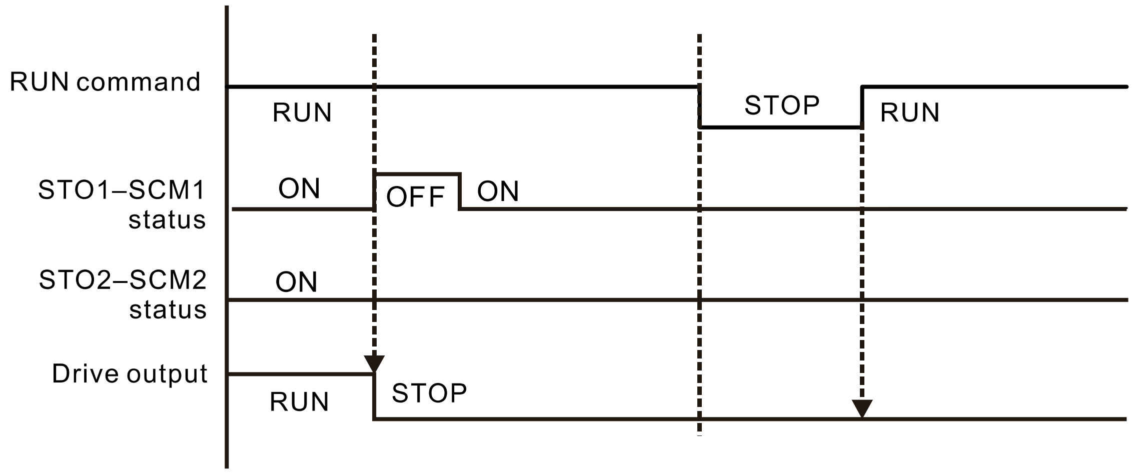


Figure 5

18-5-4 STL2

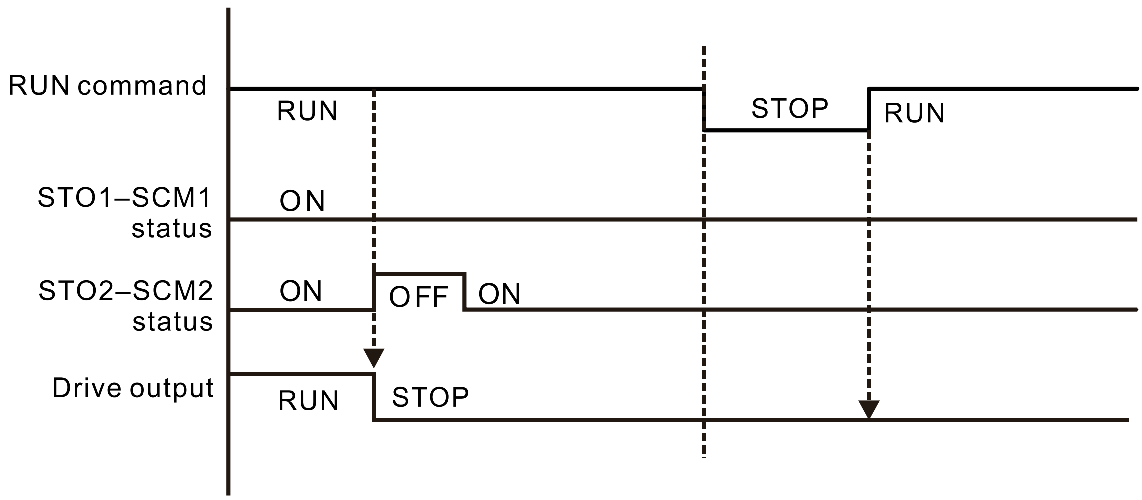


Figure 6

18-6 New Error Code for STO Function

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

Settings
72: Channel 1 (STO1–SCM1) safety loop error (STL1)
76: Safe torque off (STO)
77: Channel 2 (STO2–SCM2) safety loop error (STL2)
78: Internal loop error (STL3)

Error code	Name	Description
76	STO	Safe Torque Off function active
72	STL1 (STO1–SCM1)	STO1–SCM1 internal hardware detect error
77	STL2 (STO2–SCM2)	STO2–SCM2 internal hardware detect error
78	STL3	STO1–SCM1 and STO2–SCM2 internal hardware detect error

The Old/New control board and Old/New I/O card:

CFP2000	v1.20 firmware	v1.21 firmware
v1.20 control board + old I/O card (no STO function)	OK	OK
v1.20 control board + new I/O card (with STO function)	Error	Error
v1.21 control board + old I/O card (no STO function)	Error	Error
v1.21 control board + new I/O card (with STO function)	Error	OK

Appendix A. Revision History

New information	
Description	Related part
Warning code CK1, CK2, CK3, CK4 and CK10	Chapter 10 & 13

Updated information	
Description	Related part
The part number of zero phase reactors	Chapter 7
Update desciptions of the following parameters: ● Parameter group 05: 05-33–05-43 ● Parameter group 09: 09-60, 09-71, 09-72 ● Parameter group 10: Name of the parameter group ● Parameter group 12: 12-09	Chapter 11, Section 12-1