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Industrial Automation Headquarters

Delta Electronics, Inc.
Taoyuan Technology Center
No.18, Xinglong Rd., Taoyuan District,
Taoyuan City 330477, Taiwan
TEL: +886-3-362-6301 / FAX: +886-3-371-6301

Asia

Delta Electronics (Shanghai) Co., Ltd.
No.182 Minyu Rd., Pudong Shanghai, P.R.C.
Post code : 201209
TEL: +86-21-6872-3988 / FAX: +86-21-6872-3996
Customer Service: 400-820-9595

Delta Electronics (Japan), Inc.
Industrial Automation Sales Department
2-1-14 Shibadaimon, Minato-ku
Tokyo, Japan 105-0012
TEL: +81-3-5733-1155 / FAX: +81-3-5733-1255

Delta Electronics (Korea), Inc.
1511, 219, Gasan Digital 1-Ro., Geumcheon-gu,
Seoul, 08501 South Korea
TEL: +82-2-515-5305 / FAX: +82-2-515-5302

Delta Energy Systems (Singapore) Pte Ltd.
4 Kaki Bukit Avenue 1, #05-04, Singapore 417939
TEL: +65-6747-5155 / FAX: +65-6744-9228

Delta Electronics (India) Pvt. Ltd.
Plot No.43, Sector 35, HSIIDC Gurgaon,
PIN 122001, Haryana, India
TEL: +91-124-4874900 / FAX: +91-124-4874945

Delta Electronics (Thailand) PCL.
909 Soi 9, Moo 4, Bangpoo Industrial Estate (E.P.Z),
Pattana 1 Rd., T.Phraksa, A.Muang,
Samutprakarn 10280, Thailand
TEL: +66-2709-2800 / FAX: +66-2709-2827

Delta Electronics (Australia) Pty Ltd.
Unit 2, Building A, 18-24 Ricketts Road,
Mount Waverley, Victoria 3149 Australia
Mail: IA.au@deltaww.com
TEL: +61-1300-335-823 / +61-3-9543-3720

Americas

Delta Electronics (Americas) Ltd.
5101 Davis Drive, Research Triangle Park, NC 27709, U.S.A.
TEL: +1-919-767-3813 / FAX: +1-919-767-3969

Delta Electronics Brazil Ltd.
Estrada Velha Rio-São Paulo, 5300 Eugênio de
Melo - São José dos Campos CEP: 12247-004 - SP - Brazil
TEL: +55-12-3932-2300 / FAX: +55-12-3932-237

Delta Electronics International Mexico S.A. de C.V.
Gustavo Baz No. 309 Edificio E PB 103
Colonia La Loma, CP 54060
Tlalnepantla, Estado de México
TEL: +52-55-3603-9200

EMEA

Delta Electronics (Netherlands) B.V.
Sales: Sales.IA.EMEA@deltaww.com
Marketing: Marketing.IA.EMEA@deltaww.com
Technical Support: iatechnicalsupport@deltaww.com
Customer Support: Customer-Support@deltaww.com
Service: Service.IA.emea@deltaww.com
TEL: +31(0)40 800 3900

Delta Electronics (Netherlands) B.V.
Automotive Campus 260, 5708 JZ Helmond, The Netherlands
Mail: Sales.IA.Benelux@deltaww.com
TEL: +31(0)40 800 3900

Delta Electronics (Netherlands) B.V.
Coesterweg 45, D-59494 Soest, Germany
Mail: Sales.IA.DACH@deltaww.com
TEL: +49 2921 987 238

Delta Electronics (France) S.A.
ZI du bois Challand 2, 15 rue des Pyrénées,
Lisses, 91090 Evry Cedex, France
Mail: Sales.IA.FR@deltaww.com
TEL: +33(0)1 69 77 82 60

Delta Electronics Solutions (Spain) S.L.U
Ctra. De Villaverde a Vallecas, 265 1º Dcha Ed.
Hormigueras – P.I. de Vallecas 28031 Madrid
TEL: +34(0)91 223 74 20

Carrer Llacuna 166, 08018 Barcelona, Spain
Mail: Sales.IA.Iberia@deltaww.com

Delta Electronics (Italy) S.r.l.
Via Meda 2–22060 Novedrate(CO)
Piazza Grazioli 18 00186 Roma Italy
Mail: Sales.IA.Italy@deltaww.com
TEL: +39 039 8900365

Delta Energy System LLC
Vereyskaya Plaza II, office 112 Vereyskaya str.
17 121357 Moscow Russia
Mail: Sales.IA.RU@deltaww.com
TEL: +7 495 644 3240

Delta Greentech Elektronik San. Ltd. Sti. (Turkey)
Şerifali Mah. Hendem Cad. Kule Sok. No:16-A
34775 Ümraniye – İstanbul
Mail: Sales.IA.Turkey@deltaww.com
TEL: + 90 216 499 9910

Eltek Dubai (Eltek MEA DMCC)
OFFICE 2504, 25th Floor, Saba Tower 1,
Jumeirah Lakes Towers, Dubai, UAE
Mail: Sales.IA.MEA@deltaww.com
TEL: +971(0)4 2690148

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

DELTA_IA-MDS_CT2000_UM_EN_20240408

Digitized Automation for a Changing World

Delta Textile Vector Control Drive CT2000 Series User Manual

www.deltaww.com

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.
- ☑ Turn OFF the AC motor drive power before doing any wiring. A charge with hazardous voltages may remain in the DC bus capacitors even after the power has been turned off for a short time. Do not touch the internal circuits and components before the POWER LED (behind the digital keypad) is OFF. For your safety, measure the remaining voltage with a DC voltmeter on +1/DC+ and DC- and do not start wiring before the voltage drops to a safe level (less than 25 V_{DC}). Installing wiring with a residual voltage may cause personal injury, sparks and short circuit.
- ☑ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Take anti-static measure before touching these components or the circuit boards.
- ☑ Never modify the internal components or wiring.
- ☑ Ground the AC motor drive by using the ground terminal. The grounding method must comply with the laws of the country where the AC motor drive is to be installed.
- ☑ Do NOT install the AC motor drive in a location with high temperature, direct sunlight or inflammable materials or gases.

CAUTION

- ☑ Never connect the AC motor drive output terminals U/T1, V/T2 and W/T3 directly to the AC mains circuit power supply.
- ☑ After finishing the wiring of the AC motor drive, check if R/L1, S/L2 and T/L3 are short-circuited to ground with a multimeter. Do NOT power the drive if short circuits occur. Eliminate the short circuits before the drive is powered.
- ☑ The rated voltage of power system to install motor drives is listed below. Ensure that the installation voltage is in the correct range when installing a motor drive.
  1. For 460V models, the range is between 323–528V.
- ☑ Refer to the table below for short circuit rating:

Model (Power)	Short circuit rating
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

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

Table of Contents

Issued Edition: 02
Firmware Version: V2.03
(Refer to Parameter 00-06 on the product to get the firmware version.)
Issued Date: 2024 / 04

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Chapter 1 Introduction

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

1. Inspect the unit after unpacking to ensure that it was not damaged during shipment. Make sure that the part number printed on the package matches the part number indicated on the nameplate.
2. Make sure that the mains voltage is within the range indicated on the nameplate. Install the AC motor drive according to the instructions in this manual.
3. Before applying power, make sure that all devices, including mains power, motor, control board and digital keypad, are connected correctly.
4. When wiring the AC motor drive, make sure that the wiring of input terminals “R/L1, S/L2, T/L3” and output terminals “U/T1, V/T2, W/T3” are correct to prevent damage to the drive.
5. When power is applied, use the digital keypad (KPC-CC01) to select the language and set parameters. When executing a trial run, begin with a low speed and then gradually increases the speed to the desired speed.

1-1 Nameplate Information

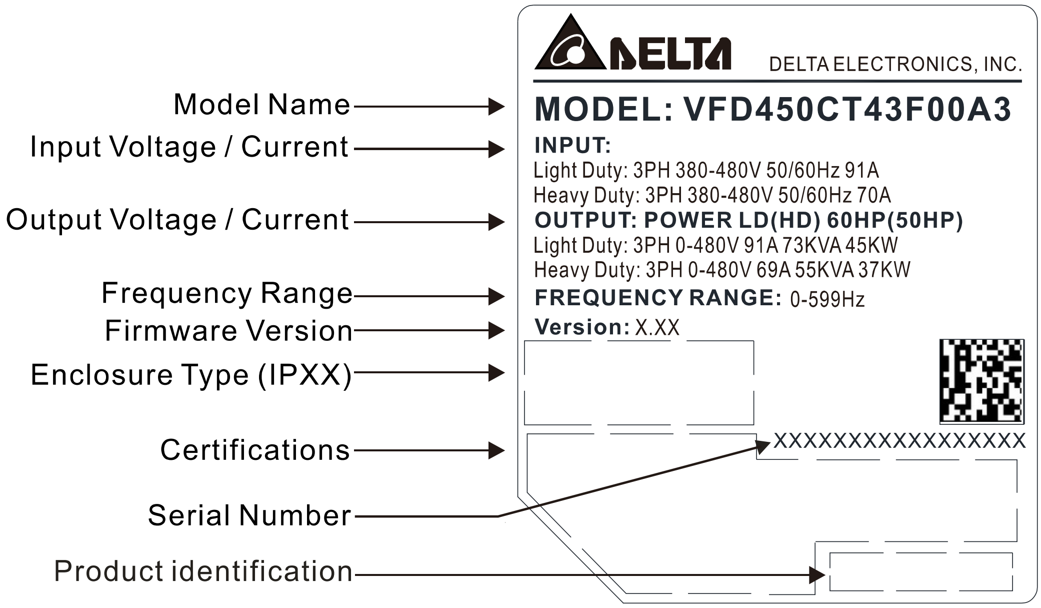


Figure 1-1

1-2 Model Name

VFD 450 CT 43 F 00 A6

Cooling Method & Wind Speed
- A: Plate cooling
- B: Airway cooling
- C: Fan cooling
- 6: Wind speed

IP Ratings
- 00: IP00 UL Open Type
- 21: IP20 NEMA1
- 21: IP20 (CT-A version)

Installation Type
- A: Wall mount
- F: Flange mount or Plate

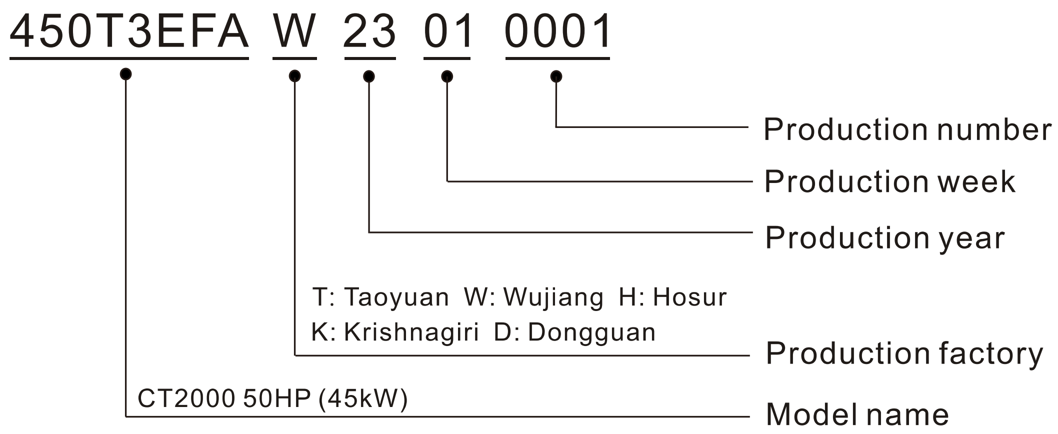
Input Voltage / Phase
- 43: 460V, 3-phase

Series
- CT: CT2000 series

Applicable Motor Capacity
- 055: 7.5HP (5.5kW) – 900: 125HP (90kW)
- Refer to Chapter 9 in user manual for more details

Product name (Variable Frequency Drive)

1-3 Serial Number



1-4 Apply After-sales 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 upper-right corner of the side where keypad is installed on the case body, as below drawing shown:

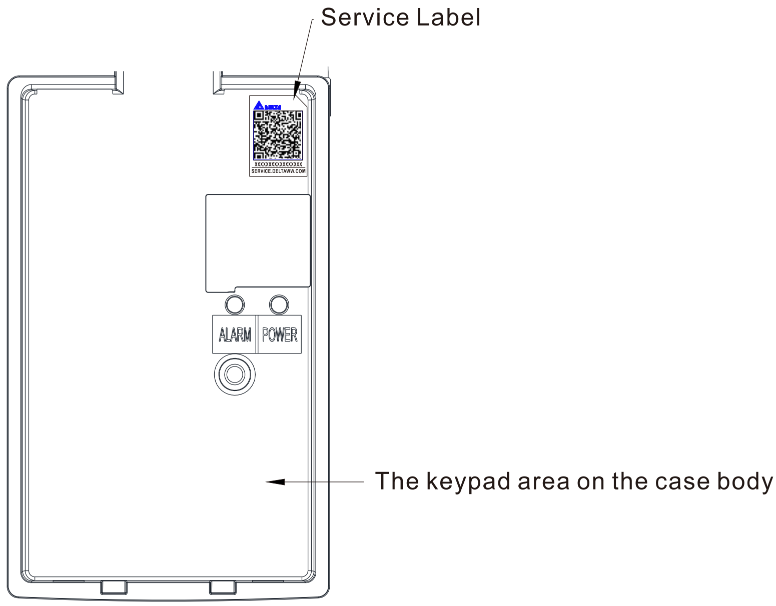


Figure 1-2

1-4-2 Service Link Label

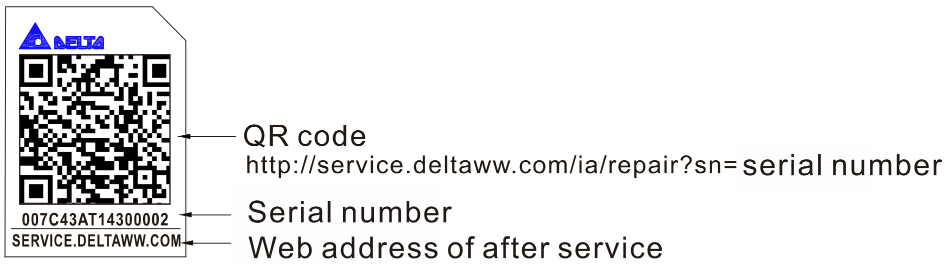


Figure 1-3

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) The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to prevent the drive from unexpected stop or damage caused by mains surges or voltage spikes. Because the Varistors / MOVs from phase to ground are connected to ground with the RFI jumper, removing the RFI jumper disables the protection.

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

Frame A–C Screw Torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)

Loosen the screws and remove the RFI jumper (as shown below).
Tighten the screws again after you remove the RFI jumper.

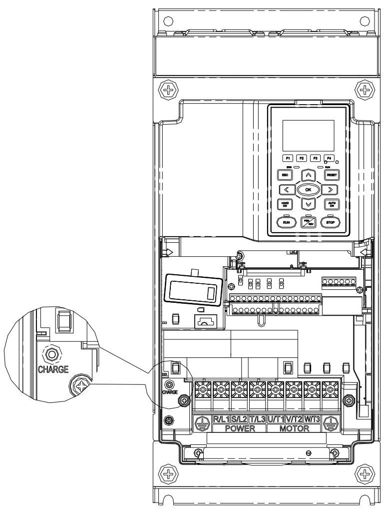


Figure 1-4

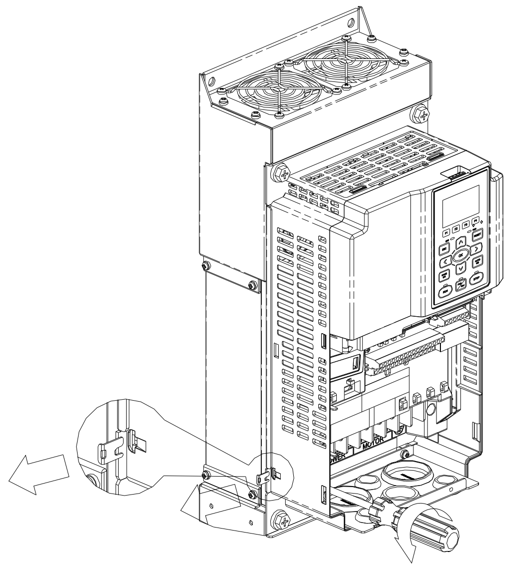


Figure 1-5

Frame D

Remove the RFI jumper by hands (as shown below).

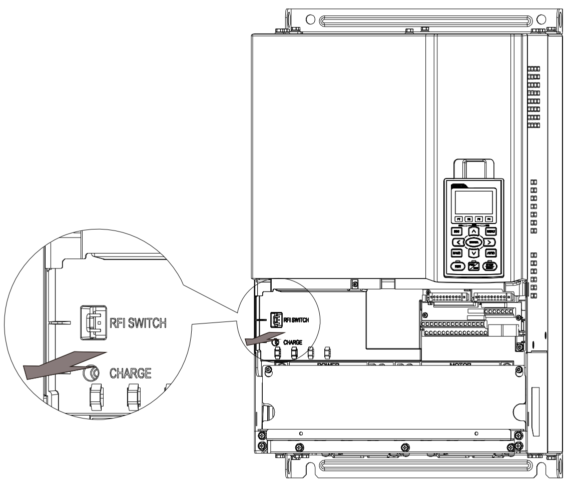


Figure 1-6

Isolating main power from ground:

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

Important points regarding ground connection

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

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

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

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

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

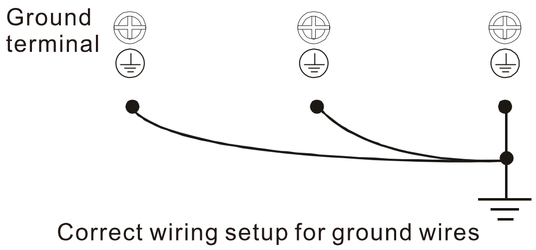


Figure 1-7

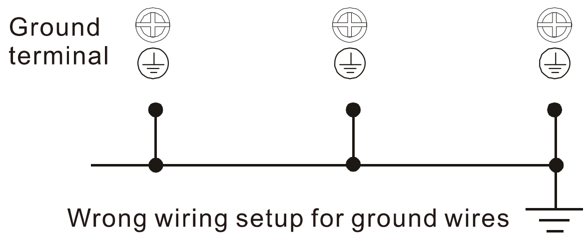


Figure 1-8

Pay particular attention to the following points:

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

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

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

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

Floating Ground System (IT Systems)

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

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

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

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

Asymmetric Ground System (Corner Grounded TN Systems)

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

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

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

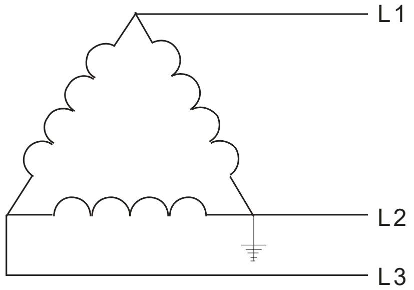


Figure 1-9</td><td>2. Grounding at a midpoint in a polygonal configuration

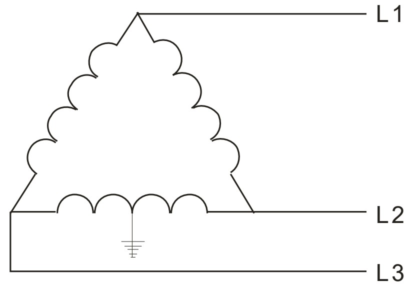


Figure 1-10</td></tr>
<tr><td>3. Grounding at one end in a single-phase configuration

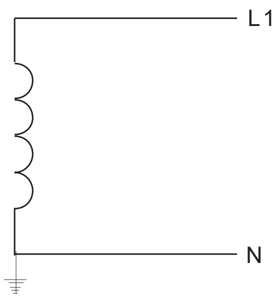


Figure 1-11</td><td>4. No stable neutral grounding in a three-phase autotransformer configuration

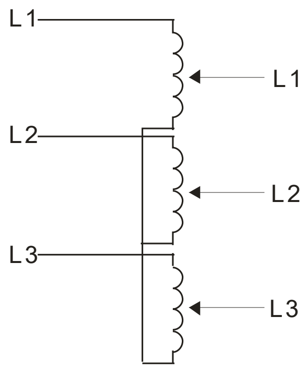


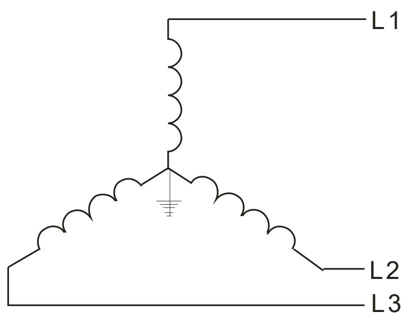
Figure 1-12</td></tr>
<tr><th colspan="2">You can use the RFI jumper for a symmetrical grounding power system</th></tr>
<tr><td>In a situation with a symmetrical grounding power system, you can use the RFI jumper to maintain the effect of the built-in EMC filter and surge absorber. For example, the diagram on the right is a symmetrical grounding power system.</td><td>


Figure 1-13</td></tr>
</table>

1-6 Dimensions

Frame A

Plate mounting: VFD055CT43F21A3; VFD075CT43F21A3

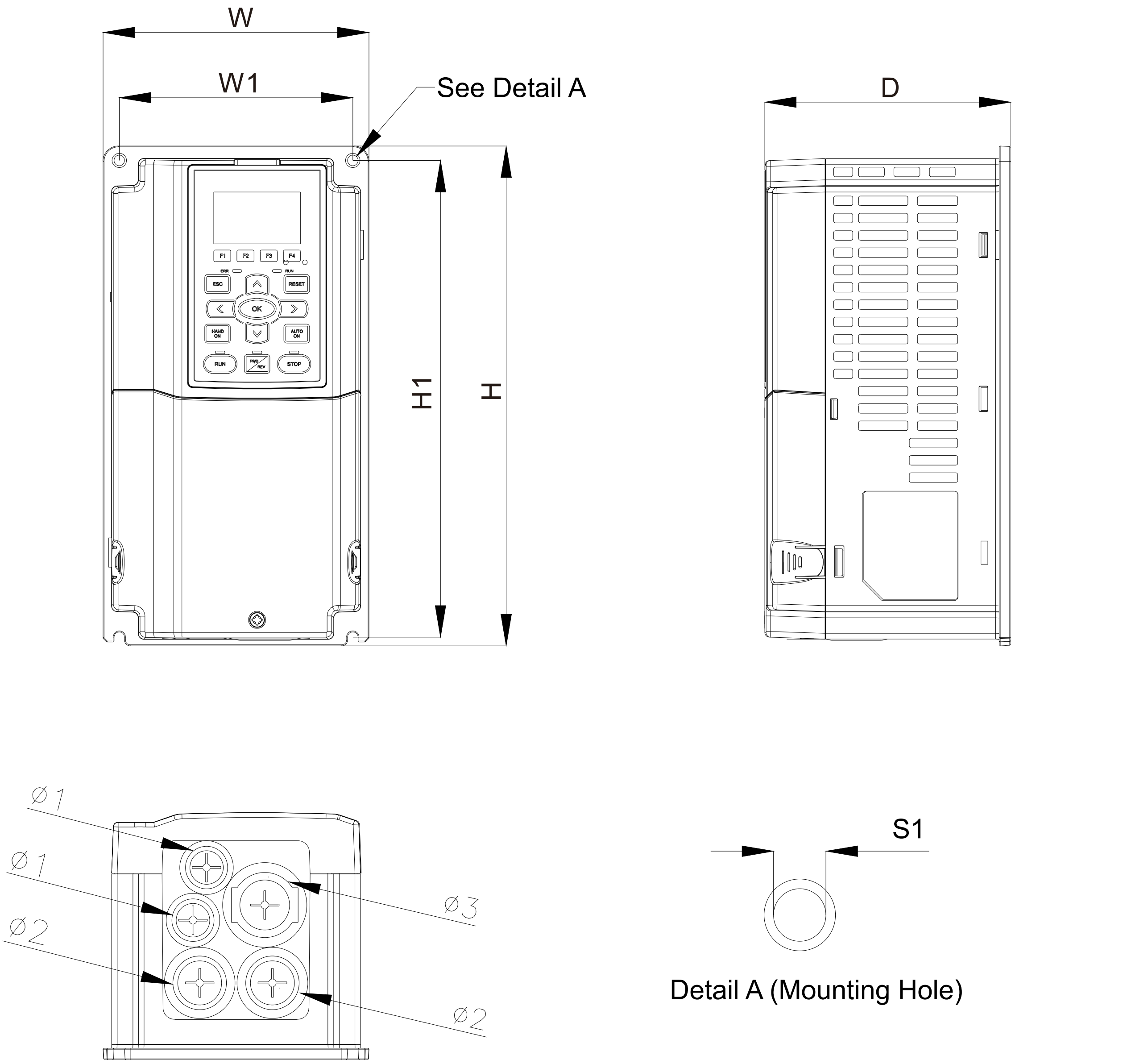


Figure 1-14

Unit: mm [inch]

Frame	W	W1	H	H1	D	S1	Φ1	Φ2	Φ3
A	139.0 [5.47]	122.0 [4.80]	260.0 [10.2]	248.0 [9.76]	128.0 [5.04]	5.5 [0.22]	22.2 [0.87]	28.0 [1.10]	34.0 [1.34]

Frame B

Plate mounting: VFD110CT43F21A3; VFD150CT43F21A3; VFD185CT43F21A3

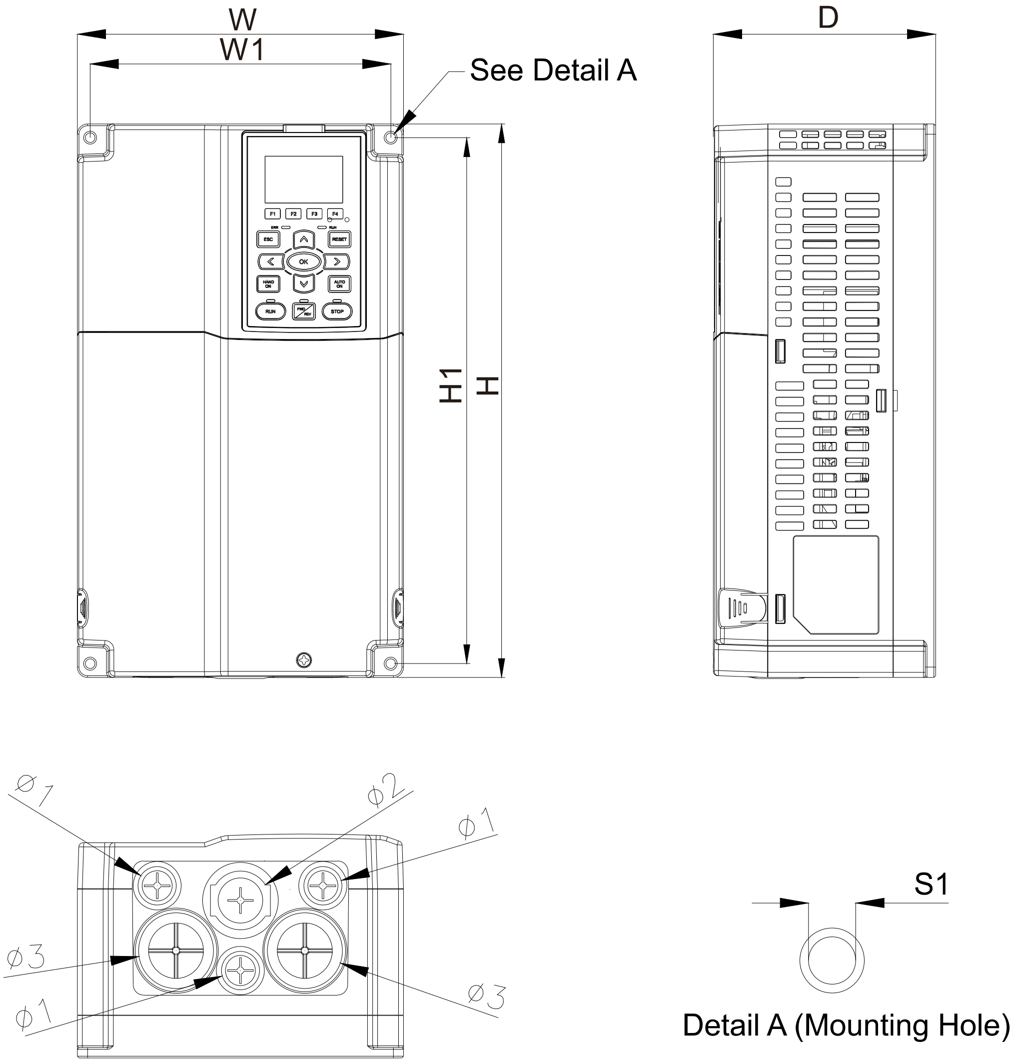


Figure 1-15

Unit: mm [inch]

Frame	W	W1	H	H1	D	S1	Φ1	Φ2	Φ3
B	190.0 [7.48]	175.0 [6.89]	320.0 [12.60]	304.0 [11.97]	129.4 [5.09]	5.5 [0.22]	22.2 [0.87]	34.0 [1.34]	43.8 [1.72]

Frame B

Flange mounting: VFD110CT43F00B; VFD150CT43F00B; VFD185CT43F00B

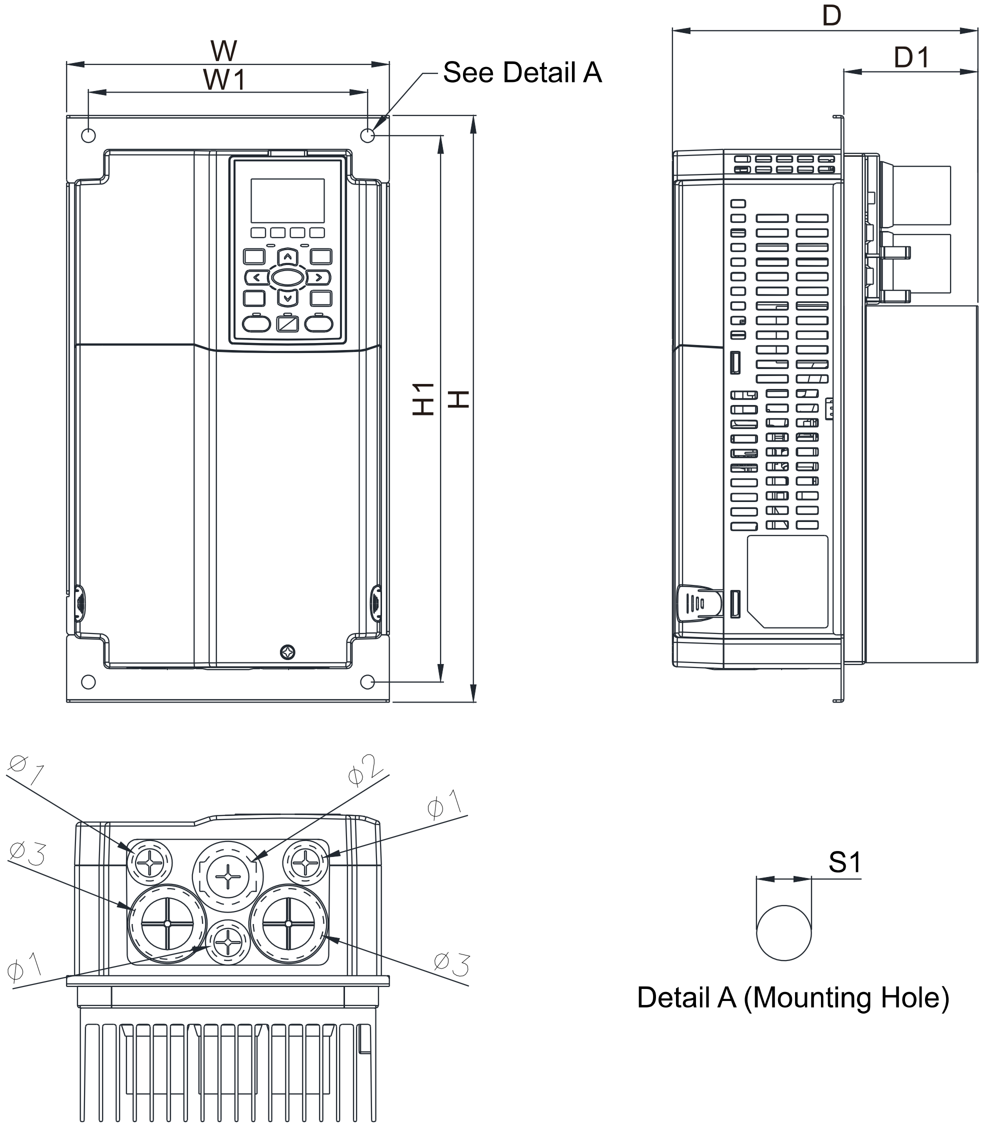


Figure 1-16

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
B	200.0 [7.87]	173.0 [6.81]	361.8 [14.24]	336.8 [13.26]	189.4 [7.46]	83.2 [3.28]	8.5 [0.33]	22.2 [0.87]	34.0 [1.34]	43.8 [1.72]

Frame B

Wall mounting: VFD110CT43A21C; VFD150CT43A21C; VFD185CT43A21C

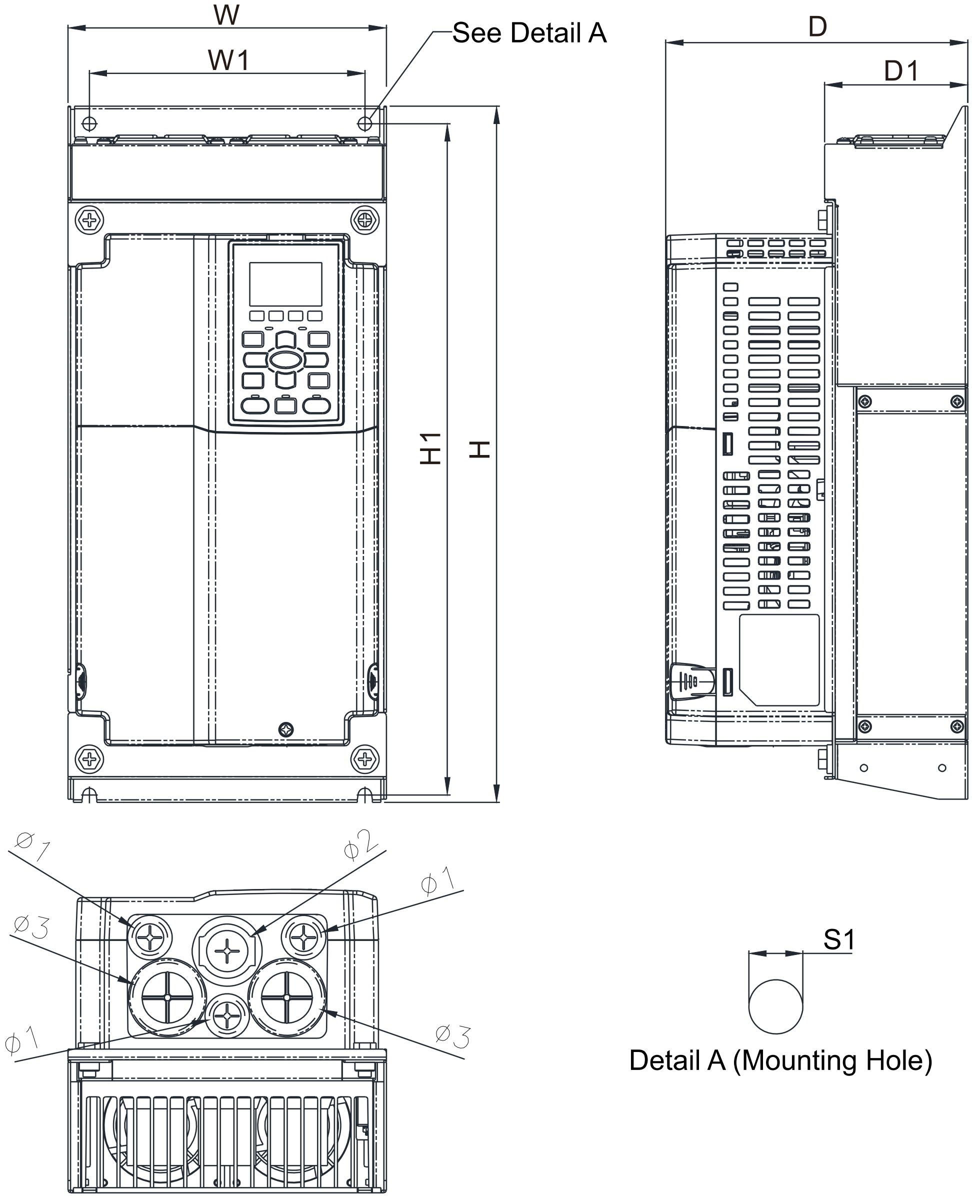


Figure 1-17

Unit: mm [inch]

Frame	W	W1	H	H1	D	D1	S1	Φ1	Φ2	Φ3
B	200.0 [7.87]	173.0 [6.81]	435.0 [17.13]	419.4 [16.51]	189.4 [7.46]	89.8 [3.54]	8.5 [0.33]	22.2 [0.87]	34.0 [1.34]	43.8 [1.72]

Frame C

Plate mounting: VFD220CT43F21A3; VFD300CT43F21A3; VFD370CT43F21A7

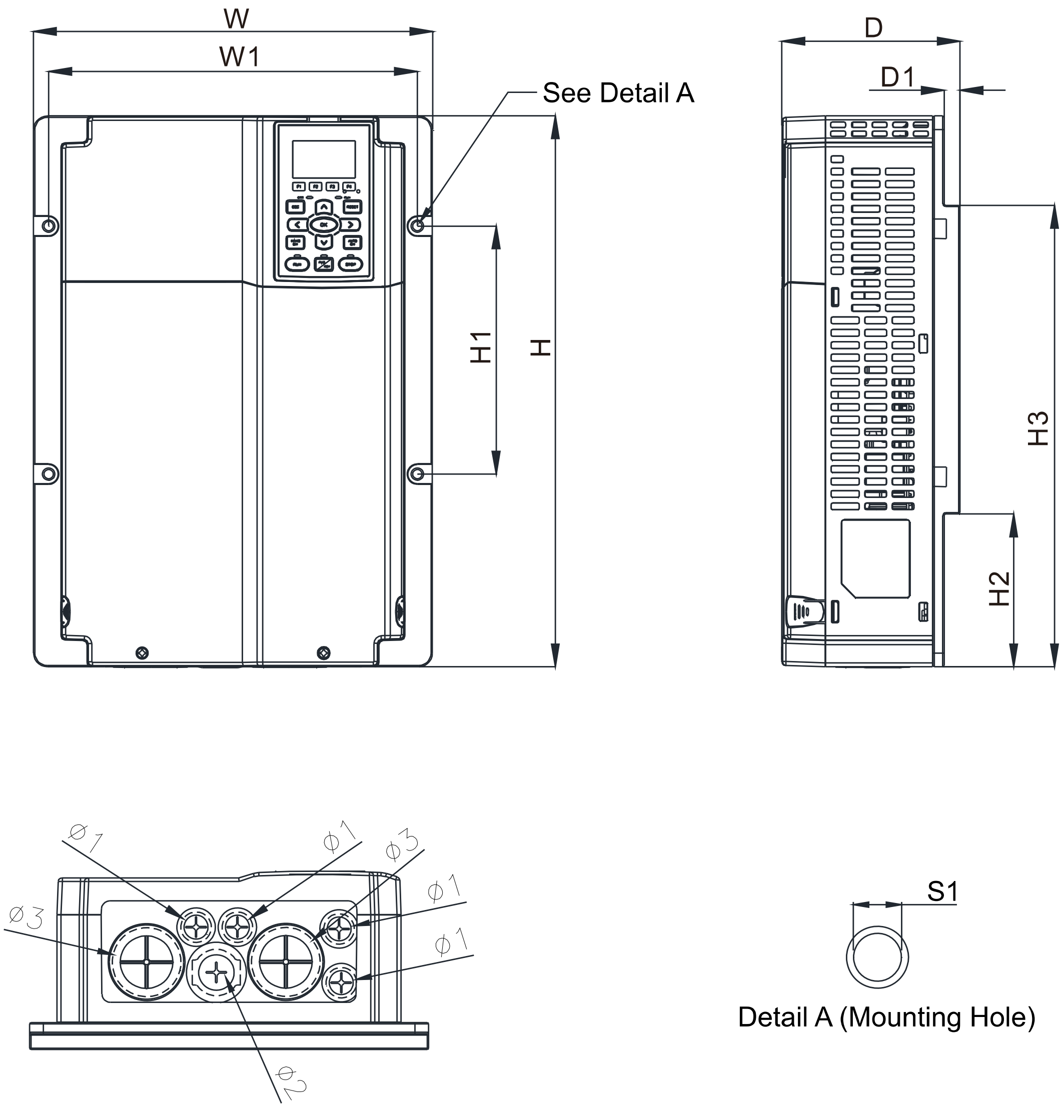


Figure 1-18

Unit: mm [inch]

Frame	W	W1	H	H1	H2	H3	D	D1	S1	Φ1	Φ2	Φ3
C	290.0 [11.42]	268.0 [10.55]	400.0 [15.75]	180.0 [7.09]	111.0 [4.37]	335.0 [13.19]	129.5 [5.10]	11.5 [0.45]	7.0 [0.28]	22.2 [0.87]	34.0 [1.34]	50.0 [1.97]

Frame C

Flange mounting: VFD220CT43F00B; VFD300CT43F00B; VFD370CT43F00B

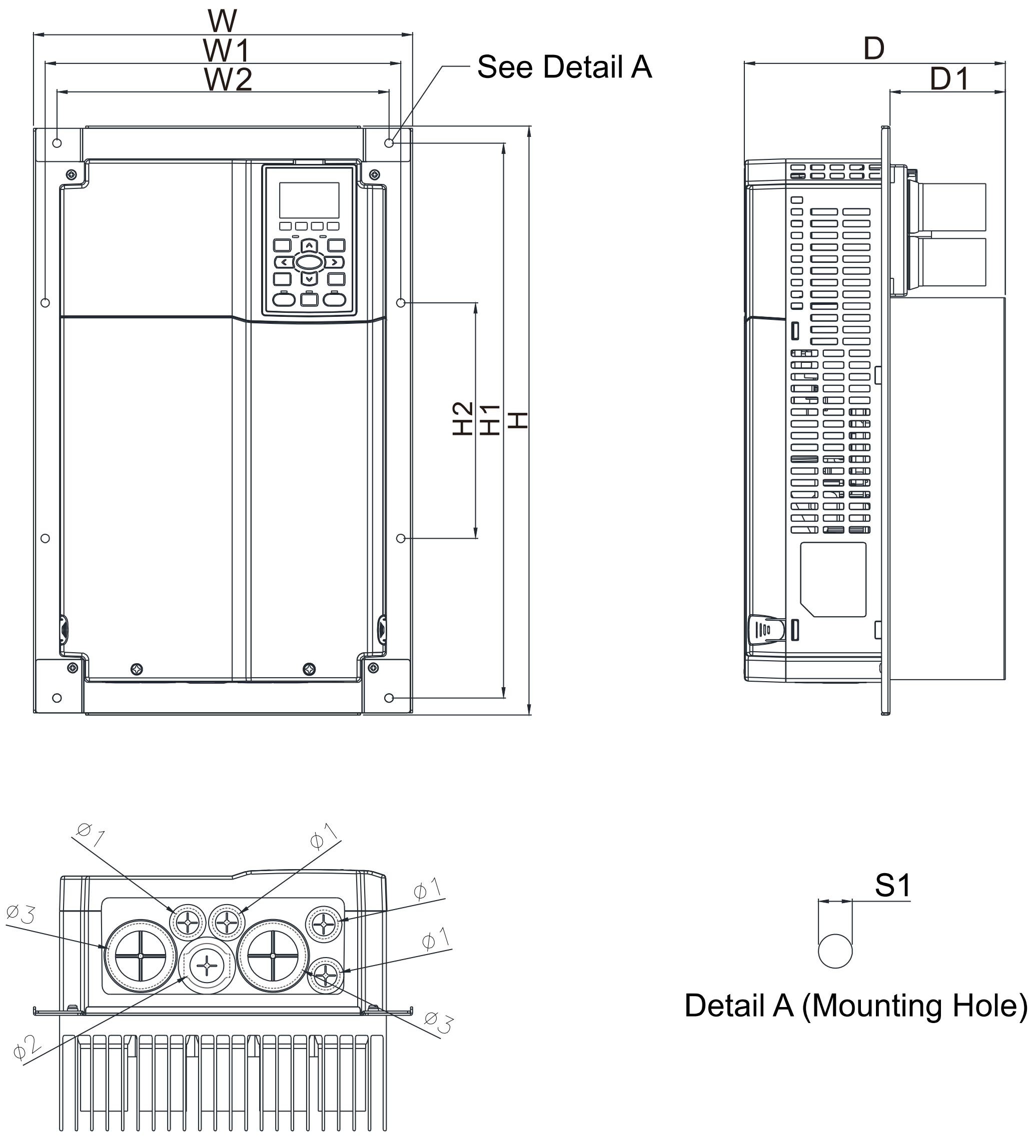


Figure 1-19

Unit: mm [inch]

Frame	W	W1	W2	H	H1	H2	D	D1	S1	Φ1	Φ2	Φ3
C	290.0 [11.42]	272.0 [10.71]	254.0 [10.00]	450.0 [17.72]	424.0 [16.69]	180.0 [7.09]	199.5 [7.86]	88.2 [3.47]	6.5 [0.26]	22.2 [0.87]	34.0 [1.34]	50.0 [1.97]

Frame C

Wall mounting: VFD220CT43A21C; VFD300CT43A21C; VFD370CT43A21C

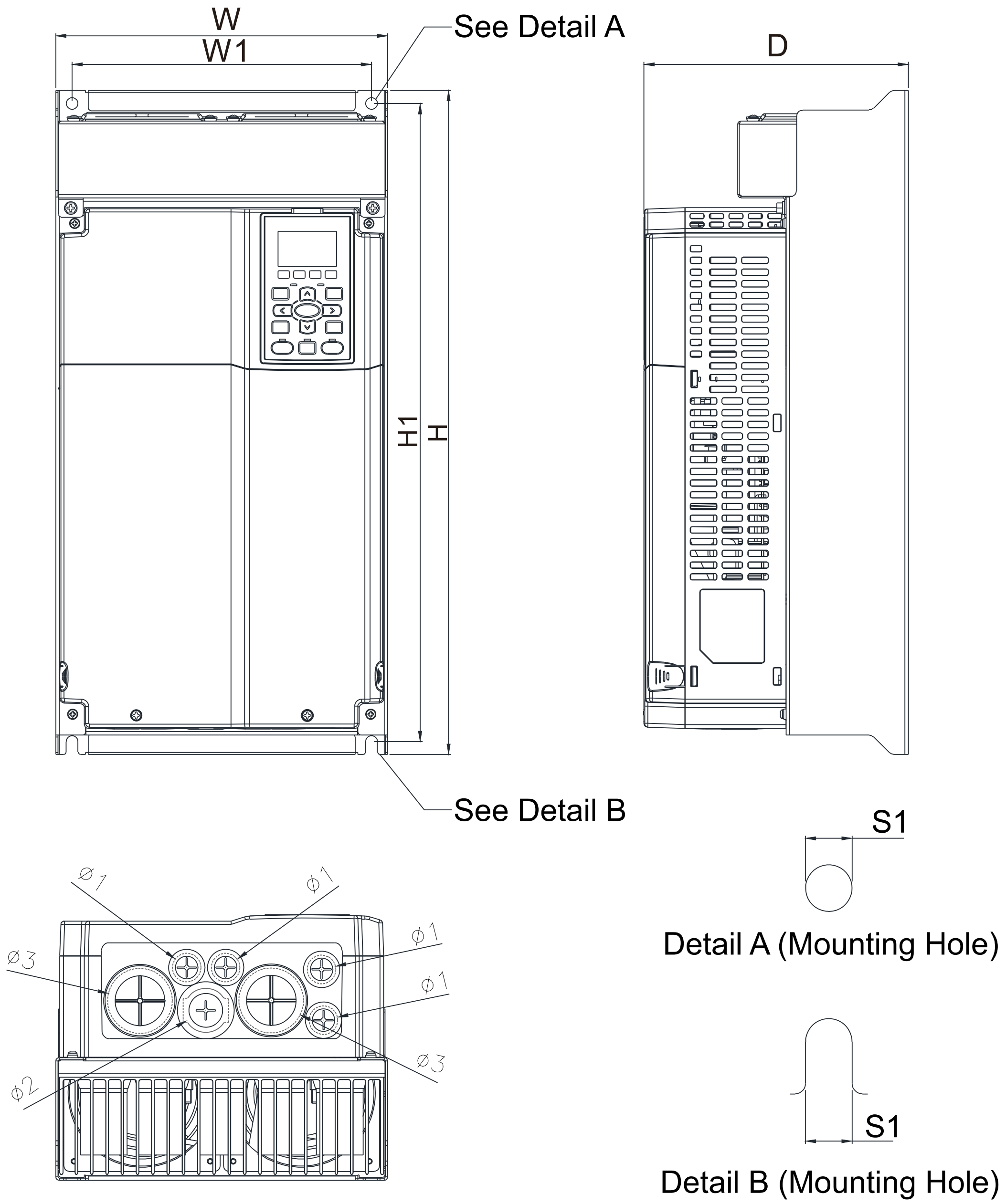


Figure 1-20

Unit: mm [inch]

Frame	W	W1	H	H1	D	S1	Φ1	Φ2	Φ3
C	256.0 [10.08]	231.0 [9.09]	510.0 [20.08]	490.0 [19.29]	204.0 [8.03]	9.0 [0.35]	22.2 [0.87]	34.0 [1.34]	50.0 [1.97]

Frame D-1

Plate mounting: VFD450CT43F00A3; VFD550CT43F00A4

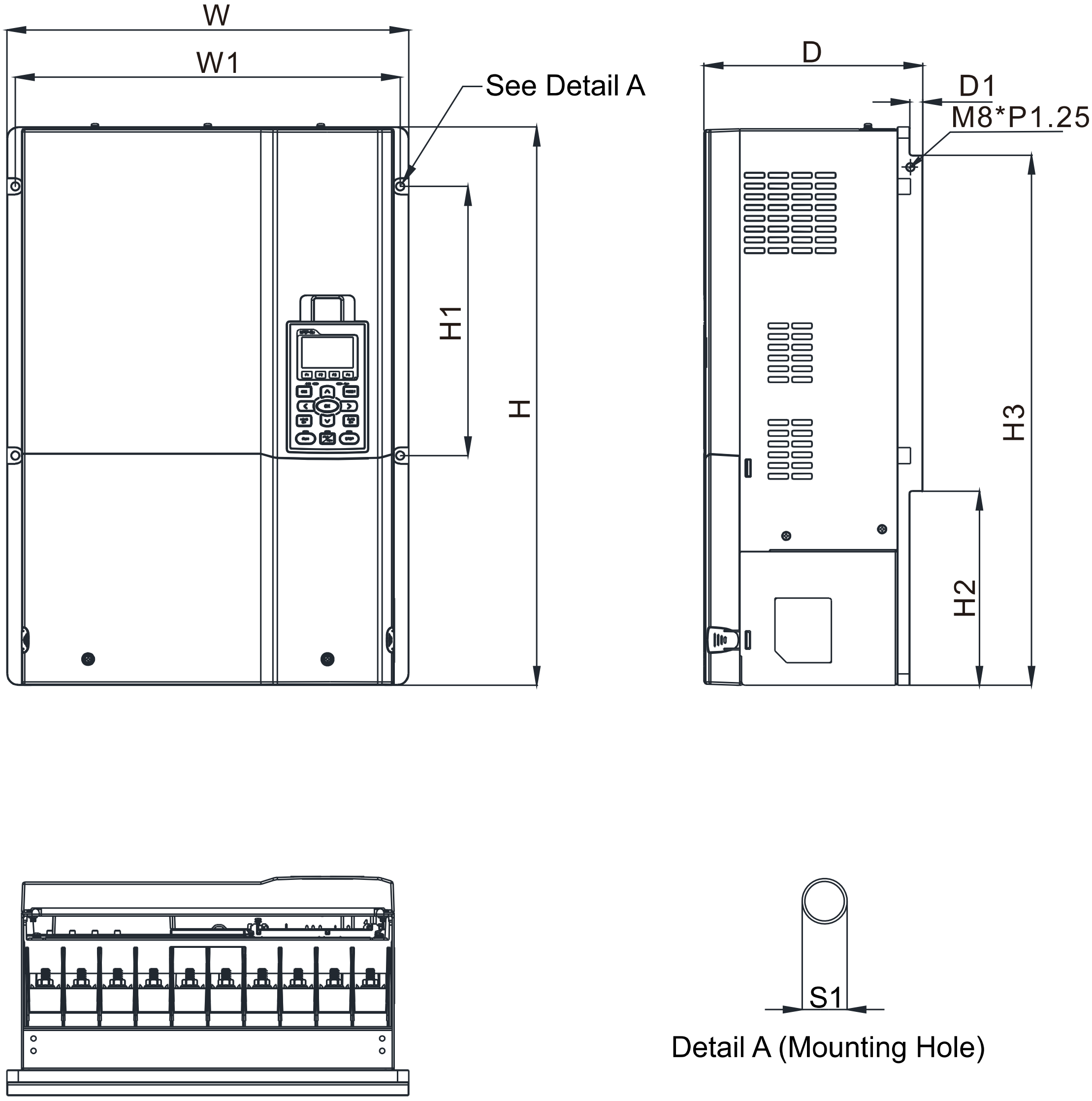


Figure 1-21

Unit: mm [inch]

Frame	W	W1	H	H1	H2	H3	D	D1	S1
D-1	356.0 [14.02]	341.0 [13.43]	493.5 [19.43]	238.0 [9.37]	171.5 [6.75]	468.5 [18.44]	193.8 [7.63]	11.5 [0.45]	7.0 [0.28]

Frame D-2

Plate mounting: VFD750CT43F00A6; VFD900CT43F00A8

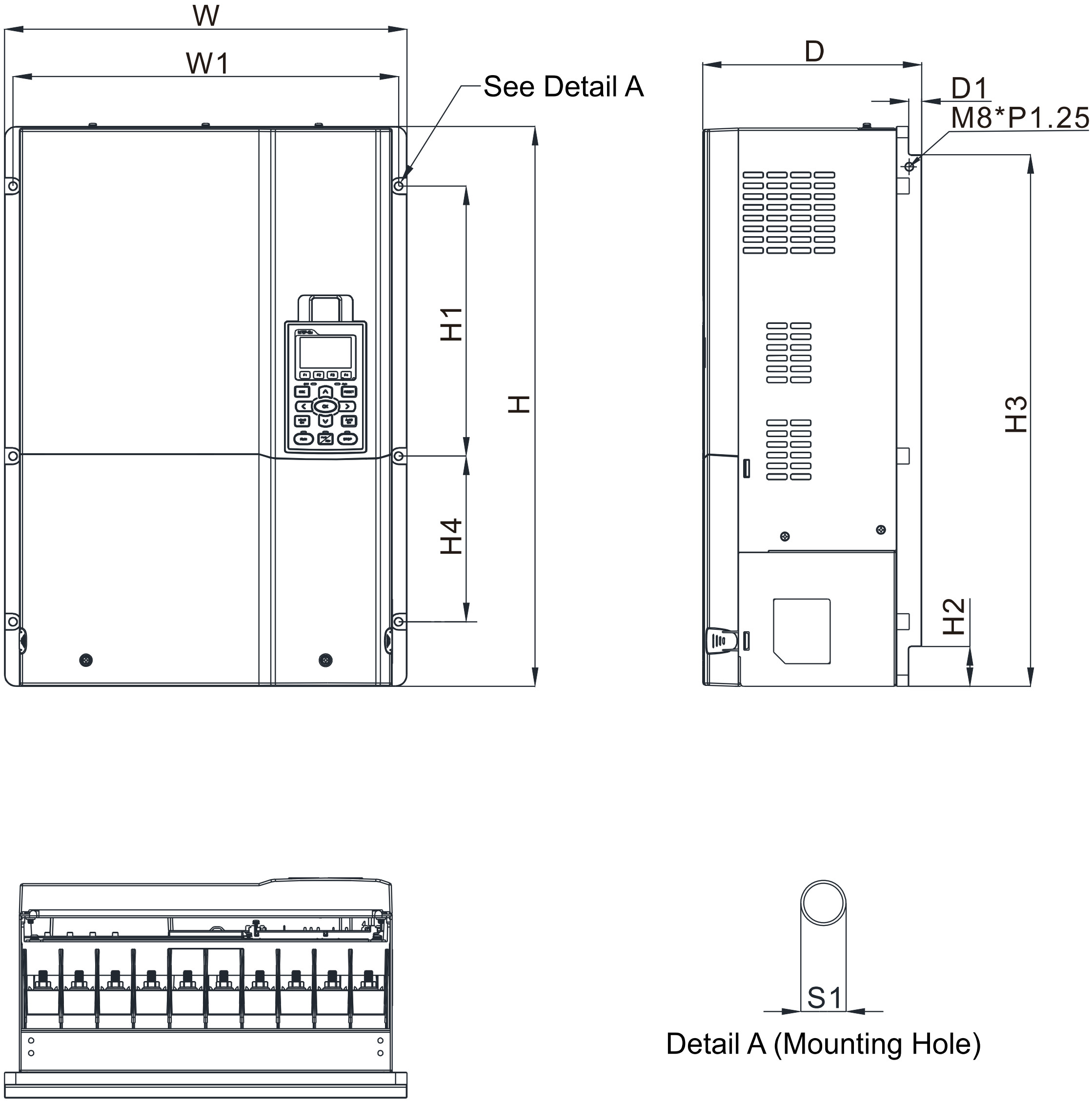


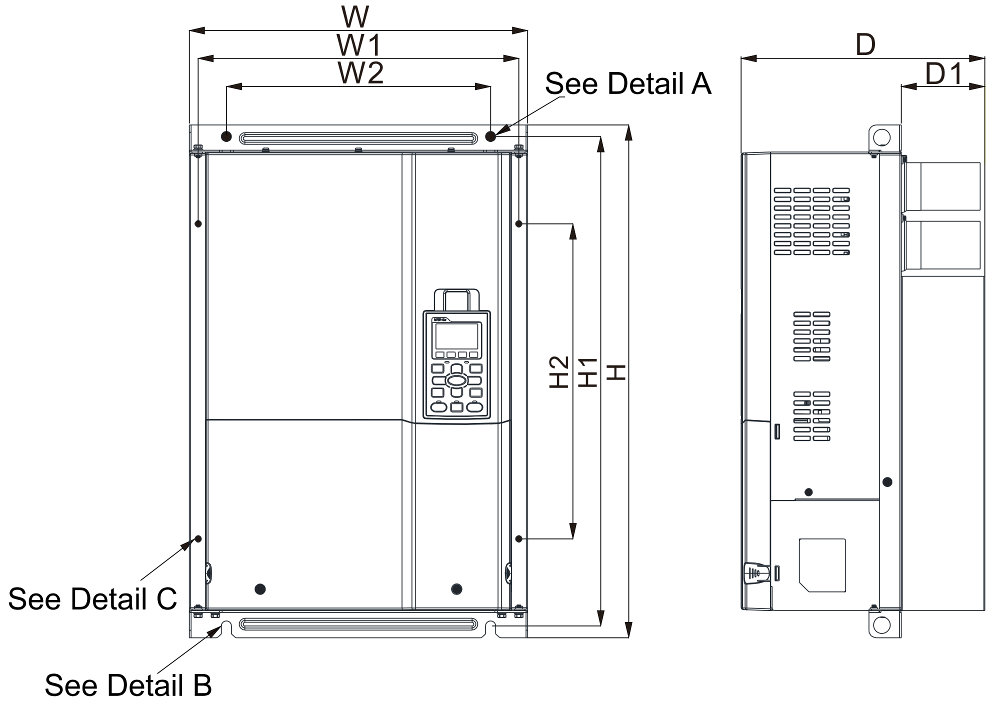
Figure 1-22

Unit: mm [inch]

Frame	W	W1	H	H1	H2	H3	H4	D	D1	S1
D-2	356.0 [14.02]	341.0 [13.43]	493.5 [19.43]	238.0 [9.37]	37.0 [1.46]	468.5 [18.44]	146.0 [5.75]	193.8 [7.63]	11.5 [0.45]	7.0 [0.28]

Frame D

Flange mounting: VFD450CT43F00B; VFD550CT43F00B



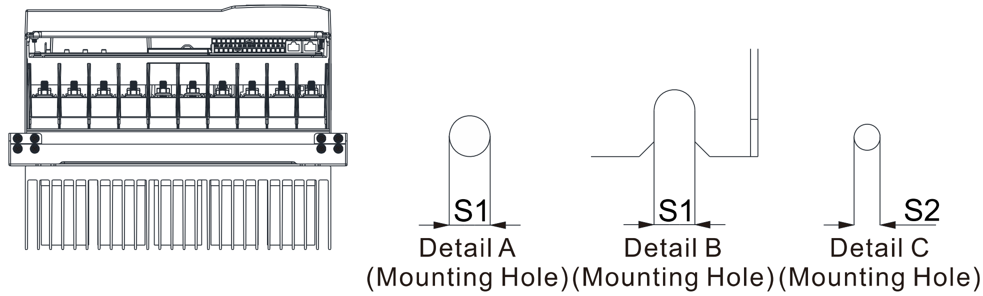


Figure 1-5

Unit: mm [inch]

Frame	W	W1	W2	H	H1	H2	D	D1	S1	S2
D	365.2 [13.38]	346.0 [13.62]	285.0 [11.22]	550.0 [21.65]	525.0 [20.67]	338.0 [13.31]	262.8 [10.35]	90.0 [3.54]	11.0 [0.43]	7.0 [0.28]

Frame D

Wall mounting: VFD450CT43A00C; VFD550CT43A00C

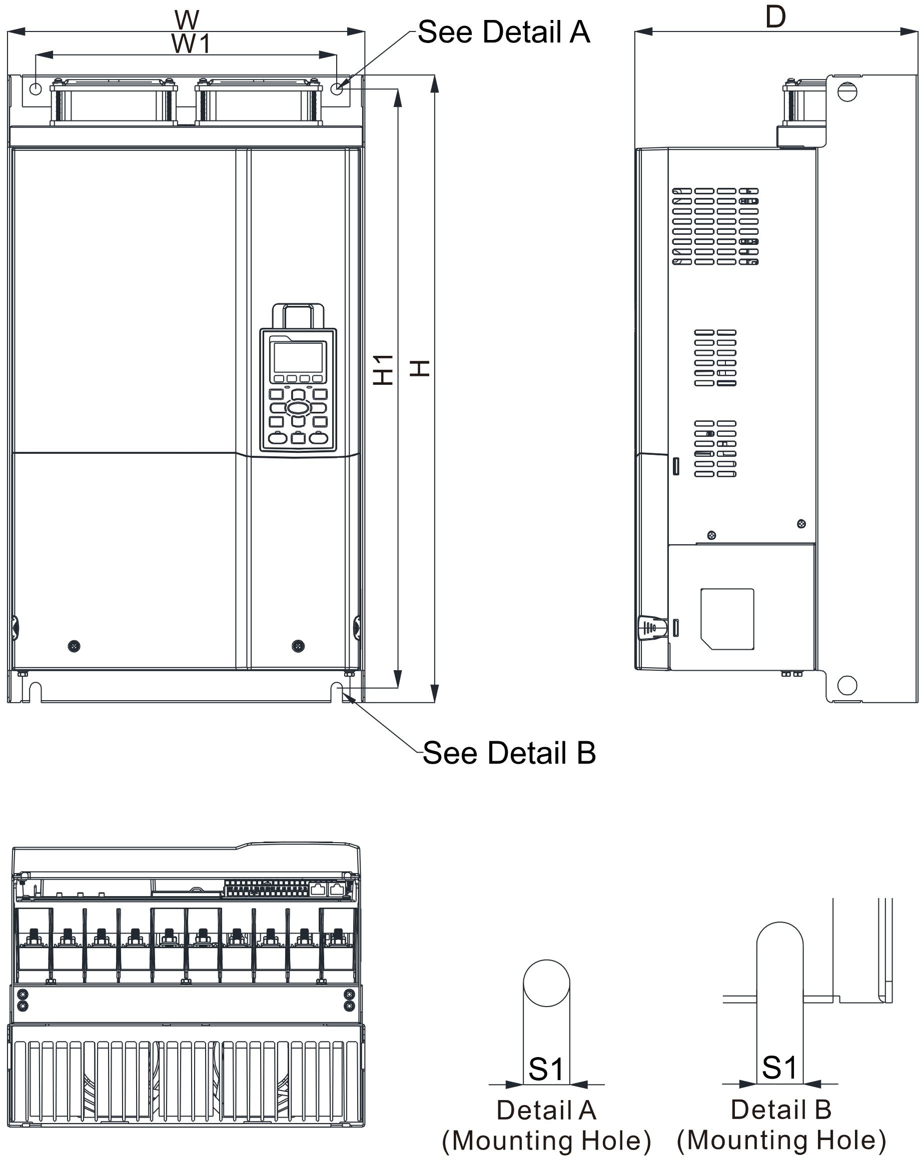


Figure 1-6

Unit: mm [inch]

Frame	W	W1	H	H1	D	S1
D	338.0 [13.31]	285.0 [11.22]	590.0 [23.22]	563.0 [22.17]	268.0 [10.55]	11.0 [0.43]

Digital Keypad

KPC-CC01

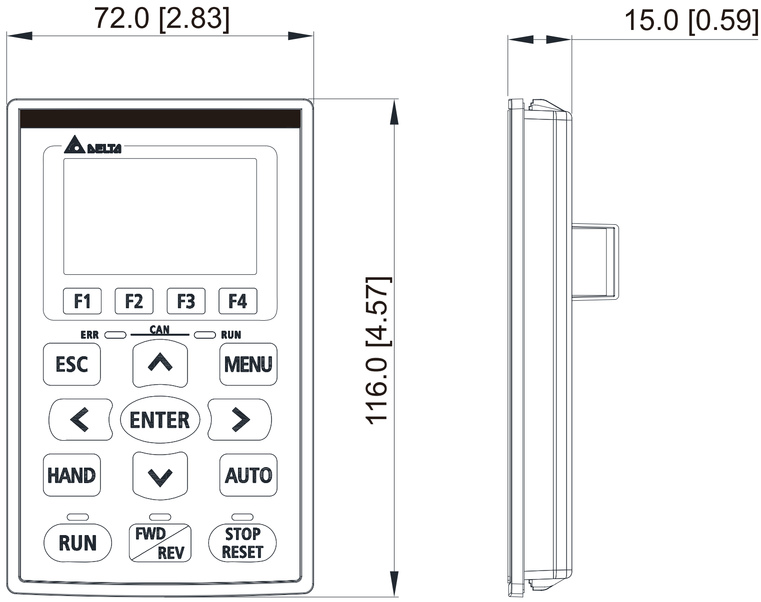
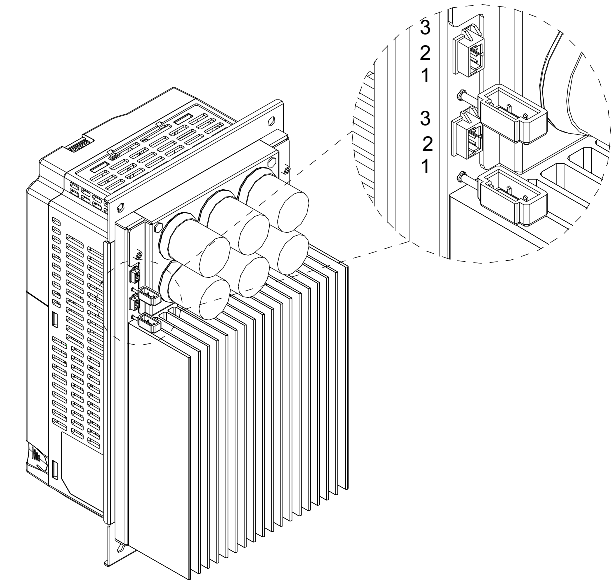
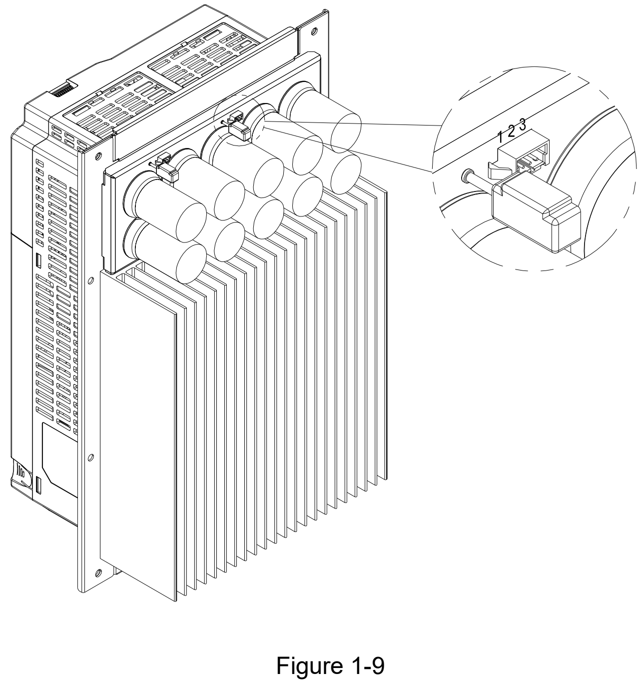


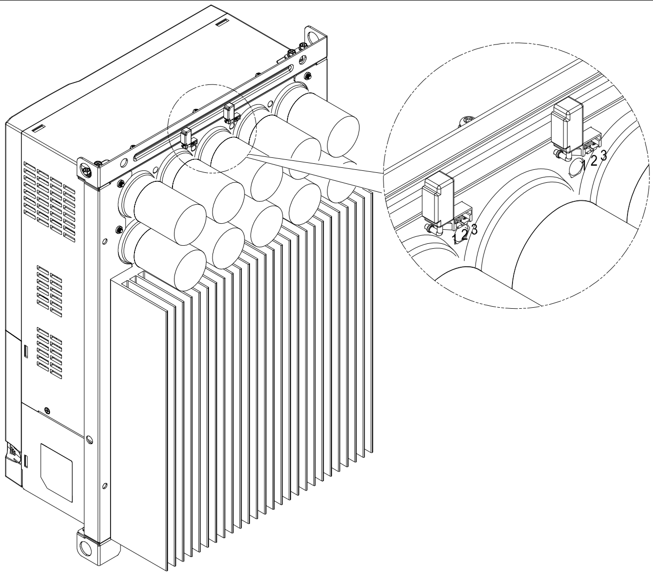
Figure 1-7

1-7 Extension Slots for Fans

CT2000-B

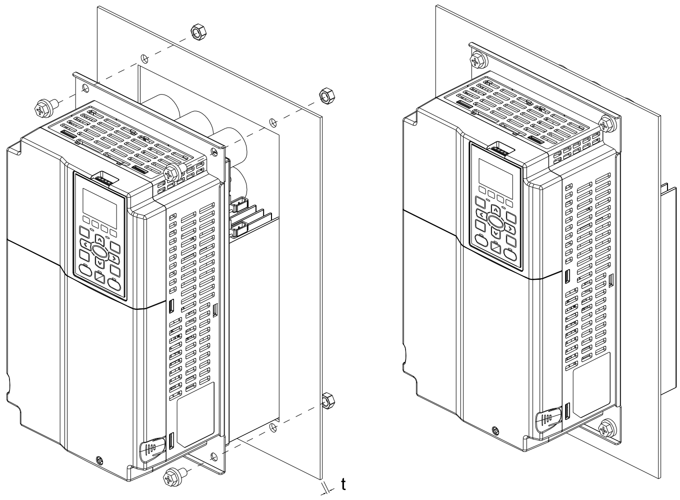
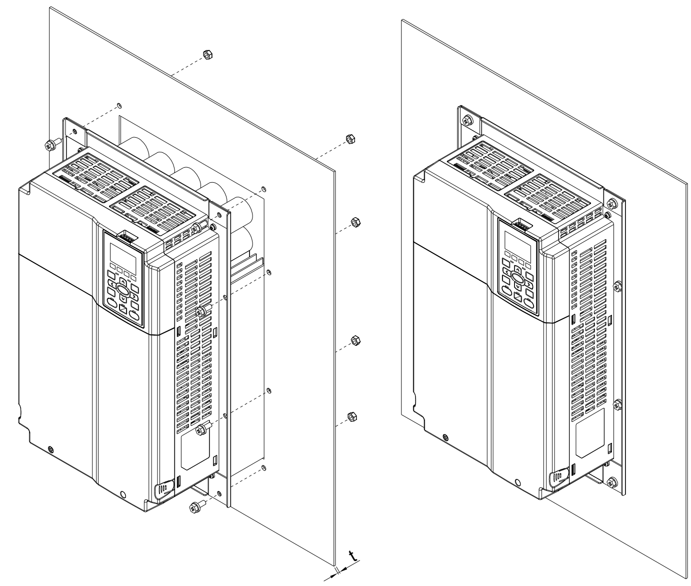
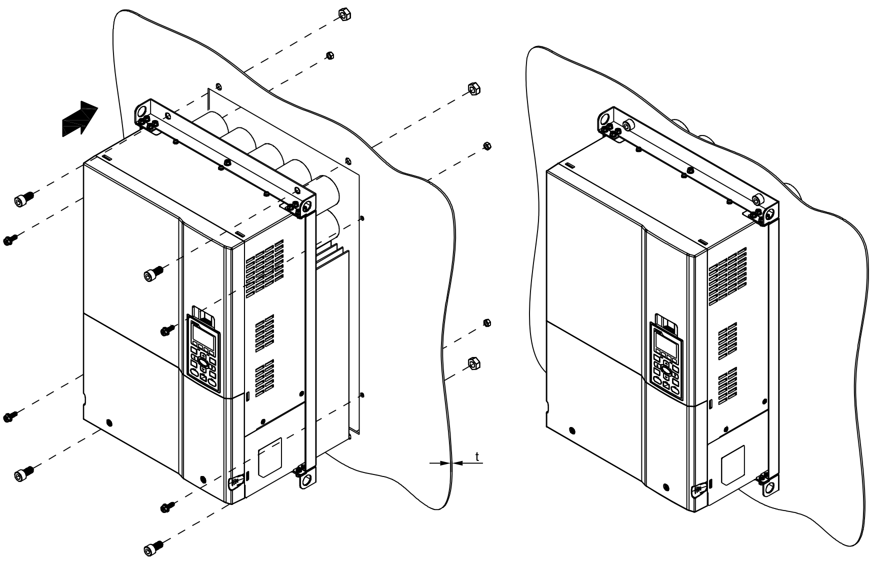
One or two sets of DC fan extension slots are reserved for users to install fans by themselves.

Frame B Electrical specification: $24V_{DC}$, 0.51A (maximum current) Fan adapter: JWT A2007 Series Definition of PIN: PIN 1: - PIN 2: Reserved PIN 3: +	 Figure 1-8
Frame C Electrical specification: $24V_{DC}$, 0.75A (maximum current per set) Fan adapter: JWT A2007 Series Definition of PIN: PIN 1: - PIN 2: Reserved PIN 3: +	 Figure 1-9

Frame D Electrical specification: $24V_{DC}$, 1A (maximum current per set) Fan adapter: JWT A2007 Series A2007T0P-00 (gold-plated), suitable for 26–28AWG。 Definition of PIN: PIN 1: - PIN 2: Reserved PIN 3: +	 Figure 1-10

1-8 Flange Mounting

CT2000-B

Frame B Torque: 40kg-cm (34.7 lb-in.)	 Figure 1-11
Frame C Torque: 40kg-cm (34.7 lb-in.)	 Figure 1-12
Frame D Torque-M6: 40kg-cm (34.7 lb-in.) Torque-M10: 200 kg-cm (173.4 lb-in.)	 Figure 1-13

Hole Locations for CT2000-B

Frame B

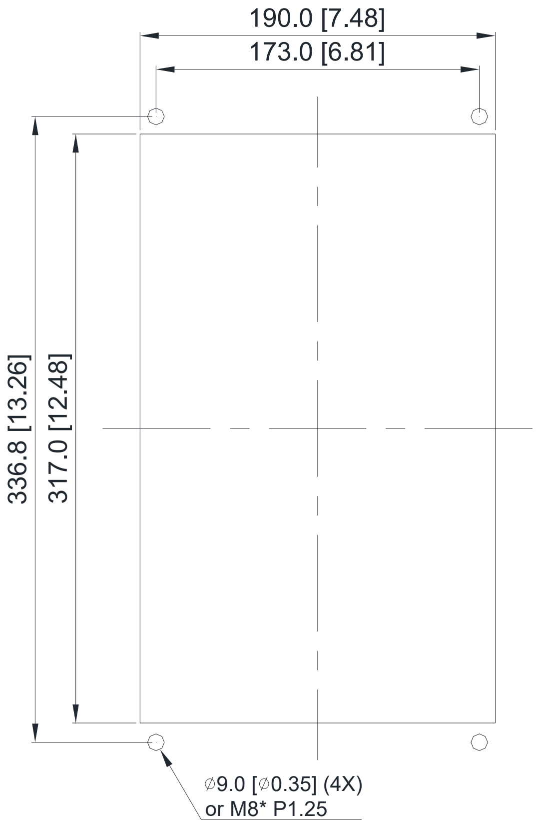


Figure 1-14

Frame C

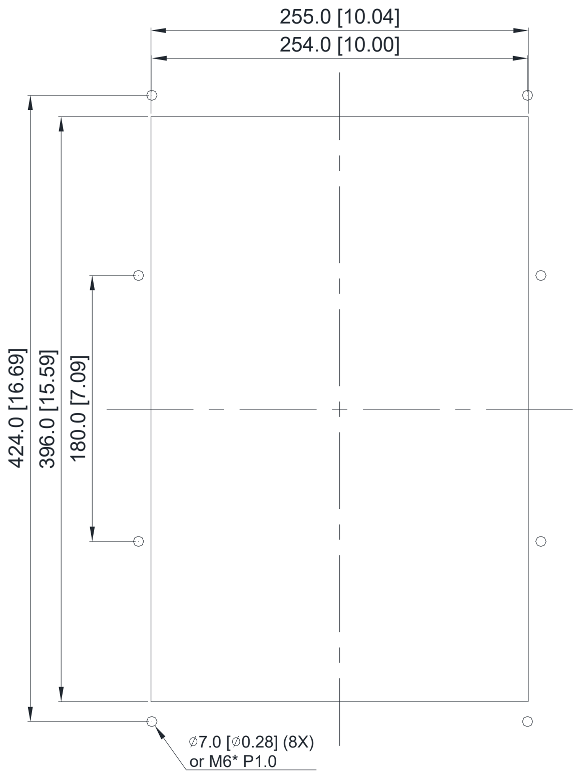


Figure 1-15

Frame D

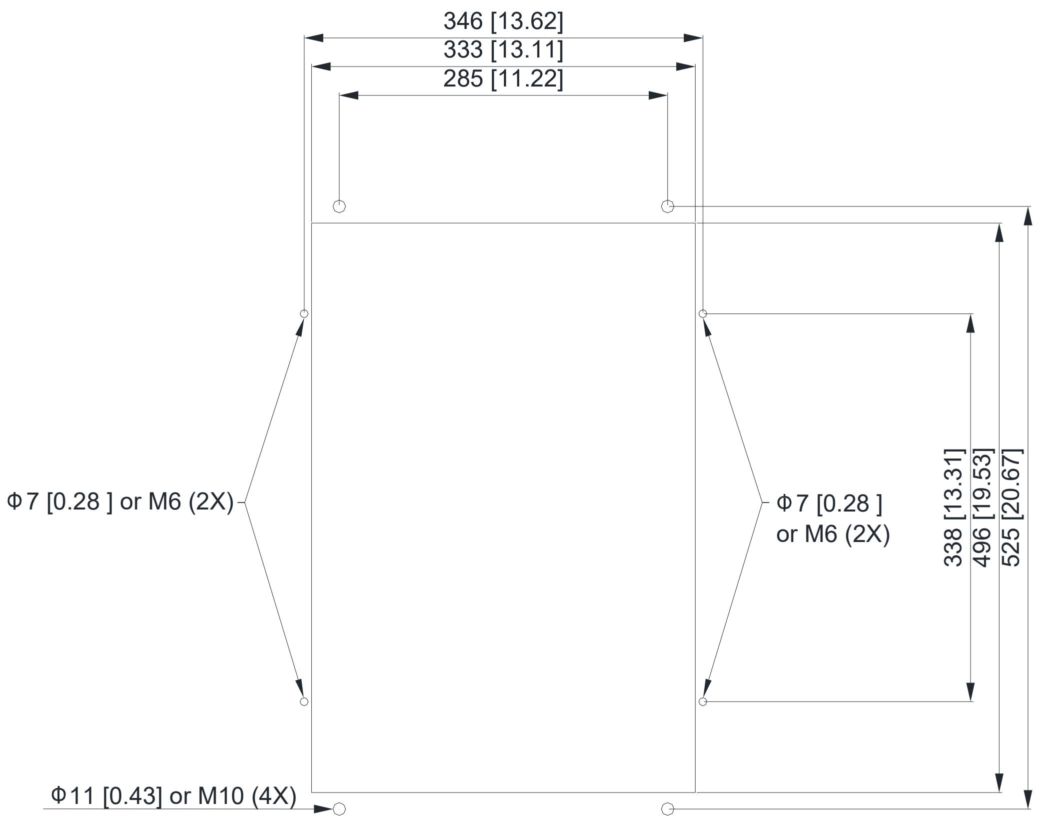


Figure 1-16

1-9 Plate Mounting

Precautions for CT2000-A installation:

1. The following conditions of heat dissipation area have to be met for plate mounting:
   (1) Flatness: ≤ 0.2 mm
   (2) Surface roughness: ≤ Ra 0.8
2. Apply thermal paste on to the heat generated area and the heat dissipation area to contact with the drive.
3. There have to be no foreign matter on the heat generated area and the heat dissipation area to contact with the drive, and it should be kept clean.
4. The heat generated area of the plate mounting models cannot exceeds the temperature listed below, otherwise the protection mechanism will be triggered to decrease carrier wave or stop, and even shorten products and components lives.
   - VFD055CT43Fxxxx ~ VFD075CT43Fxxxx：90°C
   - VFD110CT43Fxxxx ~ VFD185CT43Fxxxx：80°C
   - VFD220CT43Fxxxx ~ VFD900CT43Fxxxx：90°C

<table>
<tr>
<td>Frame A

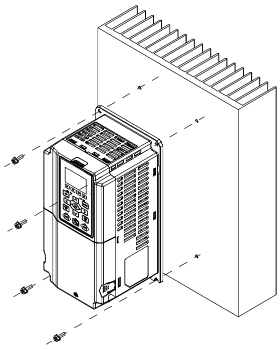
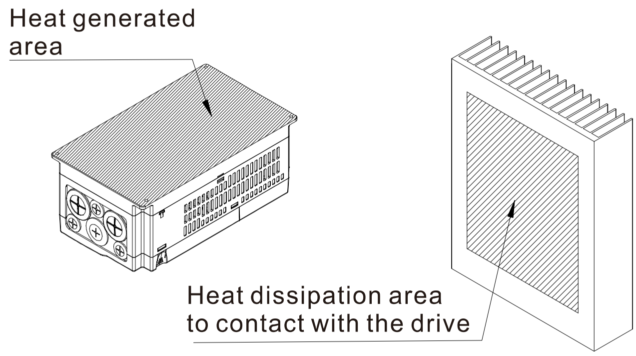
- Screw property class (Min.): 6.8
- Torque-M5: 30 kg-cm / (26.1 lb-in.) / (2.94 Nm)</td>
<td></td>
<td>

Figure 1-34</td>
</tr>
<tr>
<td>Frame B

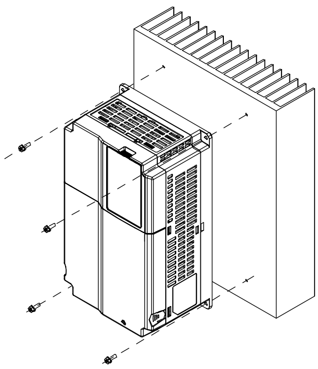
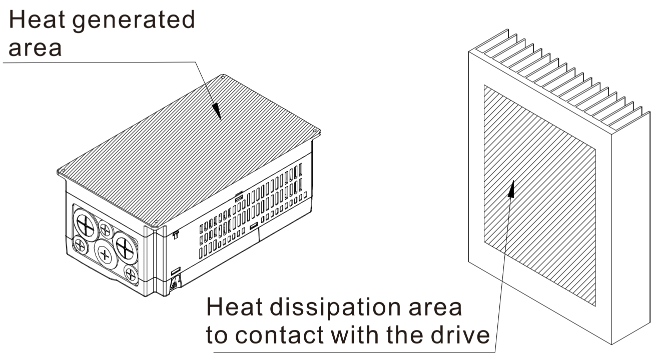
- Screw property class (Min.): 6.8
- Torque-M5: 30 kg-cm / (26.1 lb-in.) / (2.94 Nm)</td>
<td></td>
<td>

Figure 1-35</td>
</tr>
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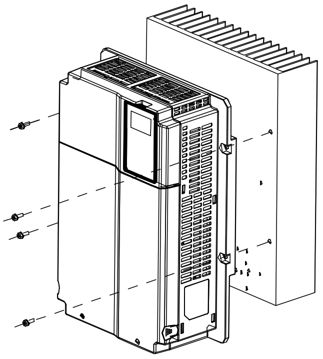
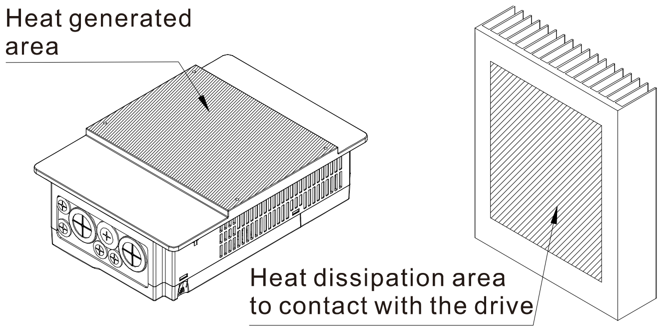
<table>
<tr>
<td>Frame C
- Screw property class (Min.): 5.8
- Torque-M6: 40 kg-cm / (34.7 lb-in.) / (3.92 Nm)</td>
<td></td>
<td>

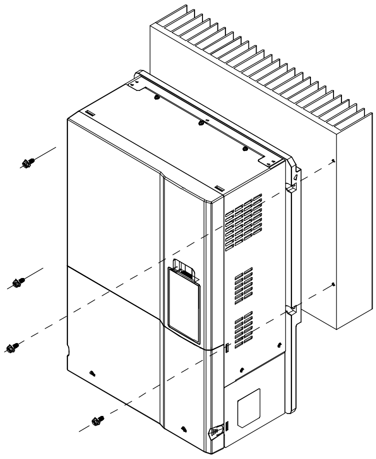
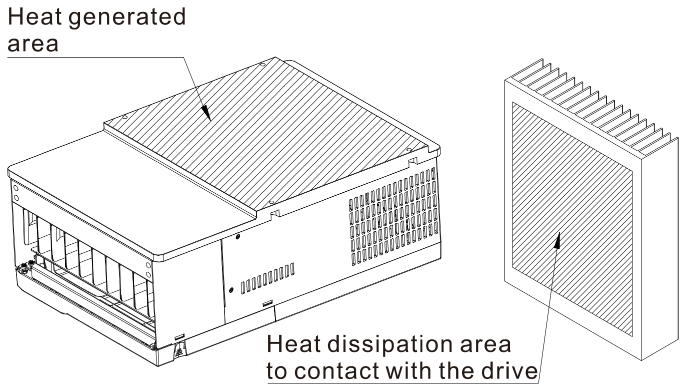
Figure 1-37</td>
</tr>
<tr>
<td>Frame D-1
- Screw property class (Min.): 8.8
- Torque-M6: 70 kg-cm / (60.8 lb-in.) / (6.86 Nm)</td>
<td></td>
<td>

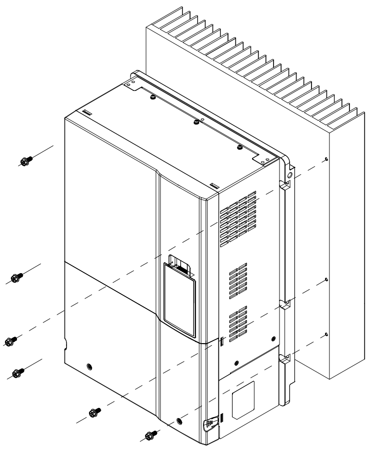
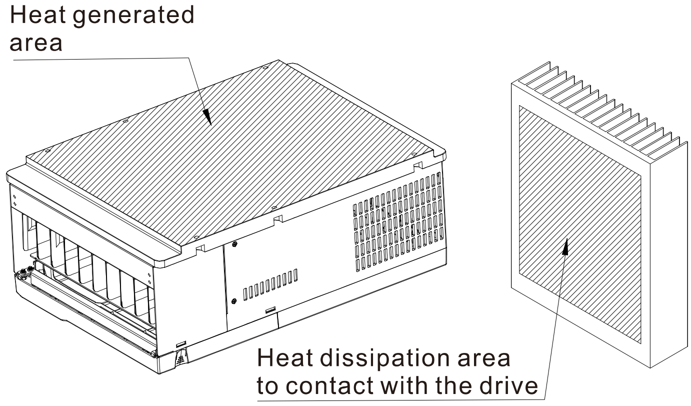
Figure 1-38</td>
</tr>
<tr>
<td>Frame D-2
- Screw property class (Min.): 8.8
- Torque-M6: 70 kg-cm / (60.8 lb-in.) / (6.86 Nm)</td>
<td></td>
<td>

Figure 1-39</td>
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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. When installing one drive below another one, use a metal separator between the AC motor drives to prevent mutual heating and to prevent the risk of fire accident.

☑ Install the AC motor drive in Pollution Degree 2 environments with clean and circulating air. A clean and circulating environment means airs without polluting substances and dust.

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)

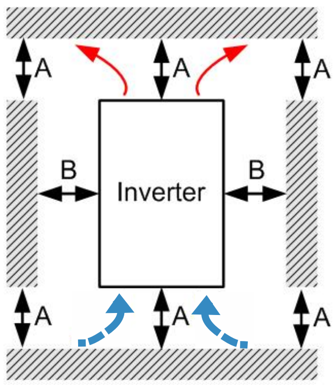


Figure 2-1

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

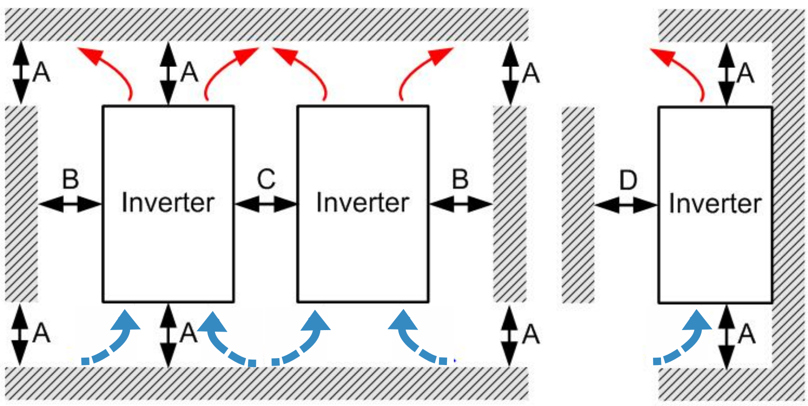


Figure 2-2

Multiple drives, single side-by-side horizontal installation (Frame A–C)

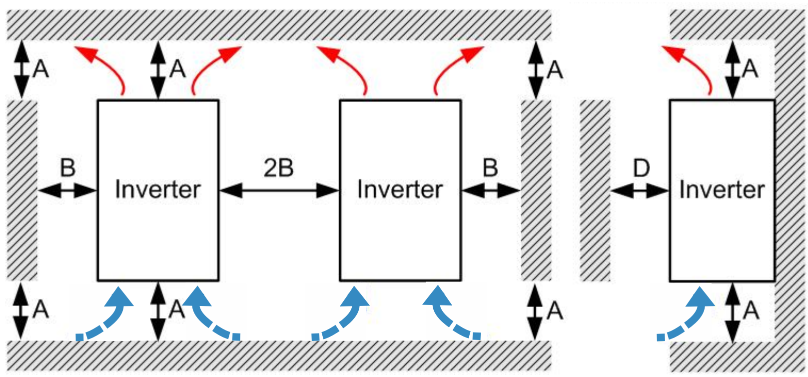


Figure 2-3

Multiple drives, side-by-side installation (Frame D)
Install metal separator between the drives.

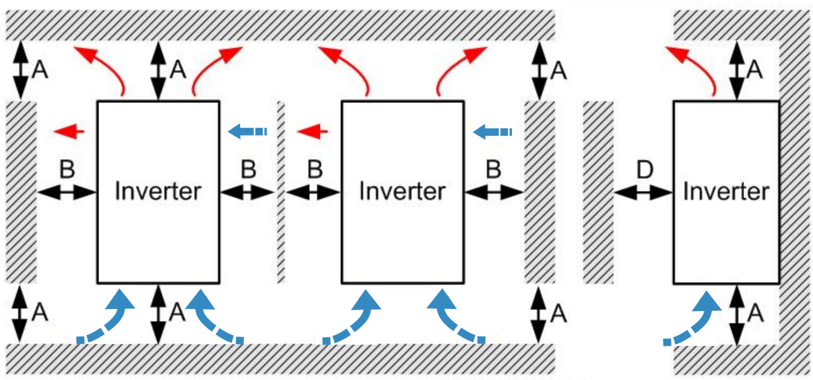


Figure 2-4

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

When installing one AC motor drive below another one (top-bottom installation), use a metal separator 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 seperator. Operation temperature is the temperature measured at 50 mm away from the fan's inflow side (as shown in the figure below).

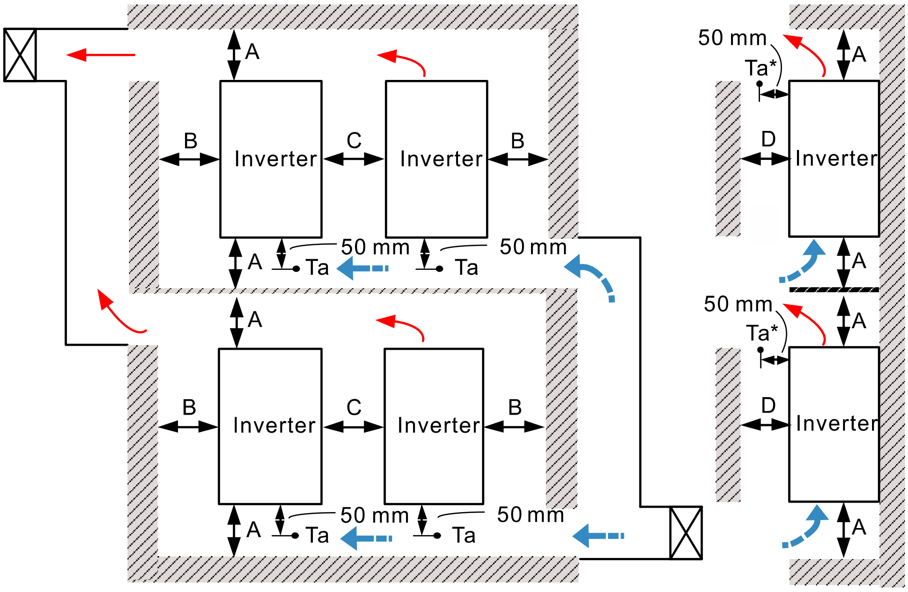


Figure 2-5

Minimum mounting clearance

Frame	A (mm)	B (mm)	C (mm)	D (mm)
A–C	60	30	10	0
D	100	50	-	0

Table 2-1

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

Frame A	VFD055CT43F21A3; VFD075CT43F21A3
Frame B	VFD110CT43F21A3; VFD150CT43F21A3; VFD185CT43F21A3; VFD110CT43F00B; VFD150CT43F00B; VFD185CT43F00B; VFD110CT43A21C; VFD150CT43A21C; VFD185CT43A21C
Frame C	VFD220CT43F21A3; VFD300CT43F21A3; VFD370CT43F21A7; VFD220CT43F00B; VFD300CT43F00B; VFD370CT43F00B; VFD220CT43A21C; VFD300CT43A21C; VFD370CT43A21C
Frame D	VFD450CT43F00A3; VFD550CT43F00A4; VFD750CT43F00A6; VFD900CT43F00A8; VFD450CT43F00B; VFD550CT43F00B; VFD450CT43A00C; VFD550CT43A00C

Table 2-2

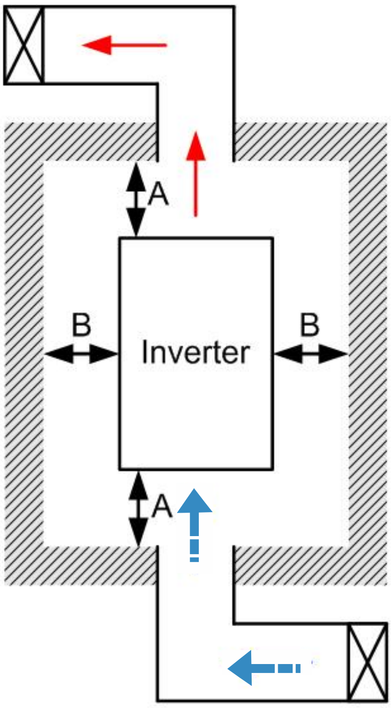


Figure 2-6

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), 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 of 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.
- Ambient temperature durating curve shows the dertaing status in different temperature in relation to different protection level.
- Refer to Section 9-7 for ambient temperature derating curve and derating curves under different control modes.

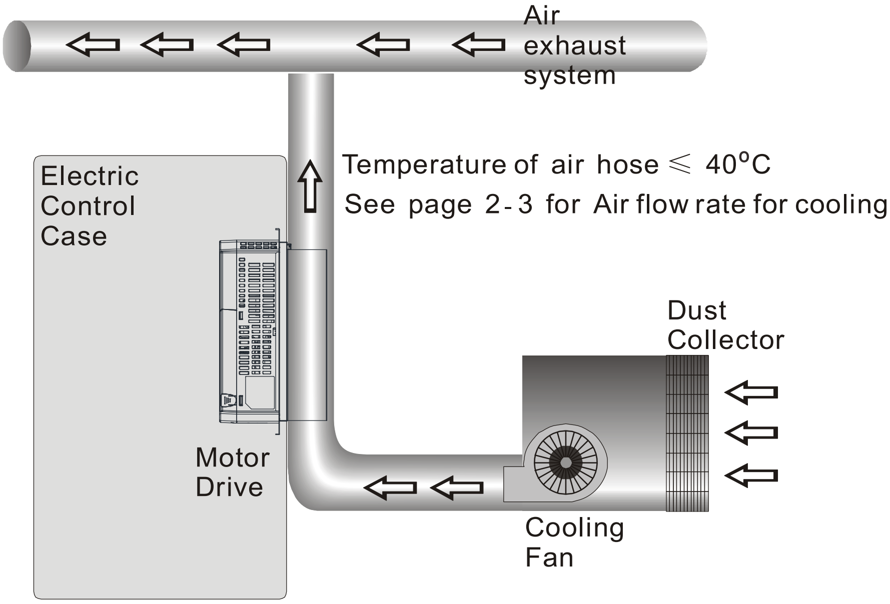
2-2 Airflow and Power Dissipation

Model No.	Airflow Rate for Cooling						Power Dissipation for AC Motor Drive		
	Flow Rate (Unit: cfm)			Flow Rate (Unit: m^3 / hr)			Power Dissipation (Unit: watt)		
	External	Internal	Total	External	Internal	Total	Loss External (Heat sink)	Internal	Total
VFD055CT43F21A3	-	-	-	-	-	-	142	116	258
VFD075CT43F21A3	-	-	-	-	-	-	205	129	334
VFD110CT43F21A3	-	14	14	-	24	24	291	175	466
VFD150CT43F21A3	-	14	14	-	24	24	376	190	566
VFD185CT43F21A3	-	14	14	-	24	24	426	192	618
VFD110CT43F00B	-	-	-	-	-	-	291	175	466
VFD150CT43F00B	-	-	-	-	-	-	376	190	566
VFD185CT43F00B	-	-	-	-	-	-	426	192	618
VFD110CT43A21C	134	-	134	228	-	228	291	175	466
VFD150CT43A21C	134	-	134	228	-	228	376	190	566
VFD185CT43A21C	134	-	134	228	-	228	426	192	618
VFD220CT43F21A3	-	21	21	-	36	36	455	358	813
VFD300CT43F21A3	-	21	21	-	36	36	586	410	996
VFD370CT43F21A7	-	21	21	-	36	36	778	422	1200
VFD220CT43F00B	-	-	-	-	-	-	455	358	813
VFD300CT43F00B	-	-	-	-	-	-	586	410	996
VFD370CT43F00B	-	-	-	-	-	-	778	422	1200
VFD220CT43A21C	173	-	173	294	-	294	455	358	813
VFD300CT43A21C	173	-	173	294	-	294	586	410	996
VFD370CT43A21C	173	-	173	294	-	294	778	422	1200
VFD450CT43F00A3	-	30	30	-	51	51	1056	459	1515
VFD550CT43F00A4	-	30	30	-	51	51	1163	669	1832
VFD750CT43F00A6	-	30	30	-	51	51	1407	712	2119
VFD900CT43F00A8	-	30	30	-	51	51	1787	955	2742
VFD450CT43F00B	-	-	-	-	-	-	1056	459	1515
VFD550CT43F00B	-	-	-	-	-	-	1163	669	1832
VFD450CT43A00C	202	-	202	343	-	343	1056	459	1515
VFD550CT43A00C	202	-	202	343	-	343	1163	669	1832
	● 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

CT2000-B

Heat Dissipation System Diagram



Air Velocity Specification at Heat Dissipation Channel

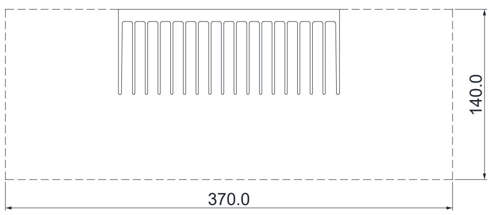
Frame	B			C			D			
Model VFD_ _ _CT43_ _ _ _ _	110	150	185	220	300	370	450	550	750	900
Air Velocity @fc=2kHz (M/sec)	3.5	3.5	3.5	3.5	3.5	7	3.5	4.5	6	8.5
Air Velocity @ default fc (M/sec)	3.5	6.5	8.5	3.5	7	9.5	5.5	6	8.5	9.5

Table 2-4

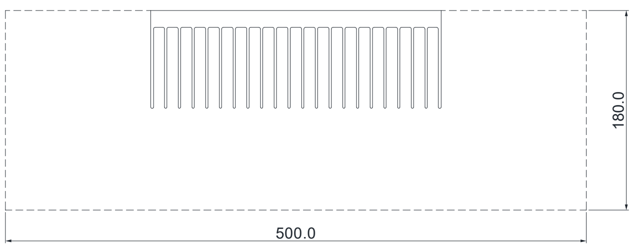
Definition of Air Velocity: When the dissipation channels are at bypass condition, the air speed that equally flows 5cm in front of the heatsink. As shown in the Figure 1 below, dotted lines are required size in mm to calculate the minimum air velocity (table above) to cool down the heat.

The closer the size of the heat dissipation channel to the size of the heatsink, the better the result of heat dissipation.

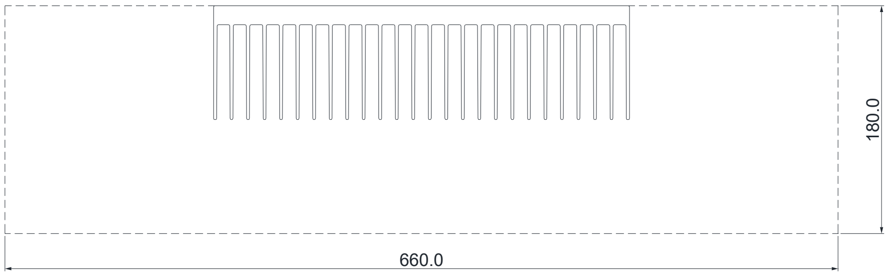
Frame B



Frame C



Frame D



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Chapter 3 Unpacking

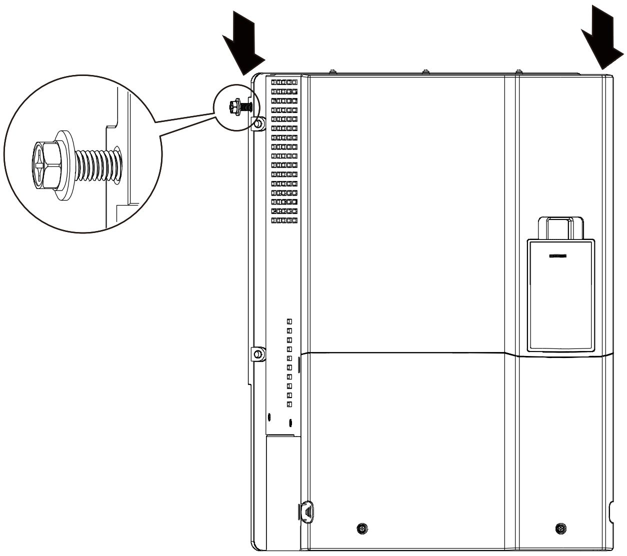
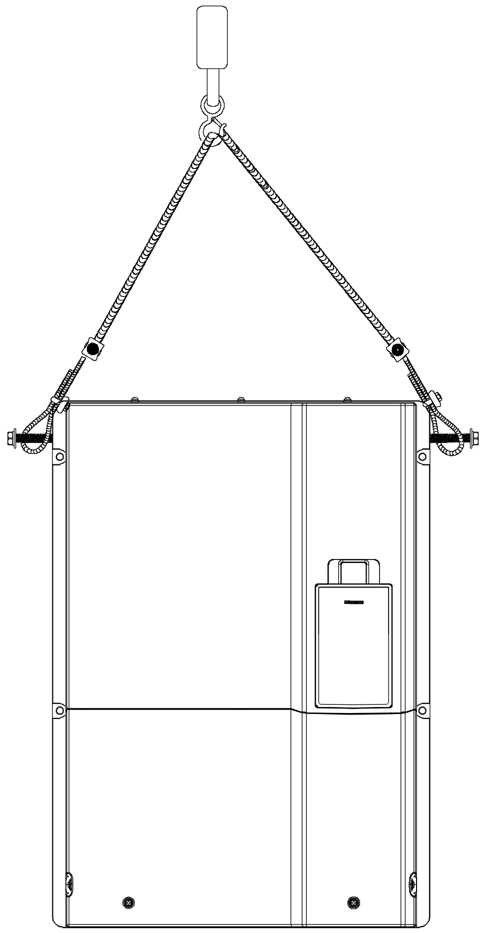
3-1 The Lifting Hook

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.

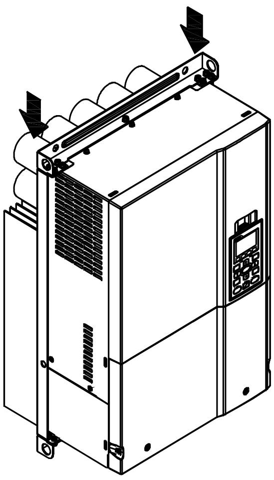
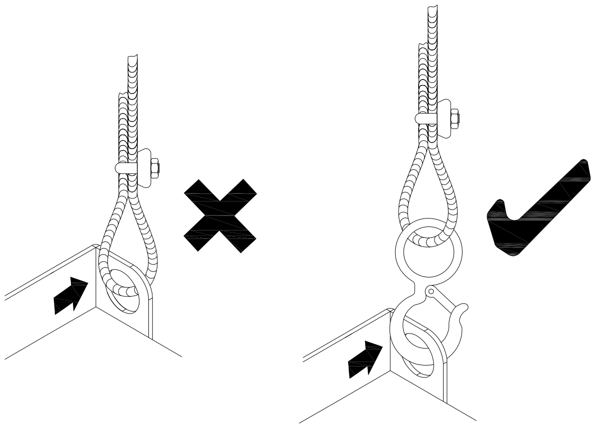
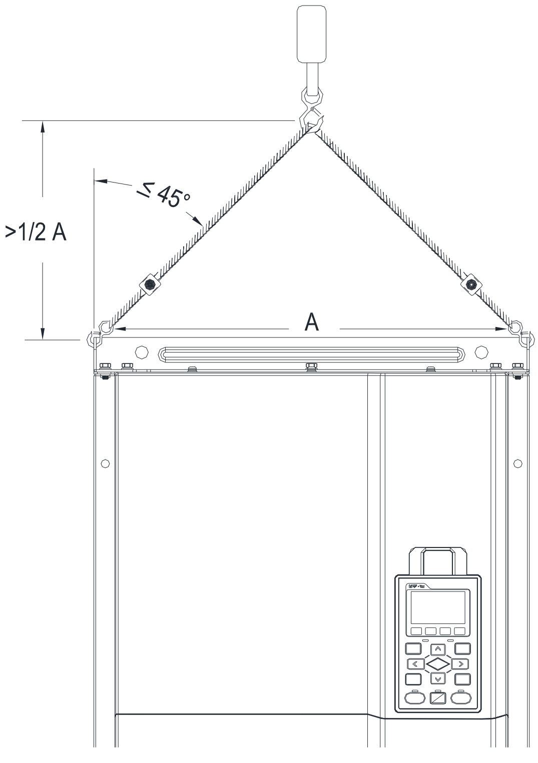
3-1 The Lifting Hook

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

CT2000-A: Plate mounting models

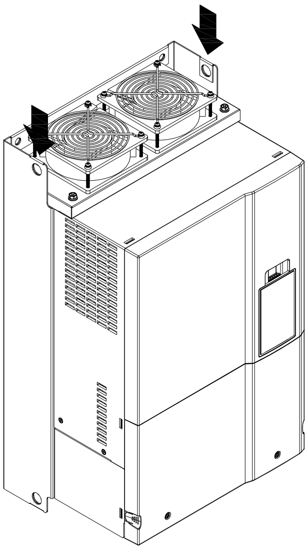
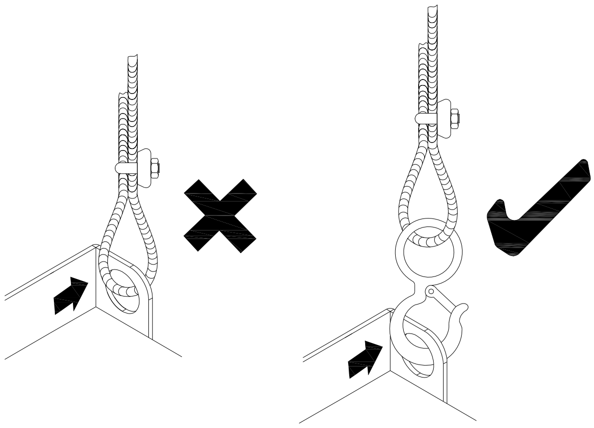
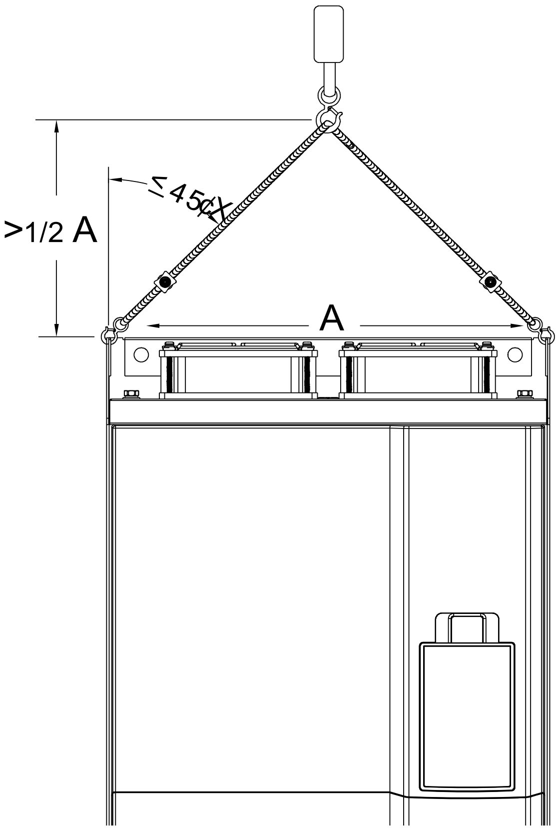
Suggested screw specification: • M8 screw • screw length > 20 • screwing length of screw thread > 10 	Weight: 32 kg When using the lifting hook, pay attention to the lifting rope so that it does not fall off the lifting screws. 

CT2000-B: Flange mounting models

<table>
<tr>
<td>The arrows indicate the location of the lifting holes, see the figure below.
</td>
<td>Pay attention to the installation method of lifting hook, avoid the lifting holes of the drive deforming due to improper installation. See the figure below.
</td>
</tr>
<tr>
<td colspan="2">Pay attention to the angle between the lifting hole and the lifting hook, see the figure below.
Applicable to VFD450CT43F00B; VFD550CT43F00B; VFD450CT43F00A3 VFD550CT43F00A4; VFD750CT43F00A6; VFD900CT43F00A8


Weight: 37.6 kg (82.9lbs.)</td>
</tr>
</table>

CT2000-C：Wall mounting models

<table>
<tr>
<td>The arrows indicate the location of the lifting holes, see the figure below.
</td>
<td>Pay attention to the installation method of lifting hook, avoid the lifting holes of the drive deforming due to improper installation. See the figure below.
</td>
</tr>
<tr>
<td colspan="2">Pay attention to the angle between the lifting hole and the lifting hook, see the figure below.
Applicable to VFD450CT43A00C; VFD550CT43A00C


Weight: 37.6 kg (82.9lbs.)</td>
</tr>
</table>

Chapter 4 Wiring

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

DANGER	☑ **Turn off the AC motor drive power** before doing any wiring. A charge with hazardous voltages may remain in the DC bus capacitors even after the power has been turned off for a short time. Measure the remaining voltage with a DC voltmeter on +1/DC+ and DC- before doing any wiring. For your safety, do not start wiring before the voltage drops to a safe level (less than 25 V_{DC}). Installing wiring with a residual voltage may cause personal injury, sparks and short circuit. ☑ Only qualified personnel familiar with AC motor drives are allowed to perform installation, wiring and commissioning. Make sure the power is turned off before wiring to prevent electric shock. ☑ Make sure that power is only applied to the R/L1, S/L2 and T/L3 terminals. Failure to comply may result in damage to the equipment. The voltage and current must be in the range indicated on the nameplate (refer to Section 1-1 Nameplate Information for details). ☑ All units must be grounded directly to a common ground terminal to prevent damage from a lightning strike or electric shock and reduce noise interference. ☑ Tighten the screws of the main circuit terminals to prevent sparks caused by screws loosened due to vibration.
CAUTION	☑ For your safety, choose wires that comply with local regulations when wiring. ☑ Check the following items after finishing the wiring: 1. Are all connections correct? 2. Are there any loose wires? 3. Are there any short circuits between the terminals or to ground?

4-1 System Wiring Diagram

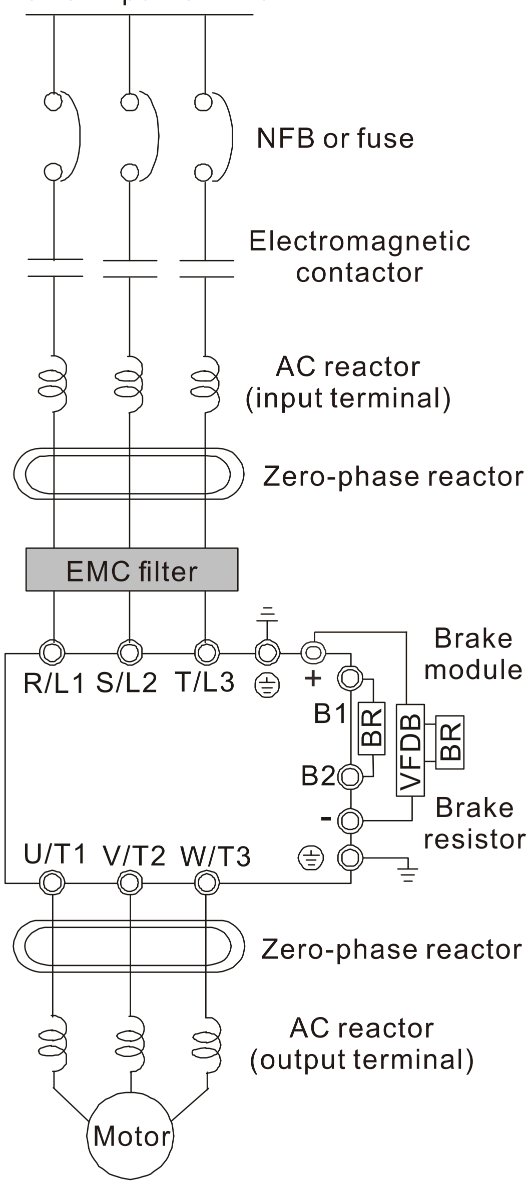


Figure 4-1

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

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

Table 4-1

4-2 Wiring

4-2-1 Wiring

Wiring Diagram for Frame A–C

Input: 3-phase power

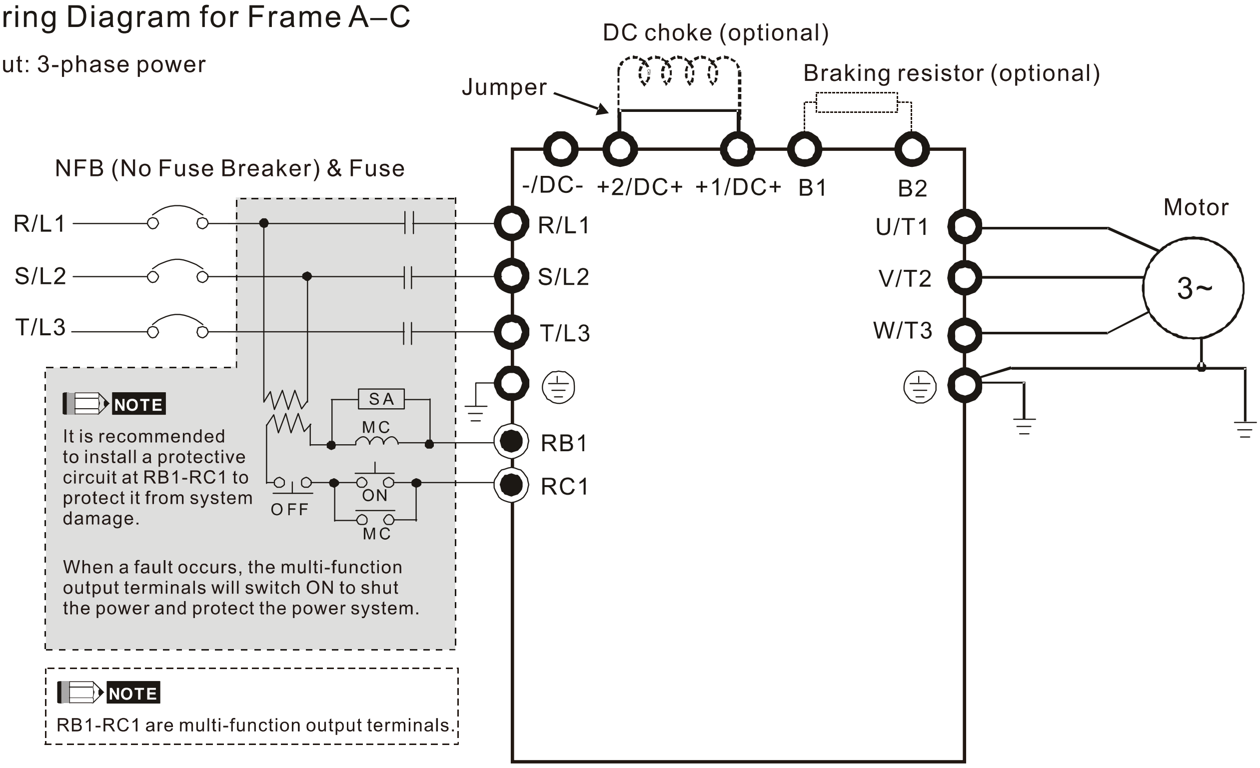


Figure 4-2

Wiring Diagram for Frame D

Input: 3-phase power

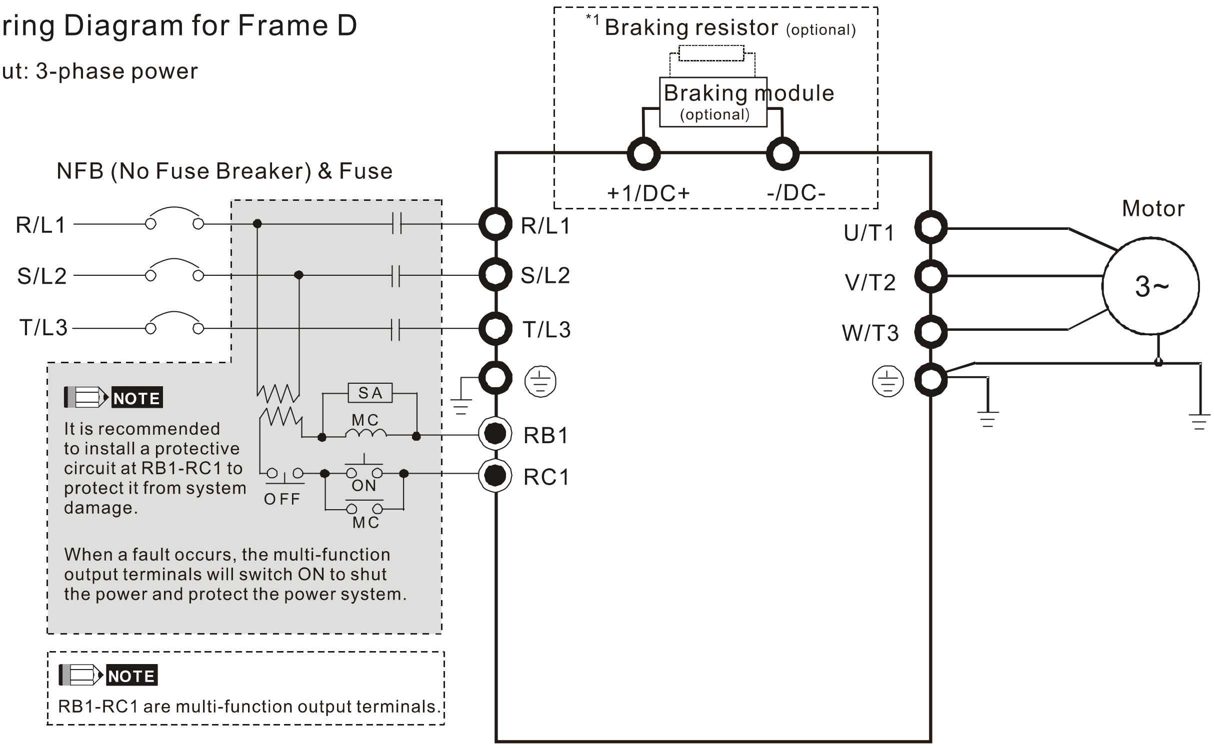


Figure 4-3

NOTE: *1 means that refer to Section 7-1 for brake units and resistors selection.

Wiring Diagram for Frame A–D

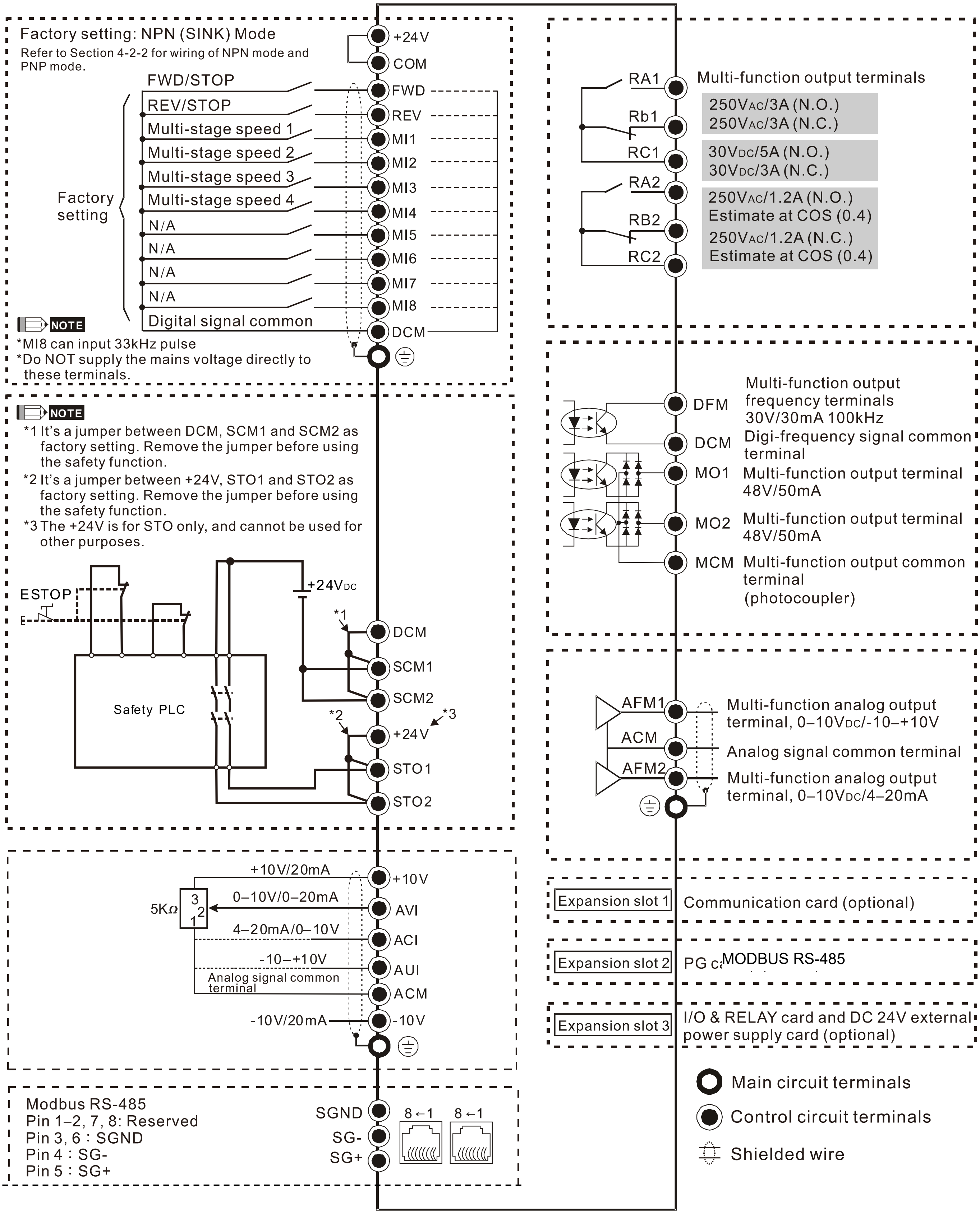


Figure 4-4

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

① Sink Mode
with internal power (+24VDC)

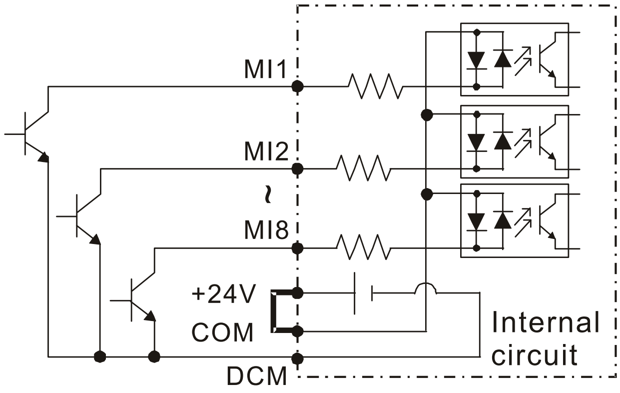


Figure 4-5

② Source Mode
with internal power (+24VDC)

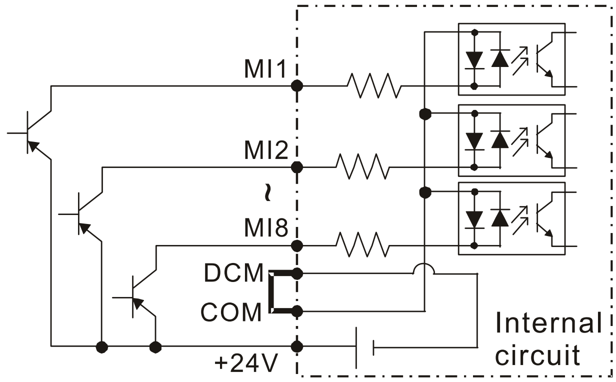


Figure 4-6

③ Sink Mode
with external power

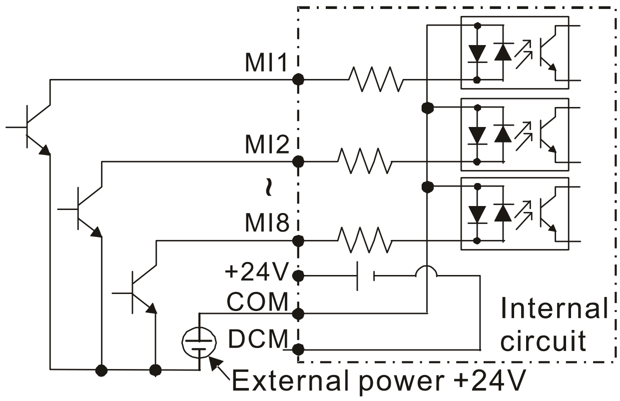


Figure 4-7

④ Source Mode
with external power

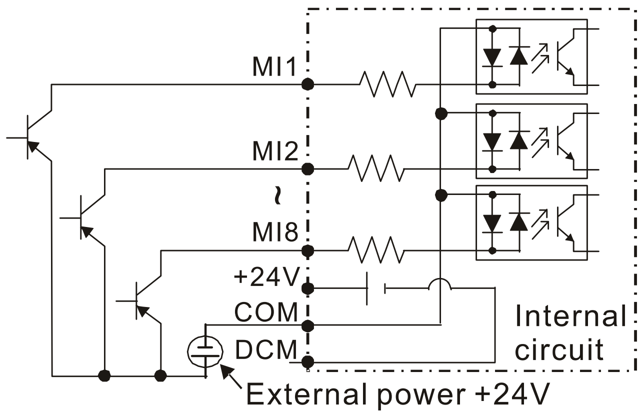


Figure 4-8

Chapter 5 Main Circuit Terminals

DANGER

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

CAUTION

Main input power terminals

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

Output terminals of the 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) upon a forward operation command is received. To permanently reverse the direction of motor rotation, switch over any of the two motor leads.

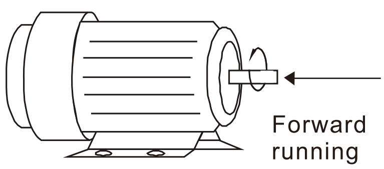


Figure 5-1

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

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

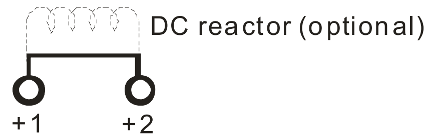


Figure 5-2

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

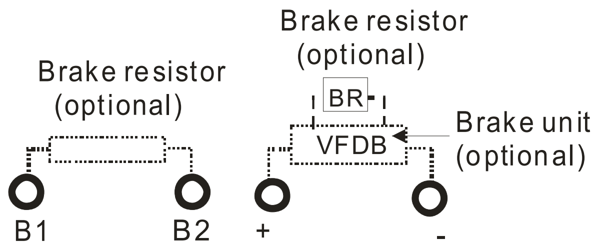


Figure 5-3

- ☑ 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, +2 and - are not used, leave the terminals open.
- ☑ DC+ and DC- are connected by common DC bus, refer to Section 5-1 (Main Circuit Terminal) for the wiring terminal specification and the wire gauge information.
- ☑ 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

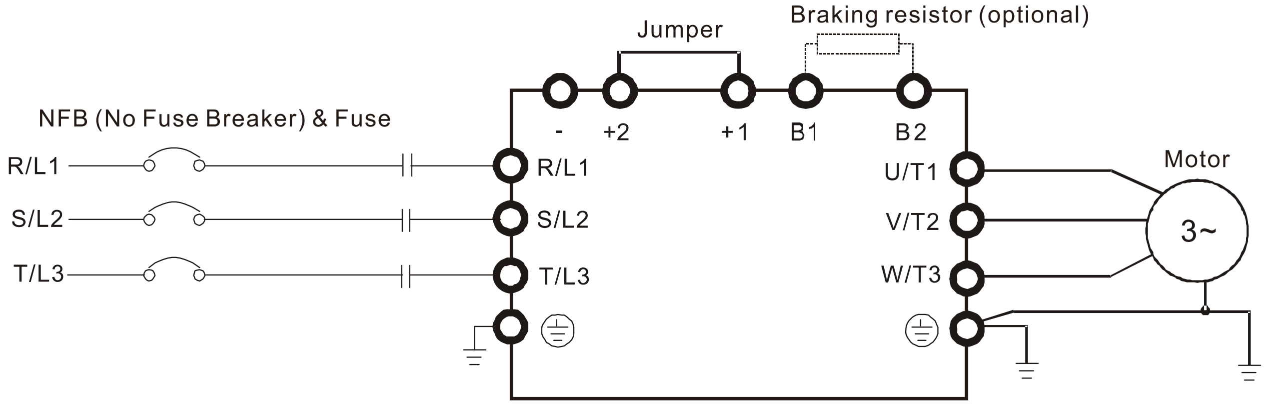


Figure 5-4

Wiring Diagram for Frame A–C

Input: 3-phase power

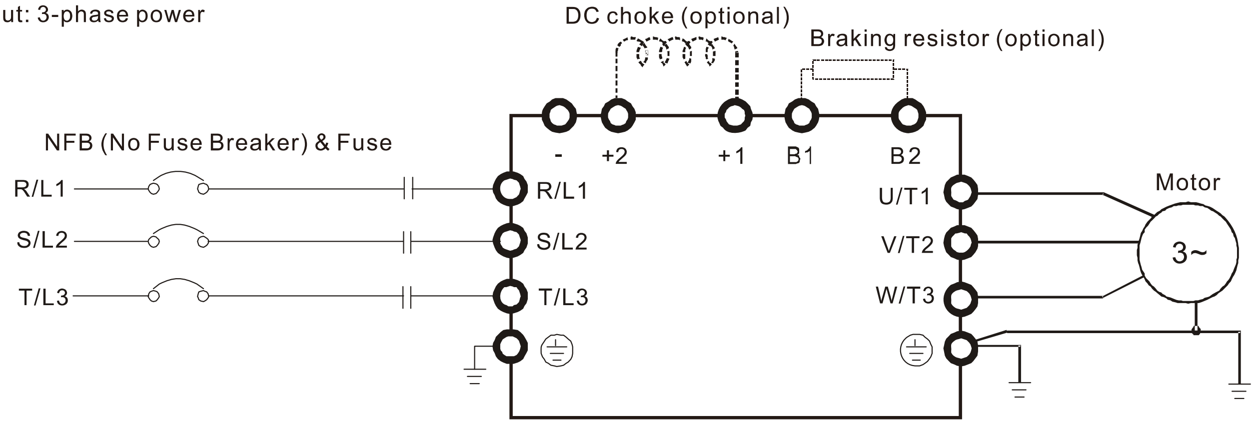


Figure 5-5

Wiring Diagram for Frame D

Input: 3-phase power

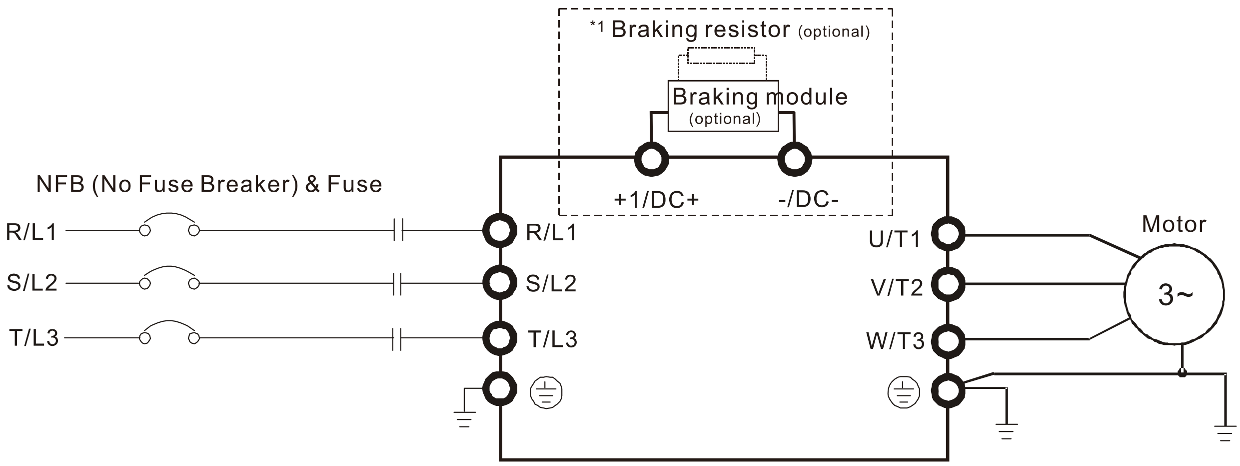


Figure 5-6

NOTE:

1. Mark *1 means that refer to Section 7-1 for brake units and resistors selection.
2. If the wiring between motor drive and motor is over 75 meters, refer to Section 7-4 Specifications of limits for motor cable length.

Terminals	Descriptions
R/L1, S/L2, T/L3	Mains input terminals (three-phase)
U/T1, V/T2, W/T3	AC motor drive output terminals for connecting three-phase induction motor
+1/DC+, +2/DC+	Applicable to frame A–C Connections for DC reactor to improve the power factor. Remove the jumper before installing a DC reactor.
+1/DC+, -/DC-	Connections for brake module (VFDB series) (for 460V models: ≤ 37 kW, built-in brake module) Common DC bus
B1, B2	Connections for brake resistor (optional). Refer to Section 7-1 for details.
⏚	Ground connection; comply with local regulations.

Table 5-1

5-2 Main Circuit Terminal Specifications

- Use the specified ring lug for main circuit terminal wiring. See figure 5-7 and figure 5-8 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 600V$_{AC}$ insulation over the live part. Refer to figure 5-7 below.

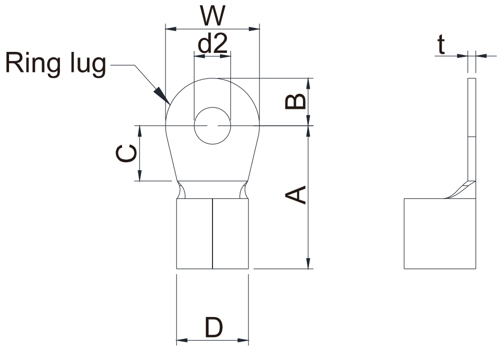


Figure 5-7

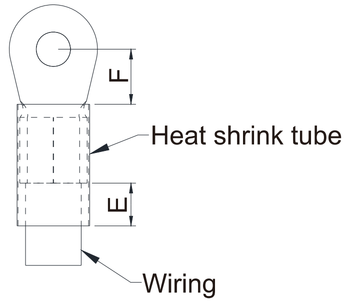


Figure 5-8

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.

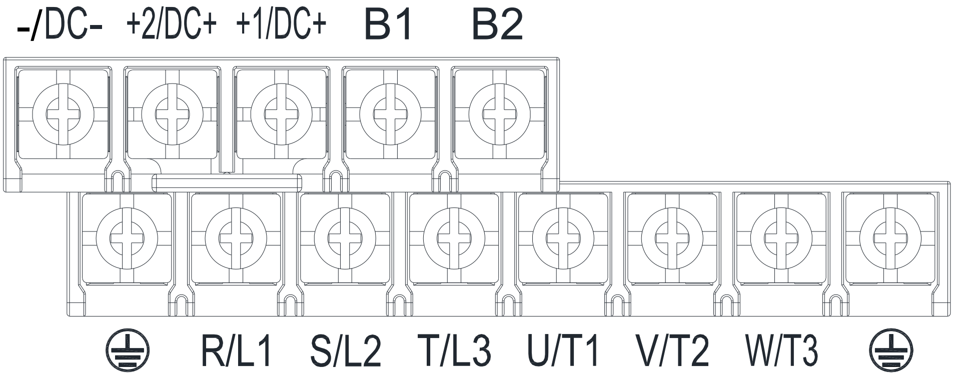
Unit: mm

Frame	AWG[*1]	Kit P/N	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	t (MAX)
A	16	RNBL2-4	20.0	5.0	5.5	9.0	4.3	8.0	5.5	10.0	1.5
	14	RNBL2-4									
	12	RNBL5-4									
	10	RNBL5-4									
	8	RNBS8-4									
B	8	RNBM8-5	28.0	7.0	7.5	14.0	5.2	13.0	12.0	14.0	1.5
	6	RNB14-5									
	4	RNBS22-5									
C	6	RNB14-8	40.0	12.0	12.5	22.0	8.3	13.0	12.5	24.0	2.5
	4	RNB22-8									
	2	RNBS38-8									
	1/0	RNB60-8									
D	4	RNB22-8	50.0	16.0	10.0	27.0	8.3	13.0	14.0	28.0	6.0
	2	RNBS38-8									
	1/0	RNB60-8									
	2/0	RNB70-8									
	3/0	RNB80-8									
	4/0	SQNBS100-8									
	250MCM	SQNBS150-8									
	300MCM	SQNBS150-8									

Table 5-2

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

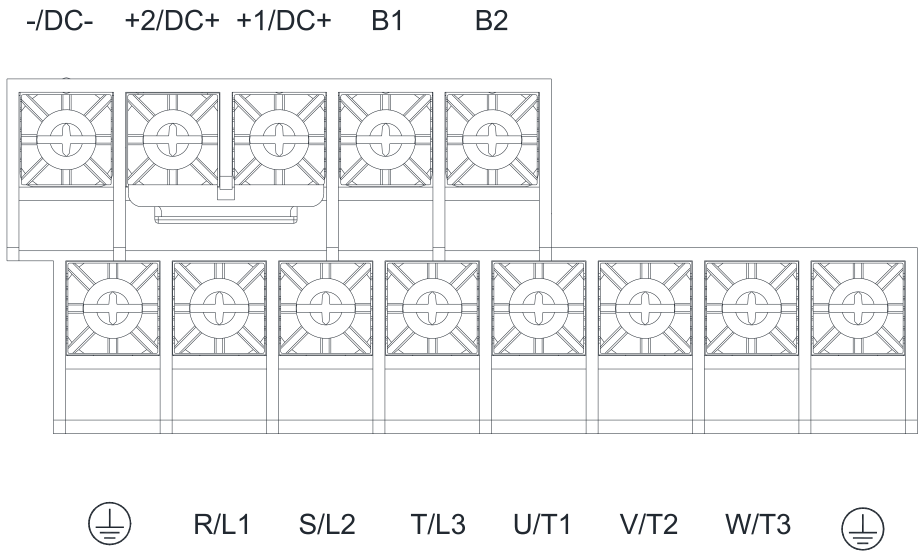
Frame A



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

Model Name	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -/DC-, +1/DC+, +2/DC+, B1, B2			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD055CT43F21A3	10 mm^2 (8 AWG)	10.0 mm^2 (8 AWG)	M4 20kg-cm (17.4lb-in.) (1.96Nm)	10.0 mm^2 (8 AWG)	10.0 mm^2 (8 AWG)	M4 20kg-cm (17.4lb-in.) (1.96Nm)
VFD075CT43F21A3		10.0 mm^2 (8 AWG)		10.0 mm^2 (8 AWG)	10.0 mm^2 (8 AWG)	

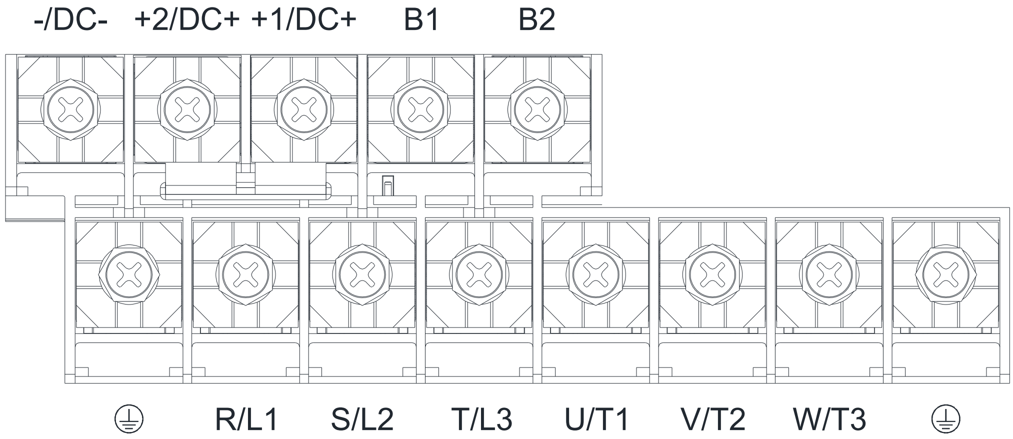
Frame B



- If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 75°C or 90°C for wiring.
- If the installation is in an environment where the ambient temperature is above 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- +2/DC+ and +1/DC+: with 45 kg-cm / (39.0 Ib-in) / (4.42 Nm) (±10%) torque

Model Name	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -/DC-, +1/DC+, +2/DC+, B1, B2			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD110CT43F21A3	25 mm^2 (4 AWG)	10 mm^2 (8 AWG)	M5 35kg-cm (30.4lb-in.) (3.43Nm)	10 mm^2 (8 AWG)	10 mm^2 (8 AWG)	M5 35kg-cm (30.4lb-in.) (3.43Nm)
VFD150CT43F21A3		16 mm^2 (6 AWG)		16 mm^2 (6 AWG)	16 mm^2 (6 AWG)	
VFD185CT43F21A3		25 mm^2 (4 AWG)		25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	
VFD110CT43F00B		10 mm^2 (8 AWG)		10 mm^2 (8 AWG)	10 mm^2 (8 AWG)	
VFD150CT43F00B		16 mm^2 (6 AWG)		16 mm^2 (6 AWG)	16 mm^2 (6 AWG)	
VFD185CT43F00B		25 mm^2 (4 AWG)		25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	
VFD110CT43A21C		10 mm^2 (8 AWG)		10 mm^2 (8 AWG)	10 mm^2 (8 AWG)	
VFD150CT43A21C		16 mm^2 (6 AWG)		16 mm^2 (6 AWG)	16 mm^2 (6 AWG)	
VFD185CT43A21C		25 mm^2 (4 AWG)		25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	

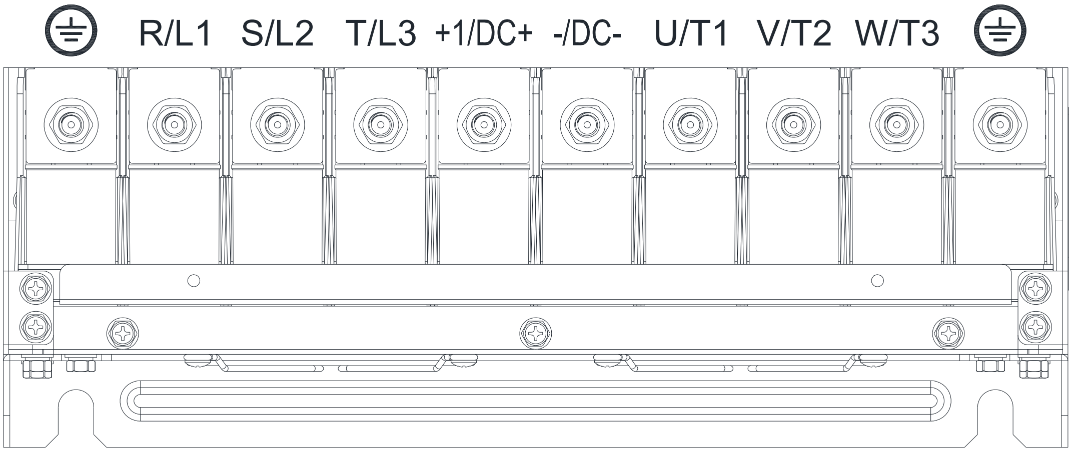
Frame C



- If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 75°C or 90°C for wiring.
- If the installation is in an environment where the ambient temperature is above 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.
- +2/DC+ and +1/DC+: with 90 kg-cm / (78.2 lb-in) / (8.83 Nm) (±10%) torque

Model Name	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -/DC-, +1/DC+, +2/DC+, B1, B2			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD220CT43F21A3	50 mm^2 (1/0 AWG)	25 mm^2 (4 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)	25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)
VFD300CT43F21A3		35 mm^2 (2 AWG)		35 mm^2 (2 AWG)	16 mm^2 (6 AWG)	
VFD370CT43F21A7		50 mm^2 (1/0 AWG)		50 mm^2 (1/0 AWG)	25 mm^2 (4 AWG)	
VFD220CT43F00B		25 mm^2 (4 AWG)		25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	
VFD300CT43F00B		35 mm^2 (2 AWG)		35 mm^2 (2 AWG)	16 mm^2 (6 AWG)	
VFD370CT43F00B		50 mm^2 (1/0 AWG)		50 mm^2 (1/0 AWG)	25 mm^2 (4 AWG)	
VFD220CT43A21C		25 mm^2 (4 AWG)		25 mm^2 (4 AWG)	16 mm^2 (6 AWG)	
VFD300CT43A21C		35 mm^2 (2 AWG)		35 mm^2 (2 AWG)	16 mm^2 (6 AWG)	
VFD370CT43A21C		50 mm^2 (1/0 AWG)		50 mm^2 (1/0 AWG)	25 mm^2 (4 AWG)	

Frame D



- If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 75°C or 90°C for wiring.
- If the installation is in an environment where the ambient temperature is above 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C or above for wiring.
- For VFD900CT43F00A8 model: If the installation is in an environment where the ambient temperature is 50°C, use copper wire with a rated voltage of 600V and a temperature resistance of 90°C for wiring.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wire.

Model Name	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -/DC-, +1/DC+			Terminal ⏚		
	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)	Max. Wire Gauge	Min. Wire Gauge	Screw Spec. and Torque (±10%)
VFD450CT43F00A3	70 mm^2 (2/0 AWG)	70 mm^2 (2/0 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)	35 mm^2 (2 AWG)	25 mm^2 (4 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)
VFD550CT43F00A4		70 mm^2 (2/0 AWG)			25 mm^2 (4 AWG)	
VFD750CT43F00A6	120 mm^2 (4/0 AWG)	120 mm^2 (4/0 AWG)	M8 180kg-cm (156.2lb-in.) (17.65Nm)	120 mm^2 (4/0 AWG)	70 mm^2 (2/0 AWG)	M8 180kg-cm (156.2lb-in.) (17.65Nm)
VFD900CT43F00A8		120 mm^2 (4/0 AWG)		120 mm^2 (4/0 AWG)	70 mm^2 (2/0 AWG)	
VFD450CT43F00B	70 mm^2 (2/0 AWG)	50 mm^2 (1 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)	35 mm^2 (2 AWG)	25 mm^2 (4 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)
VFD550CT43F00B		70 mm^2 (2/0 AWG)			25 mm^2 (4 AWG)	
VFD450CT43A00C	70 mm^2 (2/0 AWG)	50 mm^2 (1 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)	35 mm^2 (2 AWG)	25 mm^2 (4 AWG)	M8 80kg-cm (69.4lb-in.) (7.84Nm)
VFD550CT43A00C		70 mm^2 (2/0 AWG)		35 mm^2 (2 AWG)	25 mm^2 (4 AWG)	

Chapter 6 Control Terminals

CAUTION

Analog input terminals (AVI, ACI, AUI, 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 the ACM terminal can reduce interference.

☑ Use twisted-pair wire for weak analog signals.

☑ If the analog input signals are affected by noise from the AC motor drive, connect a capacitor and a ferrite core as shown in Figure 6-1.

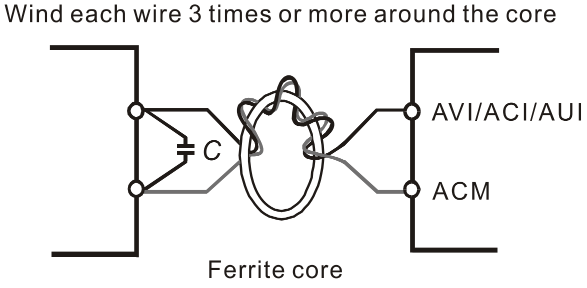


Figure 6-1

Contact input terminals (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".

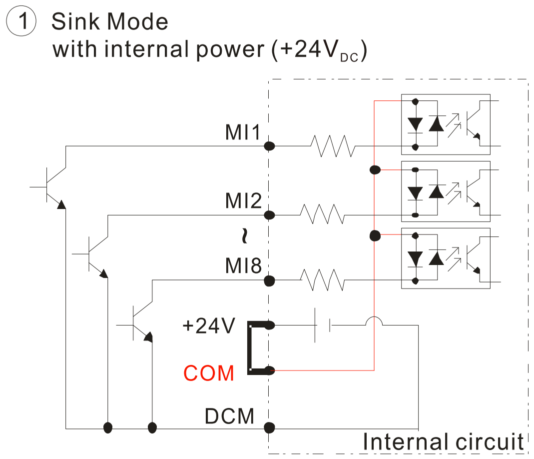


Figure 6-2

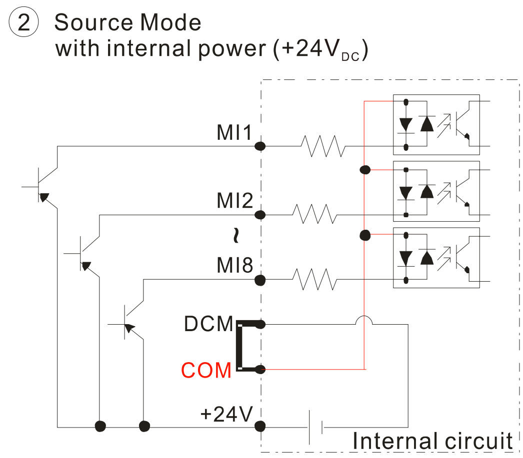


Figure 6-3

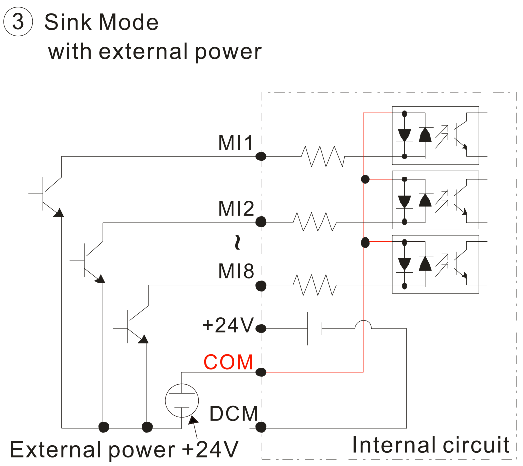


Figure 6-4

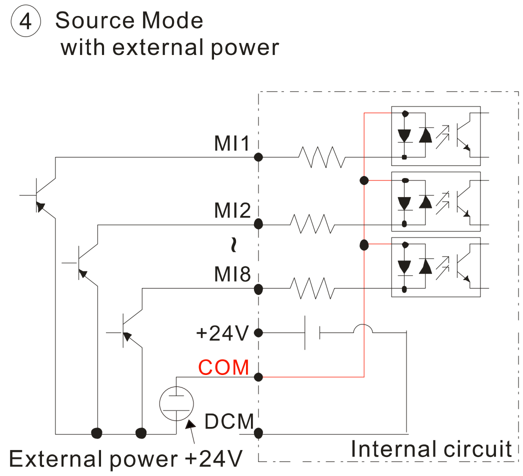


Figure 6-5

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

6-1 Remove the Cover for Wiring

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: VFD055CT43F21A3; VFD075CT43F21A3; VFD110CT43F21A3; VFD150CT43F21A3; VFD185CT43F21A3; VFD110CT43F00B; VFD150CT43F00B; VFD185CT43F00B; VFD110CT43A21C; VFD150CT43A21C; VFD185CT43A21C

Screw torque: 12–15 kg-cm / (10.4–13 Ib-in.) / (1.2–1.5 Nm)
Loosen the screws and press the tabs on both sides to remove the cover.

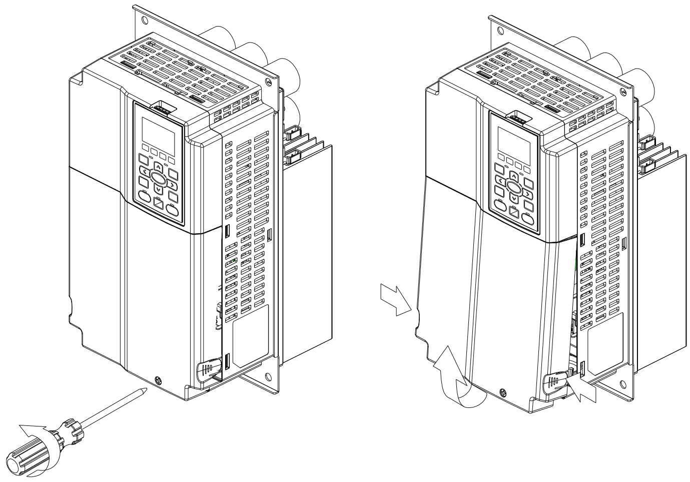


Figure 6-6

Frame C

Applicable models: VFD220CT43F21A3; VFD300CT43F21A3; VFD370CT43F21A7; VFD220CT43F00B; VFD300CT43F00B; VFD370CT43F00B; VFD220CT43A21C; VFD300CT43A21C; VFD370CT43A21C

Screw torque: 12–15 kg-cm / (10.4–13 Ib-in.) / (1.2–1.5 Nm)
Loosen the screws and press the tabs on both sides to remove the cover.

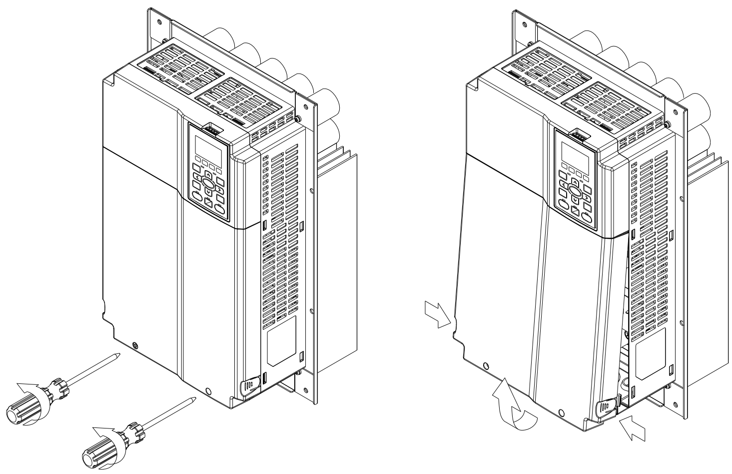


Figure 6-7

Frame D

Applicable models: VFD450CT43F00A3; VFD550CT43F00A4; VFD750CT43F00A6; VFD900CT43F00A8; VFD450CT43F00B; VFD550CT43F00B; VFD450CT43A00C; VFD550CT43A00C

Screw torque: 10–12 kg-cm / (8.7–10.4 Ib-in.) / (0.98–1.18 Nm)

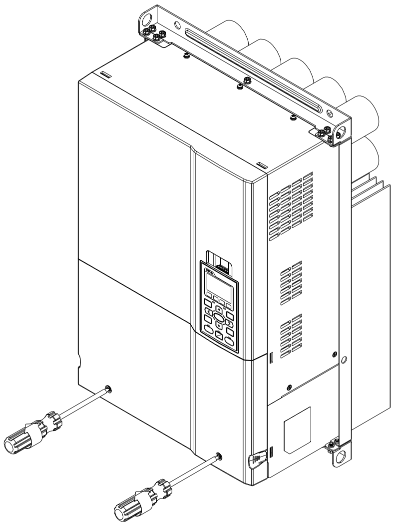


Figure 6-8

Loosen the screws and press the tabs on both sides to remove the cover.

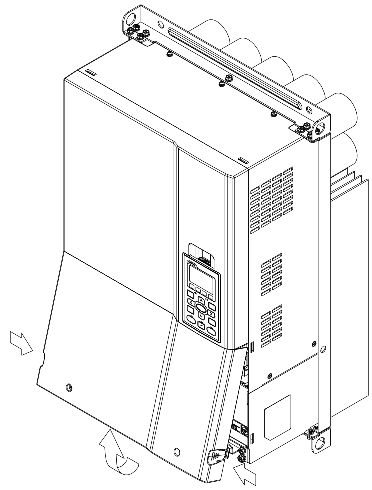


Figure 6-9

6-2 Control Terminal Specifications

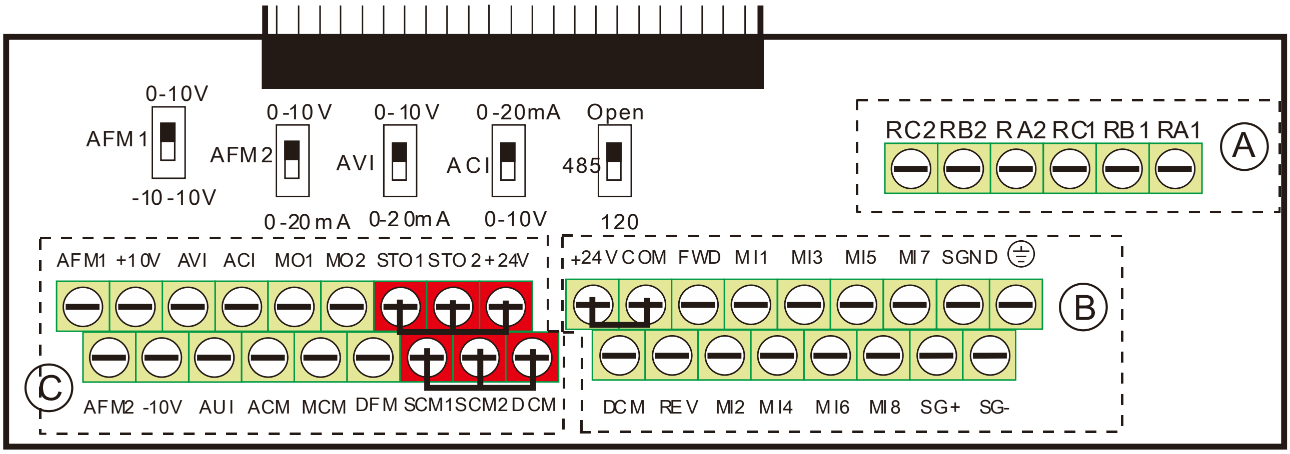


Figure 6-10 Removable Terminal Block

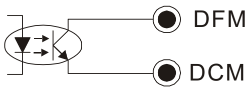
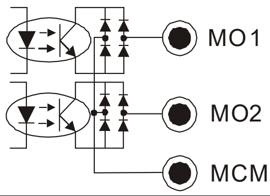
Function name	Area	Conductor	Stripping Length (mm)	Maximum Wire Gauge	Minimum Wire Gauge	Tightening Torque (±10 %)
RELAY Terminals	Ⓐ	Conductor cross section solid wire	4–5	1.5 mm² (16 AWG)	0.2 mm² (26 AWG)	5 kg-cm (4.3 lb-in.) (0.49 Nm)
		Conductor cross section stranded wire				
Control Terminals	Ⓑ	Conductor cross section solid wire	6–7			8 kg-cm (6.9 lb-in.) (0.78 Nm)
		Conductor cross section stranded wire				
Control Terminals	Ⓒ	Conductor cross section solid wire				2 kg-cm (1.7 lb-in.) (0.20 Nm)
		Conductor cross section stranded wire				

Table 6-1

Wiring precautions:

- In the figure above, the factory default for STO1, STO2, +24V and SCM1, SCM2, DCM are short-circuited. Use the +24V power supply of the safety function (as shown in section Ⓒ of above figure) for STO only. Do NOT use it for other purposes. The factory setting for +24V-COM is short-circuited and SINK mode (NPN); please refer to Chapter 4 Wiring for 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, ensure that 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

Terminals	Terminal Function	Factory Setting (NPN mode)
REV	Reverse-Stop command	REV-DCM: ON➔ reverse running OFF➔ deceleration to stop
MI1 – MI8	Multi-function input 1–8	Refer to Pr.02-01–02-08 to program the multi-function inputs MI1–MI8. Source mode ON: activation current 3.3 mA ≥ 11 V_{DC} OFF: cut-off voltage ≤ 5 V_{DC} Sink Mode ON: activation current 3.3 mA ≤ 13 V_{DC} OFF: cut-off voltage ≥ 19 V_{DC}
DFM	Digital frequency signal output  Figure 6-11	DFM uses pulse voltage as an output monitoring signal; Duty-cycle: 50 % Min. load impedance: 1 kΩ / 100 pF Max. current endurance: 30 mA Max. voltage: 30 V_{DC}
DCM	Digital control / Frequency signal common	
MO1	Multi-function output 1 (photocoupler)	The AC motor drive outputs various monitoring signals, such as drive in operation, frequency reached, and overload indication through a transistor (open collector).  Figure 6-12
MO2	Multi-function output 2 (photocoupler)	
MCM	Multi-function output common	Max 48 V_{DC} 50 mA
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} 2.0A (N.O.) / 1.2A (N.C.) 30 V_{DC} To output different kinds of monitoring signals such as motor drive in operation, frequency reached, and overload indication.
RB1	Multi-function relay output 1 (N.C.) b	
RC1	Multi-function relay common	
RA2	Multi-function relay output 2 (N.O.) a	
RB2	Multi-function relay output 2 (N.C.) b	
RC2	Multi-function relay common	
+10V	Potentiometer power supply	Power supply for analog frequency setting: +10V_{DC} 20 mA
-10V	Potentiometer power supply	Power supply for analog frequency setting: -10V_{DC} 20 mA

<table>
<tr><th>Terminals</th><th>Terminal Function</th><th>Factory Setting (NPN mode)</th></tr>
<tr><td>AVI</td><td>Analog voltage frequency command

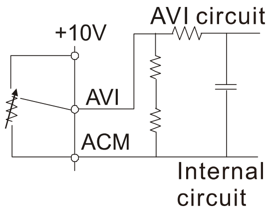



Figure 6-13</td><td>Impedance: 20 kΩ
Range: 0–20 mA / 4–20 mA / 0–10 V = 0–Max. Operation Frequency (Pr.01-00)
AVI switch, factory setting is 0–10 V</td></tr>
<tr><td>ACI</td><td>Analog current input

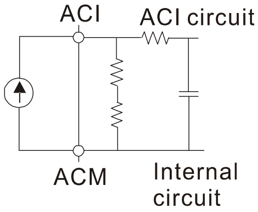



Figure 6-14</td><td>Impedance: 250 Ω
Range: 0–20mA / 4–20mA / 0–10V = 0–Max. Operation Frequency (Pr.01-00)
ACI Switch, factory setting is 4–20 mA</td></tr>
<tr><td>AUI</td><td>Auxiliary analog voltage input

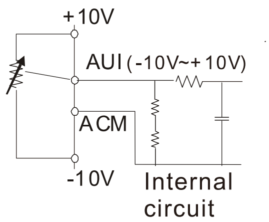



Figure 6-15</td><td>Impedance: 20 kΩ
Range: -10– +10 V_{DC} = 0–Max. Operation Frequency (Pr. 01-00)</td></tr>
<tr><td>AFM1</td><td rowspan="2">Multi-function analog voltage output

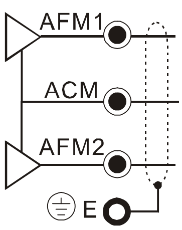



Figure 6-16</td><td>0–10V Max. output current 2mA, Max. load 5 kΩ
-10–10V maximum output current 2 mA, maximum load 5 kΩ
Output current: 2 mA max
Resolution: 0–10V corresponds to Max. operation frequency
Range: 0–10V → -10– +10V
AFM1 Switch, factory setting is 0–10V</td></tr>
<tr><td>AFM2</td><td>0–10V Max. output current 2 mA, Max. load 5 kΩ
0–20 mA Max. load 500 Ω
Output current: 20 mA max
Resolution: 0–10V corresponds to Max. operation frequency
Range: 0–10V → 4–20 mA
AFM2 Switch, factory setting is 0–10V</td></tr>
<tr><td>ACM</td><td>Analog signal common</td><td>Analog signal common terminal</td></tr>
<tr><td>STO1</td><td colspan="2" rowspan="4">Default setting is shorted
Power removal safety function for EN954-1 and IEC/EN61508
When STO1–SCM1; STO2–SCM2 is activated, the activation current is 3.3 mA ≥ 11V_{DC}
NOTE: Refer to Chapter 17 SAFE TORQUE OFF FUNCTION for details.</td></tr>
<tr><td>SCM1</td></tr>
<tr><td>STO2</td></tr>
<tr><td>SCM2</td></tr>
</table>

Terminals	Terminal Function	Factory Setting (NPN mode)
SG+	Modbus RS-485 **NOTE:** Refer to Chapter 12 Descriptions Of Parameter Settings parameter group 09 Communication Parameters for details.	
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).

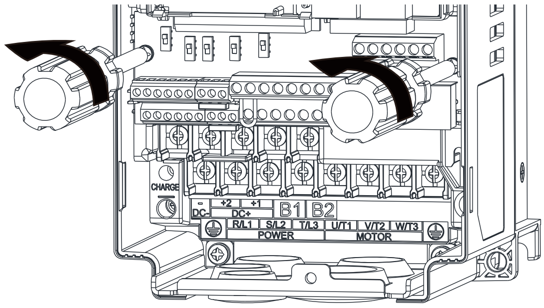


Figure 6-17

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).

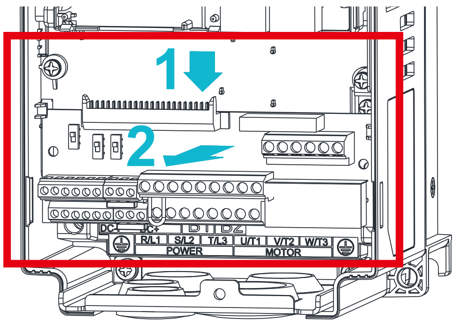


Figure 6-18

Chapter 7 Optional Accessories

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

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

Models	Applicable Motor		125% Braking Torque / 10% ED*1							Max. Braking Torque*2		
	HP	kW	Braking Torque (kg-m)	Brake Unit	Brake Resistor for Each Brake Unit*3			Resistor Value Spec. for Each AC Motor Drive	Total Braking Current (A)	Min. Resistor Value (Ω)	Max. Total Braking Current (A)	Peak Power (kW)
				VFDB*4	P/N	Q'ty	Usage					
VFD055CT43F21A3	7.5	5.5	2.7	-	BR1K0W075	1	-	1000W 75Ω	10.2	54.3	14	10.6
VFD075CT43F21A3	10	7.5	3.7	-	BR1K0W075	1	-	1000W 75Ω	10.2	54.3	14	10.6
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	15	11	5.1	-	BR1K0W075	1	-	1000W 75Ω	10.2	47.5	16	12.2
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	20	15	7.4	-	BR1K5W043	1	-	1500W 43Ω	17.6	42.2	18	13.7
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	25	18	10.2	-	BR1K0W016	2	2 in series	2000W 32Ω	24	26.2	29	22.0
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	30	22	12.2	-	BR1K0W016	2	2 in series	2000W 32Ω	24	23.0	33	25.1
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	40	30	14.9	-	BR1K5W013	2	2 in series	3000W 26Ω	29	23.0	33	25.1
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	50	37	20.3	-	BR1K0W016	4	2 parallel, 2 in series	4000W 16Ω	47.5	14.1	54	41.0
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	60	45	25	4045*1	BR1K2W015	4	2 parallel, 2 in series	4800W 15Ω	50	12.7	60	45.6
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	75	55	30.5	4045*1	BR1K5W013	4	2 parallel, 2 in series	6000W 13Ω	59	12.7	60	45.6
VFD750CT43F00A6	100	75	37.2	4030*2	BR1K0W5P1	4	4 in series	8000W 10.2Ω	76	9.5	80	60.8
VFD900CT43F00A8	125	90	50.8	4045*2	BR1K2W015	4	2 parallel, 2 in series	9600W 7.5Ω	100	6.3	120	91.2

Table 7-1

*1. Calculation of 125% brake toque: (kW) * 125% * 0.8; where 0.8 is the motor efficiency.
Since there is a resistor power consumption limit, the longest operation time for 10% ED is 10 seconds (ON: 10 seconds / OFF: 90 seconds).
*2. Refer to Chapter 7 "Brake Module and Brake Resistors" in the application manual for "Operation Duration & ED" vs. "Braking Current".
*3. To dissipate heat, mount a resistors of 400 W or lower to a frame to keep the surface temperature below 250°C. Fix a resistor of 1000 W or higher to a surface to keep the surface temperature below 350°C. (If the surface temperature is higher than the temperature limit, install extra cooling or increase the size of the resistor.)
*4. The calculation of the brake resistor is based on a four-pole motor (1800 rpm). Refer to VFDB series Braking Module Instruction for more details on brake resistor.

NOTE:

1. Specification and Appearance of Brake Resistors

   1.1 Wire wound resistors: For 1000 W and above, refer to the following appearance of wire wound resistor (Figure7-1) and its model and specification comparison table (Table 7-5) for details.

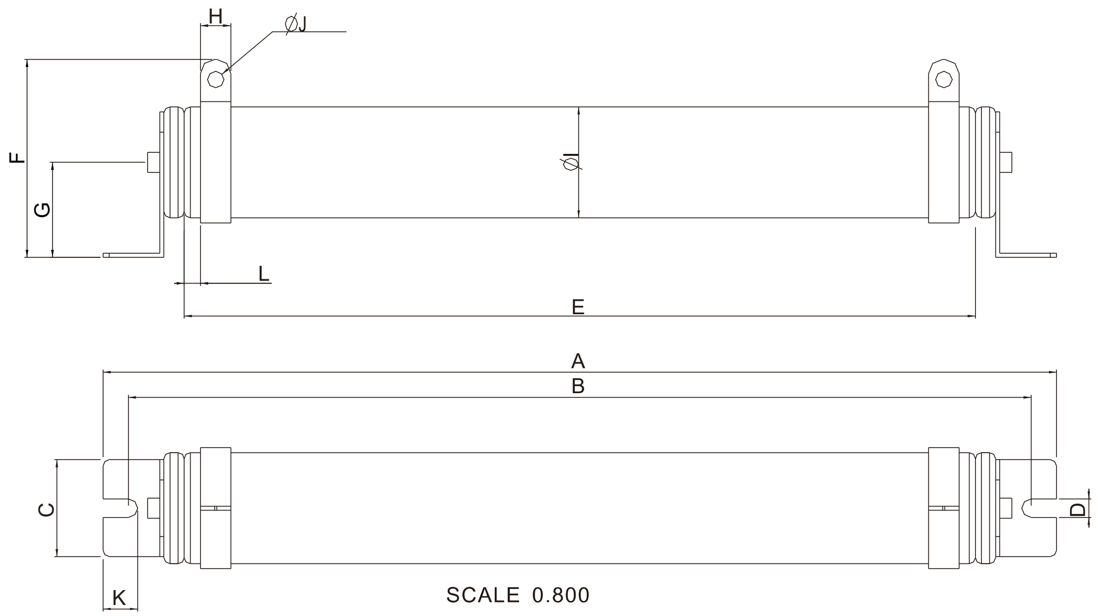


Figure 7-1

Models and Specifications Comparison Table of Wire Wound Resistors: Unit: mm

Models	A	B	C	D	E	F	G	H	Ø	ØJ	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 1000 W, refer to the following appearance of aluminum-housed resistor (Figure 7-2) and its model and specification comparison table (Table 7-6) for details

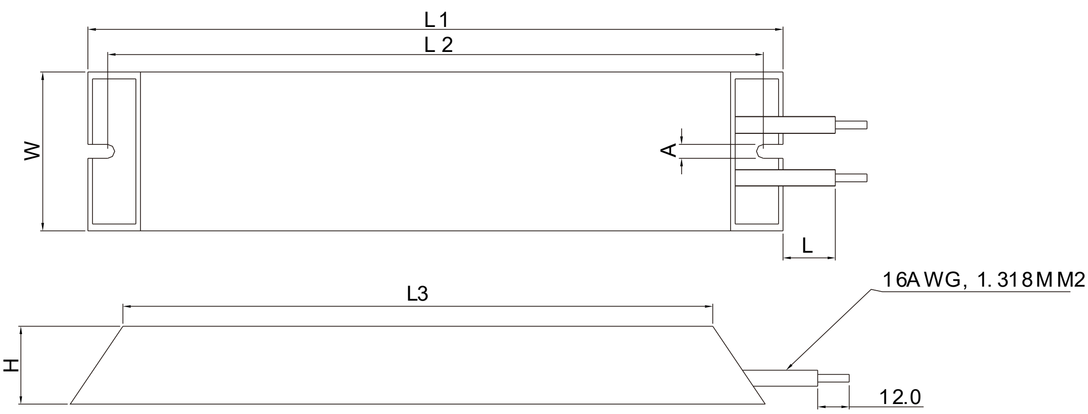


Figure 7-2

Unit: mm

Models	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							

Table 7-3

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

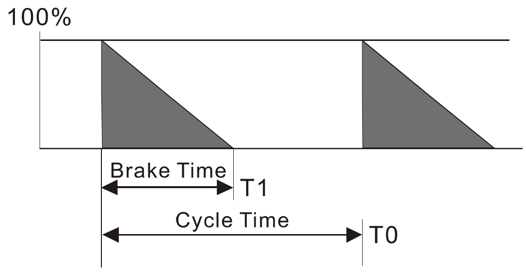
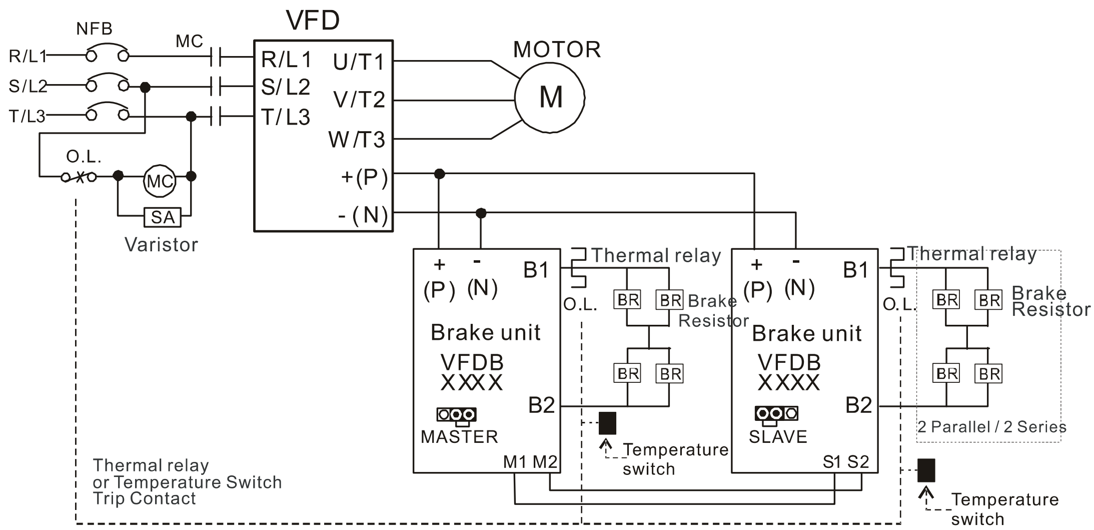


Figure 7-3

ED% = T1/T0 x 100 (%)

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

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



- 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 7-4

3. Any damage to the drive or other equipment caused by using brake resistors and brake units that are not provided by Delta voids the warranty.

4. Consider environmental safety factors when installing the brake resistors. If you use the minimum resistance value, consult your local dealers for the power calculation.

5. 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 user manual thoroughly prior to operation. Visit the following links to get the instruction sheets for the wiring in the brake unit:

   - VFDB2015 / 2022 / 4030 / 4045 / 5055 Braking Modules Instruction Sheet
     http://www.deltaww.com/Products/PluginWebUserControl/downloadCenterCounter.aspx?DID=1574&DocPath=1&hl=zh-TW
   - VFDB4110 / 4160 / 4185 Braking Modules Instruction Sheet
     http://www.deltaww.com/Products/PluginWebUserControl/downloadCenterCounter.aspx?DID=1562&DocPath=1&hl=zh-TW
   - VFDB6055 / 6110 / 6160 / 6200 Braking Modules Instruction Sheet
     http://www.deltaww.com/Products/PluginWebUserControl/downloadCenterCounter.aspx?DID=8594&DocPath=1&hl=zh-TW

6. The selection tables are for normal use. If the AC motor drive requires frequent braking, increase the Watts by two to three times.

7. Thermal Overload Relay (TOR):

Thermal overload relay selection is based on its overload capacity. A standard braking capacity of the CT2000 is 10% ED (Tripping time=10 s). As shown in the graph below, a 460V, 110 kW CT2000 requires the thermal relay to take 260% overload capacity for 10 seconds (hot starting) and the braking current is 126 A. In this case, select a thermal overload relay rated at 50 A. The specification of each thermal relay may vary among different manufacturers. Carefully read the specification before using it.

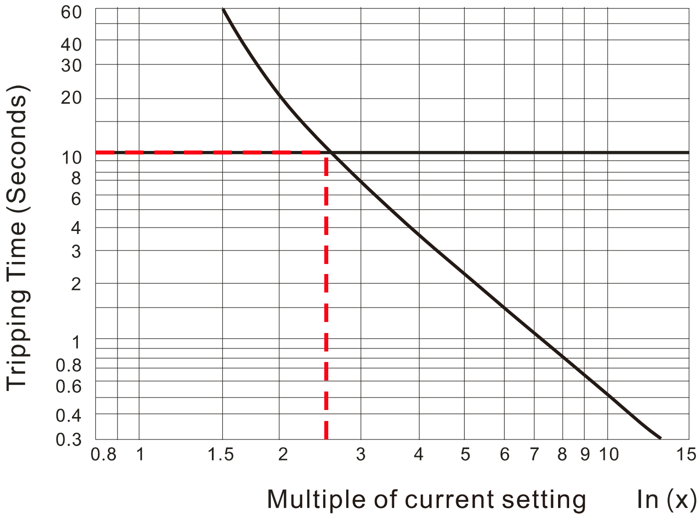


Figure 7-5

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	Models	Light Duty Output Current (A)	Light Duty Input Current (A)	MC / ACB Selection (A)
A	VFD055CT43F21A3	13	16	32
	VFD075CT43F21A3	18	22	40
B	VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	24	26	40
	VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	32	35	55
	VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	38	42	65
C	VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	45	50	75
	VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	60	66	105
	VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	73	80	130
D	VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	91	91	150
	VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	110	110	185
	VFD750CT43F00A6	150	144	265
	VFD900CT43F00A8	180	180	265

Table 7-4

Non-fuse Circuit Breaker

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

The rated current of the non-fuse circuit breaker should be 1.6–2.6 times the drive's rated input current.

NOTE: CT2000-A (plate mounting models) do not have UL certification.

460V, three-phase	
Models	Breaker Rated Input Recommended Current (A)
VFD055CT43F21A3	40
VFD075CT43F21A3	40
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	50
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	60
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	75
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	100
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	125
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	150
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	175
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	250
VFD750CT43F00A6	300
VFD900CT43F00A8	350

Table 7-5

7-3 Fuse Specification Chart

☑ Fuse specifications 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.

NOTE: CT2000-A (plate mounting models) do not have UL certification.

Models	Input Current I (A)		Line Fuse	
	Heavy Duty	Light Duty	I (A)	Bussmann P/N
VFD055CT43F21A3	12	16	40	JJS-30
VFD075CT43F21A3	14	22	40	JJS-40
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	19	26	50	JJS-50
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	25	35	60	JJS-60
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	33	42	75	JJS-75
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	38	50	100	JJS-100
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	45	66	125	JJS-125
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	60	80	150	JJS-150
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	70	91	175	JJS-175
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	96	110	250	JJS-250
VFD750CT43F00A6	108	144	300	JJS-300
VFD900CT43F00A8	149	180	300	JJN-300

Table 7-6

7-4 AC / DC Reactor

AC Input Reactor

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

Installation

Install an AC input reactor in series between the main power and the three input phases R S T, as shown in the figure below:

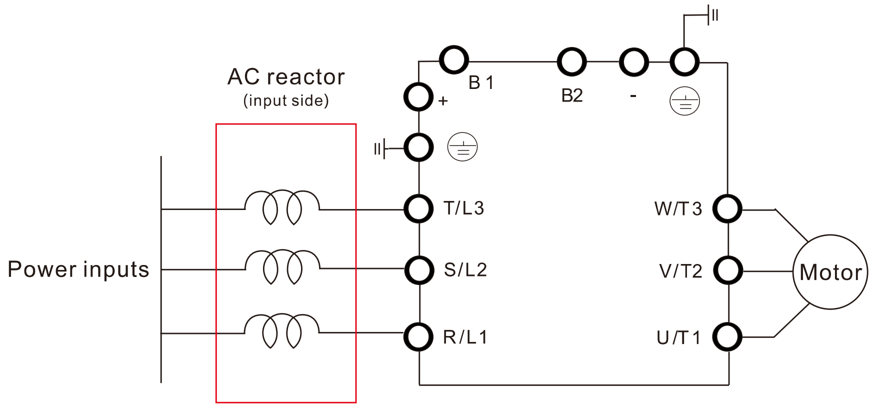


Figure 7-6 Wiring of AC input reactor

Applicable Reactors

380V–460V, 50 / 60 Hz, Light Duty

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissipation (W)
VFD055CT43F21A3	5.5	7.5	13	15.6	2.025	3.375	No	DR012A0202	50
VFD075CT43F21A3	7.5	10	18	21.6	1.35	2.25	No	DR018A0117	54
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	24	28.8	1.01	1.683	No	DR024AP881	60
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	32	38.4	0.76	1.267	No	DR032AP660	80
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	38	45.6	0.639	1.065	No	DR038AP639	85
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	45	54	0.541	0.902	No	DR045AP541	95
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	60	72	0.405	0.675	No	DR060AP405	100
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	73	87.6	0.334	0.557	No	DR073AP334	115
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	45	60	91	109.2	0.267	0.445	Yes	DR091AP267	130
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	55	75	110	132	0.221	0.368	Yes	DR110AP221	150

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissipation (W)
VFD750CT43F00A6	75	100	150	180	0.162	0.27	Yes	DR150AP162	170
VFD900CT43F00A8	90	125	180	216	0.135	0.225	Yes	DR180AP135	190

*Note 1: The inductance value for the above applications of Delta's reactors will be closer, but less than 3%.
Note 2: The above heat dissipation is calculated based on AC reactor's rated current; the actual dissipation varies with the operation current.

Table 7-7

380V–460V, 50 / 60 Hz, Heavy Duty

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissipation (W)
VFD055CT43F21A3	5.5	7.5	9.5	18.9	2.315	3.858	No	DR010A0231	50
VFD075CT43F21A3	7.5	10	11	21.6	2.025	3.375	No	DR012A0202	50
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	17	32.4	1.174	1.957	No	DR018A0117	54
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	23	43.2	0.881	1.468	No	DR024AP881	60
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	30	57.6	0.66	1.101	No	DR032AP660	80
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	36	68.4	0.639	1.066	No	DR038AP639	85
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	43	81	0.541	0.900	No	DR045AP541	95
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	57	108	0.405	0.675	No	DR060AP405	100
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	45	60	69	131.4	0.334	0.555	Yes	DR073AP334	115
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	55	75	86	163.8	0.267	0.445	Yes	DR091AP267	130
VFD750CT43F00A6	75	100	105	198	0.221	0.368	Yes	DR110AP221	150
VFD900CT43F00A8	90	125	143	270	0.162	0.270	Yes	DR150AP162	170

*Note 1: The inductance value for the above applications of Delta's reactors will be closer, but less than 3%.
Note 2: The above heat dissipation is calculated based on AC reactor's rated current; the actual dissipation varies with the operation current.

Table 7-8

AC input reactor dimension and specifications:

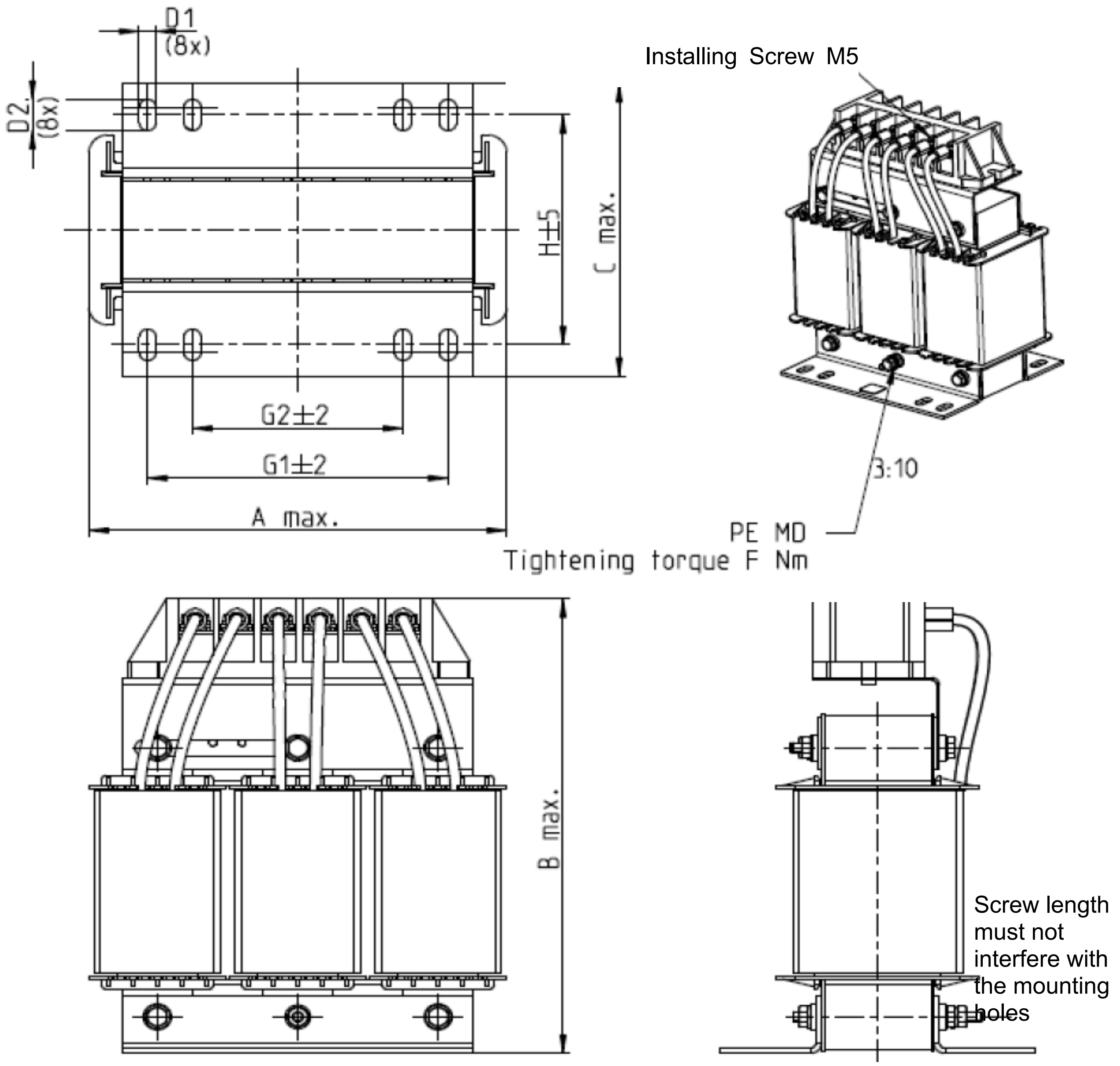


Figure 7-7

Unit: mm

AC Input Reactors Delta part #	A	B	C	D1*D2	H	G1	G2	PE D	F
DR024AP881	160	175	115	6*12	90	107	75	M4	11.2–13.3 kg-cm / (9.7–11.5 lb-in.) / (1.1–1.3 Nm)
DR032AP660	195	200	145	6*12	115	122	85	M6	29.1–32.1 kg-cm / (25.3–27.9 lb-in.) / (2.85–3.15 Nm)
DR038AP639	190	200	145	6*12	115	122	85	M6	
DR045AP541	190	200	145	6*12	115	122	85	M6	

Table 7-9

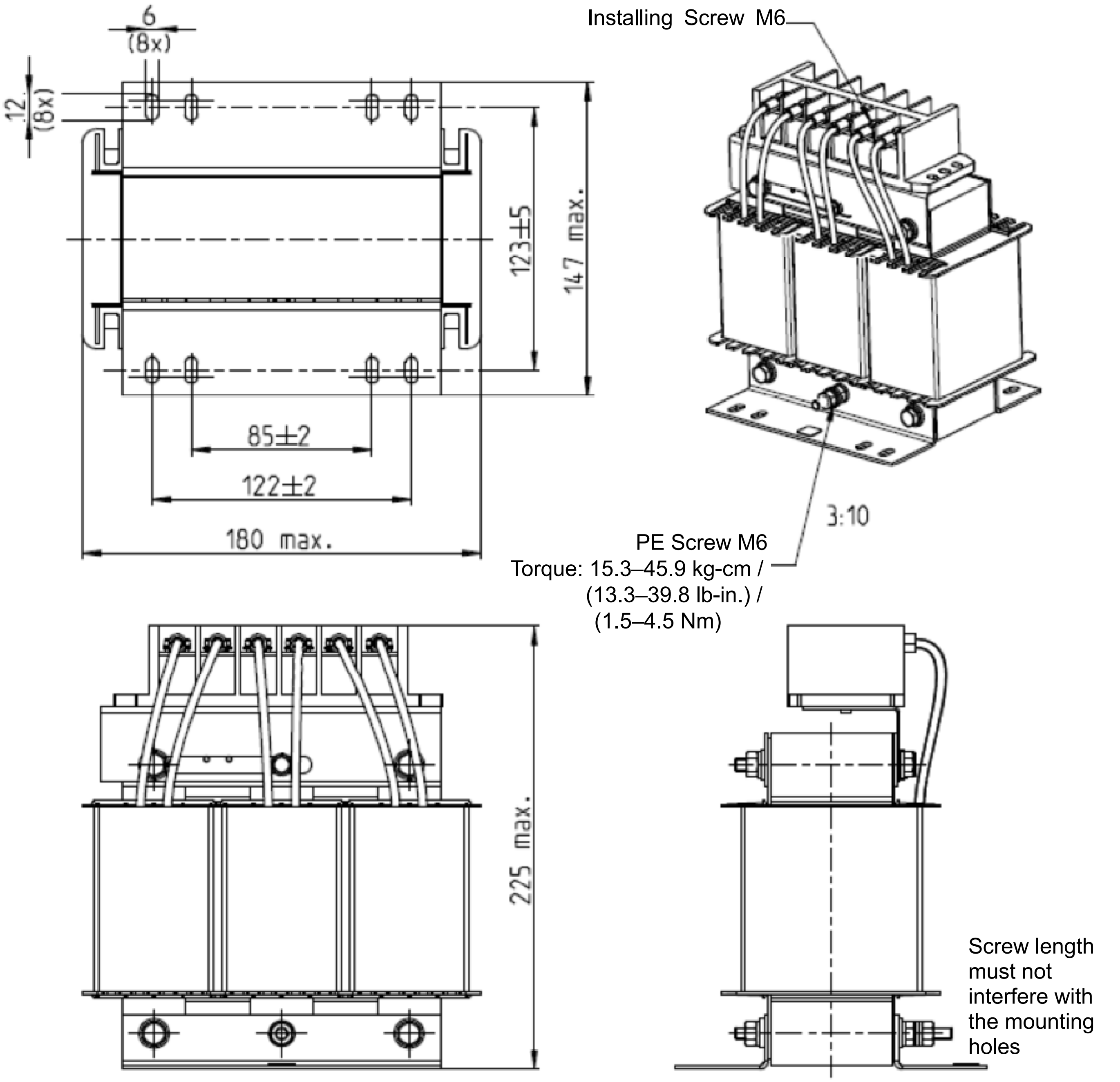


Figure 7-8

Unit: mm

AC Input Reactors Delta part #	Dimensions
DR060AP405	Dimensions are as shown in the figures above.

Table 7-10

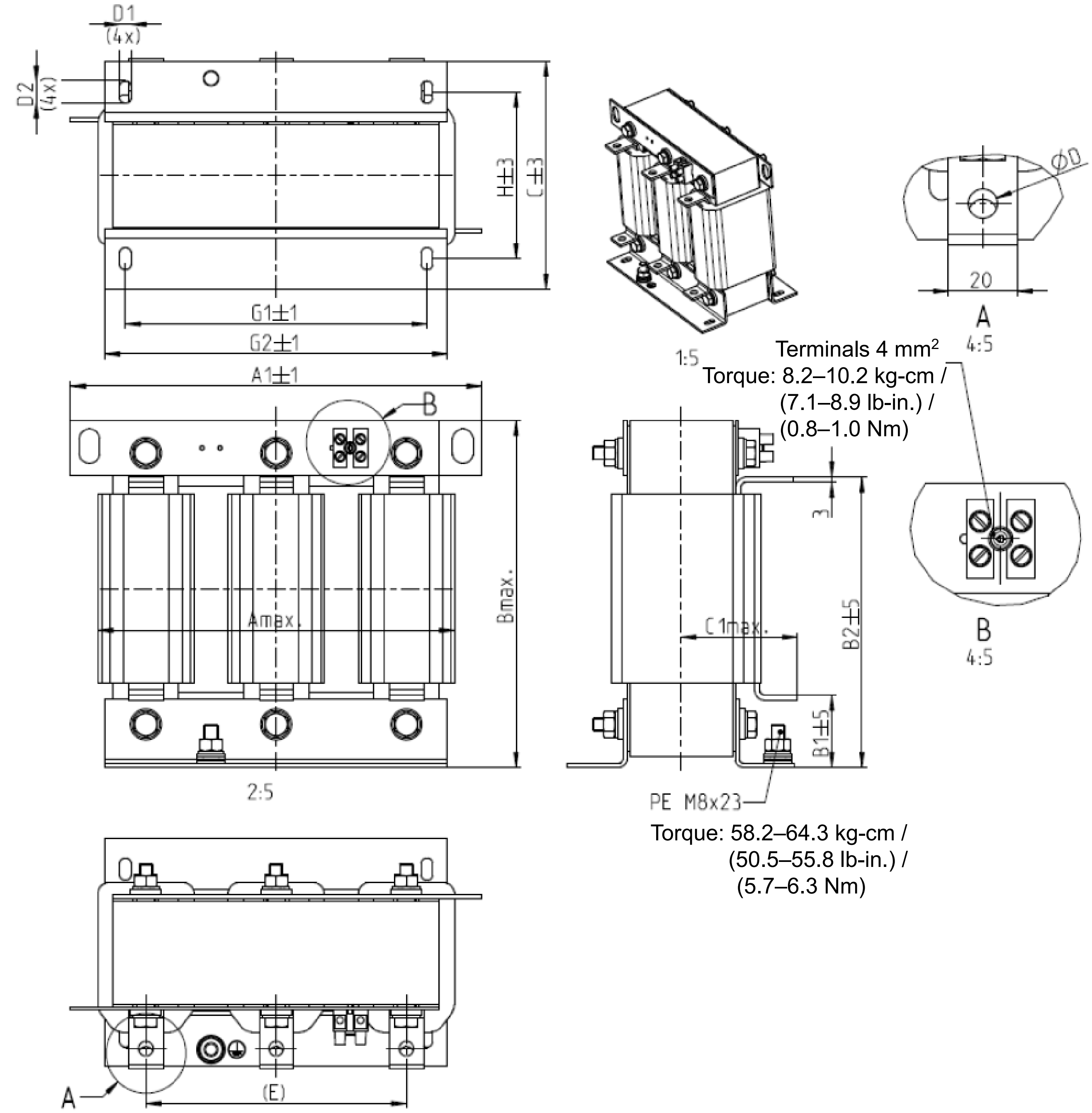


Figure 7-9

Unit: mm

AC Input Reactors Delta part #	A	A1	B	B1	B2	C	C1	D	D1*D2	E	G1	G2	H
DR073AP334	228	240	215	40	170	133	75	8.5	7*13	152	176	200	97
DR091AP267	228	240	245	40	195	133	90	8.8	7*13	152	176	200	97
DR110AP221	228	240	245	40	195	138	95	8.5	7*13	152	176	200	102

Table 7-11

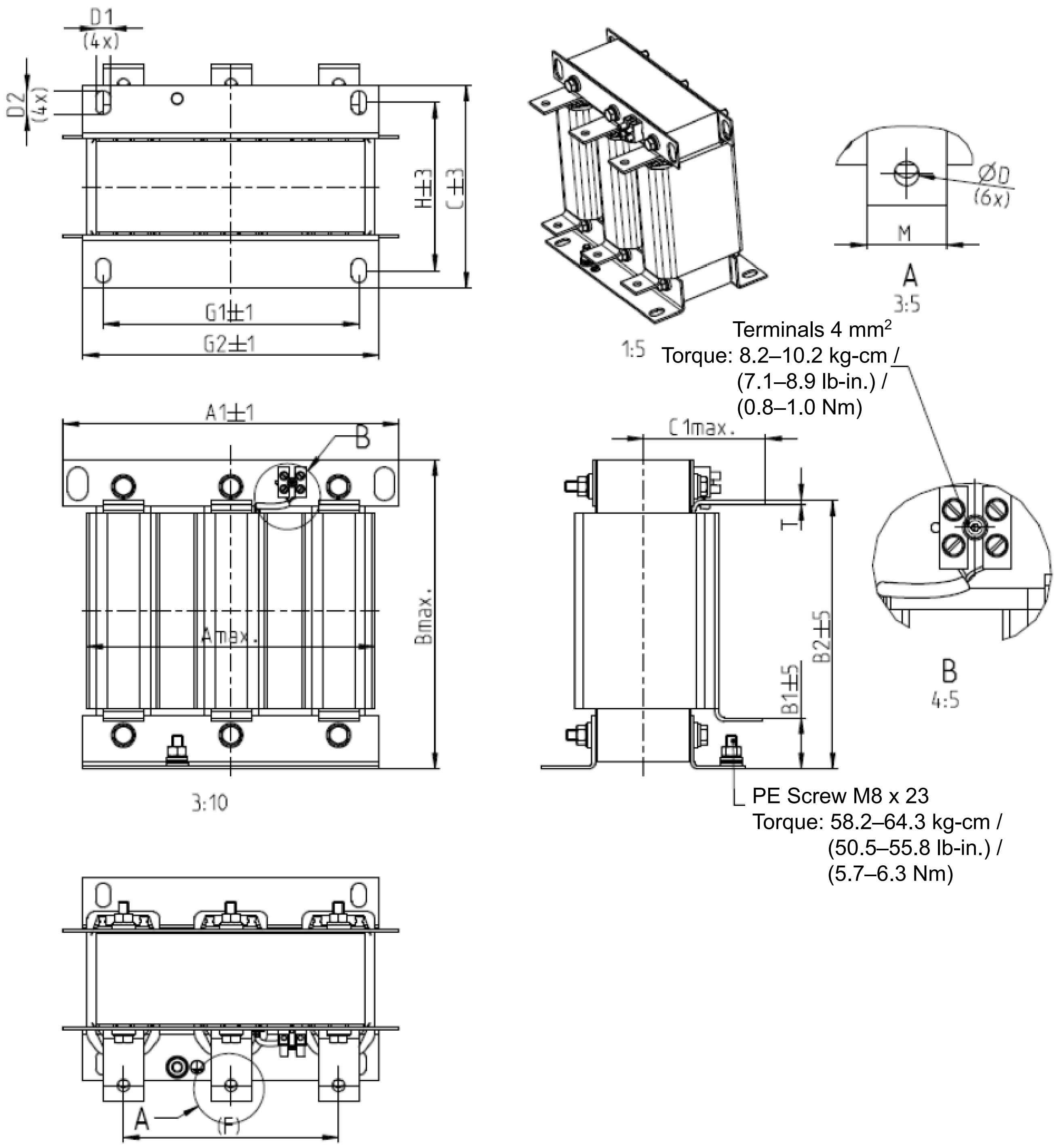


Figure 7-10

Unit: mm

AC Input Reactors Delta part #	A	A1	B	B1	B2	C	C1	D	D1*D2	F	G1	G2	H	M*T
DR150AP162	240	250	245	40	200	151	105	9	11*18	160	190	220	125	20*3
DR180AP135	240	250	245	40	200	151	105	9	11*18	160	190	220	125	20*3

Table 7-12

DC Reactor

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

Installation

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

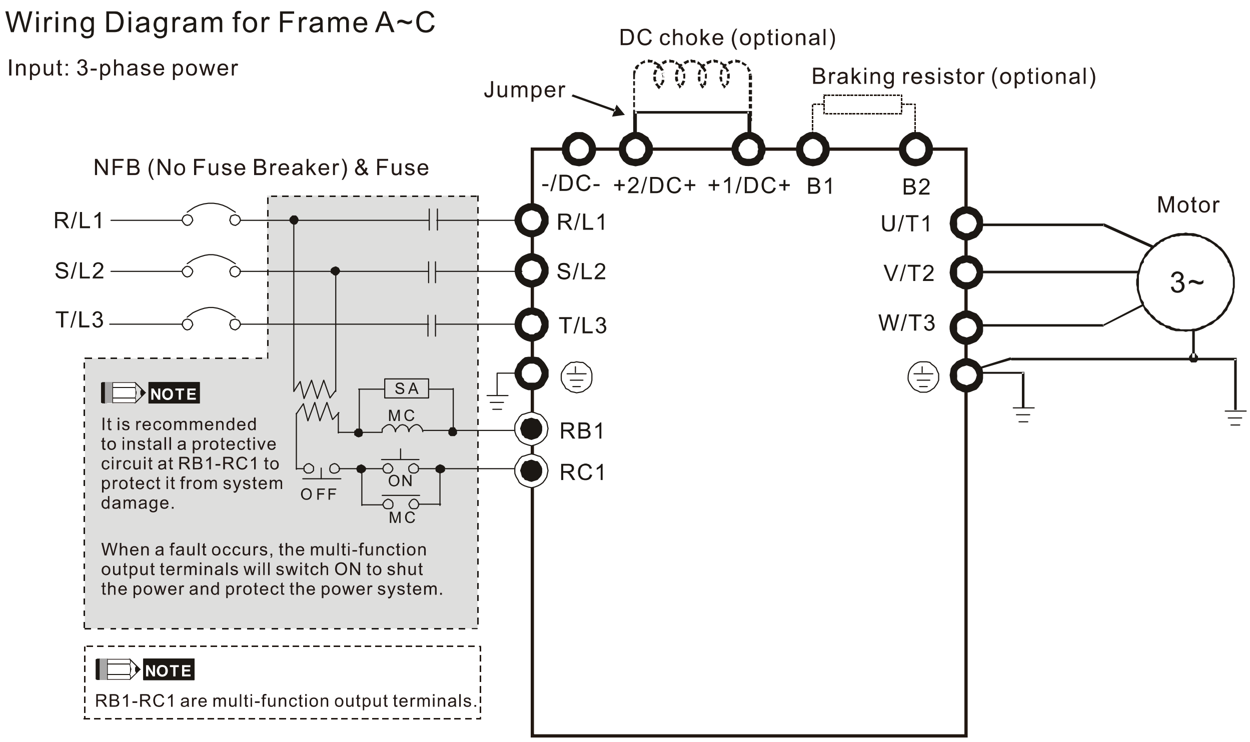


Figure 7-11 Wiring of DC reactor

Applicable Reactors

380V–460V, 50 / 60 Hz

Models	kW	HP	Rated Current (Arms)		Saturation Current (Arms)		DC Reactor (mH)		DC Reactor Delta Part #	
			Heavy Duty	Light Duty	Heavy Duty	Light Duty	Heavy Duty	Light Duty	Heavy Duty	Light Duty
VFD055CT43F21A3	5.5	7.5	9.5	13	17.1	15.6	5.345	4.677	DR010D0534	DR012D0467
VFD075CT43F21A3	7.5	10	11	18	19.8	21.6	4.677	3.119	DR012D0467	DR018D0311
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	17	24	30.6	28.8	3.119	2.338	DR018D0311	DR024D0233
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	23	32	41.4	38.4	2.338	1.754	DR024D0233	DR032D0175
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	30	38	54	45.6	1.754	1.477	DR032D0175	DR038D0147
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	36	45	60.8	54	1.477	1.247	DR038D0147	DR045D0124
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	43	60	77.4	72	1.247	0.935	DR045D0124	DR060DP935
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	57	73	102.6	87.6	0.935	0.768	DR060DP935	Contact Delta

*Note: Use with DR003D1870, but the inductance value will be 3% short

Table 7-13

DC reactor dimension and specifications:

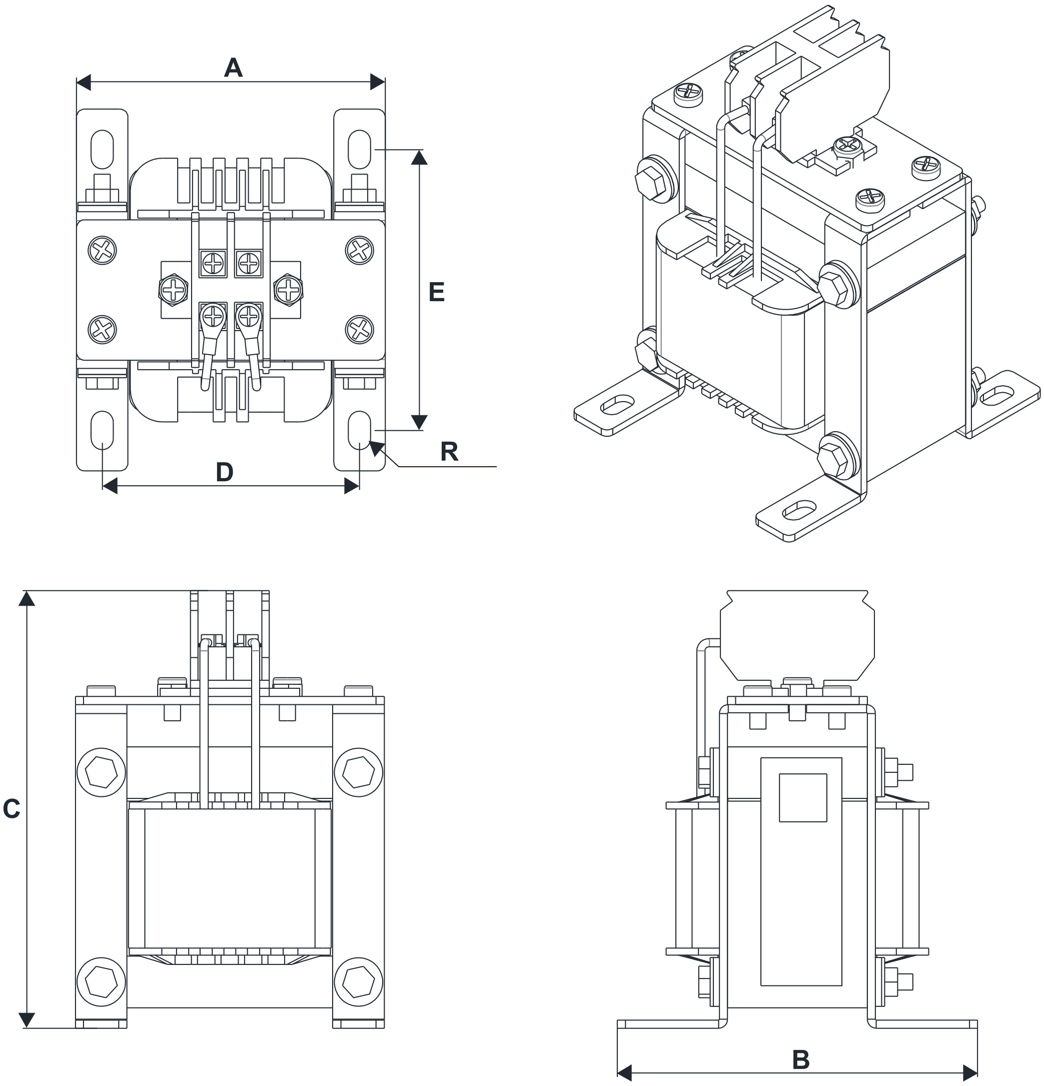


Figure 7-12

DC reactor Delta Part #	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	R (mm)
DR024D0233	117	120	144	95±2	97±2	10*6.5
DR032D0175	117	140	157	95±2	116.5±2	10*6.5
DR038D0147	136	135	172	111±2	112±2	10*6.5
DR045D0124	136	135	173	111±2	112±2	10*6.5
DR060DP935	136	150	173	111±2	127±2	10*6.5

Table 7-14

The table below shows the THDi specification when using Delta's drives to work with AC/DC reactors:

Current Harmonics	Models without built-in DC reactor				Models with built-in DC reactor		
	No AC/DC reactor	3% input AC reactor	5% input AC reactor	4% DC reactor	No AC/DC reactor	3% input AC reactor	5% input AC reactor
5th	73.3%	38.5%	30.8%	25.5%	31.16%	27.01%	25.5%
7th	52.74%	15.3%	9.4%	18.6%	23.18%	9.54%	8.75%
11th	7.28%	7.1%	6.13%	7.14%	8.6%	4.5%	4.2%
13th	0.4%	3.75%	3.15%	0.48%	7.9%	0.22%	0.17%
THDi	91%	43.6%	34.33%	38.2%	42.28%	30.5%	28.4%

Table 7-15

NOTE: The THDi specification listed here may be slightly different from the actual THDi, depending on the installation and environmental conditions (wires, motors).

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

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

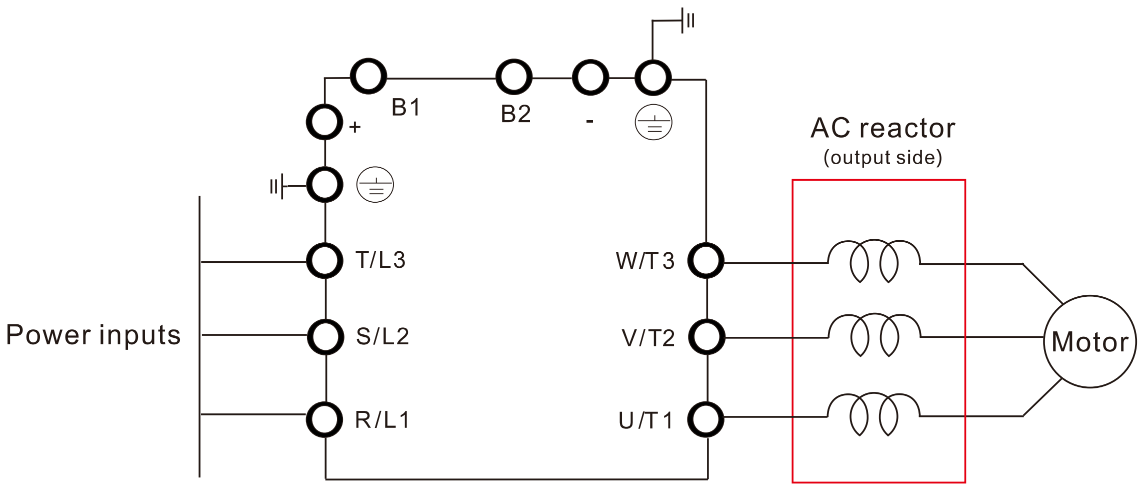


Figure 7-13 Wiring of AC output reactor

Applicable Reactors:

380V–460V, 50 / 60 Hz, Light Duty

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissipation (W)
VFD055CT43F21A3	5.5	7.5	13	15.6	2.025	3.375	No	DR012L0202	45
VFD075CT43F21A3	7.5	10	18	21.6	1.35	2.25	No	DR018L0117	48
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	24	28.8	1.01	1.683	No	DR024LP881	52
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	32	38.4	0.76	1.267	No	DR032LP660	66
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	38	45.6	0.639	1.065	No	DR038LP639	70
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	45	54	0.541	0.902	No	DR045LP541	85
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	60	72	0.405	0.675	No	DR060LP405	85
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	73	87.6	0.334	0.557	No	DR073LP334	110
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	45	60	91	109.2	0.267	0.445	Yes	DR091LP267	130

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissip ation (W)
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	55	75	110	132	0.221	0.368	Yes	DR110LP221	150
VFD750CT43F00A6	75	100	150	180	0.162	0.27	Yes	DR150LP162	175
VFD900CT43F00A8	90	125	180	216	0.135	0.225	Yes	DR180LP135	195
*Note 1: The inductance value for the above applications of Delta's reactors will be closer, but less than 3%. Note 2: The above heat dissipation is calculated based on AC reactor's rated current; the actual dissipation varies with the operation current.									

Table 7-16

380V–460V, 50 / 60 Hz, Heavy Duty

Model	kW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	Built-in DC Reactor	Input AC Reactor Delta Part #	Heat Dissip ation (W)
VFD055CT43F21A3	5.5	7.5	9.5	17.1	2.315	3.858	No	DR010L0231	40
VFD075CT43F21A3	7.5	10	11	19.8	2.025	3.375	No	DR012L0202	45
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	17	30.6	1.174	1.957	No	DR018LP117	48
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	23	41.4	0.881	1.468	No	DR024LP881	52
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	30	54	0.66	1.101	No	DR032LP660	66
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	36	64.8	0.639	1.066	No	DR038LP639	70
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	43	77.4	0.541	0.900	No	DR045LP541	85
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	57	102.6	0.405	0.675	No	DR060LP405	85
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	45	60	69	124.2	0.334	0.555	Yes	DR073LP334	110
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	55	75	86	154.8	0.267	0.445	Yes	DR091LP267	130
VFD750CT43F00A6	75	100	105	189	0.221	0.368	Yes	DR110LP221	150
VFD900CT43F00A8	90	125	143	257.4	0.162	0.270	Yes	DR150LP162	175
*Note 1: The inductance value for the above applications of Delta's reactors will be closer, but less than 3%. Note 2: The above heat dissipation is calculated based on AC reactor's rated current; the actual dissipation varies with the operation current.									

Table 7-17

Motor Cable Length

1. Consequence of leakage current on the motor

If the cable length is too long, the stray capacitance between cables increase and may cause leakage current. In this case, It activates the over-current protection, increases leakage current, or may affect the current display. The worst case is that it may damage the AC motor drive. If more than one motor is connected to one AC motor drive, the total wiring length should be the sum of the wiring length from AC motor drive to each motor.

For the 460V series AC motor drive, when you install an overload thermal relay between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50 m; however, an overload thermal relay malfunction may still occur. To prevent the malfunction, install an output reactor (optional) to the drive or lower the carrier frequency setting (see Pr.00-17 Carrier Frequency).

2. Consequence of the surge voltage on the motor

When a motor is driven by a PWM-type AC motor drive, the motor terminals experience surge voltages (dv/dt) due to power transistor conversion of AC motor drive. When the motor cable is very long (especially for the 460V series), surge voltages (dv/dt) may damage the motor insulation and bearing. To prevent this, follow these rules:

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

Refer to the following tables for the suggested motor shielded cable length. Use a motor with a rated voltage ≤ 500 V_{AC} and insulation level ≥ 1.35 kV in accordance with IEC 60034-17.

Models	kW	HP	Rated Current (Arms)		Without an AC Output Reactor		With an AC Output Reactor	
			Heavy Duty (HD)	Light Duty (LD)	Shielded Cable [meter]	Non-shielded Cable [meter]	Shielded Cable [meter]	Non-shielded Cable [meter]
VFD055CT43F21A3	5.5	7.5	9.5	13	50	75	75	115
VFD075CT43F21A3	7.5	10	11	18	100	150	150	225
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	17	24	100	150	150	225
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	23	32	100	150	150	225
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	30	38	100	150	150	225
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	36	45	100	150	150	225
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	43	60	100	150	150	225
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	57	73	100	150	150	225
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	45	60	69	91	150	225	225	325
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	55	75	86	110	150	225	225	325
VFD750CT43F00A6	75	100	105	150	150	225	225	325
VFD900CT43F00A8	90	125	143	180	150	225	225	325

Table 7-18

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 sine-wave, and motor cable length can be longer than 1000 meters.

Installation

Install a Sine-wave filter in series between the three output phases U V W and the motor, as shown in the figure below:

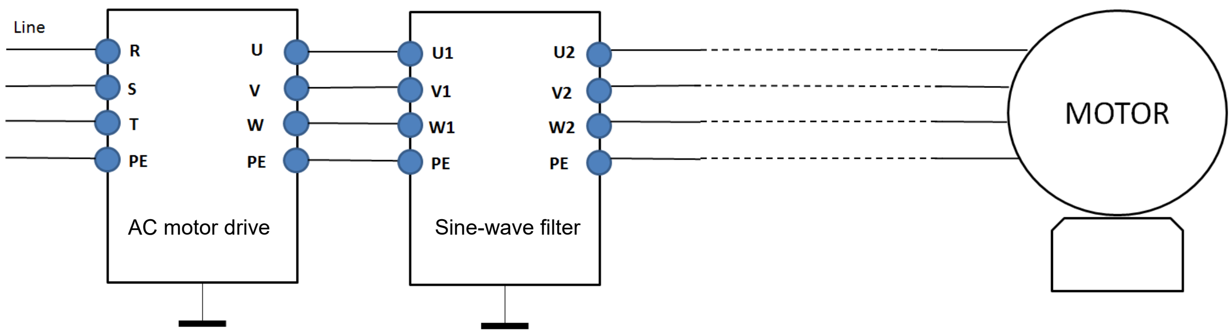


Figure 7-14 Wiring of non-shielded cable

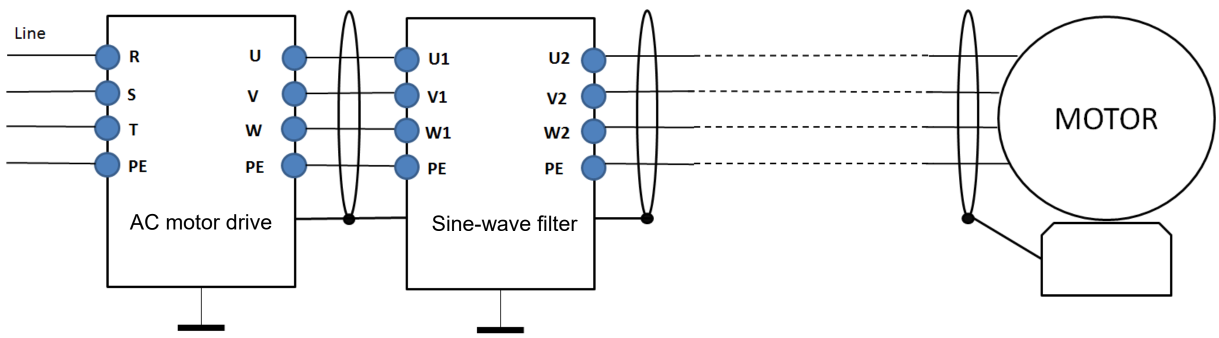


Figure 7-15 Wiring of shielded cable

Applicable Sine-wave Filters:

380V–460V, 50/60 Hz

Models	kW	HP	Rated Current (Arms)		Suggested Sine-wave Filter Part #	Output Cable Length (Shielded or Non-shielded)
			Heavy Duty	Light Duty		
VFD055CT43F21A3	5.5	7.5	9.5	13	B84143V0016R227	1000
VFD075CT43F21A3	7.5	10	11	18	B84143V0025R227	1000
VFD110CT43F21A3 VFD110CT43F00B VFD110CT43A21C	11	15	17	24	B84143V0025R227	1000
VFD150CT43F21A3 VFD150CT43F00B VFD150CT43A21C	15	20	23	32	B84143V0033R227	1000

Models	kW	HP	Rated Current (Arms)		Suggested Sine-wave Filter Part #	Output Cable Length (Shielded or Non-shielded)
			Heavy Duty	Light Duty		
VFD185CT43F21A3 VFD185CT43F00B VFD185CT43A21C	18.5	25	30	38	B84143V0050R227	1000
VFD220CT43F21A3 VFD220CT43F00B VFD220CT43A21C	22	30	36	45	B84143V0050R227	1000
VFD300CT43F21A3 VFD300CT43F00B VFD300CT43A21C	30	40	43	60	B84143V0066R227	1000
VFD370CT43F21A7 VFD370CT43F00B VFD370CT43A21C	37	50	57	73	B84143V0075R227	1000
VFD450CT43F00A3 VFD450CT43F00B VFD450CT43A00C	45	60	69	91	B84143V0095R227	1000
VFD550CT43F00A4 VFD550CT43F00B VFD550CT43A00C	55	75	86	110	B84143V0132R227	1000
VFD750CT43F00A6	75	100	105	150	B84143V0180R227	1000
VFD900CT43F00A8	90	125	143	180	B84143V0180R227	1000

Table 7-19

Sine wave filter part #	Please refer to 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
B84143V0250R227	I_R:250A, Sine-wave output filters for 3-phase systems
B84143V0320R227	I_R:320A, Sine-wave output filters for 3-phase systems

Table 7-20

7-5 Zero Phase Reactors

Reactor Model*	Recommended Wire Size		Wiring Method	Max. Wiring Q'ty	Applicable Model
RF008X00A	≤ 8 AWG	≤ 8.37 mm^2	Diagram A	1C*3 or 4C*1	VFD055CT43xxxxx VFD075CT43xxxxx
T60006L2040W453	≤ 8 AWG	≤ 8.37 mm^2	Diagram B		
RF004X00A	≤ 1 AWG	≤ 42.41 mm^2	Diagram A	1C*3 or 4C*1	VFD110CT43xxxxx VFD150CT43xxxxx VFD185CT43xxxxx
T60006L2050W565	≤ 1 AWG	≤ 42.41mm^2	Diagram B		
RF002X00A	≤ 600 MCM	≤ 304 mm^2	Diagram A	1C*3 or 4C*1	VFD220CT43xxxxx VFD300CT43xxxxx VFD370CT43xxxxx
T60006L2160V066	≤ 600 MCM	≤ 304 mm^2	Diagram B		
RF300X00A	≤ 350 MCM	≤ 185 mm^2	Diagram A	1C*12 or 4C*3	VFD450CT43xxxxx VFD550CT43xxxxx VFD750CT43xxxxx VFD900CT43xxxxx

Table 7-21

NOTE:
1. Mark * means that motor cable is a 600V insulated power cable.
2. The table above only considers the motor cable size
3. For the max. wiring quantity, refer to Chapter 5 Main Circuit Terminal.

Diagram A

Put all wires through at least one core without winding.

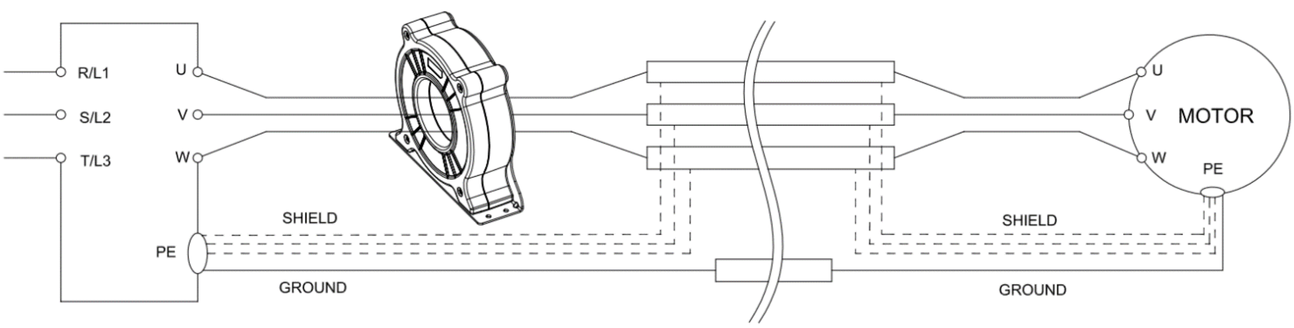


Figure 7-16

Diagram B

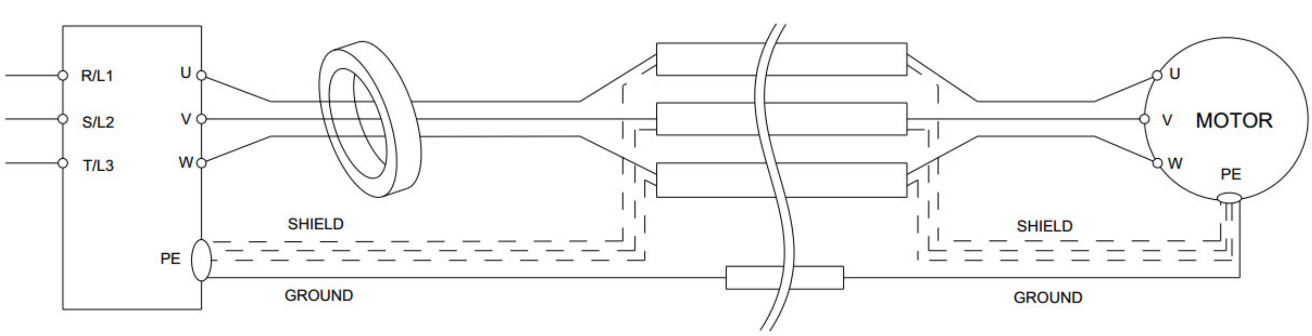


Figure 7-17

NOTE:

1. The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and diameter of cable fitted, i.e. the cable must fit through the center hole of zero phase reactors.
2. Only the phase conductors should pass through, not the earth core or screen.
3. For the zero phase reactor used for signal cables, it is recommended to install near to the driver and well fixed, as to prevent vibration and pulling of the cable.

Model*	Recommended wire size	Wiring method	Q'ty	Applicable cables
T60006L2050W565	≤ 1 AWG	Diagram D	1	D-sub
T60006L2040W453	≤ 8 AWG	Diagram C	1	Category 5e shielding、Shielded twisted pair cable、CAN standard cable (TAP-CB05, TAP-CB10)
T60004L2025W622	≤ 10AWG	Diagram E	1	PG card signal cable
T60004L2016W620	≤ 12AWG	Diagram E	1	PG card signal cable

Table 7-22

NOTE:

1. Mark * means that the table above is for reference only, select the zero phase reactor based on the actual wire size that you are using.
2. Some of the cables are recommended to choose bigger zero phase reactor due to its corresponded mechanical size.

Diagram C

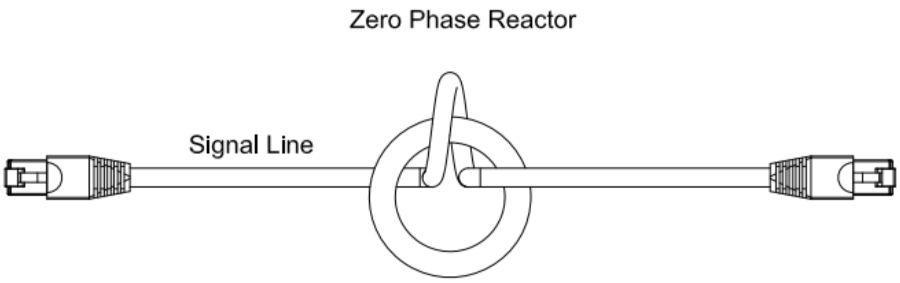


Figure 7-18

Diagram D

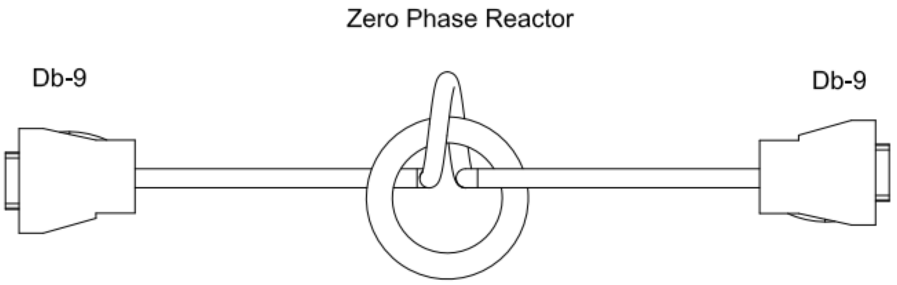


Figure 7-19

Diagram E

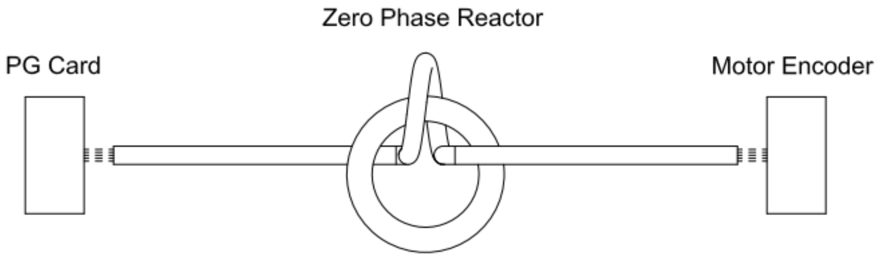


Figure 7-20

NOTE:

1. The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and diameter of cable fitted, i.e. the cable must fit through the center hole of zero phase reactors.
2. Only the phase conductors should pass through, not the earth core or screen.
3. For the zero phase reactor used for signal cables, it is recommended to install near to the driver and well fixed, as to prevent vibration and pulling of the cable.

Recommended max. motor cable size of zero phase reactor (included LUG width and temperature tolerance of motor cable)

Zero phase reactor	Available max. wire size/ LUG width	Available max. AGW (1C*3)		Available max. AWG (4C*1)	
		75C	90C	75C	90C
RF008X00A	13 mm	3 AWG	1 AWG	3 AWG	1 AWG
RF004X00A	16 mm	1 AWG	2/0 AWG	1 AWG	1/0 AWG
RF002X00A	36 mm	600 MCM	600 MCM	1 AWG	1/0 AWG
RF300X00A	73 mm	650 MCM	650 MCM	300 MCM	300 MCM
T60006L2040W453	11 mm	9 AWG	4 AWG	6 AWG	6 AWG
T60006L2050W565	16 mm	1 AWG	2/0 AWG	1 AWG	1/0 AWG
T60006L2160V066	57 mm	600 MCM	600 MCM	300 MCM	300 MCM

Table 7-23

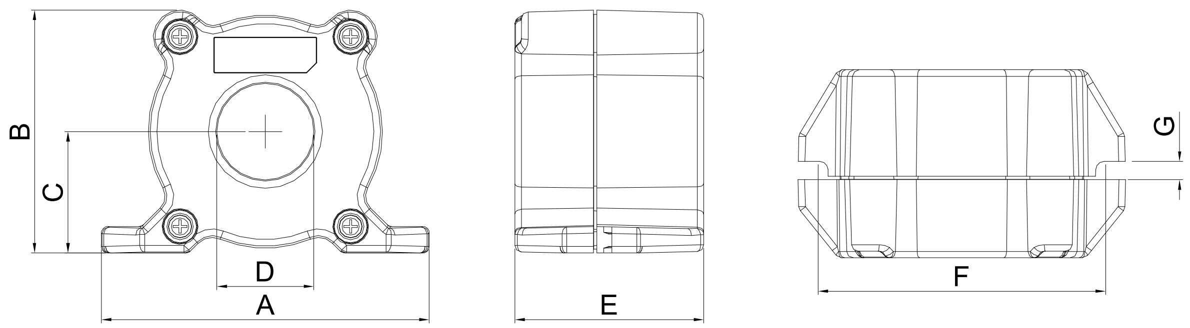


Figure 7-21

Unit: mm (inch)

Model	A	B	C	D	E	F	G(Ø)	Torque
RF008X00A	98 (3.858)	73 (2.874)	36.5 (1.437)	29 (1.142)	56.5 (2.224)	86 (3.386)	5.5 (0.217)	< 10 kgf/cm^2
RF004X00A	110 (4.331)	87.5 (3.445)	43.5 (1.713)	36 (1.417)	53 (2.087)	96 (3.780)	5.5 (0.217)	< 10 kgf/cm^2

Table 7-24

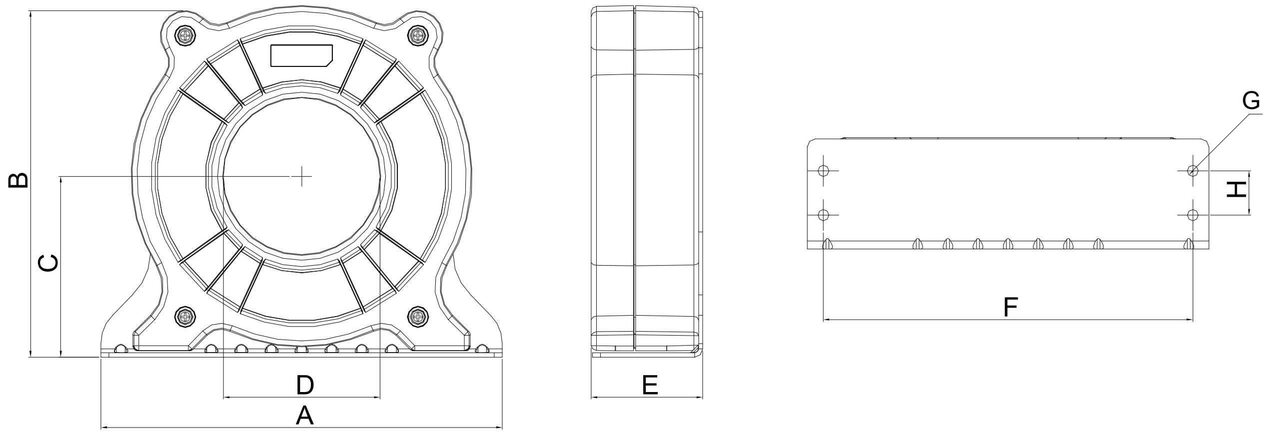


Figure 7-22

Unit: mm (inch)

Model	A	B	C	D	E	F	G(Ø)	H	Torque
RF002X00A	200 (7.874)	172.5 (6.791)	90 (3.543)	78 (3.071)	55.5 (2.185)	184 (7.244)	5.5 (0.217)	22 (0.866)	<45 kgf/cm^2

Table 7-25

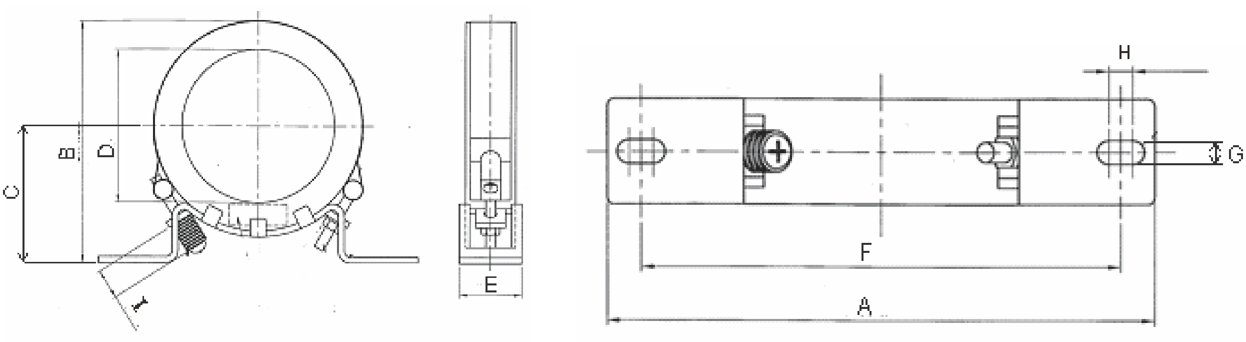


Figure 7-23

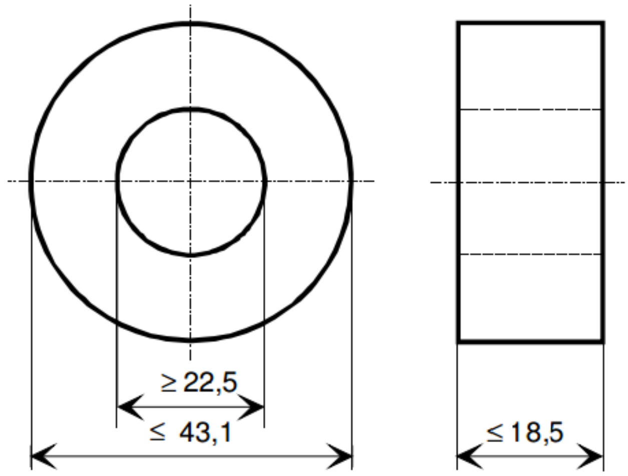
Unit: mm (inch)

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

Table 7-26

Magnetic Ring

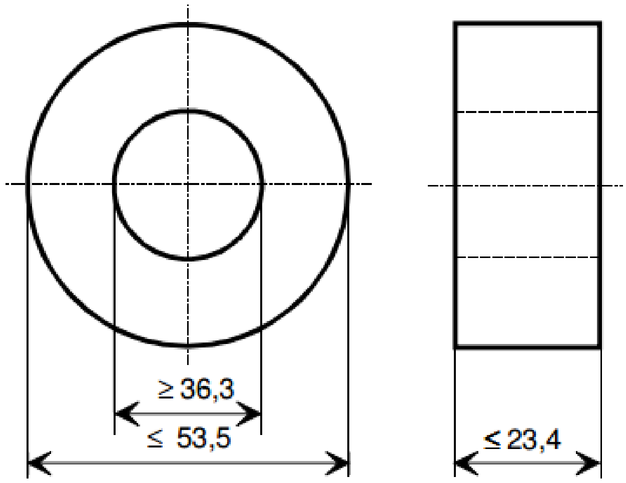
Model number: T60006-L2040-W453



Unit: mm

Figure 7-24

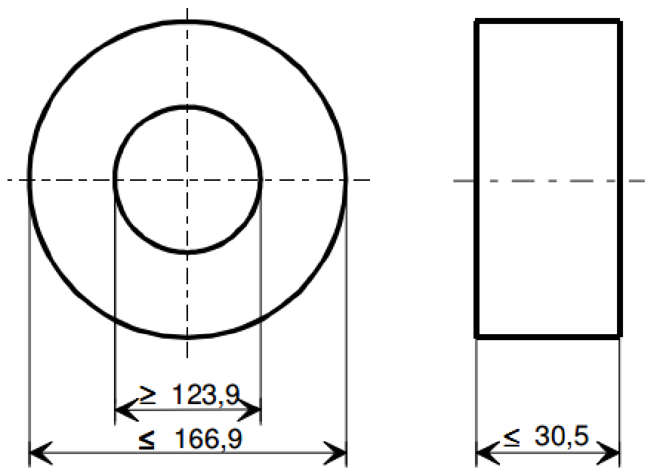
Model number: T60006-L2050-W565



Unit: mm

Figure 7-25

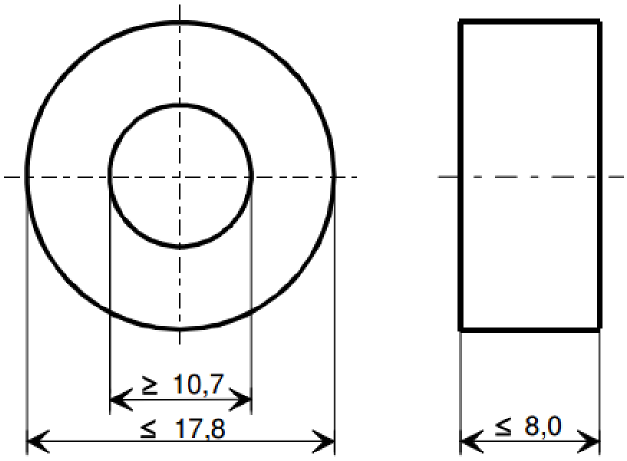
Model number: T60006-L2160-V066



Unit: mm

Figure 7-26

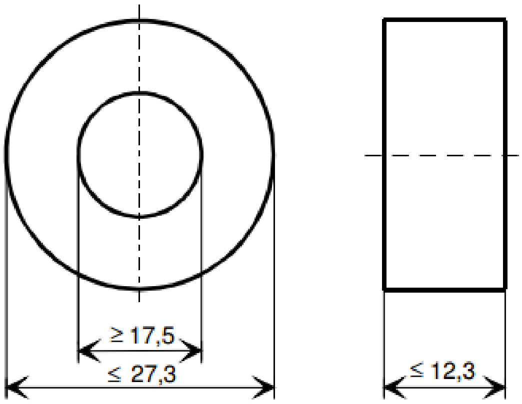
Model number: T60004-L2016-W620



Unit: mm

Figure 7-27

Model number: T60004-L2025-W622



Unit: mm

Figure 7-28

7-6 EMC Filter

Following table is the external EMC filter of AC motor drives, 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 input side.

<table>
<tr><th colspan="3">CT2000</th><th rowspan="3">Filter model name</th><th colspan="2">Zero phase reactor</th><th rowspan="3">Fc</th><th colspan="2">Conducted Emission (CE)</th><th>Radiation Emission (RE)</th></tr>
<tr><th rowspan="2">Frame</th><th rowspan="2">Models</th><th rowspan="2">Rated input current (A)</th><th rowspan="2">Input side (R / S / T)</th><th rowspan="2">Output side (U / V / W)</th><th colspan="2">Output shielded cable length</th><th rowspan="2">EN61800-3</th></tr>
<tr><th>C1</th><th>C2</th></tr>
<tr><td rowspan="2">A</td><td>VFD055CT43F21A3</td><td>16</td><td rowspan="4">EMF039A43A</td><td rowspan="2">RF008X00A</td><td rowspan="2">RF008X00A</td><td rowspan="5">≤8 kHz</td><td rowspan="12">50 m</td><td rowspan="12">100 m</td><td rowspan="12">C2</td></tr>
<tr><td>VFD075CT43F21A3</td><td>22</td></tr>
<tr><td rowspan="3">B</td><td>VFD110CT43F21A3
VFD110CT43F00B
VFD110CT43A21C</td><td>26</td><td rowspan="3">RF004X00A</td><td rowspan="3">RF004X00A</td></tr>
<tr><td>VFD150CT43F21A3
VFD150CT43F00B
VFD150CT43A21C</td><td>35</td></tr>
<tr><td>VFD185CT43F21A3
VFD185CT43F00B
VFD185CT43A21C</td><td>42</td><td rowspan="3">KMF370A</td></tr>
<tr><td rowspan="3">C</td><td>VFD220CT43F21A3
VFD220CT43F00B
VFD220CT43A21C</td><td>50</td><td rowspan="7">N/A</td><td rowspan="7">RF002X00A</td><td rowspan="7">≤6 kHz</td></tr>
<tr><td>VFD300CT43F21A3
VFD300CT43F00B
VFD300CT43A21C</td><td>66</td></tr>
<tr><td>VFD370CT43F21A7
VFD370CT43F00B
VFD370CT43A21C</td><td>80</td><td rowspan="4">B84143D0150R127</td></tr>
<tr><td rowspan="4">D</td><td>VFD450CT43F00A3
VFD450CT43F00B
VFD450CT43A00C</td><td>91</td></tr>
<tr><td>VFD550CT43F00A4
VFD550CT43F00B
VFD550CT43A00C</td><td>110</td></tr>
<tr><td>VFD750CT43F00A6</td><td>144</td></tr>
<tr><td>VFD900CT43F00A8</td><td>180</td><td>B84143D0150R127</td></tr>
</table>

Table 7-27

Zero phase reactor installation position diagram:

1* Install at the cable between the power supply and the EMC filter

2* Install at the cable between the EMC filter and the drive

3* Install at the cable between the drive and the motor

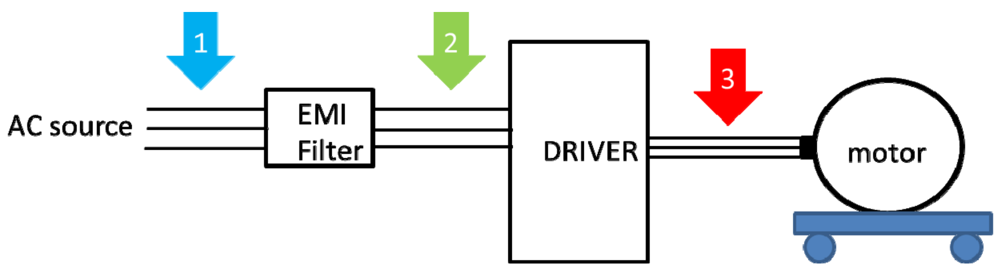


Figure 7-29

EMC Filter Dimension

Model name: EMF021A23A, EMF014A43A

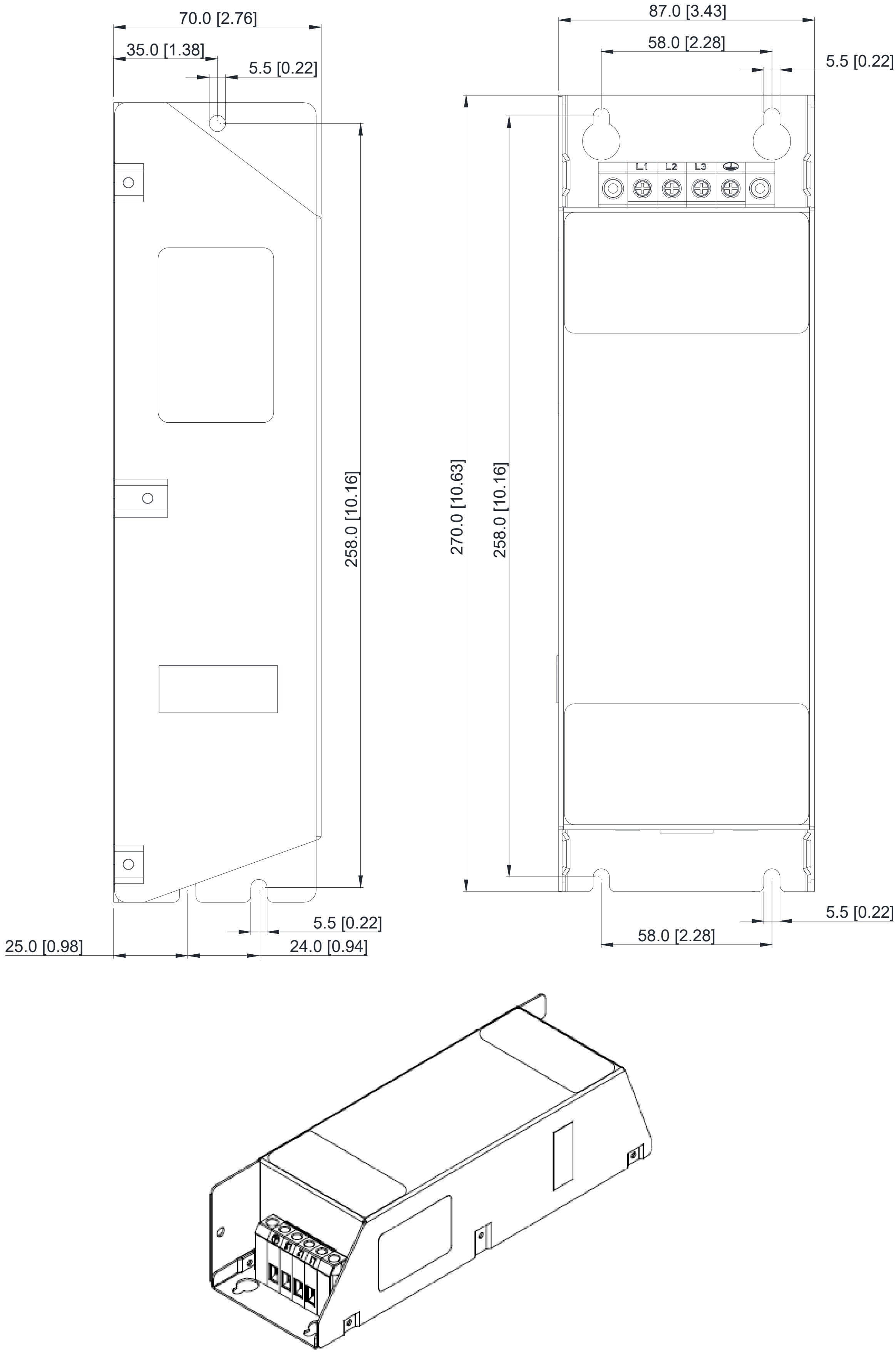


Figure 7-30

Model name: EMF018A43A, EMF014A63A, EMF027A63A

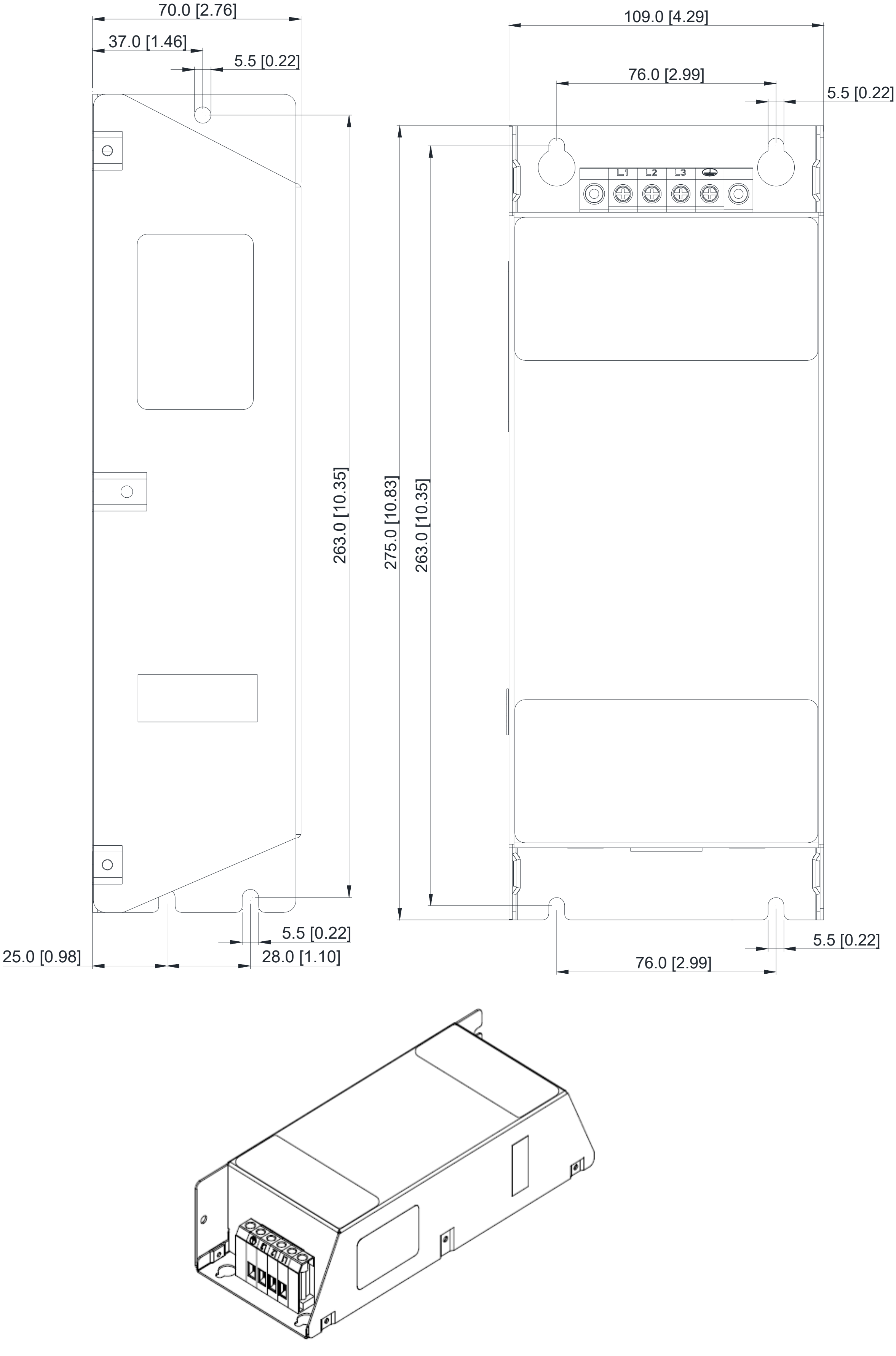


Figure 7-31

Model name: EMF056A23A, EMF039A43A

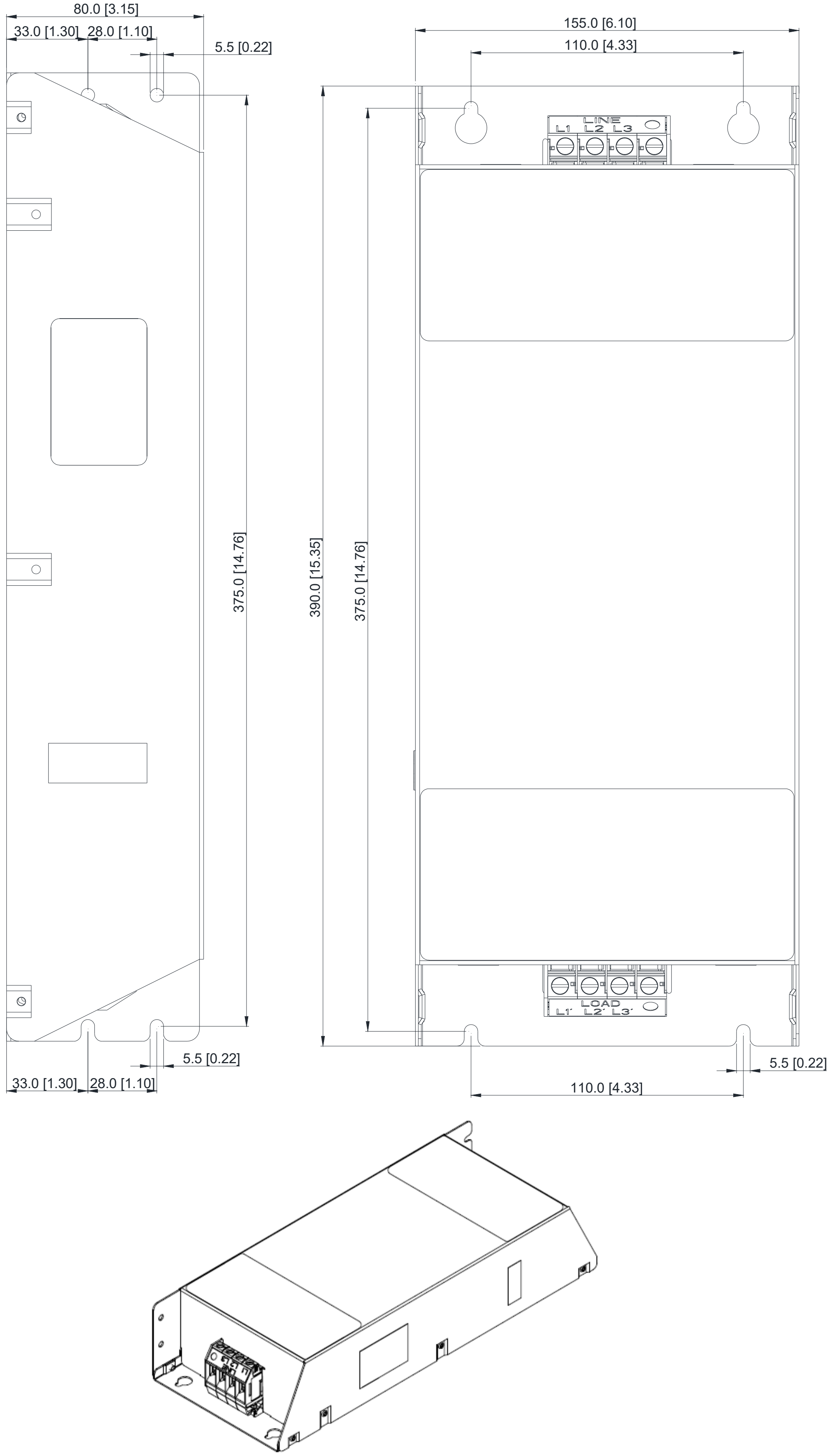
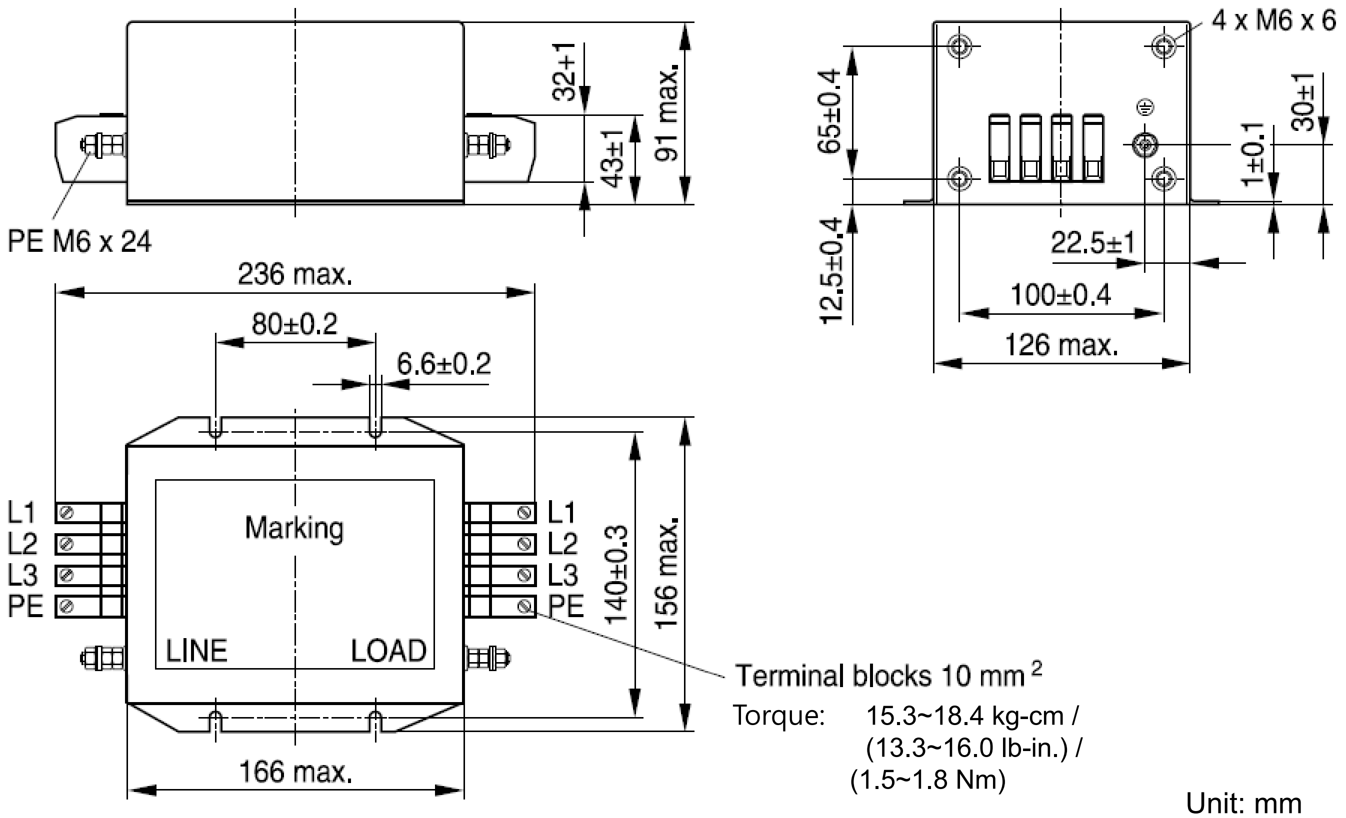


Figure 7-32

Model name: B84143A0050R021

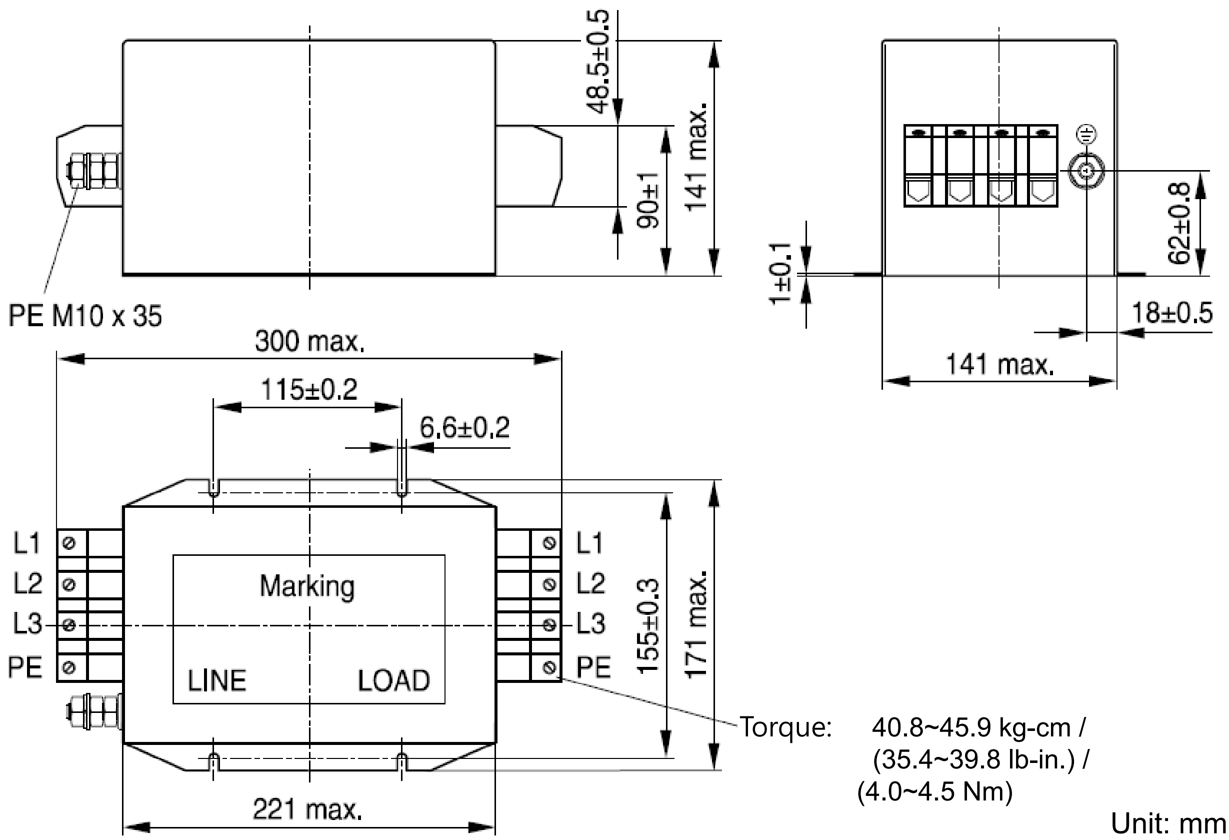


Torque: 15.3~18.4 kg-cm / (13.3~16.0 lb-in.) / (1.5~1.8 Nm)

Unit: mm

Figure 7-33

Model name: B84143A0080R021



Torque: 40.8~45.9 kg-cm / (35.4~39.8 lb-in.) / (4.0~4.5 Nm)

Unit: mm

Figure 7-34

Model name: B84143A0120R105

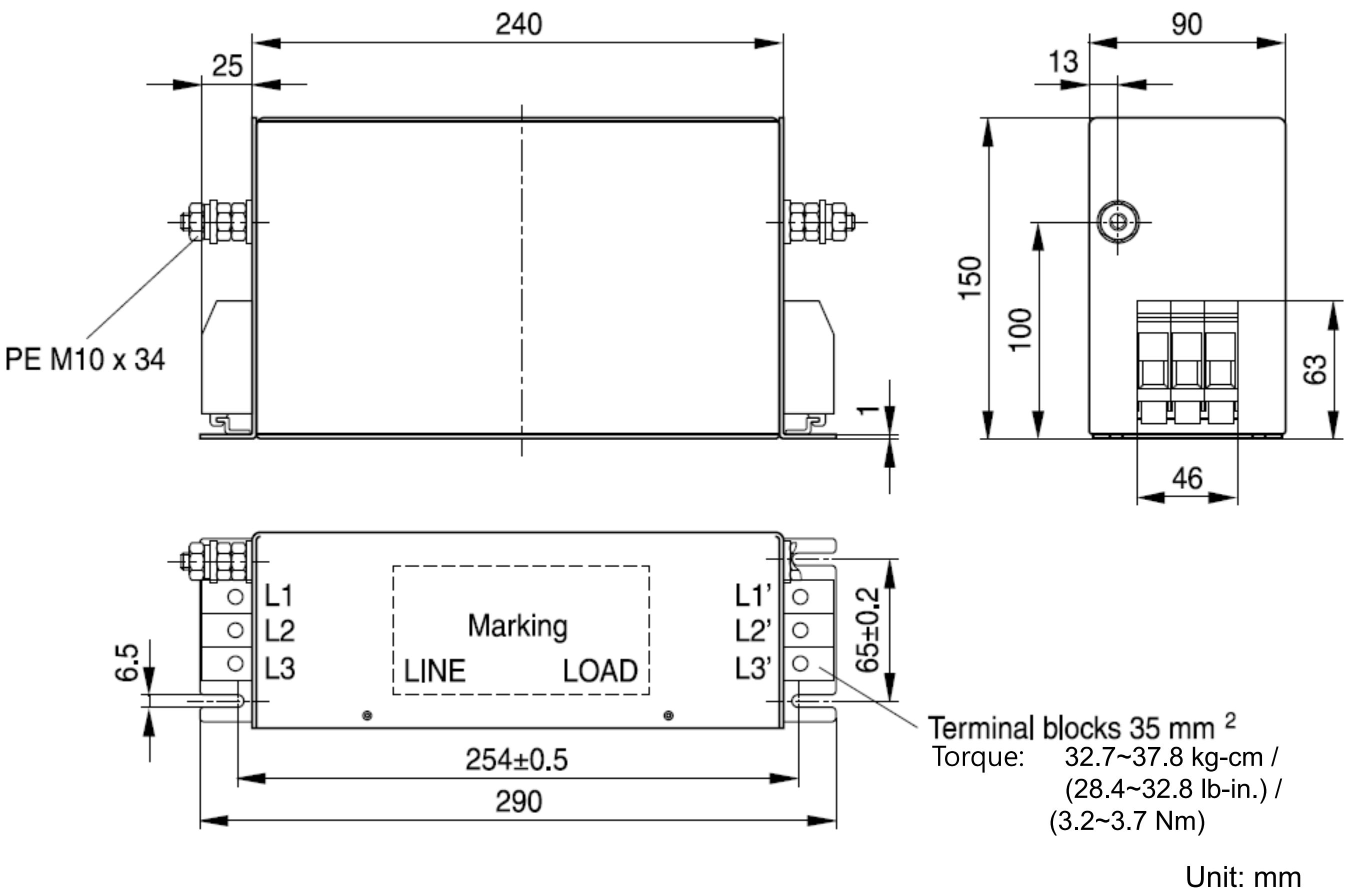


Figure 7-35

Model name: B84143B0120R110

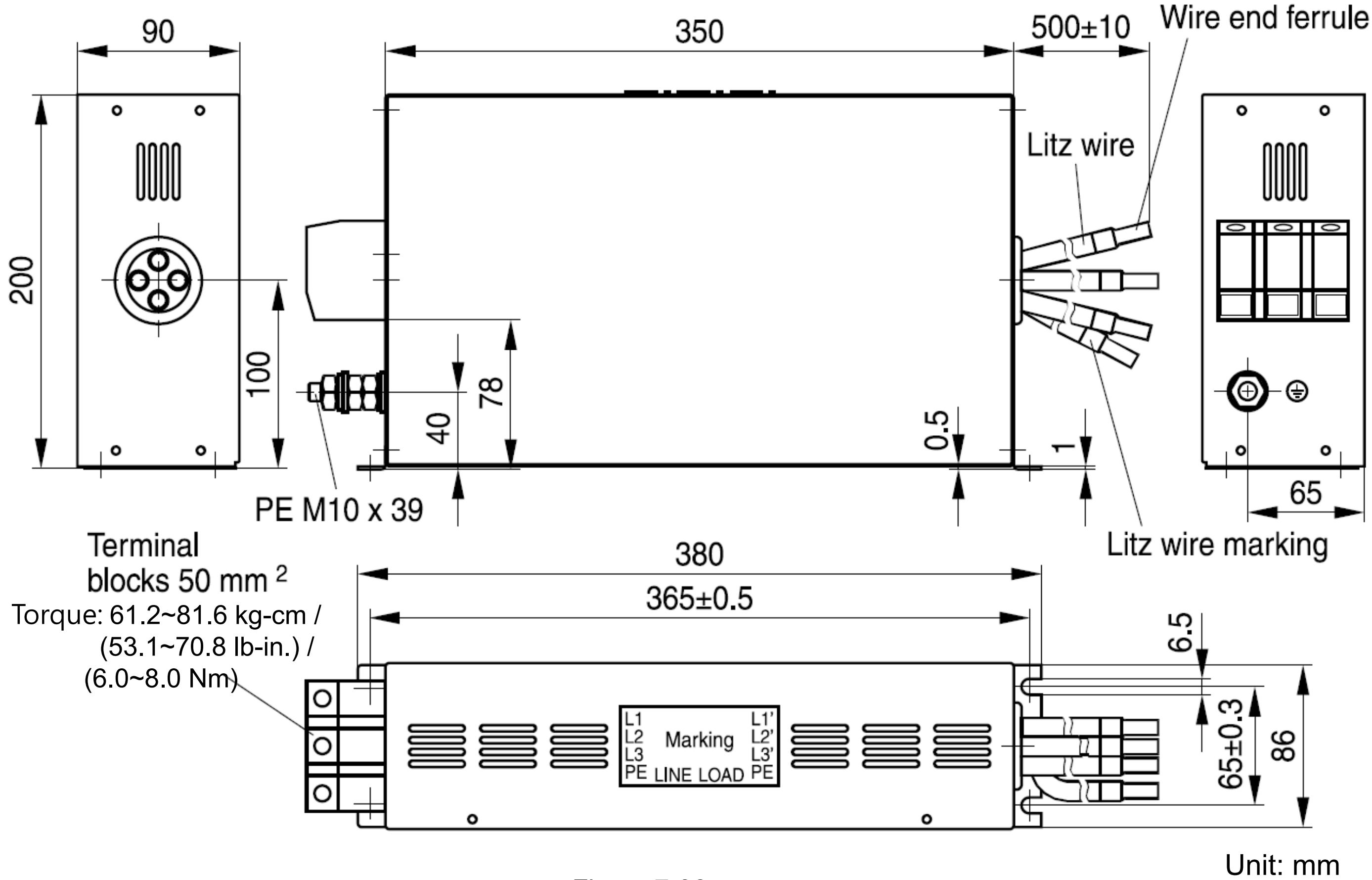


Figure 7-36

Model name: B84143B0150S021, B8414B0180S020

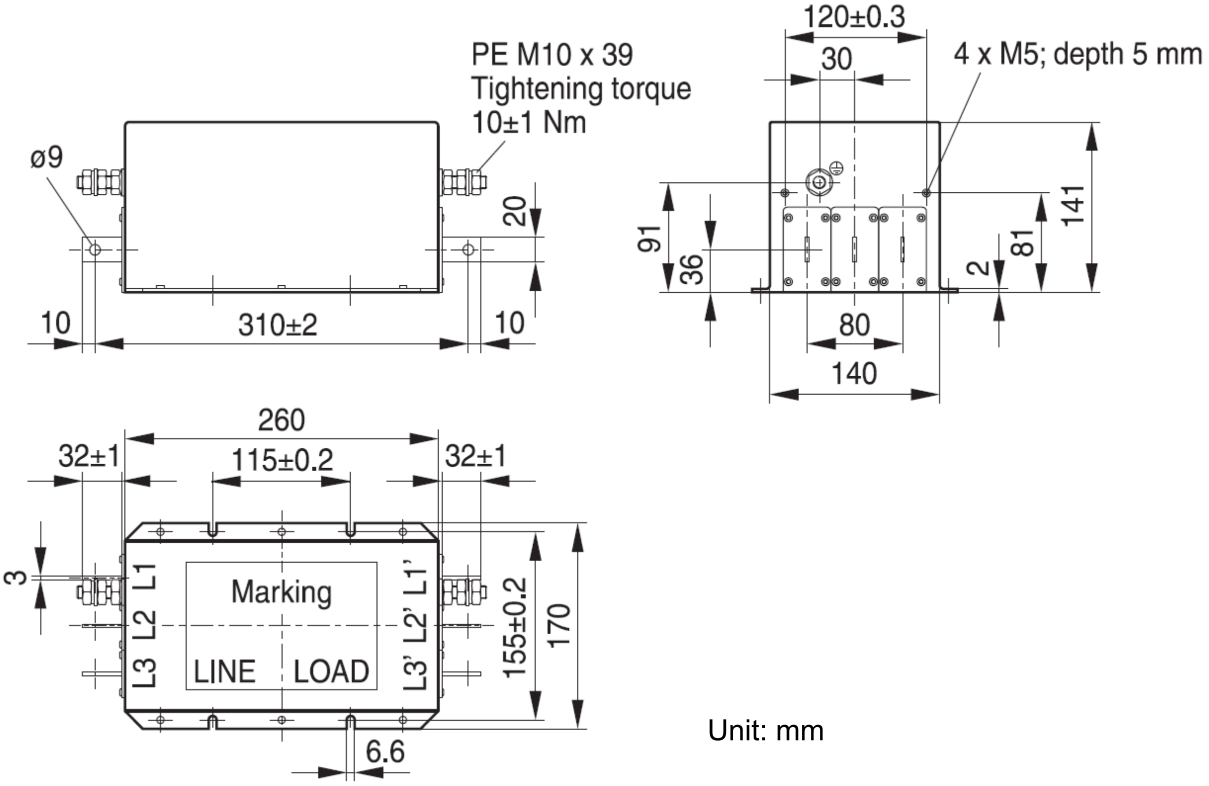


Figure 7-37

Model name: B84143B0180S080, B84143B0250S080

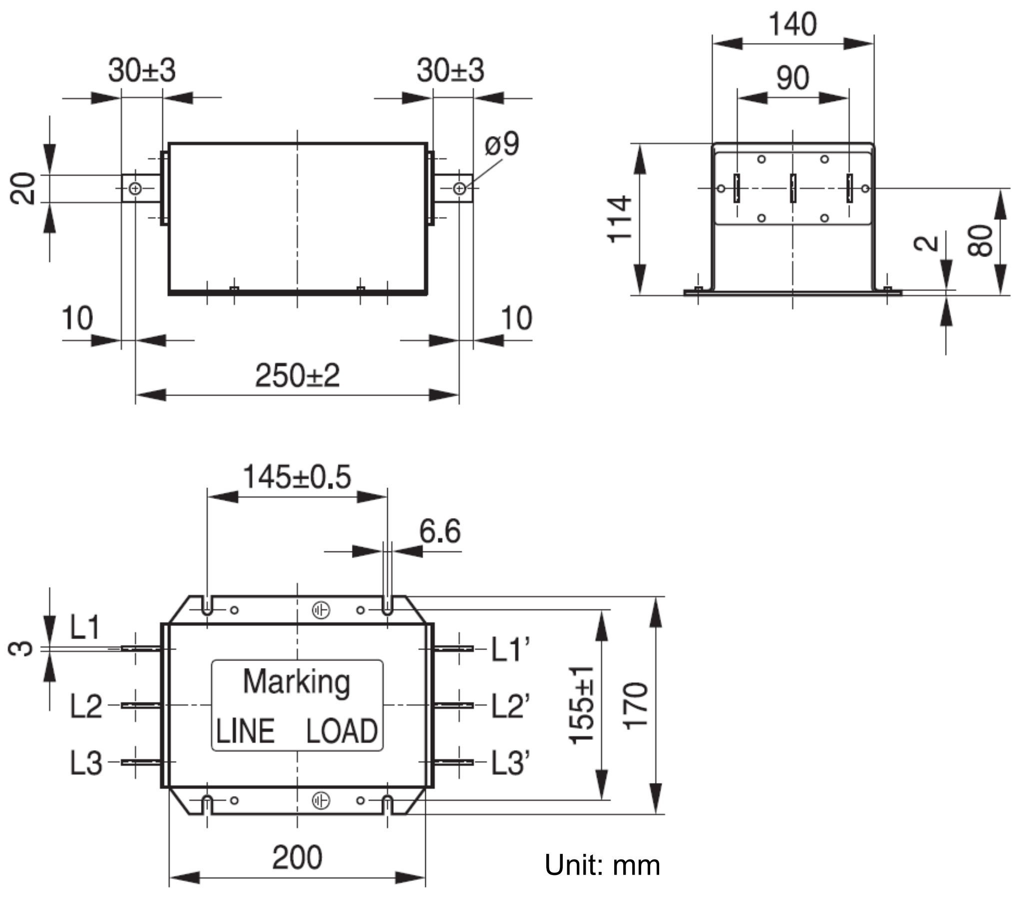


Figure 7-38

Model name: B84143B0250S020, B84143B0250S021

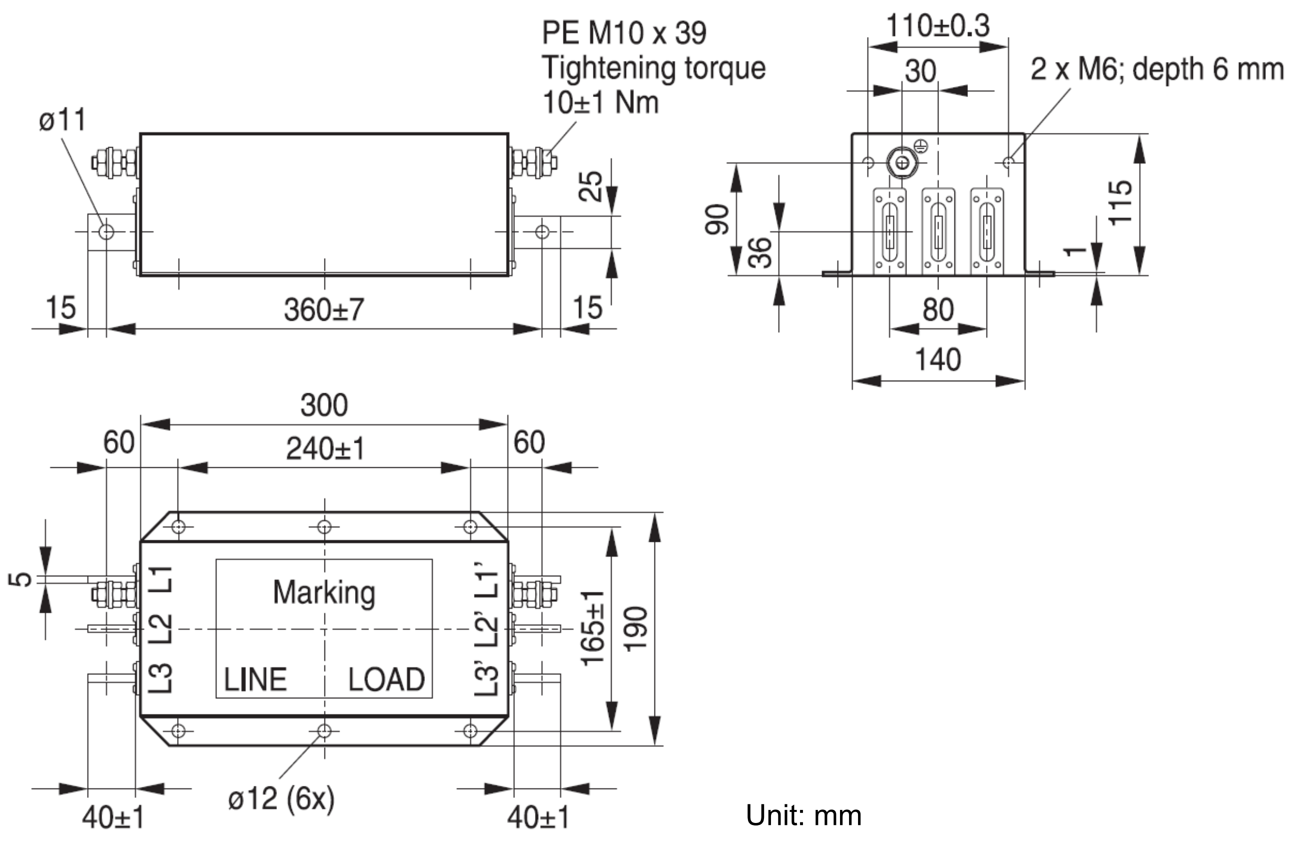


Figure 7-39

Model name: B84143B0400S020, B84143B0400S021

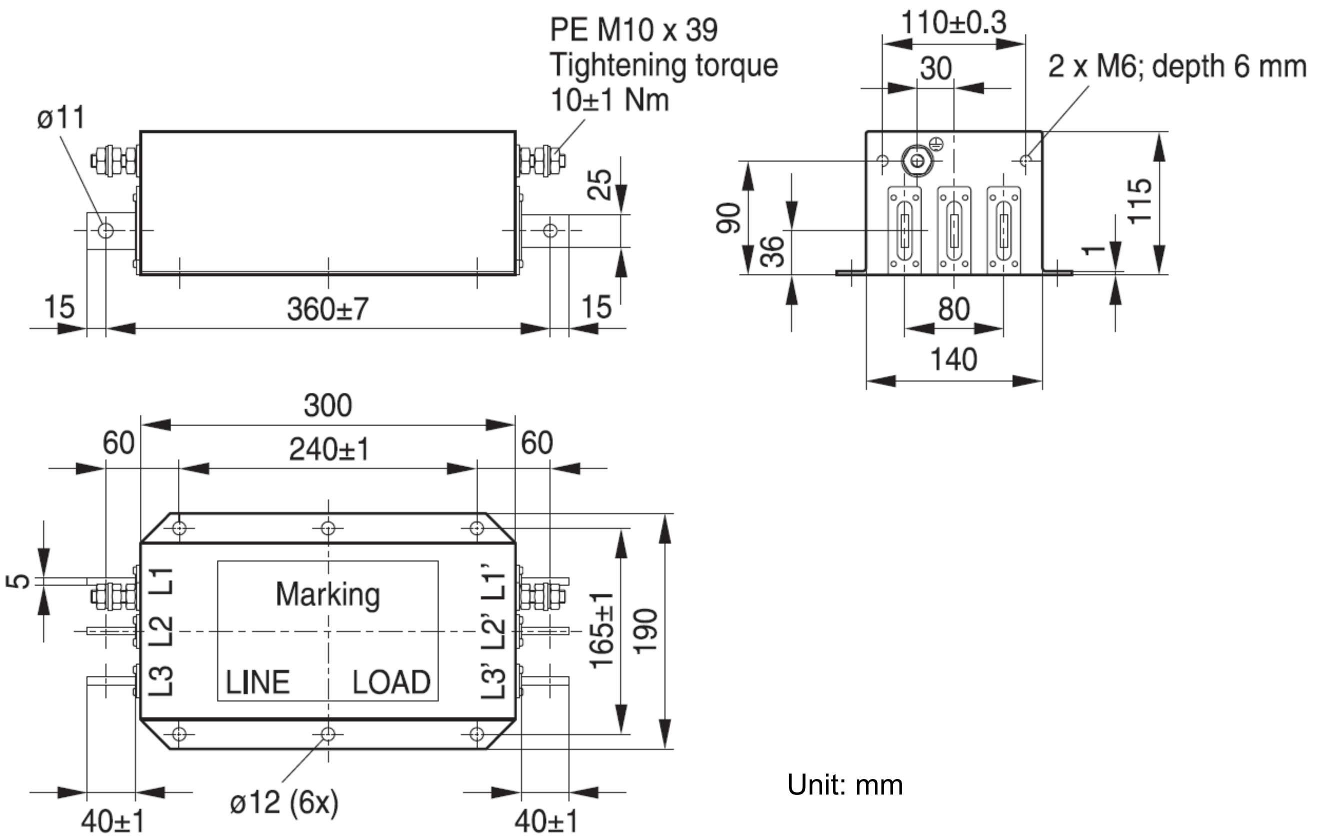
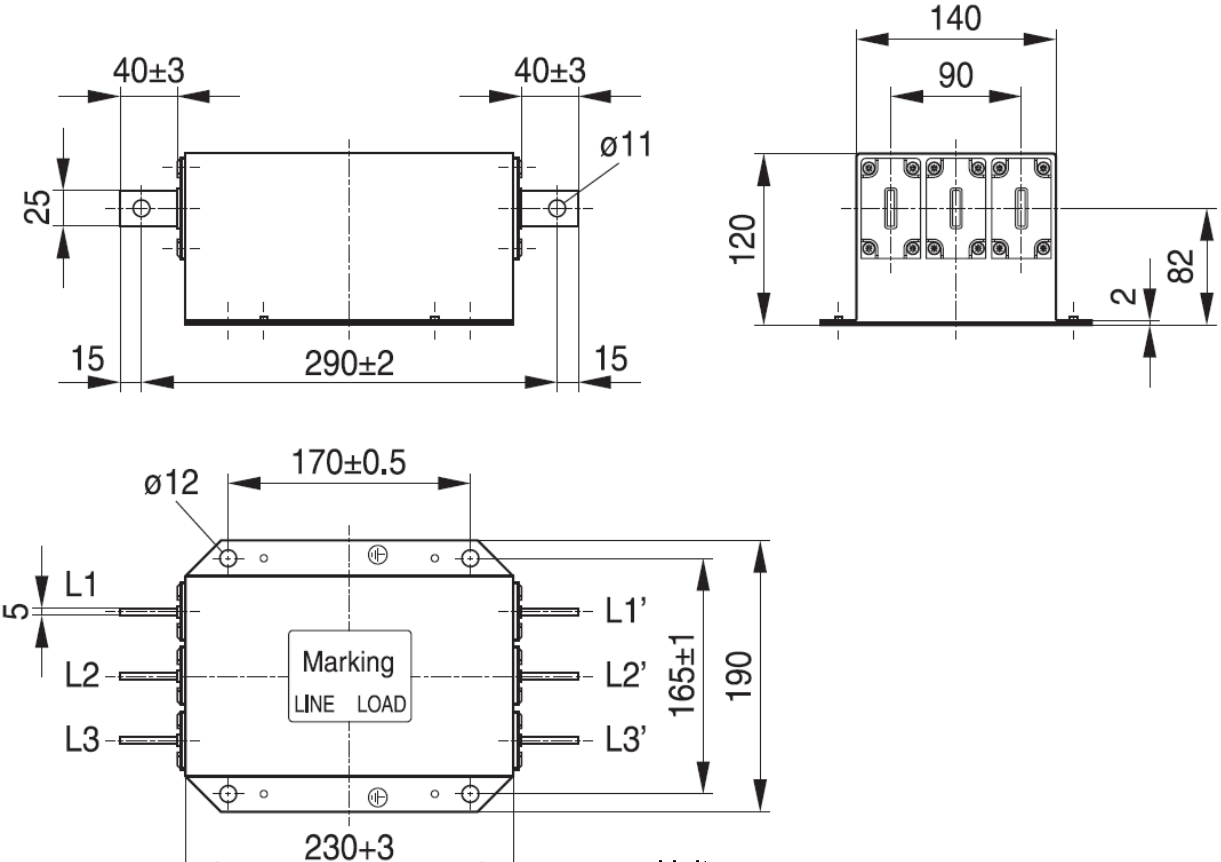


Figure 7-40

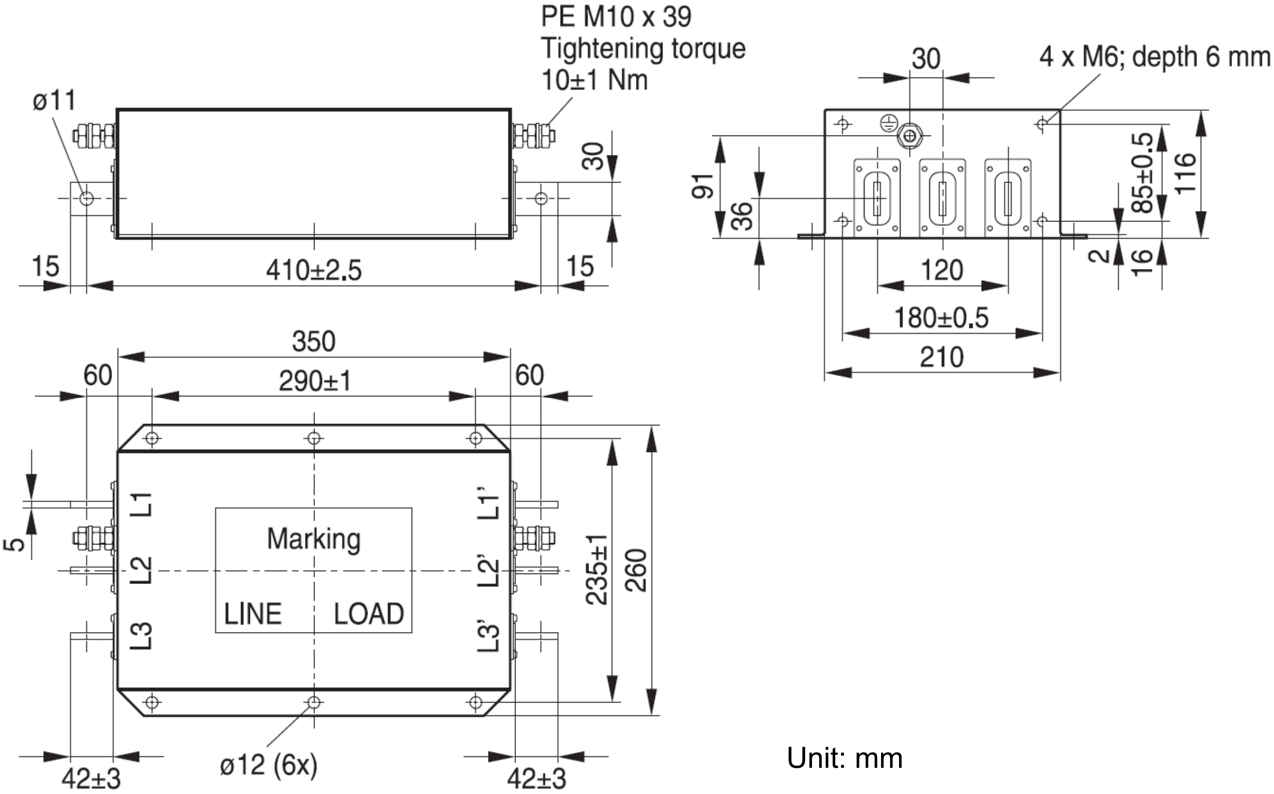
Model name: B84143B0400S080



Unit: mm

Figure 7-41

Model name: B84143B0600S020



Unit: mm

Figure 7-42

Model name: B84143B0600S080

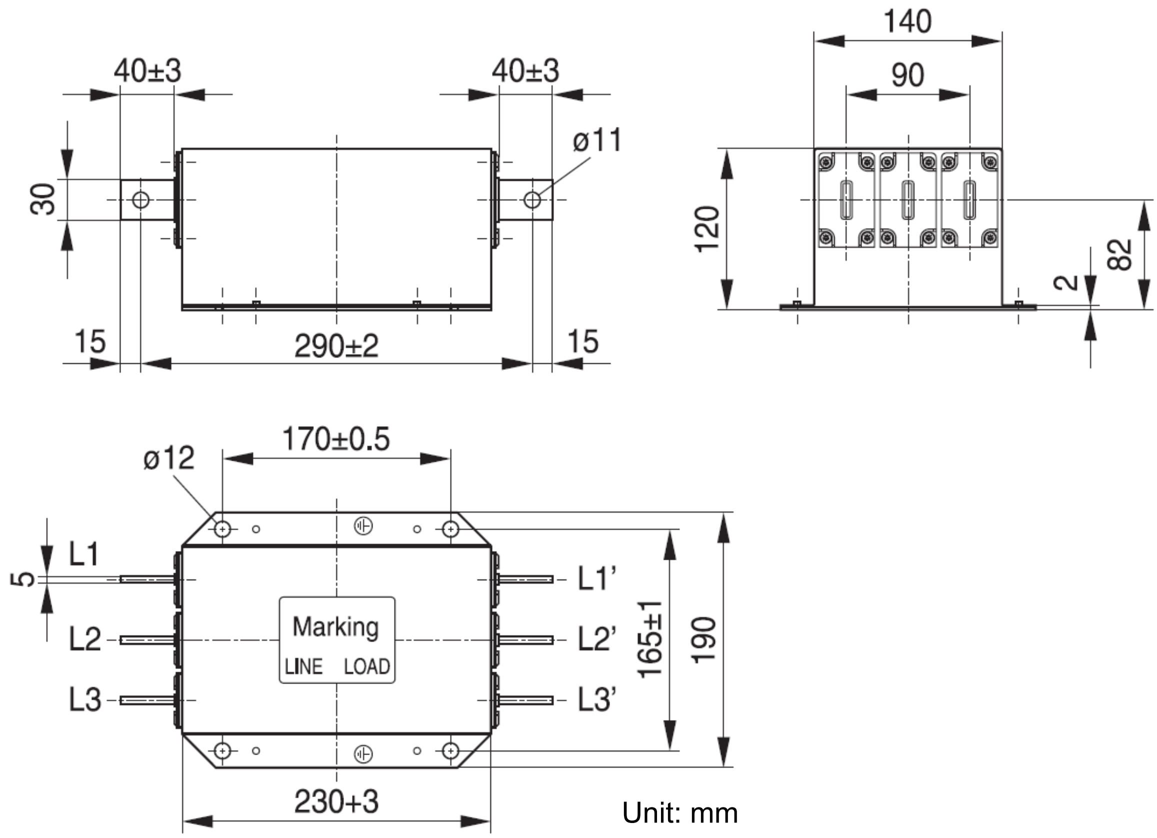


Figure 7-43

Model name:B84143B1000S020, B84143B1000S021

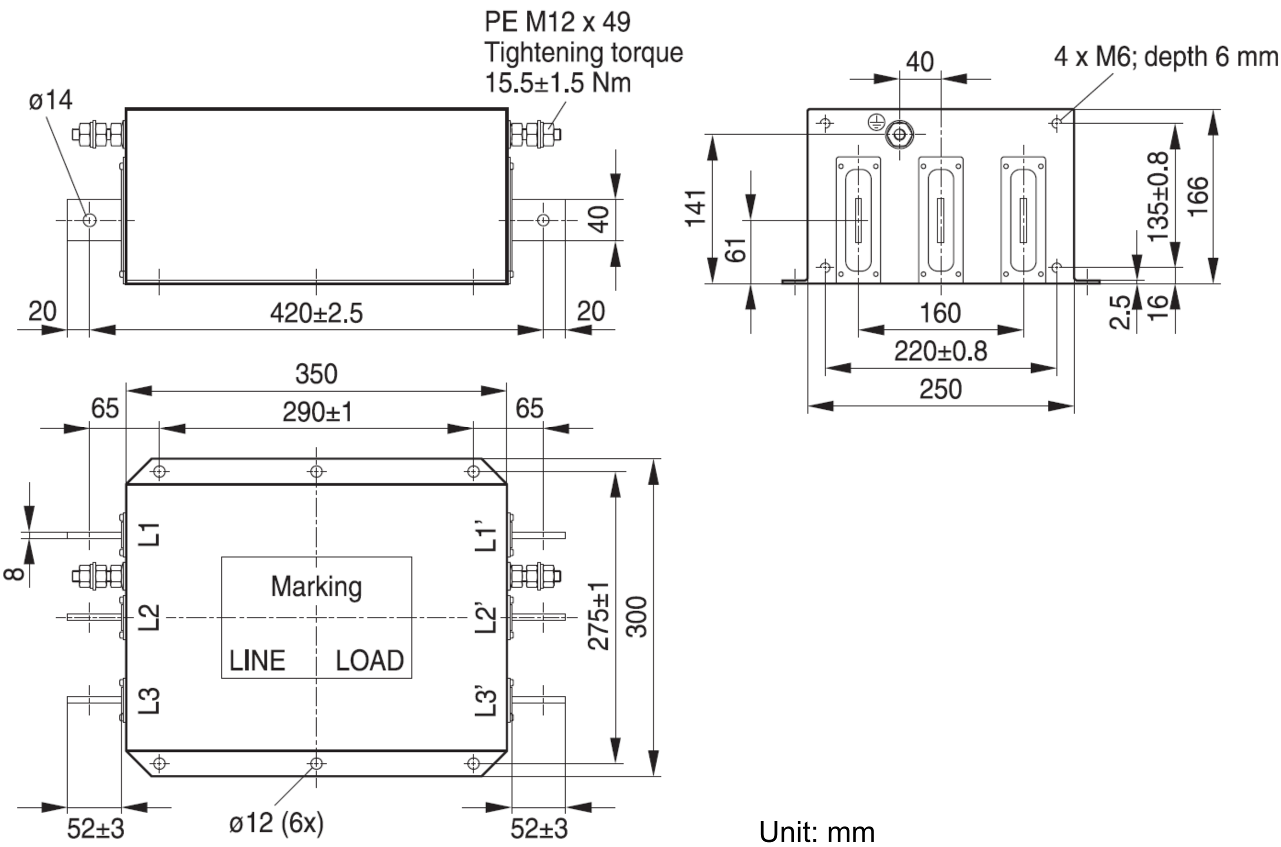
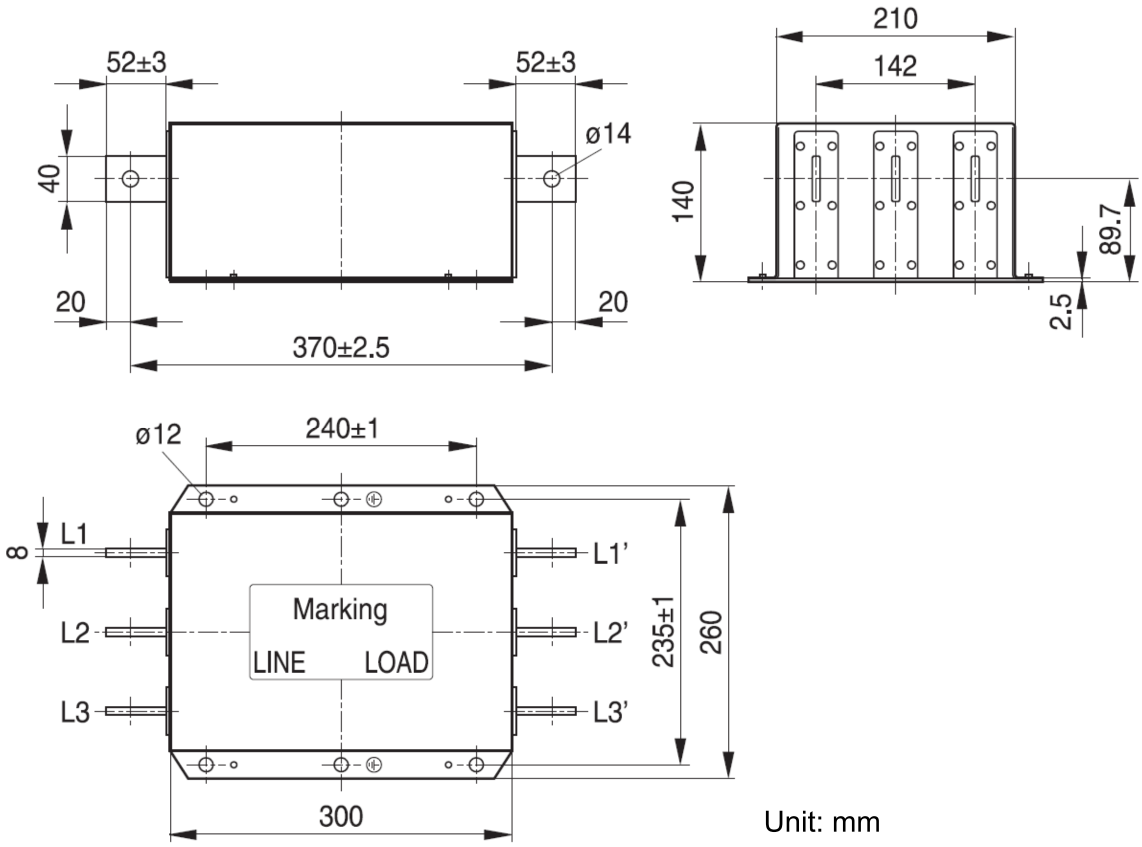


Figure 7-44

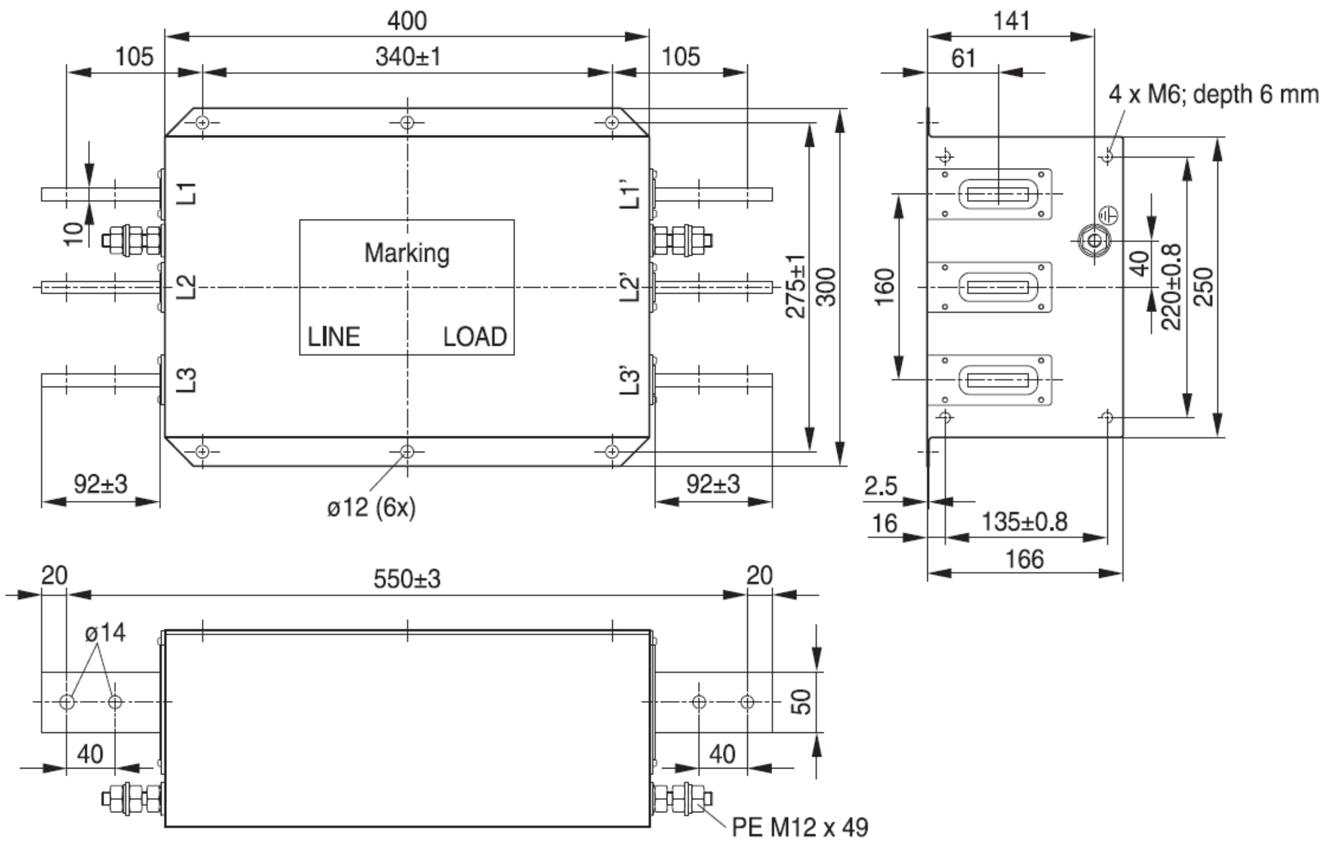
Model name: B84143B1000S080



Unit: mm

Figure 7-45

Model name: B84143B1600S020



Torque: 142.9~173.5 kg-cm / (132.9~150.6 lb-in.) / (14.0~17.0 Nm)

Unit: mm

Figure 7-46

Model name: B84143B1600S080

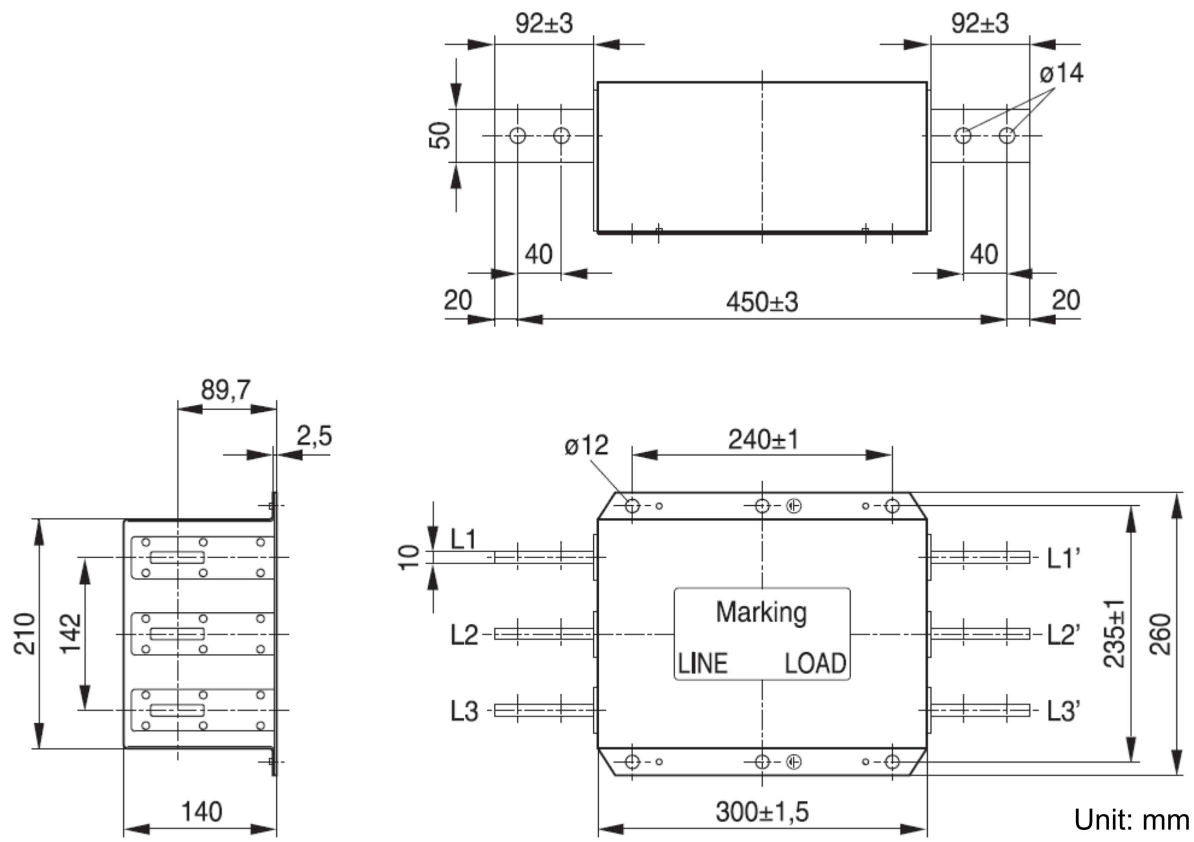


Figure 7-47

Model name: B84143D0150R127

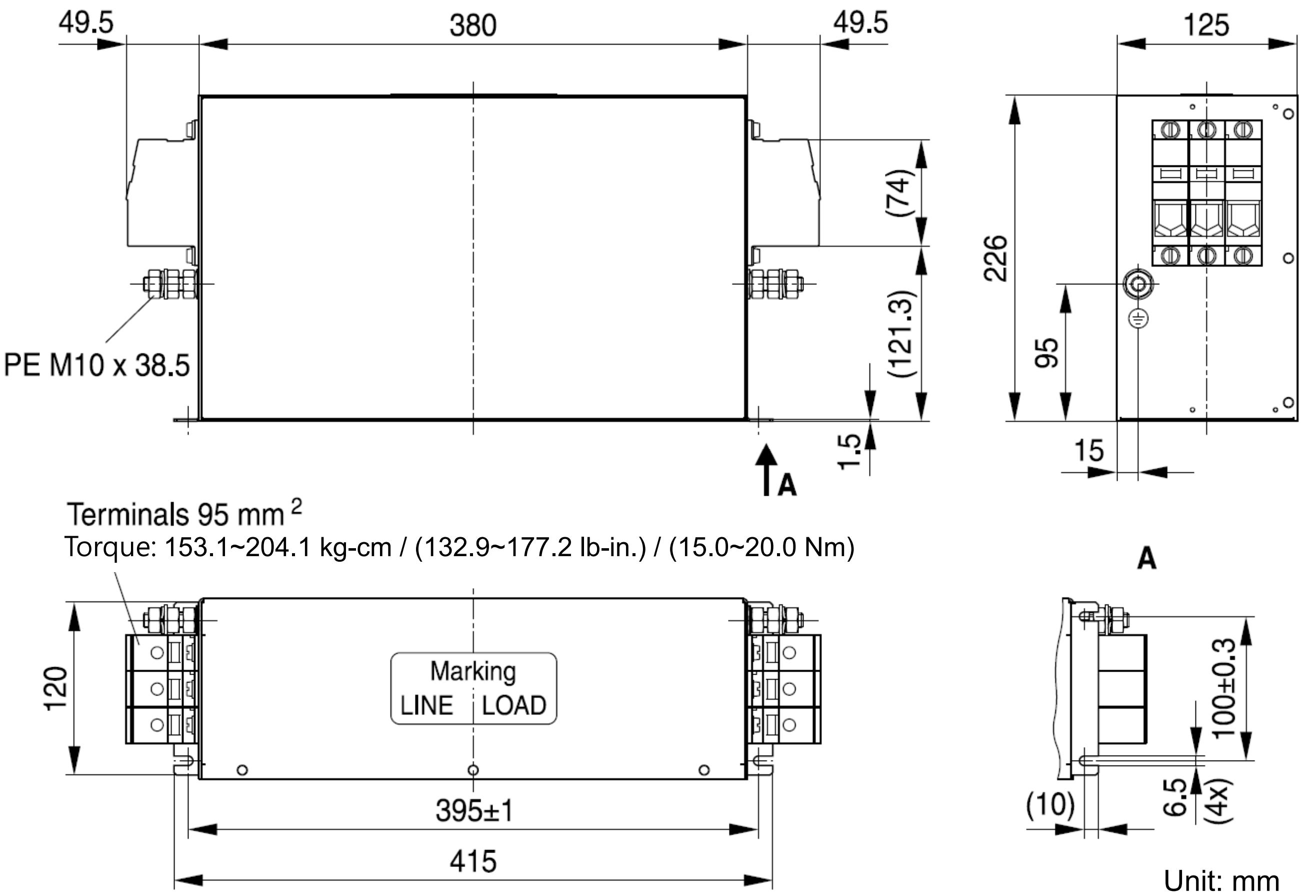
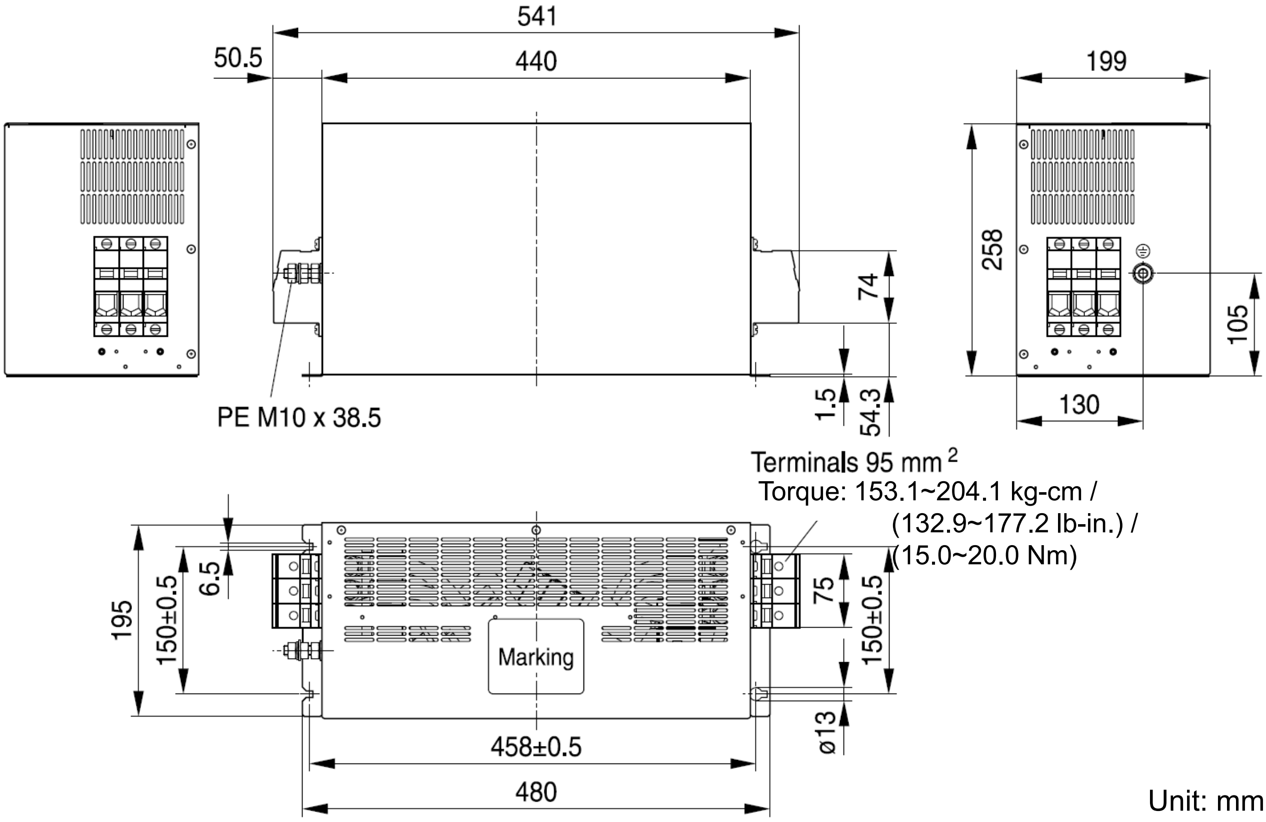


Figure 7-48

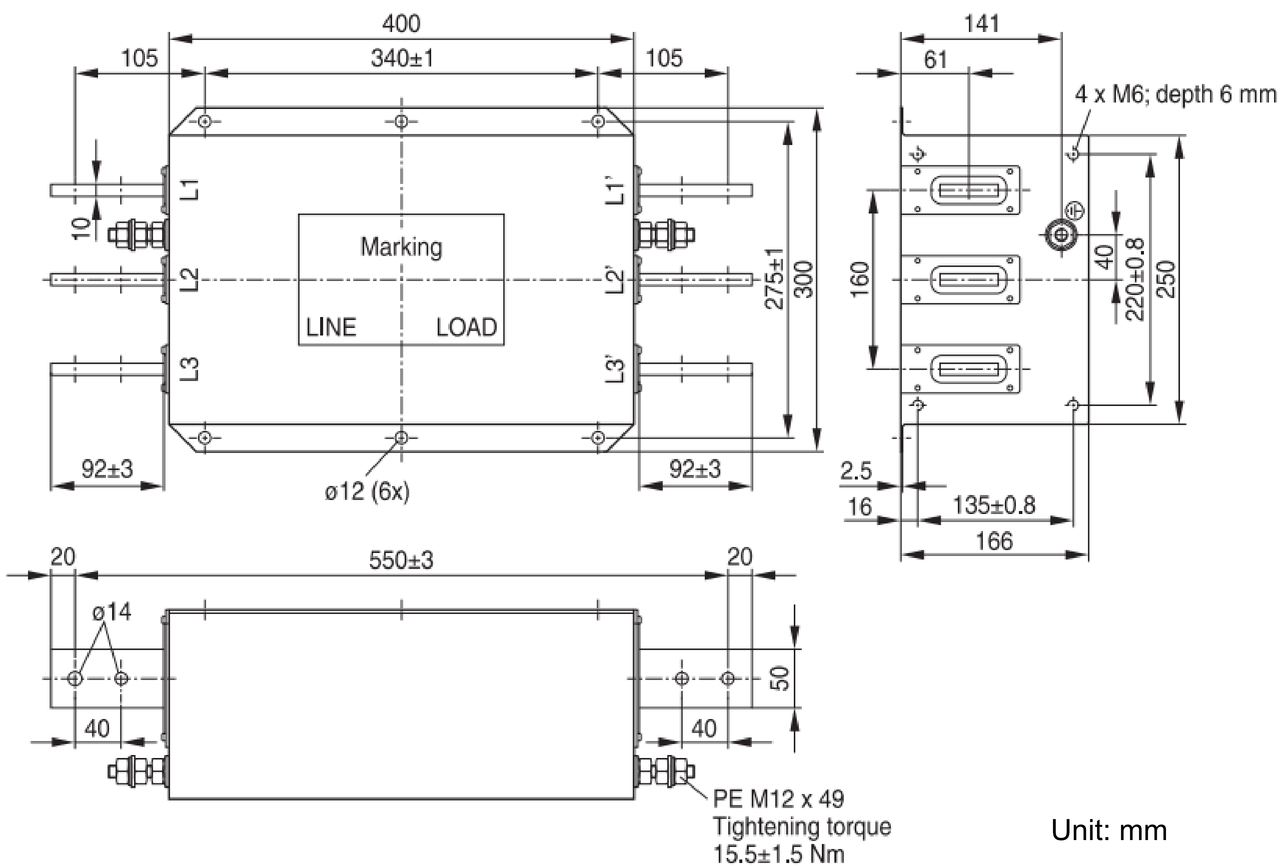
Model name: B84143D0200R127



Unit: mm

Figure 7-49

Model name: B84143B1600S021



Unit: mm

Figure 7-50

Model name: KMF370A

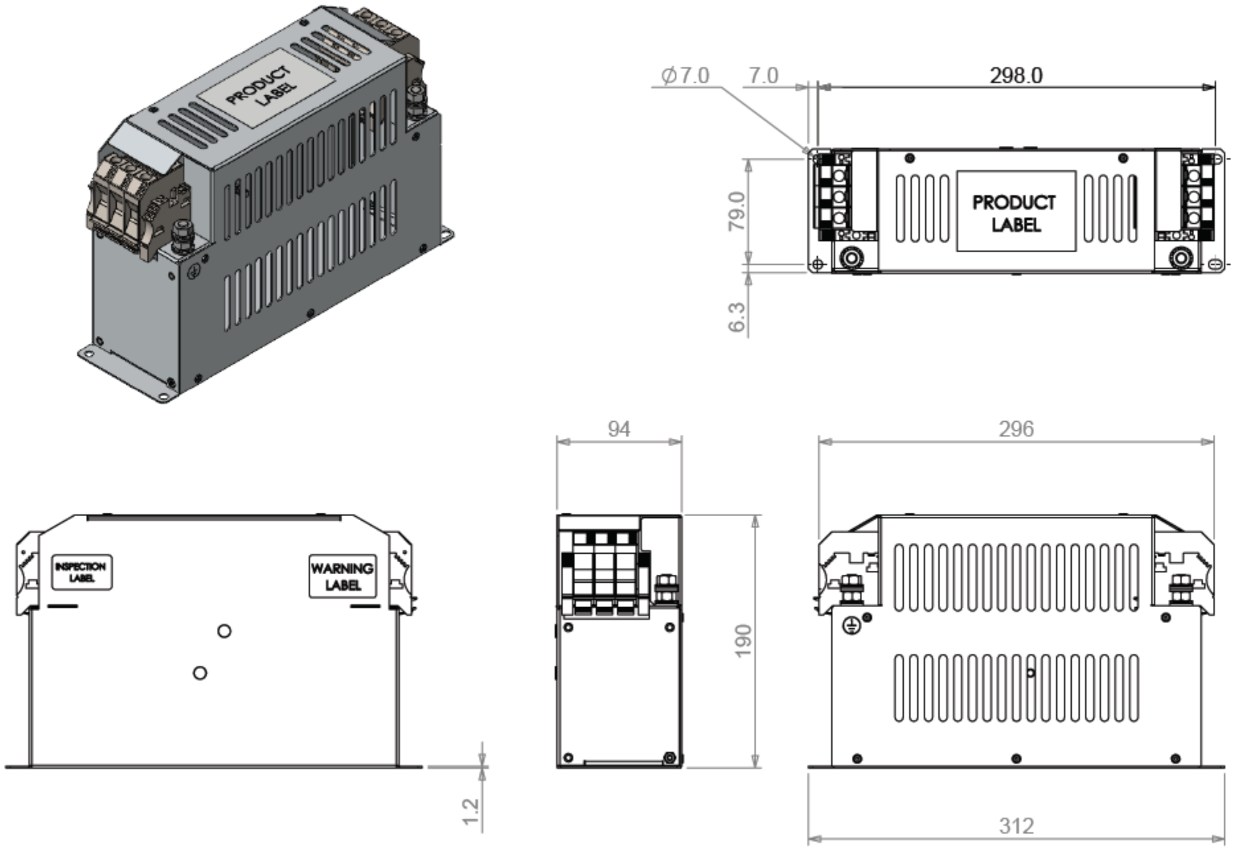
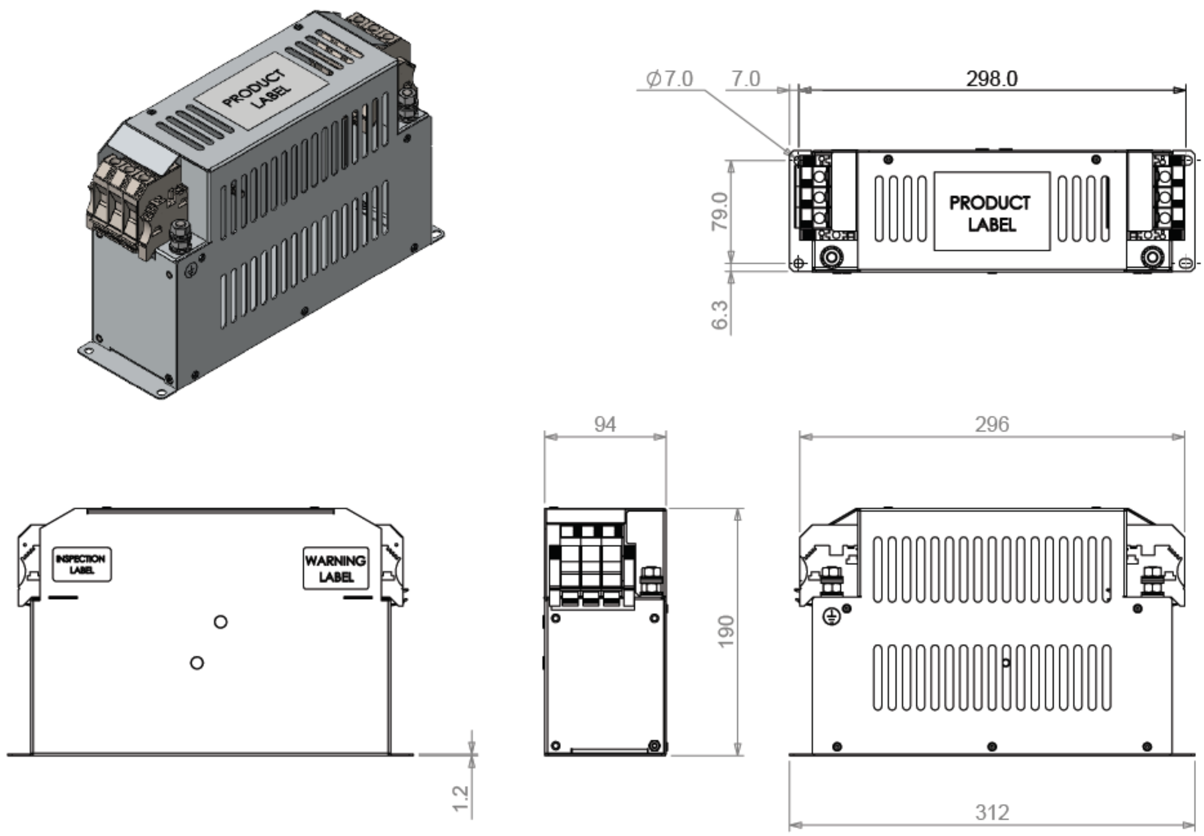


Figure 7-51

Unit: mm

Model name: KMF3100A



Unit: mm

Figure 7-52

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 user manual:

1. EN61000-6-4
2. EN61800-3: 1996
3. EN55011 (1991) 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 AC motor drive should follow the user manual. In addition, be sure to observe the following precautions:

1. EMC filter and AC motor drive should be installed on the same metal plate.
2. Please install AC motor drive on footprint EMC filter or install EMC filter as close as possible to the AC motor drive.
3. Please wire as short as possible.
4. Metal plate should be grounded.
5. The cover of EMC filter and AC motor drive or grounding should be fixed on the metal plate and the contact area should be as large as possible.

Choose suitable motor cable and precautions

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

1. Use the motor cable with copper braid shielded wire (double shielded is better). The copper braid shielded wire on the both ends of the motor cable must ground with the shortest distance and the maximum contact area.
2. Remove the protective painting where the metal plate fixes with the two-hole straps. This is for ensuring a good contact. See Figure 7-53.
3. Correctly connect the copper braid shielded wire of the motor cable with the metal plate. Use two-hole straps to fix both ends of copper braid shielded wire of the motor cable on the metal plate. See Figure 7-54.

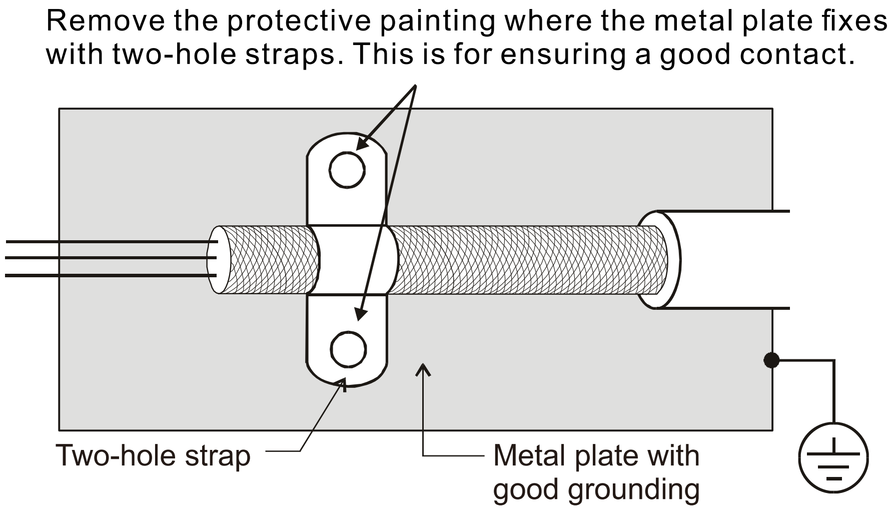


Figure 7-53

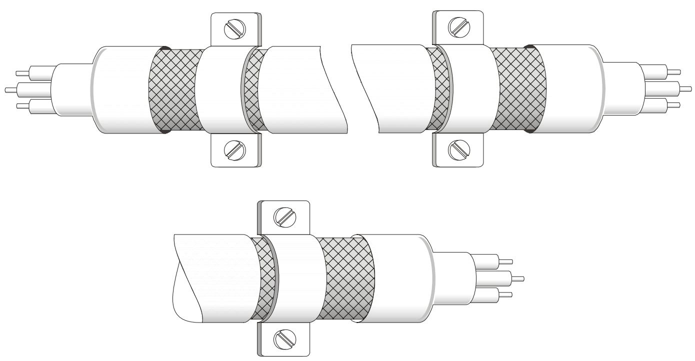


Figure 7-54

Capacitor Filter

Capacitor Filter is a simple filter accessory, installed to provide simple filtering and eliminating interference.

Installation

Installed on the input side, connect each cable on terminal R, S, T and PE. As shown in the figure below. (Please do NOT install the capacitor filter on the output side.)

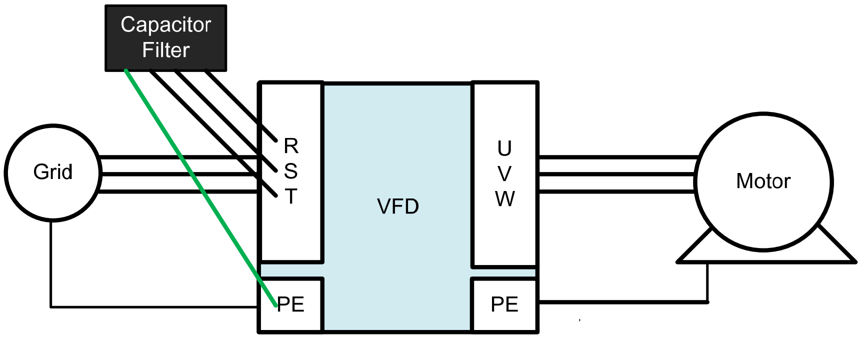


Figure 7-55

Model / Specification

Model	Capacitance of the capacitor	Temperature
CXY101-43A	Cx：1uF±20% Cy：1uF±20%	-40 – +85°C

Table 7-28

Unit: mm (inch)

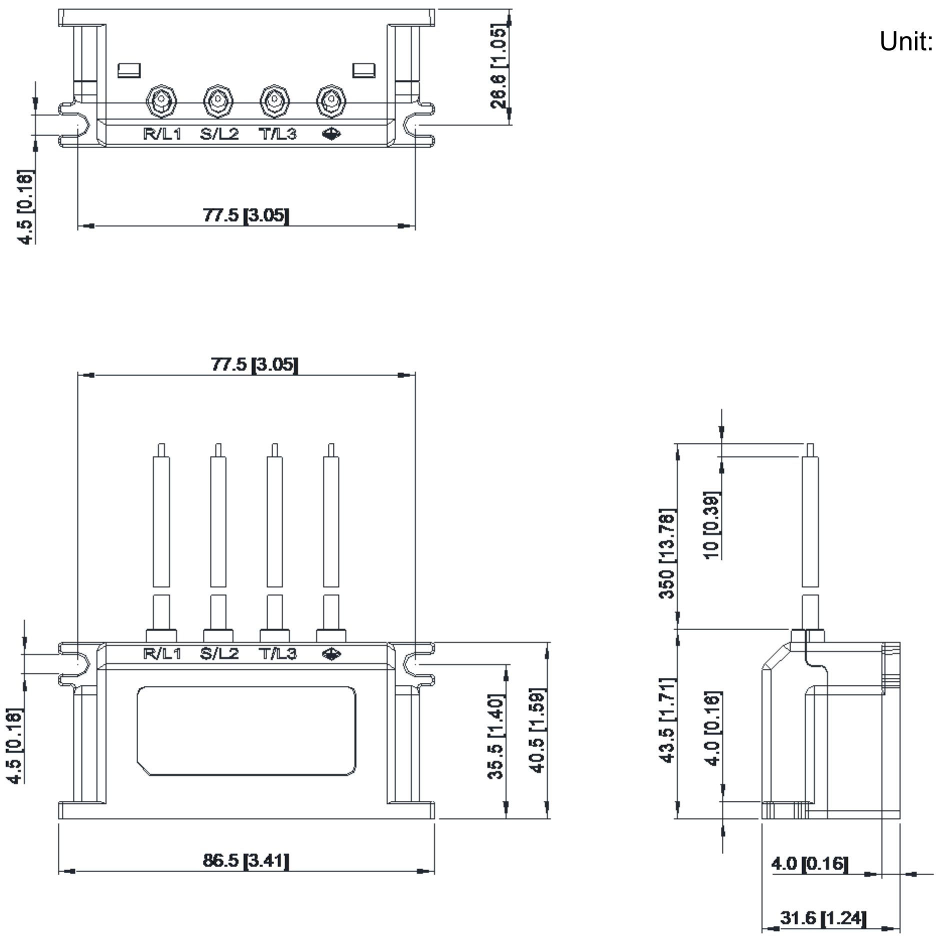


Figure 7-56

7-7 Panel Mounting (MKC-KPPK)

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

Wall Mounting

Accessories*1

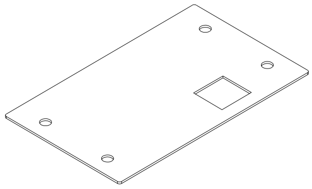


Figure 7-57

Screw *4 –M4*p 0.7 *L8mm
Torque: 10–12 kg-cm / (8.7–10.4 Ib-in.) /
(1.0–1.2 Nm)

Panel cutout dimension
Unit: mm (inch)

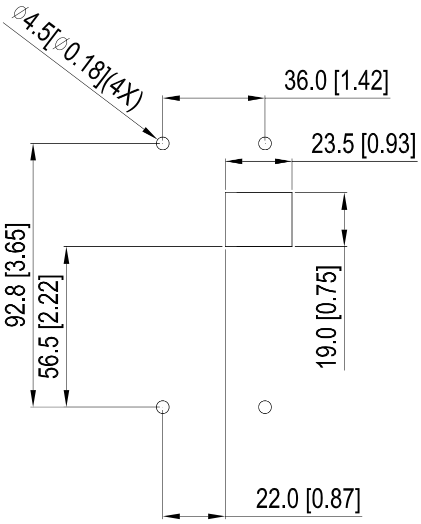


Figure 7-58

Embedded Mounting

Accessories*2

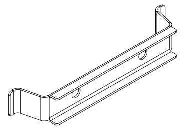


Figure 7-60

Screw *4 –M4*p 0.7 *L8mm
Torque: 10–12 kg-cm / (8.7–10.4 Ib-in.) /
(1.0–1.2 Nm)

Panel cutout dimension Unit: mm (inch)

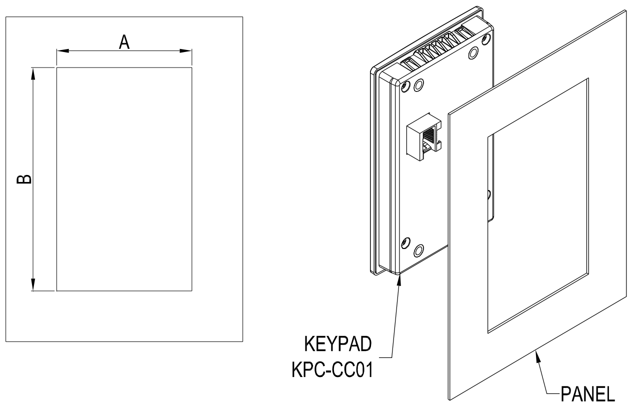


Figure 7-61

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 7-29

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 7-30

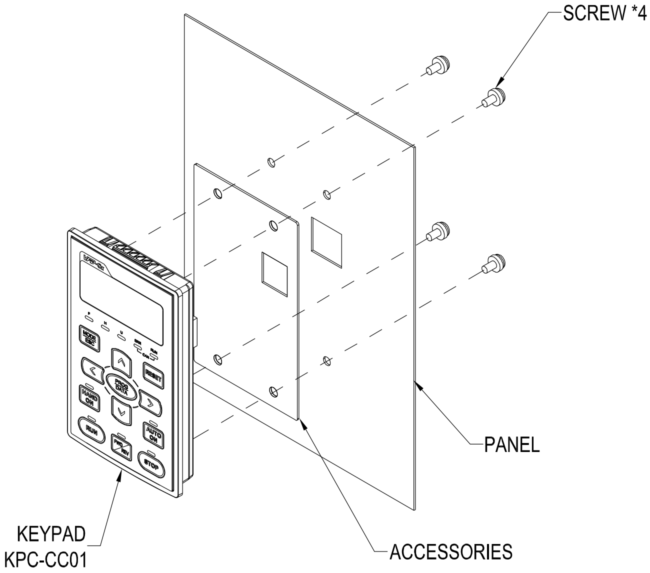
<table>
<tr><th>Wall Mounting</th><th>Embedded Mounting</th></tr>
<tr><td>


Figure 7-59
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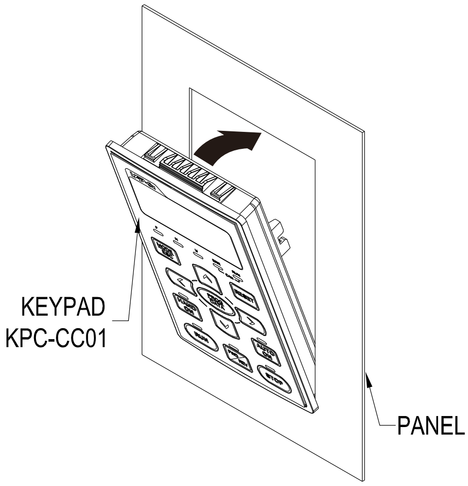


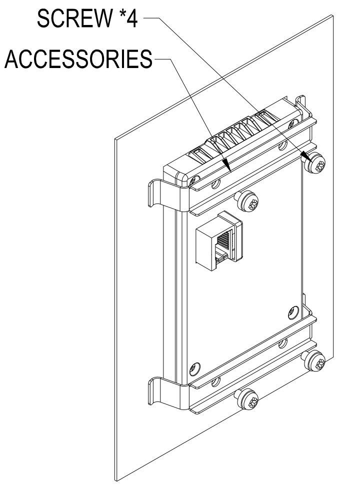
Figure 7-62


Figure 7-63
</td></tr>
</table>

7-8 Fan Kit

- Appearance

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

Frame B

Applicable models:
VFD110CT43F21A3; VFD150CT43F21A3;
VFD185CT43F21A3

Capacitor Fan Model “MKC-BFKB”

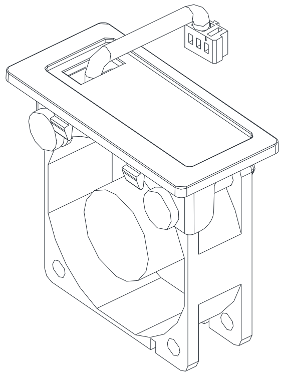


Figure 7-64

Frame B

Applicable models:
VFD110CT43A21C; VFD150CT43A21C;
VFD185CT43A21C

Heat Sink Fan Model ”MKCT-BFKM”

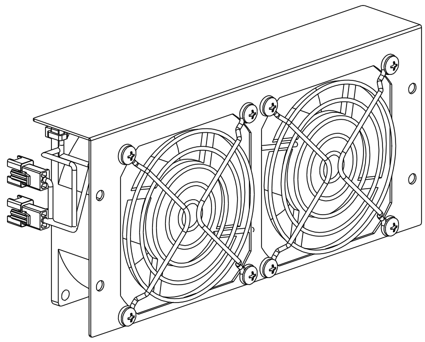


Figure 7-65

Frame C

Applicable models:
VFD220CT43F21A3; VFD300CT43F21A3;
VFD370CT43F21A7

Capacitor Fan Model ”MKC-CFKB2”

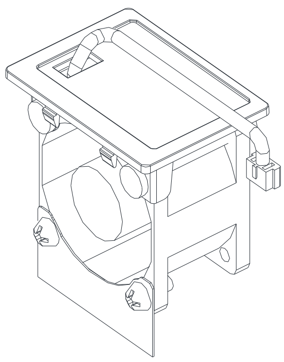
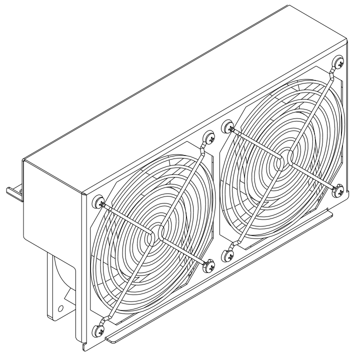
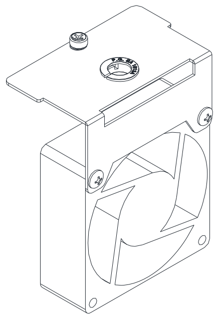
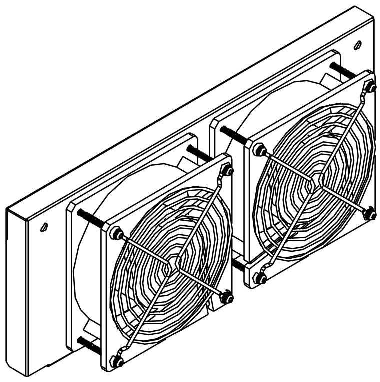


Figure 7-66

Frame C Applicable models: VFD220CT43A21C; VFD300CT43A21C; VFD370CT43A21C	Heat Sink Fan Model "MKCT-CFKM"  Figure 7-67
Frame D Applicable models: VFD450CT43F00A3; VFD550CT43F00A4; VFD750CT43F00A6; VFD900CT43F00A8	Capacitor Fan Model "MKC-DFKB"  Figure 7-68
Frame D Applicable models: VFD450CT43A00C; VFD550CT43A00C	Heat Sink Fan Model "MKC-DFKM"  Figure 7-69

- Fan Removal

Frame B

Model "MKCT-BFKM" Heat Sink Fan

Applicable models:
VFD110CT43A21C; VFD150CT43A21C; VFD185CT43A21C

Loosen 4 screws of the fan (see the picture below), and disconnect the fan power.
Screw torque: 14–16 kg-cm

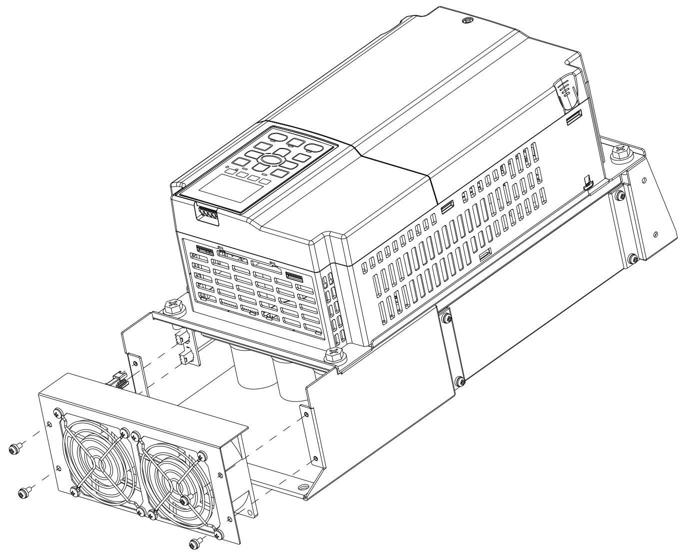


Figure 7-70

Frame B

Model "MKC-BFKB" Capacitor Fan

Applicable models:
VFD110CT43F21A3; VFD150CT43F21A3; VFD185CT43F21A3

Disconnect fan power and pull out the fan by using a flat-head screwdriver. (As shown in the enlarged picture)

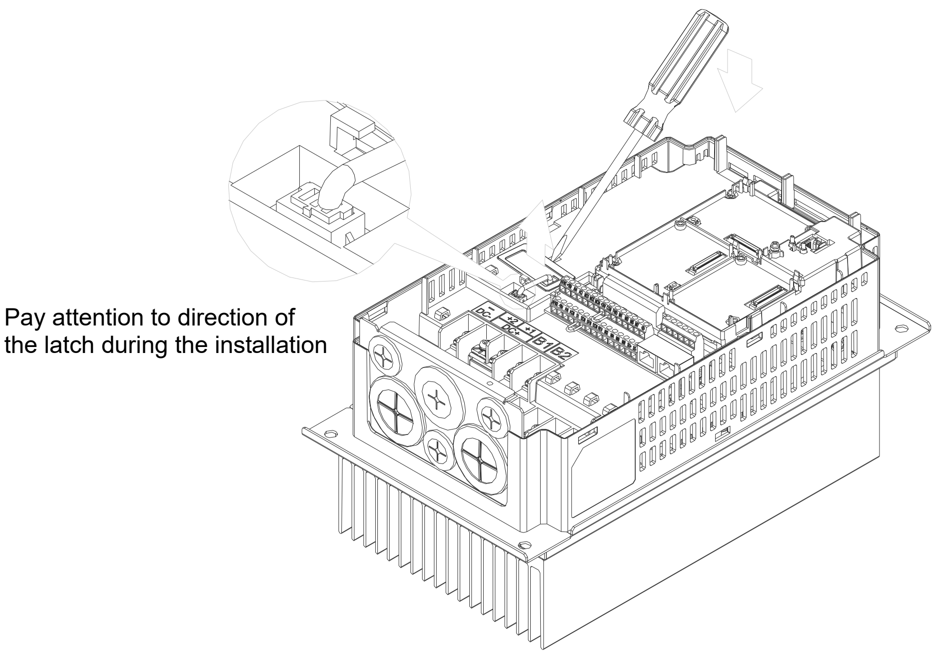


Figure 7-71

Frame C

Model "MKCT-CFKM" Heat Sink Fan

Applicable models:
VFD220CT43A21C; VFD300CT43A21C; VFD370CT43A21C

Loosen the screw 1 and 2 (see the picture below), and disconnect the fan power.
Screw torque: 14–16 kg-cm

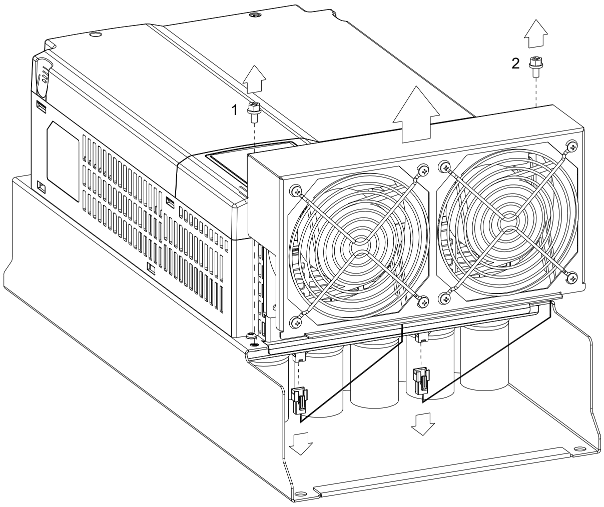


Figure 7-72

Frame C

Model "MKC-CFKB2" Capacitor Fan

Applicable models:
VFD220CT43F21A3; VFD300CT43F21A3; VFD370CT43F21A7

Disconnect fan power and pull out the fan by using a flat-head screwdriver. (As shown in the partial enlarged view)

Pay attention to direction of the latch during the installation

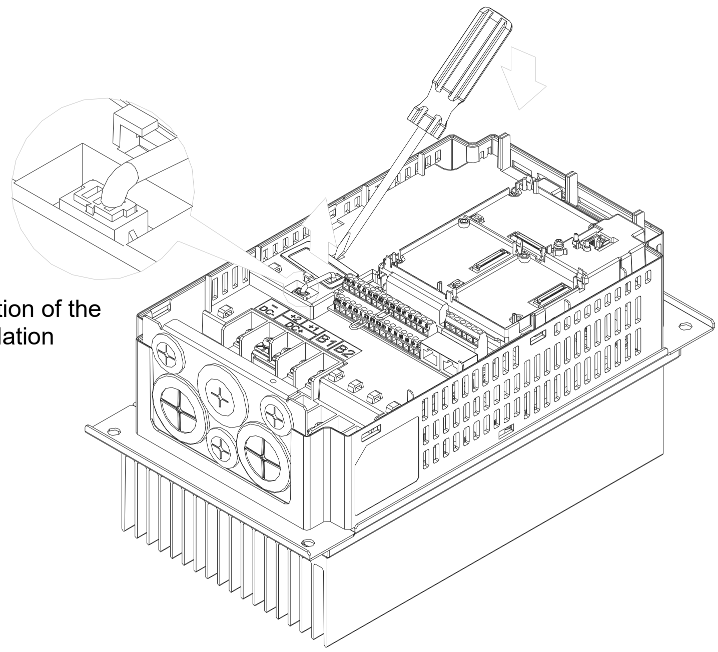


Figure 7-73

Frame D

Model “MKC-DFKM” Heat Sink Fan

Applicable models:
VFD450CT43A00C; VFD550CT43F00C

1. Loosen the screw 1 and 2, move the fan kit out of the snap fit.
   Screw torque: 24–26 kg-cm

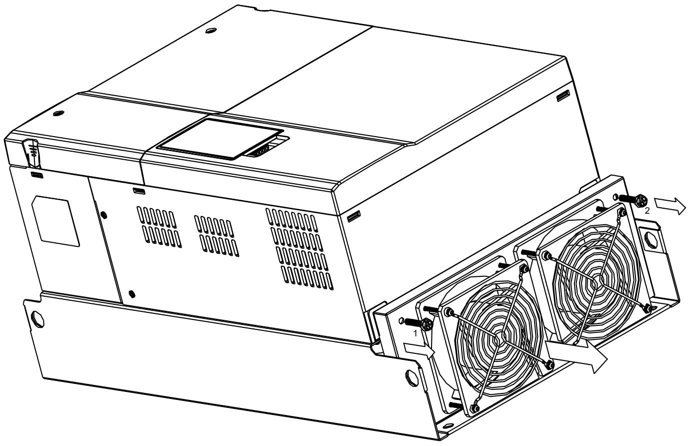


Figure 7-74

2. Disconnect fan power and pull out the fan.

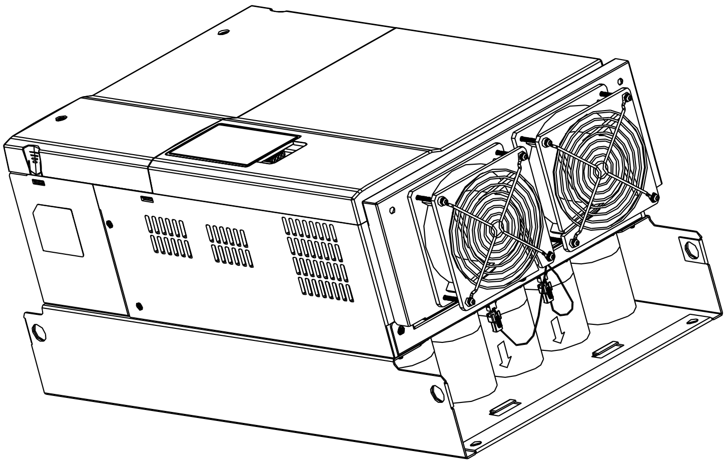


Figure 7-75

Frame D

Model "MKC-DFKB" Capacitor Fan

Applicable models:
VFD450CT43F00A3; VFD550CT43F00A4; VFD750CT43F00A6; VFD900CT43F00A8

1. Loosen the screw 1 and 2, press the right and the left side of the lower half of the front case (see the arrows showed in the picture below), and then remove it. After that, press the snap fit of keypad and remove the keypad.
   Screw torque of screw 1 and 2: 10–12kgf-cm (8.6–10.4in-lbf)

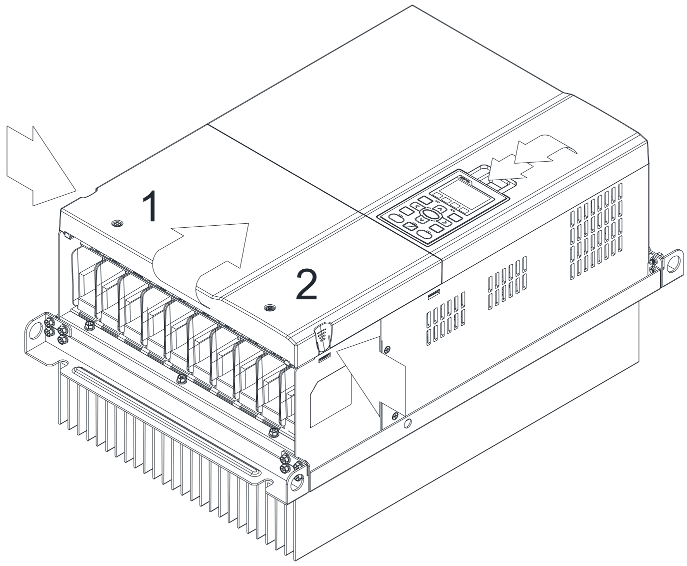


Figure 7-76

2. Loosen the screw 3 and 4, press the right and the left side of the upper half of the front case (see the picture below), and remove it.
   Screw torque of screw 3 and 4: 6–8kgf-cm (5.2–6.9in-lbf)

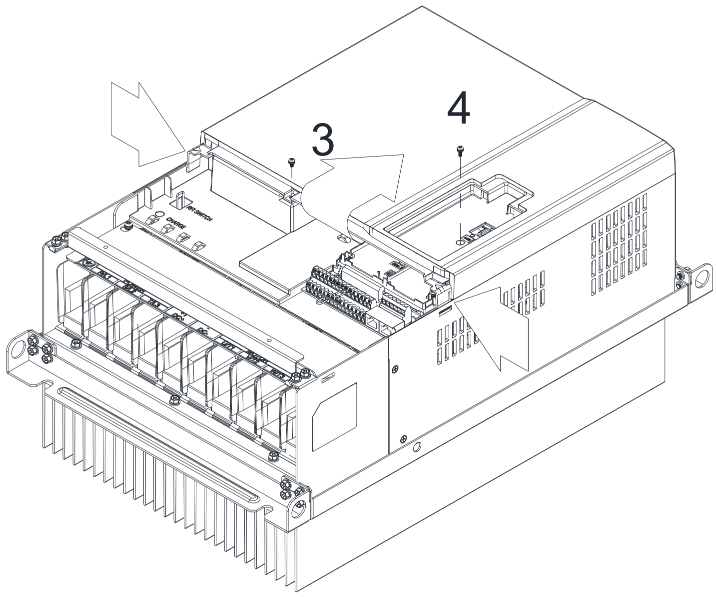


Figure 7-77

3. Loosen the screw 5, disconnect fan power (as shown in the partial enlarged view), and then remove the fan.
   Screw torque of screw 5: 10–12kgf-cm (8.6–10.4in-lbf)

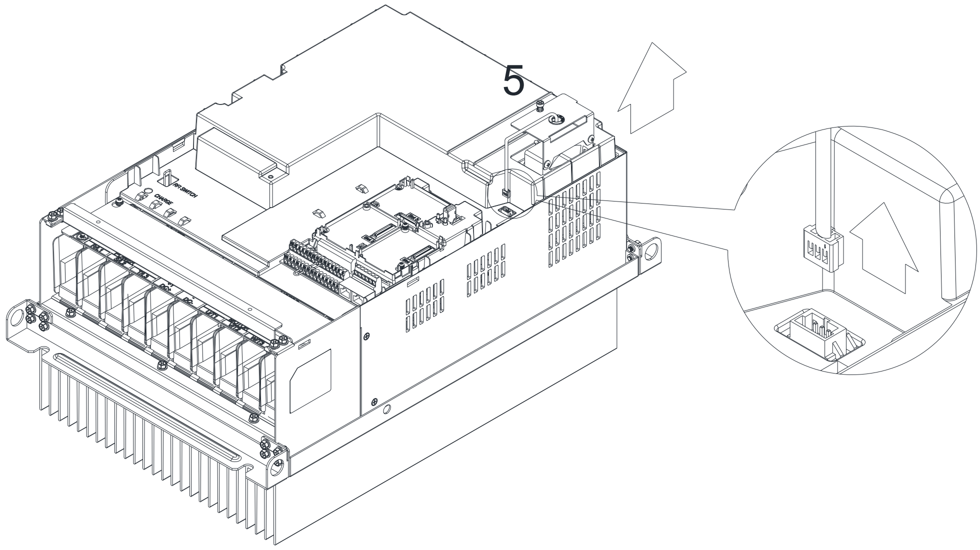


Figure 7-78

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 from website.

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

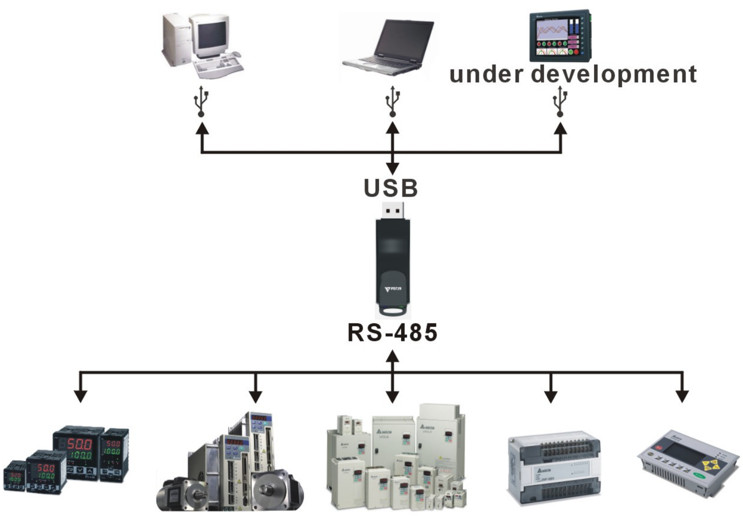


Figure 7-79

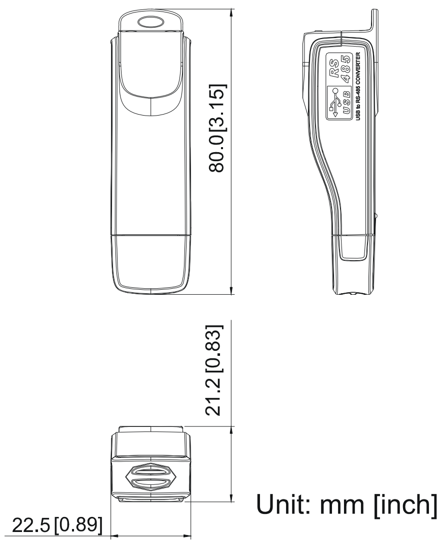


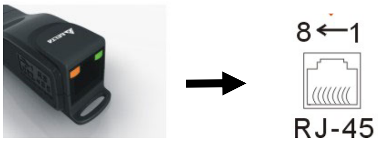
Figure 7-80

Specifications

Power supply	No external power is needed
Power consumption	1.5W
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	

Table 7-31

RJ45



PIN	Description
1	Reserved
2	Reserved
3	GND
4	SG-

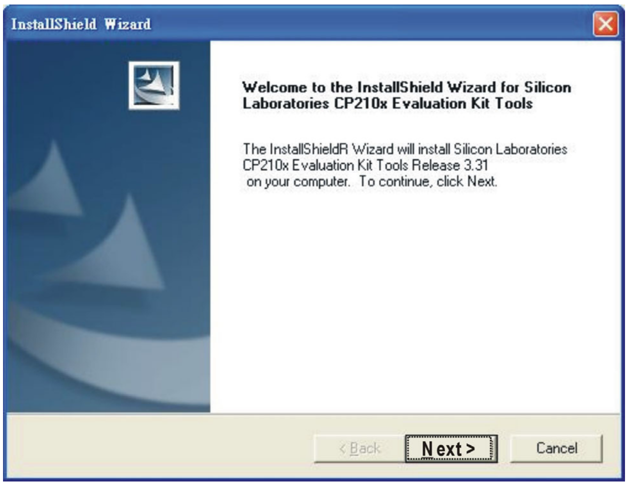
PIN	Description
5	SG+
6	GND
7	Reserved
8	+9V

Preparations before Driver Installation

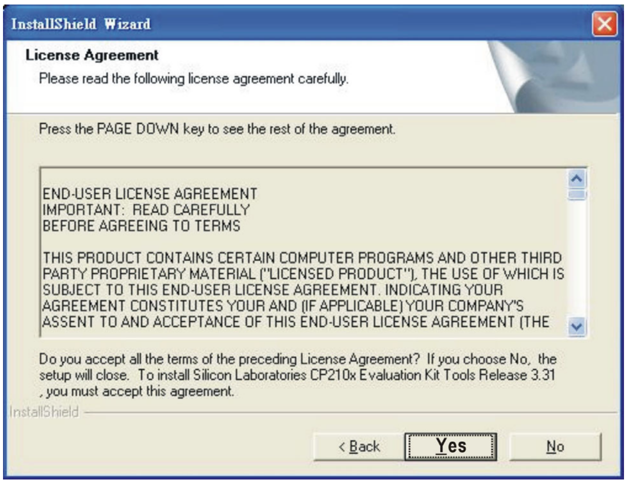
Download the driver file (IFD6530_Drivers.exe) from website, and extract it by following steps.

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

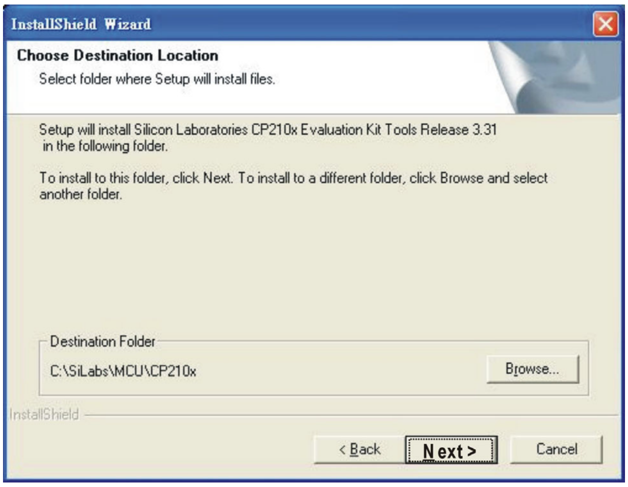
STEP 1



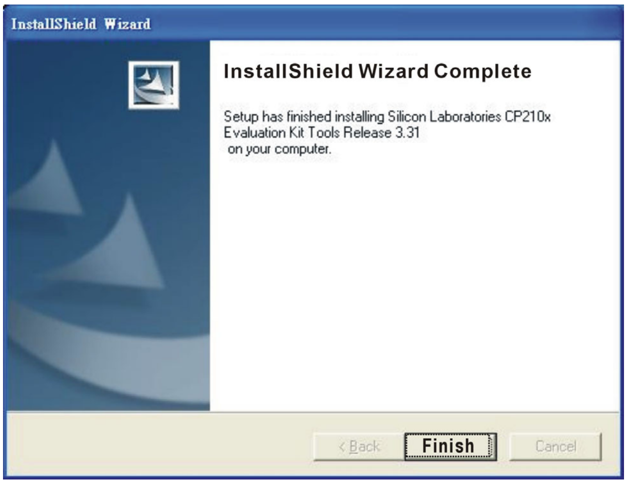
STEP 2



STEP 3



STEP 4



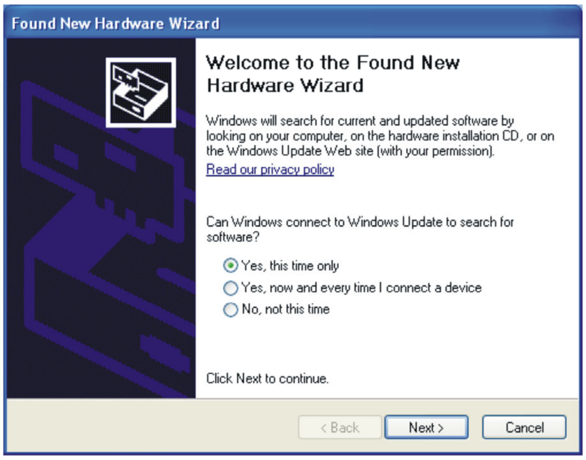
STEP 5

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

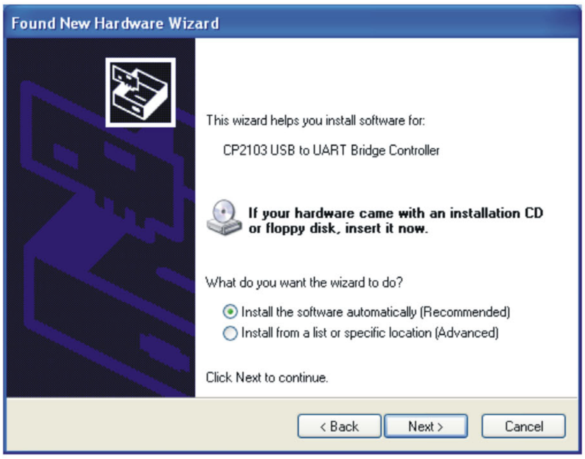
Driver Installation

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

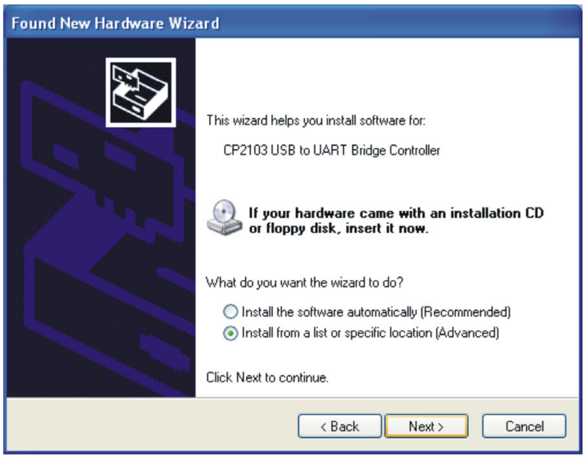
STEP 1

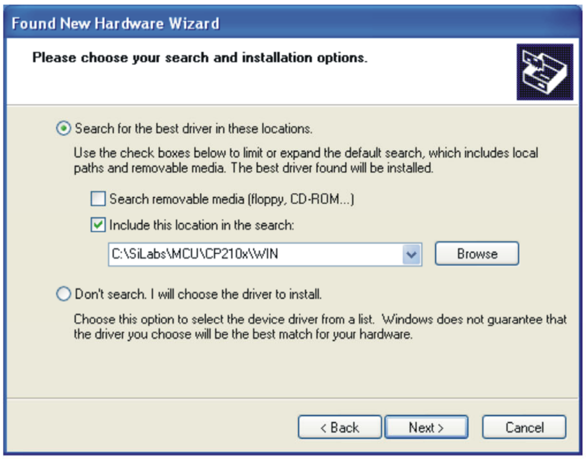


STEP 2



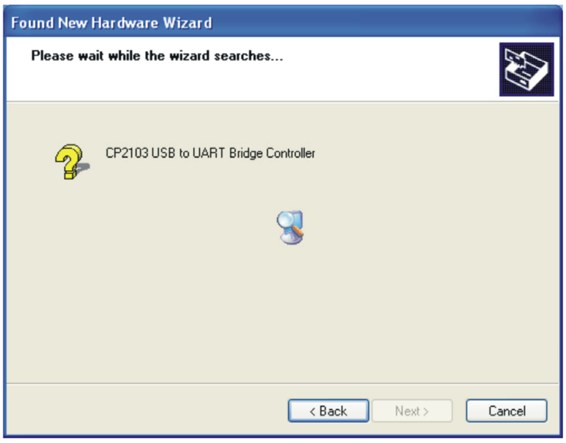
OR



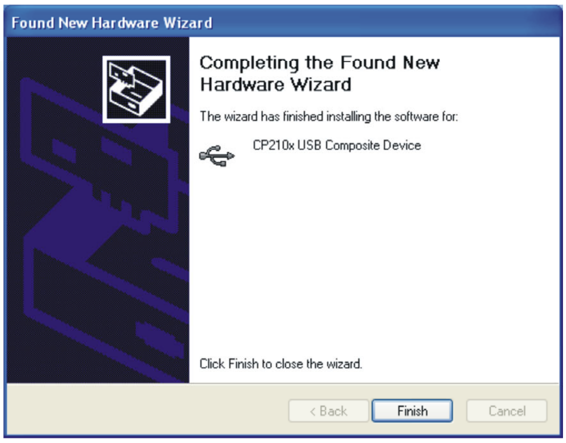


Browse and select directory, or enter C:\SiLabs\MCU\CP210x\WIN

STEP 3



STEP 4



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

LED Display

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

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Chapter 8 Option Cards

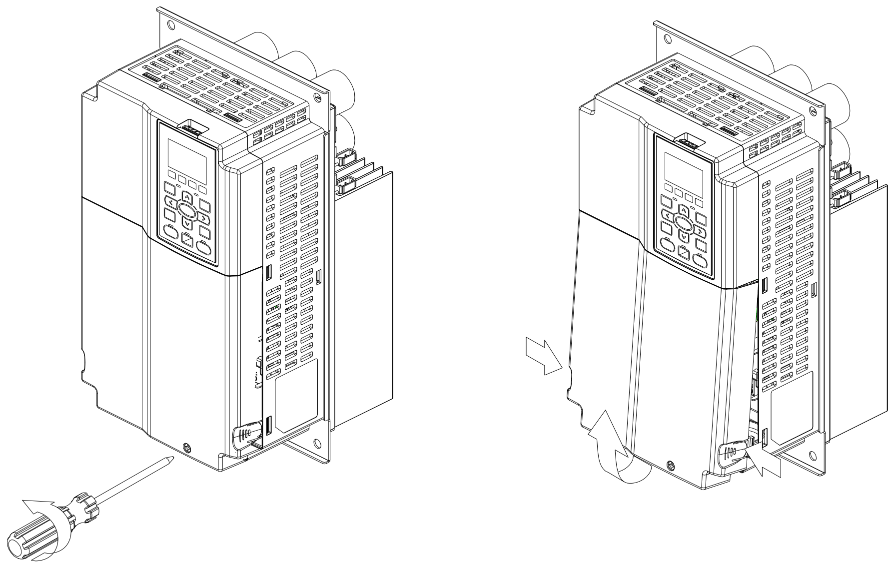
- The option cards in this chapter are optional accessories. Select the applicable option cards for your motor drive, or contact your local distributor for suggestions. The option cards can significantly improve the efficiency of the motor drive.
- To prevent damage to the motor drive during installation,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

8-1 Option Card Installation

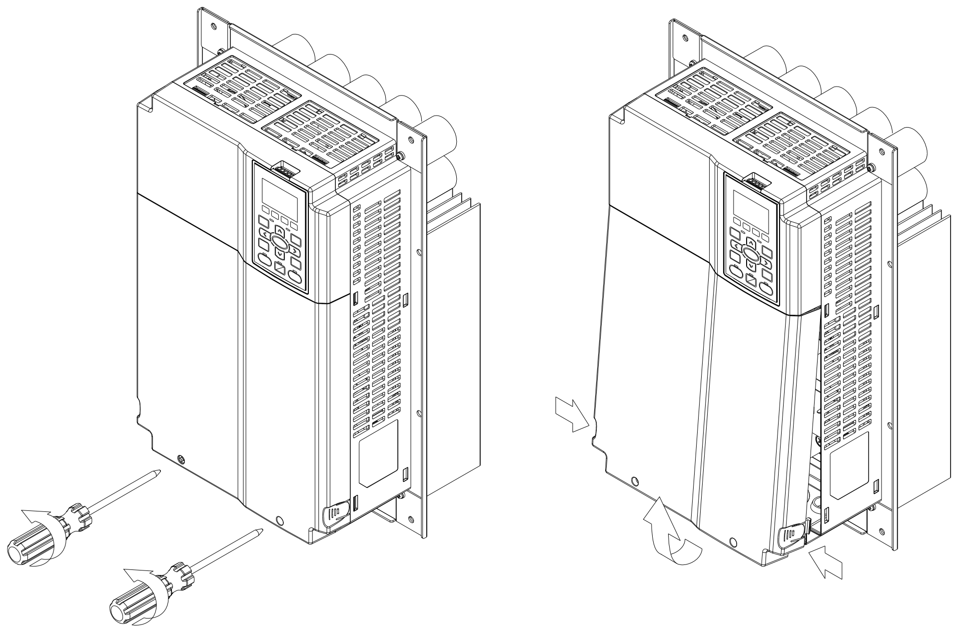
8-1-1 Remove the front cases (take CT2000-B flange mounting models as an example)

Step 1

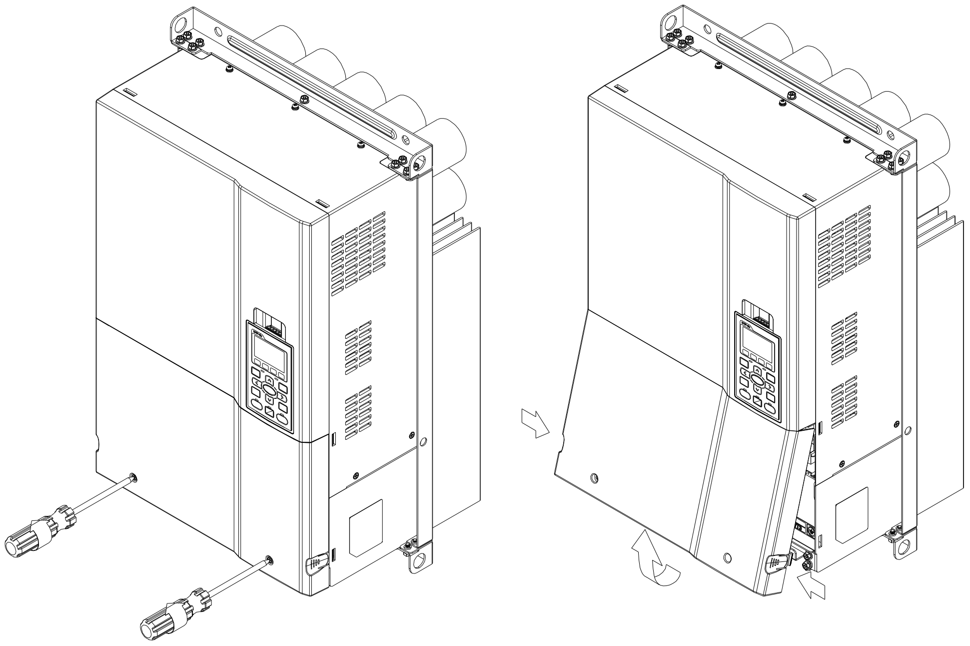
Frame A, B   Screw torque: 12–15 kg-cm / (10.4–13 lb-in.) / (1.18–1.47 Nm)



Frame C   Screw torque: 12–15 kg-cm / (10.4–13 lb-in.) / (1.18–1.47 Nm)

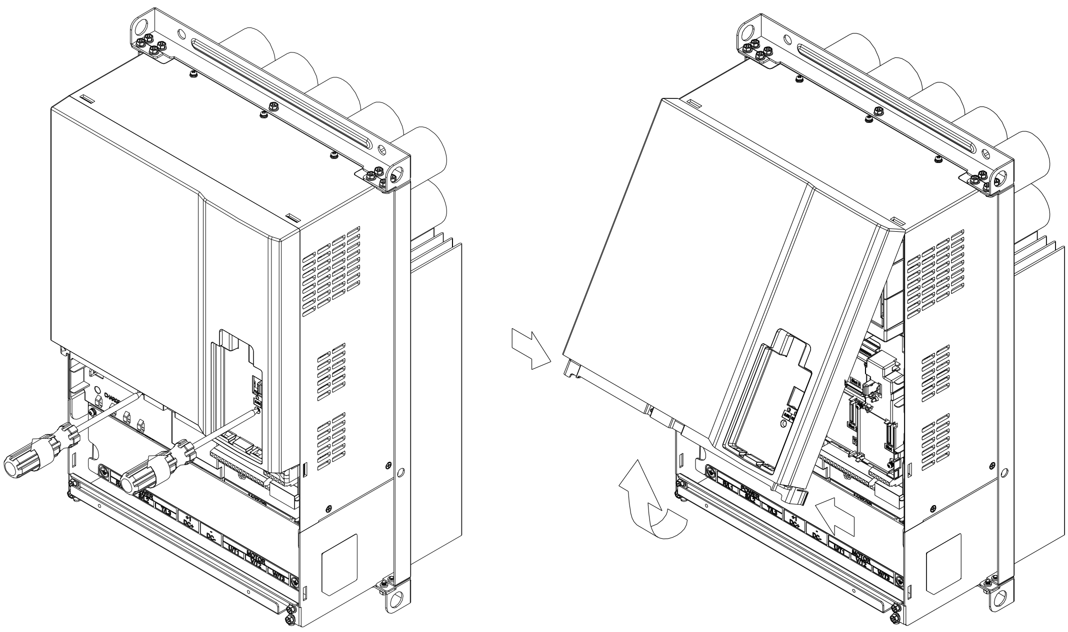


Frame D Screw torque: 10–12 kg-cm / (8.7–10.4 lb-in.) / (1.0–1.18 Nm)

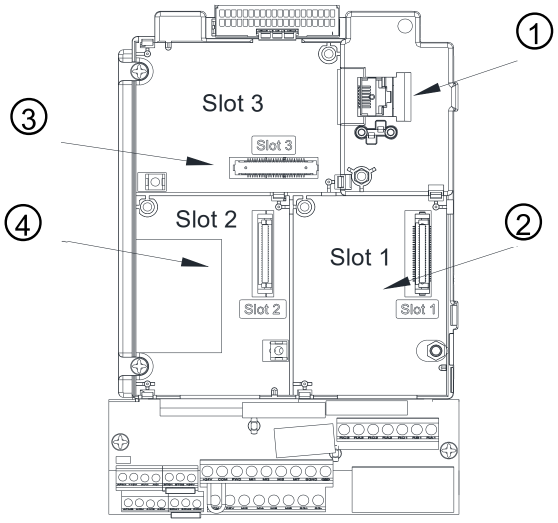


Step 2

Frame A–D Screw torque: 6–8 kg-cm / (5.2–6.9 lb-in.) / (0.59–0.78 Nm)



8-1-2 Option Card Installation Position



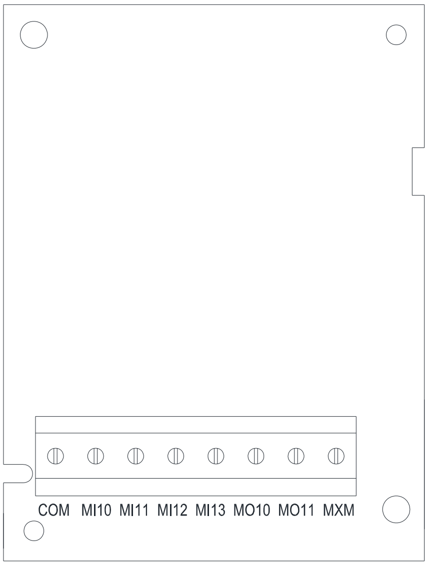
1	RJ45 (Socket) for digital keypad KPC-CC01 ● Refer to CH10 Digital Keypad for more details on KPC-CC01. ● Refer to CH10 Digital Keypad for more details on optional accessory RJ45 extension cable.
2	Communication extension card (Slot 1) CMC-PD01; CMC-DN01; CMC-EIP01; EMC-COP01; CMC-EC01; CMC-PN01
3	I/O & Relay extension card (Slot 3) EMC-D42A; EMC-D611A; EMC-R6AA; EMC-BPS01; EMC-A22A
4	PG Card (Slot 2) EMC-PG01L; EMC-PG02L; EMC-PG01O; EMC-PG02O; EMC-PG01U; EMC-PG02U; EMC-PG01R; EMC-PG01H

Screw specification for option card terminals:

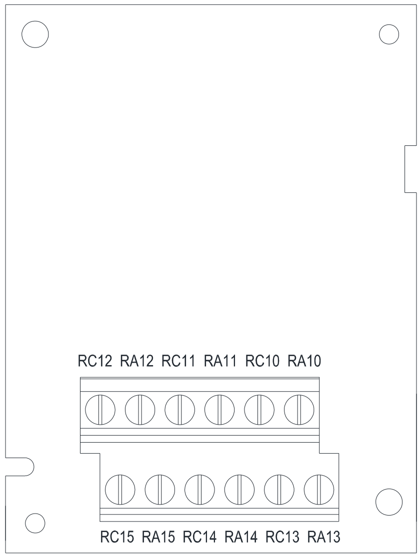
EMC-D42A; EMC-D611A; EMC-BPS01	Wire gauge	0.2–0.5 mm^2 (26–20 AWG)
	Torque	5 kg-cm / (4.4 Ib-in) / (0.5 Nm)
EMC-R6AA	Wire gauge	0.2–0.5 mm^2 (26–20 AWG)
	Torque	8 kg-cm / (7 Ib-in) / (0.8 Nm)
EMC-A22A	Wire gauge	0.2–4 mm^2 (24–12 AWG)
	Torque	5 kg-cm / (4.4 Ib-in) / (0.5 Nm)
EMC-PG01L; EMC-PG02L; EMC-PG01O; EMC-PG02O; EMC-PG01U; EMC-PG02U; EMC-PG01R; EMC-PG01H	Wire gauge	0.2–0.5 mm^2 (26–20 AWG)
	Torque	2 kg-cm / (1.73 Ib-in) / (0.2 Nm)

I/O & Relay extension card (Slot 3)

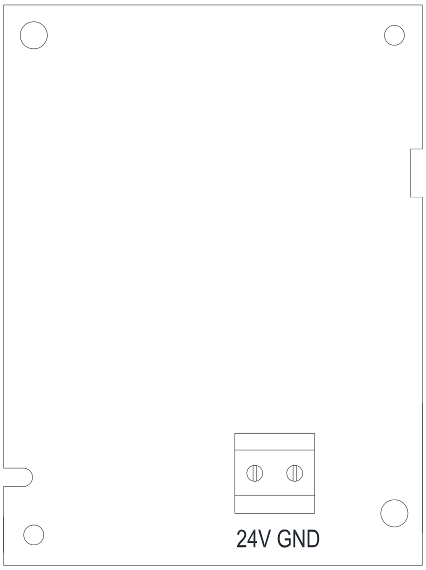
EMC-D42A



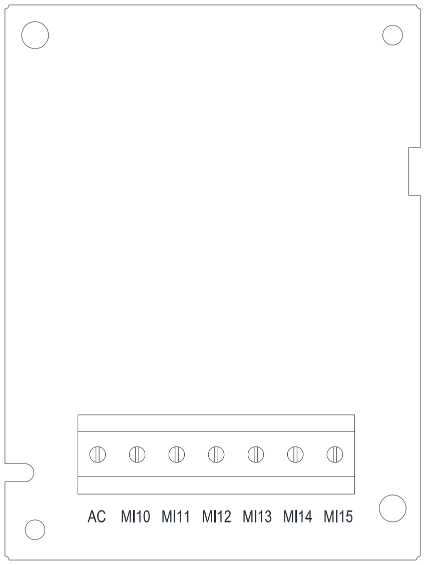
EMC-R6AA



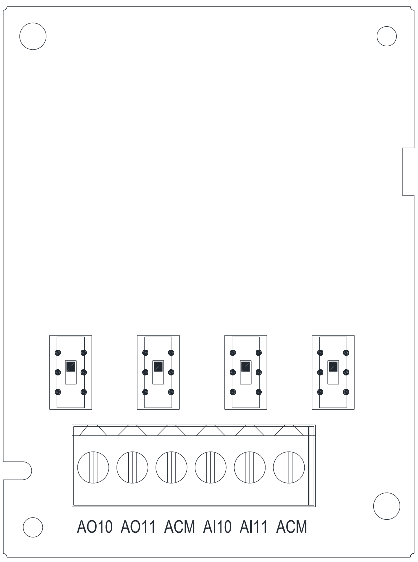
EMC-BPS01



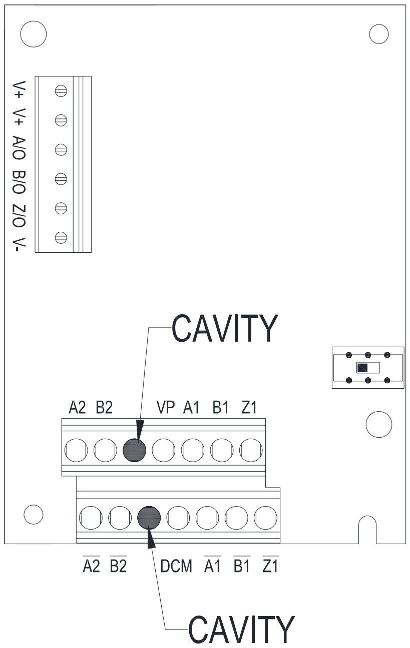
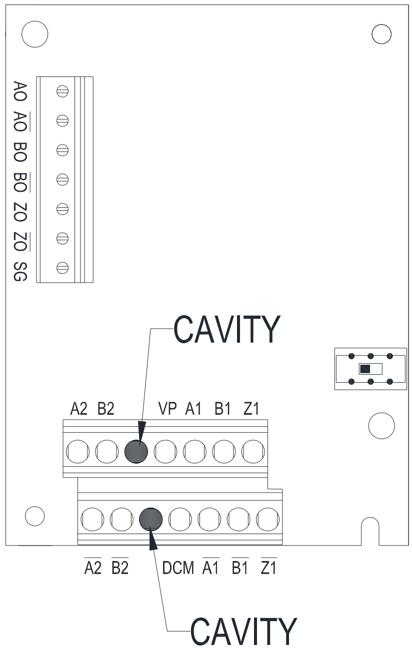
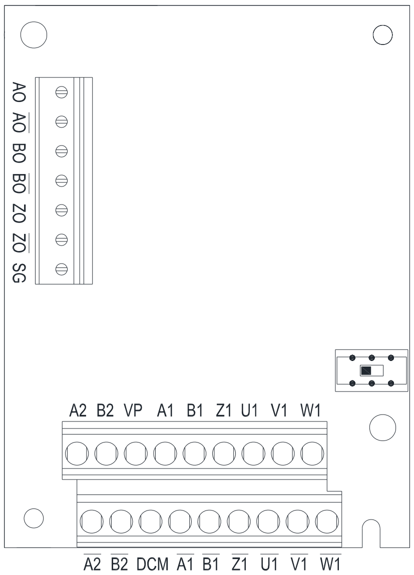
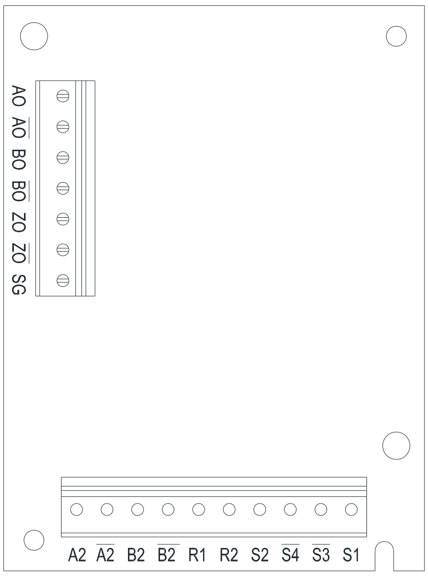
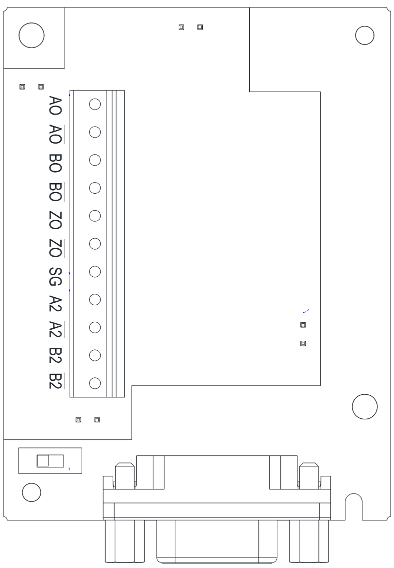
EMC-D611A



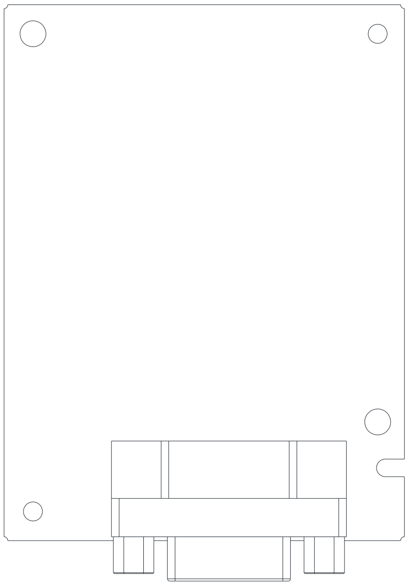
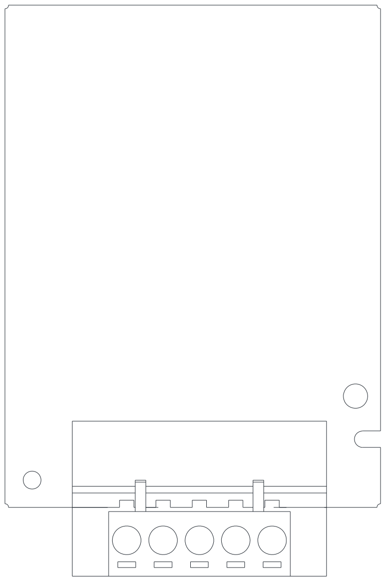
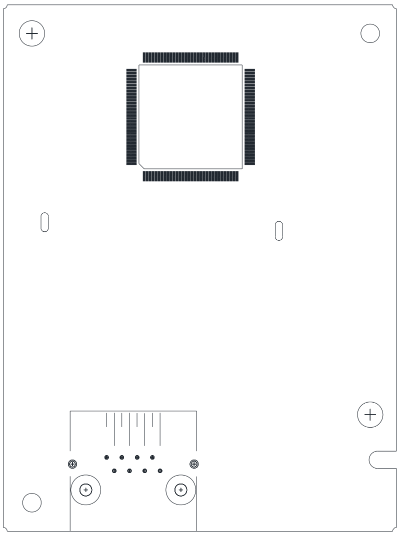
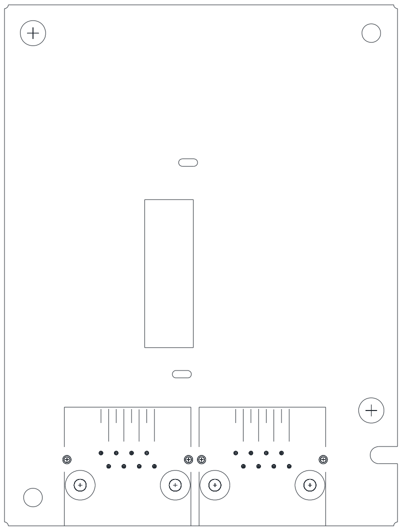
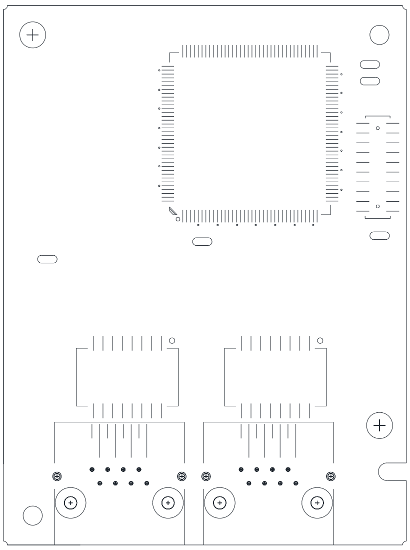
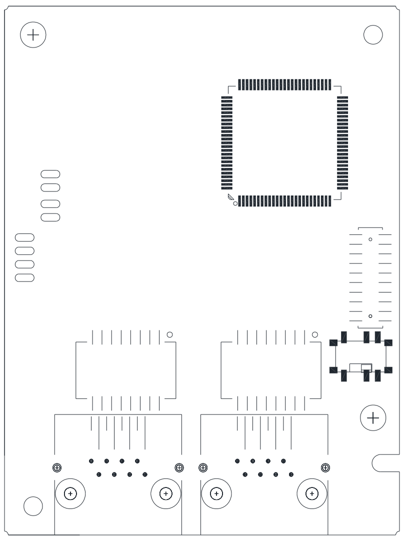
EMC-A22A



PG card (Slot 2)

EMC-PG01O / EMC-PG02O 	EMC-PG01L / EMC-PG02L 
EMC-PG01U / EMC-PG02U 	EMC-PG01R 
EMC-PG01H 	

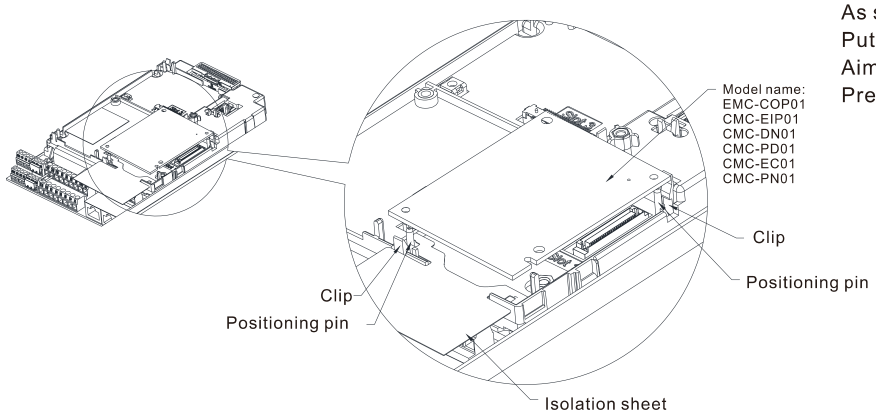
Communication extension card (Slot 1)

CMC-PD01 	CMC-DN01 
CMC-EIP01 	EMC-COP01 
CMC-EC01 	CMC-PN01 

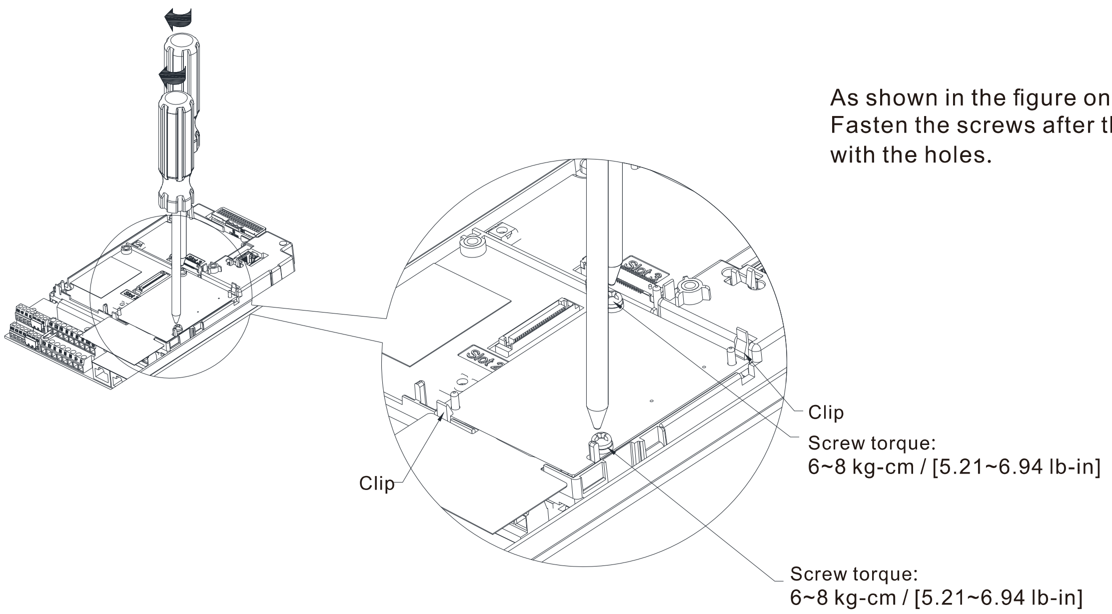
8-1-3 Installation and Disconnection of Extension Card

8-1-3-1 Installation

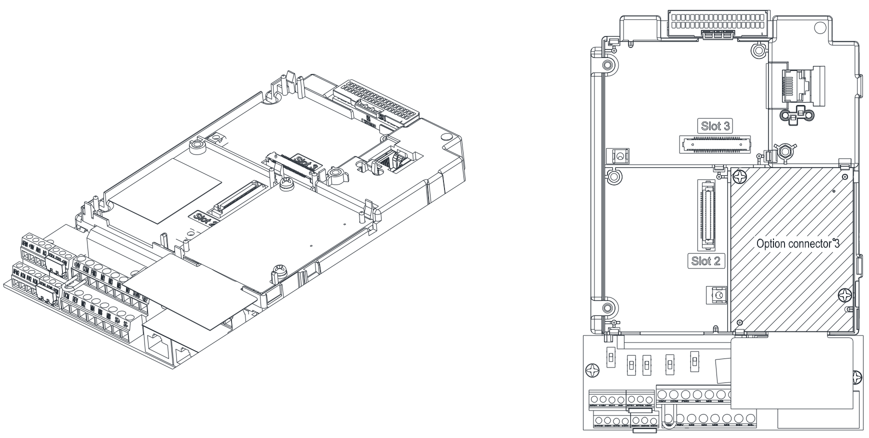
Communication card: EMC-COP01, CMC-EIP01, CMC-DN01, CMC-PD01, CMC-EC01, CMC-PN01



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.

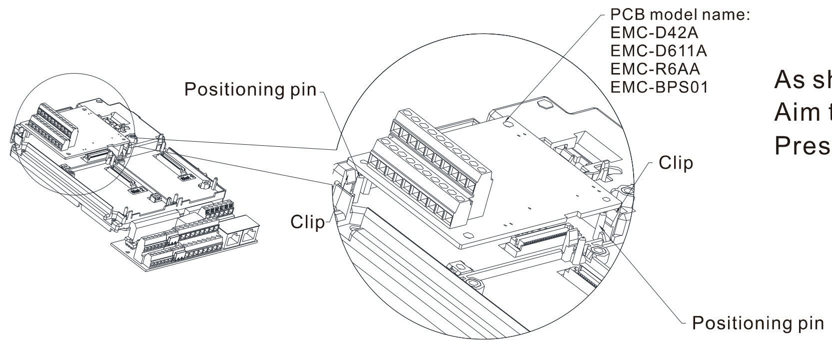


As shown in the figure on the left.
Fasten the screws after the PCB is clipped with the holes.

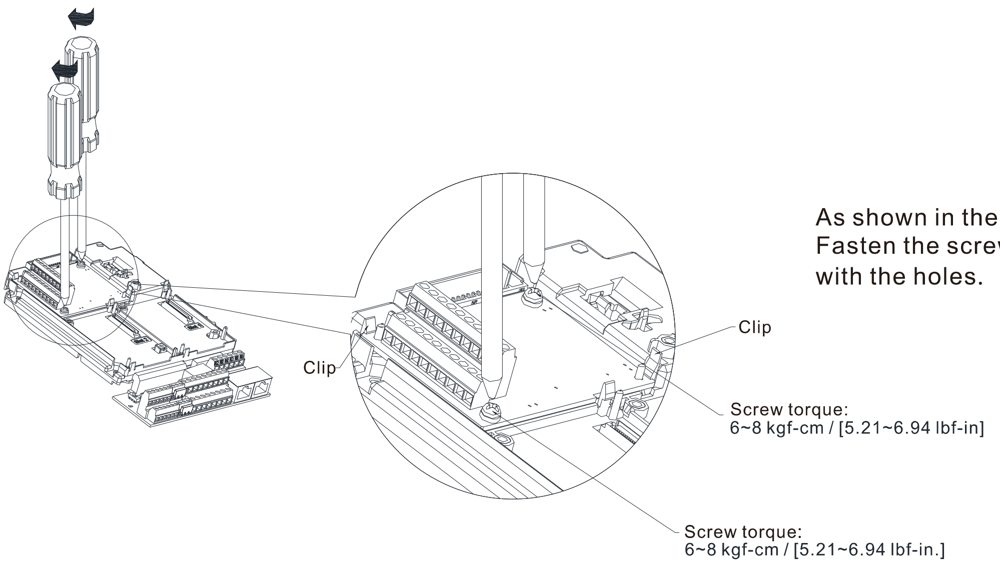


As shown in the figure on the left, installation is completed.

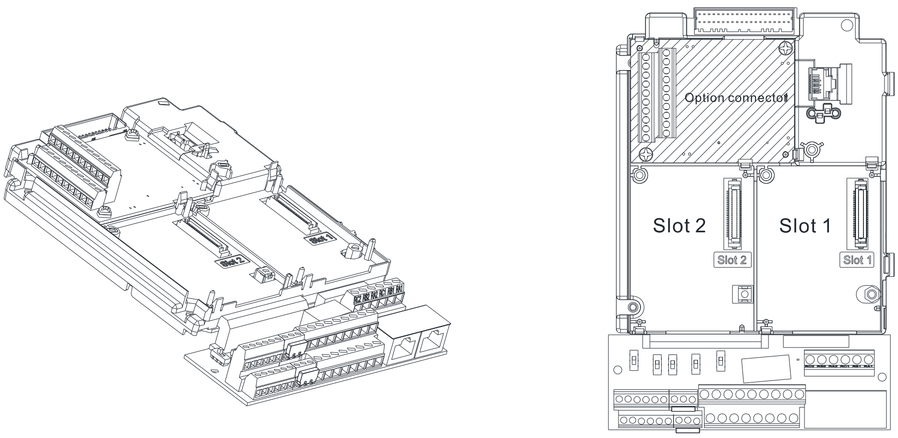
I/O & Relay card: EMC-D42A, EMC-D611A, EMC-R6AA, EMC-BPS01, EMC-A22A



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.

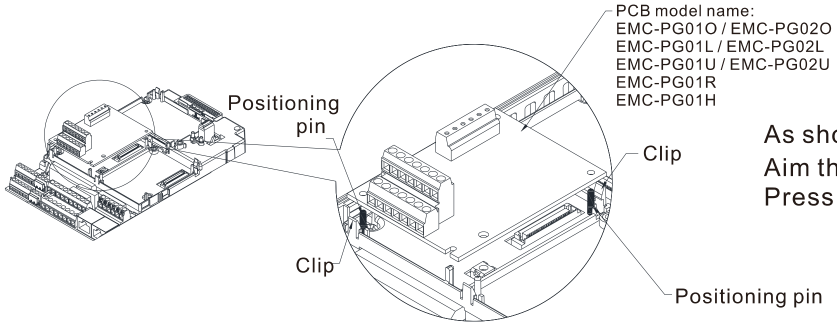


As shown in the figure on the left.
Fasten the screws after the PCB is clipped with the holes.

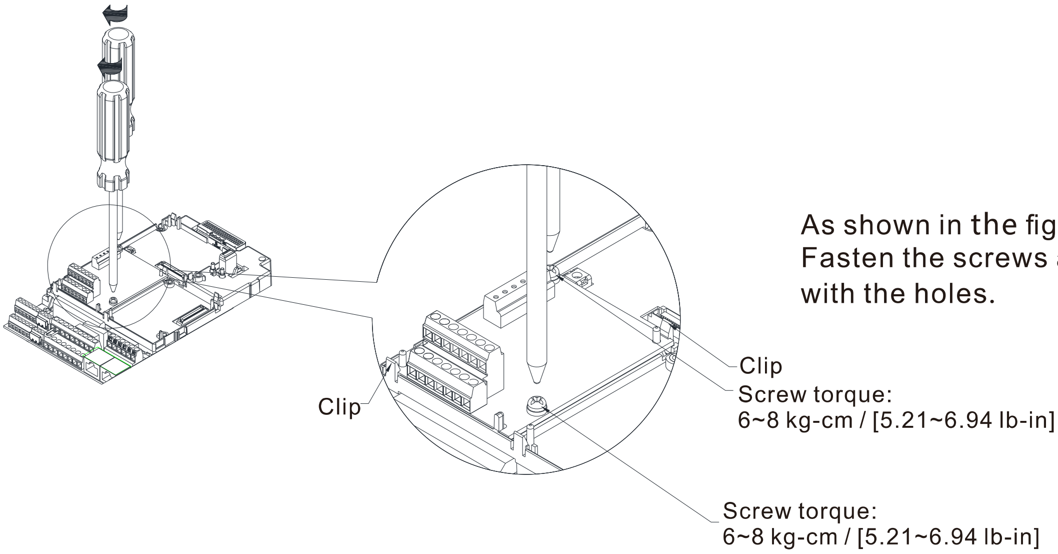


As shown in the figure on the left, installation is completed.

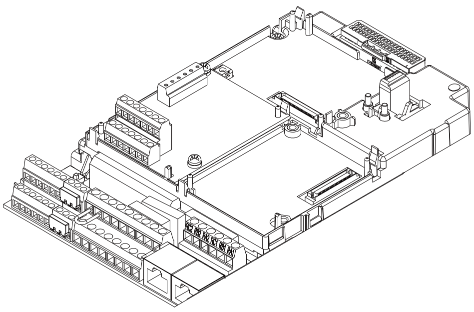
PG card: EMC-PG01O / EMC-PG02O, EMC-PG01L / EMC-PG02L, EMC-PG01U / EMC-PG02U, EMC-PG01R, EMC-PG01H

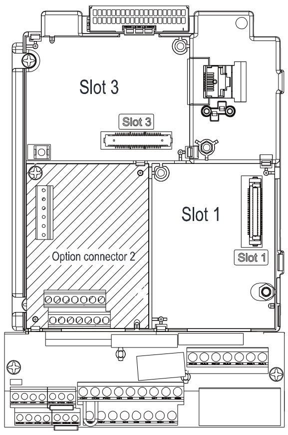


As shown in the figure on the left.
Aim the two holes at the positioning pin.
Press the pin to clip the holes with the PCB.



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

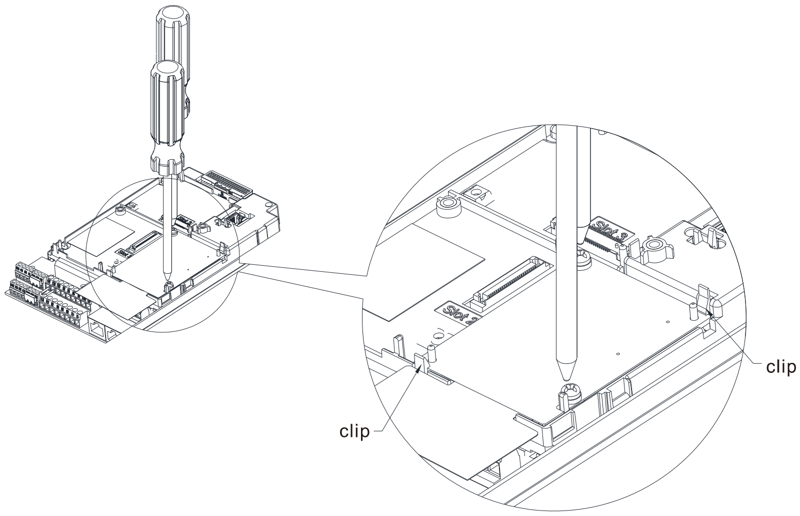




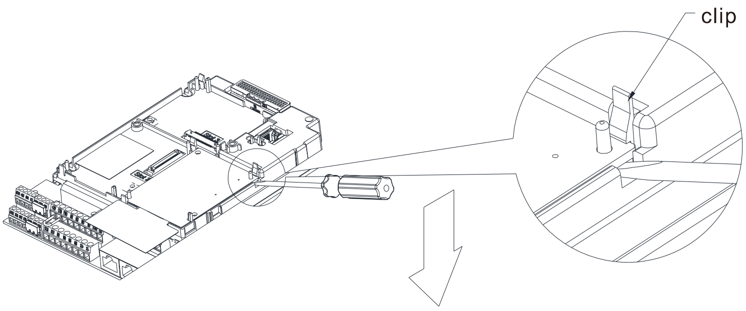
As shown in the figure on the left, installation is completed.

8-1-3-2 Disconnecting the Extension Card

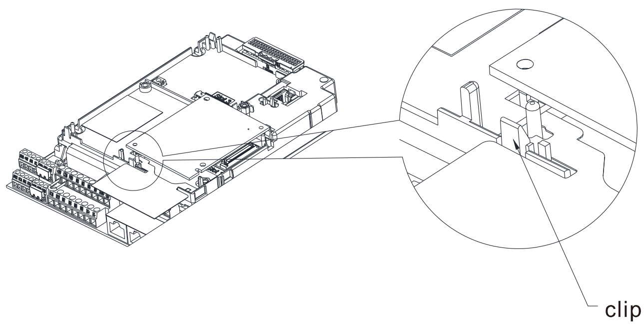
Communication card: EMC-COP01, CMC-EIP01, CMC-DN01, CMC-PD01, CMC-EC01, CMC-PN01



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

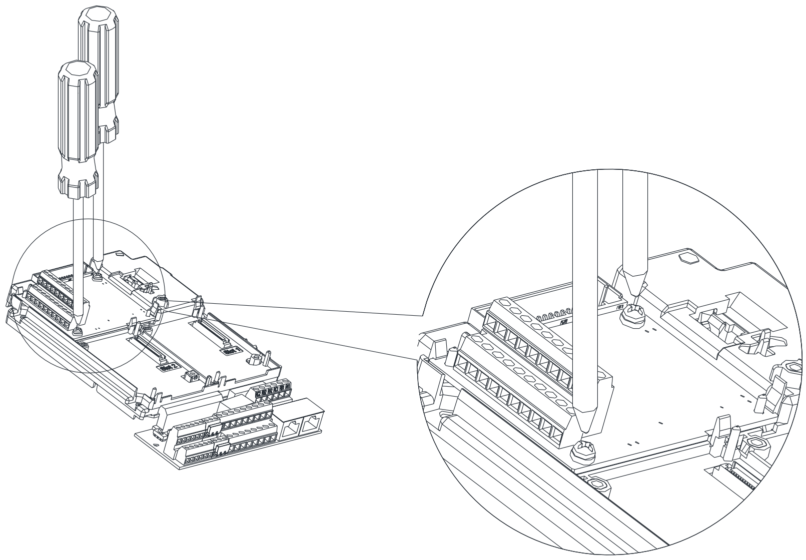


As shown in the figure on the left.
Twist to open the clip.
Insert a slot type screwdriver into the hollow to prize the PCB off the clip.

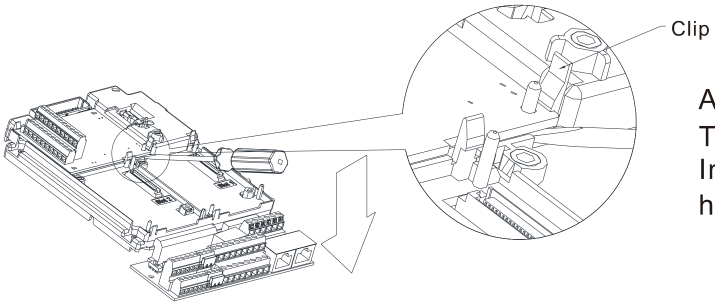


As shown in the figure on the left.
Twist to open the other clip to remove the PCB.

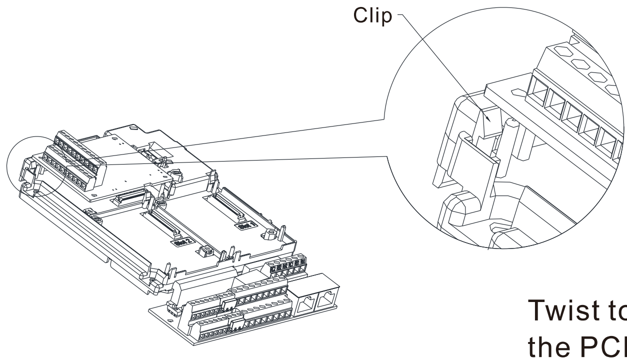
I/O & Relay card: EMC-D42A, EMC-D611A, EMC-R6AA, EMC-BPS01, EMC-A22A



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

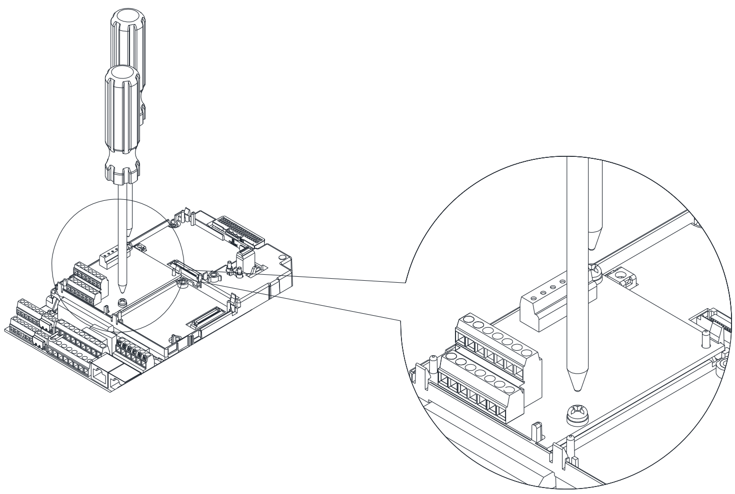


As shown in the figure on the left.
Twist to open the clip.
Insert a slot type screwdriver into the hollow to prize the PCB off the clip.

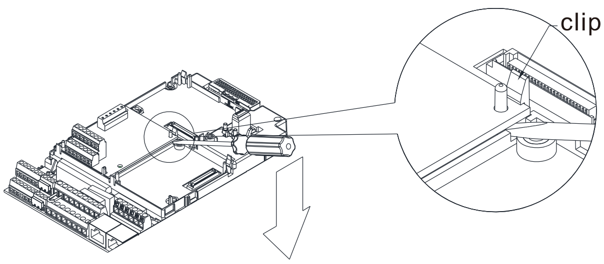


Twist to open the other clip to remove the PCB, as shown in the figure on the left.

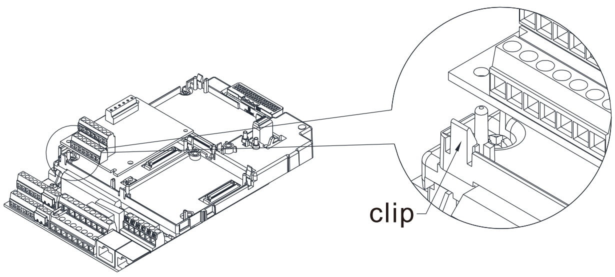
PG card: EMC-PG01O / EMC-PG02O, EMC-PG01L / EMC-PG02L, EMC-PG01U / EMC-PG02U, EMC-PG01R, EMC-PG01H, EMC-MC01



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

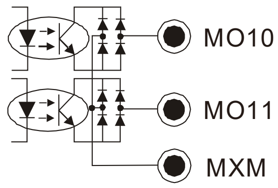


As shown in the figure on the left.
Twist to open the clip.
Insert a slot type screwdriver into the hollow to prize the PCB off the clip.



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

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.02-26–02-29 to program the multi-function inputs MI10–MI13. Internal power is applied from terminal E24: +24 V_{DC} ± 5% 200 mA, 5W External power +24 V_{DC}: max. voltage 30 V_{DC}, min. voltage 19 V_{DC}, 30W ON: the activation current is 6.5 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 (photocoupler) Max 48 V_{DC} 50 mA

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

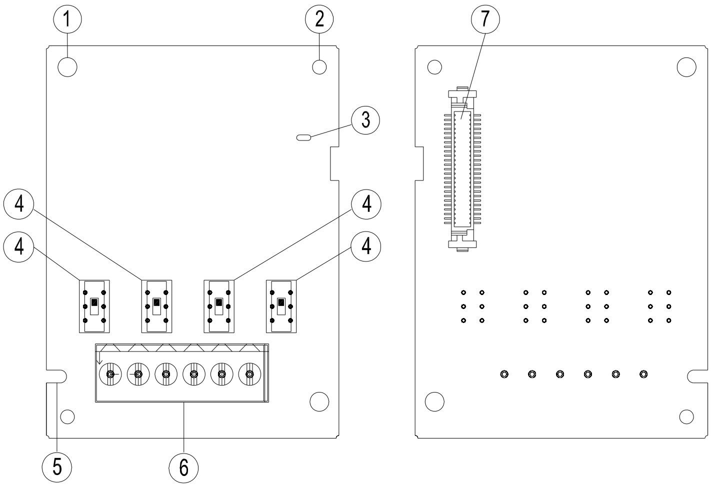
	Terminals	Descriptions
Relay Extension Card	RA10–RA15 RC10–RC15	Refer to Pr.02-36– Pr.02-41 for multi-function output selection Resistive load: 3A (N.O.) / 250 V_{AC} 5A (N.O.) / 30 V_{DC} Inductive load (COS 0.4) 1.2A (N.O.) / 250 V_{AC} 2.0A (N.O.) / 30 V_{DC} It is used to output each monitor signal, 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: 24 V± 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 communication 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-input (FWD, REV, MI1–MI8) needs external power supply to operate Following functions are not supported： Relay output (including extension card), PG card, PLC function

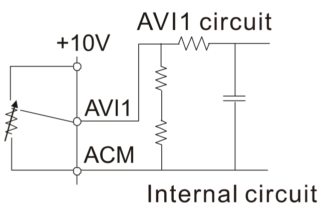
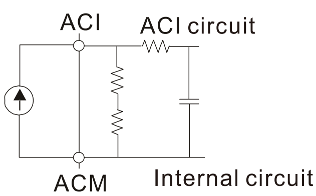
8-6 EMC-A22A -- Extension card for 2-point analog input/ 2-point analog output

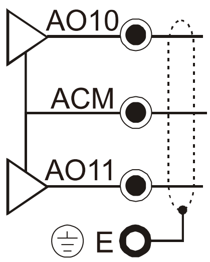
8-6-1 Product File



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 Specifications

<table>
<tr><th rowspan="4">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>
</table>

<table>
<tr><td rowspan="4"></td><td rowspan="3">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>
<tr><td rowspan="2">Multi-function analog output

</td><td>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</td></tr>
<tr><td>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</td></tr>
<tr><td>ACM</td><td>Analog Signal Common</td><td>Common for analog terminals</td></tr>
</table>

8-7 EMC-PG01L / EMC-PG02L -- PG card (Line driver)

8-7-1 Terminal Description

Set by Pr.10-00–10-02, Pr.10-16–10-18

<table>
<tr><th colspan="2">Terminals</th><th>Descriptions</th></tr>
<tr><td rowspan="3">PG1</td><td>VP</td><td>Output voltage for power: +5 V / +12 V ± 5% (use FSW3 to switch +5V / +12 V)
Max. output current: 200 mA</td></tr>
<tr><td>DCM</td><td>Common for power and signal</td></tr>
<tr><td>A1, /A1,
B1, /B1,
Z1, /Z1</td><td>Encoder input signal (Line Driver or Open Collector)
Open Collector input voltage: +5 – +24V (NOTE 1)
It can be single-phase or two-phase input.
EMC-PG01L: Max. input frequency: 300 kHz
EMC-PG02L: Max. input frequency: 30 kHz (NOTE 2)</td></tr>
<tr><td>PG2</td><td>A2, /A2,
B2, /B2</td><td>Pulse Input signal (Line Driver or Open Collector)
Open Collector input voltage: +5 – +24V (NOTE 1)
It can be single-phase or two-phase input.
EMC-PG01L: Max. input frequency: 300 kHz
EMC-PG02L: Max. input frequency: 30 kHz (NOTE 2)</td></tr>
<tr><td>PG OUT</td><td>AO, /AO,
BO, /BO,
ZO, /ZO,
SG</td><td>PG Card Output signals. It has division frequency function: 1–255 times
Max. output voltage for Line driver: 5 V_{DC}
Max. output current: 15 mA
EMC-PG01L Max. output frequency: 300 kHz
EMC-PG02L Max. output frequency: 30 kHz
SG is the GND of PG card. It is also the GND of position machine or PLC to make the output signal to be the common pivot point.</td></tr>
</table>

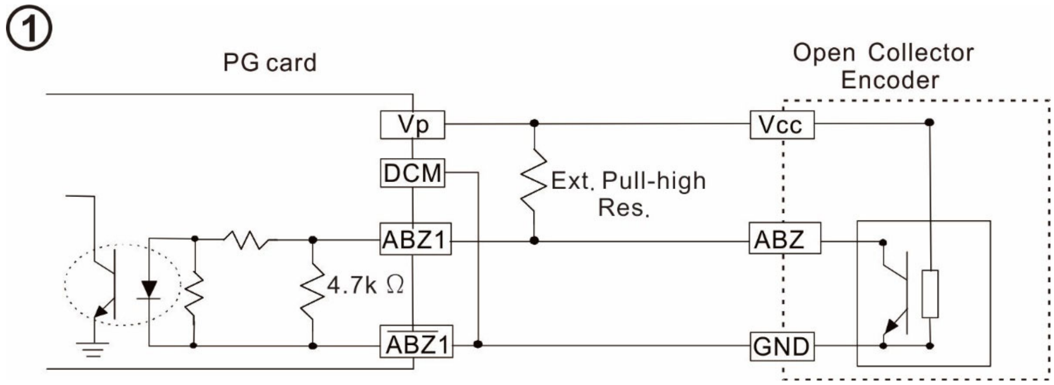
NOTE:

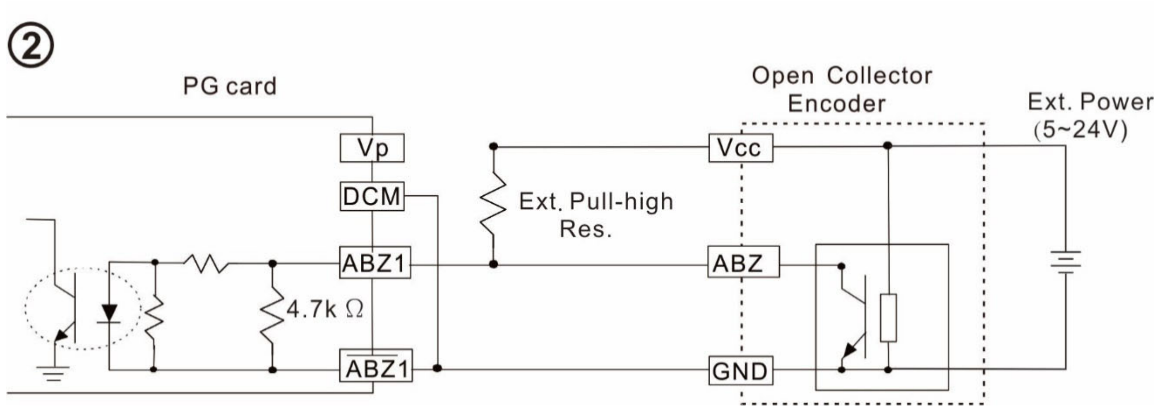
1. Open Collector application, input current 5–15 mA to each set then each set needs one pull-up resistor. If input voltage of open collector is 24V, the power of encoder needs to be connected externally. Refer to diagram 2 of PG1.

5V	Recommended pull-up resistor: above 100–220 Ω, 1/2W
12V	Recommended pull-up resistor: above 510–1.35 kΩ, 1/2W
24V	Recommended pull-up resistor, above 1.8k–3.3 kΩ, 1/2W

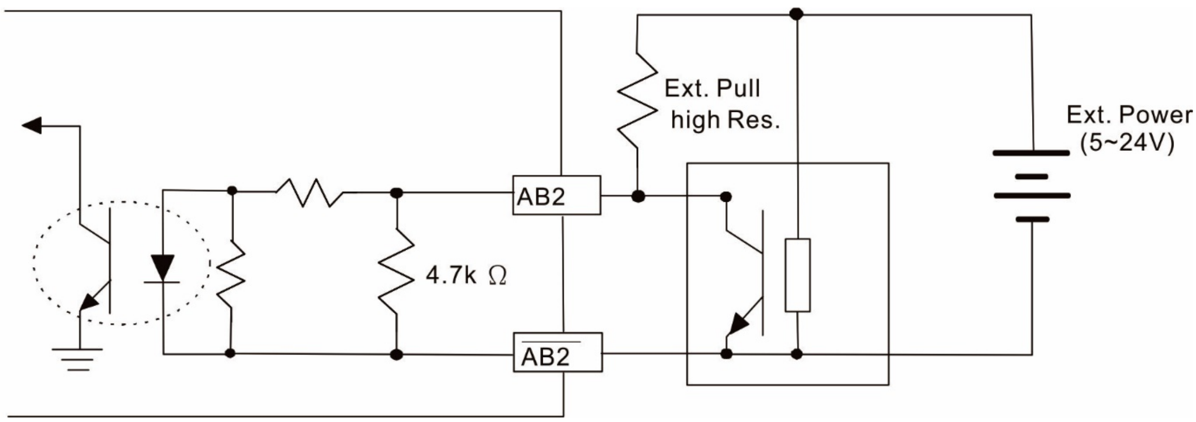
2. If the required bandwidth is not over 30 kHz at the application, it is recommended to use EMC-PG02O / EMC-PG02L (bandwidth 30 kHz) to avoid interference.

PG1 card wiring diagram (two images below are wiring diagrams of open collector encoder)



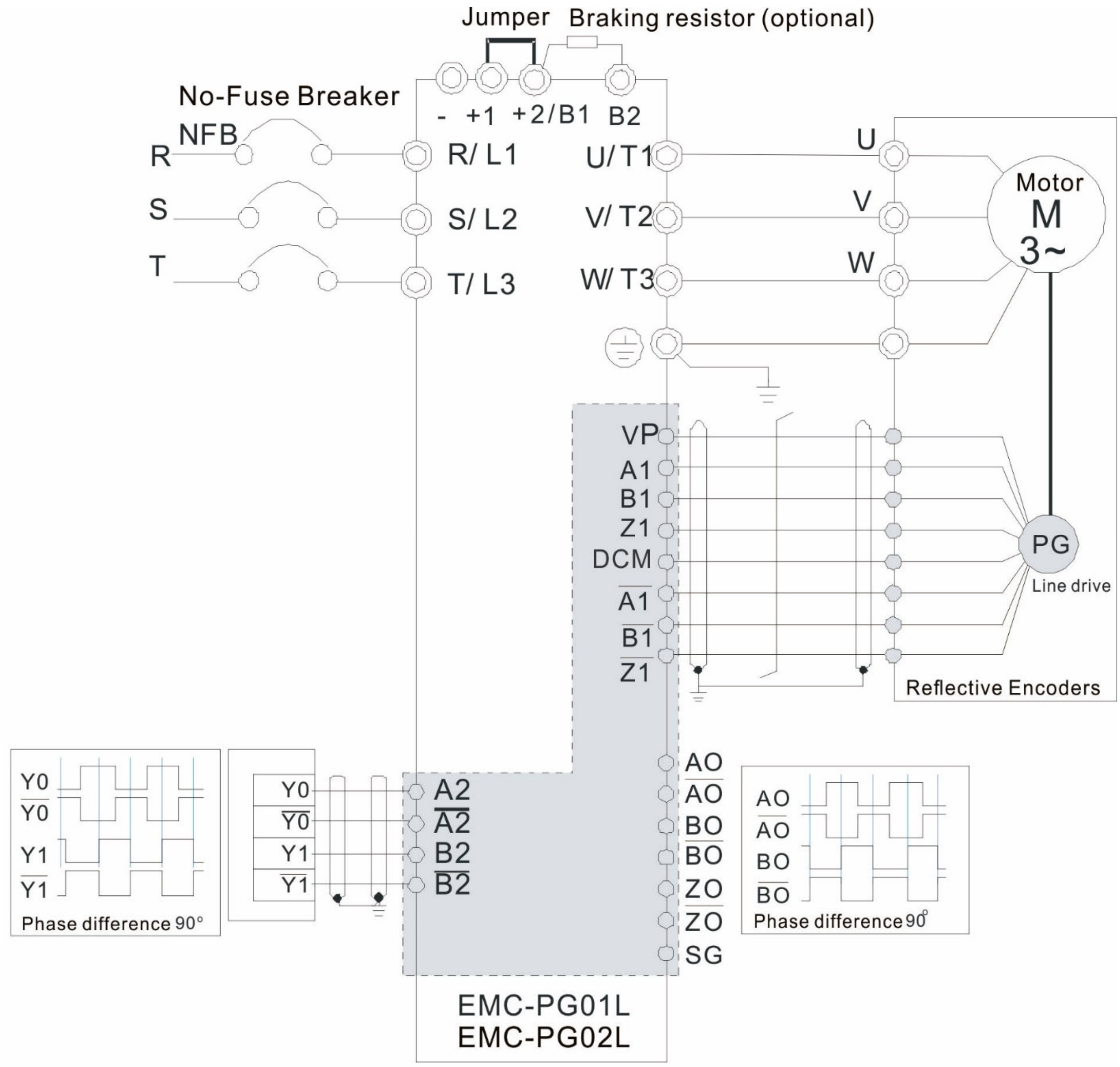


PG2 wiring diagram



8-7-2 EMC-PG01L / EMC-PG02L Wiring Diagram

- Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200 V_{AC} and above).
- Recommended wire size 0.2–0.75 mm^2 (24–18 AWG).
- Cable length: Single-phase input, less than 30 m / two-phase input, less than 100 m.



8-8 EMC-PG01O / EMC-PG02O -- PG card (Open collector)

8-8-1 Terminal Descriptions

Set by Pr.10-00–10-02, Pr.10-16–10-18

Terminals		Descriptions
PG1	VP	Output voltage for power: +5V/+12V±5% (use FSW3 to switch +5V/+12V) Max. output current: 200 mA
	DCM	Common for power and signal
	A1, /A1, B1, /B1, Z1, /Z1	Encoder Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5V – +24V (NOTE 1) It can be single-phase or two-phase input. EMC-PG01O Max. input frequency: 300 kHz EMC-PG02O Max. input frequency: 30 kHz (NOTE 2)
PG2	A2, /A2, B2, /B2	Pulse Input Signal (Line Driver or Open Collector) Open Collector Input Voltage: +5 – +24V (NOTE 1) It can be single-phase or two-phase input. EMC-PG01O Max. input frequency: 300 kHz EMC-PG02O Max. input frequency: 30 kHz (NOTE 2)
PG OUT	V+, V+	Needs external power source for PG OUT circuit. Input voltage of power: +7V – +24V
	V-	Input voltage for the negative side
	A/O, B/O, Z/O	PG Card Output signals has division frequency function: 1–255 times. On the open collector's output signal, add a high-pull resistor on the external power V+ – V- (e.g. power of PLC) to prevent the interference of the receiving signal. Max. [Three pull-up resistor are included in the package (1.8 kΩ / 1W)] (NOTE 1) EMC-PG01O Max. input frequency: 300 kHz EMC-PG02O Max. input frequency: 30 kHz (NOTE 2)

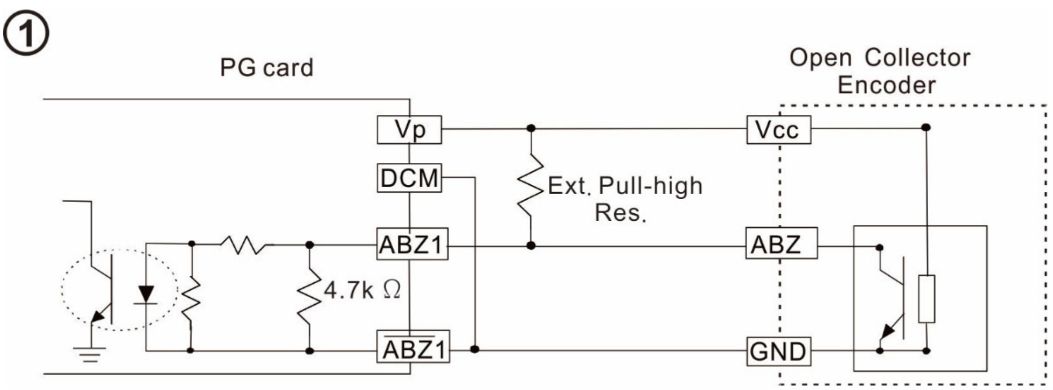
NOTE:

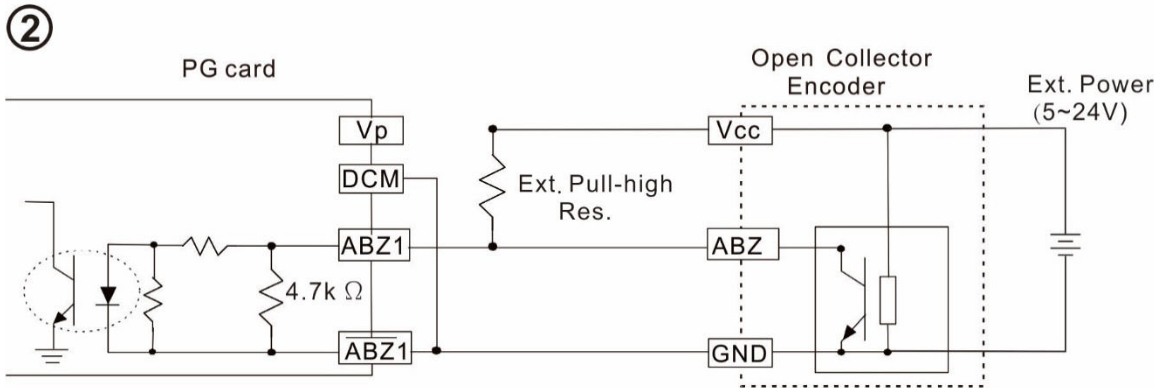
1. Open Collector application, input current 5–15 mA to each set then each set needs one pull-up resistor. If input voltage of open collector is 24V, the power of encoder needs to be connected externally. Refer to diagram 2 of PG1.

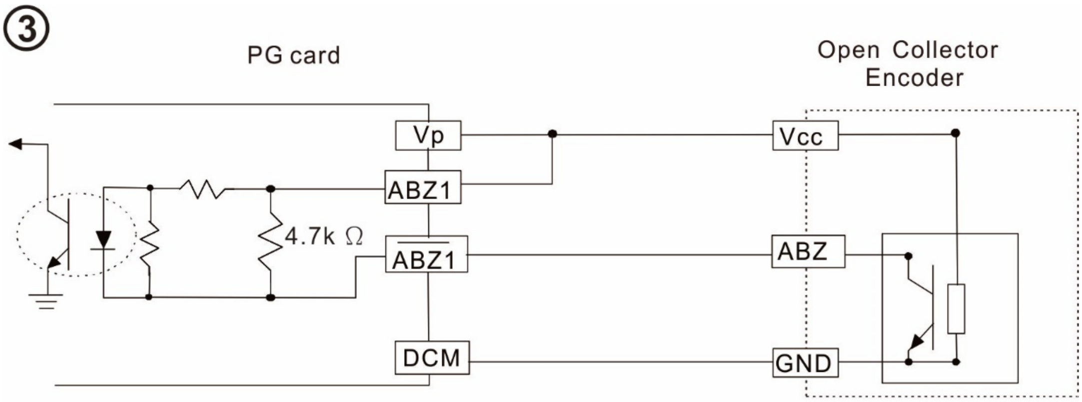
5V	Recommended pull-up resistor: above 100–220 Ω, 1/2W
12V	Recommended pull-up resistor: above 510–1.35 kΩ, 1/2W
24V	Recommended pull-up resistor, above 1.8k–3.3k Ω, 1/2W

2. If the required bandwidth is not over 30 kHz at the application, it is recommended to use EMC-PG02O / EMC-PG02L (bandwidth 30 kHz) to avoid interference.

PG1 card wiring diagram (three images below are wiring diagrams of open collector encoder)



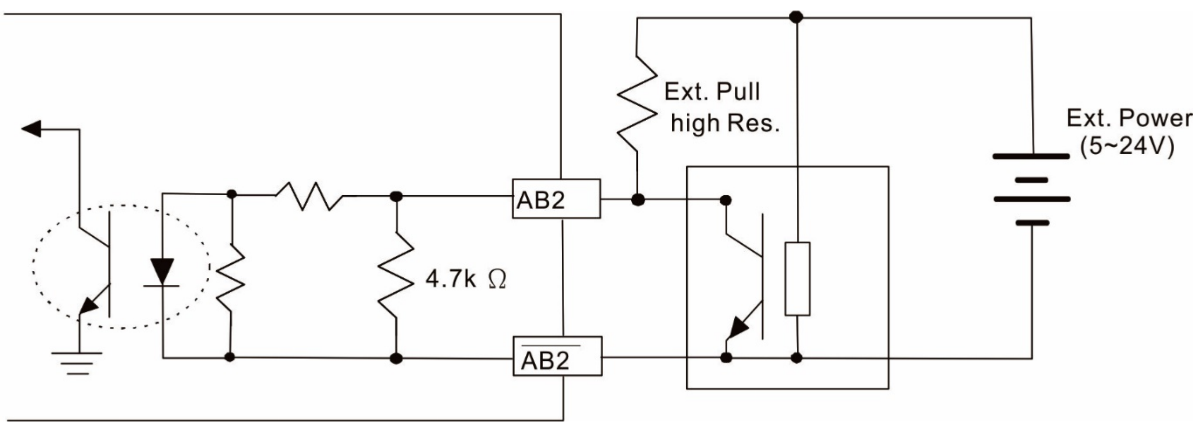




When wiring in this way, if there is a signal on EMC-PG01O's A1, B1 and Z1, LED lights is OFF.

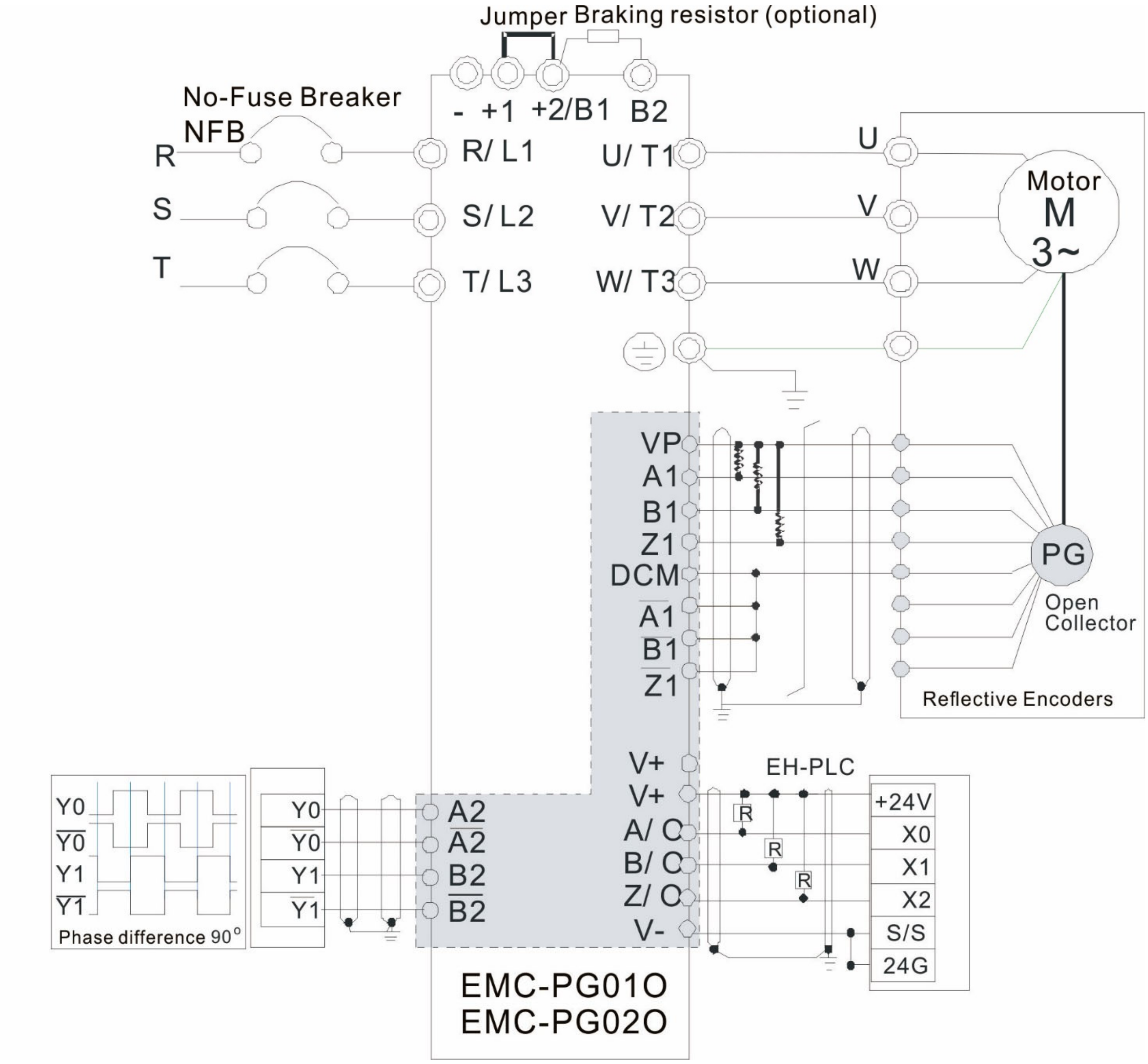
If A1, B1 and Z1 have no signals, LED lights is ON.

PG2 Wiring Diagram



8-8-2 EMC-PG01O / EMC-PG02O Wiring Diagram

- Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200 V and above).
- Recommended wire size 0.2–0.75 mm^2 (24–18 AWG).
- Cable length: Single-phase input, less than 30 m / two-phase input, less than 100 m.



8-9 EMC-PG01U / EMC-PG02U

-- PG card (ABZ Incremental encoder signal/ UVW Hall position signal input)

1. FSW1 $\boxed{S}$: Standard UVW Output Encoder; $\boxed{D}$: Delta Encoder
2. When using the Delta Encoder, wait for at least 250 ms after powering up to receive signals from UVW. If a running command is received before UVW signals finished, a PGF5 error message will be given. So wait for 250 ms before sending a running command.
3. EMC-PG02U has encoder disconnection detection function.

8-9-1 Terminal Descriptions

Set by Pr.10-00–10-02, Pr.10-16–10-18

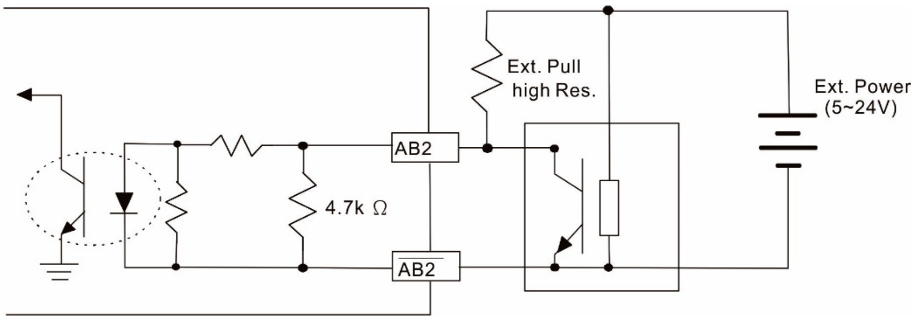
Terminals		Descriptions
PG1	VP	Output voltage for power: +5V / +12V ± 5% (use FSW3 to switch +5V / +12V) Max. output current: 200 mA
	DCM	Common for power and signal
	A1, /A1, B1, /B1, Z1, /Z1	Encoder input signal (Line Driver) It can be single-phase or two-phase input. Max. output frequency: 300 kHz
	U1, /U1, V1, /V1, W1, /W1	Encoder input signal
PG2	A2, /A2, B2, /B2	Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5 – +24V (NOTE1) It can be single-phase or two-phase input. Max. output frequency: 300 kHz.
PG OUT	AO, /AO, BO, /BO, ZO, /ZO, SG	PG Card Output signals. It has division frequency function: 1–255 times Max. output voltage for Line driver: 5 V_{DC} Max. output current: 15 mA Max. output frequency: 300 kHz SG is the GND of PG card. It is also the GND of position machine or PLC to make the output signal to be the common pivot point.

NOTE:

1. Open Collector application, input current 5–15 mA to each set then each set needs one pull-up resistor.

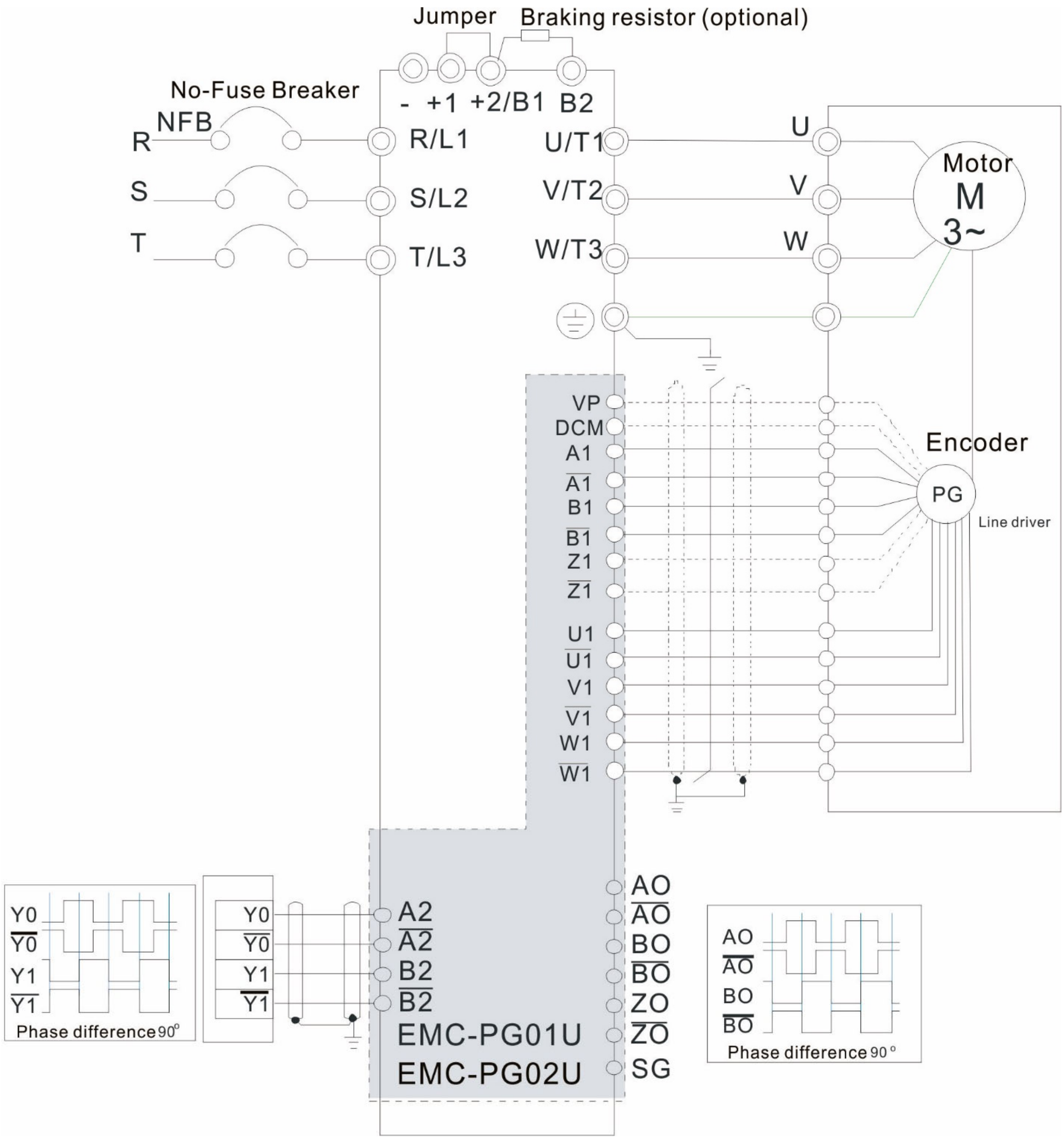
5V	Recommended pull-up resistor: above 100–220 Ω, 1/2W
12V	Recommended pull-up resistor: above 510–1.35 kΩ, 1/2W
24V	Recommended pull-up resistor, above 1.8k–3.3 kΩ, 1/2W

PG2 Wiring Diagram



8-9-2 EMC-PG01U Wiring Diagram

- Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200 V and above).
- Recommended wire size 0.2–0.75 mm^2 (24–18 AWG).
- Cable length: Single-phase input, less than 30 m / two-phase input, less than 100 m.



8-10 EMC-PG01R -- PG card (Resolver)

8-10-1 Terminal Descriptions

Set by Pr.10-00–10-02 and Pr.10-30 Resolver. (Pr.10-00=3, Pr.10-01=1024)

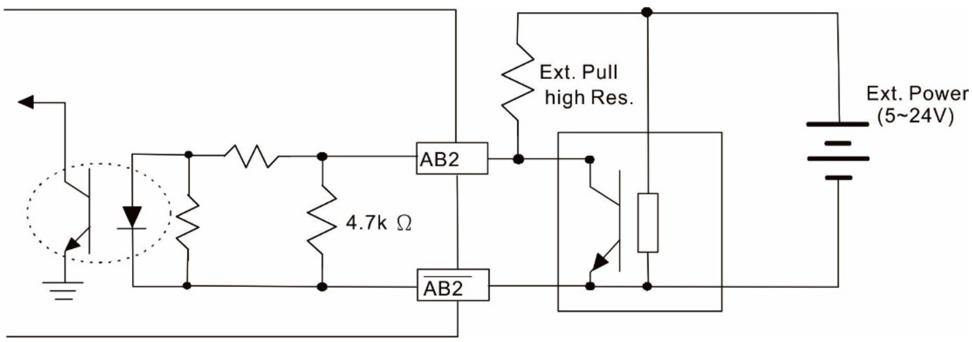
Terminals		Descriptions
PG1	R1- R2	Resolver Output Power 7 Vrms, 10 kHz
	S1, /S3, S2, /S4,	Resolver Input Signal (S2, /S4=Sin; S1, /S3=Cos) 3.5±0.175 Vrms, 10 kHz
PG2	A2, /A2, B2, /B2	Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5 – +24V (NOTE 1) It can be single-phase or two-phase input. Max. output frequency: 300 kHz
PG OUT	AO, /AO, BO, /BO, ZO, /ZO, SG,	PG Card Output signals. It has division frequency function: 1–255 times Max. output voltage for Line driver: 5 V_{DC} Max. output current: 15 mA Max. output frequency: 300 kHz SG is the GND of PG card. It is also the GND of position machine or PLC to make the output signal to be the common pivot point.

NOTE:

1. Open Collector application, input current 5–15 mA to each set then each set needs one pull-up resistor.

5V	Recommended pull-up resistor: above 100–220 Ω, 1/2W
12V	Recommended pull-up resistor: above 510–1.35 kΩ, 1/2W
24V	Recommended pull-up resistor, above 1.8k–3.3 kΩ, 1/2W

PG2 Wiring Diagram

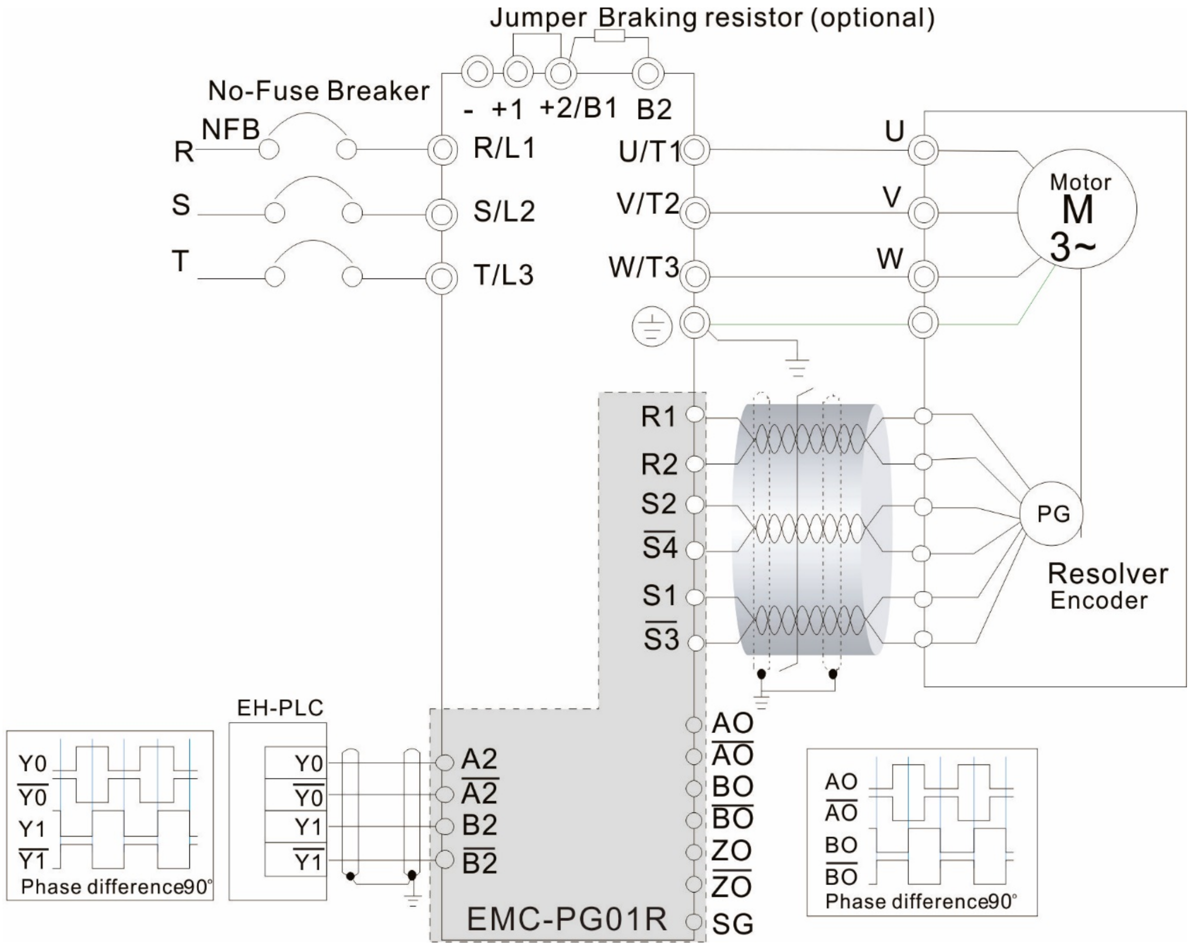


- DOS (Degradation of Signal) : If the amplitude of the sine wave input of the S1-/S3/ S2-/S4 is lower than or higher than the encoder IC's specification, a red light will be on. The possible reasons which cause this problem are the following.
  1. The turns ratio of the resolver encoder is not 1:0.5 which makes the sine wave input of the S1-/S3/S2-/S4 not equal to 3.5±0.175 Vrms.
  2. While motor is running, motor creates common mode noise which makes accumulated voltage to be more than 3.5±0.175 Vrms

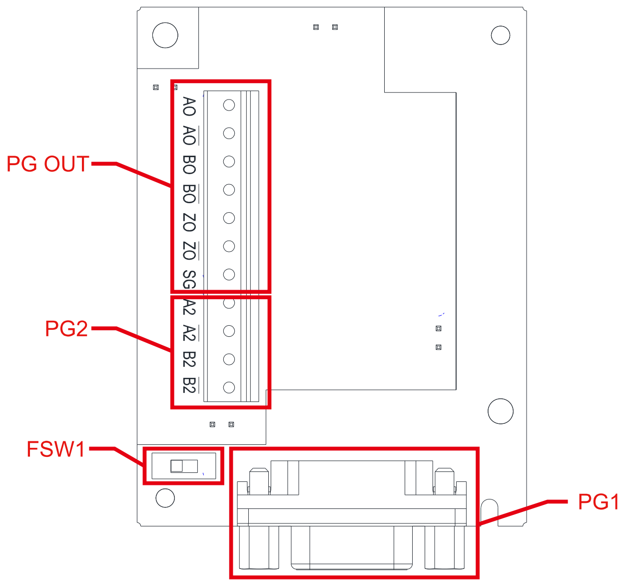
- LOT (Loss of Tracking): Compare the angle of S1-/S3/S2-/S4 sine wave input to the R1-R2 cosine wave. If their difference is more than 5 degrees, a red light will be on. Here are the possible reasons why that happens:
  1. The output frequency of the PG card is incorrect.
  2. The specification of Resolver's encoder is not 10 kHz
  3. The motor creates common mode noise while it is running. That causes a big difference, while the motor is rotating, between main winding's cosine wave angle and the sine wave angle of second and third windings.

8-10-2 EMC-PG01R Wiring Diagram

- Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200 V_{AC} and above).
- Recommended wire size 0.2–0.75 mm^2 (24–18 AWG).
- Cable length: PG1 input, less than 30m; PG2 single-phase input, less than 30 m / two-phase input, less than 100 m.



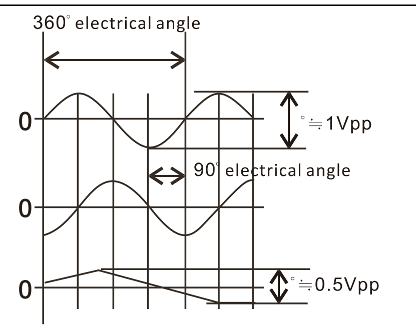
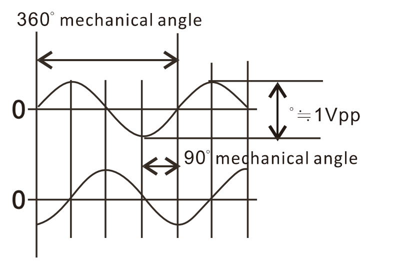
8-11 EMC-PG01H – PG card (Resolver)

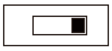
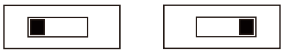


1. The PG1 at input side is SinCos signal of 1 Vpp, and the bandwidth is 600 kHz.
2. The principle of operation for a SinCos encoder is similar to a square-wave encoder, but use SinCos signal instead.
3. The pulse unit of SinCos encoder is ppr, 1024 ppr means 1024 SinCos signals per revolution with single phase.

8-11-1 Terminal Descriptions

Set by Pr.10-00–10-03 and Pr.10-16–10-18.

Terminals		Descriptions	
PG1	VP	Power output voltage: +5V / +8V ± 5% (+5V / +8V decided by FSW1) Max. output current: 200 mA	
	DCM	Digital control / Frequency signal common	
	A+, A-, B+, B-, R+, R-	Encoder wave difference signal input (Incremental signal) Max. output frequency: 600 kHz	
	C+, C-, D+, D-	Encoder wave difference signal input (Absolute signal)	
PG2	A2, /A2, B2, /B2	Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: +5 – +24V (NOTE 1) It can be single-phase or two-phase input. Max. output frequency: 300 kHz	

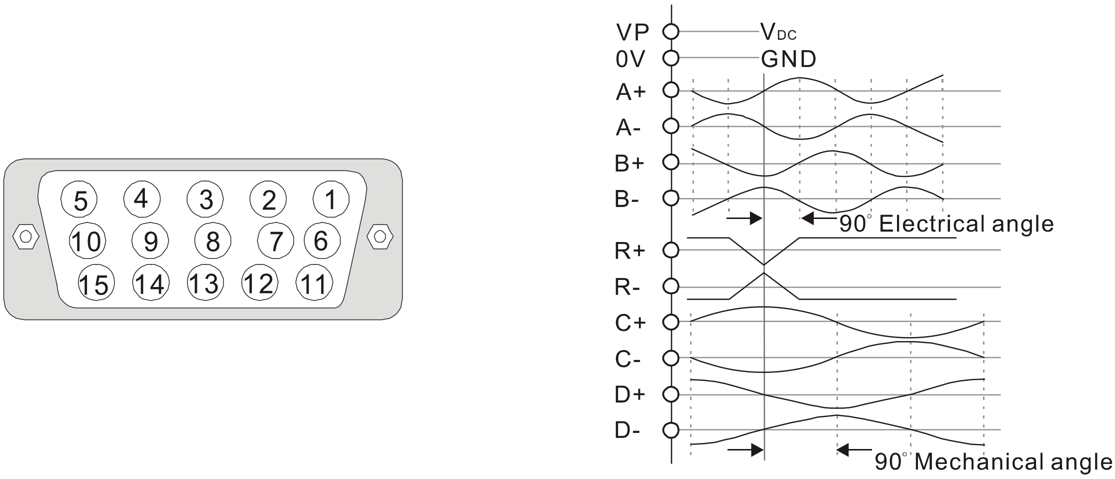
PG OUT	AO, /AO, BO, /BO, ZO, /ZO, SG	PG Card Output signals. It has division frequency function: 1–255 times Max. output voltage for Line driver: 5 V_{DC} Max. output current: 15 mA Max. output frequency: 600 kHz ± 5% SG is the GND of PG card. It is also the GND of position machine or PLC to make the output signal to be the common pivot point.
FSW1 		Use FSW1 to switch the power of VP: +5V / +8V  +8V +5V

NOTE:

1. Open Collector application, input current 5–15 mA to each set then each set needs one pull-up resistor. If input voltage of open collector is 24V, the power of encoder needs to be connected externally. Refer to diagram 2 of PG2.

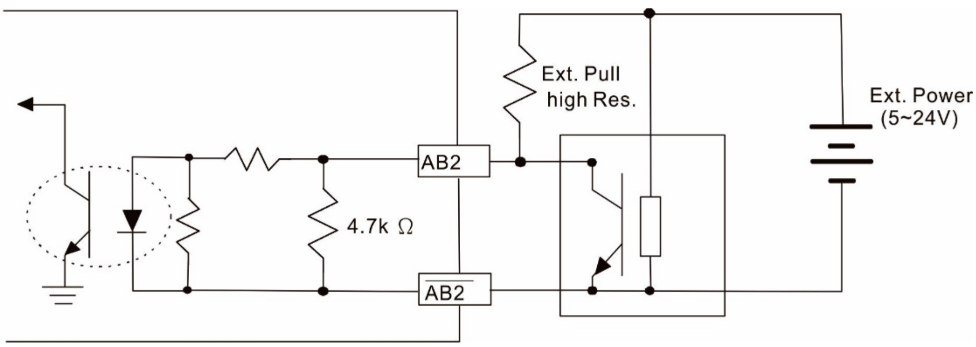
5V	Recommended pull-up resistor: above 100–220 Ω, 1/2W
12V	Recommended pull-up resistor: above 510Ω–1.35 kΩ, 1/2W
24V	Recommended pull-up resistor: above 1.8k–3.3 kΩ, 1/2W

PG1 Terminal descriptions (15pin D-SUB female connector)



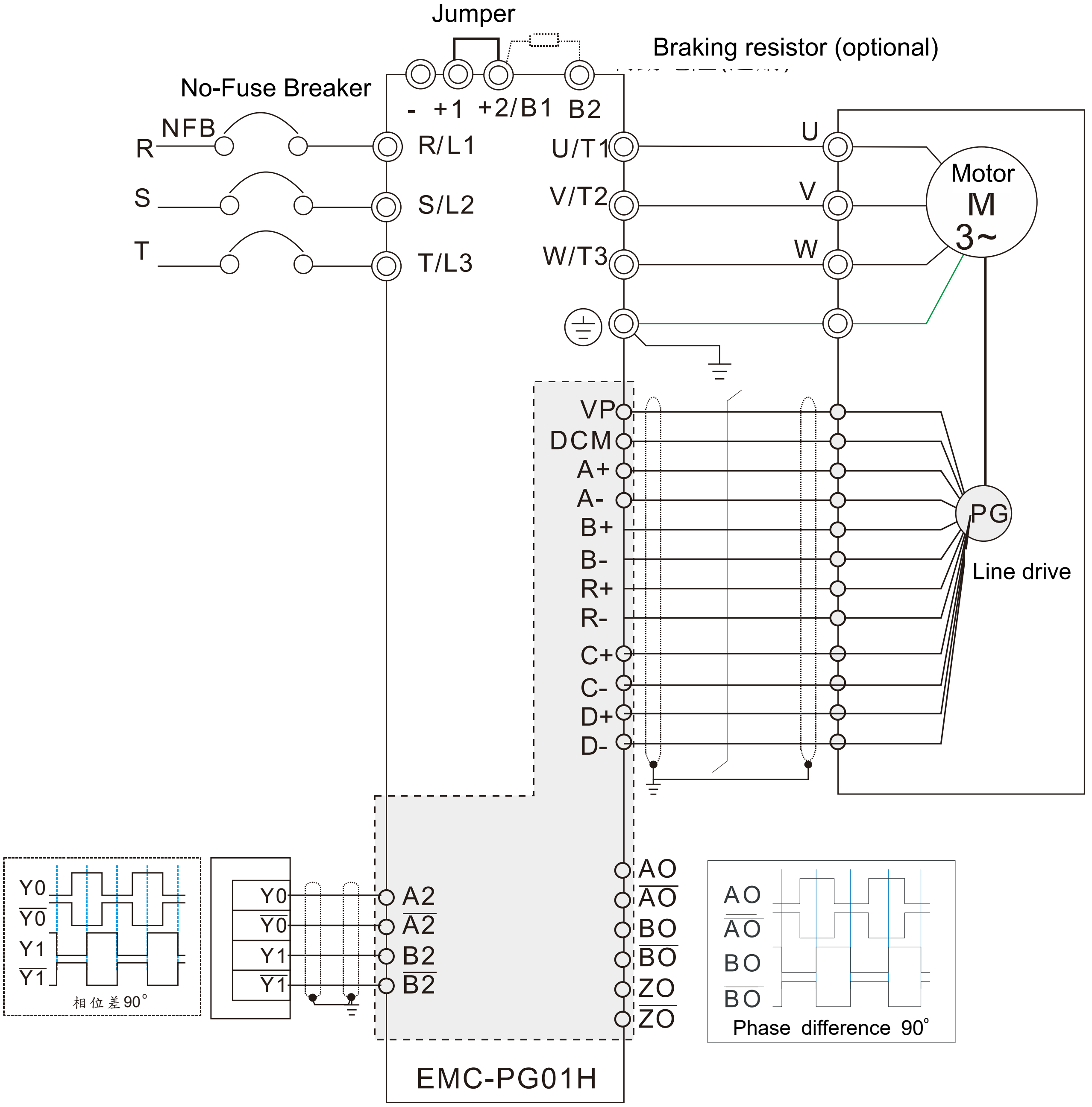
No.	Terminals	No.	Terminals
1	B-	9	VP
2	NC	10	C+
3	R+	11	C-
4	R-	12	D+
5	A+	13	D-
6	A-	14	NC
7	DCM	15	NC
8	B+		

PG2 wiring diagram



8-11-2 EMC-PG01H Wiring Diagram

- Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200 V_{AC} and above).
- Recommended wire size 0.2–0.75 mm^2 (24–18 AWG).
- Cable length: PG1 input, less than 10 m; PG2 single-phase input, less than 30 m / two-phase input, less than 100 m.

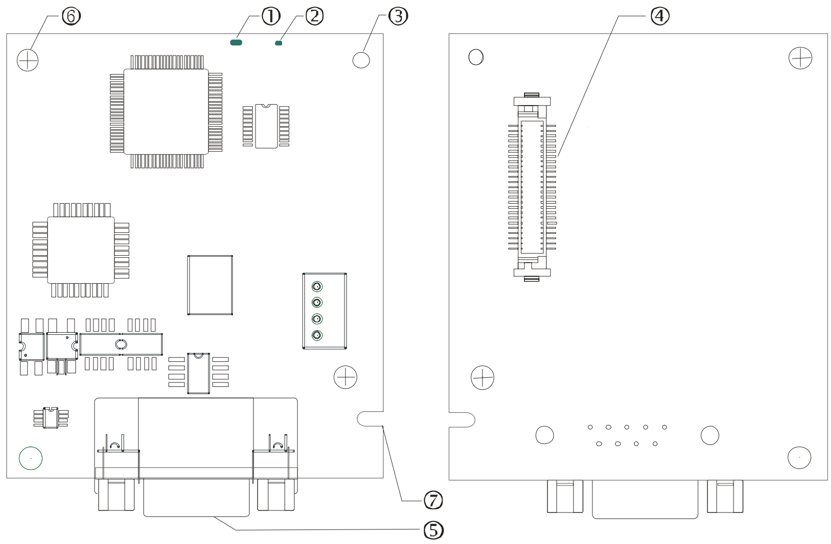


8-12 CMC-PD01 -- Communication card, PROFIBUS DP

8-12-1 Features

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

8-12-2 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

8-12-3 Specifications

PROFIBUS DP Connector

Interface	DB9 connector
Transmission method	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 voltage	5 V_{DC} (supplied by the AC motor drive)
Insulation voltage	500 V_{DC}
Power consumption	1 W
Weight	28 g

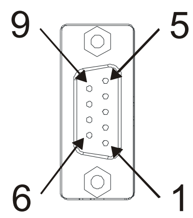
Environment

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 & IEC 60068-2-27 (TEST Ea)

8-12-4 Installation

PROFIBUS DP Connector

PIN	Signal	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



8-12-5 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	Corrective Action
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

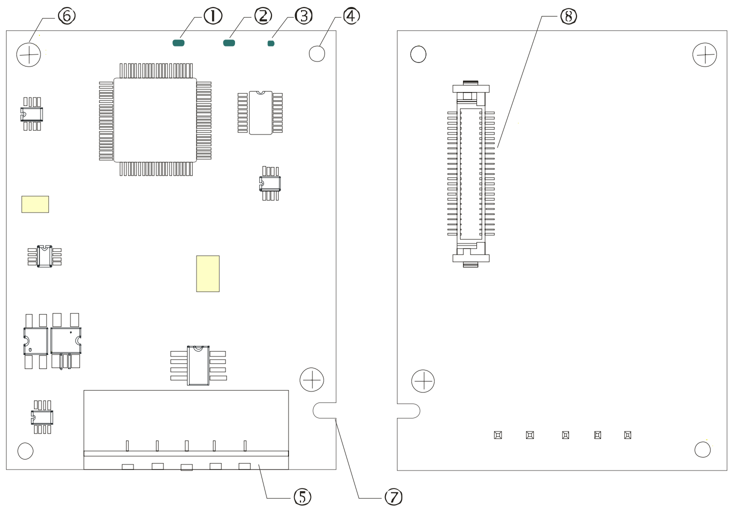
LED status	Indication	Corrective Action
Green light ON	Normal status	--
Red light ON	CMC-PD01 is not connected to PROFIBUS DP bus.	Connect CMC-PD01 to PROFIBUS DP bus.
Red light flashes	Invalid PROFIBUS communication address	Set the PROFIBUS address of CMC-PD01 between 1 – 125 (decimal)
Orange light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

8-13 CMC-DN01 -- Communication card, DeviceNet

8-13-1 Functions

1. Based on the high-speed communication interface of Delta HSSP protocol, which is able to conduct immediate control to AC motor drive.
2. Supports Group 2 only slave device 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.

8-13-2 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

8-13-3 Specifications

DeviceNet Connector

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

AC Motor Drive Connection Port

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

Electrical Specification

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

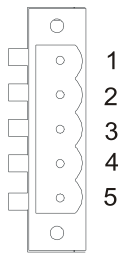
Environment

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: IEC61800-5-1, IEC60068-2-6 (TEST Fc) / IEC61800-5-1 & IEC60068-2-27 (TEST Ea)

8-13-4 Installation

DeviceNet Connector

PIN	Signal	Color	Definition
1	V+	Red	DC 24V
2	H	White	Signal+
3	S	-	Earth
4	L	Blue	Signal-
5	V-	Black	0V



8-13-5 LED Indicator & Troubleshooting

There are three LED indicators on the CMC-DN01. 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	Corrective Action
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	Corrective Action
OFF	No power supply or CMC-DN01 does not pass the MAC ID test.	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 does not connect 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 normally connects 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 the same as 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

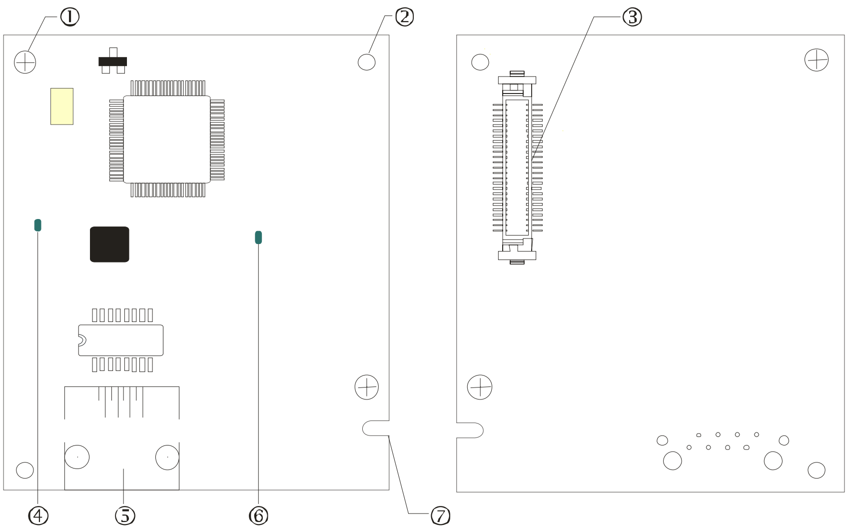
LED status	Indication	Corrective Action
OFF	No power supply or being off-line	Check the power supply of CMC-DN01 and see if the connection is normal.
Green light flashes	Waiting for I/O data	Switch the master PLC to RUN status
Green light ON	I/O data is normal	--
Red light flashes	Mapping error	1. Reset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

8-14 CMC-EIP01 -- Communication card, EtherNet/IP

8-14-1 Features

1. Supports Modbus TCP and Ethernet/IP protocol
2. User-defined corresponding parameters (use with EIP V.1.06)
3. IP filter simple firewall function
4. MDI/MDI-X auto-detect
5. Baud rate: 10/100Mbps auto-detect

8-14-2 Product Profile



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

8-14-3 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, HTTP, SMTP, Modbus over TCP/IP, EtherNet/IP, Delta Configuration

Electrical Specification

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

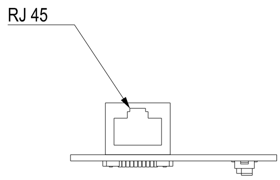
Environment

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 standards: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

8-14-4 Installation

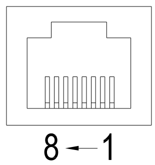
Connecting CMC-EIP01 to Network

1. Turn OFF the power of the drive.
2. Open the cover of the AC motor drive.
3. Connect a CAT-5e network cable to the RJ45 port on the CMC-EIP01 (See the figure on the right-hand side).



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 reception
3	Rx+	Positive pole for data reception	7	--	N/C
4	--	N/C	8	--	N/C



8-14-5 CT2000 Communication Parameter Settings for Connecting to Ethernet

When the CT2000 is connected to an Ethernet network, please set up the communication parameters for it according to the table below. The Ethernet master is only able to reads and writes the frequency words and control word of CT2000 after the communication parameters are set.

Parameters	Functions	Current Setting Value	Descriptions
00-20	Master frequency command setting	8	The frequency command is controlled by communication card.
00-21	Source of operation command setting	5	The operation command is controlled by communication card.
09-30	Communication decoding method	0	The decoding method for Delta AC motor drive
09-75	IP configuration	0	0: Static IP 1: Dynamic IP (DHCP)
09-76	IP address -1	192	IP address 192.168.1.5

Parameters	Functions	Current Setting Value	Descriptions
09-77	IP address -2	168	IP address 192.168.1.5
09-78	IP address -3	1	IP address 192.168.1.5
09-79	IP address -4	5	IP address 192.168.1.5
09-80	Netmask -1	255	Netmask 255.255.255.0
09-81	Netmask -2	255	Netmask 255.255.255.0
09-82	Netmask -3	255	Netmask 255.255.255.0
09-83	Netmask -4	0	Netmask 255.255.255.0
09-84	Default gateway -1	192	Default gateway 192.168.1.1
09-85	Default gateway -2	168	Default gateway 192.168.1.1
09-86	Default gateway -3	1	Default gateway 192.168.1.1
09-87	Default gateway -4	1	Default gateway 192.168.1.1

8-14-6 LED Indicator & Troubleshooting

There are two LED indicators on the CMC-EIP01. 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	Corrective Action
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	Corrective Action
POWER LED OFF	The AC motor drive not powered	Check the power of the AC motor drive, and see if the power supply is normal.
	The CMC-EIP01 not connected to the AC motor drive	Ensure that CMC-EIP01 is connected to the AC motor drive.
LINK LED OFF	The CMC-EIP01 not connected to network	Ensure that the network cable is correctly connected to network.
	Poor contact to RJ45 connector	Ensure that RJ45 connector is connected to Ethernet port.
Cannot find communication card	The CMC-EIP01 not connected to network	Ensure that CMC-EIP01 is connected to network.
	The PC and CMC-EIP01 in different networks and blocked by network firewall.	Search by IP or set up relevant settings by the AC motor drive keypad.
Cannot open CMC-EIP01 setup page	The CMC-EIP01 not connected to network	Ensure that CMC-EIP01 is connected to the network.
	Incorrect communication setting in DCISoft	Ensure that the communication setting in DCISoft is set to Ethernet.

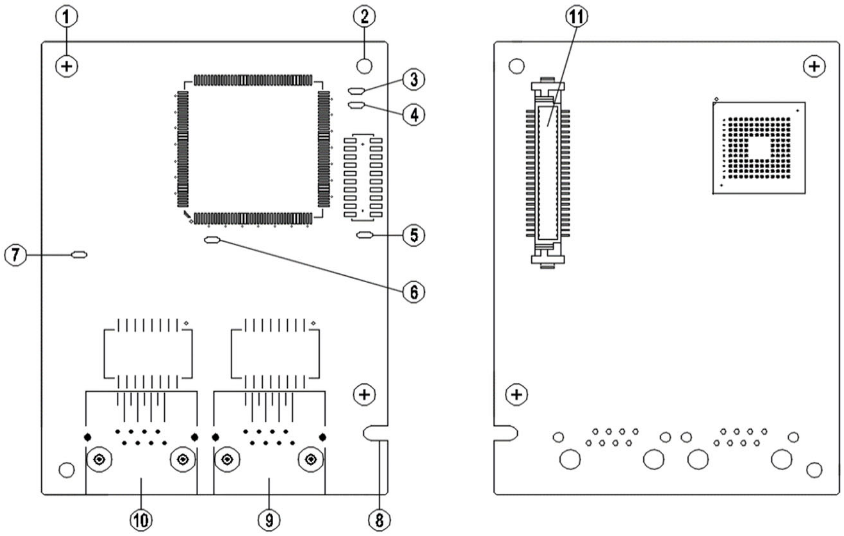
Abnormality	Cause	Corrective Action
	The PC and CMC-EIP01 in different networks and blocked by network firewall.	Set up with the AC motor drive keypad.
The CMC-EIP01 setup page opens successfully but webpage monitoring is unavailable	Incorrect network setting in CMC-EIP01	Check if the network setting 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.
Cannot send e-mails	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.

8-15 CMC-EC01 -- Communication card, EtherCAT

8-15-1 Features

The EtherCAT of CT2000 currently provides standard control mode of CiA402 Velocity (Index 6060 = 2), but it is non-synchronous control mode. There is no need to turn on the DC (Distribute Clock) function when operating. However, if the DC function is required for using with synchronous products (e.g. ASDA-A2), the CMC-EC01 can still be used normally under this circumstances. The CT2000 supports the EtherCAT function with firmware version 3.05 and later. Make sure the firmware you use.

8-15-2 Product Profile



1. Screw fixing hole
2. Positioning hole
3. RUN indicator
4. ERR indicator
5. POWER indicator
6. OUT LINK indicator
7. IN LINK indicator
8. Fool-proof groove
9. RJ45 connection port
10. RJ45 connection port
11. Control board connection port

8-15-3 Specifications

Network Interface

Interface	RJ45
Number of ports	2 ports
Transmission method	IEEE802.3, IEEE802.3u
Transmission cable	Category 5e shielding 100 M
Transmission speed	10 / 100 Mbps Auto-Defect
Network protocol	EtherCAT

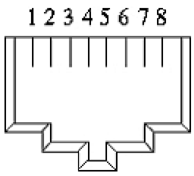
Electrical Specification

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 – 15°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

8-15-4 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

8-15-5 Communication Parameters for CT2000 Connected to EtherCAT

When operating CT2000 via CMC-EC01, set the control and operation command as controlled by communication card. When CT2000 connects to EtherCAT network, set up the communication parameters according to the table below.

Parameters	Set value (Dec)	Explanation
00-20	8	The frequency command is controlled by communication card.
00-21	5	The operation command is controlled by communication card.
09-60	6	Identification: when CMC-EC01 is connected, Pr.09-60 will show value 6 (EtherCAT Slave)
09-61	--	Version of communication card

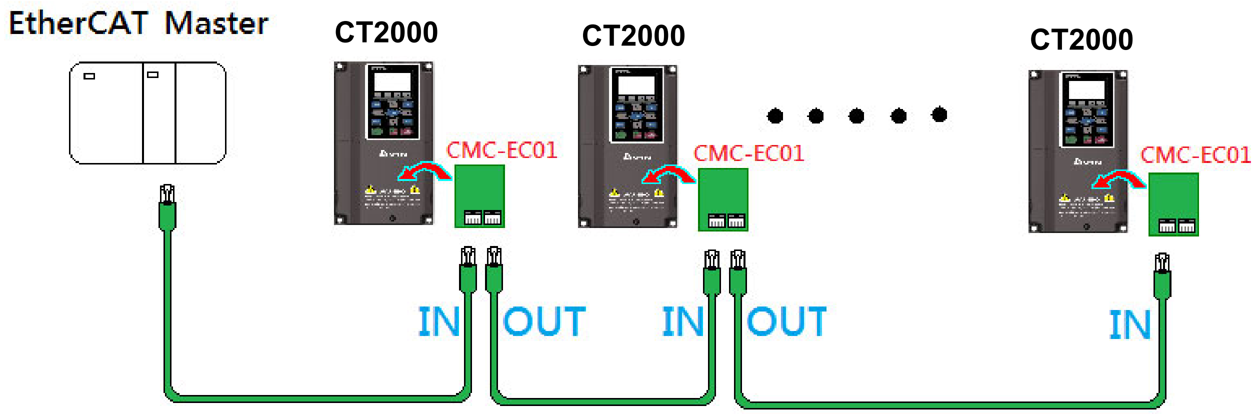
8-15-6 LED Indicator

LED	Status		Indication
POWER	Green	ON	Power supply in normal status
		OFF	No power supply
LINK	Green	ON	Normal operation
		Flashes	Pre-operation (The light stays ON for 200 ms and then goes OFF for 200 ms alternately)
			Operate in safe mode (The light stays ON for 200 ms and then goes OFF for 1000 ms alternately)
		OFF	Initial state

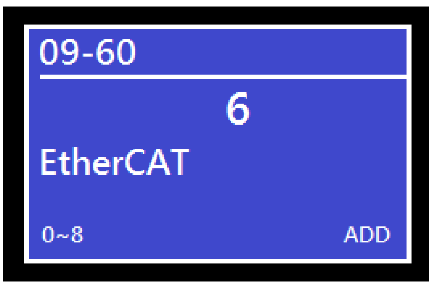
LED	Status		Indication
ERROR	Red	Flashes	Basic configuration error (The light stays ON for 200 ms and then goes OFF for 200 ms alternately)
			Status switching error (The light stays ON for 200 ms and then goes OFF for 1000 ms alternately)
			Times out (ON 200 ms twice / Off 1000 ms)
		OFF	No error
IN LINK	Green	ON	Network connection is in normal status
		Flashes	Network is in operation
		Off	Doesn't connect to network
OUT LINK	Green	ON	Network connection is in normal status
		Flashes	Network is in operation
		OFF	Doesn't connect to network

8-15-7 Network Connection

Because the packet delivery of EtherCAT has directional characteristics, the connection must be correct. The designed delivery direction of CMC-EC01 is left for IN / right for ON, the correct wiring is shown as below:



When the hardware is installed and power on, check for the display. The current set value of Pr.09-60 will be 6, and shows "EtherCAT" on the display. If the above information does not show on the display, check the version of CT2000 (V3.05 and later) and the connection of the card.



8-16 CMC-PN01 -- Communication card, PROFINET

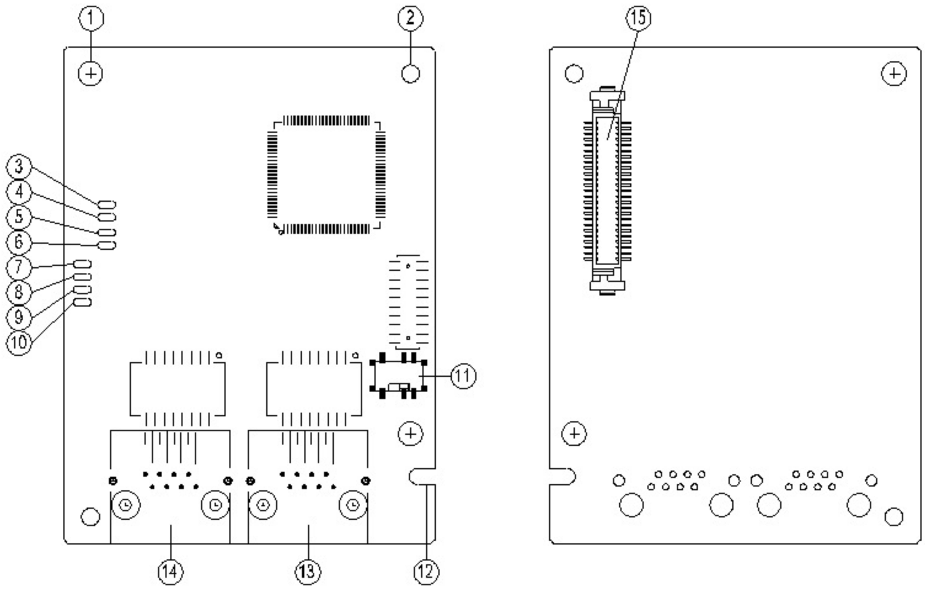
8-16-1 Features

CMC-PN01 connects CT2000 drive to PROFINET to exchange data with the host controller easily. This simple network solution saves cost and time for connection and installation of factory automation. Moreover, its components are compatible with suppliers'.

By installing CMC-PN01 in CT2000 through the main PROFINET device, you can:

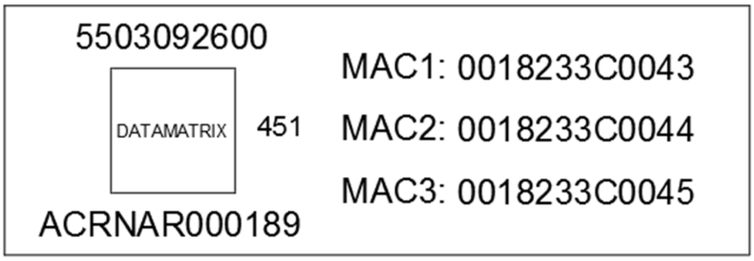
1. Control the drive through PROFINET
2. Modify the drive's parameters through PROFINET
3. Monitor the drive's status through PROFINET.

8-16-2 Product profile



1. Screw fixing hole
2. Communication card fixing hole
3. Indicator light: Ready out
4. Indicator light: MT out
5. Indicator light: SD
6. Indicator light: BF out
7. Indicator light: ACT PHY2
8. Indicator light: Link PHY2
9. Indicator light: ACT PHY1
10. ndicator light: Link PHY2
11. ON / OFF switch
12. Fool-proofing slot to the communication card
13. RJ45 port (Port2)
14. RJ45 port (Port1)
15. A port to connect with control board

Label with MAC address



Definition	Description
MAC1	Port 1 MAC Address
MAC2	Port 2 MAC Address
MAC3	Interface MAC Address

8-16-3 Specifications

Network interface

Item	Specifications
Interface	RJ45
Number of ports	2 ports
Transmission cable	IEEE 802.3
Transmission rate	Category 5e shielding 100 M
Communication protocol	10/100 Mbps auto-negotiate
Interface	PROFINET

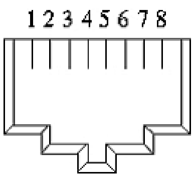
Electrical specification

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

Environmental conditions

Item	Specifications
Noise immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Teat (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operation and storage	-10–50°C (temperature), 90% (humidity)
Vibration & shock resistance	International Standard: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

8-16-4 Definition of PINs in RJ45 port

RJ45	PIN	Signal	Definition
	1	Tx+	Positive pole for data transmission
	2	Tx-	Negative pole for data transmission
	3	Rx+	Positive pole for receiving data
	4	--	N/C
	5	--	N/C
	6	Rx-	Negative pole for receiving data
	7	--	N/C
	8	--	N/C

8-16-5 To set the communication parameters when CT2000 connects with PROFINET

When you operate CT2000 through CMC-PN01, set up the communication card as the source of CT2000 controls and settings. You need to use the keypad to configure the following parameter addresses to the corresponding values:

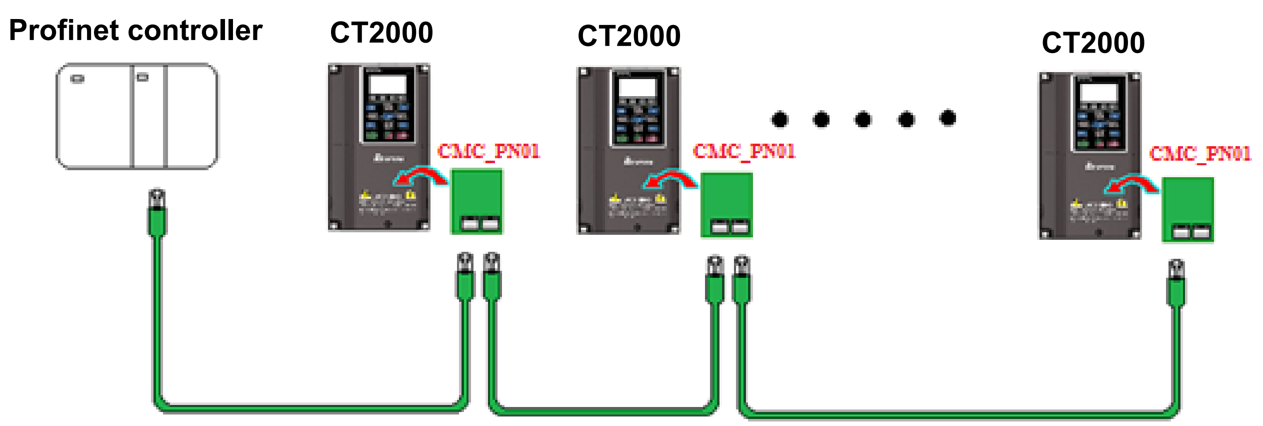
Parameters	Setting value	Description
00-20	8	The frequency command is controlled by communication card
00-21	5	The frequency command is controlled by communication card
09-30	1	Use decoding method (60xx or 20xx)
09-60	12	Communication card identification: When CMC-PN01 communication card is connected, the value of this parameter displays “12”.

8-16-6 LED indicator introduction

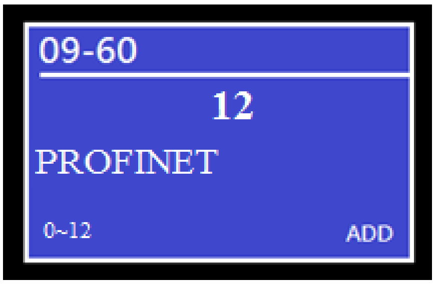
Name	Indicator status		Indication
Ready out indicator	Yellow LED	Always ON	PN Stack starts normally
		Flashing	PN Stack starts normally, and waiting for syncing with MCU
		OFF	PN Stack failed to start
MT out indicator	Green LED	-	-
SD indicator	Red LED	-	-
BF out indicator	Red LED	Always ON	Connection with PROFINET Controller is interrupted
		Flashing	Connection is in normal state, but the communication with PROFINET Controller is abnormally
		OFF	Connection with PROFINET Controller is in normal state
ACT PHY1 indicator	Orange LED	Always ON	It’s online, and exchanging the data with Master normally
		Flashing	It’s offline, but hand shaking the data with Master
		OFF	Initial state
LINK PHY1 indicator	Green LED	Always ON	Internet connection is in normal state
		OFF	Doesn’t connect to network
ACT PHY2 indicator	Orange LED	Always ON	It’s online, and exchanging the data with Master normally
		Flashing	It’s offline, but hand shaking the data with Master
		OFF	Initial state
LINK PHY2 indicator	Green LED	Always ON	Internet connection is in normal state
		OFF	Doesn’t connect to network

8-16-7 Network connection

The wiring of CMC-PN01 shows as follows:

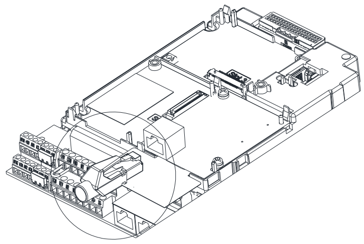


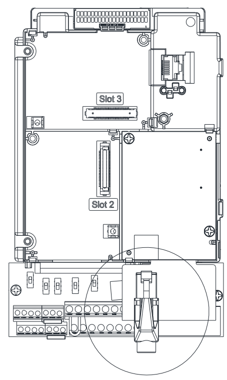
When the installation is finished, supply electricity to the drive. The Pr.09-60 of the drive should be able to display “PROFINET” with a current value of 12. If not, make sure your version of the drive is correct (CT2000 needs V3.05 or later versions) and the communication card is correctly connected.



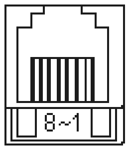
8-17 EMC-COP01 -- Communication card, CANopen

8-17-1 Terminating Resistor Position





8-17-2 RJ45 Pin Definition



RS485 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-

8-17-3 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

8-18 Delta Standard Fieldbus Cables

Delta Cables	Part Number	Description	Length
CANopen Cable / RJ45 extension cable for keypad	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 121 Ω terminal resistor	1 in 2 out
	TAP-CN02	1 in 4 out, built-in 121 Ω terminal resistor	1 in 4 out
	TAP-CN03	1 in 4 out, RJ45 connector, built-in 121 Ω terminal resistor	1 in 4 out, RJ45
PROFIBUS Cable	UC-PF01Z-01A	PROFIBUS DP cable	305 m

Chapter 9 Specification

9-1 460V Models

		Frame	A*2		B			C			D			
		VFD _ _ _ CT43F _ _ A _ VFD _ _ _ CT43F00B VFD _ _ _ CT43A _ _ C	055	075	110	150	185	220	300	370	450	550	750	900
Output Rating*1	Light Duty	Rated Output Capacity (kVA)	10.4	14.3	19	25	30	36	48	58	73	88	120	143
		Rated Output Current (A)	13	18	24	32	38	45	60	73	91	110	150	180
		Applicable Motor Output (kW)	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
		Applicable Motor Output (HP)	7.5	10	15	20	25	30	40	50	60	75	100	125
		Overload Capacity	120% of rated output current: 1 minute for every 5 minutes											
		Max. Output Frequency (Hz)	599.00 Hz											
		Carrier Frequency (kHz)	2–15					2–10						2–9
	Heavy Duty	Rated Output Capacity (kVA)	7.6	9.6	14	18	24	29	34	45	55	69	84	114
		Rated Output Current (A)	9.5	11	17	23	30	36	43	57	69	86	105	143
		Applicable Motor Output (kW)	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75
		Applicable Motor Output (HP)	5.5	7.5	10	15	20	25	30	40	50	60	75	100
		Overload Capacity	150% of rated output current: 1 minute for every 5 minutes											
		Max. Output Frequency (Hz)	300.00 Hz											
		Carrier Frequency (kHz)	2–15		2–6									
Input Rating	Input Current (A)	Light Duty	16	22	26	35	42	50	66	80	91	110	144	180
		Heavy Duty	12	14	19	25	33	38	45	60	70	96	108	149
	Rated Voltage / Frequency		Three-phase AC 380V–480V (-15 % – +10 %), 50 / 60 Hz											
	Operating Voltage Range		323–528 V_{AC}											
	Frequency Tolerance		47–63 Hz											
Efficiency (%)			97.8											98.3
Displacement Power Factor (cosθ)			> 0.98											
Weight (kg)		CT2000-A	2.3	2.3	4.7	4.7	4.7	9.2	9.2	9.2	32	32	32	32
		CT2000-B	-	-	5.6	5.6	5.6	11.9	11.9	11.9	25.5	25.5	-	-
		CT2000-C	-	-	8.8	8.8	8.8	15.4	15.4	15.4	34	34	-	-
Cooling Method			Plate mounting models: Collaborate with the heat dissipation method of user’s equipment Flange mounting models: Natural cooling, but can be used with heat dissipation channel to be limited cooling Wall mounting models: Fan cooling											
Braking Copper			Frame A–C: Built-in Frame D: Optional											
DC Reactor			Frame A–C: Optional Frame D: Built-in											
EMC Filter			Optional											

Table 9-1

NOTE:

1. *1: The factory setting is light duty mode.
2. *2: Applicable for CT2000-A only.
3. The carrier frequency is default. Increasing the carrier frequency requires a reduction in current. Refer to Section 9-7 Derating Curve for details.
4. The AC motor drive should operate in derating current when its control method is set to FOC Sensorless, TQC+PG, TQC sensorless. PM+PG, PM sensorless. Refer to Pr. 06-55 for more information.
5. The rated input current will be affected by not only power transformer and the connection of the reactors on input side, but also fluctuates with the impedance of power side.
6. Rated output capacity is calculated by 460 V_{AC}, it is as a reference for the mains power drive capacity selection.

General Specifications

Item		Specifications
Control Characteristics	Control Method	1: V/F, 2: SVC, 3: VF+PG, 4: FOC+PG, 5: TQC+PG
	Starting Torque	Reach up to 150% or above at 0.5Hz. Under FOC+PG mode, starting torque can reach 150% at 0Hz.
	V/F Curve	4 point adjustable V/F curve and square curve
	Speed Response Ability	5Hz (vector control can reach up to 40Hz)
	Torque Limit	Light duty: 130% torque current; Heavy duty: 175% torque current
	Torque Accuracy*1	±5%
	Max. Output Frequency *2	Light duty: 0.01–599.00Hz; Heavy duty: 0.00–300.00Hz
	Frequency Output Accuracy	Digital command: ±0.01% of the maximum output frequency (Pr.01-00), -10°C– +40°C; Analog command: ±0.1% of the maximum output frequency (Pr.01-00), 25±10°C
	Output Frequency Resolution	Digital command: 0.01 Hz ; Analog command: 0.05% x max. output frequency (Pr.01-00), 11 bit plus sign
	Overload Tolerance	Light duty: When rated output current is 120%, 60 seconds for every 5 minutes Heavy duty: When rated output current is 150%, 60 seconds for every 5 minutes
	Frequency Setting Signal	+10V— -10, 0 — +10V, 4–20mA, 0–20mA, Pulse input
	Accel./decal. Time	0.00–600.00/0.0–6000.0 seconds
	Main Control Function	Torque control, Droop control, Speed/torque control switching, Feed forward control, Zero-servo control, Momentary power loss ride thru, Speed search, Over-torque detection, Torque limit, 17-step speed (max), Accel/decel time switch, S-curve accel/decel, 3-wire sequence, Auto-Tuning (rotational, stationary), 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, MODOBUS communication (RS-485 RJ45, max. 115.2 kbps), Fault restart, Parameter copy
	Fan Control	CT2000-B do not have built-in fan when leave the factory
Protection Characteristics	Motor Protection	Electronic thermal relay protection
	Over-current Protection	Over-current protection for 220% rated current current clamp『Light duty: 130~140%』;『Heavy duty: 180~185%』
	Over-voltage Protection	The 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
Product Compliance*3		CE Low Voltage Directive(LVD) 2014/35/EU, EN61800-5-1 EMC Directive 2014/30/EU, EN61800-3 **UL**508C, **cUL** CAN/CSA C22.2 No.14-13, No.274, **Plenum rated** **SEMI F47**-0706, **GB**12668.3 **WEEE** 2012/19/EU, **RoHS** 2011/65/EU, 2015/863/EC Quality assurance system **ISO 9001** and Environmental system **ISO 14001**
Safety Standard*4		Safe Torque Off (EN / IEC61800-5-2) TUV Rheinland Certified IEC62061/IEC61508, SIL CL2 EN ISO13849-1, Cat.3/PL d

Table 9-2

NOTE:

*1: Defined under torque control (TQC) mode.

*2: Based on heavy duty, and the speed control range varies from environment, application conditions, types of motor and encoder.

*3: CT2000-A only complies with CE certification.

*4: All models have completed certification except 5.5 kW and 7.5 kW models of CT2000-A are in the process of certification. For information on Certifications and Declaration of Conformity (DoC), visit Delta | Download Center (deltaww.com)

9-2 Environment for Operation, Storage and Transportation

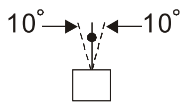
<table>
<tr><td colspan="4">DO NOT expose the AC motor drive in the bad environment, such as dust, direct sunlight, corrosive / inflammable gasses, humidity, liquid and vibration environment. The salt in the air must be less than 0.01mg / cm^2 every year.</td></tr>
<tr><td rowspan="14">Environment</td><td>Installation location</td><td colspan="2">IEC60364-1 / IEC60664-1 Pollution degree 2, Indoor use only</td></tr>
<tr><td rowspan="2">Surrounding Temperature (°C)</td><td>Storage / Transportation</td><td>-25 – +70</td></tr>
<tr><td colspan="2">Non-condensation, non-frozen</td></tr>
<tr><td rowspan="2">Rated Humidity (%)</td><td colspan="2">Max. 95</td></tr>
<tr><td colspan="2">No condense water</td></tr>
<tr><td rowspan="2">Air Pressure (kPa)</td><td>Operation</td><td>86–106</td></tr>
<tr><td>Transportation</td><td>70–106</td></tr>
<tr><td rowspan="5">Pollution Level</td><td colspan="2">IEC 60721-3-3</td></tr>
<tr><td>Operation</td><td>Class 3C3</td></tr>
<tr><td>Storage</td><td>Class 1C2</td></tr>
<tr><td>Transportation</td><td>Class 2C2</td></tr>
<tr><td colspan="2">If the AC motor drive is to be used under harsh environment with high level of contamination (e.g. dew, water, dust), make sure it is installed in an environment qualified for IP54 such as in a cabinet.</td></tr>
<tr><td>Altitude</td><td>Operation</td><td>If the AC motor drive is installed at an altitude of 0–1000 m, follow normal operation restrictions. For altitudes of 1000–2000 m, decrease the drive’s rated current by 1% or lower the temperature by 0.5°C for every 100 m increase in altitude. The maximum altitude for corner grounding is 2000 m.</td></tr>
<tr><td colspan="0" style="display:none"></td></tr>
<tr><td rowspan="2">Package Drop</td><td>Storage</td><td colspan="2" rowspan="2">ISTA procedure 1A (according to weight)</td></tr>
<tr><td>Transportation</td></tr>
<tr><td>Vibration</td><td colspan="3">0.075 mm, peak to peak value range from 10 Hz to 57 Hz; 1.0G range from 57 Hz to 150 Hz. Comply with IEC 60068-2-6</td></tr>
<tr><td>Impact</td><td colspan="3">IEC / EN 60068-2-27</td></tr>
<tr><td>Operation Position</td><td colspan="2">Max. allowed offset angle ±10° (under normal installation position)</td><td></td></tr>
</table>

Table 9-3

9-3 Specification for Operation Temperature and Protection Level

<table>
<tr><th>Model</th><th>Frame</th><th>Top cover</th><th>Conduit Box</th><th>Protection Level</th><th>Operation Temperature</th></tr>
<tr><td rowspan="2">VFDxxxCT43_ _ _ _ _</td><td>B, C</td><td>Top cover Removed</td><td>Standard conduit box</td><td>IP20/UL Open Type</td><td rowspan="2">Plate mounting models
-10–50℃
Flange mounting models
Body:
-10–50℃
Heat sink:
-10–40℃

Wall mounting models
-10–50℃</td></tr>
<tr><td>D</td><td>N/A</td><td>No conduit box</td><td>IP00
IP20/UL Open Type

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

Table 9-4

9-4 Derating Curve

- For more information on calculation for derating curve, refer to Pr.06-55.
- When choosing the correct model, consider factors such as ambient temperature, altitude, carrier frequency, control mode, and so on. That is,
  Actual rated current for application (A) = Rated output current (A) x Ambient temp. rated derating (%) x Altitude rated derating (%) x (Normal / Advanced control) carrier frequency rated derating (%)

Protection Level	Operating Environment
UL Type I / IP20	If the AC motor drive operates at the rated current, the ambient temperature needs to be between -10–40°C. If the temperature is above 40°C, decrease 2% of the rated current for every 1°C increase in temperature. The maximum allowable temperature is 60°C.
UL Open Type / IP20	If the AC motor drive operates at the rated current, the ambient temperature needs to be between -10–50°C. If the temperature is above 50°C, decrease 2% of the rated current for every 1°C increase in temperature. The maximum allowable temperature is 60°C.

Table 9-5

Ambient Temperature Derating Curve

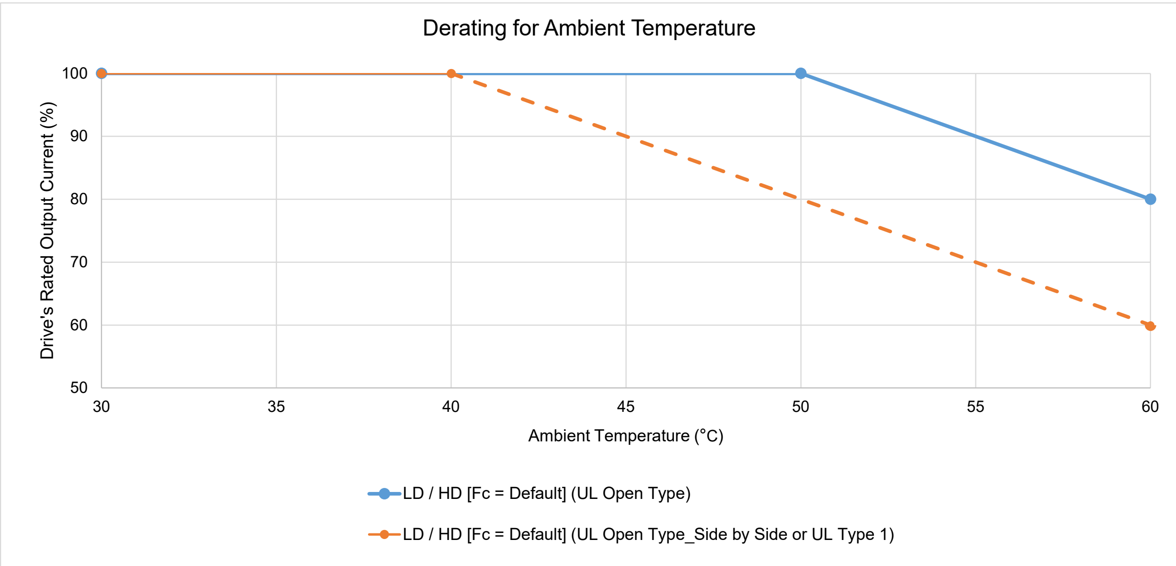


Figure 9-1

UL Open Type:

The rated output current derating (%) in light duty / heavy duty when carrier frequency is the default value:

Fc (kHz) \ Ambient Temp. / 100% Load	30°C	50°C	60°C
Default Value	100	100	80

Table 9-6

UL Open Type_Side by Side or UL Type 1:

The rated output current derating (%) in light duty / heavy when carrier frequency is the default value:

Fc (kHz) \ Ambient Temp. / 100% Load	30°C	40°C	60°C
Default Value	100	100	60

Table 9-7

Altitude Derating Curve

Condition	Operating Environment
High Altitude	If the AC motor drive is installed at an altitude of 0–1000 m, follow normal operation restrictions. For altitudes of 1000–2000 m, decrease the drive's rated current by 1% or lower the temperature by 0.5°C for every 100 m increase in altitude. The maximum altitude for corner grounding is 2000 m. If installing at an altitude higher than 2000 m is required, contact Delta for more information.

Table 9-8

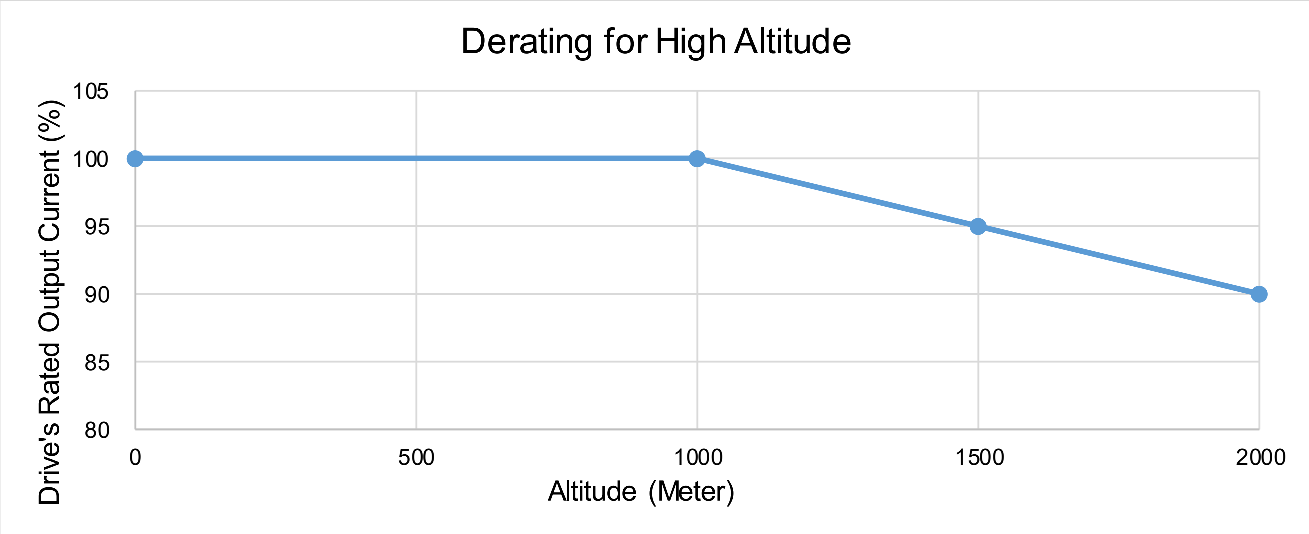


Figure 9-2

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

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

Table 9-9

Carrier Frequency Derating Curve

Applicable to CT2000-A, CT2000-B

- 460V models, Normal Control

  Pr.00-11 = 0 (IMVF)

  = 1 (IMVFPG)

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

  = 3 (IMFOCPG)

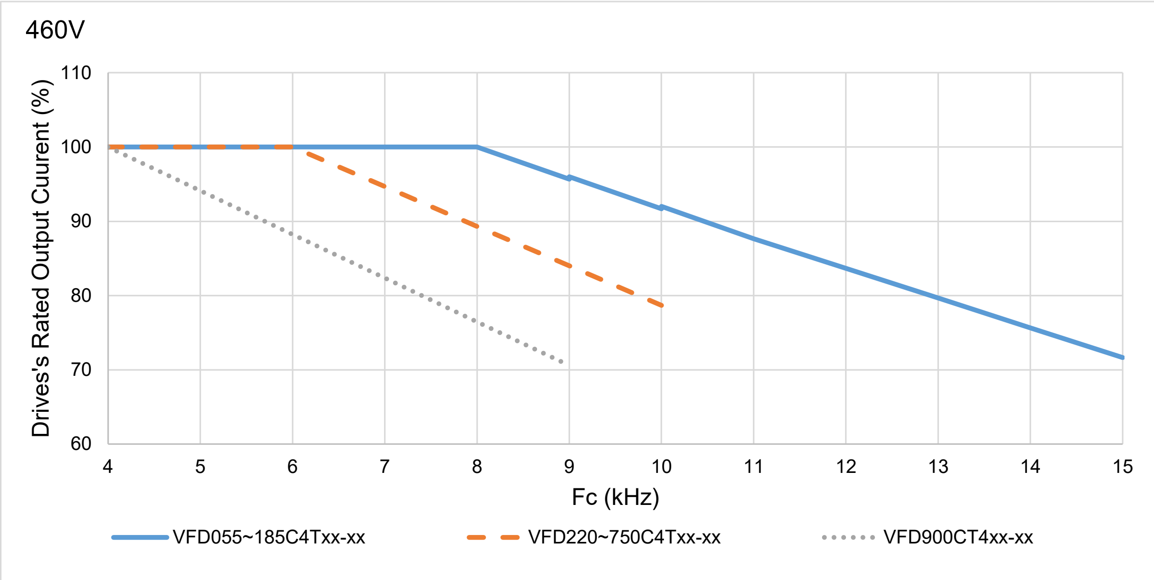


Figure 9-3

The rated output current derating (%) of 460V models in normal control mode for different carrier frequencies:

Model No. \ Fc (kHz)	4	5	6	7	8	9	10	11	12	13	14	15
VFD055–185CT4xx-xx	100	100	100	100	100	96	92	88	84	80	76	72
VFD220–750CT4xx-xx	100	100	100	95	89	84	79	-	-	-	-	-
VFD900CT4xx-xx	100	94	88	82	76	71	-	-	-	-	-	-

Table 9-10

● 460V models, Advanced Control

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

= 4 (PMFOCPG)

= 5 (IMFOC Sensorless)

= 6 (PM Sensorless)

= 7 (IPM Sensorless)

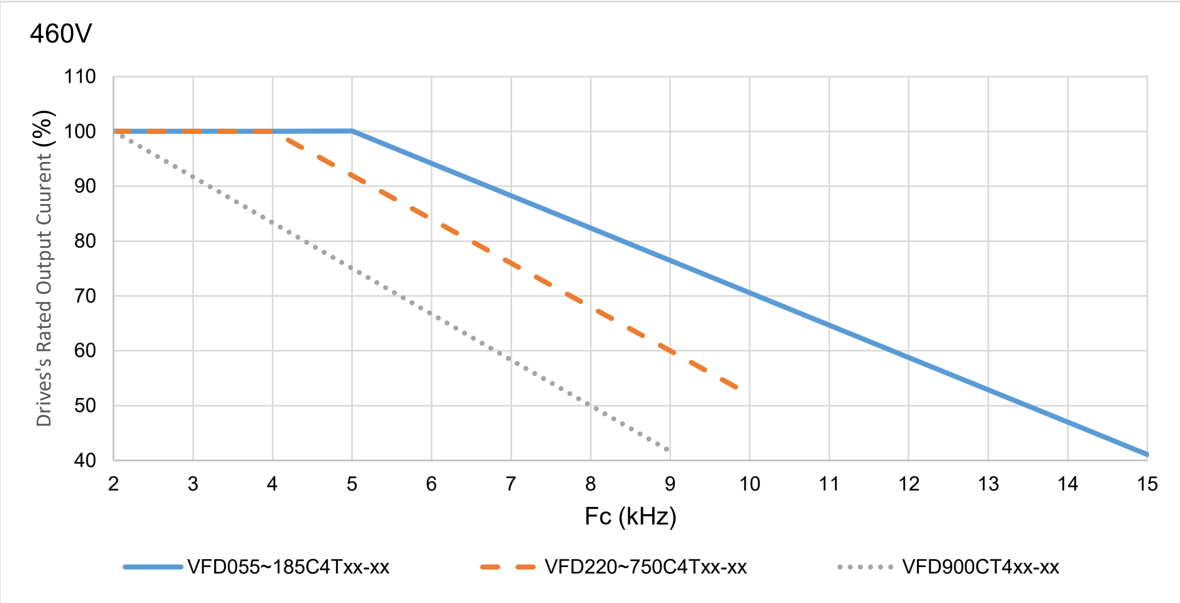


Figure 9-4

The rated output current derating (%) of 460V models in advanced control mode for different carrier frequencies:

Fc (kHz) / Model No.	2	3	4	5	6	7	8	9	10	11	12	13	14	15
VFD055–185CT4xx-xx	100	100	100	100	94	88	82	76	71	65	59	53	47	41
VFD220–750CT4xx-xx	100	100	100	92	84	76	68	60	52	-	-	-	-	-
VFD900CT4xx-xx	100	92	83	75	67	58	50	42	-	-	-	-	-	-

Table 9-11

Applicable to CT2000-C

- 460V models, Normal Control

Pr.00-11 = 0 (IMVF)
= 1 (IMVFPG)
= 2 (IM SVC, Pr.05-33 = 0)
= 3 (IMFOCPG)

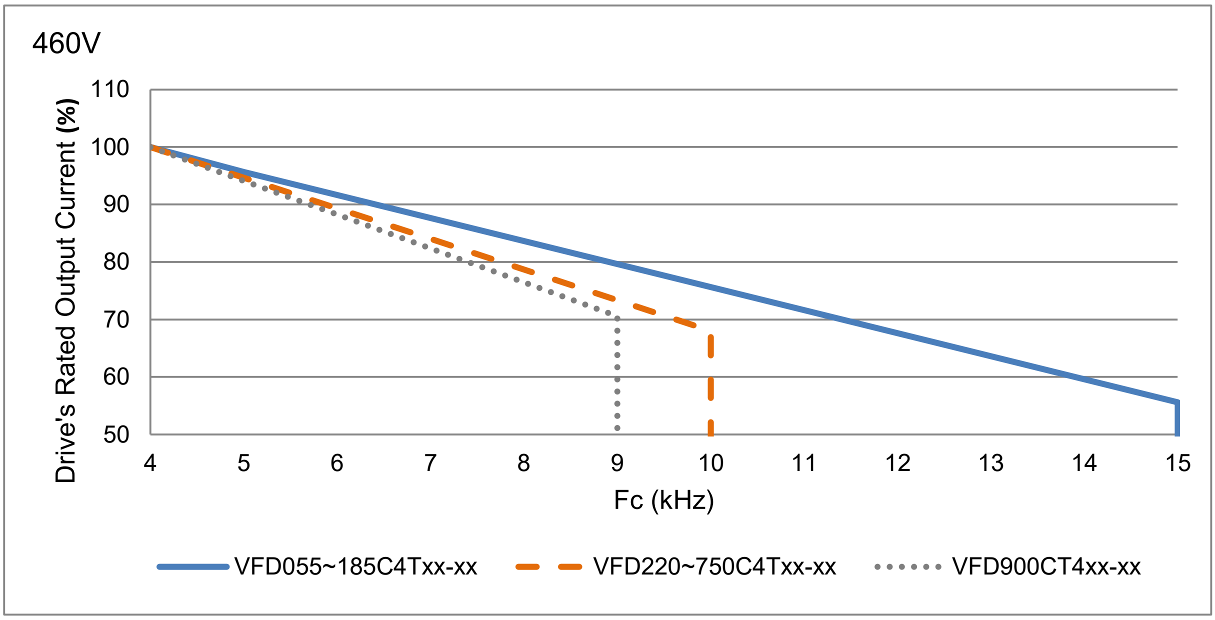


Figure 9-5

The rated output current derating (%) of 460V models in normal control mode for different carrier frequencies:

Fc (kHz) / Model No.	4	5	6	7	8	9	10	11	12	13	14	15
VFD055–185CT4xx-xx	100	96	92	88	84	80	76	72	68	64	60	56
VFD220–750CT4xx-xx	100	95	89	84	79	73	68	-	-	-	-	-
VFD900CT4xx-xx	100	94	88	82	76	71	-	-	-	-	-	-

Table 9-12

- 460V models, Advanced Control

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

  = 4 (PMFOCPG)

  = 5 (IMFOC Sensorless)

  = 6 (PM Sensorless)

  = 7 (IPM Sensorless)

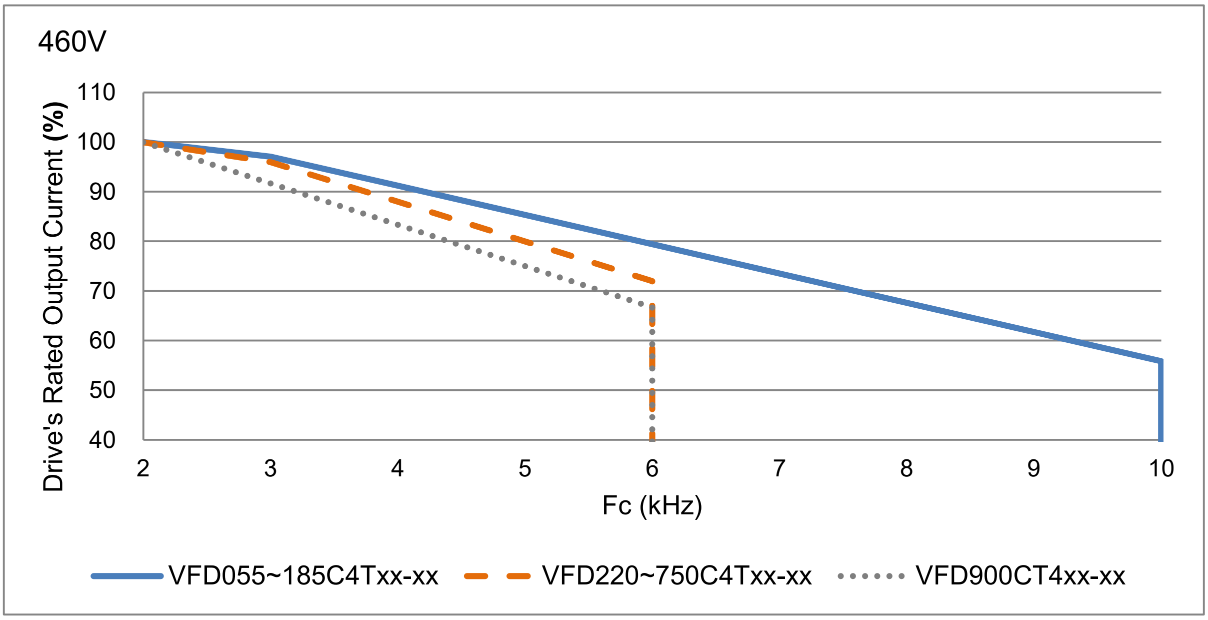


Figure 9-6

The rated output current derating (%) of 460V models in advanced control mode for different carrier frequencies:

Fc (kHz) / Model No.	2	3	4	5	6	7	8	9	10
VFD055–185CT4xx-xx	100	97	91	85	79	74	68	62	56
VFD220–750CT4xx-xx	100	96	88	80	72	-	-	-	-
VFD900CT4xx-xx	100	92	83	75	67	-	-	-	-

Table 9-13

9-5 Efficiency Curve

- Models:
  VFD055–750CT4xx-xx

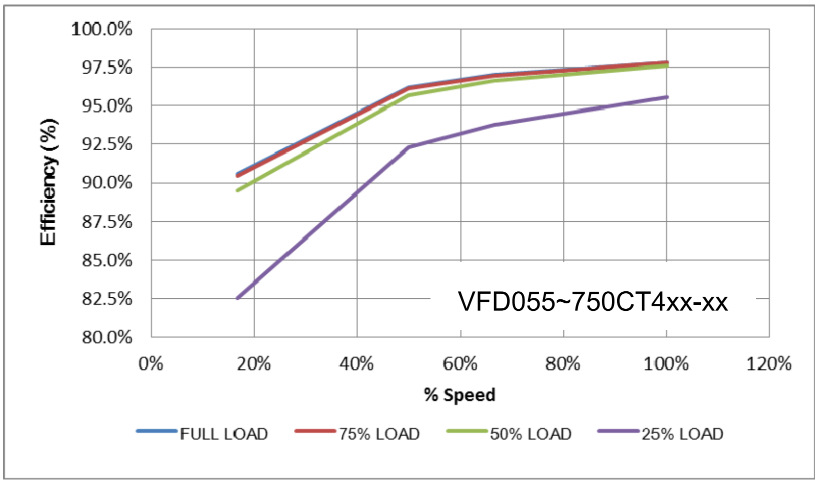


Figure 9-7

Efficiency (%) under different loads:

Speed (%) / Load (%)	16.7	50	66.7	100
100% Load	90.6	96.2	97.0	97.8
75% Load	90.4	96.1	96.9	97.8
50% Load	89.5	95.7	96.6	97.6
25% Load	82.5	92.3	93.8	95.5

Table 9-14

- Models:
  VFD900C4Txx-xx

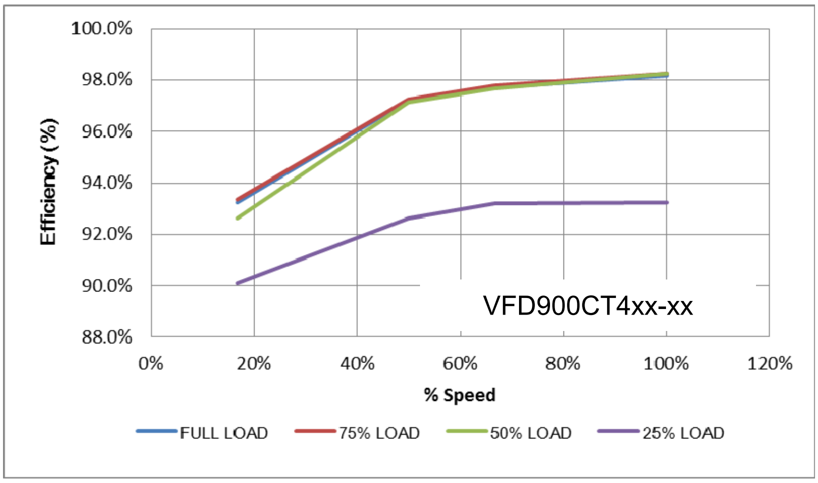


Figure 9-8

Efficiency (%) under different loads:

Speed (%) / Load (%)	16.7	50	66.7	100
100% Load	93.4	97.3	97.8	98.3
75% Load	93.4	97.3	97.8	98.3
50% Load	92.6	97.1	97.7	98.2
25% Load	90.1	92.6	93.2	93.2

Table 9-15

Chapter 10 Digital Keypad

10-1 Descriptions of Digital Keypad

KPC-CC01

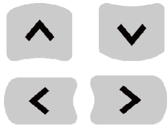
Communication Interface
RJ45 (socket), RS-485 interface

Communication protocol:
RTU19200, 8, N, 2

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

Keypad Function Description

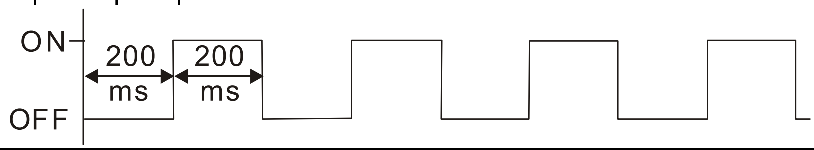
Key	Descriptions
	Start Operation Key 1. Only valid when the source of operation command is the keypad. 2. Operates the AC motor drive by the function setting. The RUN LED will be ON. 3. Can be pressed repeatedly at the stop process.
	Stop Command Key. 1. This key has the highest priority when the command is from the keypad. 2. When it receives the STOP command, regarless of whether the AC motor drive is in operation or stop status, the AC motor drive executes the "STOP" command. 3. Use the RESET key to reset the drive after a fault occurs. 4. If you cannot reset after the error: a. The condition which triggers the fault is not cleared. After you clear the condition, you can then reset the fault. b. The drive is in fault status when powered on. After you clear the condition, restart and then you can reset the fault.
	Operation Direction Key 1. Only controls the operation direction, NOT the drive activation. FWD: forward, REV: reverse. 2. Refer to the LED descriptions for more details.
	ENTER Key Goes to the next menu level. If at the last level, press ENTER to execute the command.
	ESC Key Leaves the current menu and returns to the previous menu; also functions as a return key or cancel key in a sub-menu.
	Returns to the main menu. Menu commands: 1. Parameter Setup 2. Quick Start 3. Application Selection List 4. Changed List 5. Copy Parameter 6. Fault Record 7. Language Setup 8. Time Setup 9. Keypad Locked 10. PLC Function 11. Copy PLC 12. Display Setup 13. Start-up Menu 14. Main Page 15. PC Link 16. Start Wizard

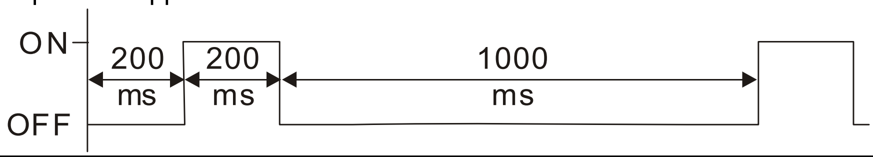
Key	Descriptions
	Direction: Left / Right / Up / Down 1. In the numeric value setting mode, moves the cursor and changes the numeric value. 2. In the menu / text selection mode, selects an item.
F1 F2 F3 F4	Function Key 1. The functions keys have defaults and can also be use-defined. The defaults for F1 and F4 work with the function list below. For example, F1 is the JOG function, and F4 is a speed setting key for adding / deleting user-defined parameters. 2. Other functions must be defined using TPEditor. (Download TPEditor software at Delta website. Select TPEditor version 1.60 or later. Refer to the installation instruction for TPEditor in Section 10-3.)
HAND	HAND Key 1. Use this key to select HAND mode. In this mode, the drive's parameter settings for frequency command source is Pr.00-30, and that for operation command source is Pr.00-31. 2. Press the HAND key at STOP, then the setting switches to the HAND frequency source and HAND operation source. 3. Press HAND key at RUN, and it stops the AC motor drive first (displays AHSP warning), and switches to HAND frequency source and HAND operation source. 4. Successful mode switching for the KPC-CC01 displays HAND mode on the screen.
AUTO	AUTO Key 1. The default of the drive is AUTO mode. 2. Use this key to select AUTO mode. In this mode, the drive's parameter settings for frequency command source is Pr.00-20, and that for operation command is Pr.00-21. 3. Press the AUTO key at STOP, then the setting switches to the AUTO frequency source and AUTO operation source. 4. Press AUTO key at RUN, and it stops the AC motor drive first (displays AHSP warning), and switches to AUTO frequency source and AUTO operation source. 5. Successful mode switching for the KPC-CC01 displays AUTO mode on the screen

NOTE: The defaults for the frequency command and operation command source of HAND / AUTO mode are both from the keypad.

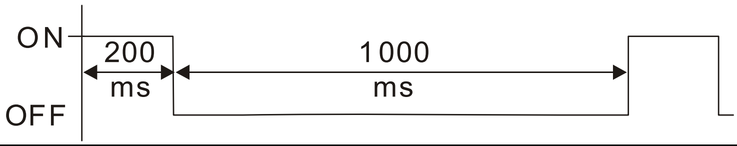
LED Functions Descriptions

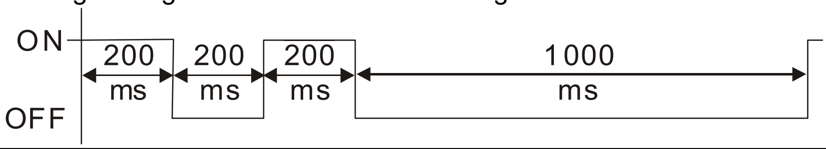
LED	Descriptions
STOP RESET	Steady ON: STOP indicator for the AC motor drive. Blinking: the drive is in standby. Steady OFF: the drive does not execute the "STOP" command.
FWD REV	Operation Direction LED 1. Green light: the drive is running forward. 2. Red light: the drive is running backward. 3. Flashing light: the drive is changing direction. Operation Direction LED under Torque Mode 1. Green light: when the torque command ≥ 0, and the motor is running forward. 2. Red light: when the torque command < 0, and the motor is running backward. 3. Flashing light: when the torque command < 0, and the motor is running forward.

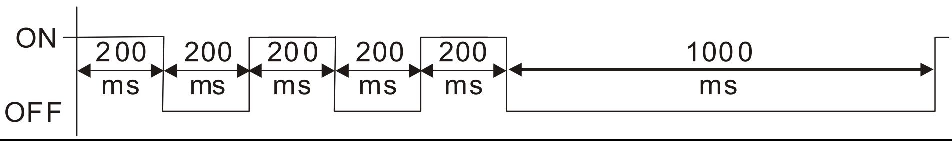
<table>
<tr><th>LED</th><th>Descriptions</th></tr>
<tr><td>CANopen–RUN</td><td>
RUN LED:
<table>
<tr><th>LED status</th><th>Condition / State</th></tr>
<tr><td>OFF</td><td>CANopen at initial state
No LED</td></tr>
<tr><td>Flashing</td><td>CANopen at pre-operation state


</td></tr>
<tr><td>Single flash</td><td>CANopen at stopped state


</td></tr>
<tr><td>ON</td><td>CANopen at operational state


</td></tr>
</table>
</td></tr>
<tr><td>CANopen–ERR</td><td>
ERR LED:
<table>
<tr><th>LED status</th><th>Condition / State</th></tr>
<tr><td>OFF</td><td>No error</td></tr>
<tr><td>Single flash</td><td>At least one packet of CANopen is in failure


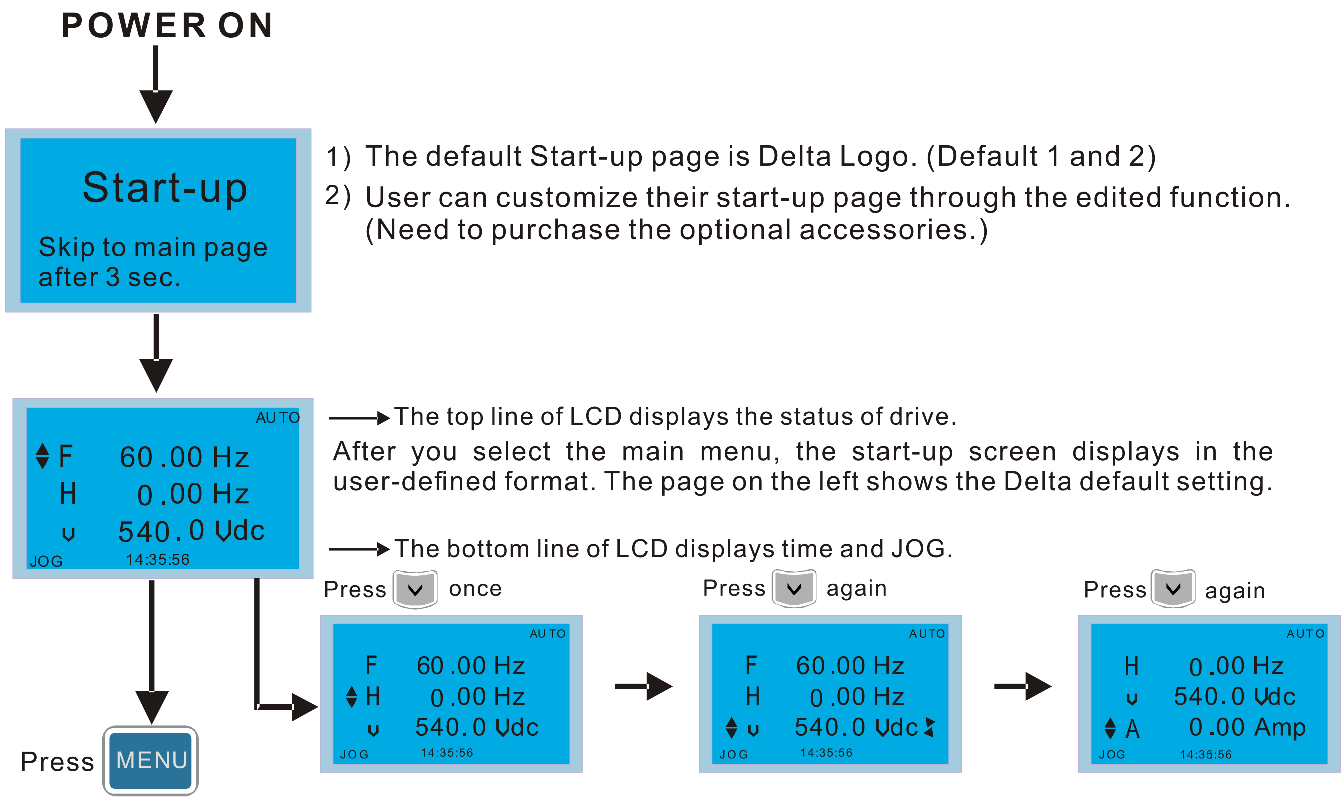
</td></tr>
<tr><td>Double flash</td><td>Node guarding failure or heartbeat message failure


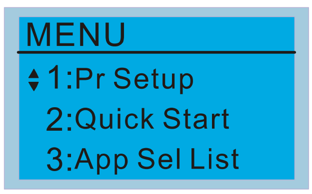
</td></tr>
<tr><td>Triple flash</td><td>Synchronization failure


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


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

10-2 Function of Digital Keypad KPC-CC01





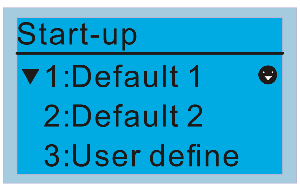
MENU

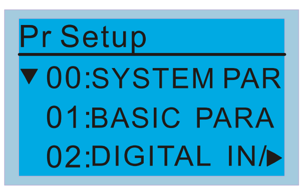
1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Start-up Menu
14: Main Page
15: PC Link
16: Start Wizard

NOTE:

1. Start-up screen can only display pictures, not animation.
2. When powered ON, it displays the start-up screen then the main screen. The main screen displays Delta's default setting F/H/A/U. You can set the display order with Pr.00-03 (Start-up display). When you select the U screen, use the left / right keys to switch between the items, and set the display order for the U screen with Pr.00-04 (User display).

Display Icon





● : present setting

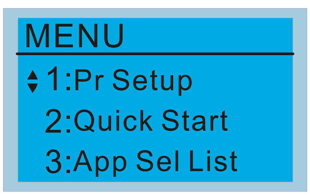
▼ : Scroll down the page for more options

Press ⌃ ⌄ for more options

▶ : show complete sentence

Press ‹ › for complete information

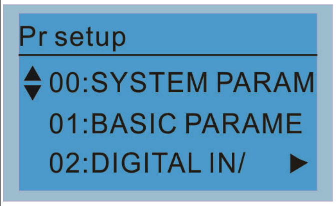
Display item



MENU

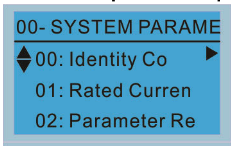
1: Parameter Setup
2: Quick Start
3: Application Selection List
4: Changed List
5: Copy Parameter
6: Fault Record
7: Language Setup
8: Time Setup
9: Keypad Locked
10: PLC Function
11: Copy PLC
12: Display Setup
13: Start-up Menu
14: Main Page
15: PC Link
16: Start Wizard

1. Parameter Setup

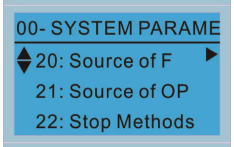


Press ENTER to select.
Press UP / DOWN to select the parameter group.
Once you select a parameter group, press ENTER to go into that group.

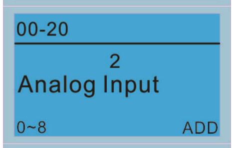
For example: Setup source for the master frequency command.



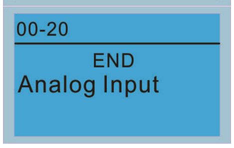
In the Group 00 Motor Drive Parameter, use UP / DOWN keys to select parameter 20: Auto Frequency Command.



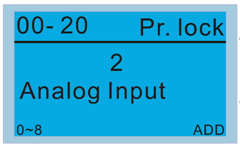
Press ENTER to go to this parameter's setting menu.



Use the UP / DOWN keys to choose a setting.
For example: choose 2 Analogue Input, and then press ENTER key.

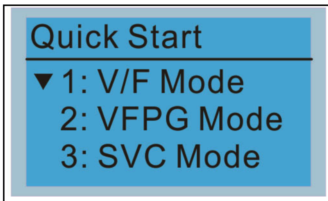


After you press ENTER, END is displayed which means that the parameter setting is done.



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

2. Quick Start

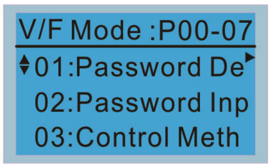


Press ENTER to select.

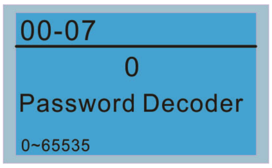
Quick Start:
1. V/F Mode
2. VFPG Mode
3. SVC Mode
4. FOCPG Mode
5. TQCPG Mode
6. My Mode

Description:

1. VF Mode



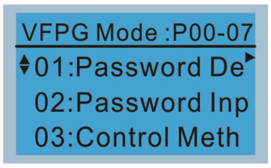
01:Password Decoder



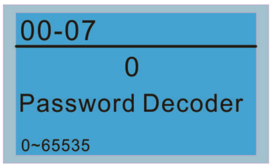
Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Control mode (Pr.00-10)
4. Speed control mode (Pr.00-11)
5. Load selection (Pr.00-16)
6. Carrier frequency (Pr.00-17)
7. Master frequency command source / Source selection of the PID target (AUTO)(Pr.00-20)
8. Operation command source (AUTO) (Pr.00-21)
9. Stop method (Pr.00-22)
10. Digital keypad STOP function (Pr.00-32)
11. Max. operation frequency (Pr.01-00)
12. Motor 1 rated / base frequency (Pr.01-01)
13. Motor 1 rated / base voltage (Pr.01-02)
14. Motor 1 mid-point frequency 1 (Pr.01-03)
15. Motor 1 min-point voltage 1 (Pr.01-04)
16. Motor 1 mid-point frequency 2 (Pr.01-05)
17. Motor 1 mid-point voltage 2 (Pr.01-06)
18. Motor 1 min. output frequency (Pr.01-07)
19. Motor 1 min. output voltage (Pr.01-08)
20. Output frequency upper limit (Pr.01-10)
21. Output frequency lower limit (Pr.01-11)
22. Acceleration time 1 (Pr.01-12)
23. Deceleration time 1 (Pr.01-13)
24. Over-voltage stall prevention (Pr.06-01)
25. Derating protection (Pr.06-55)
26. Software brake chopper action level (Pr.07-00)
27. Speed tracking during start-up (Pr.07-12)

28. Emergency stop (EF) & force to stop selection (Pr.07-20)
29. Torque command filter time (Pr.07-24)
30. Slip compensation filter time (Pr.07-25)
31. Torque compensation gain (Pr.07-26)
32. Slip compensation gain (Pr.07-27)

2. VFPG Mode

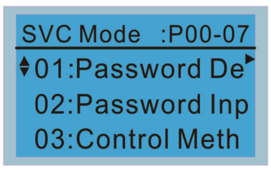


01: Password Decoder

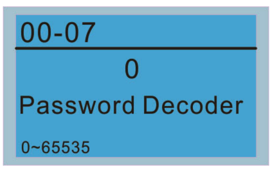


Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Control mode (Pr.00-10)
4. Speed control mode (Pr.00-11)
5. Load selection (Pr.00-16)
6. Master frequency command source (AUTO) / Source selection of the PID target (Pr.00-20)
7. Operation command source (AUTO) (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. Motor 1 rated / base frequency (Pr.01-01)
12. Motor 1 rated / base voltage (Pr. 01-02)
13. Motor 1 min. output frequency (Pr.01-07)
14. Motor 1 min. output voltage (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. Over-voltage stall prevention (Pr.06-01)
20. Software brake chopper action level (Pr.07-00)
21. Torque command filter time (Pr.07-24)
22. Slip compensation filter time (Pr.07-25)
23. Slip compensation gain (Pr.07-27)
24. Encoder type selection (Pr.10-00)
25. Encoder pulses per revolution (Pr.10-01)
26. Encoder input type setting (Pr.10-02)
27. ASR 1 gain (Pr.11-06)
28. ASR 1 integral time (Pr.11-07)
29. ASR 2 gain (Pr.11-08)
30. ASR 2 integral time (Pr.11-09)
31. ASR gain of zero speed (Pr.11-10)
32. ASR1 integral time of zero speed (Pr.11-11)

3. SVC Mode



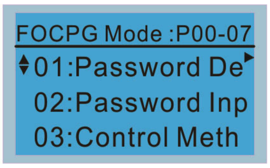
01: Password Decoder



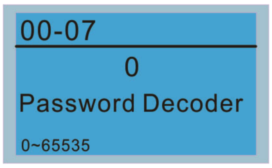
Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Control mode (Pr.00-10)
4. Speed control mode (Pr.00-11)
5. Load selection (Pr.00-16)
6. Carrier frequency (Pr.00-17)
7. Master frequency command source (AUTO) / Source selection of the PID target (Pr.00-20)
8. Operation command source (AUTO) (Pr.00-21)
9. Stop method (Pr.00-22)

10. Digital keypad STOP function (Pr.00-32)
11. Max. operation frequency (Pr.01-00)
12. Motor 1 rated / base frequency (Pr.01-01)
13. Motor 1 rated / base voltage (Pr.01-02)
14. Motor 1 min. output frequency (Pr.01-07)
15. Motor 1 min. output voltage (Pr.01-08)
16. Output frequency upper limit (Pr.01-10)
17. Output frequency lower limit (Pr.01-11)
18. Acceleration time 1 (Pr.01-12)
19. Deceleration time 1 (Pr.01-13)
20. Full-load current for induction motor 1 (Pr.05-01)
21. Rated power for induction motor 1 (Pr.05-02)
22. Rated speed for induction motor 1 (Pr.05-03)
23. Number of poles for induction motor 1 (Pr.05-04)
24. No-load current for induction motor 1 (Pr.05-05)
25. Over-voltage stall prevention (Pr.06-01)
26. Over-current stall prevention during acceleration (Pr.06-03)
27. Derating protection (Pr.06-55)
28. Software brake chopper action level (Pr.07-00)
29. Emergency stop (EF) & force to stop selection (Pr.07-20)
30. Torque command filter time (Pr.07-24)
31. Slip compensation filter time (Pr.07-25)
32. Slip compensation gain (Pr.07-27)

4. FOCPG Mode



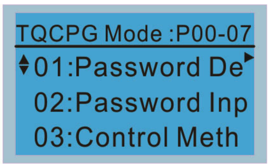
01: Password Decoder



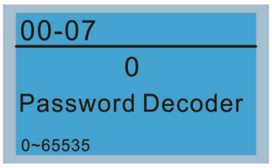
Items
1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Control mode (Pr.00-10)
4. Speed control mode (Pr.00-11)
5. Master frequency command source (AUTO) / Source seletion of the PID target (Pr.00-20)
6. Operation command source (AUTO) (Pr.00-21)
7. Stop method (Pr.00-22)
8. Max. operation frequency (Pr.01-00)
9. Motor 1 rated / base frequency (Pr.01-01)
10. Motor 1 rated / base voltage (Pr.01-02)
11. Output frequency upper limit (Pr.01-10)
12. Output frequency lower limit (Pr.01-11)
13. Acceleration time 1 (Pr.01-12)
14. Deceleration time 1 (Pr.01-13)
15. Full-load current for induction motor 1 (Pr.05-01)
16. Rated power for induction motor 1 (Pr.05-02)
17. Rated speed for induction motor 1 (Pr.05-03)
18. Number of poles for induction motor 1 (Pr.05-04)
19. No-load current for induction motor 1 (Pr.05-05)

20. Over-voltage stall prevention (Pr.06-01)
21. Over-current stall prevention during acceleration (Pr.06-03)
22. Derating protection (Pr.06-55)
23. Software brake chopper action level (Pr.07-00)
24. Emergency stop (EF) & force to stop selection (Pr.07-20)
25. Encoder type selection (Pr.10-00)
26. Encoder pulses per revolution (Pr.10-01)
27. Encoder input type setting (Pr.10-02)
28. System control (Pr.11-00)
29. Per-unit of system inertia (Pr.11-01)
30. ASR1 low-speed bandwidth (Pr.11-03)
31. ASR2 high-speed bandwidth (Pr.11-04)
32. Zero-speed bandwidth (Pr.11-05)

5. TQCPG Mode



01: Password Decoder

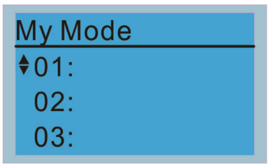


Items

1. Parameter protection password input (Pr.00-07)
2. Parameter protection password setting (Pr.00-08)
3. Control mode (Pr.00-10)
4. Speed control mdoe (Pr.00-11)
5. Master frequency command source (AUTO) / Source selection of the PID target (Pr.00-20)
6. Operation command source (AUTO) (Pr.00-21)
7. Max. operation frequency (Pr.01-00)
8. Motor 1 rated / base frequency (Pr.01-01)
9. Motor 1 rated / base voltage (Pr.01-02)
10. Full-load current for induction motor 1 (Pr.05-01)
11. Rated power for induction motor 1 (Pr.05-02)
12. Rated speed for induction motor 1 (Pr.05-03)
13. Number of poles for induction motor 1 (Pr.05-04)
14. No-load current of induction motor 1 (Pr.05-05)
15. Over-voltage stall prevention (Pr.06-01)
16. Software brake chopper action level (Pr.07-00)
17. Encoder type selection (Pr.10-00)
18. Encoder pulses per revolution (Pr.10-01)
19. Encoder input type setting (Pr.10-02)
20. System control (Pr.11-00)
21. Per-unit of system inertia (Pr.11-01)
22. ASR1 low-speed bandwidth (Pr.11-03)
23. ASR2 high-speed bandwidth (Pr.11-04)
24. Zero-speed bandwidth (Pr.11-05)
25. Max. torque command (Pr.11-27)
26. Torque offset source (Pr.11-28)
27. Torque offset setting (Pr.11-29)
28. Torque command source (Pr.11-33)
29. Torque command (Pr.11-34)
30. Speed limit selection (Pr.11-36)

31. Forward speed limit (torque mode) (Pr.11-37)
32. Reverse speed limit (torque mode) (Pr.11-38)

6. My Mode



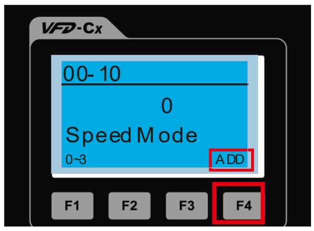
Press F4 in parameter setting screen to save the parameter to My Mode. To delete or correct the parameter, select this parameter and press F4 for DEL in the bottom right corner.

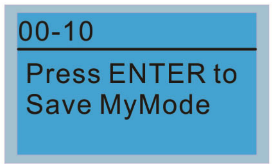
Items

It can save 1–32 sets of parameters (Pr).

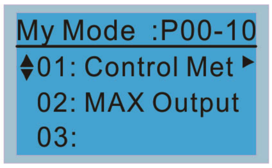
Setup process

1. Go to Parameter Setup function.
   Press ENTER to select the parameter to use. There is an ADD on the bottom right corner of the screen. Press F4 to add this parameter to My Mode.

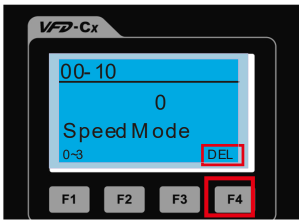


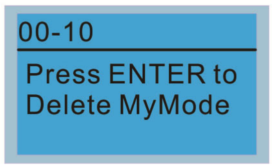


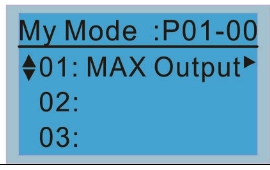
2. The parameter (Pr) displays in My mode if it is properly saved.
   To correct or to delete this parameter, press F4 for DEL.



3. To delete a parameter, go to My Mode and select the parameter to delete.
   Press ENTER to enter the parameter setting screen. DEL appears in the bottom left corner of the screen. Press F4 to delete this parameter from My Mode.

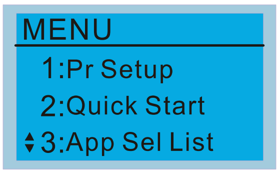


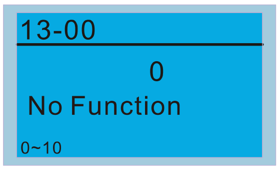


<table>
<tr><td></td><td>4. After you press ENTER to delete <01 Control Mode>, the <02 Maximum Operating Frequency > automatically replaces <01 Control Mode>.

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

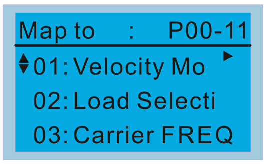
3. Application Selection List

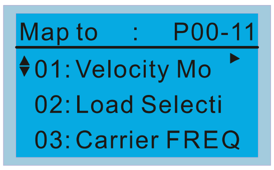
<table>
<tr><td>
</td>
<td>This function enables you to select application and its parameters sets.

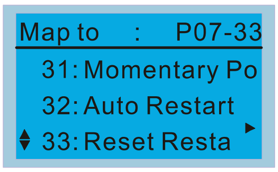
Example:
In the menu content, select 3: Application Selection List


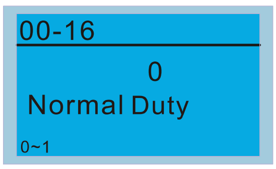
Press ENTER to go into the Application Selection List


Select Application
Press ENTER to enter the application selection screen, and the selected application industry is “Fan”.


Press ENTER to enter the Fan application screen.


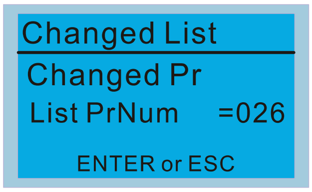
Press the UP / DOWN keys to select the parameter to set.






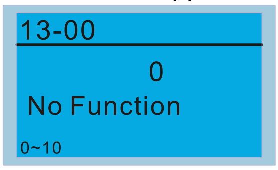
Choose 0: Normal duty or 1: Heavy duty according to your needs, then press ENTER.</td></tr>
</table>

4. Changed List

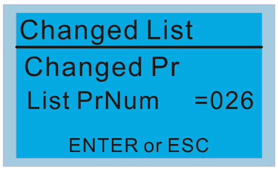


This function records the parameters you have changed.

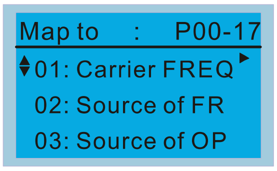
Example:
Set Pr.13-00 Application Selection = 3: Fan



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

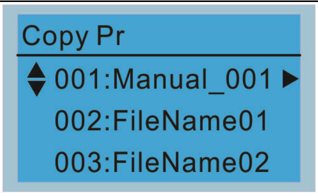


Press ENTER to enter the changed list screen.



Use the UP / DOWN keys to select the parameters to check or to change.
Press ENTER to enter the parameter.

5. Copy Parameter

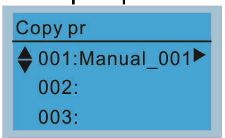


Press ENTER to go to

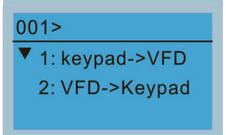
001–004 content storage

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

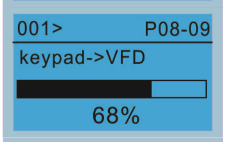
Example: parameter saved in the motor drive.



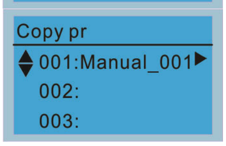
1. Go to Copy Parameter
2. Select the parameter group to copy and press ENTER.



1. Select 1: keypad→VFD
2. Press ENTER to go to the “keypad→VFD” screen.

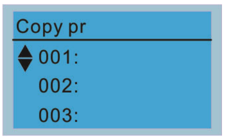


Begin copying parameters until it is done.

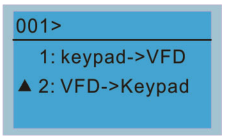
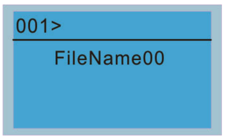
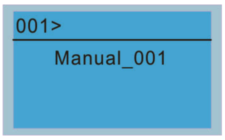
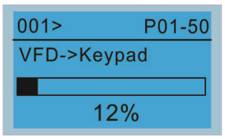
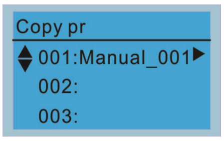
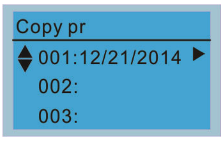
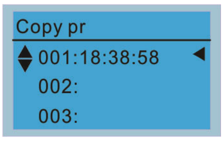


After copying is done, the keypad automatically returns to this screen.

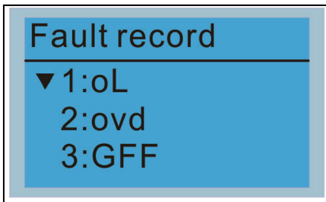
Example: parameter saved in the keypad.

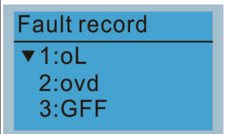
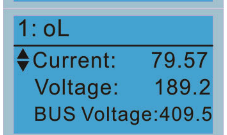
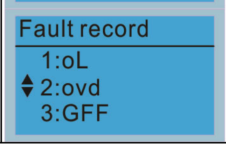


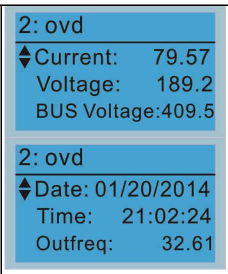
1. Go to Copy parameter
2. Select the parameter group to copy and press ENTER.

<table>
<tr><td rowspan="8"></td><td>
</td><td>Press ENTER to go to the “VFD→keypad” screen.</td></tr>
<tr><td>
</td><td>Press the UP / DOWN keys to select a symbol.
Press the LEFT / RIGHT keys to move the cursor to select a file name.</td></tr>
<tr><td colspan="2">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 { | } ~</td></tr>
<tr><td>
</td><td>After you confirm the file name, press ENTER.</td></tr>
<tr><td>
</td><td>Begin copying parameters until it is done.</td></tr>
<tr><td>
</td><td>After copying parameters is done, the keypad automatically returns to this screen.</td></tr>
<tr><td>
</td><td>Press the RIGHT key to see the date of the parameters copied.</td></tr>
<tr><td>
</td><td>Press the RIGHT key to see the time of the parameters copied.</td></tr>
</table>

6. Fault Record

<table>
<tr><td rowspan="5">

Press ENTER to see an error record’s details.</td><td colspan="2">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 shows as the first record. Choose an error record to see details such as date, time, frequency, current, voltage, and DC bus voltage)</td></tr>
<tr><td>
</td><td>Press the UP / DOWN keys to select an error record.
Press ENTER to see that error record’s details.</td></tr>
<tr><td>
</td><td rowspan="2">Press the UP / DOWN keys to scroll through an error record’s details such as date, time, frequency, current, voltage, and DC bus voltage.</td></tr>
<tr><td>
</td></tr>
<tr><td>
</td><td>Press the UP / DOWN keys to select the next error code. After selecting an error code, press ENTER to see that error record’s details.</td></tr>
</table>

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


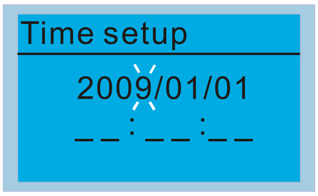
Press the UP / DOWN keys to see an error record's details such as date, time, frequency, current, voltage, and DC bus voltage.
NOTE:
The AC motor drive actions are recorded and saved to the KPC-CC01. When you remove the KPC-CC01 and connect it to another AC motor drive, the previous fault records are not deleted. The new fault records of the new AC motor drive continue to be added to the KPC-CC01.
</td>
</tr>
</table>

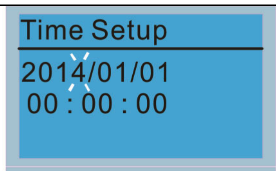
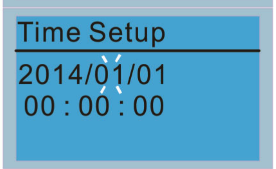
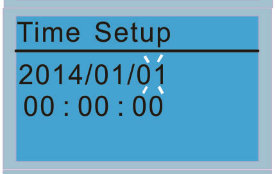
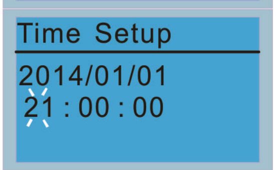
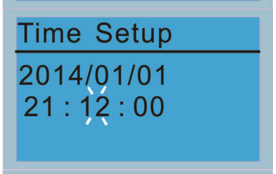
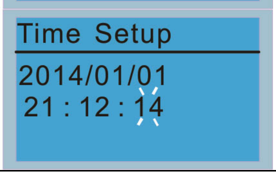
7. Language Setup

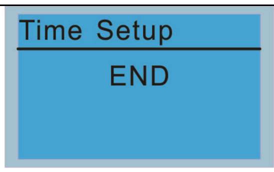
<table>
<tr>
<td>


Use the UP / DOWN keys to select the language, and than press ENTER.
</td>
<td>
The language setting option is displayed in the language of your choice.
Language setting options:
1. English 5. Русский 9. Polski
2. 繁體中文 6. Español 10. Deutsch
3. 简体中文 7. Português 11. Italiano
4. Türkçe 8. Français 12. Svenska
</td>
</tr>
</table>

8. Time Setup

<table>
<tr>
<td rowspan="6">


Use the LEFT / RIGHT keys to select Year, Month, Day, Hour, Minute or Second to change.
</td>
<td>
</td>
<td>Press the UP / DOWN keys to set the Year</td>
</tr>
<tr>
<td>
</td>
<td>Press the UP / DOWN keys to set the Month</td>
</tr>
<tr>
<td>
</td>
<td>Press the UP / DOWN keys to set the Day</td>
</tr>
<tr>
<td>
</td>
<td>Press the UP / DOWN keys to set the Hour</td>
</tr>
<tr>
<td>
</td>
<td>Press the UP / DOWN keys to set the Minute</td>
</tr>
<tr>
<td>
</td>
<td>Press the UP / DOWN keys to set the Second</td>
</tr>
</table>

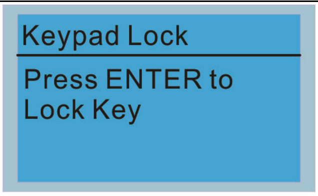


Press ENTER to confirm the Time Setup.

NOTE:

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

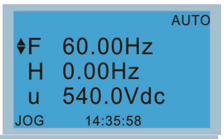
9. Keypad Locked



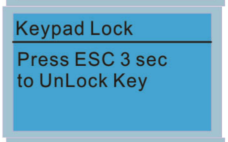
Press ENTER to lock

Lock the keypad

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

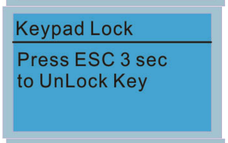


When the keypad is locked, the main screen does not indicate the lock status.

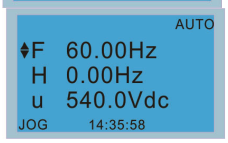


Press any key on the keypad; a message displays as shown on the left.

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



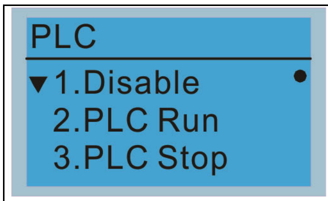
Press any key on the keypad, a message displays as shown on the left.



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

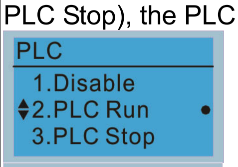
All keys on the keypad is functional. Turning the power off and on does not lock the keypad.

10. PLC Function

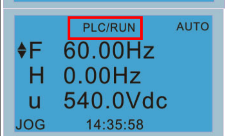


Press the UP / DOWN keys to select a PLC function, and then press ENTER.

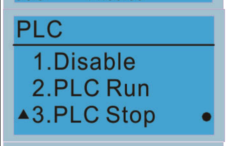
When activating and stopping the PLC function (choosing 2: PLC Run or 3: PLC Stop), the PLC status displays on main screen (Delta default setting).



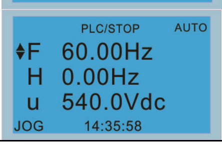
Choose option 2: PLC Run to enable the PLC function.



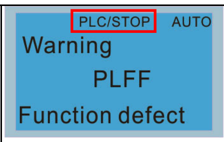
The default on the main screen displays the PLC / RUN status message.



Choose option 3: PLC Stop to disable the PLC function.

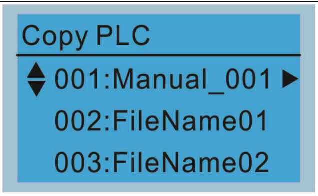


The default on the main screen displays the PLC / STOP status message.



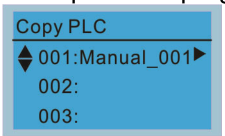
If the PLC program is not available in the control board, the PLFF warning displays when you choose option 2 or 3.
In this case, choose option 1: Disable to clear PLFF warning.

11. Copy PLC

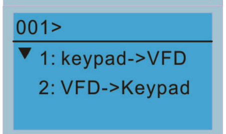


Four groups of parameters are available to copy.
The steps are shown in the example below.

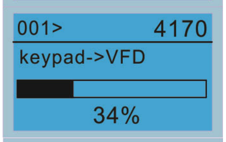
Example: PLC program saved in the motor drive.



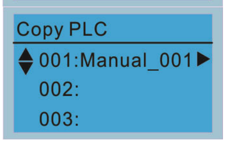
1. Go to Copy PLC
2. Select the PLC program to copy and press ENTER.



1. Select 1: Keypad→VFD
2. Press ENTER to go to the "Keypad→VFD" screen.

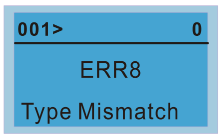


Begin copying the PLC program until it is done.

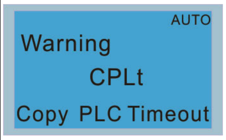


After copying is done, the keypad automatically returns to this screen.

NOTE:

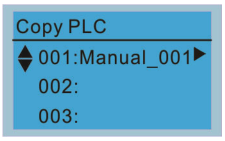


If you select "Option 1: Keypad→VFD", check if the PLC program is built-in to the KPC-CC01 keypad. If the PLC program is not available in the keypad when you select "Option 1: Keypad→VFD", an "ERR8 Warning: Type Mismatch" displays on the screen.

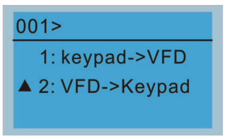


If you unplug the keypad and plug it back while copying the PLC program, the screen displays a CPLt warning.

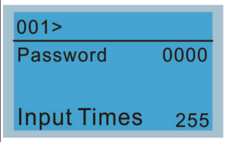
Example: PLC program saved in the keypad.



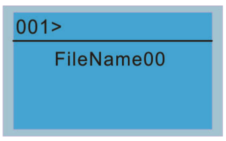
1. Go to Copy PLC.
2. Select the PLC program to copy and press ENTER.



Press ENTER to go to the "VFD→Keypad" screen.

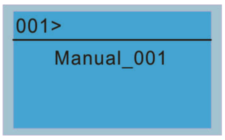


If the WPLSoft editor is installed uses password, enter the password to save the file to the keypad.

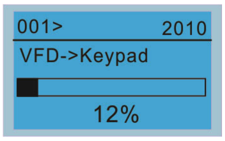


Press the UP / DOWN keys to select a symbol.
Press the LEFT / RIGHT keys to move the cursor to select a file name.

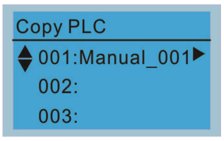
String & Symbol Table:
! " # $ % & ' ( ) * + , − . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ^ _ ' a b c d f g h i j k l m n o p q r s t u v w x y z { | } ~



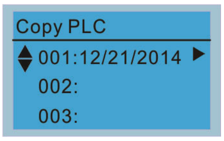
After you confirm the file name, press ENTER.



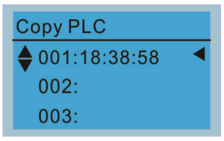
Begin copying the PLC program until it is done.



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



Press the RIGHT key to see the date of the program copied.

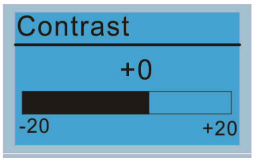


Press the RIGHT key to see the time of program copied.

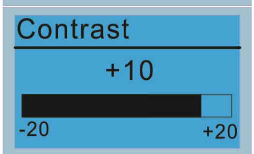
12. Display setup

Press ENTER to go to the setting screen.

1. Contrast

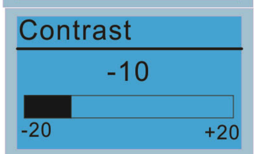


Press the UP / DOWN keys to adjust the setting value.

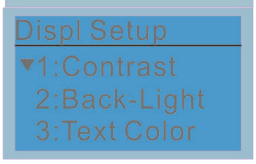


For example, increase Contrast to +10.

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



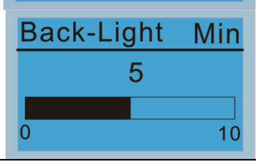
Then press ENTER and decrease the Contrast to -10.



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

2. Back-light

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



Press the UP / DOWN keys to adjust the setting value.

Screen	Description
Back-Light Min 0 0 10	When the setting value is 0 Min, the backlight remains on.
Displ Setup 1:Contrast 2:Back-Light 3:Text Color	When the setting value is 10 Min, the backlight turns off in 10 minutes.

3. Text Color

Screen	Description
Displ Setup 1:Contrast 2:Back-Light ▲3:Text Color	Press ENTER go to the Text Color Setting screen.
Text Color 0 White Text 0~1	The default value is White Text.
Text Color 1 Blue Text 0~1	Press the UP / DOWN keys to adjust the setting value, and then press ENTER.
Displ Setup ▼1:Contrast 2:Back-Light 3:Text Color	The setting value changes to Blue Text.

13. Start-up

Start-up
▼1.Default 1 ●
2.Default 2
3.User Define

1. Default 1 DELTA LOGO

DELTA
Industrial Automation

2. Default 2 DELTA Text

C Series
Industrial Automation

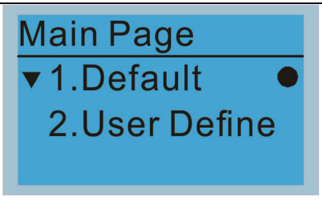
3. User Defined: an optional accessory is required (TPEditor & USB / RS-485 Communication Interface-IFD6530) to design your own start-up screen.
If the editor accessory is not installed, the User Define option displays a blank screen.

DELTA VFD C2000
X-Y-Z 3-axis station
X-axis

USB/RS-485 Communication Interface-IFD6530
Refer to Chapter 07 Optional Accessories for more details.

TPEditor
Download TPEditor software at Delta website. Select TPEditor version 1.60 or later. Refer to the installation instruction for TPEditor in Section 10-3.

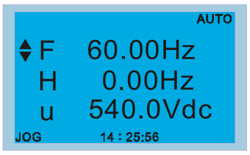
14. Main page



Default screen and editable screen are available.

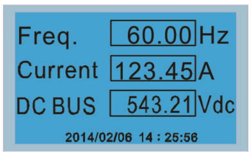
Press ENTER to select.

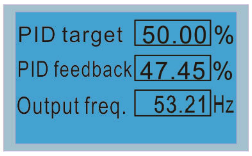
1. Default page



F 60.00Hz >>> H >>> A >>> U (options rotate)

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

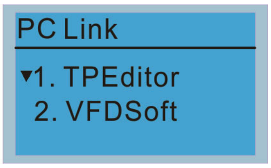




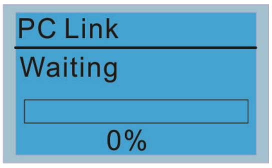
USB/RS-485 Communication Interface-IFD6530
Refer to Chapter 07 Optional Accessories for more details.

TPEditor
Download TPEditor software at Delta website. Select TPEditor version 1.60 or later. Refer to the installation instruction for TPEditor in Section 10-3.

15. PC Link

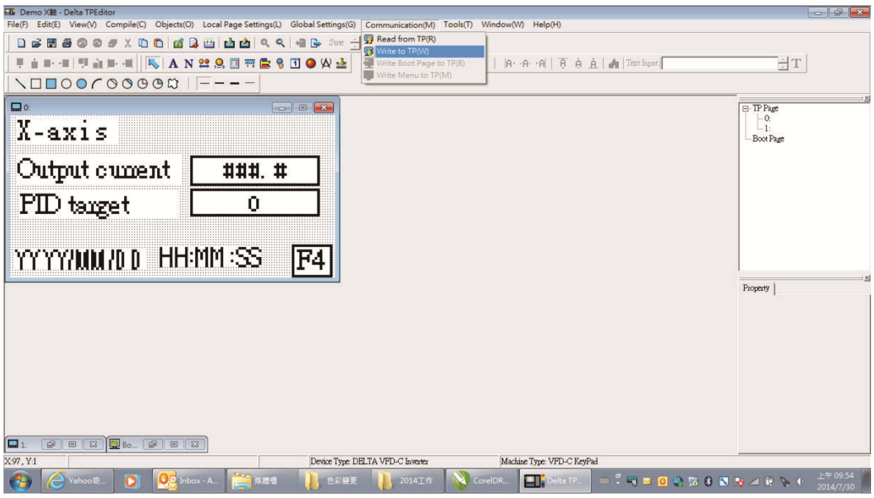


1. TPEditor: This function enables you to connect the keypad to a computer then download and edit user-defined screens.

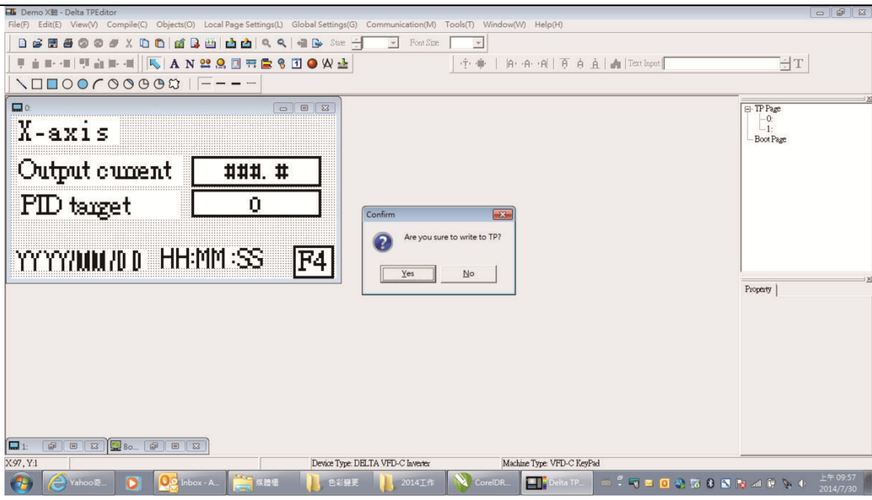


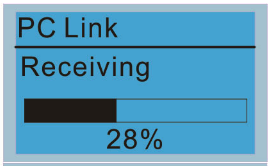
Press ENTER to go to Waiting to connect to PC screen.

In TPEditor, from the **Communication** menu, choose **Write to HMI**.

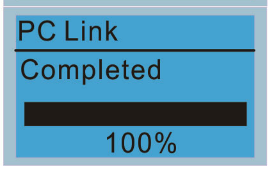


In the **Confirm** message box, click **YES**.





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

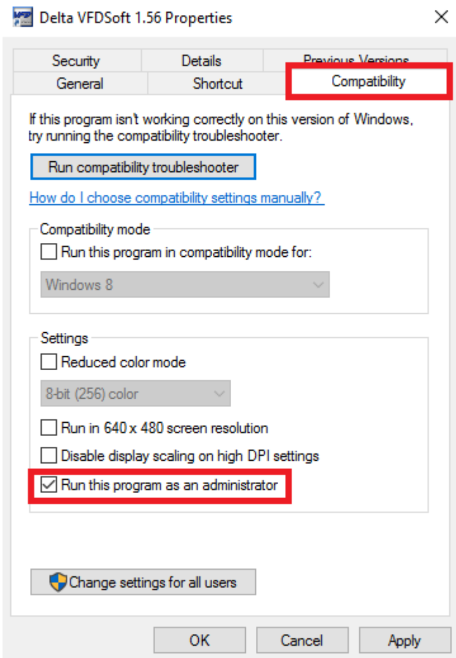


Download completed

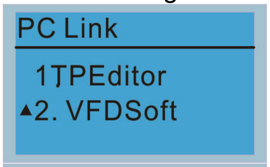
2. VFDSoft: this function enables you to link to the VFDSoft then upload the parameters 1–4 you have saved in the KPC-CC01.

NOTE

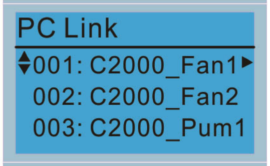
If the Operation System (OS) of your computer is Windows 10, right-click the VFDSoft icon to enter the **Property**. Then, click the **Compatibility** tab and select the **Run this program as an administrator** checkbox. (as shown in the red frames in the figure below)



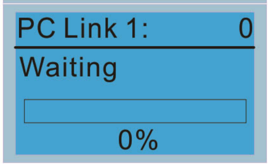
3. Connecting the KPC-CCO1 to a computer



Select 2: VFDSoft, and then press ENTER.

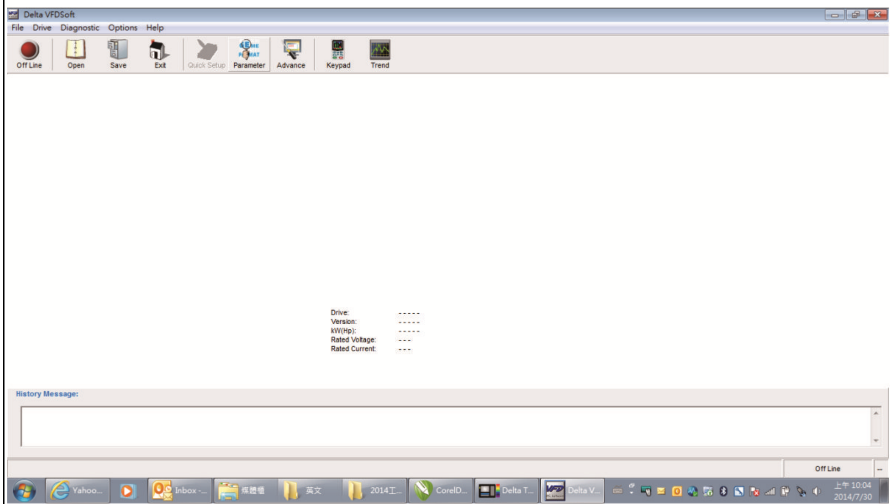


Press the UP / DOWN keys to select a parameter group to upload to VFDSoft.

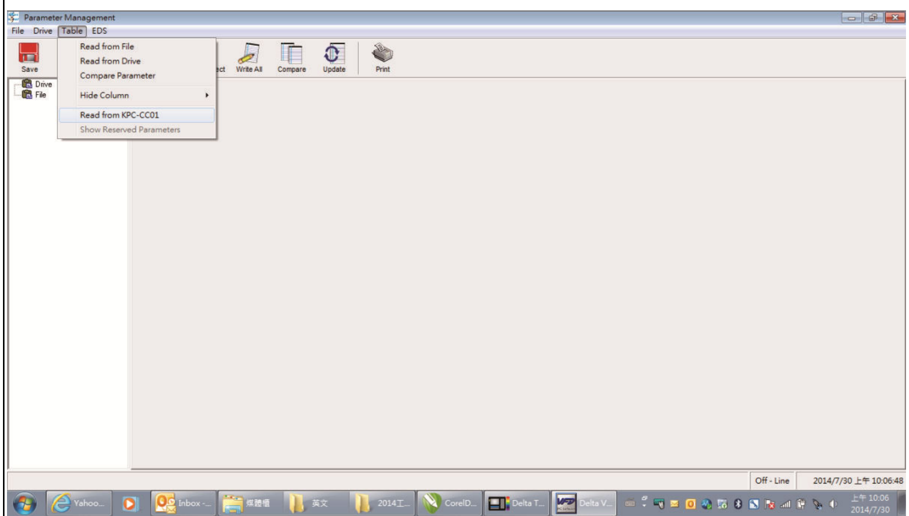


Press ENTER to go to Waiting to connect to PC screen.

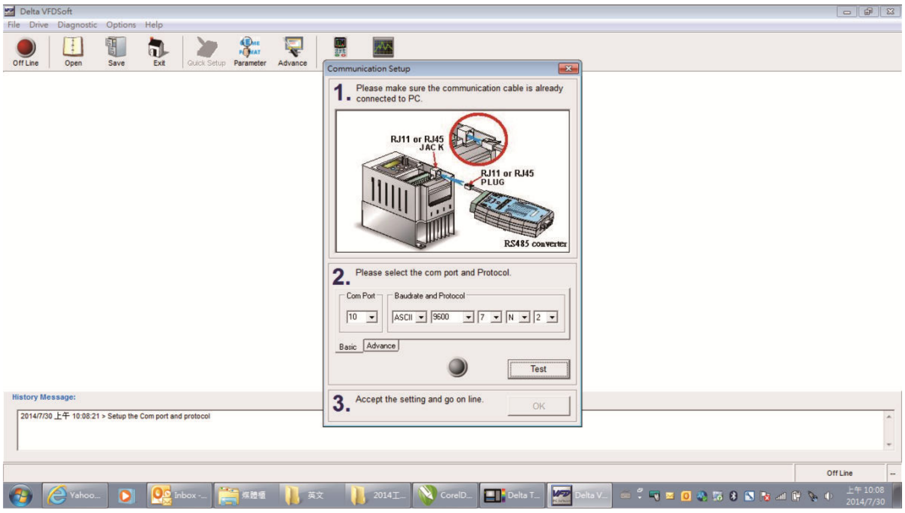
Open VFDSoft and click **Parameter** on the toolbar

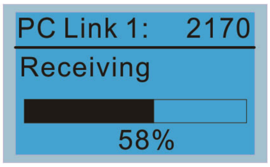


In Parameter Manager, from the **Table** menu, choose **Read from KPC-CC01**.

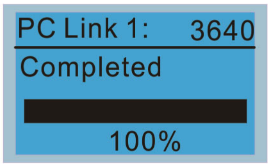


Choose the correct communication port and click **OK**.





Start to upload parameters to VFDSoft



Uploading parameter is completed

Before using the user-defined start-up screen and user-defined main screen, you must preset the start-up screen and the main screen as user-defined. If you do not download the user-defined screen to the KPC-CC01, the start-up screen and the main screen are blank.

16. Start Wizard (applicable for firmware V3.05 and later)

16.1 New drive start-up setting process

When a new drive is powered on, it directly enters the Start Wizard. There are three modes in the start-up setting process: Start Wizard, Exit Wizard and Test Mode.

(1) Start Wizard:

- In Start Wizard, you can set drive's parameters such as Calendar, Maximum operation frequency and Maximum voltage…; refer to Table 1 for setting items and orders.
- The drive exits Start Wizard when you finish the complete setting process, and will not enter this process when rebooting the power.

(2) Exit Wizard:

- Exit the Start Wizard mode. The drive does not go to Start Wizard when rebooting the power.

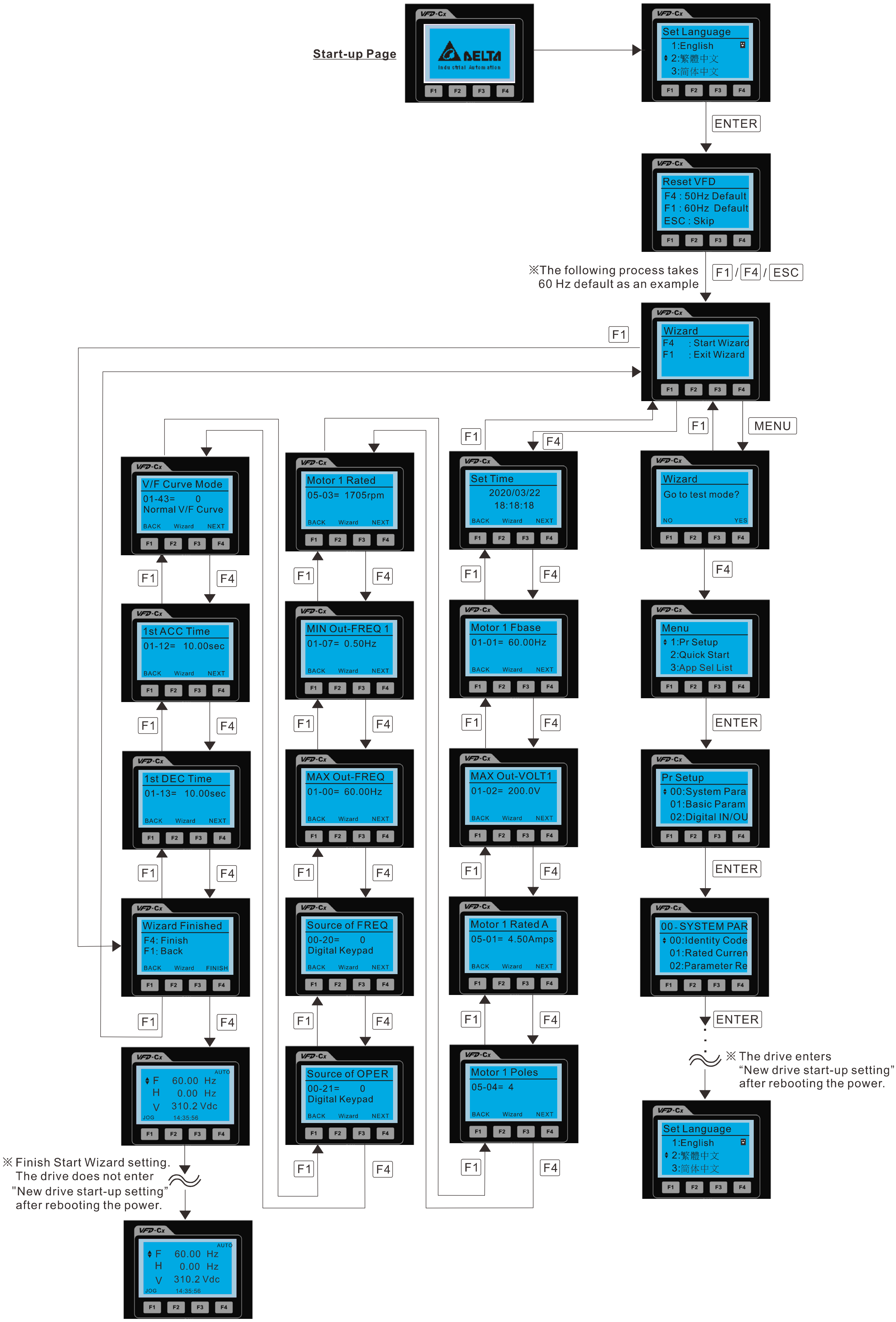
(3) Test Mode:

- This function is hidden to avoid misuse. Refer to the following flow chart to enter Test Mode.
- When the drive is in Test mode, it temporarily disables the Start Wizard and Exit Wizard mode.
- The Test Mode is designed for distributors / suppliers / clients to manage and operate the drive before shipping it out.
- If you enter Test Mode without exiting the Start Wizard process, the drive will begin with the new drive start-up process upon next power on.

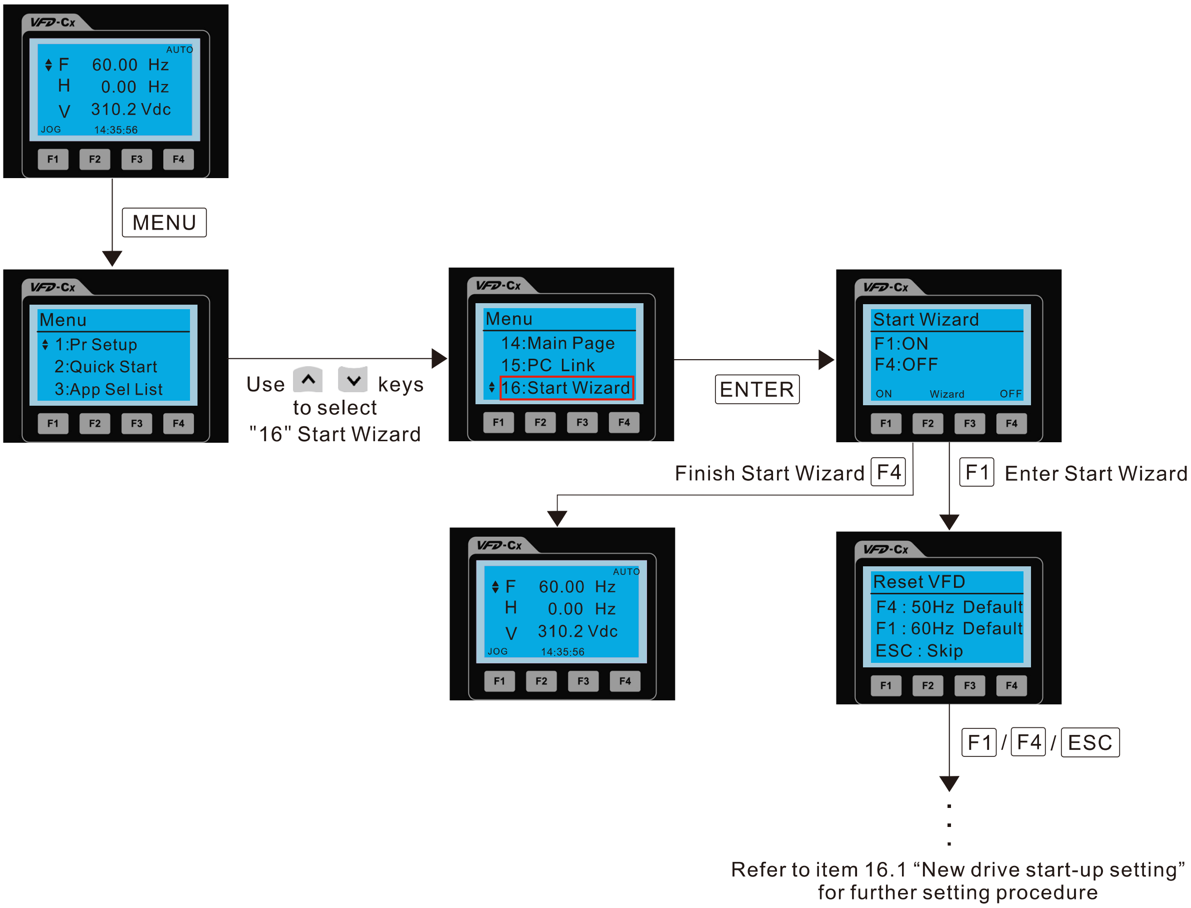
Setting Order	Description	Parameter
1	Calendar	N/A
2	Motor 1 rated / base frequency	01-01
3	Motor 1 rated / base voltage	01-02
4	Full-load current for induction motor 1 (A)	05-01
5	Number of poles for induction motor 1	05-04
6	Rated speed for induction motor 1 (rpm)	05-03
7	Minimum output frequency of motor 1	01-07
8	Maximum operation frequency	01-00
9	Master frequency command source (AUTO) / Source selection of the PID target	00-20
10	Operation command source (AUTO)	00-21
11	V/F curve selection	01-43
12	Acceleration time 1	01-12
13	Deceleration time 1	01-13

Table 1: Start Wizard setting items

Flow chart for the above setting process:



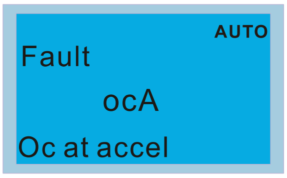
16.2 Re-start Start Wizard

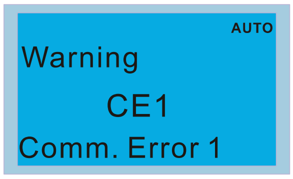


NOTE: The “16: Start Wizard” on the menu is to set whether the screen shows start wizard when powering on the drive.

Other displays

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





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

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 communication cables, buy non-shielded, 24 AWG, four-wire twisted pair, 100 ohms communication cables.

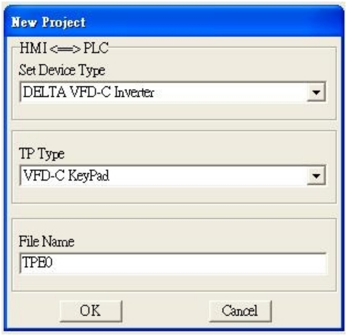
10-3 TPEditor Installation Instruction

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

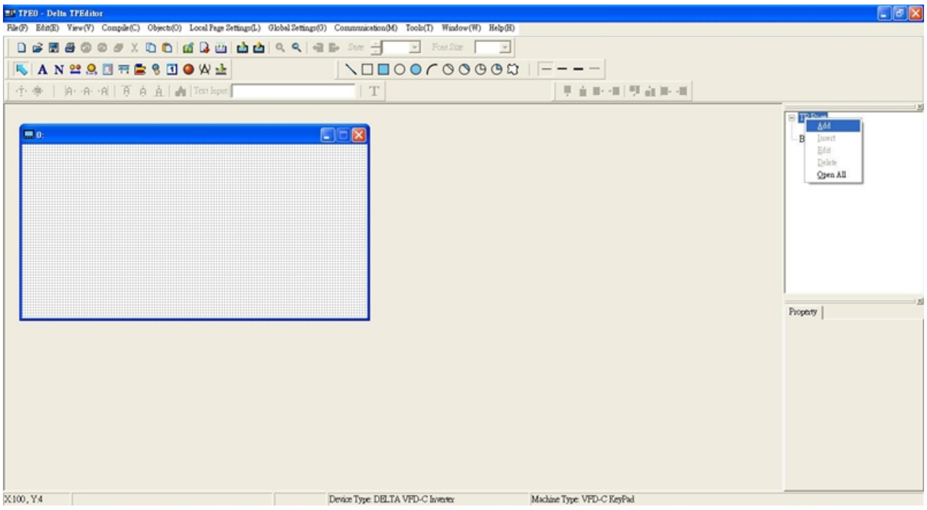
1) TPEditor: Setup & Basic Functions

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

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

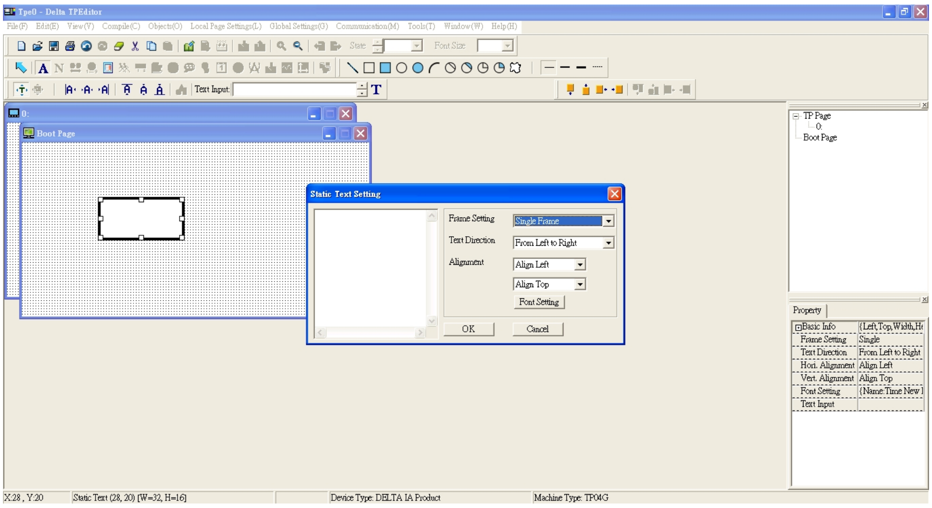


3. The editor displays the Design window. On the **Edit** menu, click **Add a New Page**. You can also right-click on the TP page in the upper right corner of the Design window and click **Add** to add one more page(s) to edit.

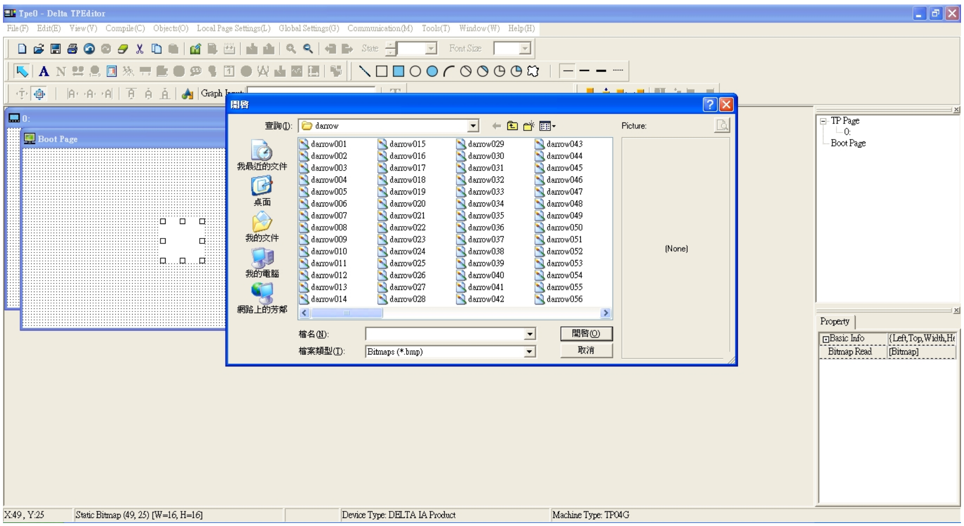


4. Edit the start-up screen.

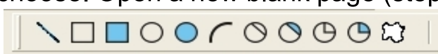
5. Add static text. Open a blank page (step 3), then on the toolbar click . Double-click the blank page to display the **Static Text Setting** dialog box, and then enter the static text.



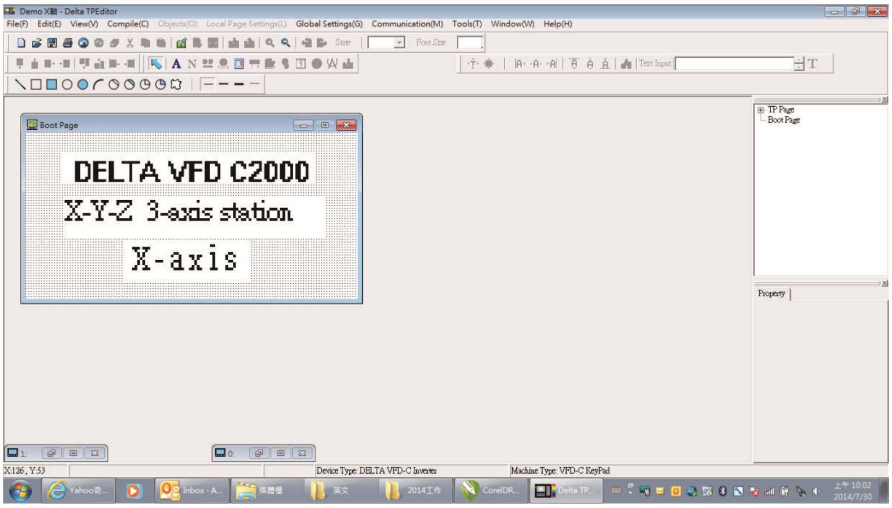
6. Add a static bitmap. Open a blank page (step 3), then on the toolbar, click . Double-click the blank page to display the **Static Bitmap Setting** dialog box where you can choose the bitmap.



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

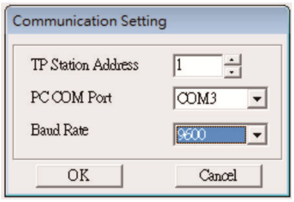
7. Add a geometric bitmap. There are 11 kinds of geometric bitmaps to choose. Open a new blank page (step 3), then on the toolbar click the geometric bitmap icon that you need . In the page, drag the geometric bitmap and enlarge it to the size that you need.

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

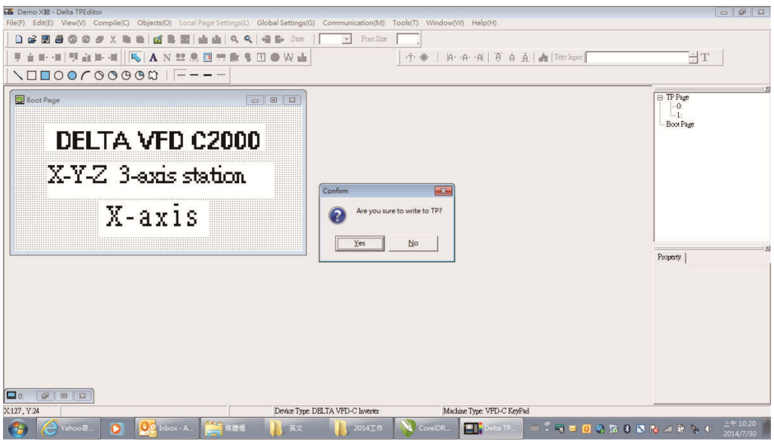


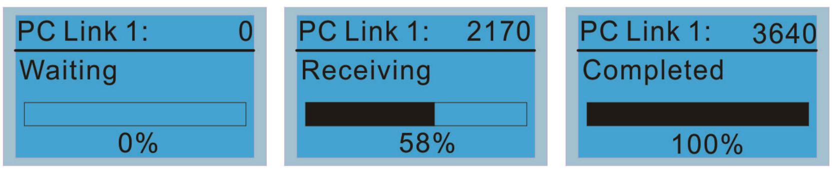
9. Download the new setting: On the **Tool** menu, click **Communication**. Set up the communication port and speed for the IFD6530. There are three speeds available: 9600 bps, 19200 bps, and 38400 bps.

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



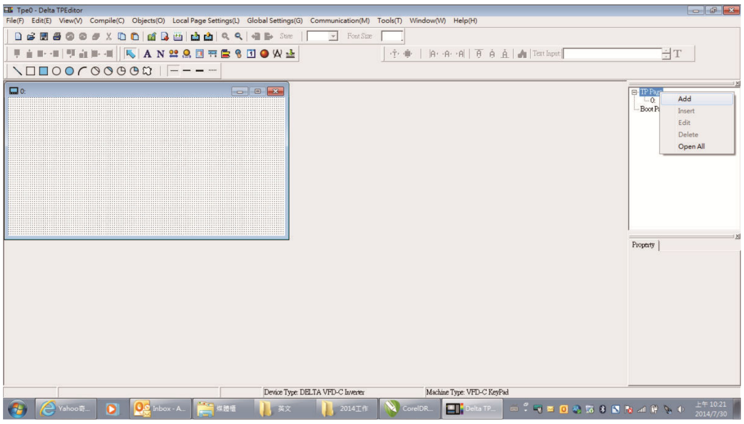
11. The Editor displays a message asking you to confirm the new setting. Before you click **OK**, on the keypad, go to MENU, select PC LINK, press ENTER and then wait for few seconds. Then click **YES** in the confirmation dialog box to start downloading.



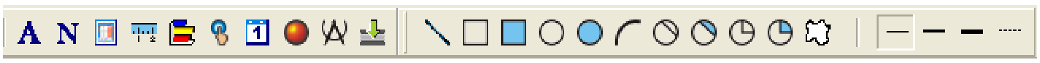


2) Edit the Main Page and Download to the Keypad

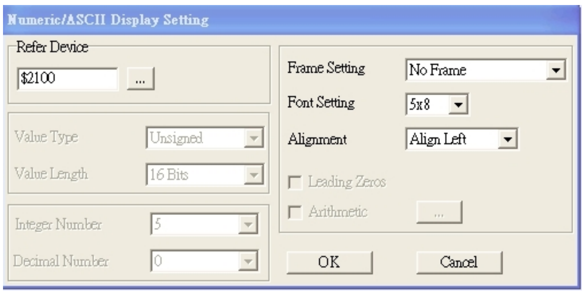
1. In the Editor, add a page to edit. On the **Edit** menu, click **Add a New Page**. You can also right-click on the TP page in the upper right corner of the Design window and click **Add** to add one more pages to edit. This keypad currently supports up to 256 pages.



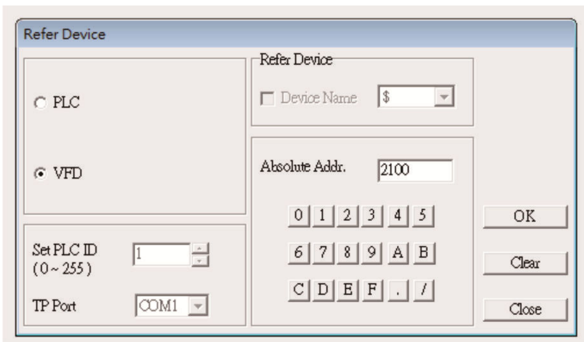
2. In the bottom right-hand corner of the Editor, click the page number to edit, or on the **View** menu, click **HMI Page** to start editing the main page. As shown in the picture above, the following objects are available. From left to right they are: Static Text, ASCII Display, Static Bitmap, Scale,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



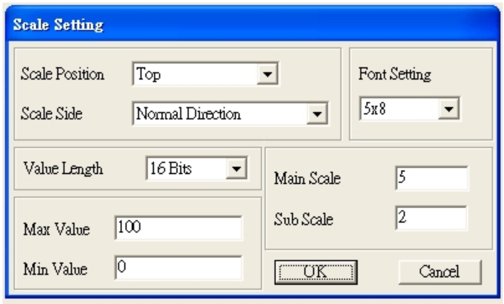
3. Add a numeric/ASCII display. On the toolbar, click the **Numeric/ASCII** button. In the page, double-click the object to specify the **Refer Device**, **Frame Setting**, **Font Setting** and **Alignment**.



Click **[…]**. In the **Refer Device** dialog box, choose the VFD communication port that you need. If you want to read the output frequency (H), set the **Absolute Addr.** to 2202. For other values, refer to the ACMD Modbus Comm Address List (see Pr.09-04 in Chapter 12 Group 09 Communication Parameters).



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



a. **Scale Position**: specifies where to place the scale.

b. **Scale Side**: specifies whether the scale is numbered from smaller numbers to larger numbers or from larger to smaller.

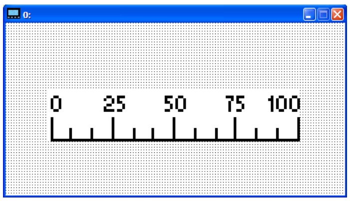
c. **Font Setting**: specifies the font.

d. **Value Length**: specifies 16 bits or 32 bits.

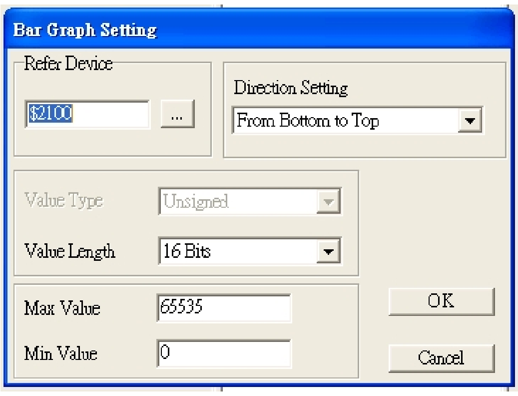
e. **Main Scale & Sub-Scale**: divides the whole scale into equal parts; enter the numbers for the main scale and sub-scale.

f. **Max Value & Min Value**: specifies the numbers on the two ends of the scale. They can be negative numbers, but the maximum and minimum values are limited by the **Value Length** setting. For example, when **Value Length** is **hexadecimal** (**16 bits**), the maximum and the minimum value cannot be entered as -40000.

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



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

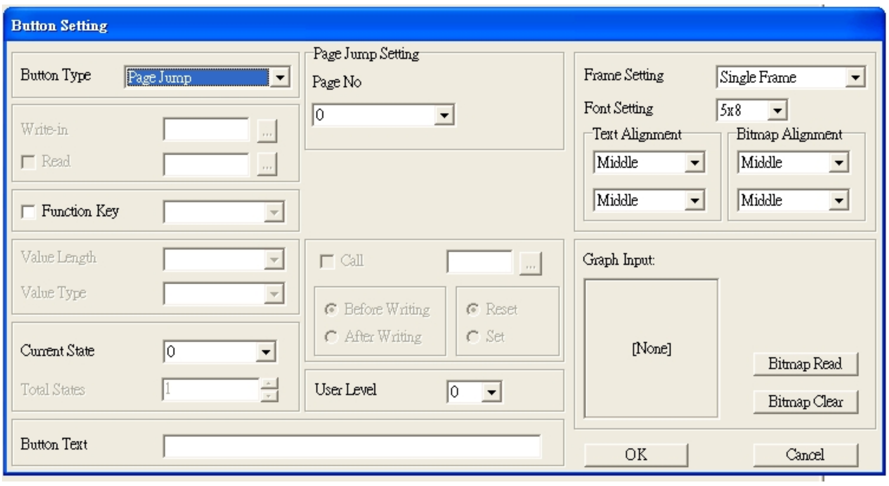


a. **Refer Device**: specifies the VFD communication port.

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

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

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

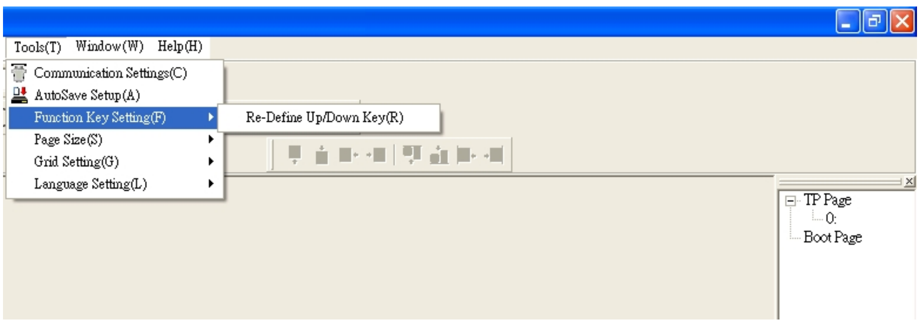


Button Type: specifies the button's functions.

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

A. Page Jump Setting

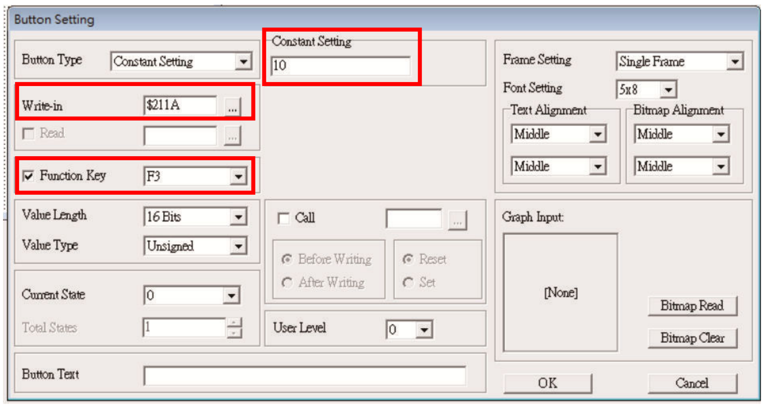
- **Page Jump Setting**: in the **Button Type** list, choose **Page Jump** to show the **Page Jump Setting**.
- **Function Key**: specifies the functions for the following keys on the KPC-CC01 keypad: F1, F2, F3, F4, Up, Down, Left and Right. Note that the Up and Down keys are locked by TPEditor. You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



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

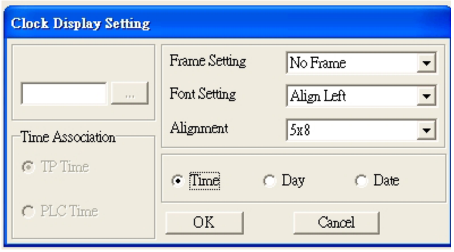
B. Constant setting

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

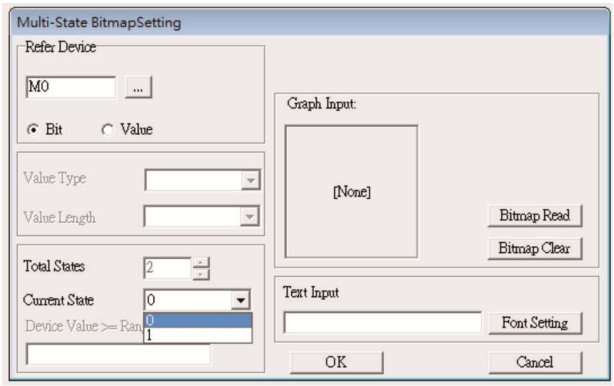


7. **Clock Display Setting**: on the toolbar, click . You can display the time, day, or date on the keypad. Open a new page and click once in that window to add a clock display.

Choose to display **Time**, **Day**, or **Date** on the keypad. To adjust time, go to #8 on the keypad's menu. You can also specify the **Frame Setting**, **Font Setting**, and **Alignment**.

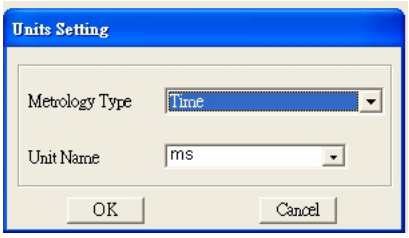


8. Multi-state bitmap: on the toolbar, click . Open a new page and click once in that window to add a Multi-state bitmap. This object reads a bit's property value from the PLC. It defines the image or text that appears when this bit is 0 or 1. Set the initial status (**Current State**) to be 0 or 1 to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



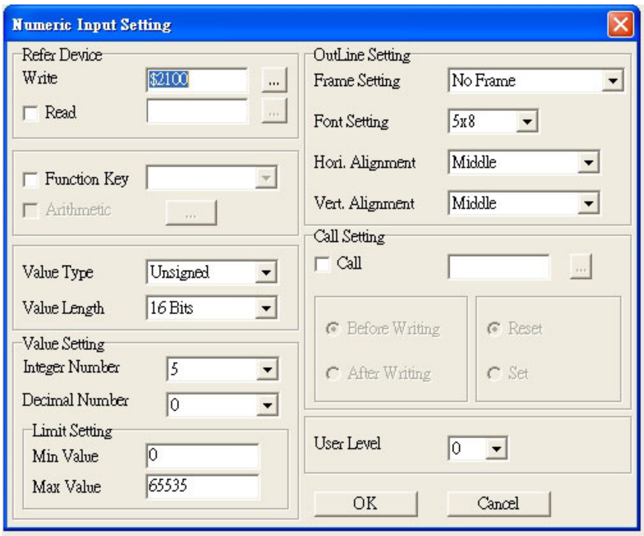
9. Unit Measurement: on the toolbar, click .

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



10. Numeric Input Setting: on the toolbar, click 

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



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

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

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

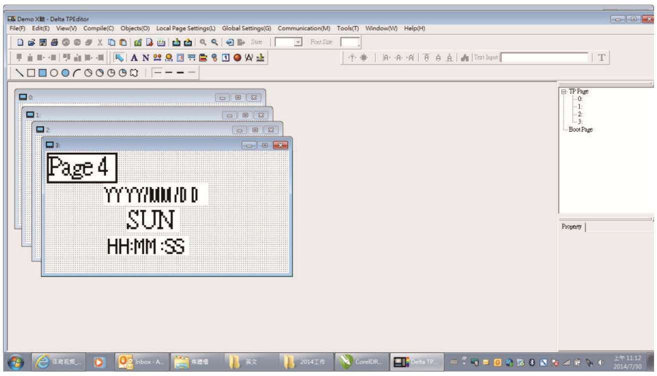
d. **Value Type** and **Value Length**: specify the range of the **Min Value** and **Max Value** for the **Limit Setting**. Note that the corresponding supporting values for MS300 must be 16 bits. 32-bit values are not supported.

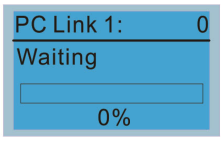
e. **Value Setting**: automatically set by the keypad itself.

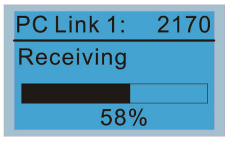
f. **Limit Setting**: specifies the range for the numeric input here.

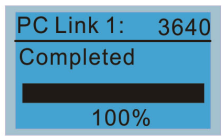
For example, if you set **Function Key** to **F1**, **Min Value** to 0 and **Max Value** to 4, when you press F1 on the keypad, then you can press Up/Down on the keypad to increase or decrease the value. Press ENTER on the keypad to confirm your setting. You can also view the parameter table 01-44 to verify if you correctly entered the value.

11. Download TP Page: Press Up / Down on the keypad to select #13 PC Link.
Then press ENTER on the keypad. The screen displays “Waiting”. In TPEditor, choose a page that you have created, and then on the **Communication** menu click **Write to TP** to start downloading the page to the keypad.
When you see “Completed” on the keypad screen, the download is finished. You can then press ESC on the keypad to go back to the menu screen.

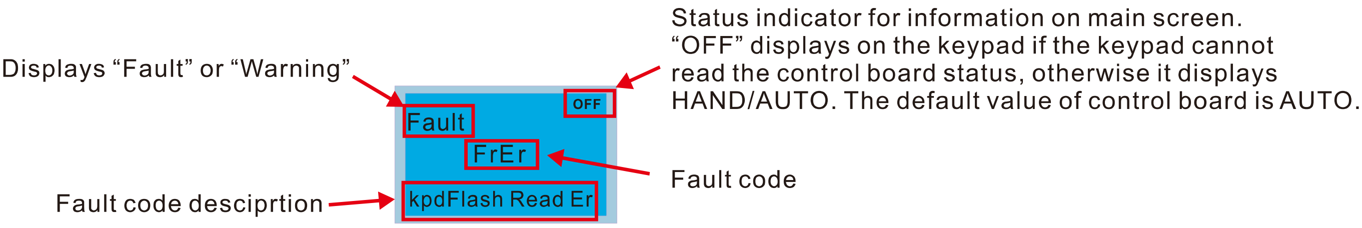




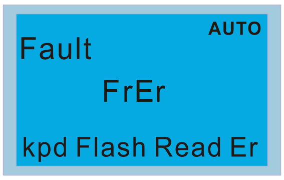
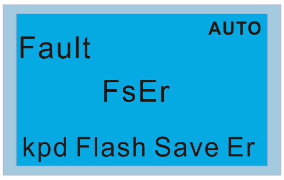
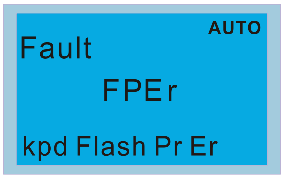
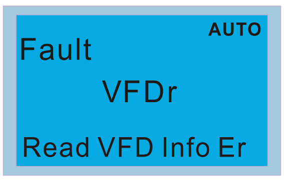
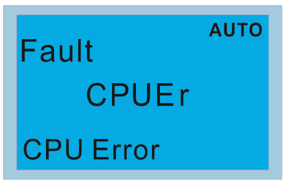




10-4 Digital Keypad KPC-CC01 Fault Codes and Descriptions



Fault Codes

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

Warning Codes

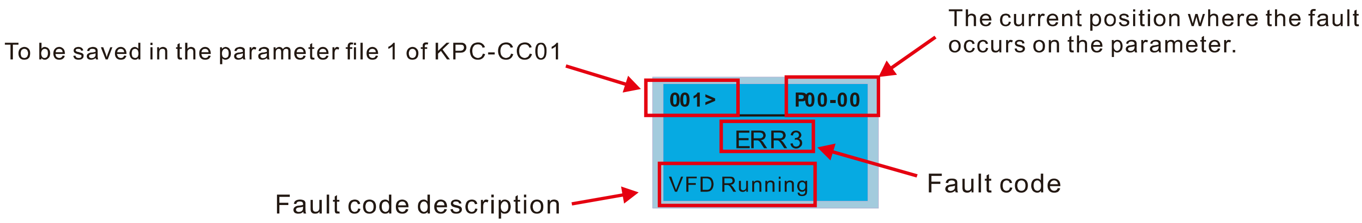
LCD Display *	Warning Name	Description	Corrective Actions
AUTO Warning CE1 Comm. Error 1	Commuication error 1 (CE1)	RS-485 Modbus illegal function code	Motor drive does not accept the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET on the keypad to clear errors. If none of the above solutions works, contact your local authorized dealer for assistance.
AUTO Warning CK1 Comm Command Er	Communication command error 1 (CK1)	Keypad communication data, illegal function code (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
AUTO Warning CE2 Comm. Error 2	Communication error 2 (CE2)	RS-485 Modbus illegal data address	Motor drive does not accept the keypad's communication address. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. If none of the above solutions works, contact your local authorized dealer for assistance.
AUTO Warning CK2 Comm Address Er	Communication address error (CK2)	Keypad communication data, illegal data address (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
AUTO Warning CE3 Comm. Error 3	Communication error 3 (CE3)	RS-485 Modbus illegal data value	Motor drive does not accept the communication data sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. If none of the above solutions works, contact your local authorized dealer for assistance.
AUTO Warning CK3 Comm Data Error	Communication data error (CK3)	Keypad communication data, illegal data value (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.

LCD Display *	Warning Name	Description	Corrective Actions
AUTO Warning CE4 Comm. Error 4	Communication error 4 (CE4)	RS-485 Modbus data is written to read-only address	Motor drive cannot process the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
AUTO Warning CK4 Comm Slave Error	Communication slave error (CK4)	Keypad communication data is written to read-only address (Keypad auto-detect this error and display it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
AUTO Warning CE10 Comm. Error 10	Communication error 10 (CE10)	RS-485 Modbus transmission time-Out	Motor drive does not respond to the communication command sent from the keypad. 1. Verify that the keypad is properly connected to the motor drive by a communication cable such as RJ45. 2. Press RESET to clear the errors. 3. Shut down the system, wait for ten minutes, and then restart the system. If none of the above solutions works, contact your local authorized dealer for assistance.
AUTO Warning CK10 KpdComm Time Out	Keypad communication time out (CK10)	Keypad communication data, transmission time-out (Keypad auto-detect this error and display it).	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If none of the above solution works, contact your local authorized dealer.
AUTO Warning TPNO TP No Object	Keypad communication time out (CK10)	Object not supported by TPEditor	Keypad's TPEditor uses an unsupported object. 1. Verify that the TPEditor is not using an unsupported object or setting. Delete unsupported objects and unsupported settings. 2. Re-edit the object in the TPEditor, and then download it to the keypad. 3. Verify that the motor drive supports the TP functions. If the drive does not support TP function, the main page displays Default. If none of the above solutions works, contact your local authorized dealer for assistance.

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

File Copy Setting Fault Description:

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



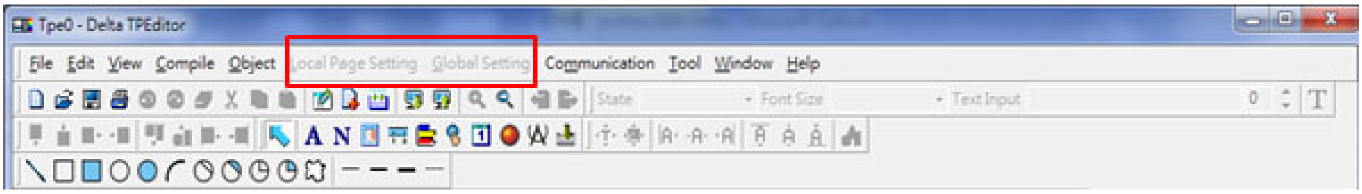
LCD Display *	Fault Name	Description	Corrective Actions
001> P00-00 ERR1 Read Only	Read only (ERR1)	Parameter and file are read-only	The parameter / file is read-only and cannot be written to. 1. Verify the specification in the user manual. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR2 Write Fail	Write in error (ERR2)	Fail to write parameter and file	An error occurred while writing to a parameter / file. 1. Check for any problem on the Flash IC. 2. Shut down the system, wait for ten minutes, and then restart the system. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR3 VFD Running	Drive operating (ERR3)	AC motor drive is in operating status	A setting cannot be changed while the motor drive is in operation. 1. Verify that the drive is not in operation. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR4 Pr Lock	Parameter locked (ERR4)	AC motor drive parameter is locked	A setting cannot be changed because a parameter is locked. 1. Check if the parameter is locked. If it is locked, unlock it and try to set the parameter again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR5 Pr Changing	Parameter changing (ERR5)	AC motor drive parameter is changing	A setting cannot be changed because a parameter is being modified. 1. Check if the parameter is being modified. If it is not being modified, try to change that parameter again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR6 Fault Code	Fault code (ERR6)	Fault code is not cleared	A setting cannot be changed because an error has occurred in the motor drive. 1. Check if any error occurred in the motor drive. If there is no error, try to change the setting again. If this solution does not work, contact your local authorized dealer for assistance.
001> P00-00 ERR7 Warning Code	Warning code (ERR7)	Warning code is not cleared	A setting cannot be changed because of a warning message given to the motor drive. 1. Check if there is a warning message given to the motor drive. If this solution does not work, contact your local authorized dealer for assistance.

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

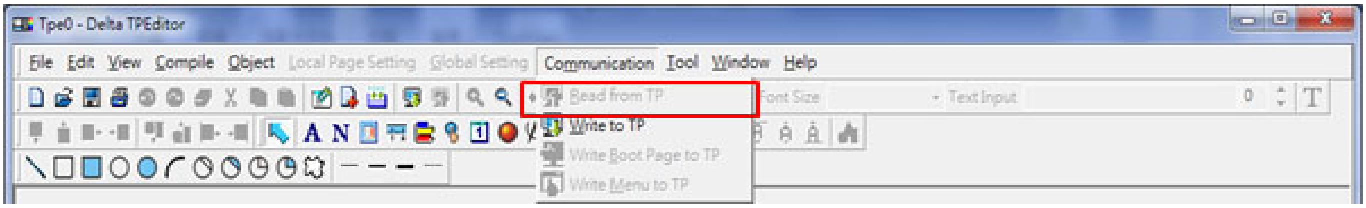
NOTE: The content in this section only applies to the KPC-CC01 keypad V1.01 and later versions.

10-5 Unsupported Functions when using TPEditor with the KPC-CC01

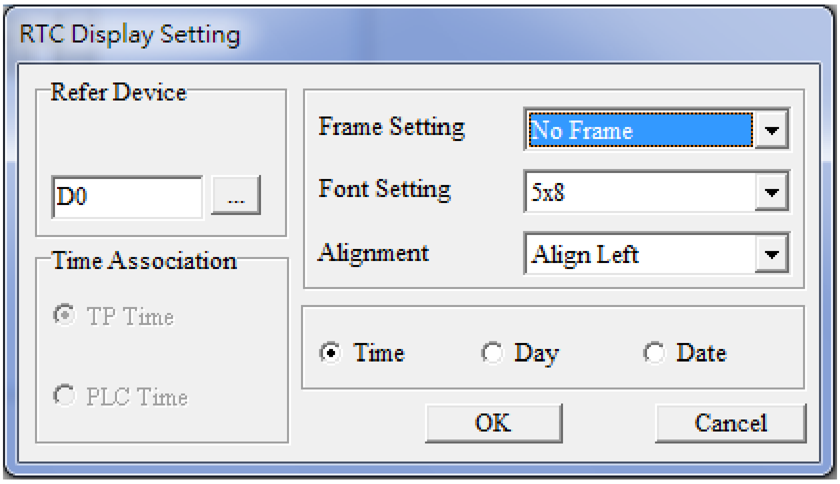
1. **Local Page Setting** and **Global Setting** functions are not supported.



2. In the **Communication** menu, **Read from TP** function is not supported.



3. In the **RTC Display Setting**, you cannot change the **Refer Device**.



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Chapter 11 Summary of Parameter Settings

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

NOTE:

1. 〆: You can set this parameter during operation
2. For more details on parameters, refer to chapter 12 Description of Parameter Settings.
3. 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

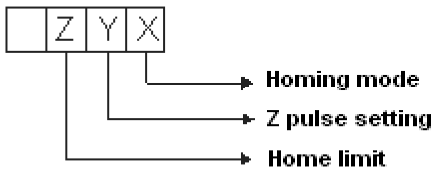
00 Drive Parameters

	Pr.	Parameter Name	Setting Range	Default
	00-00	AC Motor Drive Identity Code	408：460V, 5.5 kW 409：460V, 7.5 kW 410：460V, 11 kW 411：460V, 15 kW 412：460V, 18.5 kW 413：460V, 22 kW 414：460V, 30 kW 415：460V, 37 kW 416：460V, 45 kW 417：460V, 55 kW 418：460V, 75 kW 419：460V, 90 kW	Read only
	00-01	AC Motor Drive Rated Current Display	Display by models	Read only
	00-02	Parameter Reset	0: No function 1: Write protection for parameters 5: Return kWh displays to 0 6: Reset PLC (including CANopen Master Index) 7: Reset CANopen Slave index 9: Reset all parameters to defaults (base frequency is 50 Hz) 10: Reset all parameters to defaults (base frequency is 60 Hz)	0
〆	00-03	Start-up Display Selection	0: F (frequency command) 1: H (output frequency) 2: U (multi-function display, see Pr.00-04) 3: A (output current)	0
〆	00-04	Content of Multi-function Display	0: Display output current (A) (Unit: Amp) 1: Display counter value (c) (Unit: CNT) 2: Display the motor's actual output frequency (H.) (Unit: Hz) 3: Display the drive's DC bus voltage (v) (Unit: V_{DC}) 4: Display the drive's output voltage (E) (Unit: V_{AC}) 5: Display the drive's output power angle (n) (Unit: deg) 6: Display the drive's output power (P) (Unit: kW) 7: Display the motor speed rpm (r) (Unit: rpm) 8: Display the drive's estimated output torque, motor's rated torque is 100% (t) (Unit: %) 9: Display PG feedback (G) (refer to Pr.10-00 and Pr.10-01) (Unit: PLS) 10: Display PID feedback (b) (Unit: %)	3

Pr.	Parameter Name	Setting Range	Default
		11: Display AVI analog input terminal signal (1.) (Unit: %) 12: Display ACI analog input terminal signal (2.) (Unit: %) 13: Display AUI analog input terminal signal (3.) (Unit: %) 14: Display the drive's IGBT temperature (i.) (Unit: °C) 15: Display the drive's capacitance temperature (c.) (Unit: °C) 16: The digital input status (ON / OFF) (i) 17: The digital output status (ON / OFF) (o) 18: Display multi-step speed (S) 19: The corresponding CPU digital input pin status (d) 20: The corresponding CPU digital output pin status (0.) 21: Actual motor position (PG1 of PG card) (P.) The maximum value to display is 32bits 22: Pulse input frequency (PG2 of PG card) (S.) 23: Pulse input position (PG2 of PG card) (q.) The maximum value to display is 32bits 24: Position command tracing error (E.) 25: Overload count (0.00–100.00%) (o.) (Unit: %) 26: Ground fault GFF (G.) (Unit: %) 27: DC bus voltage ripple (r.) (Unit: V_{DC}) 28: Display PLC register D1043 data (C) 29: Display PM pole section (EMC-PG01U application) (4.) 30: Display the output of user-defined (U) 31: Display Pr.00-05 user gain (K) 32: Number of actual motor revolution during operation (PG card plug in and Z phase signal input) (Z.) 33: Motor actual position during operation (when PG card is connected)(q) 34: Operation speed of fan (F.) (Unit: %) 35: Control mode display: 0 = Speed control mode (SPD) 1 = Torque control mode (TQR) (t.) 36: Present operating carrier frequency of the drive (J.) (Unit: Hz) 38: Display the drive status (6.) 39: Display the drive's estimated output torque, positive and negative, using Nt-m as unit (t 0.0: positive torque; -0.0: negative torque (C.) 40: Torque command (L.) (Unit: %) 41: kWh display (J) (Unit: kWh) 42: PID target value (h.) (Unit: %) 43: PID compensation (o.) (Unit: %) 44: PID output frequency (b.) (Unit: Hz) 45: Hardware ID 68: STO version (d) 69: STO checksum-high word (d) 70: STO checksum-low word (d)	
00-05	Coefficient Gain in Actual Output Frequency	0.00–160.00	1.00
00-06	Software Version	Read only	Read only
✎ 00-07	Parameter Protection Password Input	0–65535 0–4: the number of password attempts allowed	0

	Pr.	Parameter Name	Setting Range	Default
ꟿ	00-08	Parameter Protection Password Setting	0–65535 0: No password protection / password is entered correctly (Pr.00-07) 1: Parameter has been set	0
ꟿ	00-10	Control Mode	0: Speed control mode 1: Position control mode 2: Torque mode 3: Home mode	0
	00-11	Control of Speed Mode	0: VF (IM V/f control) 1: VFPG (IM V/f control+ Encoder) 2: SVC(IM Sensorless vector control) 3: FOCPG (IM FOC vector control+ encoder) 4: FOCPG（PM FOC vector control + Encoder） 5: FOC Sensorless (IM field oriented sensorless vector control) 6: PM Sensorless (PM field oriented sensorless vector control) 7: IPM Sensorless (IPM field oriented sensorless vector control)	0
	00-12	Point-to-Point Position mode	0: Relative position 1: Absolute position	0
	00-13	Torque Mode Control	0: TQCPG（IM Torque control + Encoder） 1: TQCPG (PM Torque control + Encoder) 2: TQC Sensorless (IM Sensorless torque control)	0
ꟿ	00-16	Duty Selection	1: Heavy duty 2: Light duty	2
	00-17	Carrier Frequency	Light Duty 5.5–18.5 kW: 2–15 kHz 22–75 kW: 2–10 kHz 90 kW: 2–9 kHz Heavy Duty 5.5–7.5 kW: 2–15 kHz 11–90 kW: 2–6 kHz	 4 4 4 2 2
	00-19	PLC Command Mask	bit0: Control command is forced by PLC control bit1: Frequency command is forced by PLC control bit2: Position command is forced by PLC control bit3: Torque command is forced by PLC control	Read only
ꟿ	00-20	Source of Master Frequency Command（AUTO）	0: Digital keypad 1: RS-485 communication input 2: External analog input (Refer to Pr.03-00) 3: External UP / DOWN terminal 4: Pulse input without direction command (refer to Pr.10-16 without considering direction) 5: Pulse input with direction command (refer to Pr.10-16) 6: CANopen communication card 8: Communication card (does not include CANopen card)	0
	00-21	Source of the Operation Command（AUTO）	0: Digital keypad 1: External terminals 2: RS-485 communication input 3: CANopen communication card 5: Communication card (does not include CANopen card)	0
ꟿ	00-22	Stop Method	0: Ramp to stop 1: Coast to stop	0
ꟿ	00-23	Control of Motor Direction	0: Enable forward / reverse 1: Disable reverse 2: Disable forward	0
	00-24	Memory of Frequency Command	Read only	Read only

	Pr.	Parameter Name	Setting Range	Default
⌿	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
	00-26	Maximum User-Defined Value	• 0: Disabled • 0–65535 (when Pr.00-25 is set to no decimal place) • 0.0–6553.5 (when Pr.00-25 is set to 1 decimal place) • 0.00–655.35 (when Pr.00-25 is set to 2 decimal places) • 0.000–65.535 (when Pr.00-25 is set to 3 decimal places)	0
	00-27	User-Defined Value	Read only	Read Only
	00-29	LOCAL/REMOTE Selection	0: Standard HOA function 1: When switching between LOCAL and REMOTE, the drive stops. 2: When switching between LOCAL and REMOTE, the drive runs with REMOTE settings for frequency and operation status. 3: When switching between LOCAL and REMOTE, the drive runs with LOCAL settings for frequency and operation status.	0

<table>
<tr><th></th><th>Pr.</th><th>Parameter Name</th><th colspan="2">Setting Range</th><th>Default</th></tr>
<tr><td></td><td></td><td></td><td colspan="2">4: When switching between LOCAL and REMOTE, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operation status.</td><td></td></tr>
<tr><td></td><td>00-30</td><td>Source of the Master Frequency Command（HAND）</td><td colspan="2">0: Digital keypad
1: RS-485 communication input
2: External analog input (Refer to Pr.03-00)
3: External UP / DOWN terminal
4: Pulse input without direction command (refer to Pr.10-16 without considering direction)
5: Pulse input with direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication card (does not include CANopen card)</td><td>0</td></tr>
<tr><td></td><td>00-31</td><td>Source of the Operation Command（HAND）</td><td colspan="2">0: Digital keypad
1: External terminals
2: RS-485 communication input
3: CANopen communication card
5: Communication card (does not include CANopen card)</td><td>0</td></tr>
<tr><td>✓</td><td>00-32</td><td>Digital Keypad STOP Function</td><td colspan="2">0: STOP key disabled
1: STOP key enabled</td><td>0</td></tr>
<tr><td rowspan="4">✓</td><td rowspan="4">00-40</td><td rowspan="4">Homing mode</td><td colspan="2"></td><td rowspan="4">0000</td></tr>
<tr><td>X</td><td>Note: Forward run = closckwise (CW)
Reverse run = counterclockwise (CCW)
0: Forward run to home. Set PL forward limit as check point.
1: Reverse run (CCW) to home. Set NL reverse limit (CCWL) as check point.
2: Forward run to home. Set ORG : OFF→ON as check point.
3: Reverse to home. Set ORG : OFF→ON as check point.
4: Forward run and search for Z-pulse as check point.
5: Forward run and search for Z-pulse as check point.
6: Forward run to home. Set ORG: ON→OFF as check point.
7: Reverse run to home. Set ORG : ON→OFF as check point.
8: Define current position as home.</td></tr>
<tr><td>Y</td><td>Set X to 0, 1, 2, 3, 6, 7 first.
0: reverse run to Z pulse
1: continue forward run to Z pulse
2: Ignore Z pulse</td></tr>
<tr><td>Z</td><td>When home limit is reached, set X to 2, 3, 4, 5, 6, 7 first.
0: display the error
1: reverse the direction</td></tr>
<tr><td>✓</td><td>00-41</td><td>Homing by Frequency 1</td><td colspan="2">0.00–599.00 Hz</td><td>8.00</td></tr>
<tr><td>✓</td><td>00-42</td><td>Homing by Frequency 2</td><td colspan="2">0.00–599.00 Hz</td><td>2.00</td></tr>
</table>

	Pr.	Parameter Name	Setting Range	Default
⌿	00-48	Display Filter Time (Current)	0.001–65.535 sec.	0.100
⌿	00-49	Display Filter Time (Keypad)	0.001–65.535 sec.	0.100
	00-50	Software Version (date)	Read only	Read Only

01 Basic Parameters

	Pr.	Parameter Name	Setting Range	Default
〆	01-00	Maximum Operation Frequency	0.00–599.00 Hz	60.00 / 50.00
	01-01	Motor 1 Rated / Base Frequency	0.00–599.00 Hz	60.00 / 50.00
	01-02	Motor 1 Rated / Base Output Voltage	0.0V–510.0 V	400.0
	01-03	Motor 1 Mid-Point Frequency 1	0.00–599.00 Hz	3.00
〆	01-04	Motor 1 Mid-Point Voltage 1	0.0–480.0 V	22.0
	01-05	Motor 1 Mid-Point Frequency 2	0.00–599.00 Hz	1.50
〆	01-06	Motor 1 Mid-Point Voltage 2	0.0–480.0 V	10.0
	01-07	Motor 1 Minimum Output Frequency	0.00–599.00 Hz	0.50
〆	01-08	Motor 1 Minimum Output Voltage	0.0V–480.0 V	2.0
	01-09	Start-Up Frequency	0.00–599.00 Hz	0.50
〆	01-10	Output Frequency Upper Limit	0.00–599.00 Hz	599.00
〆	01-11	Output Frequency Lower Limit	0.00–599.00 Hz	0
〆	01-12	Acceleration Time 1	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-13	Deceleration Time 1	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-14	Acceleration Time 2	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-15	Deceleration Time 2	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-16	Acceleration Time 3	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-17	Deceleration Time 3	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-18	Acceleration Time 4	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-19	Deceleration Time 4	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
〆	01-20	JOG Acceleration Time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0

	Pr.	Parameter Name	Setting Range	Default
✓	01-21	JOG Deceleration Time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.00–6000.0 sec. The default of motor drive with 30HP and above: 60.00 / 60.0	10.00 10.0
✓	01-22	JOG Frequency	0.00–599.00Hz	6.00
✓	01-23	1^{st} / 4^{th} Accel. / Decel. Frequency	0.00–599.00Hz	0.00
✓	01-24	S-curve for Acceleration Begin Time 1	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
✓	01-25	S-curve for Acceleration Arrival Time 2	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
✓	01-26	S-curve for Deceleration Begin Time 1	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
✓	01-27	S-curve for Deceleration Arrival Time 2	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
	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: Output waiting 1: Zero-speed operation 2: Fmin (Refer to Pr.01-07, 01-41)	0
	01-35	Motor 2 Rated / Base Frequency	0.00–599.00 Hz	60.00 / 50.00
	01-36	Motor 2 Rated / Base Output Voltage	0.0–510.0 V	400.0
	01-37	Motor 2 Mid-Point Frequency 1	0.00–599.00 Hz	3.00
✓	01-38	Motor 2 Mid-Point Voltage 1	0.0–480.0 V	22.0
	01-39	Motor 2 Mid-Point Frequency 2	0.00–599.00 Hz	1.50
✓	01-40	Motor 2 Mid-Point Voltage 2	0.0–480.0 V	10.0
	01-41	Motor 2 Minimum Output Frequency	0.00–599.00 Hz	0.50
✓	01-42	Motor 2 Minimum Output Voltage	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: Curve to the power of 1.5 2: Curve to the power of 2 3: 60Hz, voltage saturation in 50 Hz 4: 72Hz, voltage saturation in 60 Hz 5: 50Hz, decrease gradually with third power 6: 50Hz, decrease gradually with square 7: 60Hz, decrease gradually with third power 8: 60Hz, decrease gradually with square 9: 50Hz, medium starting torque 10: 50Hz, high staring torque 11: 60Hz, medium starting torque 12: 60Hz, high starting torque 13: 90Hz, voltage saturation in 60 Hz 14: 120Hz, voltage saturation in 60 Hz 15: 180Hz, voltage saturation in 60 Hz	0
✓	01-44	Auto-Acceleration and Auto-Deceleration Setting	0: Linear acceleration and 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–Pr.01-21)	0
	01-45	Time Unit for Acceleration / Deceleration and S Curve	0: Unit: 0.01 sec. 1: Unit: 0.1sec.	0

	Pr.	Parameter Name	Setting Range	Default
✓	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

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: Multi-step speed command 1 / multi-step position command 1 2: Multi-step speed command 2 / multi-step position command 2 3: Multi-step speed command 3 / multi-step position command 3 4: Multi-step speed command 4 / multi-step position command 4 5: Reset 6: JOG command (by external control or KPC-CC01) 7: Acceleration / deceleration speed inhibit 8: 1^{st} and 2^{nd} acceleration / deceleration time selection 9: 3^{rd} and 4^{th} acceleration / deceleration time selection 10: External Fault (EF) input (Pr.07-20) 11: Base Block (B.B) input from external 12: Output voltage stops 13: Cancel the setting of auto-acceleration / auto-deceleration time 14: Switch between motor 1 and motor 2 15: Rotating speed command from AVI 16: Rotating speed command from ACI 17: Rotating speed command from AUI 18: Forced to stop (Pr.07-20) 19: Frequency up command 20: Frequency down command 21: PID function disabled 22: Clear the counter 23: Input the counter value (MI6) 24: FWD JOG command 25: REV JOG command 26: TQC / FOC mode selection 27: ASR1 / ASR2 selection 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for Δ-connection 31: High torque bias (Pr.11-30) 32: Middle torque bias (Pr.11-31) 33: Low torque bias (Pr.11-32) 34: Switch between multi-step position and multi-speed control 35: Enable single-point positioning 36: Enable multi-step position teaching function (valid at stop) 37: Enable pulse-train position command position control 38: Disable write EEPROM function 39: Torque command direction 40: Force coasting to stop 41: HAND switch 42: AUTO switch 43: Enable resolution selection (Pr.02-48) 44: Negative limit switch (NL) 45: Positive limit switch (PL) 46: Homing (ORG)	1
02-02	Multi-Function Input Command 2 (MI2)		2
02-03	Multi-function Input Command 3 (MI3)		3
02-04	Multi-Function Input Command 4 (MI4)		4
02-05	Multi-Function Input Command 5 (MI5)		0
02-06	Multi-Function Input Command 6 (MI6)		0
02-07	Multi-Function Input Command 7 (MI7)		0
02-08	Multi-Function Input Command 8 (MI8)		0
02-26	Input Terminal of I/O Extension Card (MI10)		0
02-27	Input Terminal of I/O Extension Card (MI11)		0
02-28	Input Terminal of I/O Extension Card (MI12)		0
02-29	Input Terminal of I/O Extension Card (MI13)		0
02-30	Input Terminal of I/O Extension Card (MI14)		0
02-31	Input Terminal of I/O Extension Card (MI15)		0

Pr.	Parameter Name	Setting Range	Default
		47: Homing function enabled 48: Mechanical gear ratio switch 49: Drive enabled 50: Slave dEb action to execute 51: Selection for PLC mode bit0 52: Selection for PLC mode bit1 53: Trigger CANopen quick stop 55: Brake released signal 56: Local / remote selection	
02-09	UP / DOWN Key Mode	0: By the acceleration / deceleration time 1: Constant speed (Pr.02-10)	0
02-10	Acceleration / Deceleration Speed of External 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 (RY1)	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: Overheat 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 indication 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: Δ -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) 39: Position reached (Pr.10-19) 40: Speed reached (including Stop) 41: Multi-position reached	11
02-14	Multi-Function Output 2 (RY2)		1
02-16	Multi-Function Output 3 (MO1)		66
02-17	Multi-Function Output 4 (MO2)		0
02-36	Output Terminal of 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 (MO12) or (RA12)		0
02-39	Output Terminal of I/O Extension Card (MO13) or (RA13)		0
02-40	Output Terminal of I/O Extension Card (MO14) or (RA14)		0
02-41	Output Terminal of I/O Extension Card (MO15) or (RA15)		0
02-42	Output Terminal of I/O Extension Card (MO16)		0
02-43	Output Terminal of I/O Extension Card (MO17)		0
02-44	Output Terminal of I/O Extension Card (MO18)		0
02-45	Output Terminal of I/O Extension Card (MO19)		0
02-46	Output Terminal of I/O Extension Card (MO20)		0

	Pr.	Parameter Name	Setting Range	Default
			42: Crane function 43: Motor actual speed detection 44: Low current output (use with Pr.06-71–06-73) 45: UVW output electromagnetic valve switch 46: Master dEb warning output 47: Closed brake output 49: Homing action completed 50: Output control for CANopen 51: Analog output control for RS-485 interface (InnerCOM / Modbus) 52: Output control for communication cards 65: Output control for both CANopen and RS485 66: SO output logic A 67: Analog input level reached 68: SO output logic B	
✎	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 attained (Does Not Return to 0)	0–65500	0
✎	02-21	Digital Output Gain (DFM)	1–166	1
✎	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
✎	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	0–100%	0
✎	02-34	Output Frequency Setting for Multi-Function Output Terminal	0.00–599.00 Hz (As Motor speed when using PG Card)	3.00
✎	02-35	External Operation Control Selection after Reset and Reboot	0: Disabled 1: Drive runs if the RUN command remains after reset or reboot	0
✎	02-47	Motor Zero-Speed Level	0–65535 rpm	0
✎	02-48	Maximum Frequency of Resolution Switch	0.00–599.00 Hz	60.00
✎	02-49	Switch Delay Time of Maximum Output Frequency	0–65000 ms	0
	02-50	Status of Multi-Function Input Terminal	Monitor the status of multi-function input terminals	Read only
	02-51	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
	02-56	Release Brake Check Time	0.000–65.000 sec.	0.000

	Pr.	Parameter Name	Setting Range	Default
✐	02-57	Multi-function output terminal: Function 42: Brake Current Checking Point	0–100%	0
✐	02-58	Multi-Function Output Terminal (Function 42): Brake Current Check Point	0.00–3.00 Hz	0.00
	02-63	Frequency Reached Detection Amplitude	0.00–599.00 Hz	0.00
	02-70	IO Card Types	1: EMC-BPS01 4: EMC-D611A 5: EMC-D42A 6: EMC-R6AA 11: EMC-A22A	Read only

03 Analog Input / Output Parameters

Pr.	Parameter Name	Setting Range	Default
03-00	AVI Analog Input Selection	0: No function 1: Frequency command (torque limit under torque control mode) 2: Torque command (torque limit under speed mode) 3: Torque compensation command 4: PID target value 5: PID feedback signal 6: PTC thermistor input value 7: Positive torque limit 8: Negative torque limit 9: Regenerative torque limit 10: Positive / negative torque limit 11: PT100 thermistor input value 13: PID Offset (%) (h.)	1
03-01	ACI Analog Input Selection		0
03-02	AUI Analog Input Selection		0
03-03	AVI Analog Input Bias	-100.0–100.0%	0
03-04	ACI Analog Input Bias	-100.0–100.0%	0
03-05	AUI Analog Positive Voltage Input Bias	-100.0–100.0%	0
03-07	AVI 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: Bias serves as the center	0
03-08	ACI Positive / Negative Bias Mode		
03-09	AUI Positive / Negative Bias Mode		
03-10	Reverse Setting When Analog Signal Input is Negative Frequency	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.	0
03-11	AVI Analog Input Gain	-500.0–500.0%	100.0
03-12	ACI Analog Input Gain	-500.0–500.0%	100.0
03-13	AUI Analog Positive Input Gain	-500.0–500.0%	100.0
03-14	AUI Analog Negative Input Gain	-500.0–500.0%	100.0
03-15	AVI Analog Input Filter Time	0.00–20.00 sec.	0.01
03-16	ACI Analog Input Filter Time	0.00–20.00 sec.	0.01
03-17	AUI Analog Input Filter Time	0.00–20.00 sec.	0.01
03-18	Analog Input Addition Function	0: Disabled (AVI, ACI, AUI) 1: Enabled	0
03-19	Signal Loss Selection for the Analog Input 4–20 mA	0: Disabled 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display ACE	0
03-20	AFM1 Multi-Function Output 1	0: Output frequency (Hz)	0
03-23	AFM2 Multi-Function Output 2	1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: Output torque	0

	Pr.	Parameter Name	Setting Range	Default
			9: AVI 10: ACI 11: AUI 12: Iq current 13: Iq feedback value 14: Id current 15: Id feedback value 16: Vq-axis voltage 17: Vd-axis voltage 18: Torque command 19: PG2 frequency command 20: CANopen analog output 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage/current output 25: CAN & 485 output	
〃	03-21	AFM1 Analog Output Gain 1	0.0–500.0%	100.0
〃	03-22	AFM1 Analog Output 1 in REV Direction	0: Absolute output voltage 1: Reverse output 0V; Positive output 0-10V 2: Reverse output 5-0V; Positive output 5-10V	0
〃	03-24	AFM2 Analog Output Gain 2	0.0–500.0%	100.0
〃	03-25	AFM2 Analog Output 2 in REV Direction	0: Absolute output voltage 1: Output 0V in REV direction; output 0-10V in FWD direction 2: Output 5-0V in REV direction; output 5-10V in FWD direction	0
〃	03-27	AFM2 Output Bias	-100.00–100.00%	0.00
〃	03-28	AVI Selection	0: 0-10V 1: 0-20mA 2: 4-20mA	0
〃	03-29	ACI Selection	0: 4-20mA 1: 0-10V 2: 0-20mA	0
	03-30	Status of PLC Output Terminal	Monitor the status of PLC output terminals	Read only
〃	03-31	AFM2 0-20mA Output Selection	0: 0-20mA Output 1: 4-20mA Output	0
〃	03-32	AFM1 DC Output Setting Level	0.00–100.00%	0.00
〃	03-33	AFM2 DC Output Setting Level	0.00–100.00%	0.00
〃	03-35	AFM1 Filter Output Time	0.00–20.00 sec.	0.01
〃	03-36	AFM2 Filter Output Time	0.00–20.00 sec.	0.01
〃	03-44	Multi-Function Output (MO) By AI Level Source	0: AVI 1: ACI 2: AUI	0
〃	03-45	AI Upper Level (MO)	-100.00%–100.00%	50.00
〃	03-46	AI Lower Level (MO)	-100.00%–100.00%	10.00
〃	03-50	Analog Input Curve Selection	0: Normal curve 1: Three-point curve of AVI 2: Three-point curve of ACI 3: Three-point curve of AVI & ACI 4: Three-point curve of AUI 5: Three-point curve of AVI & AUI 6: Three-point curve of ACI & AUI 7: Three-point curve of AVI & ACI & AUI	0

	Pr.	Parameter Name	Setting Range	Default
✓	03-51	AVI Lowest Point	Pr.03-28 = 0, 0.00–10.00 V Pr.03-28 ≠ 0, 0.00–20.00 mA	0.00
✓	03-52	AVI Proportional Lowest Point	-100.00–100.00%	0.00
✓	03-53	AVI Mid-Point	Pr.03-28 = 0, 0.00–10.00 V Pr.03-28 ≠ 0, 0.00–20.00 mA	5.00
✓	03-54	AVI Proportional Mid-Point	-100.00–100.00%	50.00
✓	03-55	AVI Highest Point	Pr.03-28 = 0, 0.00–10.00 V Pr.03-28 ≠ 0, 0.00–20.00 mA	10.00
✓	03-56	AVI Proportional Highest Point	-100.00–100.00%	100.00
✓	03-57	ACI Lowest Point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	4.00
✓	03-58	ACI Proportional Lowest Point	-100.00–100.00%	0.00
✓	03-59	ACI Mid-Point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	12.00
✓	03-60	ACI Proportional Mid-Point	-100.00–100.00%	50.00
✓	03-61	ACI Highest Point	Pr.03-29 = 1, 0.00–10.00 V Pr.03-29 ≠ 1, 0.00–20.00 mA	20.00
✓	03-62	ACI Proportional Highest Point	-100.00–100.00%	100.00
✓	03-63	Positive AUI Voltage Lowest Point	0.00–10.00 V	0.00
✓	03-64	Positive AUI Voltage Proportional Lowest Point	0.00–100.00%	0.00
✓	03-65	Positive AUI Voltage Mid-Point	0.00–10.00 V	5.00
✓	03-66	Positive AUI Voltage Proportional Mid-Point	0.00–100.00%	50.00
✓	03-67	Positive AUI Voltage Highest Point	0.00–10.00 V	10.00
✓	03-68	Positive AUI Voltage Proportional Highest Point	0.00–100.00%	100.00
✓	03-69	Negative AUI Voltage Lowest Point	-10.00–0.00 V	0.00
✓	03-70	Negative AUI Voltage Proportional Lowest Point	-100.00–100.00%	0.00
✓	03-71	Negative AUI Voltage Mid-Point	-10.00–0.00 V	-5.00
✓	03-72	Negative AUI Voltage Proportional Mid-Point	-100.00–100.00%	-50.00
✓	03-73	Negative AUI Voltage Highest Point	-10.00–0.00 V	-10.00
✓	03-74	Negative AUI Voltage Proportional Highest Point	-100.00–100.00%	-100.00

04 Multi-step Speed Parameters

	Pr.	Parameter Name	Setting Range	Default
ϟ	04-00	1^{st} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-01	2^{nd} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-02	3^{rd} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-03	4^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-04	5^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-05	6^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-06	7^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-07	8^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-08	9^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-09	10^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-10	11^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-11	12^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-12	13^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-13	14^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-14	15^{th} Step Speed Frequency	0.00–599.00 Hz	0.00
ϟ	04-15	Position Command 1 (Revolution)	-30000–30000	0
ϟ	04-16	Position Command 1 (Pulse)	-32767–32767	0
ϟ	04-17	Position Command 2 (Revolution)	-30000–30000	0
ϟ	04-18	Position Command 2 (Pulse)	-32767–32767	0
ϟ	04-19	Position Command 3 (Revolution)	-30000–30000	0
ϟ	04-20	Position Command 3 (Pulse)	-32767–32767	0
ϟ	04-21	Position Command 4 (Revolution)	-30000–30000	0
ϟ	04-22	Position Command 4 (Pulse)	-32767–32767	0
ϟ	04-23	Position Command 5 (Revolution)	-30000–30000	0
ϟ	04-24	Position Command 5 (Pulse)	-32767–32767	0
ϟ	04-25	Position Command 6 (Revolution)	-30000–30000	0
ϟ	04-26	Position Command 6 (Pulse)	-32767–32767	0
ϟ	04-27	Position Command 7 (Revolution)	-30000–30000	0
ϟ	04-28	Position Command 7 (Pulse)	-32767–32767	0
ϟ	04-29	Position Command 8 (Revolution)	-30000–30000	0
ϟ	04-30	Position Command 8 (Pulse)	-32767–32767	0
ϟ	04-31	Position Command 9 (Revolution)	-30000–30000	0
ϟ	04-32	Position Command 9 (Pulse)	-32767–32767	0
ϟ	04-33	Position Command 10 (Revolution)	-30000–30000	0
ϟ	04-34	Position Command 10 (Pulse)	-32767–32767	0

Pr.	Parameter Name	Setting Range	Default
04-35	Position Command 11 (Revolution)	-30000–30000	0
04-36	Position Command 11 (Pulse)	-32767–32767	0
04-37	Position Command 12 (Revolution)	-30000–30000	0
04-38	Position Command 12 (Pulse)	-32767–32767	0
04-39	Position Command 13 (Revolution)	-30000–30000	0
04-40	Position Command 13 (Pulse)	-32767–32767	0
04-41	Position Command 14 (Revolution)	-30000–30000	0
04-42	Position Command 14 (Pulse)	-32767–32767	0
04-43	Position Command 15 (Revolution)	-30000–30000	0
04-44	Position Command 15 (Pulse)	-32767–32767	0
04-50 – 04-69	PLC Buffer 0–19	0–65535	0

05 Motor Parameters

	Pr.	Parameter Name	Setting Range	Default
	05-00	Motor Auto-Tuning	0: No function 1: Rolling test for induction motor (IM) (Rs, Rr, Lm, Lx, no-load current) 2: Static test for induction motor (IM) 4: Rolling test for PM motor magnetic pole 5: Rolling test for PM (SPM) motor 6: Rolling test for IM motor flux curve 12: FOC Sensorless inertia estimation 13: Stacic test for (IPM / SPM) motor	0
	05-01	Full-load Current of Induction Motor 1(A)	0–xxxx (Depend on the power of motor)	Depend on the model power
~	05-02	Rated Power of Induction Motor 1(kW)	0.00–655.35 kW	Depend on the model power
~	05-03	Rated Speed of Induction Motor 1 (rpm)	0–xxxx (Depend on the motor's number of poles)	Depend on the motor's number of poles
	05-04	Pole Number of Induction Motor 1	2–64	4
	05-05	No-load Current of Induction Motor 1 (A)	0– Pr.05-01 default	Depend on the model power
	05-06	Stator Resistance (Rs) of Induction Motor 1	0.000–65.535 Ω	Depend on the model power
	05-07	Rotor Resistance (Rr) of Induction Motor 1	0.000–65.535 Ω	Depend on the model power
	05-08	Magnetizing Inductance (Lm) of Induction Motor 1	0.0–6553.5 mH	Depend on the model power
	05-09	Stator Inductance (Lx) of Induction Motor 1	0.0–6553.5 mH	Depend on the model power
	05-13	Full-load Current of Induction Motor 2 (A)	Depending on the model power	Depend on the model power
~	05-14	Rated Power of Induction Motor 2 (kW)	0.00–655.35 kW	Depend on the model power
~	05-15	Rated Speed of Induction Motor 2 (rpm)	0–xxxx (Depend on the motor's number of poles)	Depend on the motor's number of poles
	05-16	Pole Number of Induction Motor 2	2–64	4
	05-17	No-load Current of Induction Motor 2 (A)	0– Pr.05-01 default	Depend on the model power
	05-18	Stator Resistance (Rs) of Induction Motor 2	0.000–65.535 Ω	Depend on the model power
	05-19	Rotor Resistance (Rr) of Induction Motor 2	0.000–65.535 Ω	Depend on the model power
	05-20	Magnetizing Inductance (Lm) of Induction Motor 2	0.0–6553.5 mH	Depend on the model power
	05-21	Stator Inductance (Lx) of Induction Motor 2	0.0–6553.5 mH	Depend on the model power
~	05-22	Induction Motor 1/ 2 Selection	1: Motor 1 2: Motor 2	1
~	05-23	Frequency for Y-connection / Δ-connection Switch of Induction Motor	0.00–599.00Hz	60.00

	Pr.	Parameter Name	Setting Range	Default
	05-24	Y-connection / Δ-connection Switch of Induction Motor	0: Disabled 1: Enabled	0
✓	05-25	Delay Time for Y-connection / Δ-connection Switch of Induction Motor	0.000–60.000 sec.	0.200
	05-26	Accumulative Watt-second of Motor in Low Word (W-sec)	Read only	#.#
	05-27	Accumulative Watt-second of Motor in High Word (W-sec)	Read only	#.#
	05-28	Accumulative Watt-hour of Motor (W-Hour)	Read only	#.#
	05-29	Accumulative Kilo Watt-hour of Motor in Low Word (KW-Hour)	Read only	#.#
	05-30	Accumulative Kilo Watt-hour of Motor in High Word (KW-Hour)	Read only	#.#
	05-31	Accumulative Motor Operation Time (Min)	00–1439	0
	05-32	Accumulative Motor Operation Time (day)	00–65535	0
	05-33	Induction Motor and Permanent Magnet Motor Selection	0: Induction Motor 1: SPM Permanent Magnet Motor 2: IPM Permanent Magnet Motor	0
	05-34	Full-load current of Permanent Magnet Motor	Depending on the model power	Depend on the model power
✓	05-35	Rated Power of Permanent Magnet Motor	0.00–655.35 kW	Depend on the model power
✓	05-36	Rated speed of Permanent Magnet Motor	0–65535 rpm	2000
	05-37	Pole number of Permanent Magnet Motor	0–65535	10
	05-38	Inertia of Permanent Magnet Motor	0.0–6553.5 kg.cm^2	Depend on the power of motor
	05-39	Stator Resistance of PM Motor	0.000–65.535 Ω	0.000
	05-40	Permanent Magnet Motor Ld	0.00–655.35 mH	0.000
	05-41	Permanent Magnet Motor Lq	0.00–655.35 mH	0.000
✓	05-42	PG Offset angle of PM Motor	0.0–360.0°	0.0
✓	05-43	Ke parameter of PM Motor	0–65535 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: Disabled 0.0–900.0 V_{DC}	760.0
✓	06-02	Selection for Over-voltage Stall Prevention	0: Traditional over-voltage stall prevention 1: Smart over-voltage prevention	0
✓	06-03	Over-current Stall Prevention during Acceleration	Light duty: 0–160% (100% corresponds to the rated current of the drive) Heavy duty: 0–180% (100% corresponds to the rated current of the drive)	120 150
✓	06-04	Over-current Stall Prevention during Operation	Light duty: 0–160% (100% corresponds to the rated current of the drive) Heavy duty: 0–180% (100% corresponds to the rated current of the drive)	120 150
✓	06-05	Accel. /Decel. Time Selection of Stall Prevention at Constant Speed	0: By current acceleration / deceleration time 1: By the first acceleration / deceleration time 2: By the second acceleration / deceleration time 3: By the third acceleration / deceleration time 4: By the fourth acceleration / deceleration time 5: By Auto-acceleration / auto-deceleration	0
✓	06-06	Over-torque Detection Selection (OT1)	0: No function 1: Over-torque detection during constant speed operation, continue to operate after detection 2: Over-torque detection during constant speed operation, stop operation after detection 3: Over-torque detection during operation, continue to operate after detection 4: Over-torque detection during operation, stop operation after detection	0
✓	06-07	Over-torque Detection Level (OT1)	10–250% (100% corresponds to the 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: Over-torque detection during constant speed operation, continue to operate after detection 2: Over-torque detection during constant speed operation, stop operation after detection 3: Over-torque detection during operation, continue to operation after detection 4: Over-torque detection during operation, stop operation after detection	0
✓	06-10	Over-torque Detection Level (OT2)	10–250% (100% corresponds to the rated current of the drive)	120
✓	06-11	Over-torque Detection Time (OT2)	0.0–60.0 sec.	0.1
✓	06-12	Current Limit	0–250% (100% corresponds to the rated current of the drive)	170
✓	06-13	Electronic Thermal Relay Selection (Motor 1)	0: Inverter motor (fan doesn't run with the axel synchronously) 1: Standard motor (fan runs with the axel synchronously) 2: Electronic thermal relay disabled	2
✓	06-14	Electronic Thermal Characteristic for Motor 1	30.0–600.0 sec.	60.0
✓	06-15	Heat Sink Over-heat (OH) Warning	0.0–110.0℃	105.0

<table>
<tr><th>Pr.</th><th>Parameter Name</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>✎ 06-16</td><td>Stall Prevention Limit Level</td><td>0–100% (Pr.06-03, Pr.06-04)</td><td>50</td></tr>
<tr><td>06-17</td><td>Present Fault Record</td><td rowspan="6">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: Stop mid-low voltage (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 1 (EoL1)
23: Electronics thermal relay 2 (EoL2)
24: Motor overheat (oH3) (PTC/PT100)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Low current (uC)
29: Home limit error (LMIT)
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: Ground current detection error (Hd3)
40: Auto tuning error (AUE)
41: PID feedback loss (AFE)
42: PG feedback error (PGF1)
43: PG feedback loss (PGF2)
44: PG feedback stall (PGF3)
45: PG slip error (PGF4)
48: Analog current input loss (ACE)
49: External fault input (EF)
50: Emergency stop (EF1)
51: External Base Block (bb)
52: Password error (PcodE)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (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)
65: PG Card Error (PGF5)</td><td>0</td></tr>
<tr><td>06-18</td><td>Second Most Recent Fault Record</td><td>0</td></tr>
<tr><td>06-19</td><td>Third Most Recent Fault Record</td><td>0</td></tr>
<tr><td>06-20</td><td>Fourth Most Recent Fault Record</td><td>0</td></tr>
<tr><td>06-21</td><td>Fifth Most Recent Fault Record</td><td>0</td></tr>
<tr><td>06-22</td><td>Sixth Most Recent Fault Record</td><td>0</td></tr>
</table>

	Pr.	Parameter Name	Setting Range	Default
			68: Sensorless estimated speed have wrong direction 69: Sensorless estimated speed is over speed 70: Sensorless estimated speed deviated 73: External safety gate S1 82: U phase output phase loss (OPHL) 83: V phase output phase loss (OPHL) 84: W phase output phase loss (OPHL) 85: PG-02U ABZ hardware disconnection 86: PG-02U UVW hardware disconnection 89: Initial rotor position detection error 90: Inner PLC function is forced to stop 101: CANopen software disconnect1 (CGdE) 102: CAN open software disconnect2 (CHbE) 104: CANopen hardware disconnect (CbFE) 105: CANopen index setting error (CIdE) 106: CANopen station address error (CAdE) 107: CANopen memory error (CFrE) 111: Internal communication overtime error(InrCOM) 112: PM sensorless shaft Lock error	
✓	06-23	Fault Output Option 1	0–65535 (refer to bit table for fault code)	0
✓	06-24	Fault Output Option 2	0–65535 (refer to bit table for fault code)	0
✓	06-25	Fault Output Option 3	0–65535 (refer to bit table for fault code)	0
✓	06-26	Fault Output Option 4	0–65535 (refer to bit table for fault code)	0
✓	06-27	Electronic Thermal Relay Selection 2 (Motor 2)	0: Inverter motor (fan doesn't run with the axel synchronously) 1: Standard motor (fan runs with the axel synchronously) 2: Electronic thermal relay disabled	2
✓	06-28	Electronic Thermal Characteristic for Motor 2	30.0–600.0 sec.	60.0
✓	06-29	PTC/PT100 Detection Selection	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	0
✓	06-30	PTC Level	0.0–100.0%	50.0
✓	06-31	Frequency Command for 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	0.00–6553.5 Amp	Read only
	06-36	IGBT Temperature at Malfunction	-3276.7–3276.7 ℃	Read only
	06-37	Capacitance Temperature at Malfunction	-3276.7–3276.7 ℃	Read only
	06-38	Motor Speed in rpm at Malfunction	-32767–32767 rpm	Read only
	06-39	Torque Command at Malfunction	-3276.7–3276.7 %	Read only
	06-40	Status of Multi-function Input Terminal at Malfunction	0000h–FFFFh	Read only
	06-41	Status of Multi-function Output Terminal at Malfunction	0000h–FFFFh	Read only

	Pr.	Parameter Name	Setting Range	Default
	06-42	Drive Status at Malfunction	0000h–FFFFh	Read only
〆	06-45	Treatment to Output Phase Loss Detection (OPHL)	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	3
〆	06-46	Deceleration Time of Output Phase Loss	0.000–65.535 sec.	0.500
〆	06-47	Current Bandwidth	0.00–100.00%	1.00
〆	06-48	DC Brake Time of Output Phase Loss	0.000–65.535 sec.	0.100
〆	06-49	LvX Auto Reset	0: Disabled 1: Enabled	0
〆	06-50	Time for Input Phase Loss Detection	0.00–600.00 sec.	0.20
〆	06-52	Ripple of Input Phase Loss	0.0–320.0 V_{DC}	60.0
〆	06-53	Treatment for the detected Input Phase Loss (OrP)	0: Warn and ramp to stop 1: Warn and coast to stop	0
〆	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
〆	06-56	PT100 Detected Level 1	0.000–10.000 V	5.000
〆	06-57	PT100 Detected Level 2	0.000–10.000 V	7.000
〆	06-58	PT100 Level 1 Frequency Protect	0.00–599.00 Hz	0.00
〆	06-59	PT100 Activation Level Delay Time	0–6000 sec.	60
〆	06-60	Software Detection GFF Current Level	0.0–6553.5 %	60.0
〆	06-61	Software Detection GFF Filter Time	0.00–655.35 sec.	0.10
	06-63	Fault Record 1 (Day)	0–65535 days	Read only
	06-64	Fault Record 1 (Minute)	0–1439 min.	Read only
	06-65	Fault Record 2 (Day)	0–65535 days	Read only
	06-66	Fault Record 2 (Minute)	0–1439 min.	Read only
	06-67	Fault Record 3 (Day)	0–65535 days	Read only
	06-68	Fault Record 3 (Minute)	0–1439 min.	Read only
	06-69	Fault Record 4 (Day)	0–65535 days	Read only
	06-70	Fault Record 4 (Minute)	0–1439 min.	Read only
〆	06-71	Low Current Setting Level	0.0–100.0 %	0.0
	06-72	Low Current Detection Time	0.00–360.00 sec.	0.00
〆	06-73	Treatment for low current	0 : No function 1 : Warn and coast to stop 2 : Warn and ramp to stop by 2nd deceleration time 3 : Warn and operation continue	0

07 Special Parameters

Pr.	Parameter Name	Setting Range	Default
07-00	Software Brake Level	700.0–900.0 V_{DC}	760.0
07-01	DC Brake Current Level	0–100%	0
07-02	DC Brake Time at Start-up	0.0–60.0 sec.	0.0
07-03	DC Brake Time at Stop	0.0–60.0 sec.	0.0
07-04	Startup Frequency for DC Brake	0.00–599.00 Hz	0.00
07-05	Maximum Power Loss Duration	1–200%	100
07-06	Restart after Momentary Power Loss	0: No function 1: Speed search for last frequency command 2: Speed search for minimum output frequency	0
07-07	Maximum Power Loss Duration	0.0–20.0 sec.	2.0
07-08	Base Block Time	0.1–5.0 sec.	0.5
07-09	Current Limit for Speed Search	20–200%	100
07-10	Treatment to Reboots After Fault	0: No function 1: Speed search starts with current speed 2: Speed search starts with minimum output frequency	0
07-11	Auto Restart After Fault	0–10	0
07-12	Speed Search during Start-up	0: Disabled 1: Speed search for maximum output frequency 2: Speed search for start-up motor frequency 3: Speed search for minimum output frequency	0
07-13	dEb Function Selection	0: Disabled 1: dEb with auto accel./decel., the output frequency will not return after power reply. 2: dEb with auto accel./decel., the output frequency will return after power reply.	0
07-15	Dwell Time at Accel.	0.00–600.00 sec.	0.00
07-16	Dwell Frequency at Accel.	0.00–599.00 Hz	0.00
07-17	Dwell Time at Decel.	0.00–600.00 sec.	0.00
07-18	Dwell Frequency at Decel.	0.00–599.00 Hz	0.00
07-19	Fan Cooling Control	0: Fan always ON 1: 1 minute after the AC motor drive stops, fan will be OFF 2: When the AC motor drive runs, the fan is ON. When the AC motor drive stops, the fan is OFF 3: Fan turns ON when preliminary heat sink temperature (around 60°C) is attained. 4: Fan always OFF	0
07-20	Emergency Stop (EF) & Force to Stop Selection	0: Coast stop 1: By deceleration Time 1 2: By deceleration Time 2 3: By deceleration Time 3 4: By deceleration Time 4 5: System Deceleration 6: Automatic Deceleration	0
07-21	Auto Energy-saving Operation	0: Disabled 1: Enabled	0
07-22	Energy-saving Gain	10–1000%	100

	Pr.	Parameter Name	Setting Range	Default
✎	07-23	Auto Voltage Regulation (AVR) Function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0
✎	07-24	Filter Time of Torque Command (V/F and SVC control mode)	0.001–10.000 sec.	0.500
✎	07-25	Filter Time of Slip Compensation (V/F and SVC control mode)	0.001–10.000 sec.	0.100
✎	07-26	Torque Compensation Gain (V/F and SVC control mode)	0–10	0
✎	07-27	Slip Compensation Gain (V/F and SVC control mode)	0.00–10.00 (SVC control mode: the factory value is 1)	0.00
✎	07-29	Slip Deviation Level	0.0–100.0%	0
✎	07-30	Detection Time of Slip Deviation	0.0–10.0 sec.	1.0
✎	07-31	Over Slip Treatment	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	0
✎	07-32	Motor Hunting Gain	0–10000	1000
✎	07-33	Auto Reset Time for Restart after Fault	0.0–6000.0 sec.	60.0

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) 2: Negative PID feedback: by PG card pulse input, without direction (Pr.10-02) 3: Negative PID feedback:by PG card pulse input, with direction (Pr.10-02) 4: Positive PID feedback: by analog input (Pr.03-00) 5: Positive PID feedback: by PG card pulse input, without direction (Pr.10-02) 6: Positive PID feedback: by PG card pulse input, with direction (Pr.10-02) 7: Negative PID feedback: by communication protocols 8: Positive PID feedback: by communication protocols	0
✓	08-01	Proportional Gain (P)	0.0–500.0	1.0
✓	08-02	Integral Time (I)	0.00–100.00 sec.	1.00
✓	08-03	Derivative Control (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 Frequency 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: Warn and ramp to stop 2: Warn and coast to stop 3: Warn and operate at last frequency	0
✓	08-10	Sleep Frequency	0.00–599.00 Hz	0.00
✓	08-11	Wake-up Frequency	0.00–599.00 Hz	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	Filter Time for PID Feedback	0.1–300.0 sec.	5.0
✓	08-16	PID Compensation Selection	0: Parameter setting 1: Analog input	0
✓	08-17	PID Compensation	-100.0–100.0%	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 Operation Direction	0: Operation direction can be changed 1: Operation direction can not be changed	0
✓	08-22	Wakeup Delay Time	0.00–600.00 sec.	0.00
✓	08-23	PID Control Flag	bit 0 = 1, PID reverse running must follow the setting of Pr.00-23. bit 0 = 0, PID reverse running follow PID's calculated value.	0

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: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and continue operation	3
✎	09-03	COM1 Time-out Detection	0.0–100.0 sec.	0.0
✎	09-04	COM1 Communication Protocol	1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII) 10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	1
✎	09-09	Response Delay Time	0.0–200.0 ms	2.0
✎	09-10	Main Frequency of the Communication	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 Menthod 2 (60xx)	1
	09-31	Internal Communication Protocol	0: Modbus 485 -1: Internal Communication Slave 1	0

	Pr.	Parameter Name	Setting Range	Default
			-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	
✓	09-33	PLC command force to 0	0–65535	0
	09-35	PLC Address	1–254	2
	09-36	CANopen Slave Address	0: Disabled 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 failed bit9: The setting value of CANopen address is failed bit10: The checksum value of CANopen indexes is failed	Read only
	09-40	CANopen Decoding Method	0: Disabled (Delta defined decoding method) 1: Enabled (CANopen standard DS402 protocal)	1
	09-41	CANopen Communication Status	0: Node Reset State 1: Com Reset State 2: Boot up State 3: Pre Operation State 4: Operation State 5: Stop State	Read Only
	09-42	CANopen Control Status	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: Err Reaction Activation state 14: Error state	Read Only
	09-45	CANopen Master Function	0: Disabled 1: Enabled	0
	09-46	CANopen Master Address	0–127	100
	09-60	Identifications for Communication Card	0: No communication card 1: DeviceNet Slave 2: Profibus-DP Slave 3: CANopen Slave/Master 4: Modbus-TCP Slave 5: Ethernet/IP Slave	Read only
	09-61	Firmware Version of Communication Card	Read only	Read only
	09-62	Product Code	Read only	Read only

Pr.	Parameter Name	Setting Range	Default
09-63	Error 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 1: Non-standard DeviceNet In this mode, the baud rate of DeviceNet can be same as CANopen (0-8).	0
09-75	Communication Card IP Configuration (for EtherNet)	0: Static IP 1: Dynamic IP (DHCP)	0
09-76	Communication Card IP Address 1 (for EtherNet)	0–65535	0
09-77	Communication Card IP Address 2 (for EtherNet)	0–65535	0
09-78	Communication Card IP Address 3 (for EtherNet)	0–65535	0
09-79	Communication Card IP Address 4 (for EtherNet)	0–65535	0
09-80	Communication Card Address Mask 1 (for EtherNet)	0–65535	0
09-81	Communication Card Address Mask 2 (for EtherNet)	0–65535	0
09-82	Communication Card Address Mask 3 (for EtherNet)	0–65535	0
09-83	Communication Card Address Mask 4 (for EtherNet)	0–65535	0
09-84	Communication Card Gateway Address 1 (for EtherNet)	0–65535	0
09-85	Communication Card Gateway Address 2 (for EtherNet)	0–65535	0
09-86	Communication Card Gateway Address 3 (for EtherNet)	0–65535	0
09-87	Communication Card Gateway Address 4 (for EtherNet)	0–65535	0
09-88	Communication Card Password (Low Word) (for EtherNet)	0–99	0
09-89	Communication Card Password (High Word) (for EtherNet)	0–99	0
09-90	Reset Communication Card (for EtherNet)	0: Disabled 1: Reset to default	0
09-91	Additional Setting for Communication Card (for EtherNet)	bit0: Enable IP filter bit1: Enable internet parameters (1 bit). When the IP address is set, this bit is enabled.	0

Pr.	Parameter Name	Setting Range	Default
		After updating the parameters for the communication card, this bit changes to disabled. bit2: Enable login password (1 bit). When you enter the login password, this bit is enabled. After updating the parameters for the communication card, this bit changes to disabled.	
09-92	Communication Card Status (for EtherNet)	bit 0: password enable When the communication card is set with password, this bit is enabled. When the password is clear, this bit is disabled.	0

10 Speed Feedback Control Parameters

Pr.	Parameter Name	Setting Range	Default
10-00	Encoder Type Selection	0: Disabled 1: ABZ 2: ABZ (Delta Encoder for PM motor) 3: Resolver 4: ABZ / UVW 5: MI8 single phase pulse input	0
10-01	Encoder Pulse	1–20000	600
10-02	Encoder Input Type Setting	0: Disabled 1: Phase A leads in a forward run command and phase B leads in a reverse run command 2: Phase B leads in a forward run command and phase A leads in a reverse run command 3: Phase A is a pulse input and phase B is a direction input. (low input = reverse direction, high input = forward direction) 4: Phase A is a pulse input and phase B is a direction input. (low input = forward direction, high input = reverse direction) 5: Single-phase input	0
10-03	Output Setting for Frequency Division (denominator)	1–255	1
10-04	Electrical Gear at Load Side A1	1–65535	100
10-05	Electrical Gear at Motor Side B1	1–65535	100
10-06	Electrical Gear at Load Side A2	1–65535	100
10-07	Electrical Gear at Motor Side B2	1–65535	100
10-08	Treatment for Encoder Feedback Fault	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop	2
10-09	Detection Time of Encoder Feedback Fault	0.0–10.0 sec . 0: No function	1.0
10-10	Encoder Stall Level	0–120% 0: No function	115
10-11	Detection Time of Encoder Stall	0.0–2.0 sec.	0.1
10-12	Treatment for Encoder Stall	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop	2
10-13	Encoder Slip Range	0–50% (0: disabled)	50
10-14	Detection Time of Encoder Slip	0.0–10.0 sec.	0.5
10-15	Treatment for Encoder Stall and Slip Error	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop	2
10-16	Pulse Input Type Setting	0: Disabled 1: Phase A leads in a forward run command and phase B leads in a reverse run command 2: Phase B leads in a forward run command and phase A leads in a reverse run command 3: Phase A is a pulse input and phase B is a direction input. (L=reverse direction, H=forward direction). 4: Phase A is a pulse input and phase B is a direction input. (L=forward direction, H=reverse direction).	0
10-17	Electrical Gear A	1–65535	100
10-18	Electrical Gear B	1–65535	100
10-19	Positioning for Encoder Position	-32767–2400	0

	Pr.	Parameter Name	Setting Range	Default
✎	10-20	Range for Encoder Position Attained	0–65535 pulse	10
✎	10-21	Filter Time (PG2)	0–65.535 sec.	0.100
	10-22	Speed Mode (PG2)	0: Electronic Frequency 1: Mechanical Frequency (based on pole pair)	0
✎	10-24	FOC & TQC Function Control	0–65535	0
✎	10-25	FOC Bandwidth of Speed Observer	20.0–100.0 Hz	40.0
✎	10-26	FOC Minimum Stator Frequency	0.0–2.0%fN	2.0
✎	10-27	FOC Low-pass Filter Time Constant	1–1000 ms	50
✎	10-28	FOC Excitation Current Rise Time	33–100%Tr	100
✎	10-29	Top Limit of Frequency Deviation	0.00–200.00 Hz	20.00
	10-30	Resolver Pole Pair	1–50	1
✎	10-31	I/F Mode, Current Command	0–150%Irated (Rated current % of the drive)	40
✎	10-32	PM Sensorless Obeserver Bandwidth for High Speed Zone	0.00–600.00 Hz	5.00
✎	10-34	PM Sensorless Observer Low-pass Filter Gain	0.00–655.35	1.00
✎	10-35	AMR (Kp)	0.00–3.00	1.00
✎	10-36	AMR (Ki)	0.00–3.00	0.20
✎	10-37	PM Sensorless Control Word	0000–FFFFh	0000
✎	10-39	Frequency When Switch From I/F Mode To PM Sensorless Mode.	0.00–599.00 Hz	20.00
✎	10-40	Frequency When Switch From PM Sensorless Observer Mode To V/F Mode.	0.00–599.00 Hz	20.00
✎	10-41	I/F Mode, Low Pass-Filter Time	0.0–6.0 sec.	0.2
✎	10-42	Initial Angle Detection Time	0–50 ms	10
	10-43	PG Card Version	0–655.35	Read only
✎	10-49	Zero voltage time while start up	00.000–60.000 sec.	0.000
✎	10-50	Reverse angle limit (Electrical angle)	0.00–30.00 degree	10.00
✎	10-51	Injection Frequency	0–1200 Hz	500
✎	10-52	Injection Magnitude	0.0–200.0 V	15.0 / 30.0
✎	10-53	PM Motor Initial Rotor Position Detection Method	0: No functon 1: DC injection 2: High frequency injection 3: Pulse injection	0

11 Advanced Parameters

Pr.	Parameter Name	Setting Range	Default
11-00	System Control	bit 0: Auto tuning for ASR and APR bit 1: Inertia estimate (only for FOCPG mode) bit 2: Zero servo bit 3: Dead Time compensation closed bit 7: Selection to save or not save the freqeuncy bit 8: Maximum speed of point to point position control	0
11-01	Per Unit of System Inertia	1–65535（256 = 1PU）	256
11-02	ASR1 / ASR2 Switch Frequency	5.00–599.00 Hz	7.00
11-03	ASR1 Low-Speed Bandwidth	1–40 Hz (IM) / 1–100 Hz (PM)	10
11-04	ASR2 High-Speed Bandwidth	1–40 Hz (IM) / 1–100 Hz (PM)	10
11-05	Zero-Speed Bandwidth	1–40 Hz (IM) / 1–100 Hz (PM)	10
11-06	ASR 1 Gain	0–40 Hz (IM) / 1–100 Hz (PM)	10
11-07	ASR 1 Integral Time	0.000–10.000 sec.	0.100
11-08	ASR 2 Gain	0–40 Hz (IM) / 0–100 Hz (PM)	10
11-09	ASR 2 Integral Time	0.000–10.000 sec.	0.100
11-10	ASR Gain of Zero Speed	0–40 Hz (IM) / 0–100 Hz (PM)	10
11-11	AST Integral Time of Zero Speed	0.000–10.000 sec.	0.100
11-12	ASR Speed Feed Forward Gain	0–100%	0
11-13	PDFF Gain	0–200%	30
11-14	ASR Output Low-Pass Filter Time	0.000–0.350 sec.	0.008
11-15	Notch Filter Depth	0–20 dB	0
11-16	Notch Filter Frequency	0.00–200.00 Hz	0.00
11-17	Forward Motor Torque Limit	0–500%	500
11-18	Forward Regenerative Torque Limit	0–500%	500
11-19	Reverse Motor Torque Limit	0–500%	500
11-20	Reverse Regenerative Torque Limit	0–500%	500
11-21	Flux Weakening Curve for Motor 1 Gain Value	0–200%	90
11-22	Flux Weakening Curve for Motor 2 Gain Value	0–200%	90
11-23	Speed Response of Flux Weakening Area	0–150%	65
11-24	APR Gain	0.00–40.00 Hz (IM) / 0–100.00 Hz (PM)	10.00
11-25	Gain Value of APR Feed Forward	0–100	30
11-26	APR Curve Time	0.00–655.35 sec.	3.00
11-27	Max. Torque Command	0–500%	100
11-28	Source of Torque Offset	0: Disabled 1: Analog signal input (Pr.03-00) 2: RS485 communication (Pr.11-29) 3: Control by external terminals (Pr.11-30–11-32)	0
11-29	Torque Offset Setting	-100.0–100.0%	0.0

	Pr.	Parameter Name	Setting Range	Default
✓	11-30	High Torque Offset	-100.0–100.0%	30.0
✓	11-31	Middle Torque Offset	-100.0–100.0%	20.0
✓	11-32	Low Torque Offset	-100.0–100.0%	10.0
✓	11-33	Source of Torque Command	0: Digital keypad 1: RS-485 communication (Pr.11-34) 2: Analog input (Pr.03-00) 3: CANopen 5: Communication extension card	0
✓	11-34	Torque Command	-100.0–100.0% (Pr.11-27 = 100%)	0.0
✓	11-35	Filter Time of Torque Command	0.000–1.000 sec.	0.000
	11-36	Speed Limit Selection	0: Set by Pr.11-37 (Forward speed limit) and Pr.11-38 (Reverse speed limit) 1: Set by Pr.11-37,11-38 and Pr.00-20 (Source of Master Frequency Command) 2: Set by Pr.00-20 (Source of Master Frequency Command)	0
✓	11-37	Forward Speed Limit (torque mode)	0–120%	10
✓	11-38	Reverse Speed Limit (torque mode)	0–120%	10
	11-39	Zero Torque Command Mode	0: Torque mode 1: Speed mode	0
✓	11-40	Command Source of Point-to-Point Position Control	0: External terminal 2: RS-485 3: CAN 5: Communication card	0
✓	11-42	System Control Flags	0000–FFFFh	0000
✓	11-43	Max. Frequency of Point-to-Point Position Control	0.00–599.00 Hz	10.00
✓	11-44	Accel. Time of Point-to Point Position Control	0.00–655.35 sec.	1.00
✓	11-45	Decel. Time of Point-to Point Position Control	0.00–655.35 sec.	3.00

Chapter 12 Descriptions of Parameter Settings

12-1 Descriptions of Parameter Settings

00 Drive Parameters

✓ You can set this parameter during operation.

00-00 AC Motor Drive Identity Code

Default: Read only

Settings Read only

00-01 AC Motor Drive Rated Current Display

Default: Read only

Settings Display by models

- Pr.00-00 displays the identity code of the AC motor drive. Using the following 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 Pr.00-01.
- The factory setting is the rated current for normal duty. Please set Pr.00-16 to 1 to display the rated current for the heavy duty.

Frame	A		B			C			D			
Power (kW)	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Identity Code	408	409	410	411	412	413	414	415	416	417	418	419
Rated Current-Heavy Duty (A)	9.5	11	17	23	30	36	43	57	69	86	105	143
Rated Current-Light Duty (A)	13	18	24	32	38	45	60	73	91	110	150	180

✓ 00-02 Parameter Reset

Default: 0

Settings 0: No function

1: Write protection for parameters

5: Return kWh displays to 0

6: Reset PLC (including CANopen Master Index)

7: Reset CANopen Slave index

9: Reset all parameters to defaults (base frequency is 50 Hz)

10: Reset all parameters to defaults (base frequency is 60 Hz)

- When it is set to 1, all parameters are read only except Pr.00-02~00-08 and it can be used with password setting for password protection. It needs to set Pr.00-02 to 0 before changing other parameter settings.
- When it is set to 9 or 10: all parameters are reset to factory settings. If password is set in Pr.00-08, input the password set in Pr.00-07 to reset to factory settings.
- When it is set to 5, KWH display value can be reset to 0 even when the drive is operating. Pr. 05-26, 05-27, 05-28, 05-29, 05-30 reset to 0.
- When it is set to 6: clear internal PLC program (includes the related settings of PLC internal CANopen master)
- When it is set to 7: reset the related settings of CANopen slave.

00-03 Start-Up Display

Default: 0

Settings 0: F (frequency command)
1: H (output frequency)
2: U (multi-function display, see Pr.00-04)
3: A (output current)

This parameter determines the start-up display page after power is applied to the drive. User defined choice display according to the setting in Pr.00-04.

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

Default: 3

Settings 0: Display output current (A) (Unit: Amp)
1: Display counter value (c) (Unit: CNT)
2: Display the motor's actual output frequency (H.) (Unit: Hz)
3: Display the drive's DC bus voltage (v) (Unit: V_{DC})
4: Display the drive's output voltage (E) (Unit: V_{AC})
5: Display the drive's output power angle (n) (Unit: deg)
6: Display the drive's output power (P) (Unit: kW)
7: Display the motor speed rpm (r) (Unit: rpm)
8: Display the drive's estimated output torque, motor's rated torque is 100% (t) (Unit: %)
9: Display PG feedback (G) (refer to Pr.10-00 and Pr.10-01) (Unit: PLS)
10: Display PID feedback (b) (Unit: %)
11: Display AVI analog input terminal signal (1.) (Unit: %)
12: Display ACI analog input terminal signal (2.) (Unit: %)
13: Display AUI analog input terminal signal (3.) (Unit: %)
14: Display the drive's IGBT temperature (i.) (Unit: °C)
15: Display the drive's capacitance temperature (c.) (Unit: °C)
16: The digital input status (ON / OFF) (i)
17: The digital output status (ON / OFF) (o)
18: Display multi-step speed (S)
19: The corresponding CPU digital input pin status (d)
20: The corresponding CPU digital output pin status (0.)
21: Actual motor position (PG1 of PG card) (P.)
The maximum value to display is 32bits
22: Pulse input frequency (PG2 of PG card) (S.)
23: Pulse input position (PG2 of PG card) (q.)
The maximum value to display is 32bits
24: Position command tracing error (E.)
25: Overload count (0.00–100.00%) (o.) (Unit: %)
26: Ground fault GFF (G.) (Unit: %)
27: DC bus voltage ripple (r.) (Unit: V_{DC})

28: Display PLC register D1043 data (C)
29: Display PM pole section (EMC-PG01U application) (4.)
30: Display the output of user-defined (U)
31: Display Pr.00-05 user gain (K)
32: Number of actual motor revolution during operation (PG card plug in and Z phase signal input) (Z.)
33: Motor actual position during operation (when PG card is connected) (q)
34: Operation speed of fan (F.) (Unit: %)
35: Control mode display:
0 = Speed control mode (SPD)
1 = Torque control mode (TQR) (t.)
36: Present operating carrier frequency of the drive (J.) (Unit: Hz)
38: Display the drive status (6.)
39: Display the drive's estimated output torque, positive and negative, using Nt-m as unit (t 0.0: positive torque; -0.0: negative torque (C.)
40: Torque command (L.) (Unit: %)
41: kWh display (J) (Unit: kWh)
42: PID target value (h.) (Unit: %)
43: PID compensation (o.) (Unit: %)
44: PID output frequency (b.) (Unit: Hz)
45: Hardware ID
68: STO version (d)
69: STO checksum-high word (d)
70: STO checksum-low word (d)

Explanation 1

- When Pr.10-01 is set to 1000 and Pr.10-02 is set to 1, 2, the displayed range for PG feedback is between 0–4000.
- When Pr.10-01 is set to 1000 and Pr.10-02 is set to 3, 4, 5, the displayed range for PG feedback is between 0–1000.
- Home position: If it has Z phase, Z phase will be regarded as home position. Otherwise, home position will be the encoder start up position.

Explanation 2

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

Explanation 3

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

NOTE: 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.
- The FWD / REV action and MI1 (which is set to three-wire) are not affected by Pr.02-12.
- You can set 16 to monitor the digital input ON / OFF status, and then set 19 to check if the circuit is normal.

Explanation 4

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

Normally opened contact (N.O.)

Terminal	MO20	MO19	MO18	MO17	MO16	MO15	MO14	MO13	MO12	MO11	MO10	MO2	MO1	Reserved	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 19 is the corresponding CPU pin ON / OFF status of the digital output.
- You can set 17 to monitor the digital output ON / OFF status, and then set 20 to check if the circuit is normal.

Explanation 5

Setting value 8: 100% means the motor rated torque.

Motor rated torque = (Motor rated power x 60 / 2π) / Motor rated speed

Explanation 6

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

Explanation 7

Setting value 38

- bit0: The drive is running forward.
- bit1: The drive is running backward.
- bit2: The drive is ready.
- bit3: Errors occurred on the drive.
- bit4: The drive is running.
- bit5: Warnings occurred on the drive.

✓ 00-05 Coefficient Gain in Actual Output Frequency

Default: 1.00

Settings 0.00–160.00

📖 This parameter is to set coefficient gain in actual output frequency. Set Pr.00-04 = 31 to display the calculation result on the screen (calculation = output frequency x Pr.00-05).

00-06 Software Version

Default: Read only

Settings Read only

00-07 Parameter Protection Password Input

Default: 0

Settings 0–65535

0–4: the number of password attempts allowed

📖 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 input 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

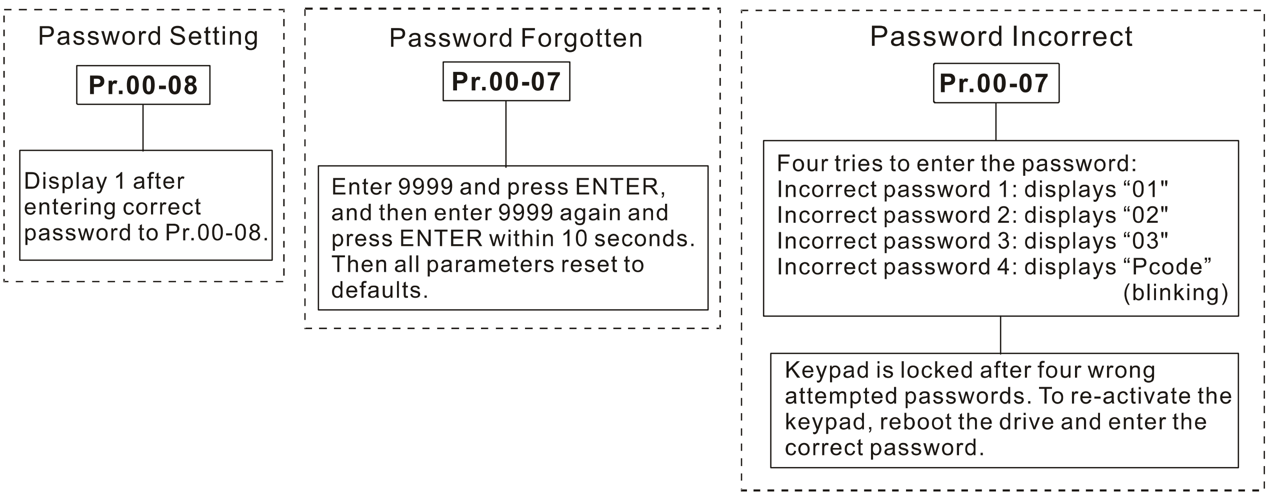
Settings 0–65535

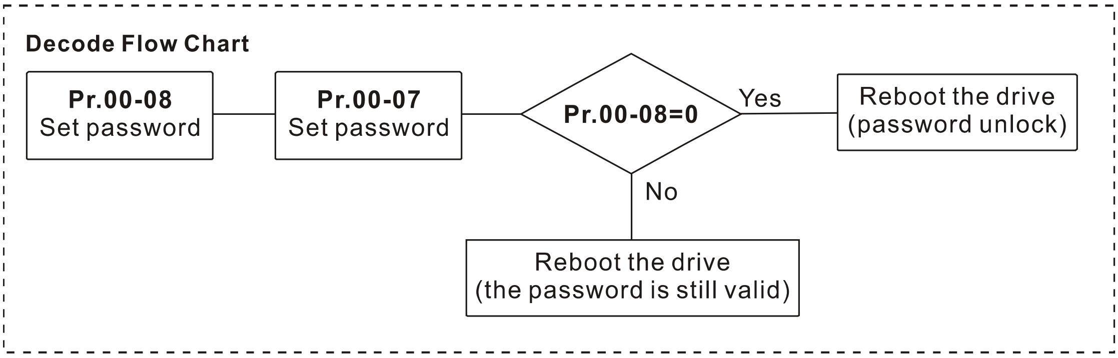
0: No password protection or password entered correctly (Pr.00-07)

1: Parameter 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 of the parameter settings, you must enter the correct password in Pr.00-07 to deactivate the password temporarily, and this would make Pr.00-08 become 0. After you finish setting the parameters, reboot the motor drive and the password is activated again.
- Entering the correct password in Pr.00-07 only temporarily deactivates the password. To permanently deactivate password protection, set Pr.00-08 to 0 manually. Otherwise, password protection is always reactivated after you reboot the motor drive.
- The keypad copy function works normally only when the password protection is deactivated (temporarily or permanently), and password set in Pr.00-08 cannot be copied to the keypad. So when copying parameters from the keypad to the motor drive, set the password manually again in the motor drive to activate password protection.

Password Decode Flow Chart





00-10 Control Mode

Default: 0

Settings 0: Speed control mode
1: Position control mode
2: Torque mode
3: Home mode

📖 Determine the control mode of the AC motor drive.

00-11 Speed Control Mode

Default: 0

Settings 0: VF (IM V/f control)
1: VFPG (IM V/f control+ Encoder)
2: SVC (IM Sensorless vector control)
3: FOCPG (IM FOC vector control+ encoder)
4: FOCPG（PM FOC vector control + Encoder）
5: FOC Sensorless (IM field oriented sensorless vector control)
6: PM Sensorless (PM field oriented sensorless vector control)
7: IPM Sensorless (IPM field oriented sensorless vector control)

📖 Determine 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.

1: IM V/F control + Encoder, you can use optional PG card with encoder for the closed-loop speed control.

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

3: IM FOC + encoder, not only can increase torque, but also can increase the accuracy of the speed control (1:1000).

4: PM FOC + Encoder, not only can increase torque, but also can increase the accuracy of the speed control (1:1000).

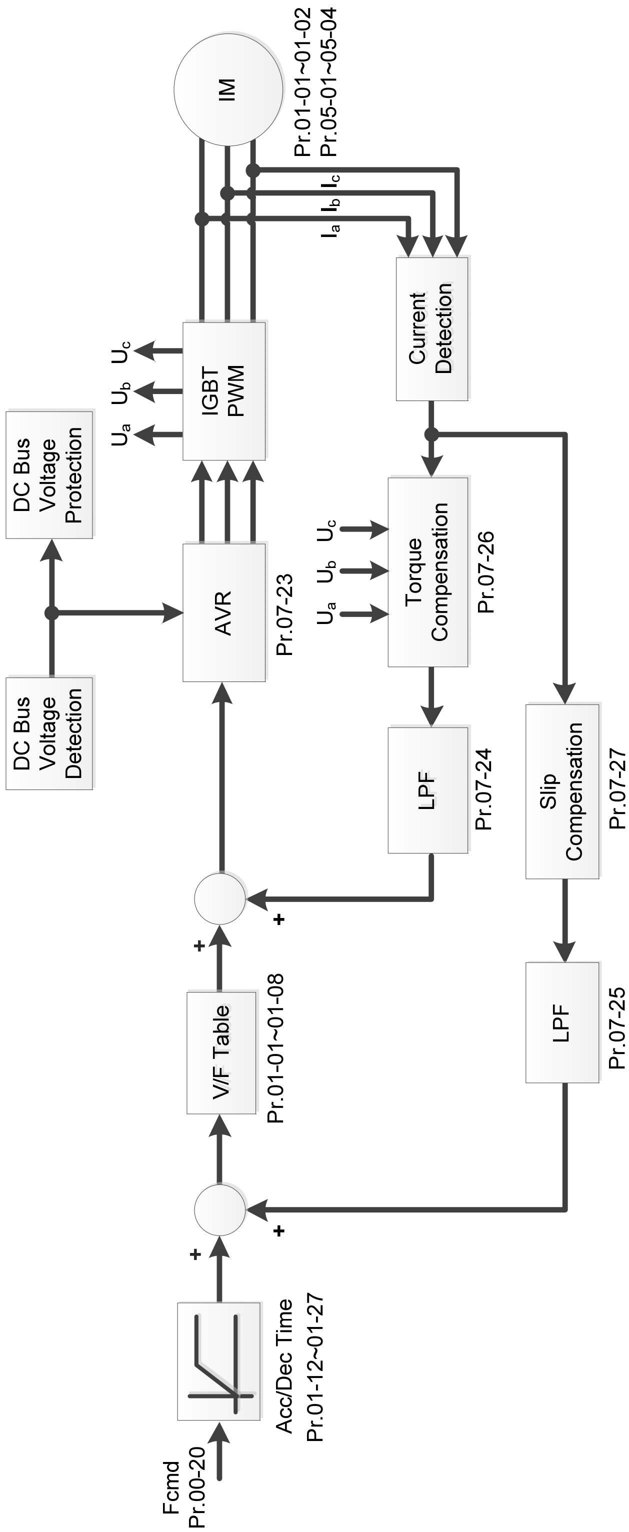
5: IM FOC sensorless, IM field oriented sensorless vector control

6: PM FOC sensorless, PM field oriented sensorless vector control

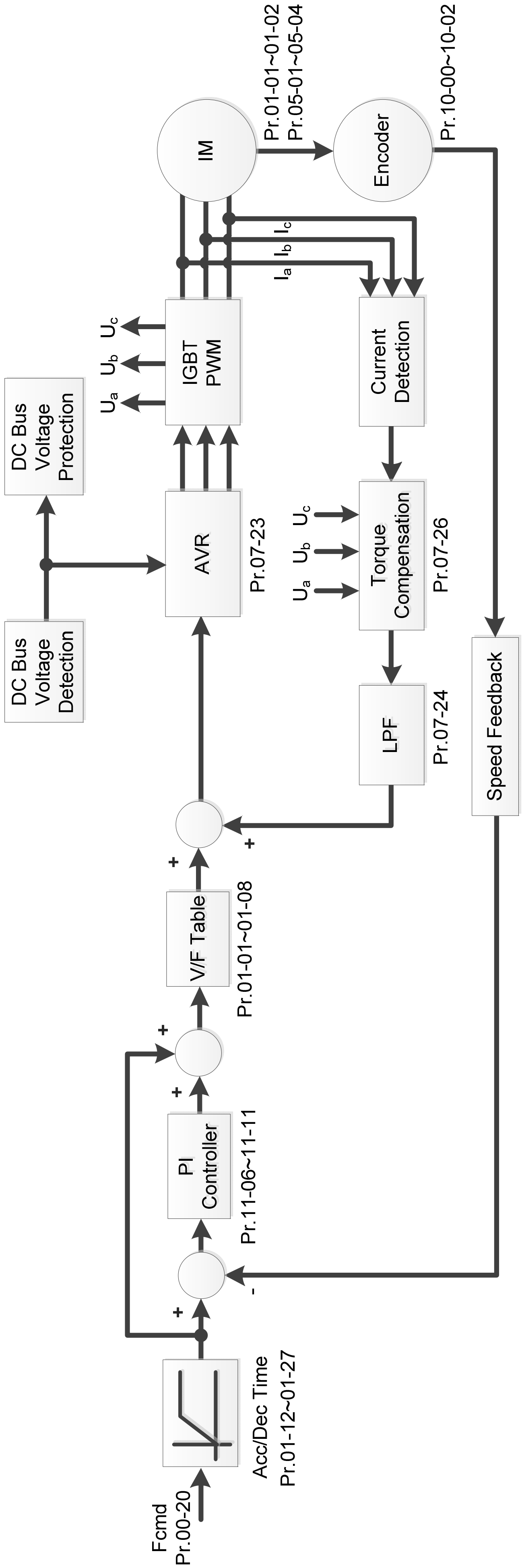
7: Interior PM FOC sensorless, Interior PM field oriented sensorless vector control

📖 There are more detailed explanations of motor adjustment procedure in section 12-2

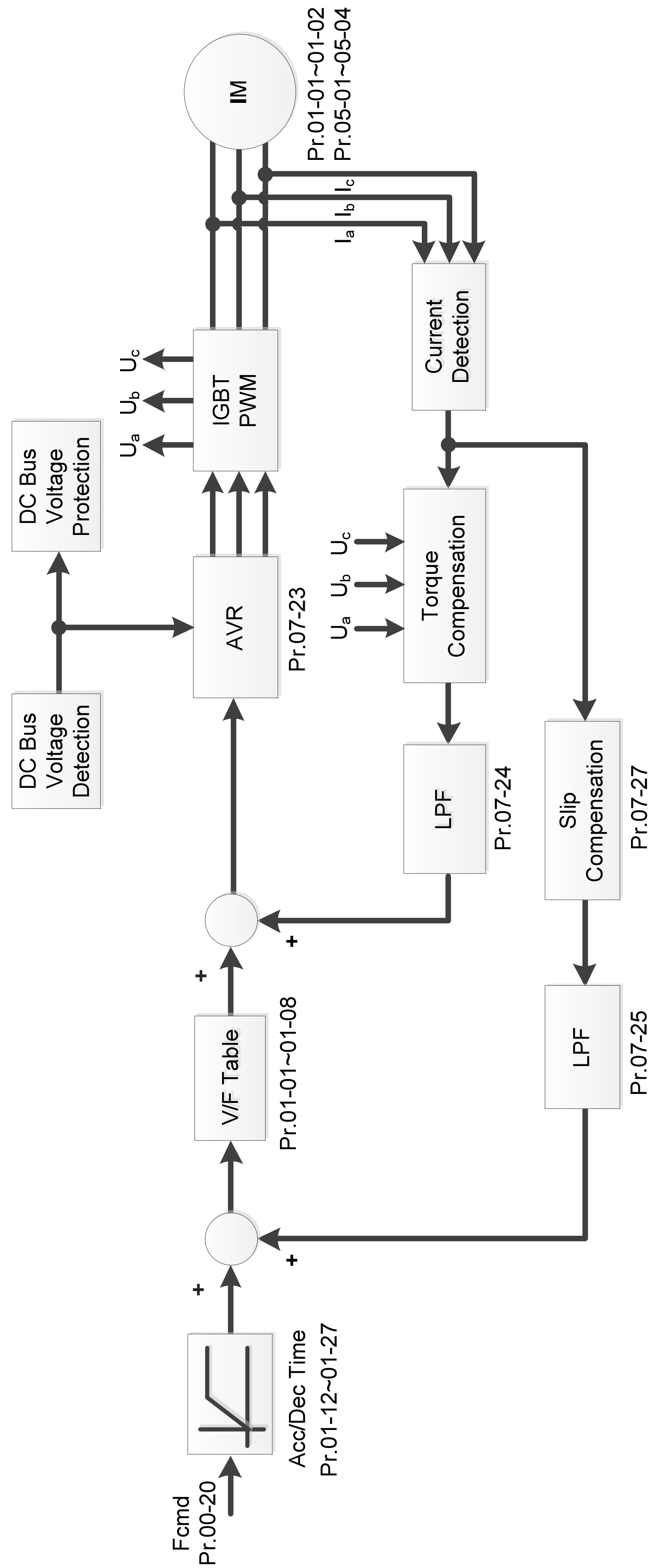
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 0, the V/F control diagram is as follows.



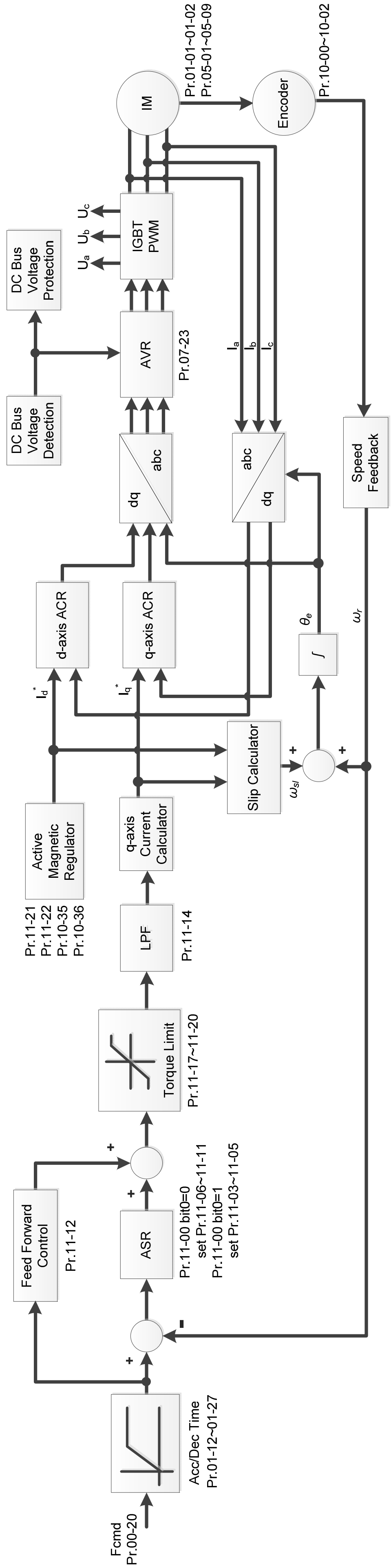
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 1, the V/F control + encoder diagram is as follows.



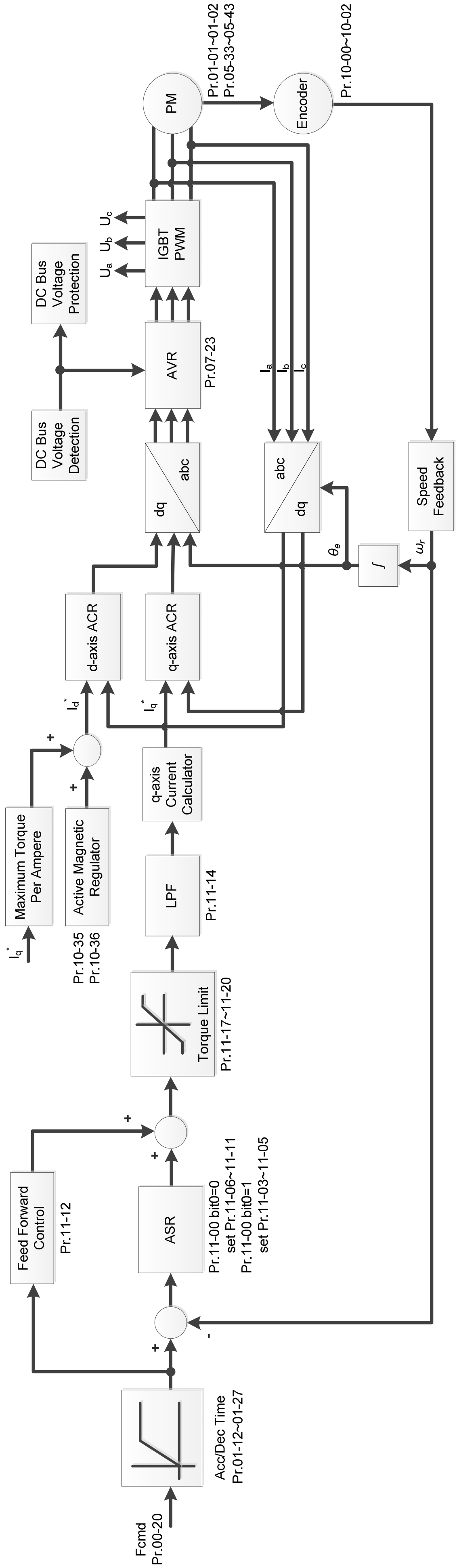
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 2, the space vector control diagram is as follows:
IM Space Vector Control (IMSVC):



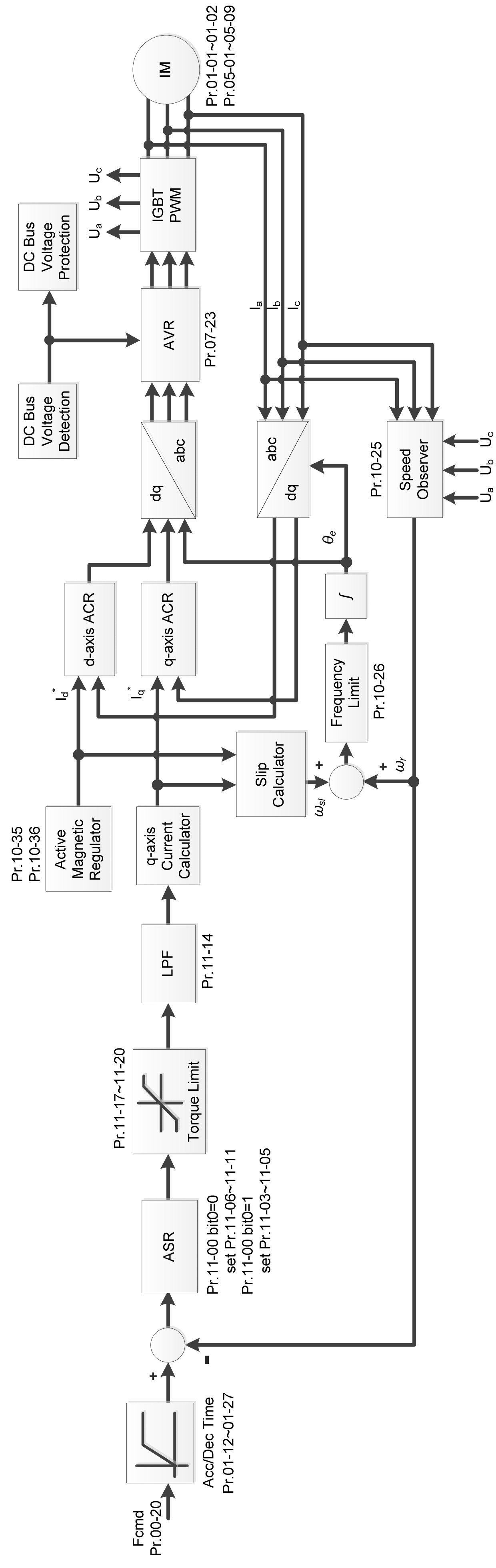
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 3, the IM FOCPG control diagram is as follows:



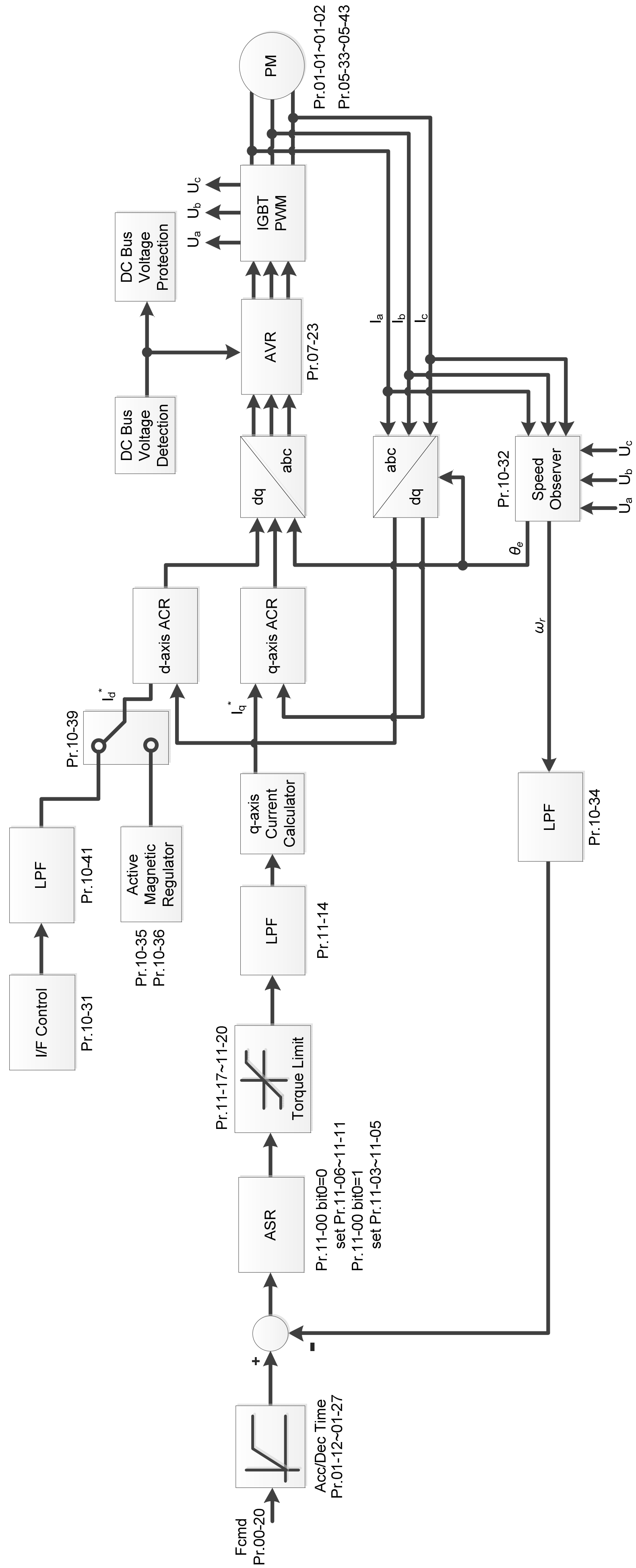
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 4, the PM FOCPG control diagram is as follows:



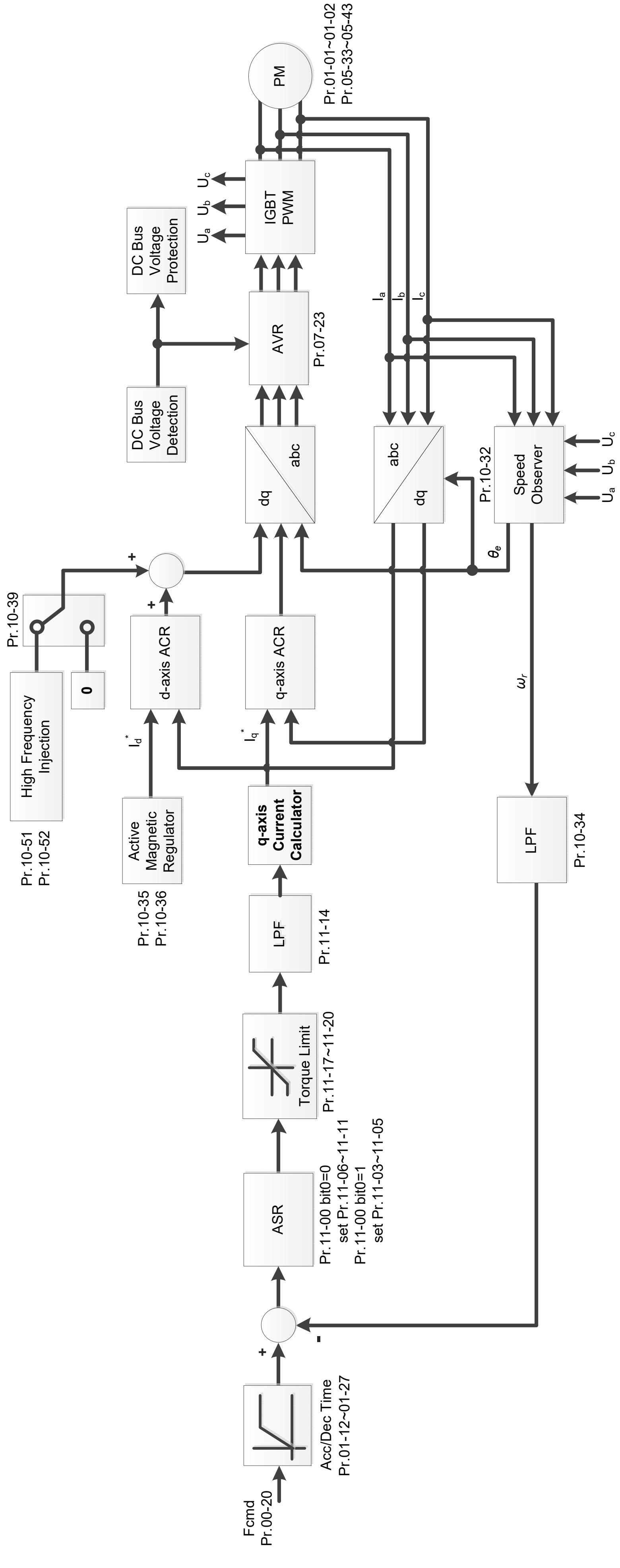
📖 When Pr.00-10 = 0, and you set Pr.00-11 to 5, IMFOC Sensorless control diagram is as follows:



📖 When Pr.00-10 = 0, and you set Pr.00-11 to 6, PM FOC Sensorless control diagram is as follows:



📖 When Pr.00-10 = 0, and you set Pr.00-11 to 7, IPM FOC sensorless control diagram is as follows:



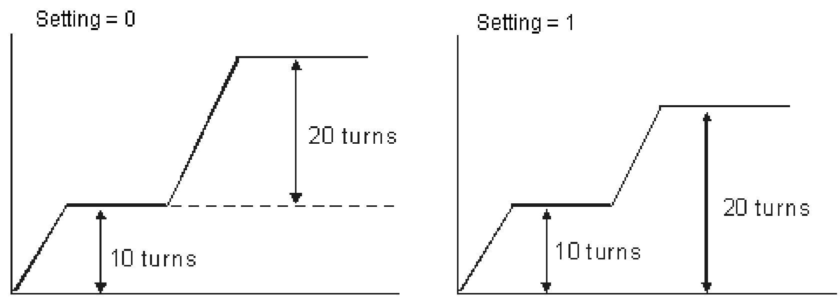
00-12 Point-to-Point Position Mode

Default: 0

Settings 0: Relative position

1: Absolute position

📖 Pr.00-12 = 0 is incremental type P2P; Pr.00-12 = 1 is absolute type P2P



00-13 Torque Mode Control

Default: 0

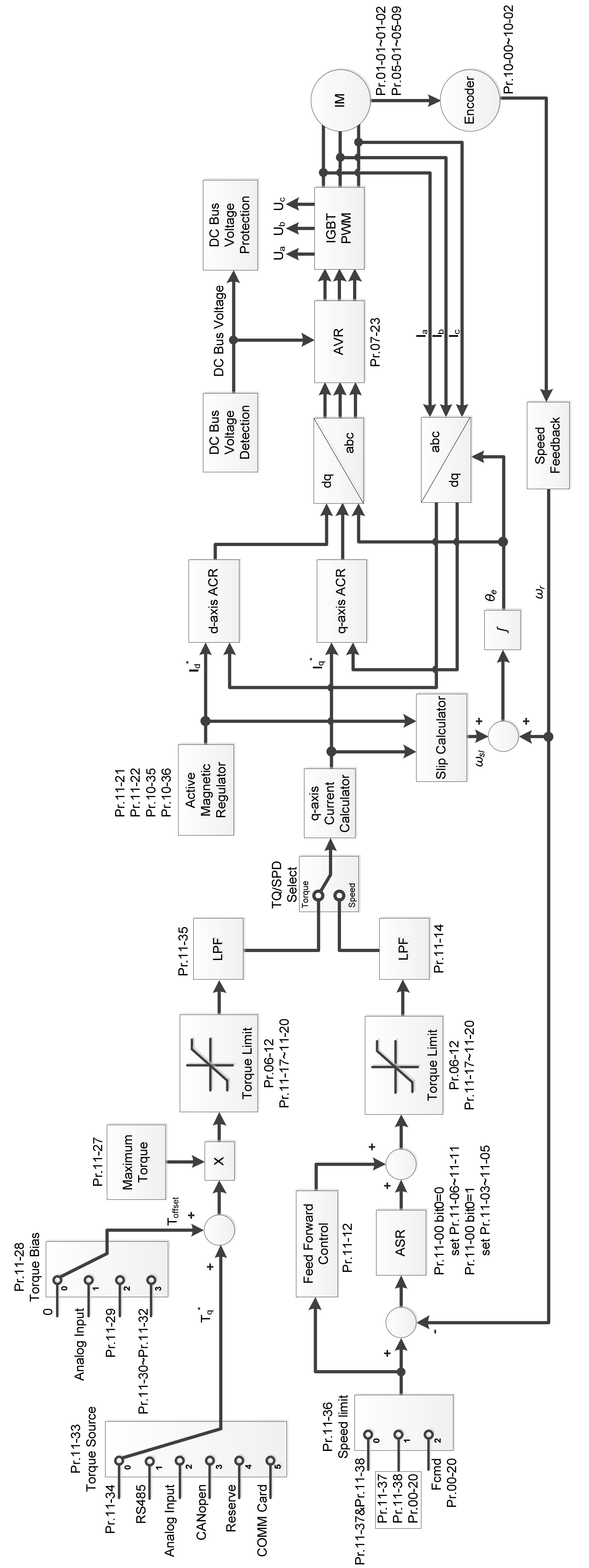
Settings 0: TQCPG（IM Torque control + Encoder）

1: TQCPG (PM Torque control + Encoder)

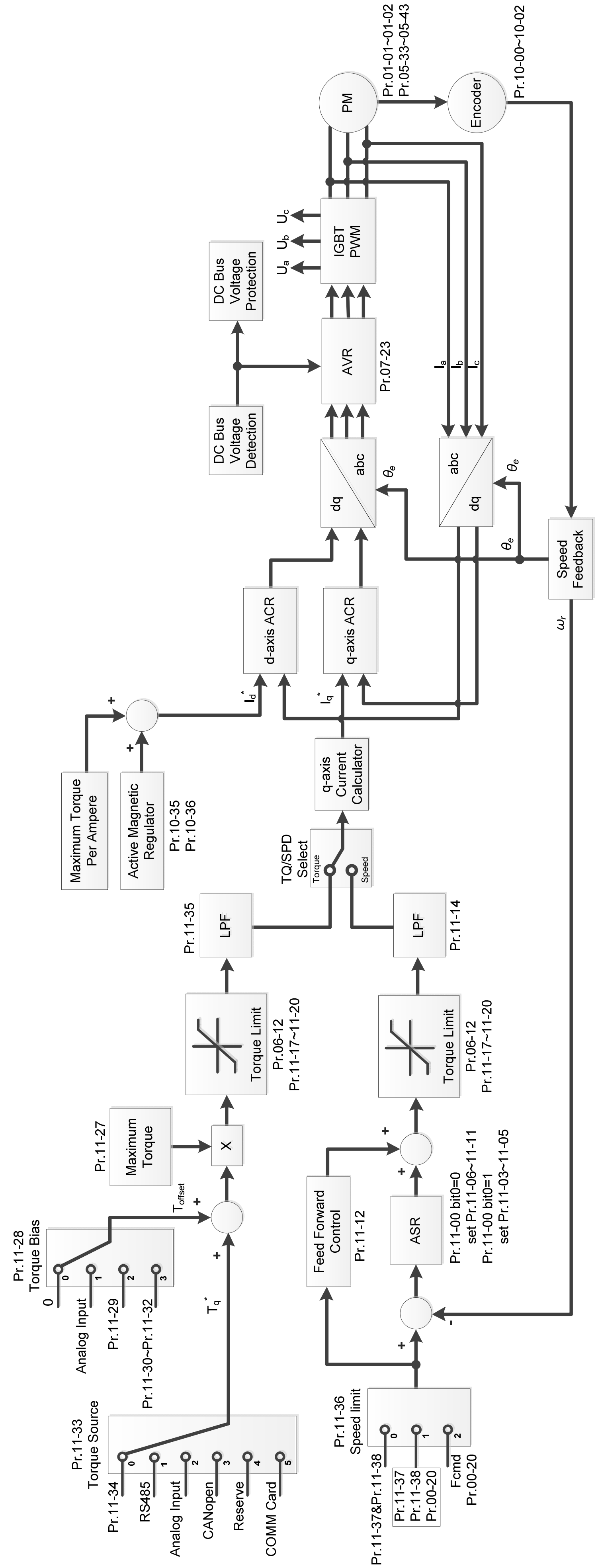
2: TQC Sensorless (IM Sensorless torque control)

📖 See the following pages for more information.

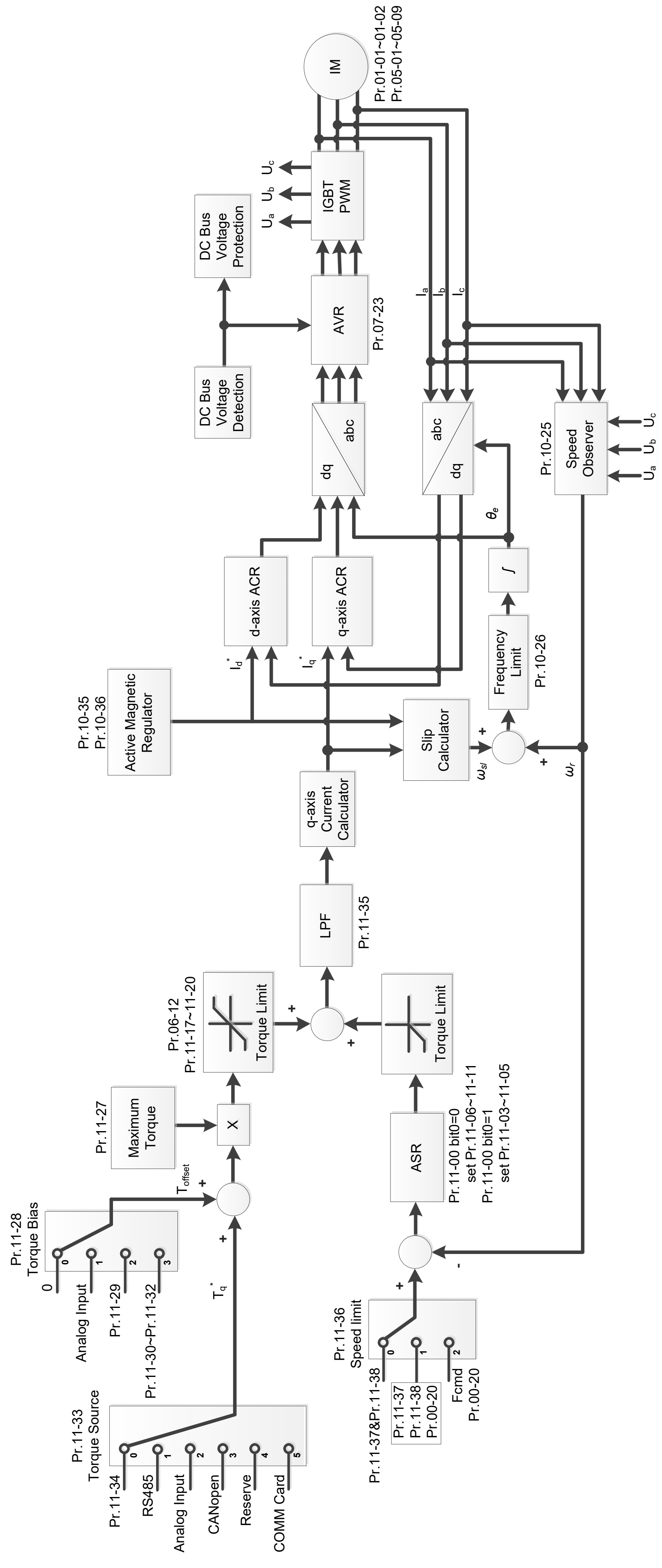
📖 Pr.00-13 = 0, IM TQCPG control diagram is as follows:



📖 Pr.00-13 = 1, PM TQCPG control diagram is as follows:



📖 Pr.00-13 = 2, IM TQC Sensorless control diagram is as follows:



00-16 Duty Selection

Default: 2

Settings 1: Heavy duty

2: Light duty

- Light duty: over-load ability is 120% rated output current in 1 minute. Refer to Pr.00-17 for the setting of carrier frequency. Refer to Chapter 9 Specifications or Pr.00-01 for the rated current.
- Heavy duty: over-load ability is 150% rated output current in 1 minute. Refer to Pr.00-17 for the setting of carrier frequency. Refer to Chapter 9 Specifications or Pr.00-01 for the rated current.
- Pr.00-01 varies with the setting value for Pr.00-16. The default value and maximum for Pr.06-03 and Pr.06-04 also vary with 100% rated current.

00-17 Carrier Frequency

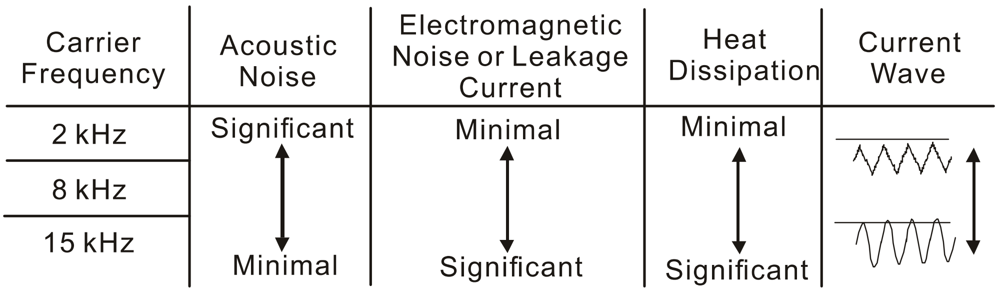
Default: 4

Settings 2–15 kHz

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

	Light Duty		
Models	5.5~18.5 kW	22~75 kW	90 kW
Setting Range	2~15 kHz	2~10 kHz	2~9 kHz
Default	4 kHz	4 kHz	4 kHz

	Heavy Duty	
Models	5.5~7.5 kW	11~90 kW
Setting Range	2~15 kHz	2~6 kHz
Default	2 kHz	2 kHz



- From the table, we see that the PWM carrier frequency has a significant influence on the electromagnetic noise, AC motor drive heat dissipation, and motor acoustic noise. Therefore, if the surrounding noise is greater than the motor noise, lower the carrier frequency is good to reduce the temperature rise. Although it is quiet operation in the higher carrier frequency, the entire wiring and interference resistance should be considerate.
- When the carrier frequency is higher than the factory setting, it needs to protect by decreasing the carrier frequency. See Pr.06-55 for the related setting and details.

00-19 PLC Command Mask

Default: Read only

Settings bit0: Control command is forced by PLC control
bit1: Frequency command is forced by PLC control
bit2: Position command is forced by PLC control
bit3: Torque command is forced by PLC control

- Determine if the frequency command, control command or torque command is locked by PLC.

00-20 Source of Master Frequency Command (AUTO)

Default: 0

Settings 0: Digital keypad
1: RS-485 communication input
2: External analog input (Refer to Pr.03-00)
3: External UP / DOWN terminal
4: Pulse input without direction command (refer to Pr.10-16 without considering direction)
5: Pulse input with direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication card (does not include CANopen card)

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

00-21 Operation command source (AUTO)

Default: 0

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

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

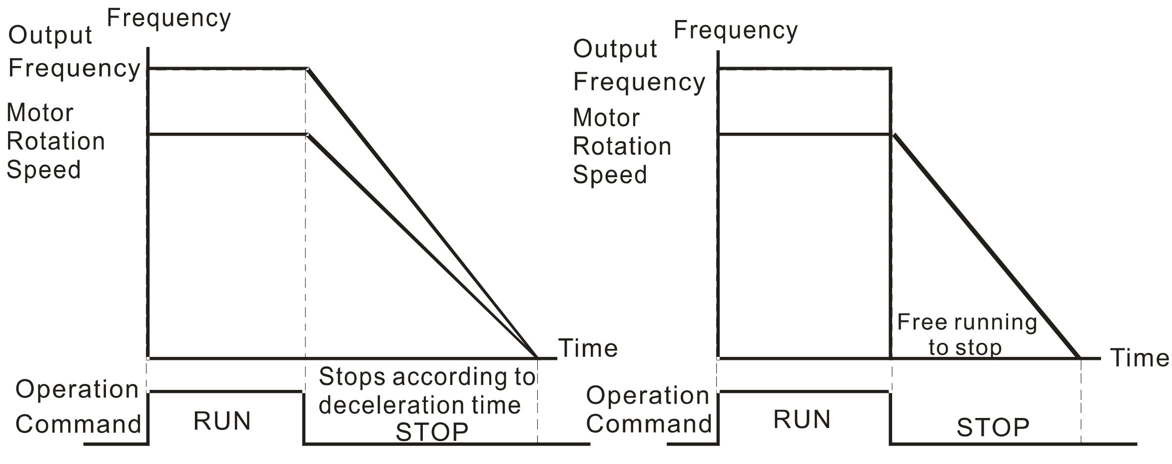
00-22 Stop method

Default: 0

Settings 0: Ramp to stop

1: Coast to stop

- Determine how the motor is stopped when the motor 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 (Pr.01-07) according to the set deceleration time, and then to stop.
- **Coast to stop:** the AC motor drive stops output immediately, and the motor coasts to stop according to the load inertia.
  - ☑ 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.
  - ☑ If idling is allowed, or the load inertia is large, use “coast to stop”. For example, blowers, punching machines and pumps

00-23 Control of Motor Direction

Default: 0

Settings 0: Enable forward / reverse

1: Disable reverse

2: Disable forward

- Enable the motor to run in the forward and reverse direction. You can use it to prevent a motor from running in a direction that would cause injury or damage to the equipment, especially when only one running direction is allowed for the motor load.

00-24 Memory of Frequency Command

Default: Read only

Settings Read only

- If keypad is the source of frequency command, when Lv or Fault occurs the present frequency command will be saved in this parameter.

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 places
0011b: three decimal places

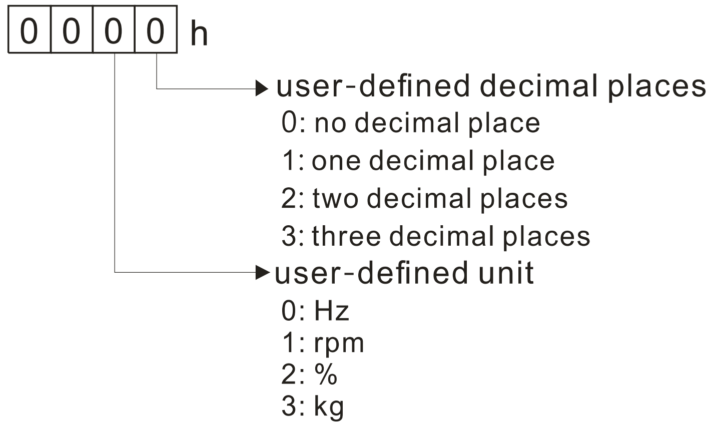
bit4–15: user-defined unit

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

📖 bit 0–3:
The displayed units for the control frequency F page and user-defined (Pr.00-04 = d10, PID feedback) and the displayed number of decimal places for Pr.00-26 (supports up to three decimal places).

📖 bit 4–15:
The displayed units for the control frequency F page, user-defined (Pr.00-04 = d10, PID feedback) and Pr.00-26.



00-26 Maximum User-Defined Value

Default: 0

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

📖 When Pr.00-26 is NOT set to 0, the user-defined value is enabled. After selecting the displayed unit and number of decimal places with Pr.00-25, the setting value of Pr.00-26 corresponds to Pr.01-00 (drive's maximum operating frequency), and then the motor operation frequency has a linear relationship with the displayed value on the digital keypad.
Example:
When the frequency set in Pr.01-00 = 60.00Hz, the maximum user-defined value for Pr.00-26 is 100.0%. This also means Pr.00-25 is set at 0021h to select % as the unit.
NOTE:
Set Pr.00-25 before using Pr.00-26. After you finish setting, when Pr.00-26 is not 0, the displayed unit on the keypad shows correctly according to Pr.00-25 settings.

✎ 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 function is valid only when Pr.00-20 (frequency source) is set to digital keypad or RS-485 communication.

00-29 LOCAL / REMOTE Selection

Default: 0

Settings 0: Standard HOA function
1: When switching between LOCAL and REMOTE, the drive stops.
2: When switching between LOCAL and REMOTE, the drive runs with REMOTE settings for frequency and operation status.
3: When switching between LOCAL and REMOTE, the drive runs with LOCAL settings for frequency and operation status.
4: When switching between LOCAL and REMOTE, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operation status.

- The factory setting of Pr.00-29 is 0 (standard Hand-Off-Auto function). The AUTO frequency and source of operation can be set by Pr.00-20 and Pr.00-21, and the HAND frequency and source of operation can be set by Pr.00-30 and Pr.00-31. AUTO/HAND mode can be selected or switched by using digital keypad (KPC-CC01) or setting multi-function input terminal MI= 41, 42.
- When external terminal MI is set to 41 and 42 (AUTO / HAND mode), the settings Pr.00-29=1,2,3,4 will be disabled. The external terminal has the highest priority among all command, Pr.00-29 will always function as Pr.00-29=0, standard HOA mode.
- When Pr.00-29 is not set to 0, Local/Remote function is enabled, the top right corner of digital keypad (KPC-CC01) will display “LOC” or “REM” (the display is available when KPC-CC01 is installed with firmware version higher than version 1.021). The LOCAL frequency and source of operation can be set by Pr.00-20 and Pr.00-21, and the REMOTE frequency and source of operation can be set by Pr.00-30 and Pr.00-31. Local/Remote function can be selected or switched by using digital keypad (KPC-CC01) or setting external terminal MI=56. The AUTO key of the digital keypad now controls for the REMOTE function and HAND key now controls for the LOCAL function.
- When MI is set to 56 for LOC/REM selection, if Pr.00-29 is set to 0, then the external terminal is disabled.
- When MI is set to 56 for LOC/REM selection, if Pr.00-29 is not set to 0, the external terminal has the highest priority of command and the ATUO / HAND keys will be disabled.

00-30 Source of the Master Frequency Command (HAND)

Default: 0

Settings 0: Digital keypad
1: RS-485 communication input
2: External analog input (refer to Pr.03-00)
3: External UP / DOWN terminal
4: Pulse input without direction command (refer to Pr.10-16 without considering direction)
5: Pulse input with direction command (refer to Pr.10-16)
6: CANopen communication card
8: Communication card (does not include CANopen card)

- Determine the master frequency source in HAND mode.

00-31 Source of the Operation Command (HAND)

Default: 0

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

- Set the source of the master frequency in HAND mode.
- Pr.00-20 and Pr.00-21 are for the settings of frequency source and operation source in AUTO mode. Pr.00-30 and Pr.00-31 are for the settings of frequency source and operation source in HAND mode. You can switch the AUTO / HAND mode with the keypad KPC-CC01 (optional) or the multi-function input terminal (MI) to set the master frequency source.
- The default for the frequency source or operation source is for AUTO mode. It returns to AUTO mode whenever 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.

00-32 Digital Keypad STOP Function

Default: 0

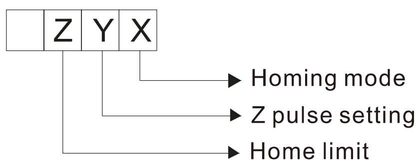
Settings 0: STOP key disabled
1: STOP key enabled

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

00-40 Homing mode

Default: 0000h

Settings

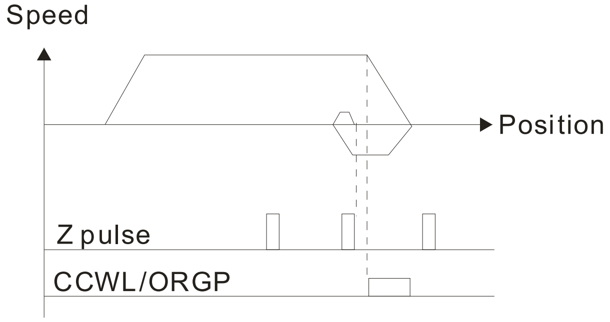


X
0: Forward run to home. Set PL forward limit as checkpoint.
1: Reverse run (CCW) to home. Set NL reverse limit (CCWL) as checkpoint.
2: Forward run to home. Set ORG: OFF→ON as checkpoint.
3: Reverse to home. Set ORG: OFF→ON as checkpoint.
4: Forward run and search for Z-pulse as checkpoint.
5: Reverse run and search for Z-pulse as checkpoint.
6: Forward run to home. Set ORG: ON→OFF as checkpoint.
7: Reverse run to home. Set ORG: ON→OFF as checkpoint.
8: Define current position as home.
Y
Set X to 0, 1, 2, 3, 6, 7
0: reverse run to Z pulse
1: continue forward run to Z pulse
2: Ignore Z pulse

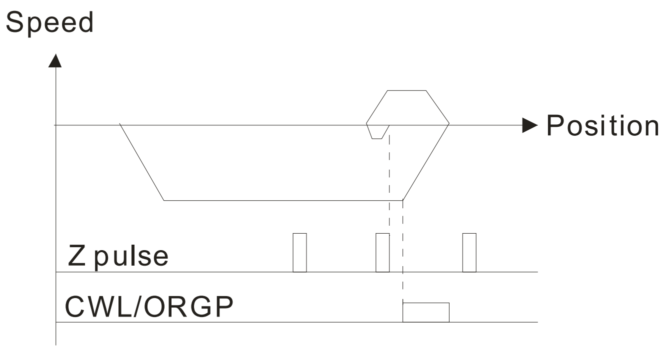
Z
When home limit is reached, set X to 2, 3, 4, 5, 6, 7 first.
0: display error
1: reverse the direction

📖 Homing action is control by Pr.00-40, 00-41, 00-42 and 02-01–02-08.

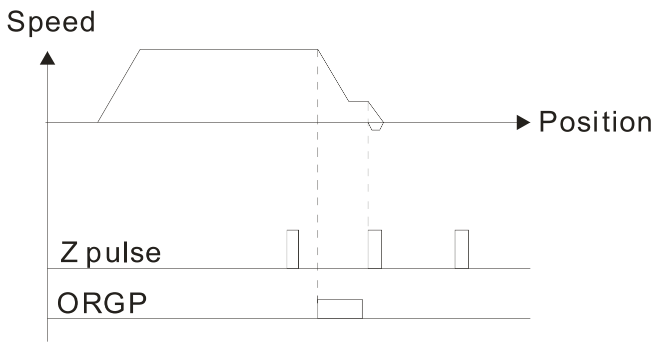
1. When Y=0, X=0 or Y=0, X=2



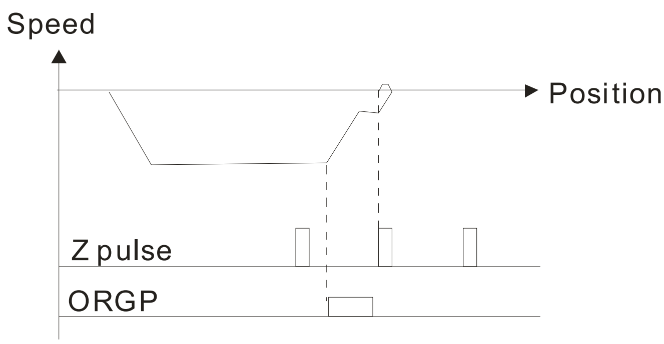
2. When Y=0, X=1 or Y=0, X=3



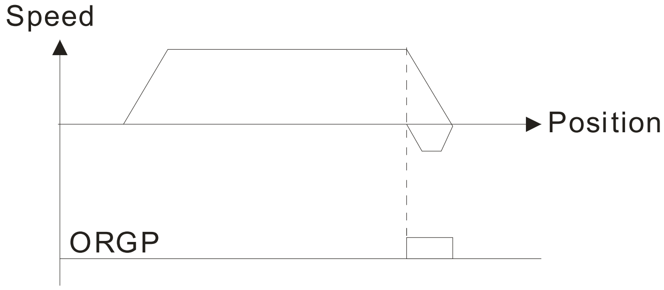
3. When Y=1, X=2



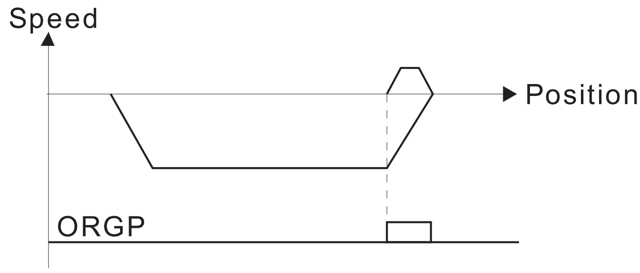
4. When Y=1, X=3



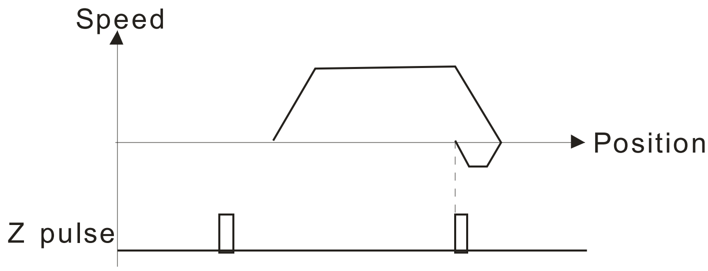
5. When Y=2, X=2



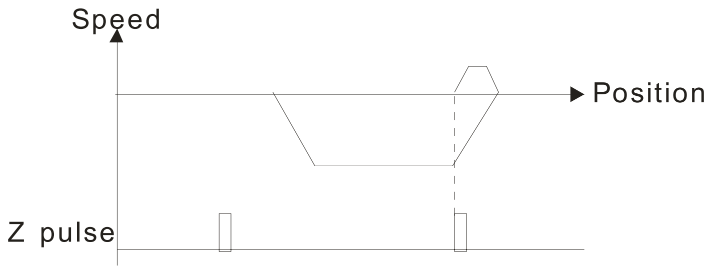
6. When Y=2, X=3



7. When Y=2, X=4



8. When Y=2, X=5



00-41 Homing by Frequency 1

Default: 8.00

Settings 0.00–599.00 Hz

00-42 Homing by Frequency 2

Default: 2.00

Settings 0.00–599.00 Hz

Control by Multi-function Input Terminal Pr. 02-01–02-08 (44–47).

44: Reverse direction homing

45: Forward direction homing

46: Homing (ORG)

47: Homing function enable

- If the drive is not control by CAN or PLC, set Pr.00-10 =1 (Control mode = P2P position control) and set external output terminal to 47 (homing function enable) for homing.
- When Pr.00-10 is set to 3, after homing is complete, user must set control mode setting Pr.00-10 to 1 in order to perform P2P position control.

00-48 Display Filter Time (Current)

Default: 0.100

Settings 0.001–65.535 sec.

- Minimize the current fluctuation displayed by the digital keypad.

00-49 Display Filter Time (Keypad)

Default: 0.100

Settings 0.001–65.535 sec.

- Minimize the display value fluctuation displayed by the digital keypad.

00-50 Software Version (Date)

Default: Read only

Settings Read only

- Display the current drive software version by date.

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01 Basic Parameters

✔ You can set this parameter during operation.

✔ **01-00** Maximum Operation Frequency

Default: 60.00 / 50.00

Settings 0.00–599.00 Hz

- This parameter determines the AC motor drive's Maximum Output Frequency. All the AC motor drive frequency command sources (analog inputs 0 to +10V, 4 to 20mA, 0 to 20mAand ±10V) are scaled to correspond to the output frequency range.
- Light duty:
  - VF, SVC, VFPG, FOCPG: 0–599 Hz
  - FOC sensorless (IM/PM): 0–300 Hz / 500 Hz
- Heavy duty:
  - The range of output is 0~300Hz

✔ **01-01** Motor 1 Rated / Base Frequency

✔ **01-35** Motor 2 Rated / Base Frequency

Default: 60.00 / 50.00

Settings 0.00–599.00 Hz

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

✔ **01-02** Motor 1 Rated / Base Output Voltage

✔ **01-36** Motor 2 Rated / Base Output Voltage

Default: 400.0

Settings 0.0–510.0 V

- Set this parameter according to the rated voltage on the motor nameplate. If the motor's rated voltage is 440 V, set this parameter to 440.0. If the motor's rated voltage is 400 V, set this parameter to 400.0.
- There are many motor types in the market and the power system for each country is also different. The economical and convenient solution is to install an AC motor drive. Then there is no problem using the motor with different voltage and frequency inputs, and the motor drive can improve the original motor characteristics and useful life.

01-03 Motor 1 Mid-Point Frequency 1

Default: 3.00

Settings 0.00–599.00 Hz

✔ **01-04** Motor 1 Mid-Point Voltage 1

Default: 22.0

Settings 0.0–480.0 V

01-37 Motor 2 Mid-Point Frequency 1

Default: 3.00

Settings 0.00–599.00 Hz

✎ 01-38 Motor 2 Mid-Point Voltage 1

Default: 22.0

Settings 0.0–480.0 V

01-05 Motor 1 Mid-Point Frequency 2

Default: 1.50

Settings 0.00–599.00 Hz

✎ 01-06 Motor 1 Mid-Point Voltage 2

Default: 10.0

Settings 0.0–480.0 V

01-39 Motor 2 Mid-Point Frequency 2

Default: 1.50

Settings 0.00–599.00 Hz

✎ 01-40 Motor 2 Mid-Point Voltage 2

Default: 10.0

Settings 0.0–480.0 V

01-07 Motor 1 Minimum Output Frequency

Default: 0.50

Settings 0.00–599.00 Hz

✎ 01-08 Motor 1 Minimum Output Voltage

Default: 2.0

Settings 0.0–480.0 V

01-41 Motor 2 Minimum Output Frequency

Default: 0.50

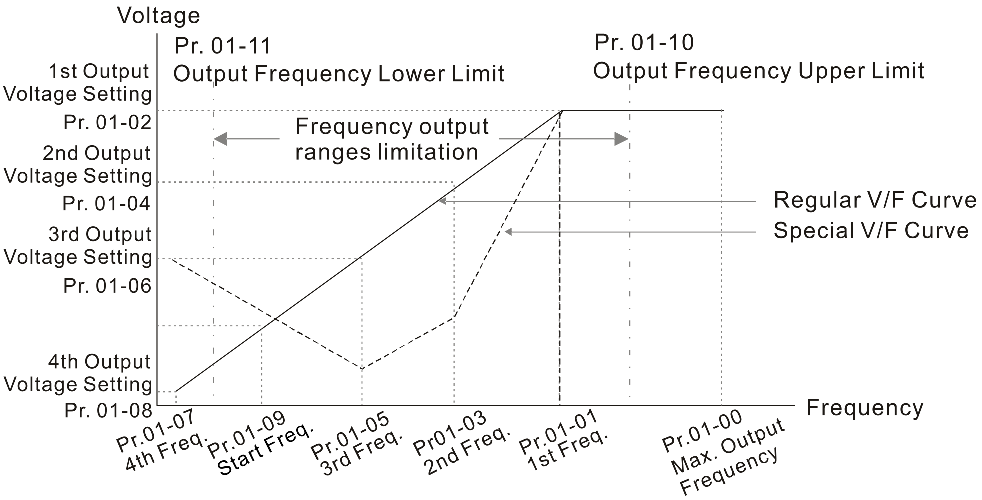
Settings 0.00–599.00 Hz

✎ 01-42 Motor 2 Minimum Output Voltage

Default: 2.0

Settings 0.0–480.0 V

- 🕮 You usually set the V/F curve according to the motor's allowable loading characteristics. Pay special attention to the motor's heat dissipation, dynamic balance, and bearing lubrication when the loading characteristics exceed the loading limit of the motor.
- 🕮 There is no limit for the voltage setting, but a high voltage at a low frequency may cause motor damage, overheating, and trigger the stall prevention or the over-current protection; therefore, use low voltage at low frequency to prevent motor damage or drive error.
- 🕮 Pr.01-35 to Pr.01-42 is the V/F curve for motor 2. When setting the multi-function input terminals [Pr.02-01–02-08 and Pr.02-26–Pr.02-31 (extension card)] to 14, the AC motor drive acts with the second V/F curve.
- 🕮 The diagram below shows the V/F curve for motor 1. You can use the same V/F curve for motor 2.

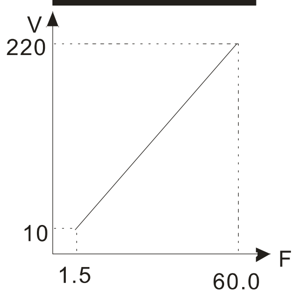


V/F Curve and The Related Parameters

Common settings for the V/F curve:

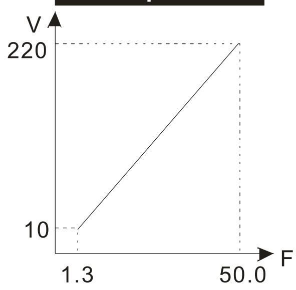
(1) General purpose

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

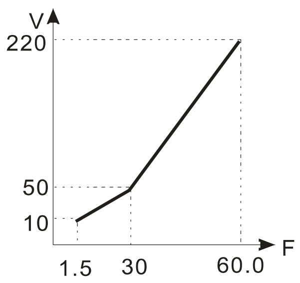
Motor spec. 50Hz



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

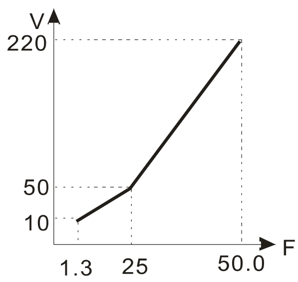
(2) For fan and hydraulic machinery

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

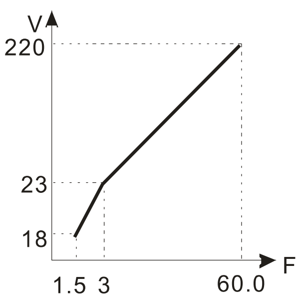
Motor spec. 50Hz



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

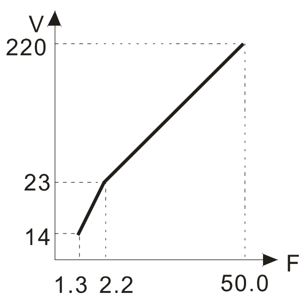
(3) High starting torque

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 larger than the minimum output frequency, the drive's frequency output starts when the starting frequency reaches the F command. Refer to the following diagram for details.

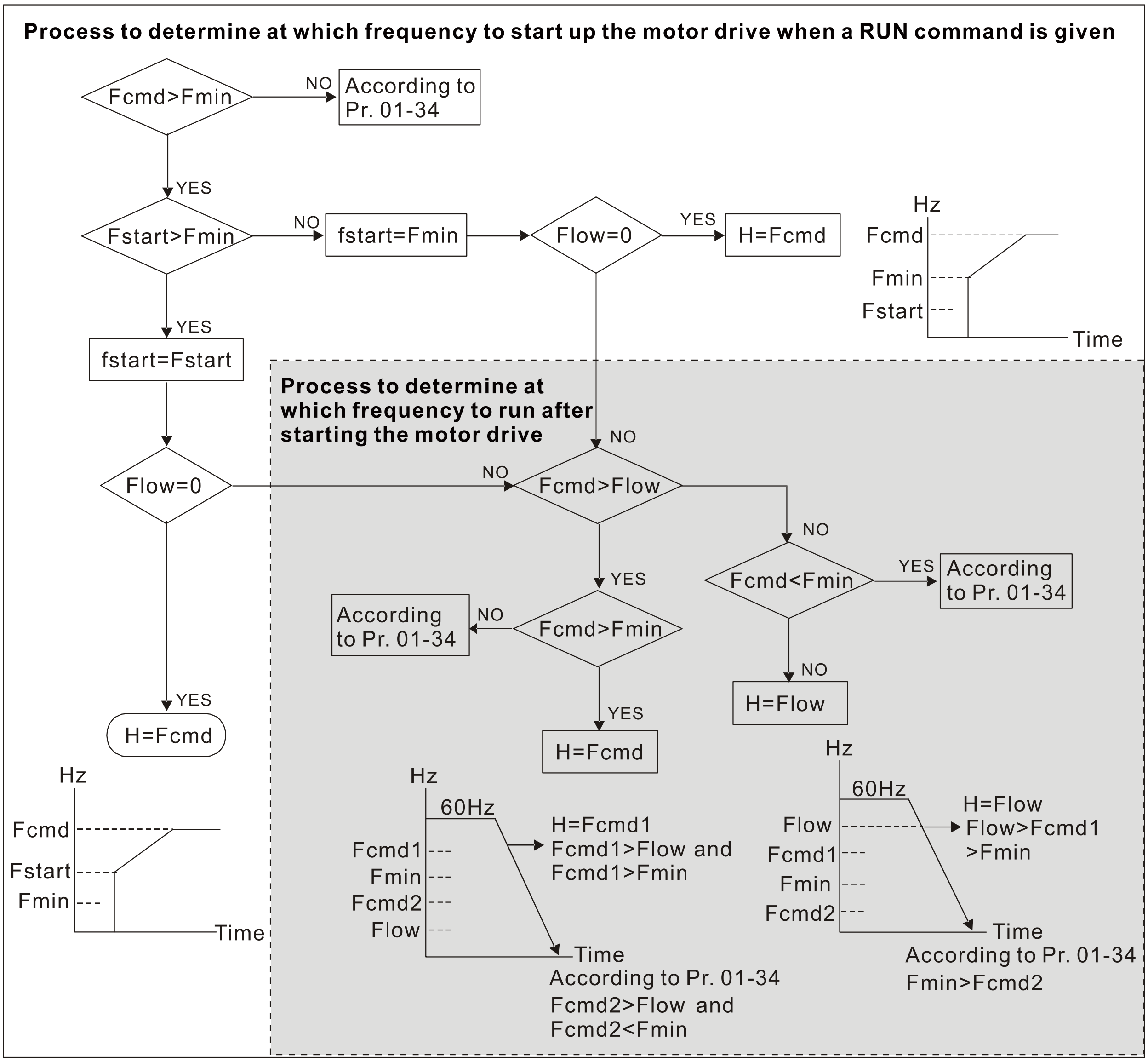
  Fcmd: frequency command

  Fstart: start-up frequency (Pr.01-09)

  fstart: actual start-up frequency of the 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, the drive runs directly by Fcmd.

  If Flow ≥ Fcmd, the drive runs with Fcmd, and then rises to Flow according to acceleration time.

- The drive's output frequency goes directly to 0 when decelerating to Fmin.

✓ 01-10 Output Frequency Upper Limit

Default: 599.00

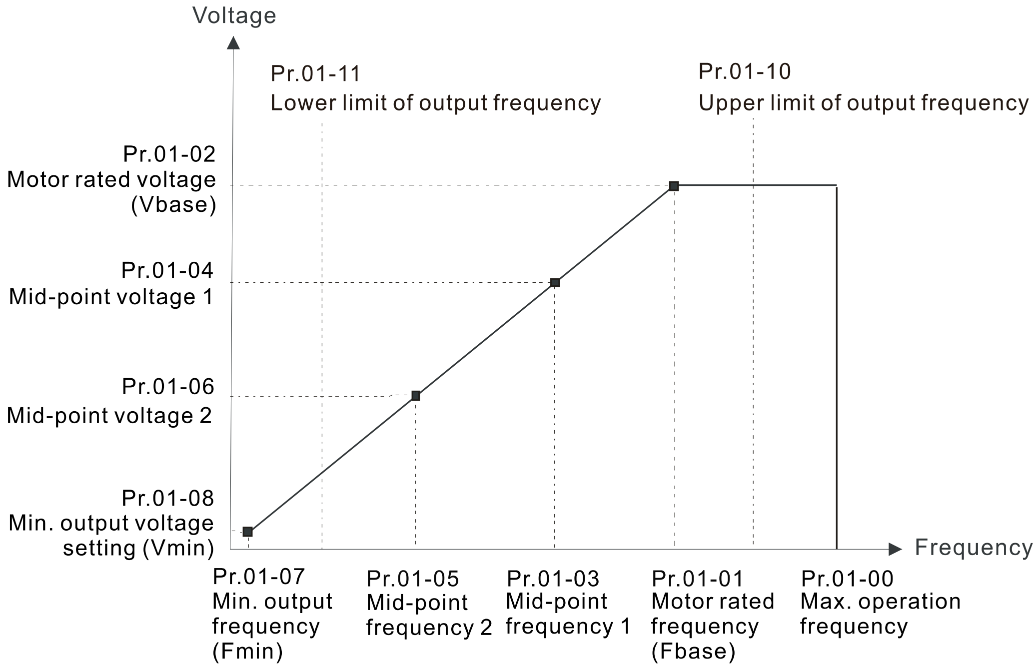
Settings 0.00–599.00 Hz

✓ 01-11 Output Frequency Lower Limit

Default: 0.00

Settings 0.00–599.00 Hz

- If the output frequency setting is higher than the upper limit (Pr.01-10), the drive runs with the upper limit frequency. If the output frequency setting is lower than the lower limit (Pr.01-11) but higher than the minimum output frequency (Pr.01-07), the drive runs with the lower limit frequency. Set the upper limit frequency > the lower limit frequency (Pr.01-10 setting value must be > Pr.01-11 setting value).
- If the slip compensation function (Pr.07-27) is enabled for the drive, the drive's output frequency may exceed the Frequency command.



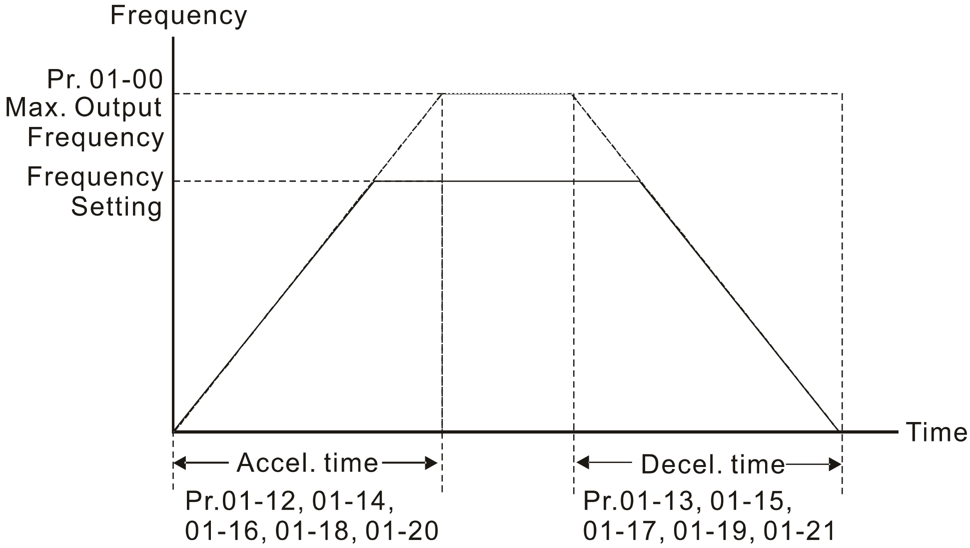
- When the drive starts, it operates according to the V/F curve and accelerates from the minimum output frequency (Pr.01-07) to the setting frequency. It is not limited by the lower output frequency settings.
- Use the frequency upper and lower limit settings to prevent operator misuse, overheating caused by the motor's operating at a too low frequency, or mechanical wear due to a too high operation frequency.
- If the frequency upper limit setting is 50 Hz and the frequency setting is 60 Hz, the maximum operation frequency is 50 Hz.
- If the frequency lower limit setting is 10 Hz and the minimum operation frequency setting (Pr.01-07) is 1.5 Hz, then the drive operates at 10 Hz when the Frequency command is higher than Pr.01-07 but lower than 10 Hz. If the Frequency command is lower than Pr.01-07, the drive is in ready status without output.

✎	**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 /10.0
The default of 30HP and above models: 60.00 / 60.0

Settings Pr.01-45 = 0: 0.00–600.00 sec.
Pr.01-45 = 1: 0.00–6000.0 sec.

- The acceleration time determines the time required for the AC motor drive to ramp from 0.00 Hz to the maximum operation frequency (Pr.01-00). The deceleration time determines the time required for the AC motor drive to decelerate from the maximum operation 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 / Deceleration time 1, 2, 3, 4 with the multi-function input terminals settings. The defaults are Acceleration Time 1 and Deceleration Time 1.
- With the enabled torque limits and stall prevention functions, the actual acceleration and deceleration time are longer than the above action time.
- Note that setting the acceleration and deceleration time too short may trigger the drive's protection function (Pr.06-03 Over-current Stall Prevention during Acceleration or Pr.06-01 Over-voltage Stall Prevention), and the actual acceleration and deceleration time are longer than this setting.
- Note that setting the acceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's acceleration.
- Note that setting the deceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's deceleration or over-voltage.
- Use suitable brake resistor (refer to Chapter 07 Optional Accessories) to decelerate in a short time and prevent over-voltage.
- When you enable Pr.01-24–Pr.01-27 (S-curve acceleration and deceleration begin and arrival time), the actual acceleration and deceleration time are longer than the setting.



Acceleration / Deceleration Time

01-22 JOG Frequency

Default: 6.00

Settings 0.00–599.00 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 0.00 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 1st / 4th Accel. / Decel. Frequency

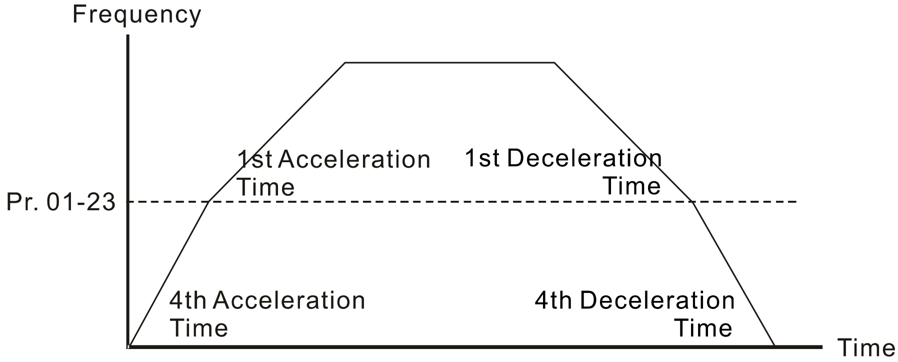
Default: 0.00

Settings 0.00–599.00 Hz

- This function does not require the external terminal switching function; it switches the acceleration and deceleration time automatically according to the Pr.01-23 setting. If you set the external terminal, the external terminal has priority over Pr.01-23.
- Use this parameter to set the switch frequency between acceleration and deceleration slope. The First / Fourth Accel. / Decel. slope is calculated by the Max. Operation Frequency (Pr.01-00) / acceleration / deceleration time.

  Example: When the Max. Operation Frequency (Pr.01-00) = 80 Hz, and Switch Frequency between First and Fourth Accel. / Decel. (Pr.01-23) = 40 Hz:

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



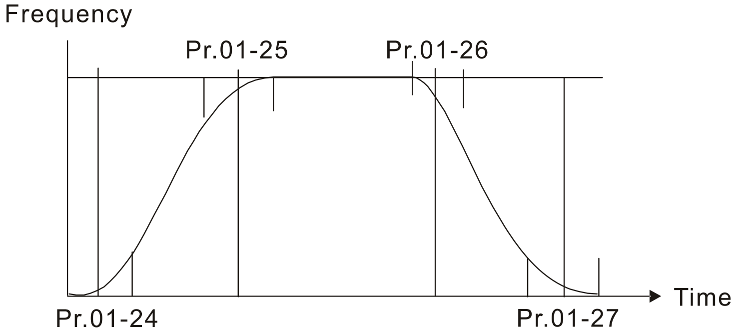
1st/4th Acceleration/Deceleration Frequency Switching

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

Default: 0.20 / 0.2

Settings Pr.01-45 = 0: 0.00–25.00 sec.
Pr.01-45 = 1: 0.0–250.0 sec.

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



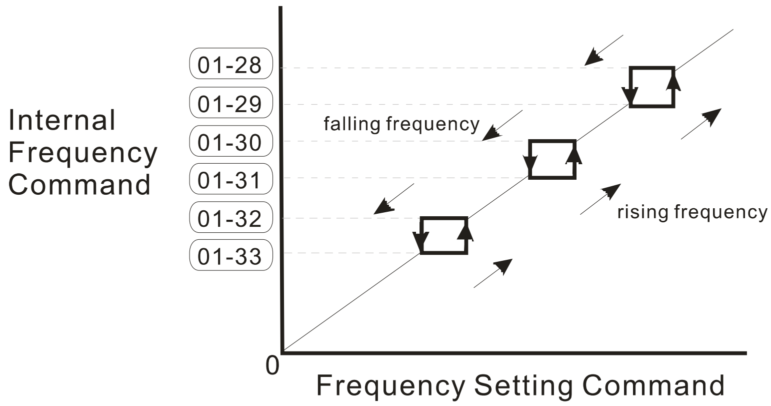
01-28	Skip Frequency 1 (Upper Limit)
01-29	Skip Frequency 1 (Lower Limit)
01-30	Skip Frequency 2 (Upper Limit)
01-31	Skip Frequency 2 (Lower Limit)
01-32	Skip Frequency 3 (Upper Limit)
01-33	Skip Frequency 3 (Lower Limit)

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. You can set Pr.01-28–01-33 as you required. There is no size distinction among these six parameters.

- These parameters set the skip frequency ranges for the AC motor drive. You can use this function to avoid frequencies that cause mechanical resonance. The skip frequencies are useful when a motor has resonance vibration at a specific frequency bandwidth. Skipping this frequency avoids the vibration. There are three frequency skip zones available.
- You can set the Frequency command (F) within the range of skip frequencies. Then the output frequency (H) is limited to the lower limit of skip frequency ranges.
- During acceleration and deceleration, the output frequency still passes through the skip frequency ranges.



01-34 Zero-Speed Mode

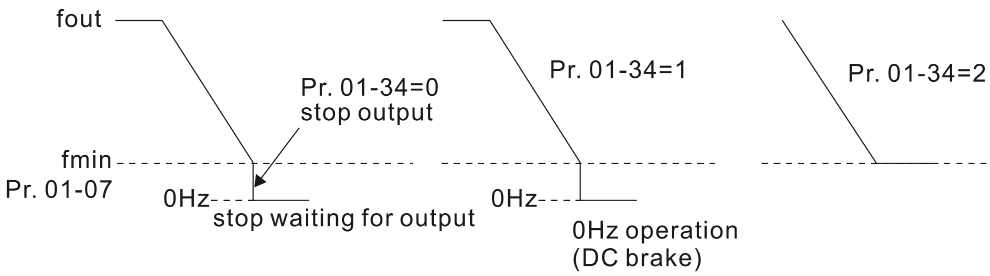
Default: 0

Settings 0: Output waiting

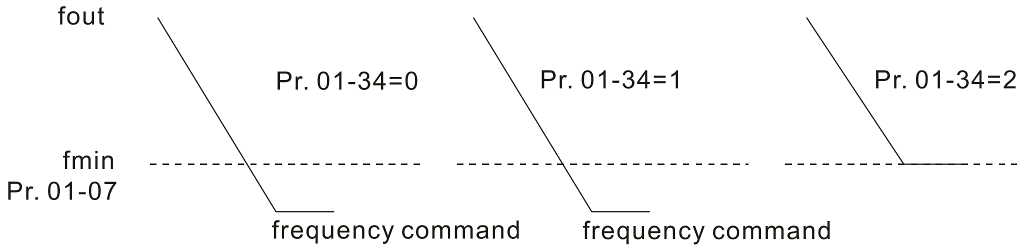
1: Zero-speed operation

2: Fmin (Refer to Pr.01-07, 01-41)

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



- In FOCPG mode, when Pr.01-34 is set to 2, the AC motor drive operates according to this setting.

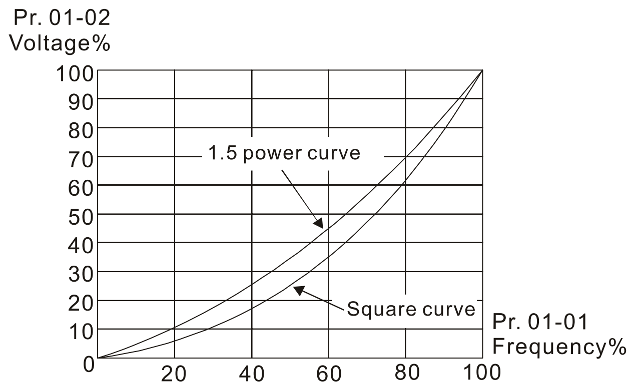


01-43 V/F Curve Selection

Default: 0

Settings
0: V/F curve determined by Pr.01-00–01-08
1: V/F curve to the power of 1.5
2: V/F curve to the power of 2
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

- 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 settings are invalid.
- If the load of the motor is a variable torque load (torque is in direct proportion to the rotating speed, such as the load of a fan or a pump), the load torque is low at low rotating speed. You can decrease the input voltage appropriately 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.

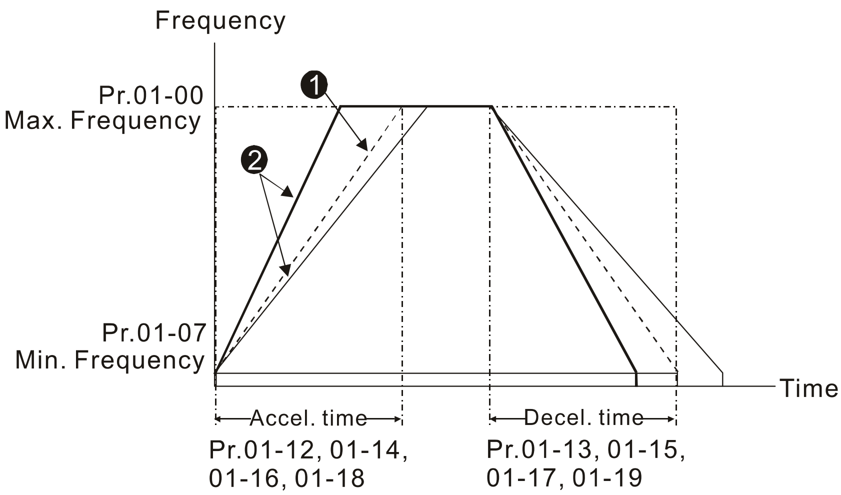


01-44 Auto-Acceleration and Auto-Deceleration Setting

Default: 0

Settings 0: Linear acceleration and 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–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 auto-tunes the acceleration and deceleration to effectively reduce the mechanical vibration during the load start-up and stop and make the auto-tuning process easier. It does not stall during acceleration and does not need a brake resistor during deceleration to stop. It can also improve operation efficiency and save energy.
- 3 (auto-acceleration and auto-deceleration–decelerating by the actual load): the drive auto-detects the load torque and automatically accelerates from the fastest acceleration time and smoothest start-up current to the setting frequency. During deceleration, the drive automatically determines the loaded regenerative energy to steadily and smoothly stop the motor in the fastest deceleration time.
- 4 (stall prevention by auto-acceleration and deceleration–reference to the acceleration and deceleration time settings): if the acceleration and deceleration time are within a reasonable range, the actual acceleration and deceleration time refer to Pr.01-12–01-19 settings. If the acceleration and deceleration time are too short, the actual acceleration and deceleration time are greater than the acceleration and deceleration time settings.



Acceleration / Deceleration Time

❶ Optimize the acceleration / deceleration time when Pr.01-44 is set to 0.
❷ Optimize the acceleration / deceleration time which load needs actually 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.

📖 Sets the time required to decelerate from the maximum operation frequency (Pr.01-00) to 0.00 Hz through the CANopen control.

02 Digital Input / Output Parameter

✓ You can set this parameter during operation.

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

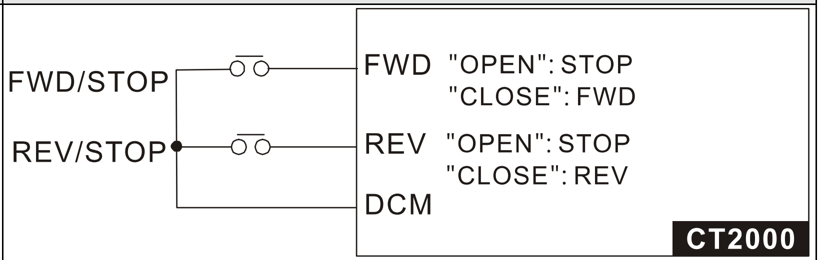
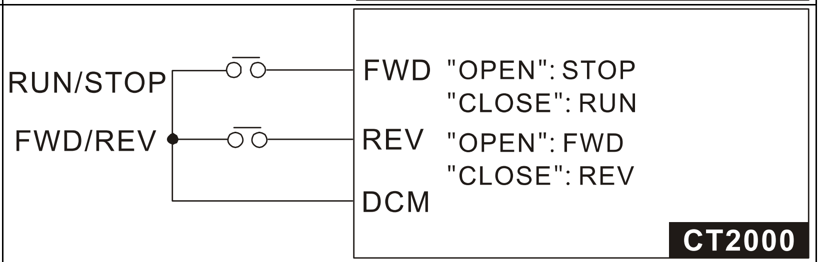
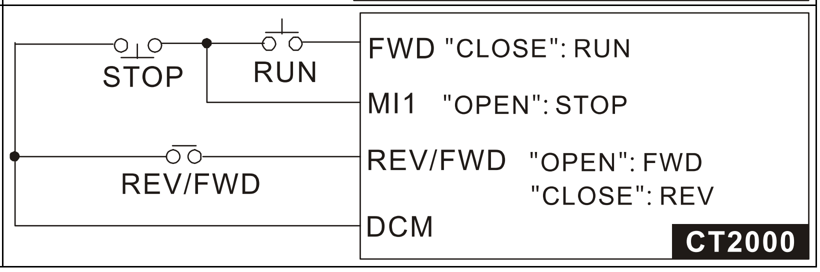
Default: 0

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 four different control modes listed in the following table.

Pr.02-00	Control Circuits of the External Terminal
Setting value: 0 Two-wire operation control FWD / STOP REV / STOP	
Setting value: 1 Two-wire operation control RUN/STOP REV/FWD	
Setting value: 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 / multi-step position command 1
2: Multi-step speed command 2 / multi-step position command 2
3: Multi-step speed command 3 / multi-step position command 3
4: Multi-step speed command 4 / multi-step position command 4
5: Reset
6: JOG command (by external control or KPC-CC01)
7: Acceleration / deceleration speed inhibit
8: 1st and 2nd acceleration / deceleration time selection
9: 3rd and 4th acceleration / deceleration time selection
10: External Fault (EF) input (Pr.07-20)
11: Base Block (B.B) input from external
12: Output voltage stops
13: Cancel the setting of auto-acceleration / auto-deceleration time
14: Switch between motor 1 and motor 2
15: Rotating speed command from AVI
16: Rotating speed command from ACI
17: Rotating speed command from AUI
18: Forced to stop (Pr.07-20)
19: Frequency up command
20: Frequency down command
21: PID function disabled
22: Clear the counter
23: Input the counter value (MI6)
24: FWD JOG command
25: REV JOG command
26: TQC / FOC mode selection
27: ASR1 / ASR2 selection
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for ∆-connection
31: High torque bias (Pr.11-30)
32: Middle torque bias (Pr.11-31)
33: Low torque bias (Pr.11-32)
34: Switch between multi-step position and multi-speed control
35: Enable single-point positioning

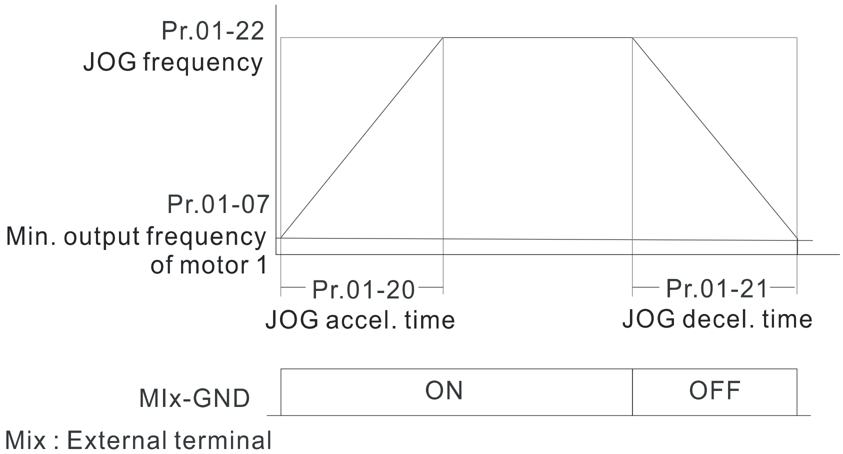
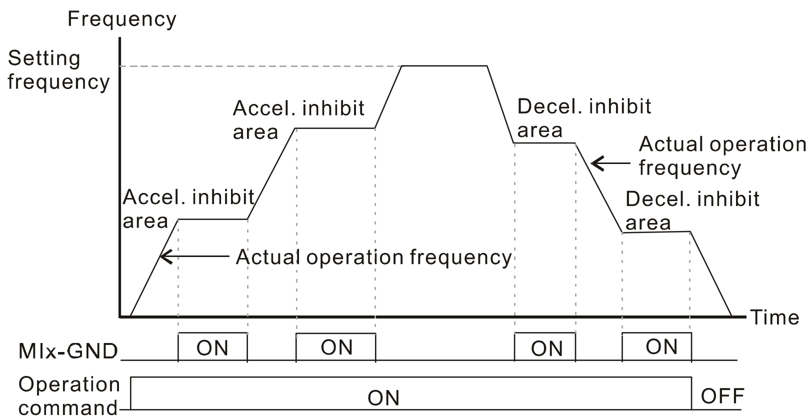
36: Enable multi-step position teaching function (valid at stop)
37: Enable pulse-train position command position control
38: Disable write EEPROM function
39: Torque command direction
40: Force coasting to stop
41: HAND switch
42: AUTO switch
43: Enable resolution selection (Pr.02-48)
44: Negative limit switch (NL)
45: Positive limit switch (PL)
46: Homing (ORG)
47: Homing function enabled
48: Mechanical gear ratio switch
49: Drive enabled
50: Slave dEb action to execute
51: Selection for PLC mode bit0
52: Selection for PLC mode bit1
53: Trigger CANopen quick stop
55: Brake released signal
56: Local / remote selection

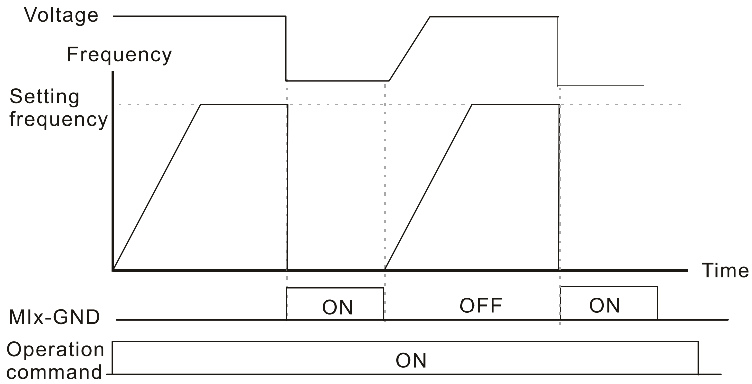
- This parameter selects the functions for each multi-function terminal.
- Pr.02-26–Pr.02-31 are entity input terminals only when extension cards are installed; otherwise, these are virtual terminals. For example, when using the multi-function extension card EMC-D42A, Pr.02-26–Pr.02-29 are defined as 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 bit 8–15.
- 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.

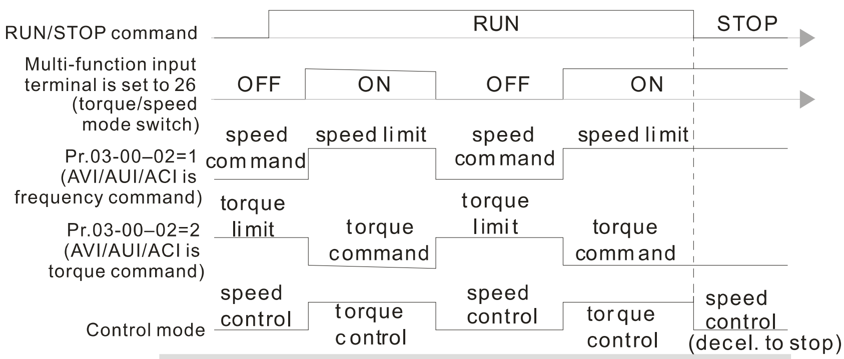
Summary of function settings

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

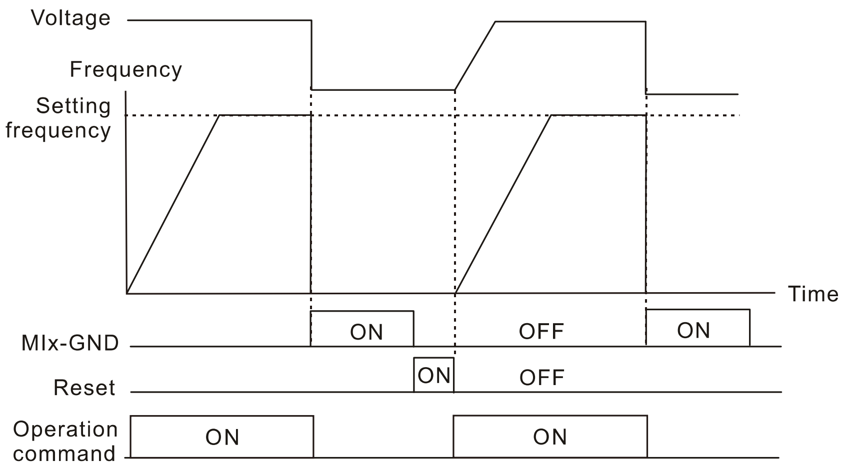
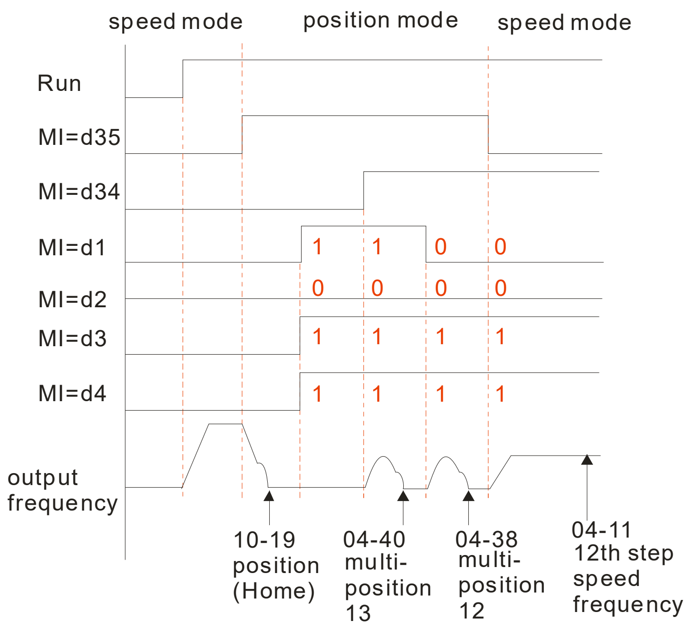
Settings	Functions	Descriptions
0	No Function	
1	Multi-step speed command 1 / multi-step position command 1	You can set 15 steps of speed or 15 positions with the digital status of these four terminals. You can use 16-steps of speed if you include the master speed when setting as 15 steps of speed (refer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

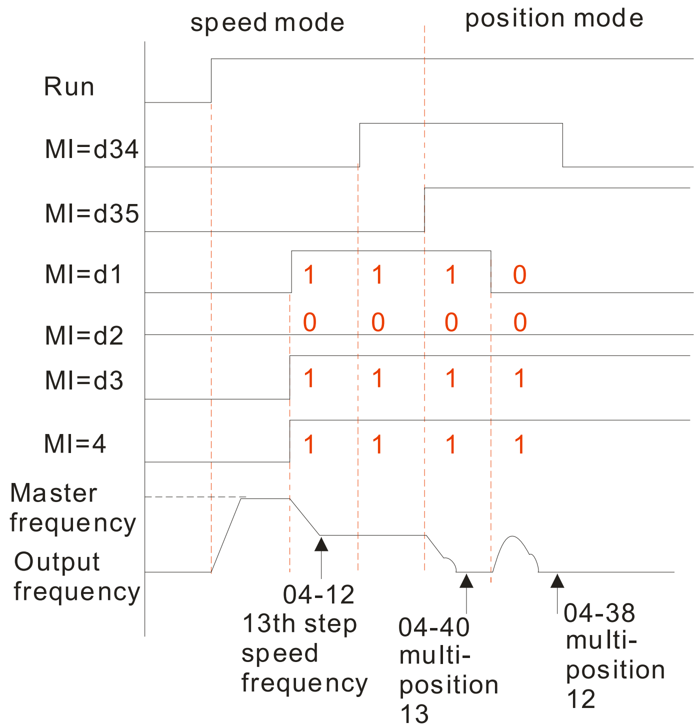
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>3</td><td>Multi-step speed command 3 / multi-step position command 3</td><td rowspan="2"></td></tr>
<tr><td>4</td><td>Multi-step speed command 4 / multi-step position command 4</td></tr>
<tr><td>5</td><td>Reset</td><td>Use this terminal to reset the drive after clearing a drive fault.</td></tr>
<tr><td>6</td><td>JOG operation [by external control or KPC-CC01 (optional)]</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. While running, you can still change the operation direction, and the STOP key on the keypad* and the STOP command from communications are valid. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to Pr.01-20–Pr.01-22 for details.
*: This function is valid when Pr.00-32 is set to 1.

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

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

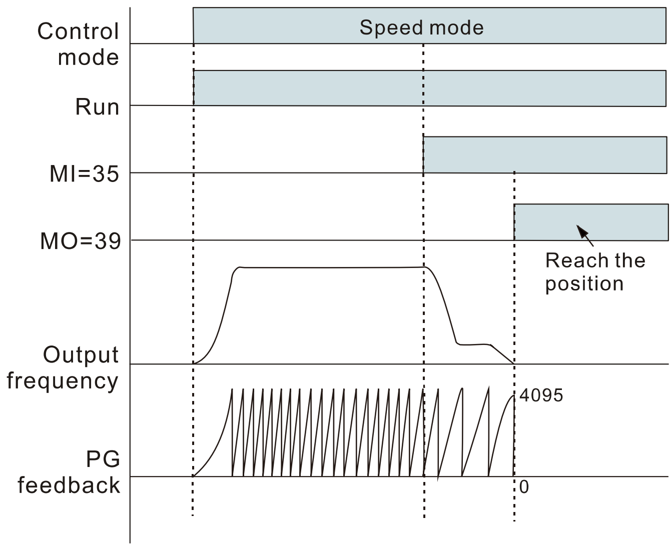
Settings	Functions	Descriptions
8	1st and 2nd acceleration / deceleration time selection	You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selections.
9	3rd and 4th acceleration / deceleration time selection	
10	External Fault (EF) Input (Pr.07-20)	For external fault input, the drive decelerates according to the Pr.07-20 setting, and the keypad shows "EF" (it shows the fault record when an external fault occurs). The drive keeps running until the fault is cleared (terminal status restored) after RESET.
11	Base block (B.B.) input from external	ON: the output of the drive stops immediately. The motor is in free run and the keypad displays the B.B. signal. Refer to Pr.07-08 for details.
12	Output voltage stops	ON: the output of the drive stops immediately and the motor is in free run status. The drive is in output waiting status until the switch is turned to OFF, and then the drive restarts and runs to the current setting frequency. 
13	Cancel the setting of auto-acceleration / auto-deceleration time	Set Pr.01-44 to one of the 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 form AVI	ON: force the source of the drive's frequency to be AVI. If the rotating speed commands are set to AVI, ACI and AUI at the same time, the priority is AVI > ACI > AUI.
16	Rotating speed command form ACI	ON: force the source of the drive's frequency to be ACI. If the rotating speed commands are set to AVI, ACI and AVI at the same time, the priority is AVI > ACI.> AUI
17	Rotating speed command form AUI	ON: force the source of the drive's frequency to be AUI. If the rotating speed commands are set to AVI, ACI and AVI at the same time, the priority is AVI > ACI.> AUI

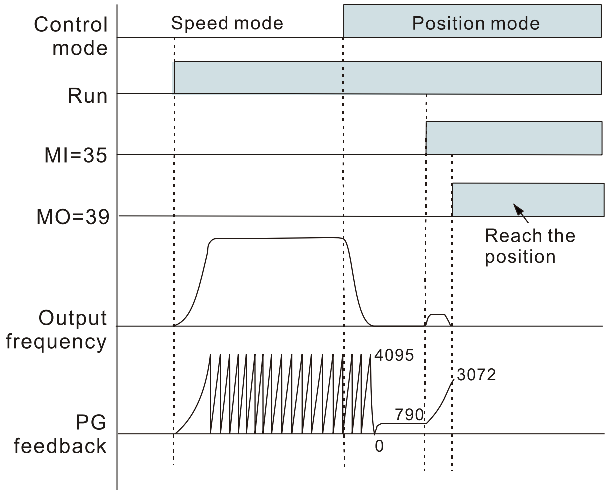
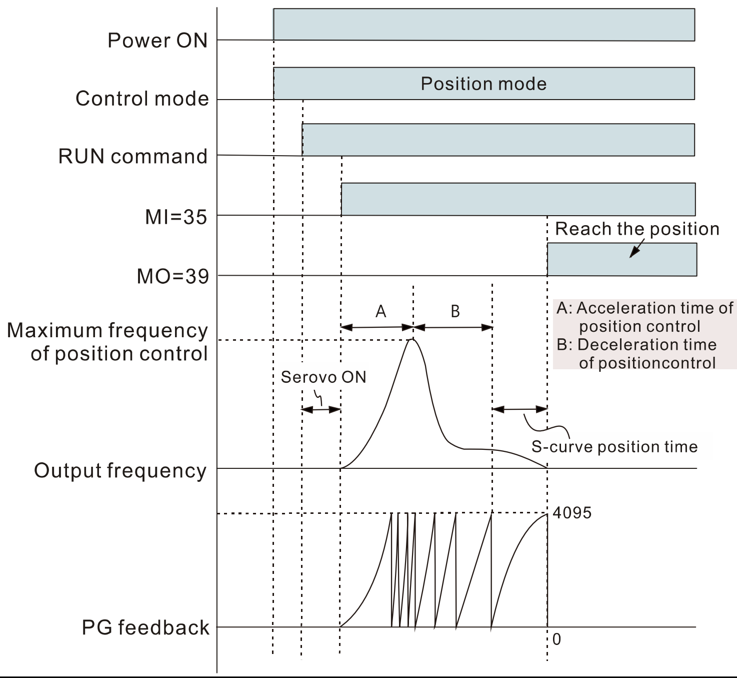
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>18</td><td>Forced to Stop (Pr.07-20)</td><td>ON: the drive ramps to stop according to the Pr.07-20 setting.</td></tr>
<tr><td>19</td><td>Frequency up command</td><td rowspan="2">ON: the frequency of the drive increases or decreases by one unit. If this function remains ON continuously, the frequency increases or decreases according to Pr.02-09 / Pr.02-10.
If the frequency command has to return to zero when the AC motor drive stops, then you should set Pr.11-00 bit7 = 1.</td></tr>
<tr><td>20</td><td>Frequency down command</td></tr>
<tr><td>21</td><td>PID function disabled</td><td>ON: the PID function is disabled.</td></tr>
<tr><td>22</td><td>Clear the counter</td><td>ON: the current counter value is cleared and displays 0. The drive counts up when this function is disabled.</td></tr>
<tr><td>23</td><td>Input the counter value (MI6)</td><td>On: the counter value increases by one. 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. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.</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. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.</td></tr>
<tr><td>26</td><td>TQC / FOC mode selection</td><td>ON: TQC mode.
OFF: FOC mode.


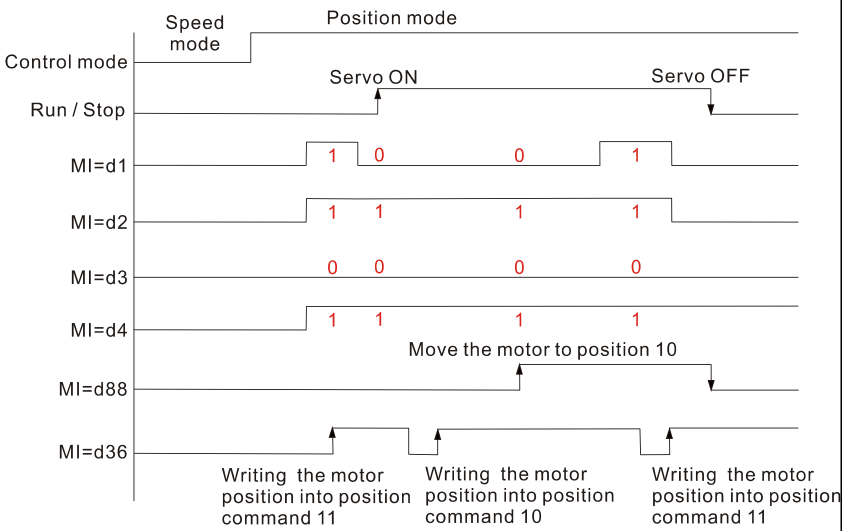
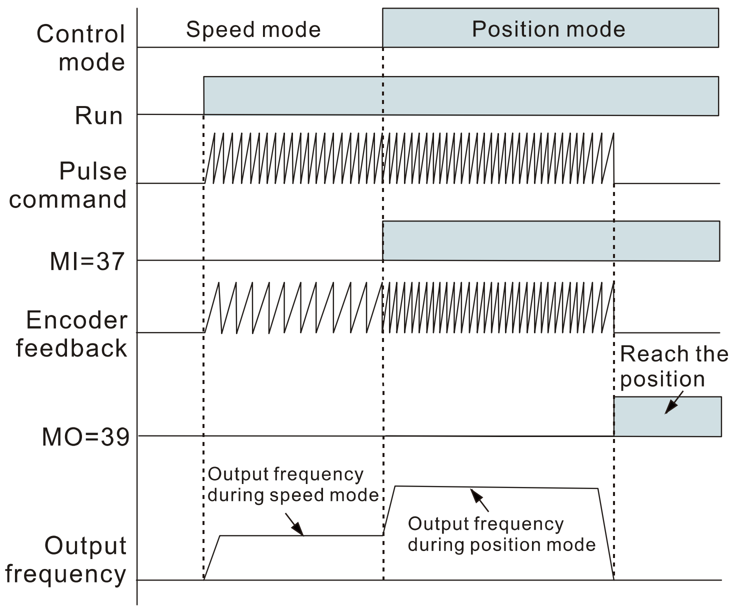
Switch timing for torque/speed control
(Pr.00-10 = 0/2, multi-function input terminal is set to 26)</td></tr>
<tr><td>27</td><td>ASR1 / ASR2 selection</td><td>ON: the speed is adjusted by the ASR 2 setting.
OFF: the speed is adjusted by the ASR 1 setting.
Refer to Pr.11-02 for details.</td></tr>
</table>

Settings	Functions	Descriptions
28	Emergency stop (EF1)	ON: the output of the drive stops immediately, displays "EF1" on the keypad, and the motor is in free run status. The drive keeps running until the fault is cleared after you press RESET on the keypad (EF: External Fault). 
29	Signal confirmation for Y-connection	When the control mode is V/F, ON: the drive operates by the first V/F.
30	Signal confirmation for Δ-connection	When the control mode is V/F, ON: the drive operates by the second V/F.
31	High torque bias (Pr.11-31)	
32	Middle torque bias (Pr.11-32)	Refer to Pr.11-30–Pr.11-32 for details.
33	Low torque bias (Pr.11-33)	
34	Switch between multi-step position and multi-speed control	When the contact is ON, the corresponding 15-step speed for the multi-function inputs 1-4 will be 15 positions. (Refer to Pr.04-16 to Pr.04-44) 

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td>
</td></tr>
<tr><td>35</td><td>Enable single-point positioning</td><td>ON: the AC motor drive executes the single-point positioning according to Pr.11-65 (single-point positioning position high byte) and Pr.11-66 (single-point positioning position low byte). This function is valid only for IMFOCPG and PMFOCPG control modes.

1. MI=35 (enable single-point positioning), MO=39 (position reached), Pr.10-01=1024 (encoder PPR), Pr.11-65=0 and Pr.11-66=0
In speed control mode (Pr.00-10=0), activate MI=35 (enable single-point positioning), the motor is positioned according to Pr.11-65 and Pr.11-66 settings. See the diagram below:

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

Settings	Functions	Descriptions
		2. MI=35 (enable single-point positioning), MO=39 (position reached), Pr.10-01=1024 (encoder PPR), Pr.11-65=0 and Pr.11-66=3072 In position control mode (Pr.00-10=1), activate MI=35 (enable single-point positioning), the motor runs from the current single revolution position to Pr.11-65 and Pr.11-66 setting positions and the moving position does not exceed one revolution if single revolution coordinate system is finished. See the diagram below:  3. MI=35 (enable single-point positioning), MO=39 (position reached), Pr.10-01=1024 (encoder PPR), Pr.11-65=0 and Pr.11-66=0 In position control mode (Pr.00-10=1), activate MI=35 (enable single-point positioning), the motor runs through the z-phase to finish single revolution coordinate system before executing single-point positioning function if single revolution coordinate system is not finished. See the diagram below: 

Settings	Functions	Descriptions
36	Enable multi-step position teaching function	Multi-step position teaching function can execute no matter the motor drive is RUN or STOP. ON / OFF: the drive determines the corresponding multi-step positions according to MI1–MI4 ON / OFF status, and the motor's current positions are written into these corresponding multi-step positions. 
37	Enable pulse-train command position command	ON: The drive automatically switches to position mode and the position command source is pulse-train input. 
38	Disable writing EEPROM function	ON: writing to EEPROM is disabled. Changed parameters are not saved after power off.
39	Torque command direction	For torque control (Pr.00-10 = 2), when the torque command is AVI or ACI, ON: negative torque.
40	Force coasting to stop	ON: during operation, the motor coasts to stop.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></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 optional keypad KPC-CC01 to switch between HAND and AUTO. The drive stops first, and then switches to HAND or AUTO status.
3. The optional 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>
<tr><td>43</td><td>Enable resolution selection</td><td>Refer to Pr.02-48 for details.</td></tr>
<tr><td>44</td><td>Negative limit switch (NL)</td><td>Signal input for negative limit switch (NL).
ON: The drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>45</td><td>Positive limit switch (PL)</td><td>Signal input for positive limit switch (PL).
ON: The drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>46</td><td>Homing (ORG)</td><td>Origin point input.
ON: The drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>47</td><td>Homing function enabled</td><td>When this terminal is active in position control mode (Pr.00-10=1), the drive executes homing based on Pr.11-68–Pr.11-74 settings.</td></tr>
<tr><td>48</td><td>Mechanical gear ratio switch</td><td>ON: The mechanical gear ratio switches to the second set of settings (refer to Pr.10-04–Pr.10-07).
OFF: Pr.10-04 and Pr.10-05 (the first set of settings)
ON: Pr.10-06 and Pr.10-07 (the second set of settings)</td></tr>
<tr><td>49</td><td>Drive enabled</td><td>When the drive is enabled, the RUN command is valid.
When the drive is disabled, the RUN command is invalid.
When the drive is operating, the motor coasts to stop.
This function varies with 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 ensures that the slave also triggers dEb, then the master and slave stop simultaneously.</td></tr>
</table>

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>51</td><td>Selection for PLC mode (bit 0)</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 (bit 1)</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 Chapter 15 CANopen overview for more details.</td></tr>
<tr><td>55</td><td>Brake released signal</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>bit0</td></tr><tr><td>REM</td><td>0</td></tr><tr><td>LOC</td><td>1</td></tr></table></td></tr>
</table>

02-09 External UP / DOWN Key Mode

Default: 0

Settings 0: By the acceleration / deceleration time

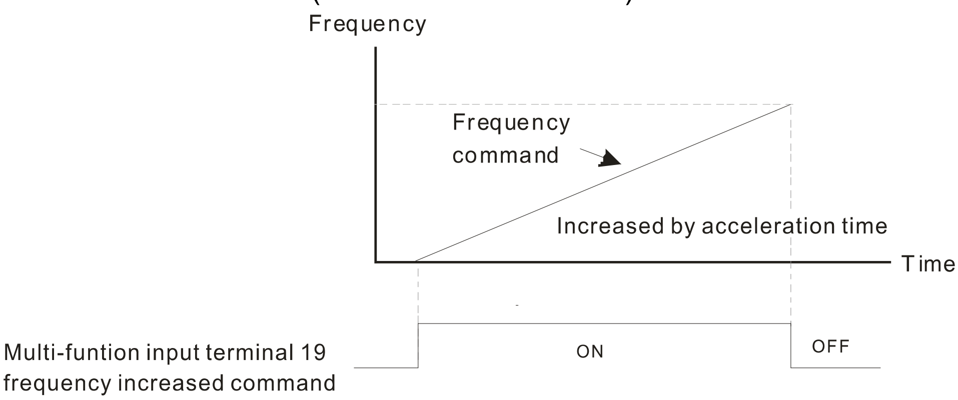
1: Constant speed (Pr.02-10)

02-10 Acceleration / Deceleration Speed of External UP / DOWN Key

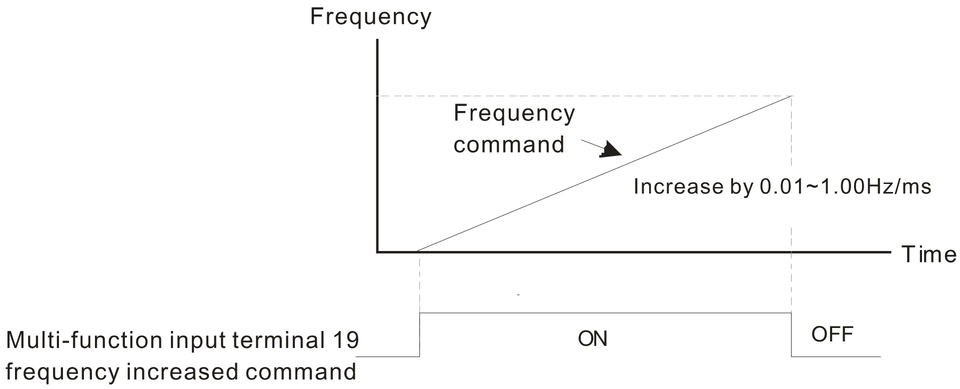
Default: 0.001

Settings 0.001–1.000 Hz / ms

- Use when the multi-function input terminals are set to 19, 20 (Frequency UP / DOWN command). The frequency increases or decreases according to Pr.02-09 and Pr.02-10.
- When Pr.11-00 bit 7=1, the frequency is not saved. The Frequency command returns to zero when the drive stops, and the displayed frequency is 0.00 Hz. At this time, increasing or decreasing the Frequency command (F) by using the UP or DOWN key is valid only when the drive is running.
- 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.01-12–01-19).



- When Pr.02-09 is set to 1:
  The increasing or decreasing Frequency command (F) operates according to the setting of 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.

- Use this parameter to set 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. But in the meanwhile, it delays the response time though confirmation improves accuracy.
- When using MI8 as encoder pulse feedback input, this parameter is not referred.

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: normally open; 1: normally closed) and it is not affected by the status of SINK / SOURCE.
- bit2–bit15 correspond to MI1–MI14
- The default for bit 0 (MI1) is FWD terminal, and the default for bit 1 (MI2) is REV terminal. You cannot use this parameter to change the input mode when Pr.02-00 ≠ 0.
- You can change the terminal ON / OFF status through communications.
  For example: MI1 is set to 1 (multi-step speed command 1) and MI2 is set to 2 (multi-step speed command 2). Then the forward + second step speed command = $1001_2 = 9_{10}$.
  As long as Pr.02-12 = 9 is set through communications, there is no need to wire any multi-function terminal to run forward with the second step speed.

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
MI14	MI13	MI12	MI11	MI10	MI9	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1		

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

✓	**02-13**	Multi-Function Output 1 (Relay1)

Default: 11

✓	**02-14**	Multi-Function Output 2 (Relay2)

Default: 1

✓	**02-16**	Multi-Function Output 3 (MO1)

Default: 66

✓	**02-17**	Multi-Function Output 4 (MO2)
✓	**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 (MO12) or (RA12)
✓	**02-39**	Output Terminal of I/O Extension Card (MO13) or (RA13)
✓	**02-40**	Output Terminal of I/O Extension Card (MO14) or (RA14)
✓	**02-41**	Output Terminal of I/O Extension Card (MO15) or (RA15)
✓	**02-42**	Output Terminal of I/O Extension Card (MO16)
✓	**02-43**	Output Terminal of I/O Extension Card (MO17)
✓	**02-44**	Output Terminal of I/O Extension Card (MO18)
✓	**02-45**	Output Terminal of I/O Extension Card (MO19)
✓	**02-46**	Output Terminal of I/O Extension Card (MO20)

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: Overheat 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 indication
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: Δ-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)
39: Position reached (Pr.10-19)
40: Speed reached (including Stop)
41: Multi-position attained
42: Crane function
43: Motor actual speed detection
44: Low current output (use with Pr.06-71–06-73)
45: UVW output electromagnetic valve switch
46: Master dEb warning output
47: Closed brake output
49: Homing action completed
50: Output control for CANopen
51: Analog output control for RS-485 interface (InnerCOM / Modbus)
52: Output control for communication cards
65: Output control for both CANopen and RS485
66: SO output logic A
67: Analog input level reached
68: SO output logic B

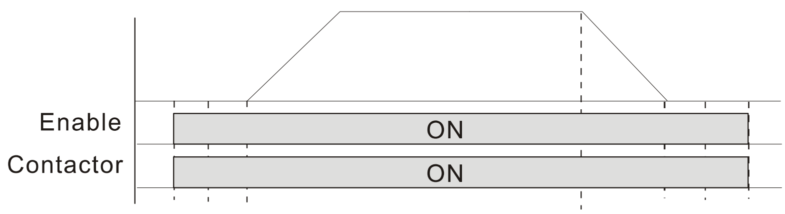
- Use this parameter to set the function of multi-function terminals.
- Pr.02-36–Pr.02-41 requires additional extension cards to display the parameters, the choices of optional cards are EMC-D42A and EMC-R6AA.
- The optional card EMC-D42A provides two output terminals, use with Pr.02-36–Pr.02-37.
- The optional card EMC-R6AA provides six output terminals, use with Pr.02-36–Pr.02-41.

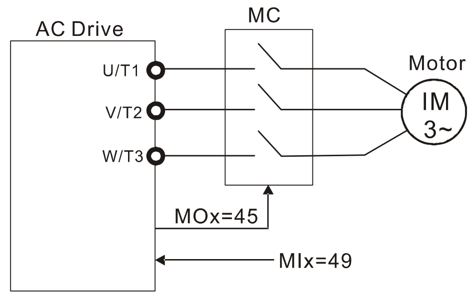
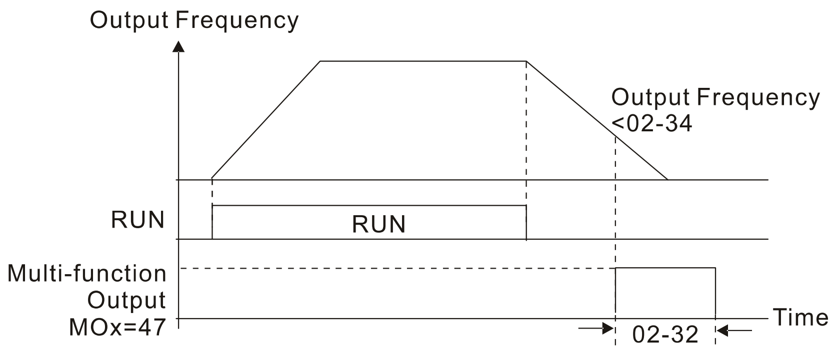
Summary of function settings

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

Settings	Functions	Descriptions
0	No Function	
1	Indication during RUN	Activate when the drive is not in STOP.
2	Operation speed reached	Activate when output frequency of the drive reaches the setting frequency.
3	Desired Frequency reached 1 (Pr.02-22)	Activate when the desired frequency (Pr.02-22) is reached
4	Desired Frequency reached 2 (Pr.02-24)	Activate when the desired frequency (Pr.02-24) is reached.
5	Zero Speed (frequency command)	Activate when frequency command =0 (the drive must be in RUN status)
6	Zero speed, including STOP (Frequency command)	Activate when frequency command =0 or stopped.
7	Over-torque 1	Activate when the drive detects over-torque. Pr.06-07 sets the over-torque detection level (motor 1), and Pr.06-08 sets the over-torque detection time (motor 1). Refer to Pr.06-06–06-08.
8	Over-torque 2	Activate when the drive detects over-torque. Pr.06-10 sets the over-torque detection level (motor 2), and Pr.06-11 sets the over-torque detection time (motor 2). Refer to Pr.06-09–06-11.
9	Drive is ready	Activate when the drive is ON and with no error detected.
10	Low voltage warning (Lv)	Activate when the DC bus voltage is too low. (refer to Pr.06-00 Low Voltage Level)
11	Malfunction indication	Activate when fault occurs (except Lv stop).
12	Mechanical brake release (Pr.02-32)	Activate when the drive runs after the set delayed time for Pr.02-32. This function must be used with DC brake function.
13	Overheat warning	Activate 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	Activate when the soft brake function is ON. (refer to Pr.07-00)
15	PID feedback error	Activate when the PID feedback signal error is detected.
16	Slip error (oSL)	Activate when the slip error is detected.
17	Count value reached, does not return to 0 (Pr.02-20)	Activate 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.

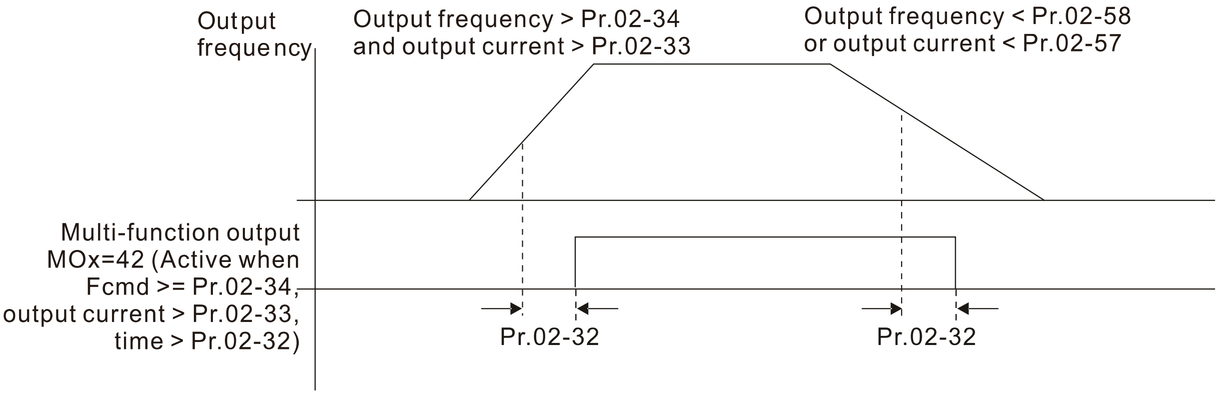
Settings	Functions	Descriptions
18	Count value reached, returns to 0 (Pr.02-19)	Activate when the drive executes the external counter, this contact is active if the count value is equal to the setting value for Pr.02-19.
19	External interrupt B.B. input (Base Block)	Activate when external interrupt (B.B.) stop output occurs in the drive.
20	Warning output	Activate when a warning is detected.
21	Over-voltage	Activate when over-voltage is detected. (Refer to chapter 14 for the action level of over-voltage)
22	Over-current stall prevention	Activate when over-current stall prevention is detected.
23	Over-voltage stall prevention	Activate when over-voltage stall prevention is detected.
24	Operation source	Activate when the operation command is not controlled by external terminal. (Pr.00-21≠0)
25	Forward Command	Activate when the operation direction is forward.
26	Reverse Command	Activate when the operation direction is reverse.
27	Output when current ≥ Pr.02-33	Activate when current is ≥ Pr.02-33.
28	Output when current < Pr.02-33	Activate when current is < Pr.02-33
29	Output when frequency ≥ Pr.02-34	Activate when frequency is ≥ Pr.02-34.
30	Output when frequency < Pr.02-34	Activate when frequency is < Pr.02-34.
31	Y-connection for the motor coil	Activate when Pr.05-24=1, when frequency output is lower than Pr.05-23 minus 2 Hz, and the time is longer than Pr.05-25.
32	Δ-connection for the motor coil	Activate when Pr.05-24=1, when frequency output is higher than Pr.05-23 plus 2 Hz, and the time is longer than Pr.05-25.
33	Zero speed (actual output frequency)	Activate when the actual output frequency is 0. (the drive is in RUN mode)
34	Zero speed including stop (actual output frequency)	Activate when the actual output frequency is 0 or stopped.
35	Error output selection 1 (Pr.06-23)	Activate when Pr.06-23 is ON.
36	Error output selection 2 (Pr.06-24)	Activate when Pr.06-24 is ON.
37	Error output selection 3 (Pr.06-25)	Activate when Pr.06-25 is ON.

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>38</td><td>Error output selection 4 (Pr.06-26)</td><td>Activate when Pr.06-26 is ON.</td></tr>
<tr><td>39</td><td>Position reached (Pr.11-65, Pr.11-66)</td><td>Activate when the position control point reaches Pr.11-65, Pr.11-66.</td></tr>
<tr><td>40</td><td>Speed reached (including speed)</td><td>Activate when the output frequency reaches the setting frequency or stopped.</td></tr>
<tr><td>41</td><td>Multi-position reached</td><td>User can set any three multi-function input terminals to 41. The current position action status of these three terminals will be outputted. Example: if setting Pr.02-36~02-38 to 41 and only the multi-position of the second point has been done. Therefore, current status is RA (ON), RA (OFF) and MO1 (OFF). In this way, their status is 010. Bit0 is RA and so on.
<table>
<tr><th></th><th>MO2
Pr.02-17=41</th><th>MO1
Pr.02-16=41</th><th>RY2
Pr.02-14=41</th><th>RY1
Pr.02-13=41</th></tr>
<tr><td>Pr.04-16</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pr.04-18</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-20</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Pr.04-22</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Pr.04-24</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>Pr.04-26</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-28</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Pr.04-30</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Pr.04-32</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pr.04-34</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-36</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Pr.04-38</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Pr.04-40</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>Pr.04-42</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>Pr.04-44</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table></td></tr>
<tr><td>42</td><td>Crane function</td><td>Use this function with Pr.02-32, Pr.02-33, Pr.02-34, Pr.02-57 and Pr.02-58.
Refer to the crane function examples below.</td></tr>
<tr><td>43</td><td>Motor actual speed detection</td><td>Activate when motor actual speed is less than Pr.02-47.</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>
</table>

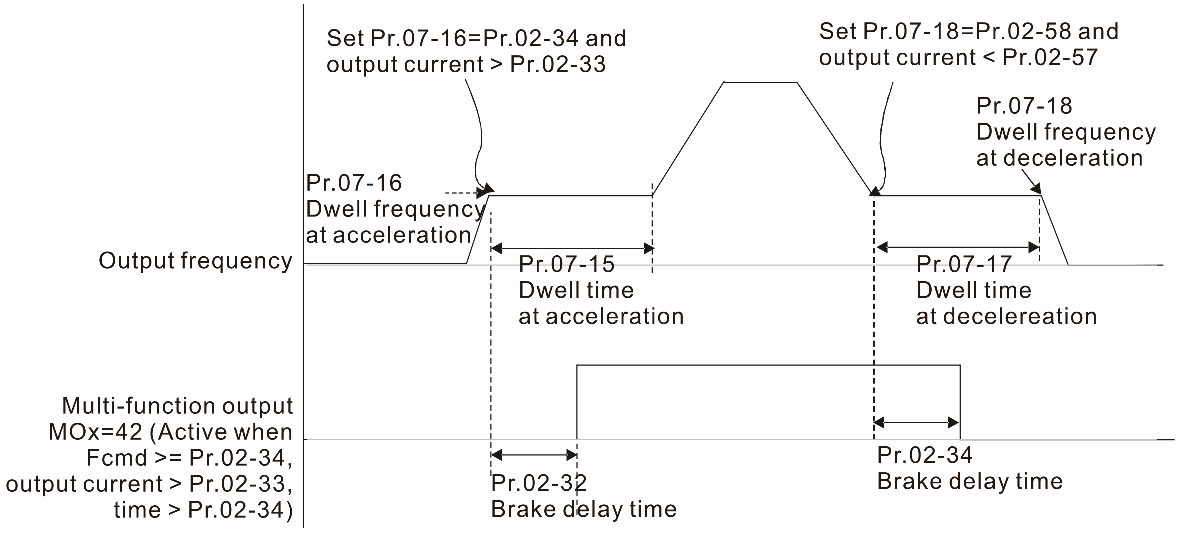
<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td></td><td></td><td>
</td></tr>
<tr><td>46</td><td>Master dEb output</td><td>When dEb rises at the master, MO sends a dEb signal to the slave. Output the message when the master triggers dEb. This ensures that the slave also triggers dEb. Then slave follows the deceleration time of the master to stop simultaneously with the master.</td></tr>
<tr><td>47</td><td>Closed brake output</td><td>When drive stops, and the frequency command < Pr.02-34, the contact of corresponding multi-function terminal is ON. The contact is OFF when the brake delay time exceeds Pr.02-32.

</td></tr>
<tr><td>49</td><td>Homing action completed</td><td>Activate when homing action is completed.</td></tr>
<tr><td>50</td><td>Output control for CANopen</td><td>Control the 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>MO1</td><td>Pr.02-16 = 50</td><td>RW</td><td>The bit3 at 2026-41</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 50</td><td>RW</td><td>The bit4 at 2026-41</td></tr>
<tr><td>MO10</td><td rowspan="2">Pr.02-36 = 50</td><td rowspan="2">RW</td><td>The bit5 at 2026-41</td></tr>
<tr><td>RY10</td><td>The bit5 at 2026-41</td></tr>
<tr><td>MO11</td><td rowspan="2">Pr.02-37 = 50</td><td rowspan="2">RW</td><td>The bit6 at 2026-41</td></tr>
<tr><td>RY11</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 (InnerCOM / Modbus)</td><td>For RS-485 interface (InnerCOM / Modbus) 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>bit0 at 2640H</td></tr>
<tr><td>RY2</td><td>Pr.02-14 = 51</td><td>RW</td><td>bit1 at 2640H</td></tr>
<tr><td>MO1</td><td>Pr.02-16 = 51</td><td>RW</td><td>bit3 at 2640H</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 51</td><td>RW</td><td>bit4 at 2640H</td></tr>
<tr><td>MO10 or RA10</td><td>Pr.02-36 = 51</td><td>RW</td><td>bit5 at 2640H</td></tr>
<tr><td>MO11 or RA11</td><td>Pr.02-37 = 51</td><td>RW</td><td>bit6 at 2640H</td></tr>
<tr><td>RA12</td><td>Pr.02-38 = 51</td><td>RW</td><td>bit7 at 2640H</td></tr>
<tr><td>RA13</td><td>Pr.02-39 = 51</td><td>RW</td><td>bit8 at 2640H</td></tr>
<tr><td>RA14</td><td>Pr.02-40 = 51</td><td>RW</td><td>bit9 at 2640H</td></tr>
<tr><td>RA15</td><td>Pr.02-41 = 51</td><td>RW</td><td>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 Address</th></tr>
<tr><td>RY1</td><td>Pr.02-13 = 52</td><td>RW</td><td>The bit0 of 2640H</td></tr>
<tr><td>RY2</td><td>Pr.02-14 = 52</td><td>RW</td><td>The bit1 of 2640H</td></tr>
<tr><td>MO1</td><td>Pr.02-16 = 52</td><td>RW</td><td>The bit3 of 2640H</td></tr>
<tr><td>MO2</td><td>Pr.02-17 = 52</td><td>RW</td><td>The bit4 of 2640H</td></tr>
<tr><td>MO10 or RA10</td><td>Pr.02-36 = 51</td><td>RW</td><td>The bit5 of 2640H</td></tr>
<tr><td>MO11 or RA11</td><td>Pr.02-37 = 51</td><td>RW</td><td>The bit6 of 2640H</td></tr>
<tr><td>RA12</td><td>Pr.02-38 = 51</td><td>RW</td><td>The bit7 of 2640H</td></tr>
<tr><td>RA13</td><td>Pr.02-39 = 51</td><td>RW</td><td>The bit8 of 2640H</td></tr>
<tr><td>RA14</td><td>Pr.02-40 = 51</td><td>RW</td><td>The bit9 of 2640H</td></tr>
<tr><td>RA15</td><td>Pr.02-41= 51</td><td>RW</td><td>The bit10 of 2640H</td></tr>
</table></td></tr>
<tr><td>65</td><td>Output for both CANopen and RS-485</td><td>To control output of CANopen & InnerCOM internal communication.</td></tr>
<tr><td>66</td><td>SO output logic A (N.O.)</td><td rowspan="2">
<table>
<tr><th rowspan="2">Status of the drive</th><th colspan="2">Status of safety output</th></tr>
<tr><th>Status A (MOx=66)</th><th>Status B (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 input channels (AVI, ACI and AUI) to be compared.
Pr.03-45: The high level for the analog input, default is 50%.
Pr.03-46: The low level for the analog input, default is 10%.
If analog input > Pr.03-45, the multi-function output terminal operates. If analog input < Pr.03-46, the multi-function output terminal stops output.</td></tr>
</table>

Example: Crane Application



It is recommended to be used with Dwell function as shown in the following:



📖 When using the crane application and MOx = 42, Pr.02-34 must be larger than Pr.02-58; Pr.02-33 must be larger than Pr.02-57.

✓ 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 a 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 the 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	MO2	MO1	Reserved	RY2	RY1

02-19 Terminal Counting Value Reached (Returns 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). Pr.02-19 cannot be set to 0 at this time.

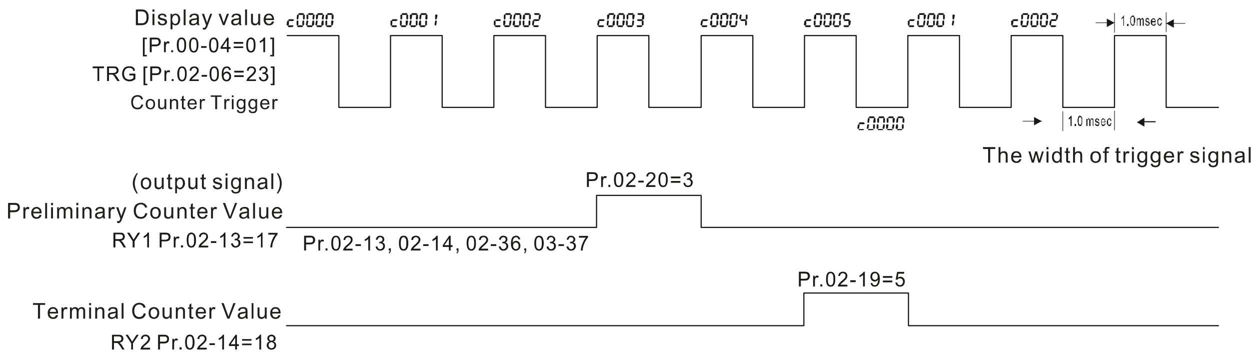
  Example: When the displayed value is c5555, the drive count is 5,555 times. If the displayed value is c5555•, the actual count value is 55,550–55,559.

02-20 Preliminary Counting Value Reached (Does Not Return to 0)

Default: 0

Settings 0–65500

- When the counter 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.



02-21 Digital Output Gain (DFM)

Default: 1

Settings 1–166

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

02-22 Desired Frequency Reached 1

Default: 60.00 / 50.00

Settings 0.00–599.00 Hz

02-23 The Width of the Desired Frequency Reached 1

Default: 2

Settings 0.00–599.00 Hz

02-24 Desired Frequency Reached 2

Default: 60.00 / 50.00

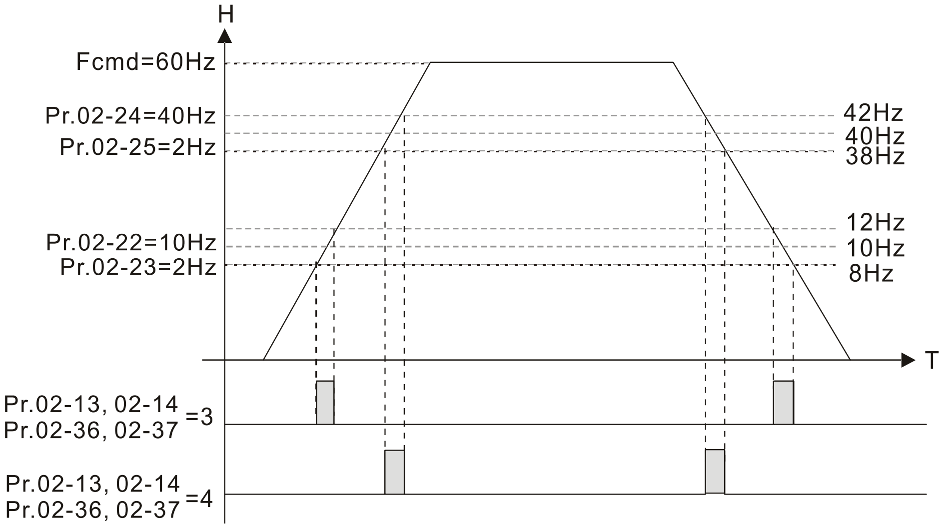
Settings 0.00–599.00 Hz

02-25 The Width of the Desired Frequency Reached 2

Default: 2.00

Settings 0.00–599.00 Hz

📖 Once the output speed (frequency) reaches 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".

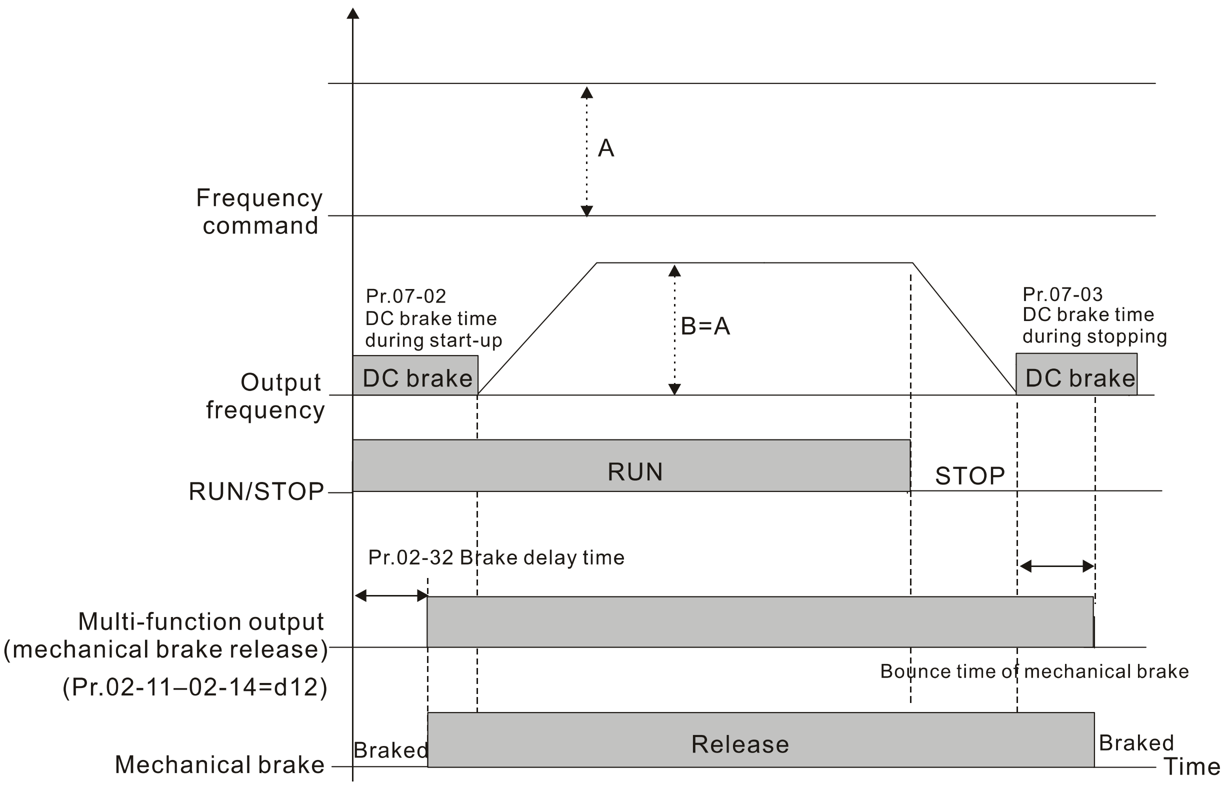


02-32 Brake Delay Time

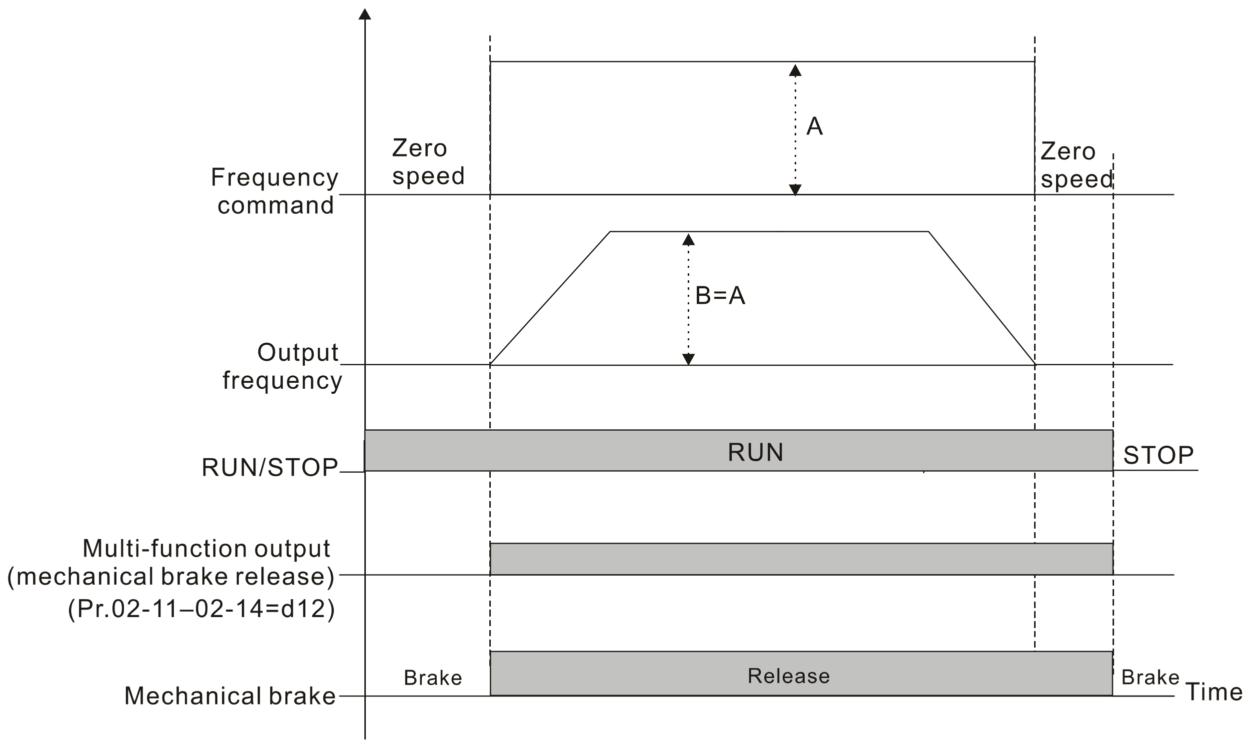
Default: 0.000

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". This 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 Terminal

Default: 0

Settings 0–100%

📖 When the drive outputs current higher than or equal to Pr.02-33 (≥ Pr.02-33), the multi-function output parameters active (Pr.02-13, Pr.02-14, Pr.02-16, and Pr.02-17 are set to 27).

📖 When the drive outputs current lower than Pr.02-33 (< Pr.02-33), the multi-function output parameters active (Pr.02-13, Pr.02-14, Pr.02-16, and Pr.02-17 are set to 28).

02-34 Output Frequency Setting for Multi-Function Output Terminal

Default: 3.00

Settings 0.00–599.00 Hz
(as motor speed when using PG Card)

📖 When the drive outputs frequency higher than or equal to Pr.02-34 (actual output frequency H ≥ Pr.02-34), the multi-function terminals activate (Pr.02-13, Pr.02-14, Pr.02-16 and Pr.02-17 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 activate (Pr.02-13, Pr.02-14, Pr.02-16 and Pr.02-17 are set to 30).

02-35 External Operation Control Selection after Reset and Reboot

Default: 0

Settings 0: Disabled
1: Drive runs if the RUN command remains after reset or reboot

Setting 1: **The drive automatically executes the RUN command under the following circumstances, pay extra attention on this.**

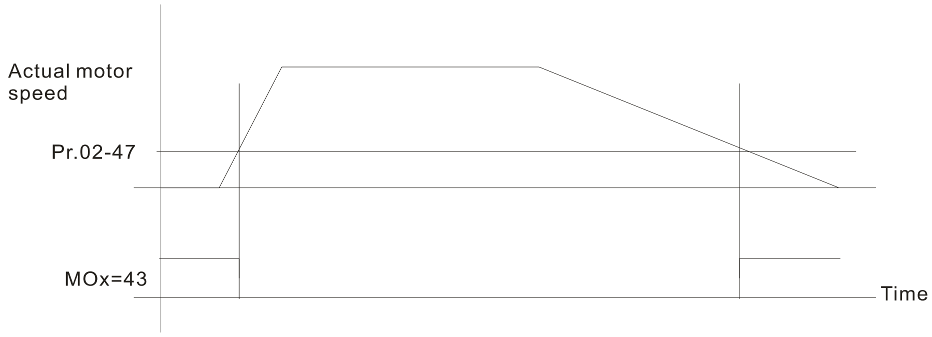
- Status 1: After the drive is **powered on** and **the external terminal for RUN stays ON**, the drive runs.
- Status 2: After clearing a fault once a fault is detected and the external terminal for RUN stays ON, you can run the drive by pressing the RESET key.

02-47 Motor Zero-Speed Level

Default: 0

Settings 0–65535 rpm

- Use this parameter with the multi-function output terminals (set to 43). The motor needs to install encoder to feedback the actual rotating speed and use with PG card.
- Use this parameter to set the level of motor at zero-speed. When the speed is lower than this setting, the corresponding multi-function output terminal that is set to 43 is ON (default), as shown below:



02-48 Maximum Frequency of Resolution Switch

Default: 60.00

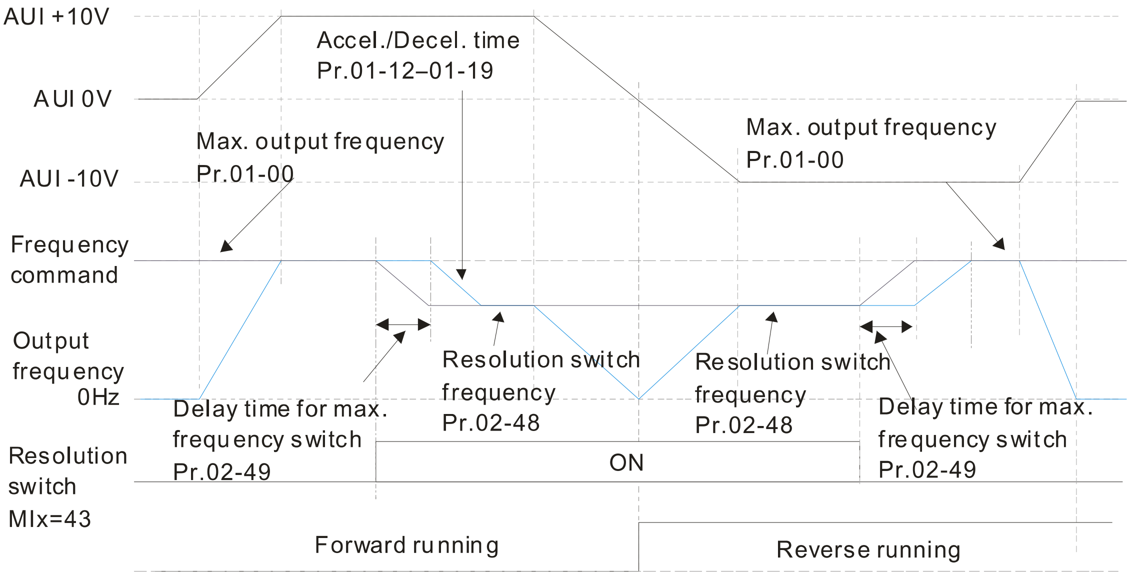
Settings 0.00–599.00 Hz

02-49 Switch Delay Time of Maximum Output Frequency

Default: 0.000

Settings 0.000–65.000 sec.

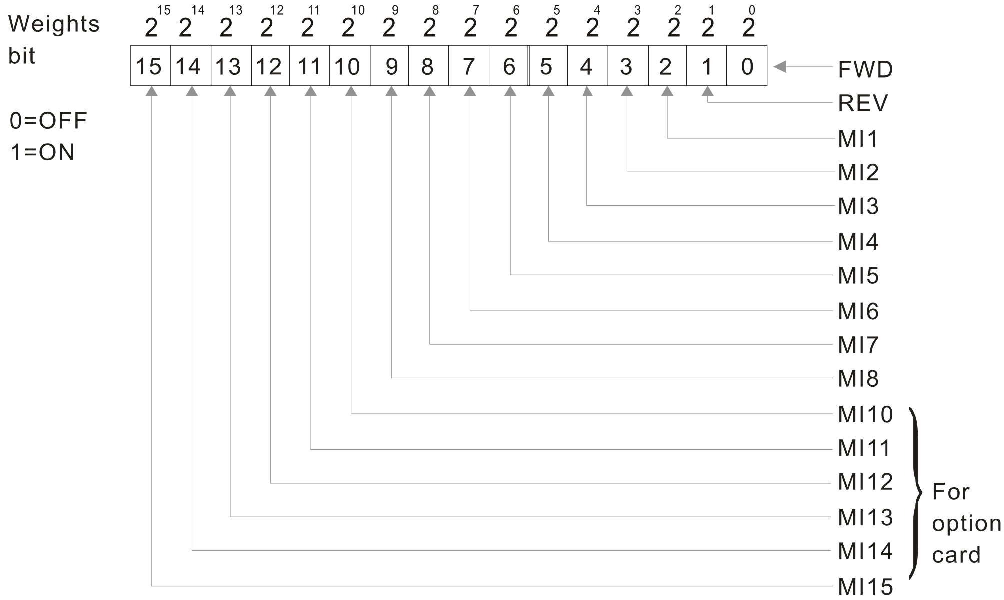
- Use this parameter to improve unstable speed or unstable position due to insufficient analog resolution. This function needs to be used with the external terminal (setting to 43). After setting this parameter, you also need to adjust the analog output resolution of the controller so as to work with the parameter function.



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

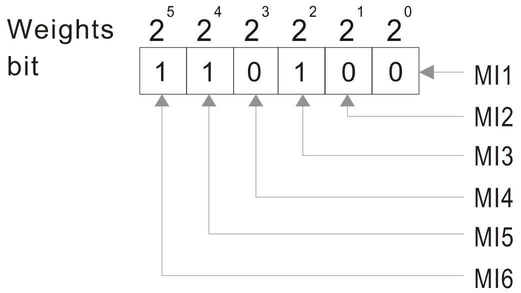
Default: Read only

Settings Monitor the status of multi-function input terminals



📖 Example:

When Pr.02-50 displays 0034h (hex) (that is, the value is 110100 (binary), it means that MI1, MI3 and MI4 are ON.



0=OFF
1=ON

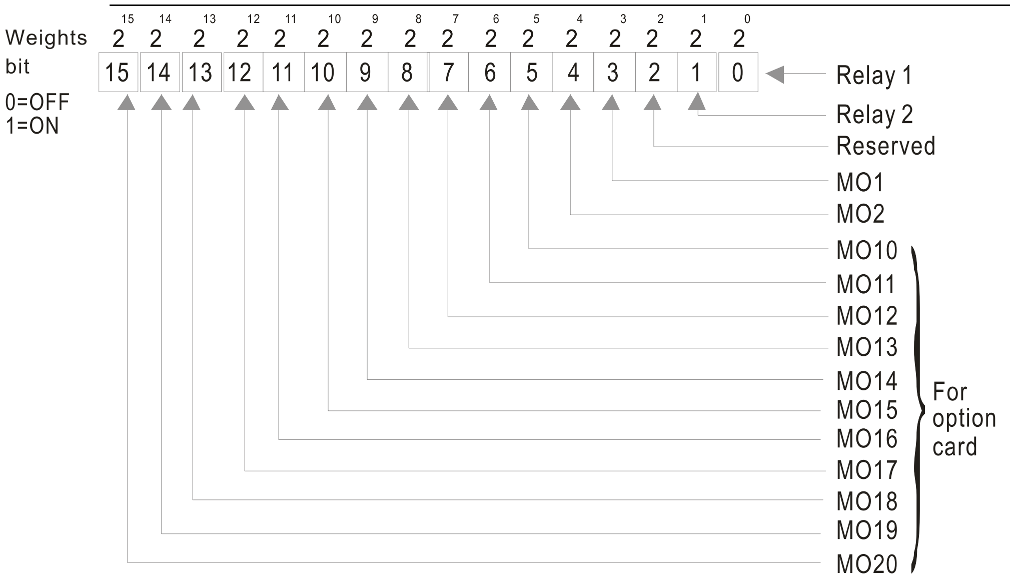
Settings
$= bit5x2^5+bit4x2^4+bit2x2^2$
$= 1x2^5+1x2^4+1x2^2$
$=32+16+4 \; =52$

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

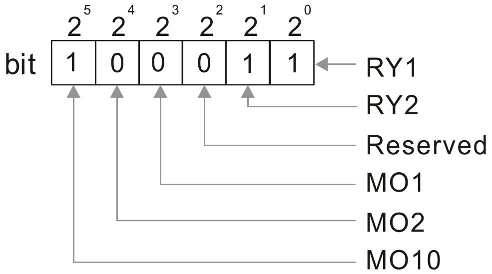
Settings Monitor the status of multi-function output terminals



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 0023h (hex) (that is, the value is 100011 (binary)), it means that RY1, RY2, and MO1 are ON.



0=OFF
1=ON
Settings
$=\text{bit5} \times 2^5 + \text{bit4} \times 2^4 + \text{bit2} \times 2^2$
$=1 \times 2^5 + 1 \times 2^1 + 1 \times 2^0$
$=32 + 2 + 1 = 35$

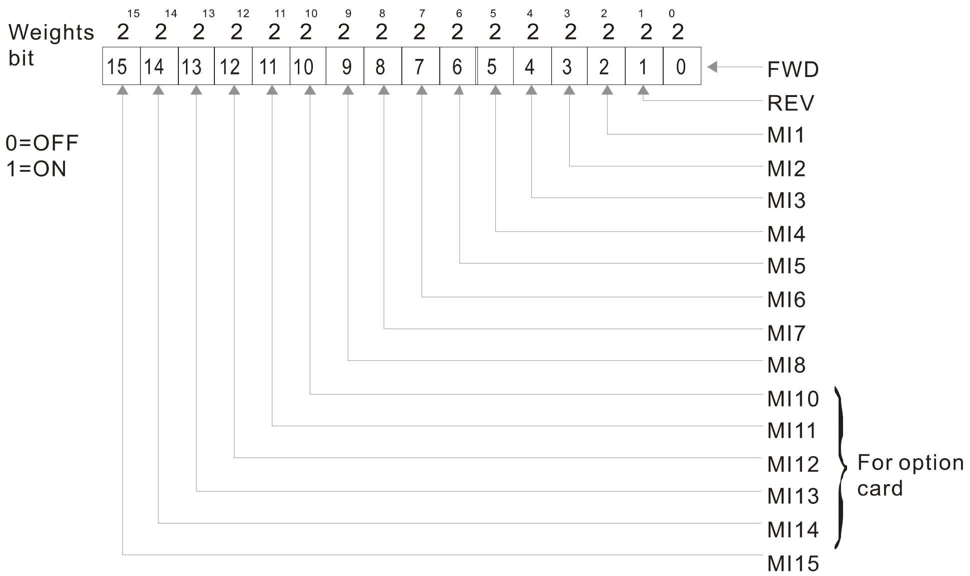
NOTE
$2^5=32$ $2^4=16$ $2^3=8$ $2^2=4$
$2^1=2$ $2^0=1$

02-52 Display the External Multi-Function Input Terminals Used by PLC

Default: Read only

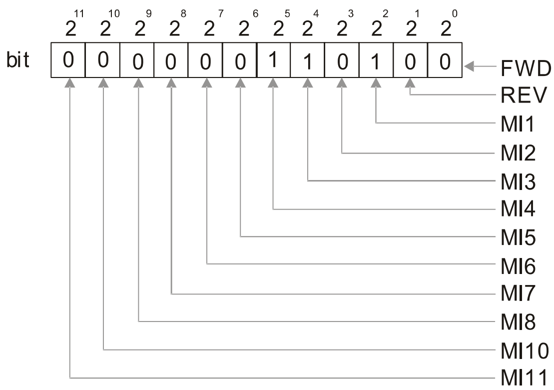
Settings Monitor the status of PLC input terminals

📖 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 that MI1, MI3 and MI4 are used by PLC.



0=Not used by PLC
1=Used by PLC
Display value
$=\text{bit5}\times2^5+\text{bit4}\times2^4+\text{bit2}\times2^2$
$=1\times2^5+1\times2^4+1\times2^2$
$=32+16+4=52$

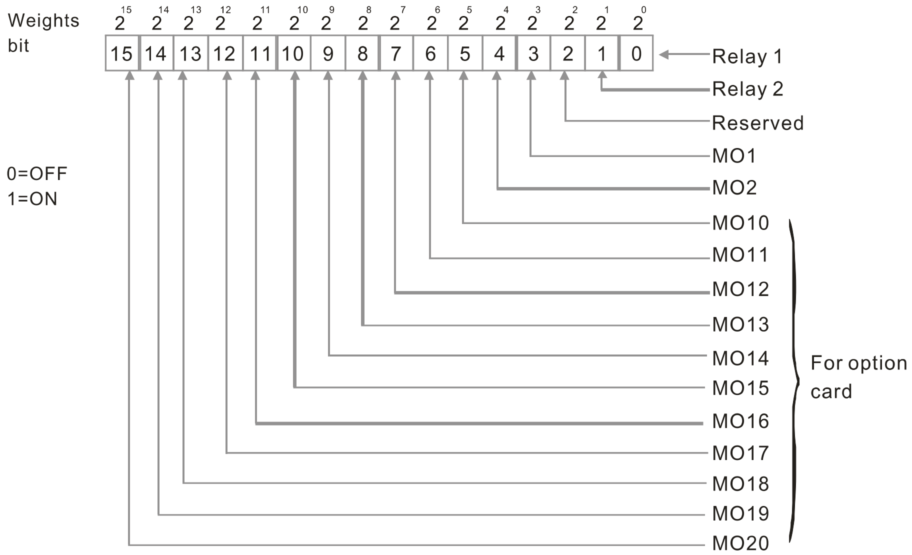
Note
$2^{14}=16384$ $2^{13}=8192$ $2^{12}=4096$
$2^{11}=2048$ $2^{10}=1024$ $2^9=512$
$2^8=256$ $2^7=128$ $2^6=64$
$2^5=32$ $2^4=16$ $2^3=8$
$2^2=4$ $2^1=2$ $2^0=1$

02-53 Display the External Multi-Function Output Terminals Used by PLC

Default: Read only

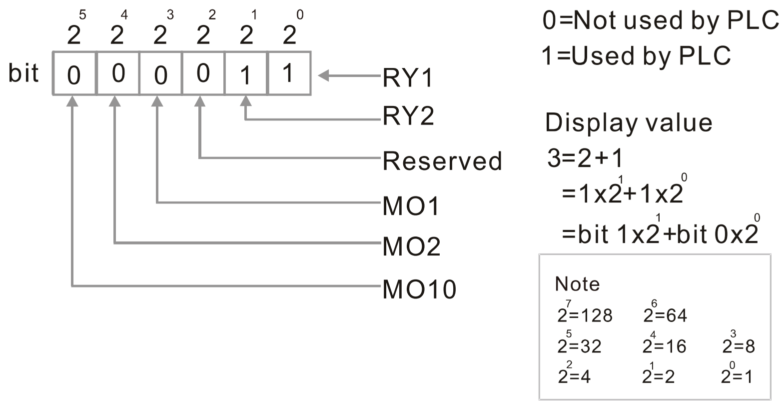
Settings Monitor the status of PLC output terminals

📖 Pr. 02-53 displays the external multi-function output terminal that used by PLC.



📖 Example:

When Pr.02-53 displays 0003h (hex) (that is, the value is 0011 (binary)), 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)

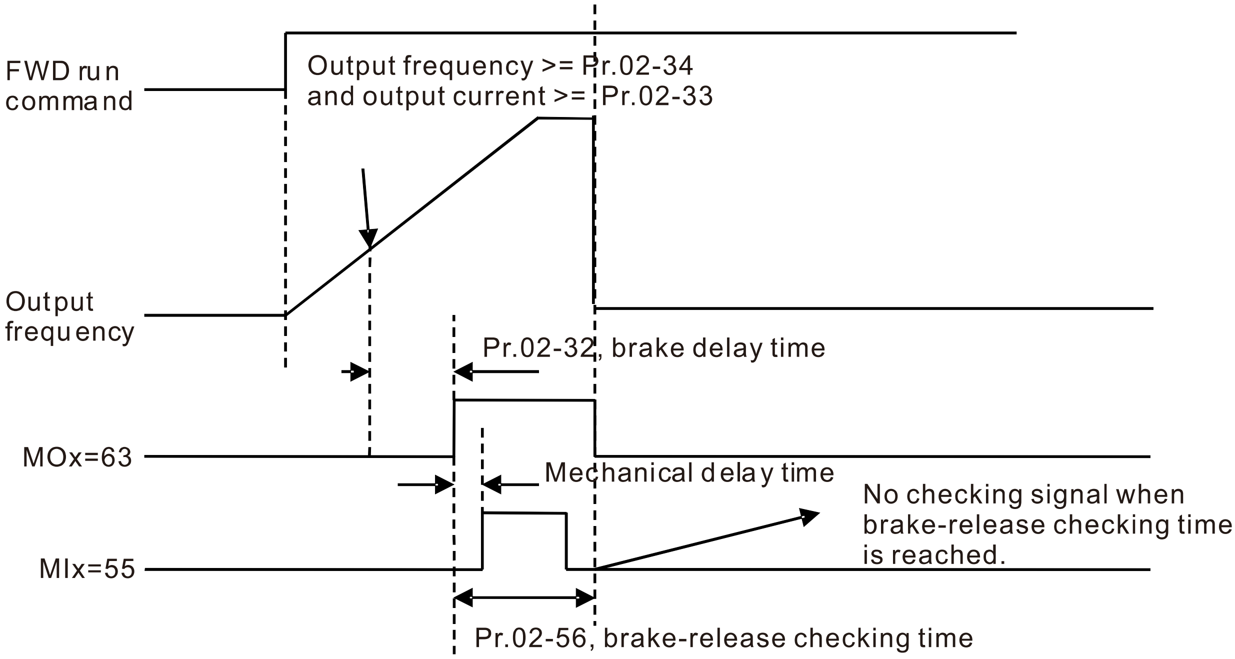
📖 When you set the source of the Frequency command as the external terminal, if Lv or Fault occurs, the external terminal Frequency command is saved in this parameter.

02-56 Brake Release Check Time

Default: 0.000

Settings 0.000–65.000 sec.

📖 Use Pr.02-56 with MIx=55 (brake release check). Sets for the time difference of mechanical brake delay time and actual brake operation.



02-57 Multi-Function Output Terminal (Function 42): Brake Current Check Point

Default: 0

Settings 0–100%

02-58 Multi-Function Output Terminal (Function 42): Brake Frequency Check Point

Default: 0.00

Settings 0.00–599.00 Hz

- Pr.02-32, Pr.02-33, Pr.02-34, Pr.02-57 and Pr.02-58 can be applied on setting up cranes. (Choose crane action #42 to set up multi-function output Pr.02-13, Pr.02-14, Pr.02-16 and Pr.02-17)
- When the drive outputs current higher than the setting for Pr.02-33 Pivot Point of the Current (≥ Pr.02-33), and outputs frequency higher than the setting for Pr.02-34 Pivot Point of the Frequency (≥ Pr.02-34), multi-function output Pr.02-13, Pr.02-14, Pr.02-16 and Pr.02-17 are set to 42 after the delay time setting for Pr.02-32.
- When the Pivot Point of the Current 's setting Pr.02-57≠0 and when the output current of the drive is lower than the setting for Pr.02-57 (< Pr.02-57), or the output frequency is lower than the setting for Pr.02-58 (< Pr.02-58), disable the setting #42 of the multi-function output Pr.02-13, Pr.02-14, Pr.02-16 and Pr.02-17
- When Pr.02-57 = 0, the output current is lower than the setting for Pr.02-33 Pivot Point of the current (< Pr.02-33), or the output frequency is lower than the setting for Pr.02-58 (< Pr.02-58), disable the setting of #42 of the multi-function output Pr.02-13, Pr.02-14, Pr.02-16 and Pr.02-17.
- When using crane application, and MOx=42, Pr.02-34 must be larger than Pr.02-58; and Pr.02-33 must be larger than Pr.02-57.

02-63 Frequency Reached Detection Amplitude

Default: 0.00

Settings 0.00–599.00 Hz

02-70 IO Card Types

Default: Read only

Settings 1: EMC-BPS01
4: EMC-D611A
5: EMC-D42A
6: EMC-R6AA
11: EMC-A22A

03 Analog Input / Output Parameter

✓ You can set this parameter during operation.

✓ **03-00** AVI Analog Input Selection

Default: 1

✓ **03-01** ACI Analog Input Selection

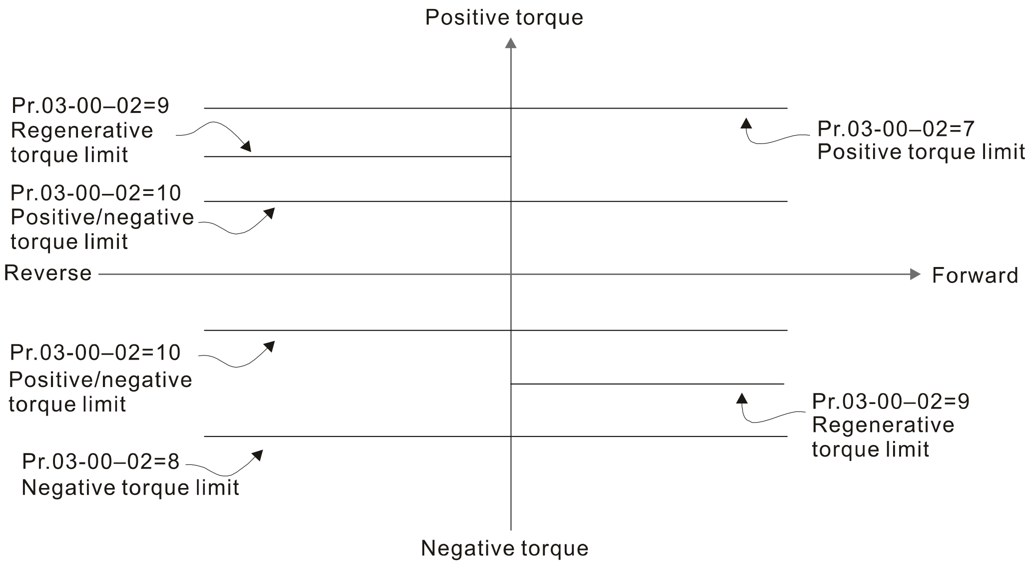
Default: 0

✓ **03-02** AUI Analog Input Selection

Default: 0

Settings 0: No function
1: Frequency command (torque limit under torque control mode)
2: Torque command (torque limit under speed mode)
3: Torque compensation command
4: PID target value
5: PID feedback signal
6: PTC thermistor input value
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive / negative torque limit
11: PT100 thermistor input value
13: PID Offset (%) (h.)

- When you use analog input as the PID reference target input, you must set Pr.00-20 to 2 (external analog input).
  Setting method 1: Pr.03-00–03-02 set 1 as Frequency command.
  Setting method 2: Pr.03-00–03-02 set 4 as PID reference target input.
  If the setting value 1 and setting value 4 exist at the same time, the AVI input has 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 using the Frequency command or TQC speed limit, the corresponding value for 0–±10 V / 4–20 mA is 0–maximum operation frequency (Pr.01-00).
- When using the torque command or torque limit, the corresponding value for 0–±10 V / 4–20 mA is 0–maximum output torque (Pr. 11-27).
- When using the torque compensation, the corresponding value for 0–±10 V / 4–20m A is 0–the motor's rated torque.
- The analog input AVI / ACI (use with Switch terminal to switch SW2 to 0–10V) supports KTY84. The AUI does not support this function.
- When you use KTY84, you can only choose either AVI or ACI at the same time. The AVI is prior to ACI.
- If the settings for Pr.03-00–Pr.03-02 are the same, the AVI input has highest priority.



03-03 AVI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

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

03-04 ACI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

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

03-05 AUI Analog Input Bias

Default: 0.0

Settings -100.0–100.0%

- Set the corresponding AUI 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.

03-07 AVI Positive / Negative Bias Mode
03-08 ACI Positive / Negative Bias Mode
03-09 AUI Positive / Negative Bias Mode

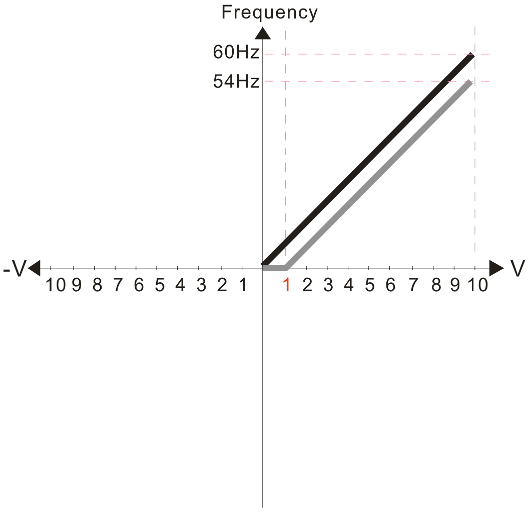
Default: 0

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

- Using negative bias to set the frequency greatly reduces the noise interference. In a noisy environment, do NOT use signals less than 1 V to set the drive's operation frequency.

In the diagram below: Black line: Curve with no bias. Gray line: curve with bias

Diagram 1



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

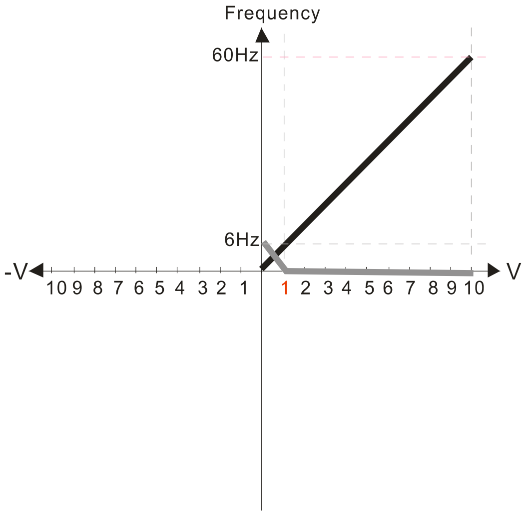
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI)= 100%

Diagram 2



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

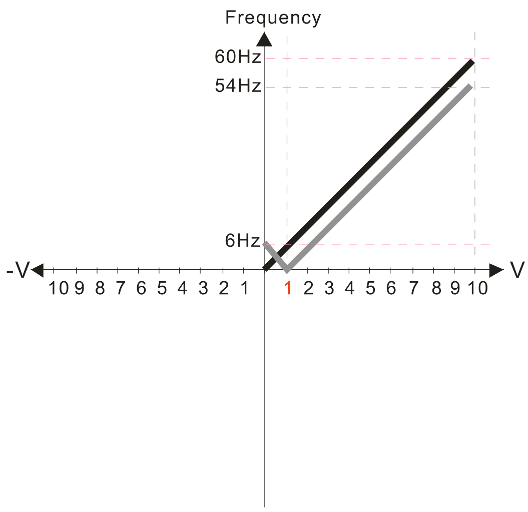
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI)=100%

Diagram 3



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

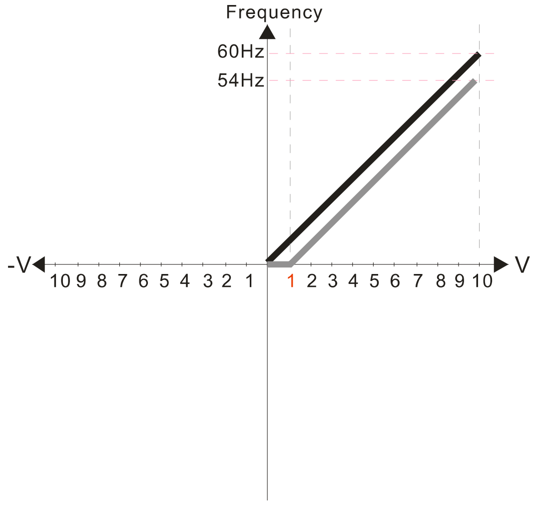
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI) = 100%

Diagram 4



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

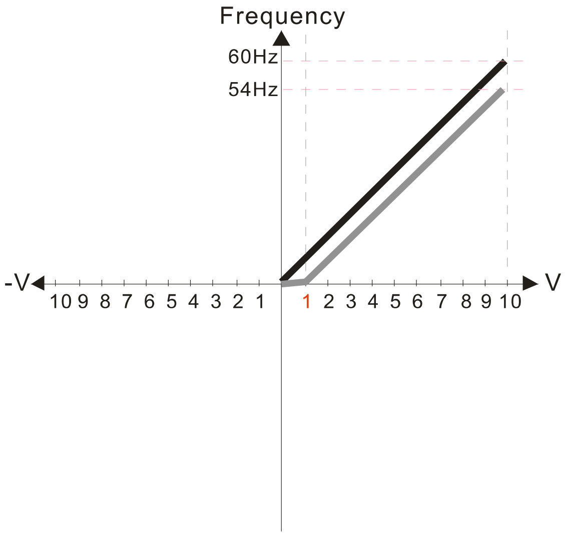
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI) = 100%

Diagram 5



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

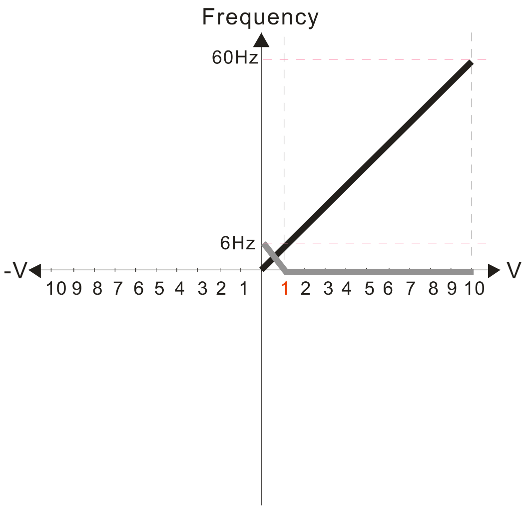
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI)= 100%

Diagram 6



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

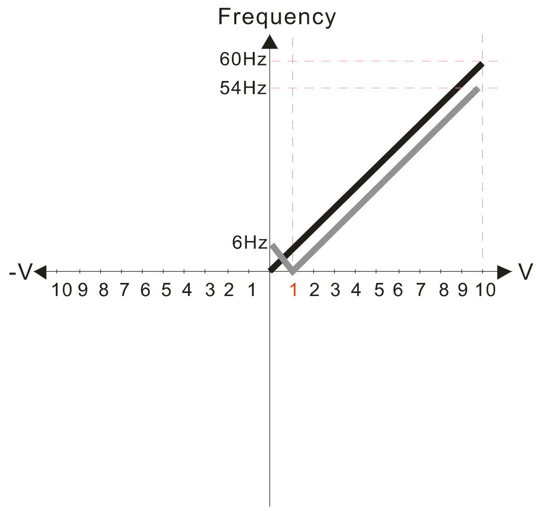
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI)= 100%

Diagram 7



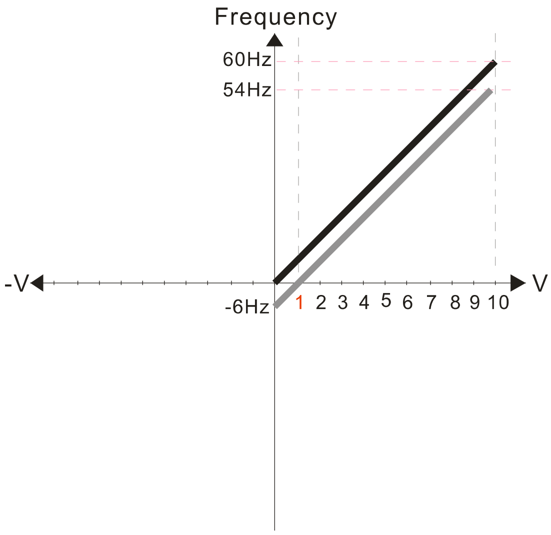
Pr.03-03=10%

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 (AVI) = 100%

Diagram 8



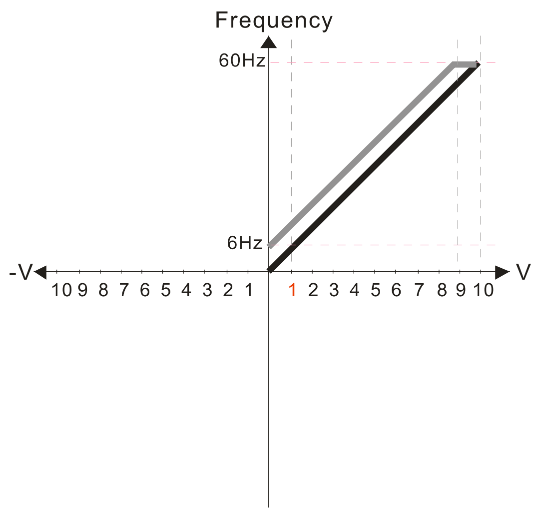
Pr.03-03=10%

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 (AVI) = 100%

Diagram 9



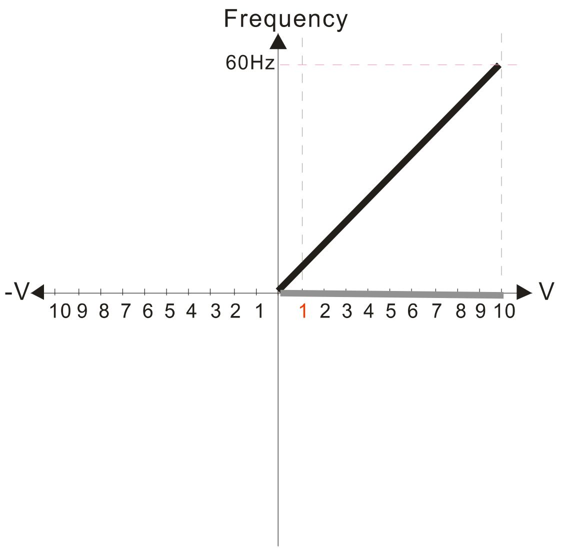
Pr.03-03=-10%

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)
- 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 (AVI)= 100%

Diagram 10



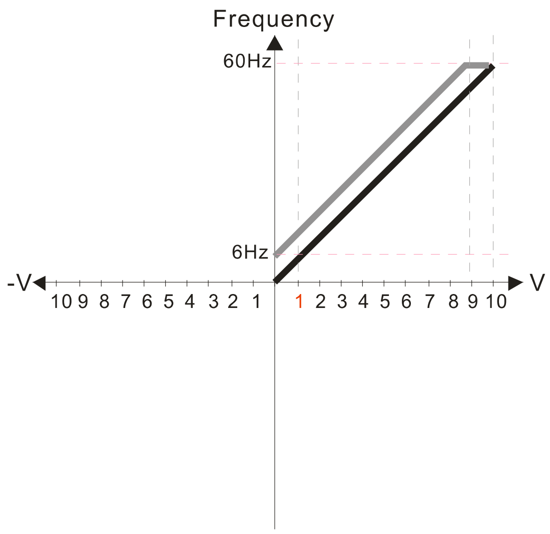
Pr.03-03=-10%

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 (AVI)= 100%

Diagram 11



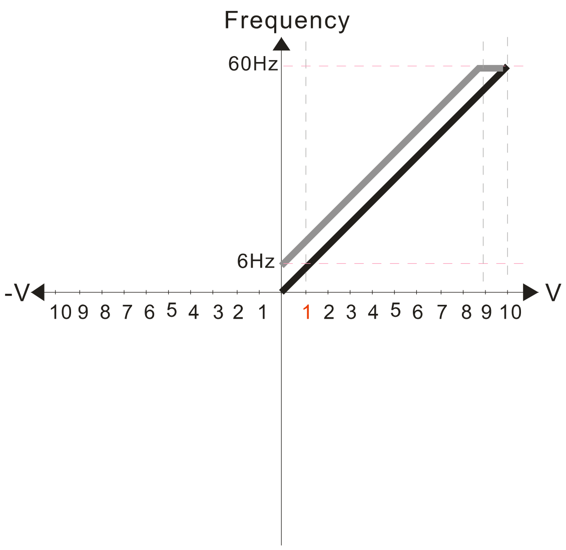
Pr.03-03=-10%

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 (AVI) = 100%

Diagram 12



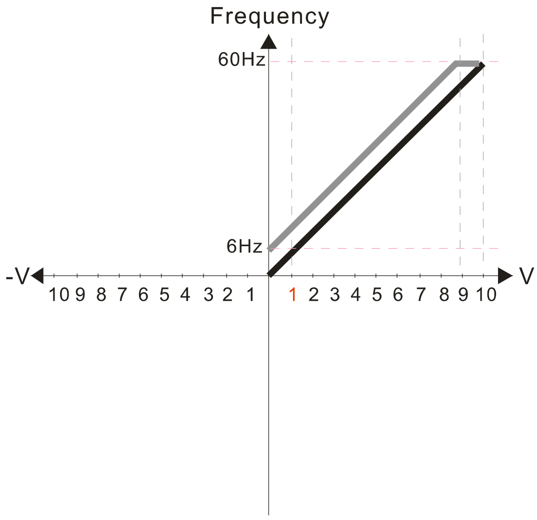
Pr.03-03=-10%

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 (AVI) = 100%

Diagram 13



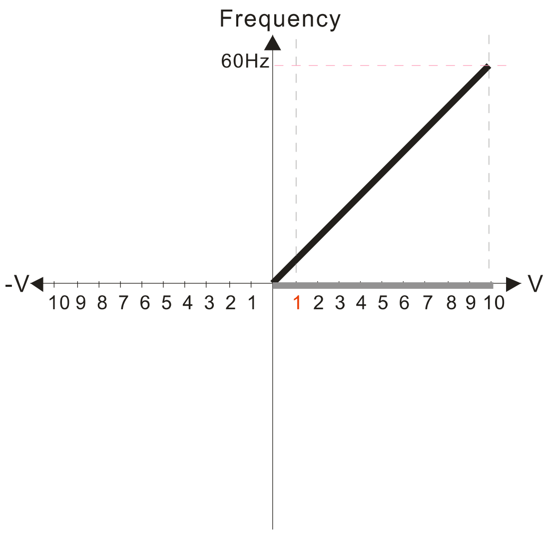
Pr.03-03=-10%

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 (AVI)= 100%

Diagram 14



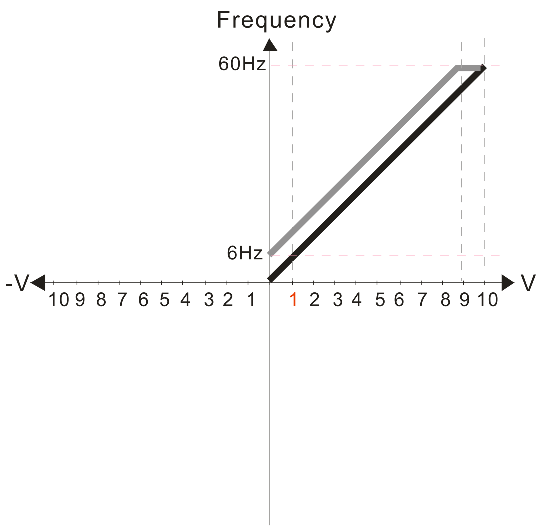
Pr.03-03=-10%

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 (AVI)= 100%

Diagram 15



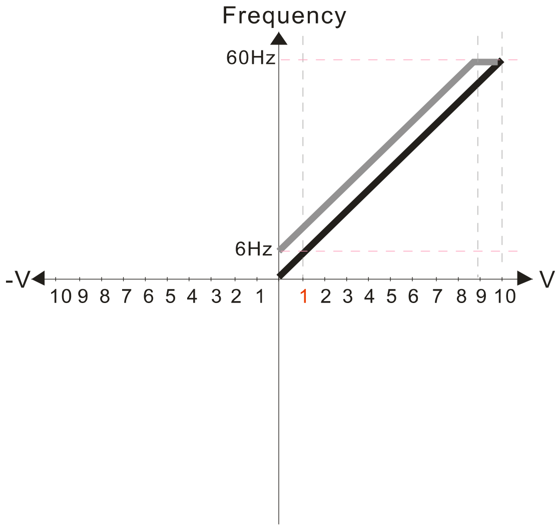
Pr.03-03=-10%

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 (AVI) = 100%

Diagram 16



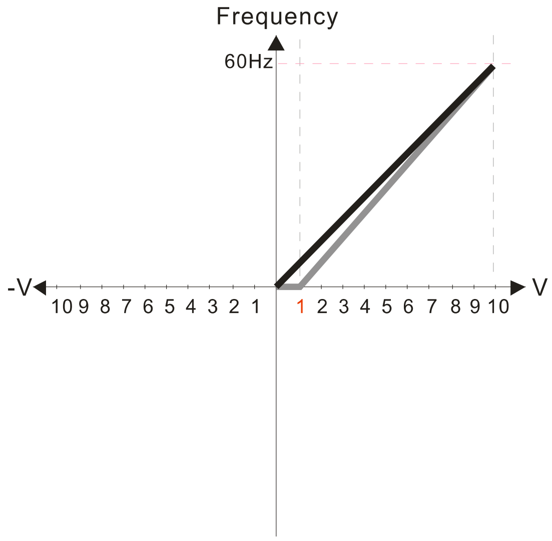
Pr.03-03=-10%

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 (AVI) = 100%

Diagram 17



Pr.03-03=10%

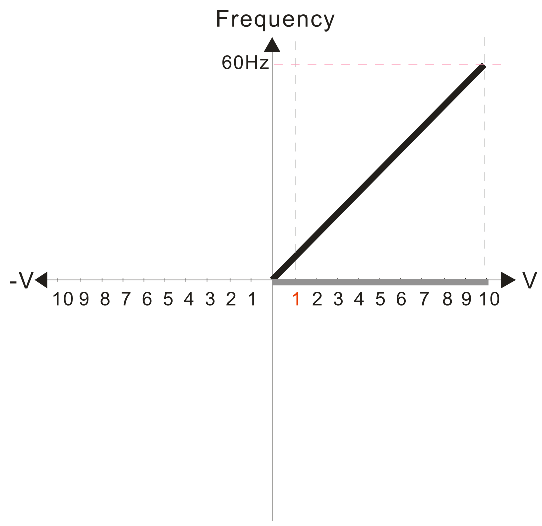
Pr.03-07~03-09 (Positive/Negative Bias Mode)
- 0: No bias
- 1: Lower than or equal to bias
- 2: Greater than or equal to bias
- 3: The absolute value of the bias voltage while serving as the center
- 4: Serve bias as the center

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 (AVI)= 111.1%

10/9=111.1%

Diagram 18



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

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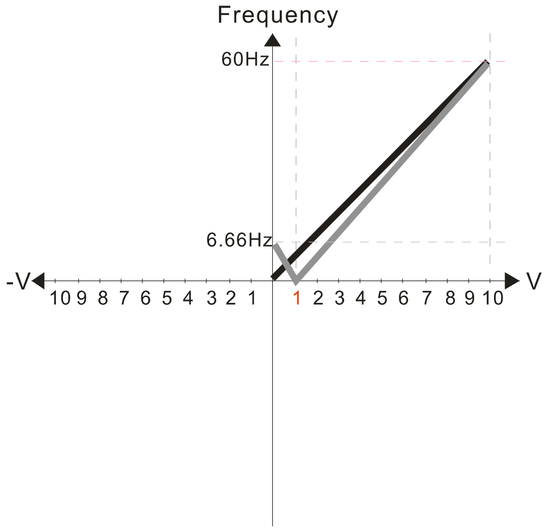
- 0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
- 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain (AVI)=111.1%

10/9 =111.1%

Diagram 19



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

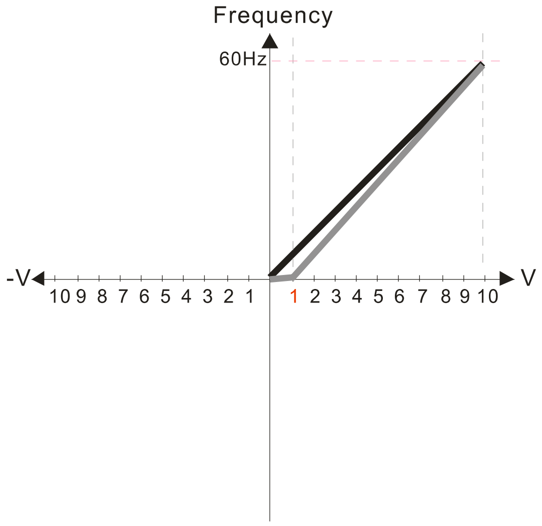
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI) = 111.1%
10/9 =111.1%

Diagram 20



Pr.03-03=10%

Pr.03-07~03-09 (Positive/Negative Bias Mode)

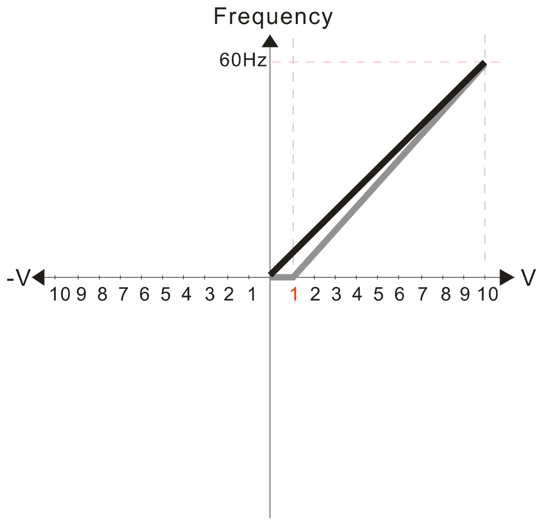
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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 (AVI) = 111.1%
10/9 =111.1%

Diagram 21



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

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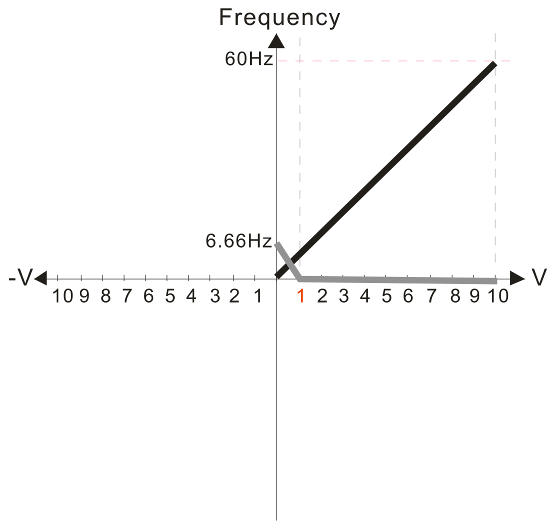
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

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

Diagram 22



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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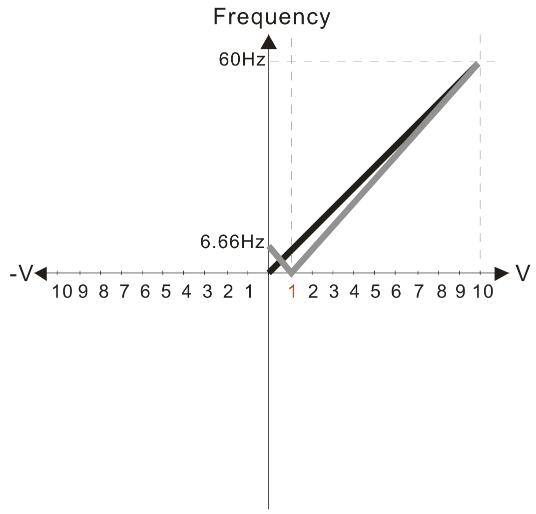
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr03-11Analog Input Gain (AVI) = 111.1%
10/9 =111.1%

Diagram 23



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

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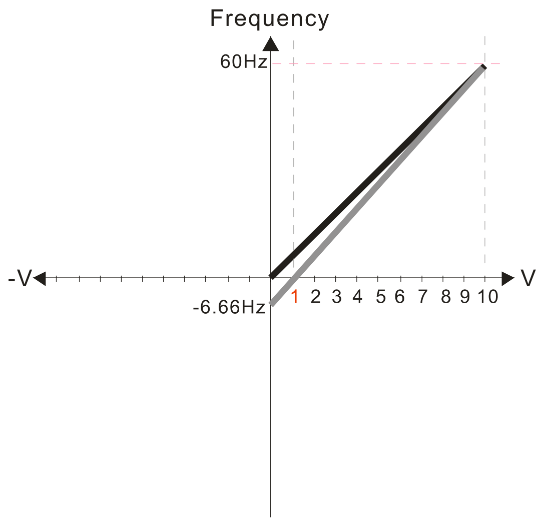
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

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

Diagram 24



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

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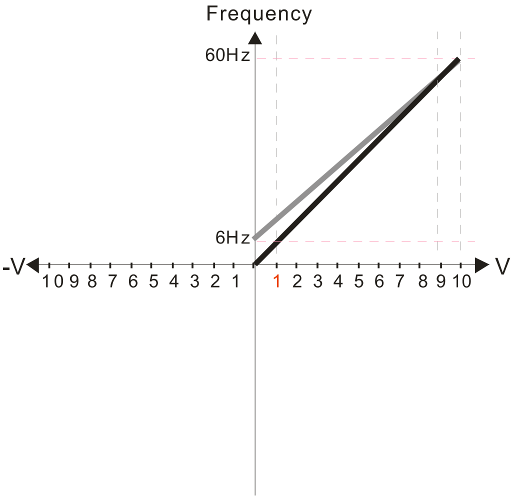
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain (AVI) = 100%
10/9 =111.1%

Diagram 25



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

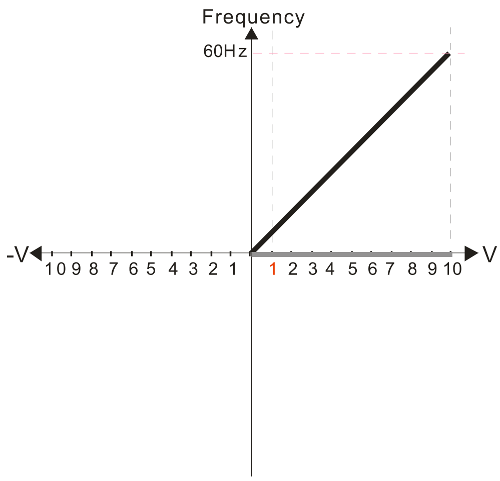
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital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

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

Diagram 26



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

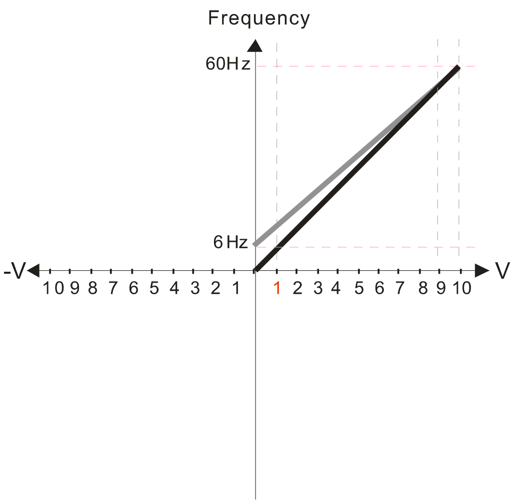
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital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

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

Diagram 27



Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
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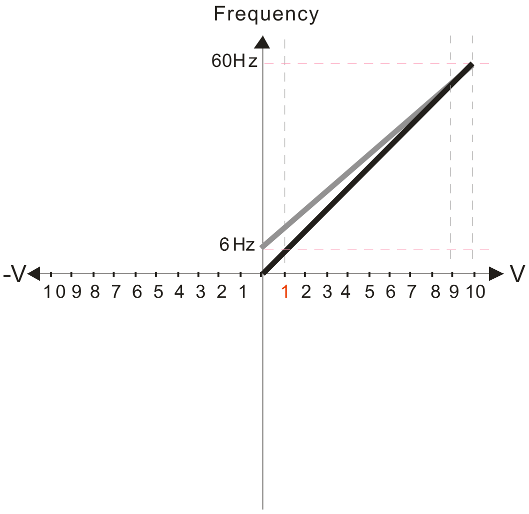
$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{Hz}}{(0\text{-}x\text{V})} \quad x\text{V}=\frac{10}{-9}=-1.11\text{V} \quad \therefore 03\text{-}03=\frac{-1.11}{10}\times 100\% = -11.1\%$$

Calculate the gain: $03\text{-}11=\frac{10\text{V}}{11.1\text{V}}\times 100\%=90.0\%$

Diagram 28



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
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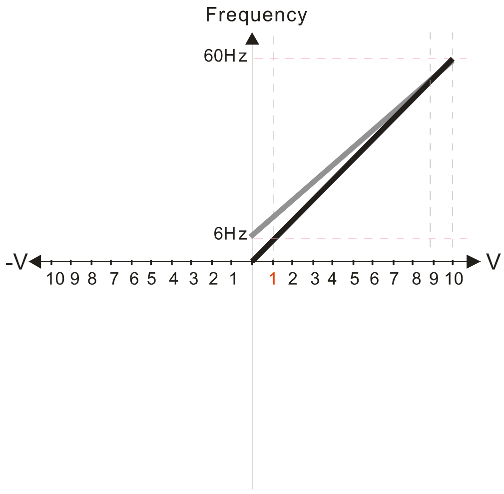
$$\frac{60\text{-}6Hz}{10V}=\frac{6\text{-}0Hz}{(0\text{-}xV)} \quad xV=\frac{10}{-9}=-1.11V \quad \therefore 03\text{-}03=\frac{-1.11}{10}\times100\% =-11.1\%$$

Calculate the gain: $03\text{-}11=\frac{10V}{11.1V}\times100\%=90.0\%$

Diagram 29



Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
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3: The absolute value of the bias voltage while serving as the center
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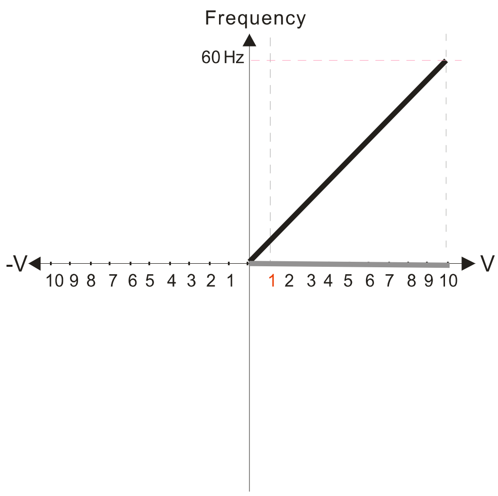
Calculate the bias:

$$\frac{60\text{-}6Hz}{10V}=\frac{6\text{-}0Hz}{(0\text{-}xV)} \quad xV=\frac{10}{-9}=-1.11V \quad \therefore 03\text{-}03=\frac{-1.11}{10}\times100\% =-11.1\%$$

Calculate the gain: $03\text{-}11=\frac{10V}{11.1V}\times100\%=90.0\%$

Diagram 30



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

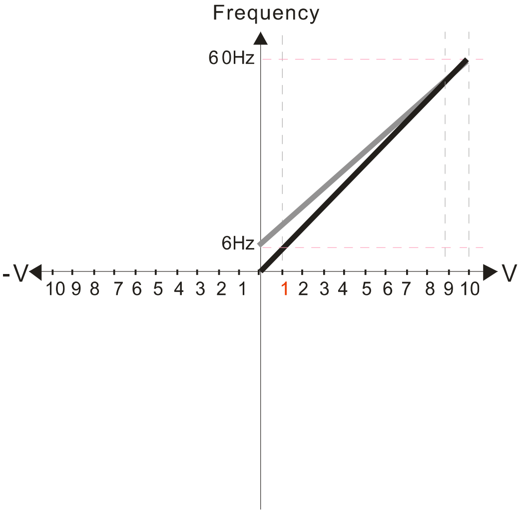
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital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

Calculate the bias:

$$\frac{60\text{-}6Hz}{10V}=\frac{6\text{-}0Hz}{(0\text{-}xV)} \quad xV=\frac{10}{-9}=-1.11V \quad \therefore 03\text{-}03=\frac{-1.11}{10}\times100\% =-11.1\%$$

Calculate the gain: $03\text{-}11=\frac{10V}{11.1V}\times100\%=90.0\%$

Diagram 31



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
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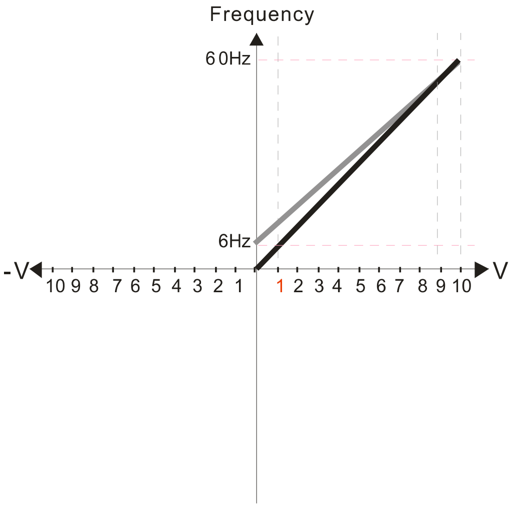
Calculate the bias:

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

Calculate the gain: $03\text{-}11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$

Diagram 32



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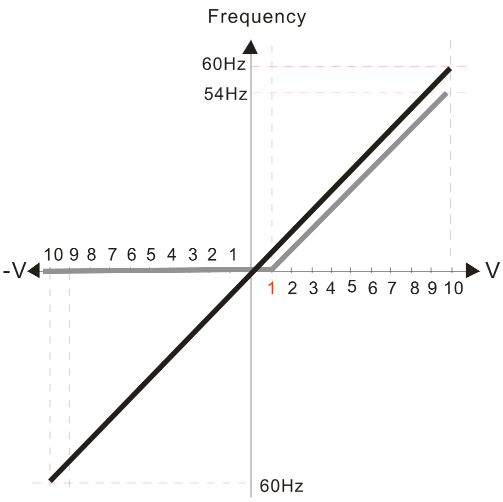
$$\frac{60\text{-}6Hz}{10V} = \frac{6\text{-}0Hz}{(0\text{-}xV)} \quad xV = \frac{10}{-9} = -1.11V \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain: $03\text{-}11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$

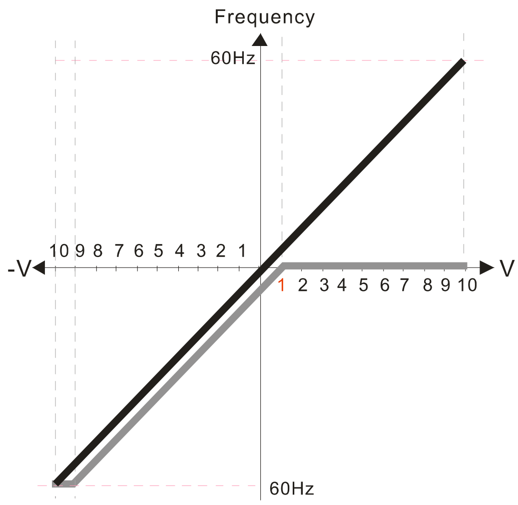
Diagram 33



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 100%
Pr.03-14 Analog Positive Input Gain (AUI) = 100%

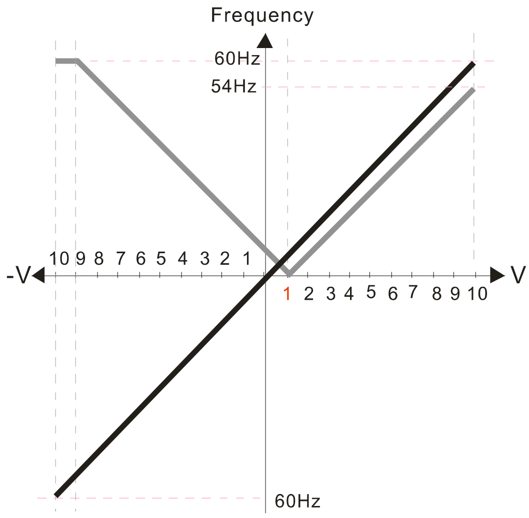
Diagram 34



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 100%
Pr.03-14 Analog Positive Input Gain (AUI) = 100%

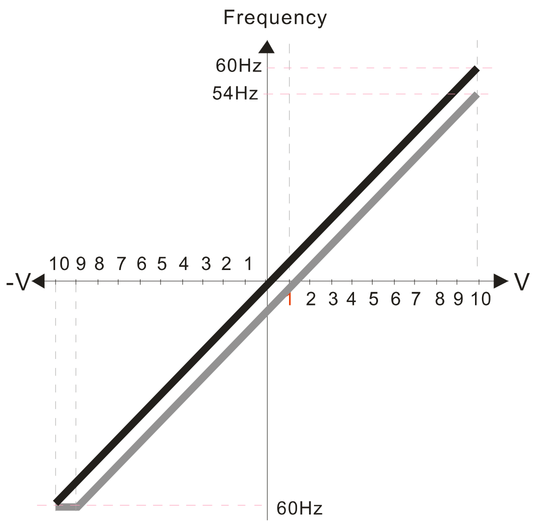
Diagram 35



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 100%
Pr.03-14 Analog Positive Input Gain (AUI) = 100%

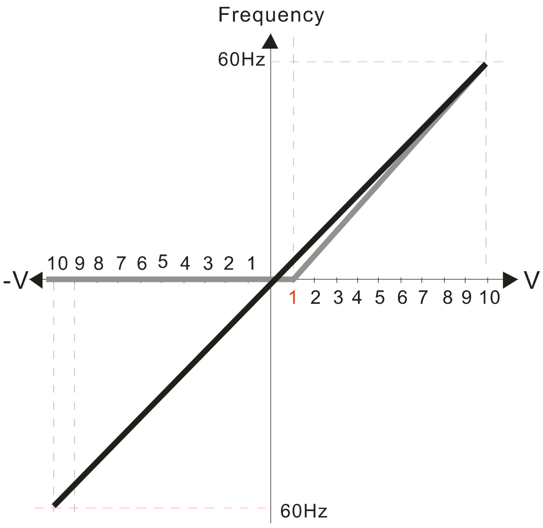
Diagram 36



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 100%
Pr.03-14 Analog Positive Input Gain (AUI) = 100%

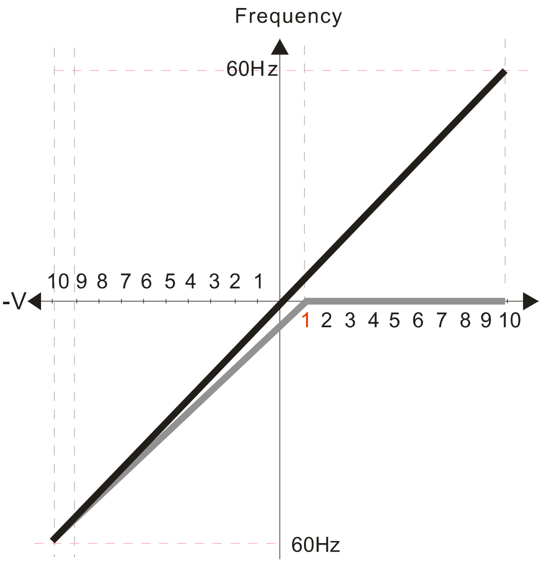
Diagram 37



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 111.1%
(10/9)*100% = 111.1%
Pr.03-14 Analog Positive Input Gain (AUI) = 100%

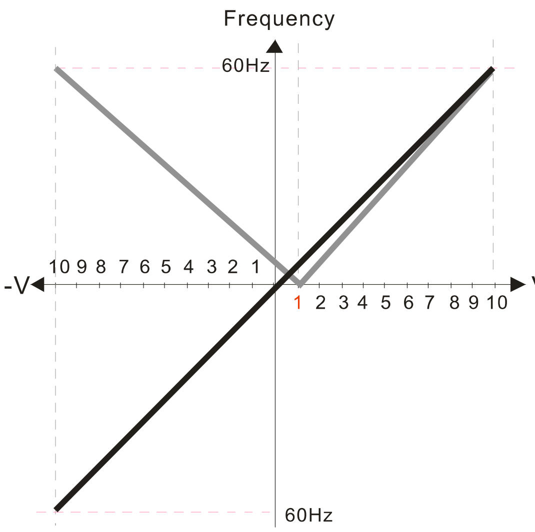
Diagram 38



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 100%
Pr.03-14 Analog Positive Input Gain (AUI) = 90.0%
(10/11)*100% = 90.9%

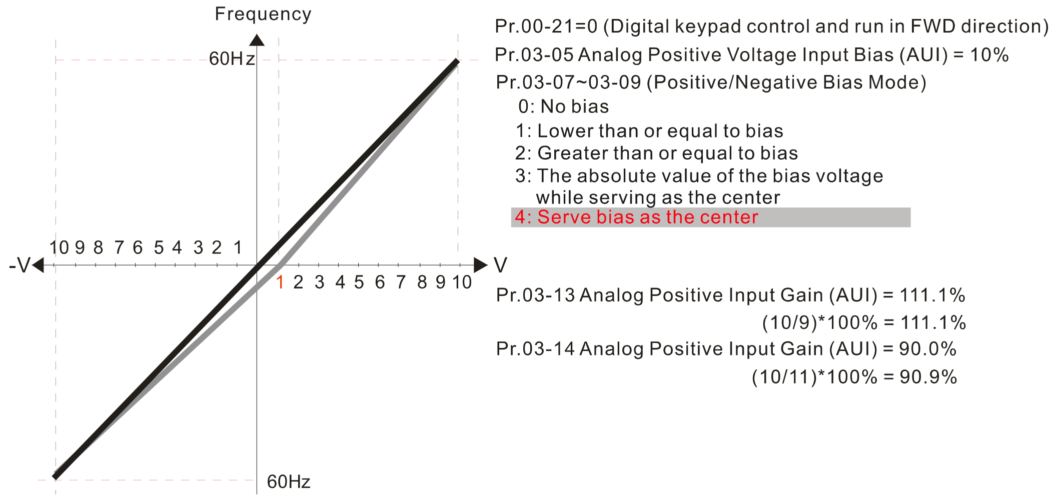
Diagram 39



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 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 (AUI) = 111.1%
(10/9)*100% = 111.1%
Pr.03-14 Analog Positive Input Gain (AUI) = 90.0%
(10/11)*100% = 90.9%

Diagram 40



03-10 Reverse Setting When Analog Signal Input is Negative Frequency

Default: 0

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

- Use this parameter only for AVI or ACI analog input.
- Requirements for negative frequency (reverse running)
  1. Pr.03-10 = 1
  2. Bias mode = Bias serves as the center
  3. Corresponded analog input gain < 0 (negative); this makes the input frequency negative.
- In using the additional analog input function (Pr.03-18 = 1), when the analog signal is negative after the addition, you can set this parameter to allow or not allow the reverse running. The result after adding depends on the “Requirements for negative frequency (reverse running)”.

03-11 AVI Analog Input Gain
03-12 ACI Analog Input Gain
03-13 AUI Analog Positive Input Gain
03-14 AUI Analog Negative Input Gain

Default: 100.0

Settings -500.0–500.0%

- Pr.03-03–Pr.03-14 are used when the Frequency command source is the analog voltage or current signal.

03-15 AVI Analog Input Filter Time
03-16 ACI Analog Input Filter Time
03-17 AUI Analog Input Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

- Analog signals, such as those entering AVI, ACI and AUI, are commonly affected by interference that affects the stability of the analog control. Use the Input Noise Filter to create a more stable system.
- When the time constant setting is too large, the control is stable but the control response is slow. When the time constant setting is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

03-18 Analog Input Addition Function

Default: 0

Settings 0: Disabled (AVI, ACI, AUI)

1: Enabled

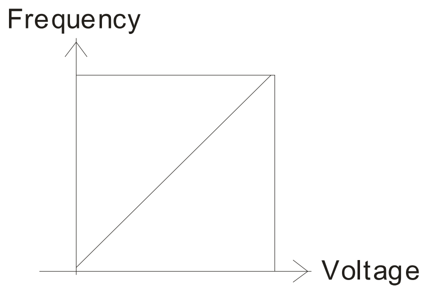
- When Pr.03-18 = 1:

  Example 1: Pr.03-00 = Pr.03-01 = 1, Frequency command= AVI+ACI

  Example 2: Pr.03-00 = Pr.03-01 = Pr.03-02 = 1, Frequency command = AVI+ACI+AUI

  Example 3: Pr.03-00 = Pr.03-02 = 1, Frequency command = AVI+AUI

  Example 4: Pr.03-01 = Pr.03-02 = 1, Frequency command = ACI+AUI
- When Pr.03-18=0 and the analog input selection settings (Pr.03-00, Pr.03-01 and Pr.03-02) are the same, AVI has priority over ACI and AUI (AVI > ACI > AUI).



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

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 the Analog Input 4–20 mA

Default: 0

Settings 0: Disabled

1: Continue operation at the last frequency

2: Decelerate to 0 Hz

3: Stop immediately and display ACE

4: Operate with output frequency lower limit (Pr.01-11) and displays ANL

- Determines the treatment when the 4–20 mA signal is lost [AVIc (Pr.03-28 = 2) or ACIc (Pr.03-29 = 0)].
- When Pr.03-28 ≠ 2, the voltage input to AVI terminal is 0–10 V or 0–20 mA, and Pr.03-19 is invalid.

- When Pr.03-29 ≠ 0, the voltage input to ACI terminal is 0–10 V or 0–20 mA, and the Pr.03-19 is invalid.
- When the setting is 1,2, or 4, the keypad displays the warning code "ANL". It keeps blinking until the ACI signal is recovered.
- When the drive stops, the condition that causes the warning does not exist, so the warning automatically disappears.

03-20 AFM1 Multi-Function Output 1
03-23 AFM2 Multi-Function Output 2

Default: 0

Settings 0–25

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 × drive rated current) is processed as 100%</td></tr>
<tr><td>4</td><td>Output voltage</td><td>(2 × motor rated voltage) is processed as 100%</td></tr>
<tr><td>5</td><td>DC bus Voltage</td><td>450 V (900 V) =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 × drive rated power) is processed as 100%</td></tr>
<tr><td>8</td><td>Output torque</td><td>Full-load torque = 100%</td></tr>
<tr><td>9</td><td>AVI</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>AUI</td><td>-10–10 V = 0–100%</td></tr>
<tr><td>12</td><td>Iq current command</td><td>(2.5 × drive rated current) is processed as 100%</td></tr>
<tr><td>13</td><td>Iq feedback value</td><td>(2.5 × drive rated current) is processed as 100%</td></tr>
<tr><td>14</td><td>Id current command</td><td>(2.5 × drive rated current) is processed as 100%</td></tr>
<tr><td>15</td><td>Id feedback value</td><td>(2.5 × drive rated current) is processed as 100%</td></tr>
<tr><td>18</td><td>Torque command</td><td>Motor rated torque = 100%</td></tr>
<tr><td>19</td><td>PG2 frequency command</td><td>Maximum operation frequency (Pr.01-00) is processed as 100%.</td></tr>
<tr><td>20</td><td>CANopen analog output</td><td>For CANopen communication analog output
<table><tr><th>Terminal</th><th>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 analog output
<table>
<tr><th>Terminal</th><th>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>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 the voltage output level.
0–100% of Pr.03-32 corresponds to 0–10 V of AFM1.</td></tr>
<tr><td>25</td><td>CANopen and RS-485 analog output</td><td>For CANopen and InnerCOM control output</td></tr>
</table>

03-21 AFM1 Analog Output Gain 1
03-24 AFM2 Analog Output Gain 2

Default: 100.0

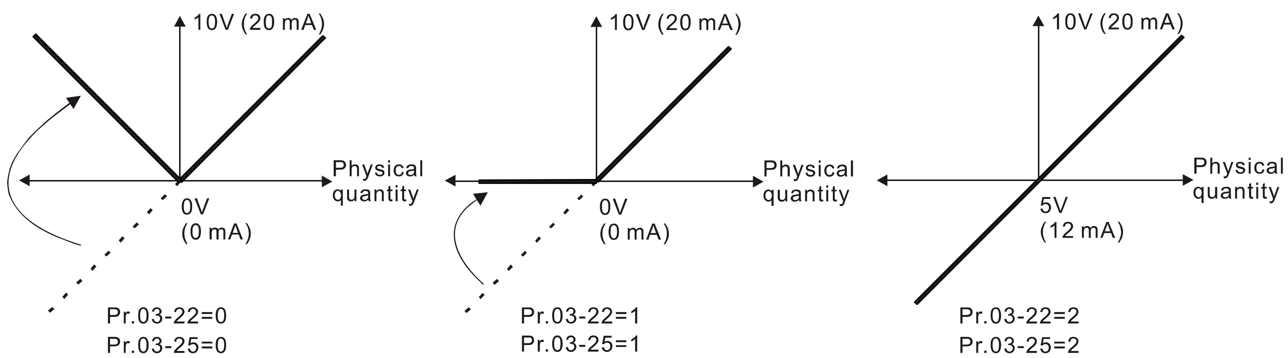
Settings 0.0–500.0%

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

03-22 AFM1 Analog Output 1 in REV Direction
03-25 AFM2 Analog Output 2 in REV Direction

Default: 0

Settings 0: Absolute value in 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 of the analog output 0.

03-28 AVI 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

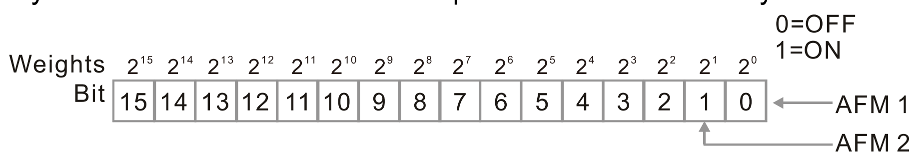
- When you change the input mode, verify that the external terminal switch (SW3, SW4) corresponds to the setting for Pr.03-28–Pr.03-29.

03-30 PLC Analog Output Terminal Status

Default: Read only

Settings Monitor the status of the PLC analog output terminals

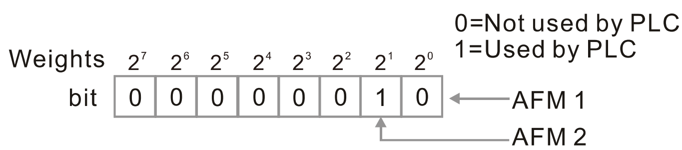
- Pr.03-30 displays the external multi-function output terminal that used by PLC.



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

For Example:

When Pr.03-30 displays 0002h (hex), it means that AFM2 is used by PLC.



Display value
$2=1\text{x}2^1+0\text{x}2^0$
$=\text{bit } 1\text{x}2^1+\text{bit } 0\text{x}2^0$

✎ 03-31 AFM2 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%

✎ 03-35 AFM1 Output Filter Time
✎ 03-36 AFM2 Output Filter Time

Default: 0.01

Settings 0.00–20.00 sec.

✎ 03-44 Multi-Function Output (MO) By AI Level Source

Default: 0

Settings 0: AVI
1: ACI
2: AUI

✎ 03-45 AI Upper Level (MO)

Default: 50.00

Settings -100.00–100.00%

✎ 03-46 AI Lower Level (MO)

Default: 10.00

Settings -100.00–100.00%

- Use this function (Pr.03-44) with the multi-function output setting 67 (analog input level reached). The MO is active when the AI input level is higher than the Pr.03-45. The MO is disabled when the AI input is lower than the Pr.03-46.
- When setting levels, Pr.03-45 AI upper level must be higher than Pr.03-46 AI lower level.

✎ 03-50 Analog Input Curve Selection

Default: 0

Settings 0: Normal curve
1: Three-point curve of AVI
2: Three-point curve of ACI
3: Three-point curve of AVI & ACI
4: Three-point curve of AUI
5: Three-point curve of AVI & AUI
6: Three-point curve of ACI & AUI
7: Three-point curve of AVI & ACI & AUI

- Set 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, AVI calculates by frequency and voltage / current (Pr.03-51–03-56), other analog input signal calculates by bias and gain.
- When Pr.03-50 = 2, ACI consulates by frequency and voltage / current (Pr.03-57–03-62), other analog input signal calculates by bias and gain.
- When Pr.03-50 = 3, AVI and ACI calculate by frequency and voltage/ current (Pr.03-51–03-62), other analog input signal calculates by bias and gain.
- When Pr.03-50 = 4, AVI calculates by frequency and voltage / current (Pr.03-63–03-74), other analog input signal calculates by bias and gain.
- When Pr.03-50 = 5, AVI and AUI calculate by frequency and voltage / current (Pr.03-51–03-56 and 03-63–03-74), other analog input signal calculates by bias and gain.
- When Pr.03-50 = 6, ACI and AVI calculate by frequency and voltage / current (Pr.03-57–03-74), other analog input signal calculates by bias and gain.
- When Pr.03-50 = 7, all analog input signal calculates by frequency and voltage / current (Pr.03-51–03-74).

03-51 AVI Lowest Point

		Default:
Settings	Pr.03-28 = 0, 0.00–10.00 V	0.00
	Pr.03-28 = 1, 0.00–20.00 mA	0.00
	Pr.03-28 = 2, 4.00–20.00 mA	4.00

03-52 AVI Proportional Lowest Point

		Default:
Settings	-100.00–100.00%	0.00

03-53 AVI Mid-Point

		Default:
Settings	Pr.03-28 = 0, 0.00–10.00 V	5.00
	Pr.03-28 = 1, 0.00–20.00 mA	10.00
	Pr.03-28 = 2, 4.00–20.00 mA	12.00

03-54 AVI Proportional Mid-Point

		Default:
Settings	-100.00–100.00%	50.00

03-55 AVI Highest Point

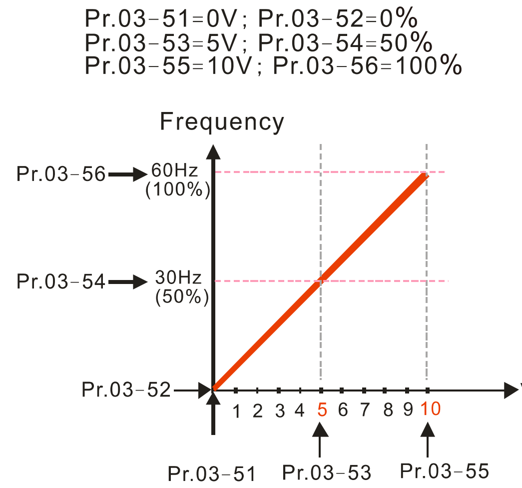
		Default:
Settings	Pr.03-28 = 0, 0.00–10.00 V	10.00
	Pr.03-28 = 1, 0.00–20.00 mA	20.00
	Pr.03-28 = 2, 4.00–20.00 mA	20.00

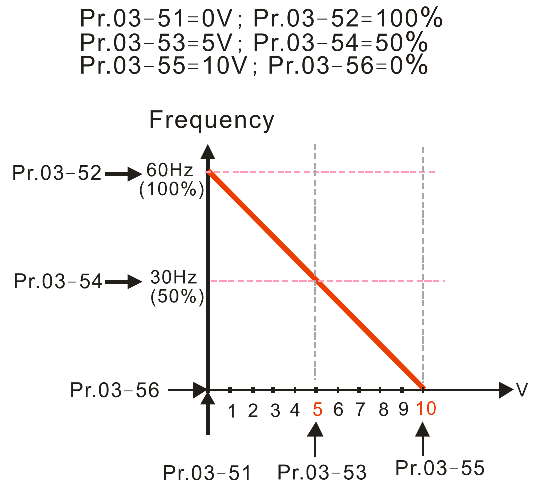
03-56 AVI Proportional Highest Point

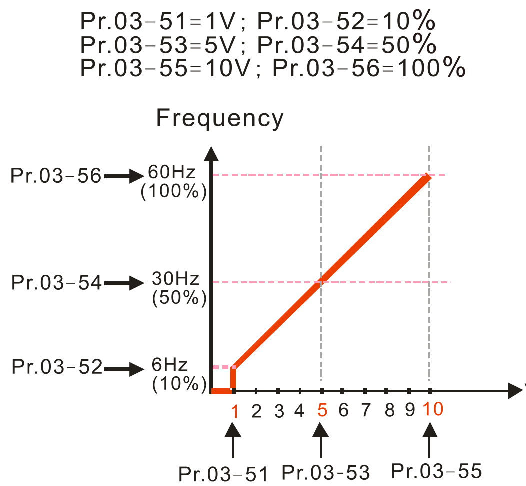
		Default:
Settings	-100.00–100.00%	100.00

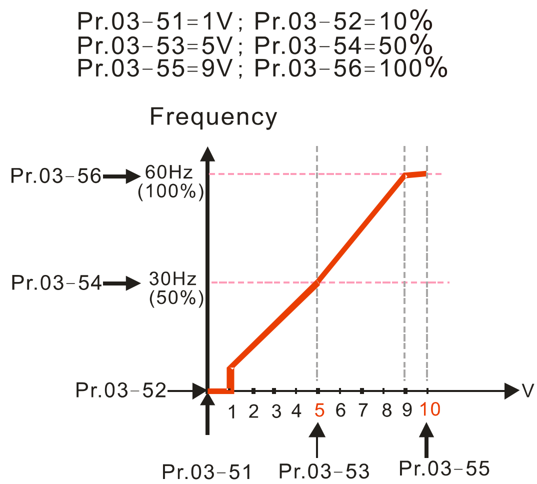
- When Pr.03-28 = 0, the AVI setting is 0–10 V and the unit is in voltage (V).
  When Pr.03-28 ≠ 0, the AVI setting is 0–20 mA or 4–20 mA and the unit is in current (mA).

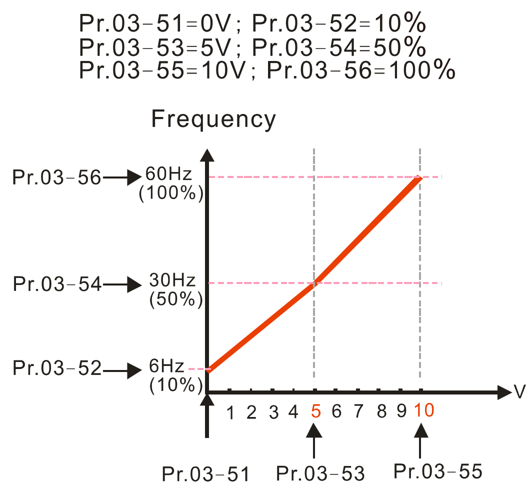
- When you set the analog input AVI to frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).
- The requirement for these three parameters (Pr.03-51, Pr.03-53 and Pr.03-55) is Pr.03-51 < Pr.03-53 < Pr.03-55. The values for three proportional points (Pr.03-52, Pr.03-54 and Pr.03-56) have no limits. Values between two points are calculated by a linear equation. The ACI and AUI are same as AVI.
- The output percentage 0% when the AVI input value is lower than the lowest point setting.
  Example: Pr.03-51 = 1 V; Pr.03-52 = 10%. The output is 0 % when AVI input is lower than 1V. If the AVI input varies between 1V and 1.1V, the drive's output frequency is between 0% and 10%.

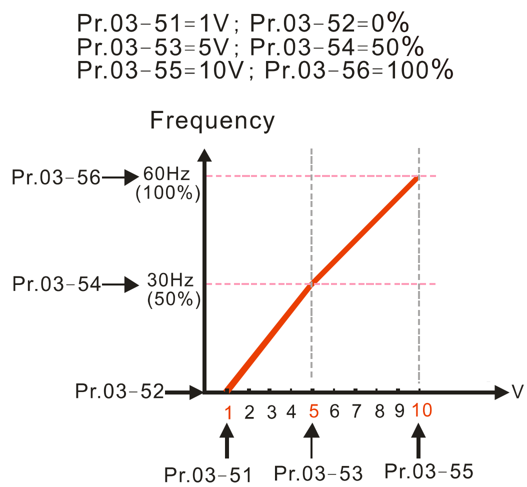












03-57 ACI Lowest Point

		Default:
Settings	Pr.03-29 = 0, 4.00–20.00 mA	4.00
	Pr.03-29 = 1, 0.00–10.00 V	0.00
	Pr.03-29 = 2, 0.00–20.00 mA	0.00

03-58 ACI Proportional Lowest Point

		Default:
Settings	-100.00–100.00%	0.00

03-59 ACI Mid-Point

		Default:
Settings	Pr.03-29 = 0, 4.00–20.00 mA	12.00
	Pr.03-29 = 1, 0.00–10.00 V	5.00
	Pr.03-29 = 2, 0.00–20.00 mA	10.00

03-60 ACI Proportional Mid-Point

		Default:
Settings	-100.00–100.00%	50.00

03-61 ACI Highest Point

		Default:
Settings	Pr.03-29 = 0, 4.00–20.00 mA	20.00
	Pr.03-29 = 1, 0.00–10.00 V	10.00
	Pr.03-29 = 2, 0.00–20.00 mA	20.00

03-62 ACI Proportional Highest Point

		Default:
Settings	-100.00–100.00%	100.00

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

03-63 Positive AUI Voltage Lowest Point

Default: 0.00

Settings 0.00–10.00 V

03-64 Positive AUI Voltage Proportional Lowest Point

Default: 0.00

Settings -100.00–100.00%

03-65 Positive AUI Voltage Mid-Point

Default: 5.00

Settings 0.00–10.00 V

03-66 Positive AUI Voltage Proportional Mid-Point

Default: 50.00

Settings -100.00–100.00%

03-67 Positive AUI Voltage Highest Point

Default: 10.00

Settings 0.00–10.00 V

03-68 Positive AUI Voltage Proportional Highest Point

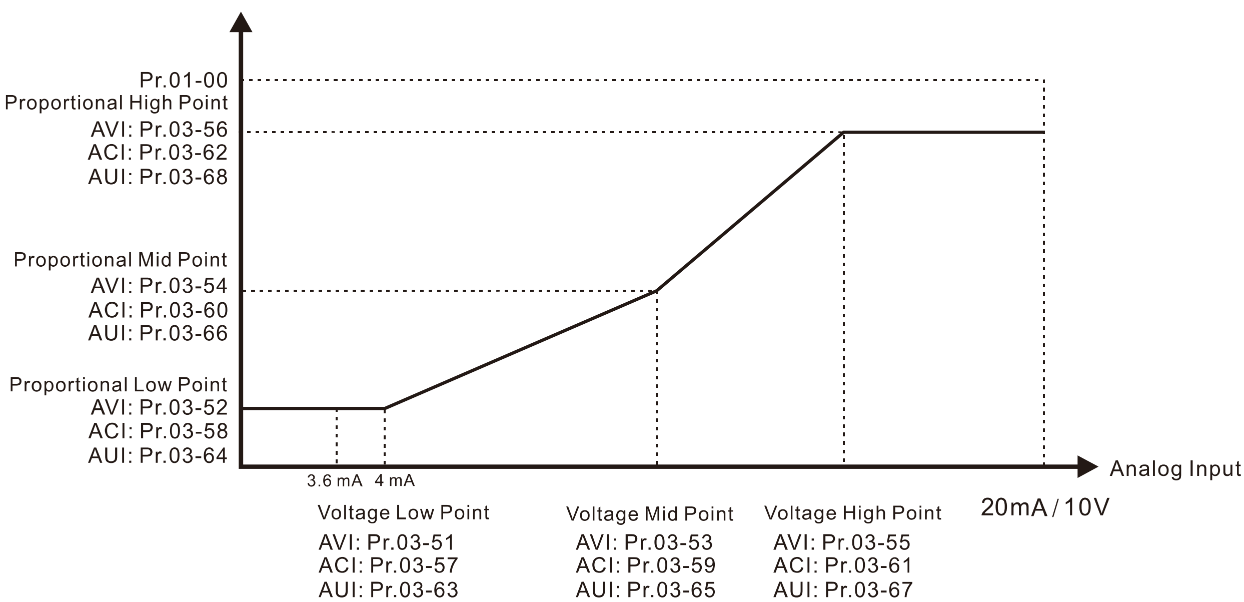
Default: 100.00

Settings -100.00–100.00%

- When you set the positive voltage AUI 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. There is a linear calculation between two points.
- The output percentage becomes 0% when the positive voltage AUI input value is lower than the lowest point setting.

  For example:

  If Pr.03-63 = 1 V; Pr.03-64 = 10%, then the output becomes 0% when the AUI input is ≤ 1V. If the AUI input swings between 1V and 1.1V, the drive's output frequency oscillates between 0% and 10%.
- Use Pr.03-51~03-68 to set the open circuit corresponding function of analog input value and max. operation frequency (Pr.01-00), as shown in the figure below:



03-69 Negative AUI Voltage Highest Point

Default: 0.00

Settings -10.00–0.00 V

03-70 Negative AUI Voltage Proportional Highest Point

Default: 0.00

Settings -100.00–100.00%

03-71 Negative AUI Voltage Mid-Point

Default: -5.00

Settings -10.00–0.00 V

03-72 Negative AUI Voltage Proportional Mid-Point

Default: -50.00

Settings -100.00–100.00%

03-73 Negative AUI Voltage Lowest Point

Default: -10.00

Settings -10.00–0.00 V

03-74 Negative AUI Voltage Proportional Lowest Point

Default: -100.00

Settings -100.00–100.00%

- When you set the negative voltage AUI to the Frequency command, -100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency) and the motor runs in the reverse direction.
- The requirement for these three parameters (Pr.03-69, Pr.03-71 and Pr.03-73) is Pr.03-69 < Pr.03-71 < Pr.03-73. The values for three proportional points (Pr.03-70, Pr.03-72 and Pr.03-74) have not limits. There is a linear calculation between two points.
- The output percentage becomes 0% when the negative AUI input value is lower than the lowest point setting.

  For example:

  If Pr.03-69 = -1 V; Pr.03-70 = 10%, then the output becomes 0% when the AUI input is ≥ -1V. If the AUI input swings] between -1 V and -1.1 V, the drive's output frequency oscillates between 0% and 10%.

04 Multi-step Speed Parameters

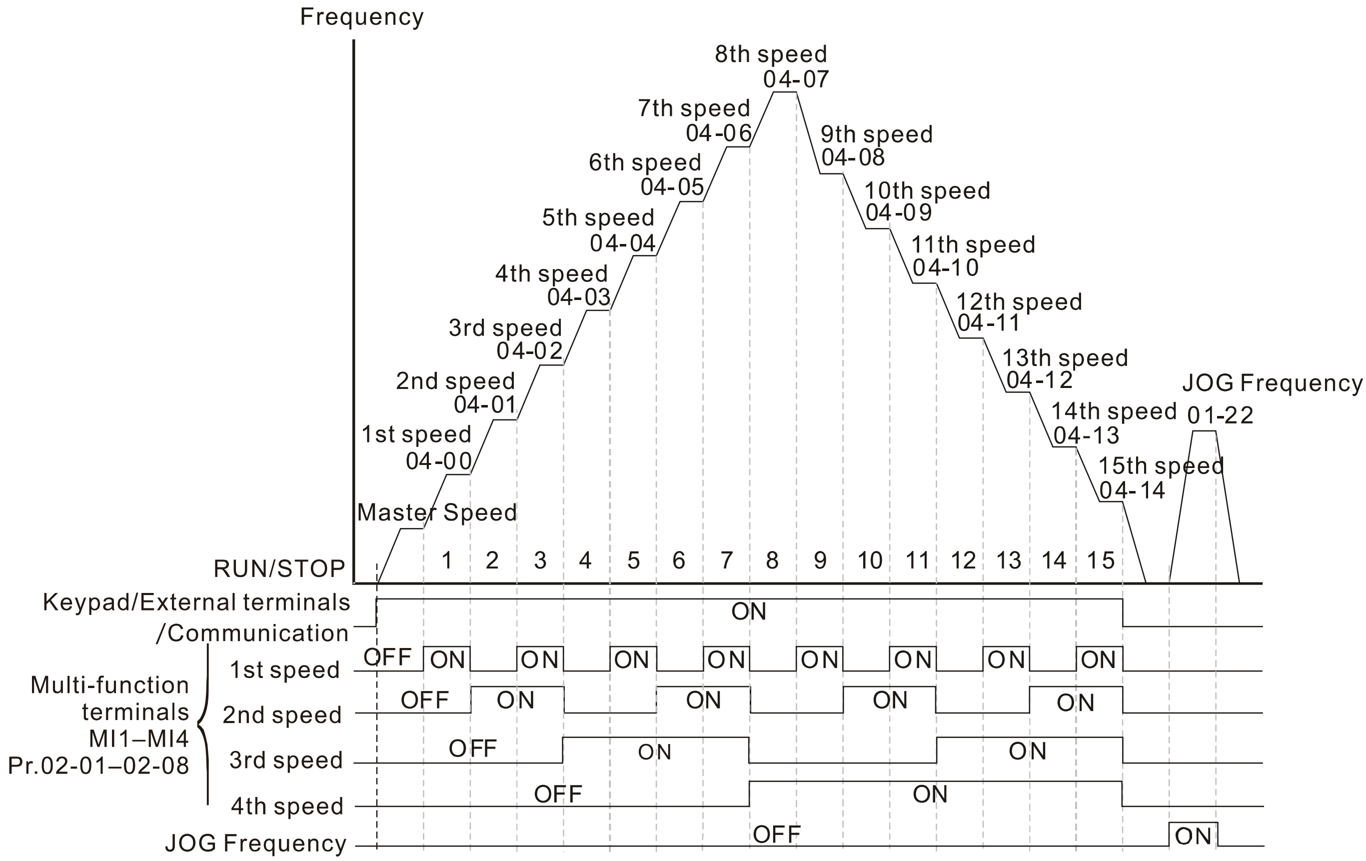
✓ You can set this parameter during operation.

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

Default: 0.00

Settings 0.00–599.00 Hz

- Use the multi-function input terminals (refer to settings 1–4 of Pr.02-01–02-08 and Pr.02-26–02-31 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–Pr.04-14: sets the 1st–15th multi-step speed (to set the frequency of each step speed)
  2. Pr.02-01–Pr.02-08 and Pr.02-26–Pr.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

✓	**04-15**	Position Command 1 (Rotation)
✓	**04-17**	Position Command 2 (Rotation)
✓	**04-19**	Position Command 3 (Rotation)
✓	**04-21**	Position Command 4 (Rotation)
✓	**04-23**	Position Command 5 (Rotation)
✓	**04-25**	Position Command 6 (Rotation)
✓	**04-27**	Position Command 7 (Rotation)
✓	**04-29**	Position Command 8 (Rotation)
✓	**04-31**	Position Command 9 (Rotation)
✓	**04-33**	Position Command 10 (Rotation)
✓	**04-35**	Position Command 11 (Rotation)
✓	**04-37**	Position Command 12 (Rotation)
✓	**04-39**	Position Command 13 (Rotation)
✓	**04-41**	Position Command 14 (Rotation)
✓	**04-43**	Position Command 15 (Rotation)

Default: 0

Settings -30000–30000

✓	**04-16**	Position Command 1 (Pulse)
✓	**04-18**	Position Command 2 (Pulse)
✓	**04-20**	Position Command 3 (Pulse)
✓	**04-22**	Position Command 4 (Pulse)

04-24	Position Command 5 (Pulse)
04-26	Position Command 6 (Pulse)
04-28	Position Command 7 (Pulse)
04-30	Position Command 8 (Pulse)
04-32	Position Command 9 (Pulse)
04-34	Position Command 10 (Pulse)
04-36	Position Command 11 (Pulse)
04-38	Position Command 12 (Pulse)
04-40	Position Command 13 (Pulse)
04-42	Position Command 14 (Pulse)
04-44	Position Command 15 (Pulse)

Default: 0

Settings -32767–32767

Switch the target position through external terminal, that is, set the multi-function input commands MI1 to MI4 (Pr.02-01 = 1, Pr.02-02 = 2, Pr.02-03 = 3, and Pr.02-04 = 4), and determine the P2P target position using the multi-step speed.

Setting method: Target Position = Pr.04-15 × (Pr.10-01*4) + Pr.04-16

Multi-step Speed Status	P2P Target Position			P2P Maximum Speed	
0000	0			Pr.11-00 bit8=0	Pr.11-00 bit8=1
0001	Position 1	Pr.04-15	Pr.04-16	Pr.11-43	Pr.04-00
0010	Position 2	Pr.04-17	Pr.04-18		Pr.04-01
0011	Position 3	Pr.04-19	Pr.04-20		Pr.04-02
0100	Position 4	Pr.04-21	Pr.04-22		Pr.04-03
0101	Position 5	Pr.04-23	Pr.04-24		Pr.04-04
0110	Position 6	Pr.04-25	Pr.04-26		Pr.04-05
0111	Position 7	Pr.04-27	Pr.04-28		Pr.04-06
1000	Position 8	Pr.04-29	Pr.04-30	Pr.11-43	Pr.04-07
1001	Position 9	Pr.04-31	Pr.04-32		Pr.04-08
1010	Position 10	Pr.04-33	Pr.04-34		Pr.04-09
1011	Position 11	Pr.04-35	Pr.04-36		Pr.04-10
1100	Position 12	Pr.04-37	Pr.04-38		Pr.04-11
1101	Position 13	Pr.04-39	Pr.04-40		Pr.04-12
1110	Position 14	Pr.04-41	Pr.04-42		Pr.04-13
1111	Position 15	Pr.04-43	Pr.04-44		Pr.04-14

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.

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

✔ You can set this parameter during operation.

05-00 Motor Parameter Auto-Tuning

Default: 0

Settings 0: No function
1: Rolling test for induction motor (IM) (Rs, Rr, Lm, Lx, no-load current)
2: Static test for induction motor (IM)
4: Rolling test for PM motor magnetic pole
5: Rolling test for PM (SPM) motor
6: Rolling test for IM motor flux curve
12: FOC Sensorless inertia estimation
13: Stacic test for (IPM / SPM) motor

📖 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

📖 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) is 25 A. The default is 22.5 A.
The setting range is between 40%–120% of the rated current.
(25 × 40% = 10 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

📖 Set 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’s number of poles

Settings 0–xxxx rpm (Depending on the motor’s number of poles)

📖 Set the rated speed for the motor as indicated on the motor nameplate.

05-04 Number of Poles for Induction Motor 1

Default: 4

Settings 2–64

- Set 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 the 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 0.00–Pr.05-01 default

- The default is 40% of 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 W

05-07 Rotor Resistance (Rr) for Induction Motor 1

Default: Depending on the model power

Settings 0.000–65.535 W

05-08 Magnetizing Inductance (Lm) for Induction Motor 1

Default: Depending on the model power

Settings 0.0–6553.5 mH

05-09 Stator Inductance (Lx) for Induction Motor 1

Default: Depending on the model power

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 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 40 %–120 % of rated current.

25 × 40 % = 10 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's number of poles

Settings 0–xxxx rpm (Depending on the motor's number of poles)

- Set 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

- Set 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 40% of 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 W

05-19 Rotor Resistance (Rr) for Induction Motor 2

Default: Depending on the model power

Settings 0.000–65.535 W

05-20 Magnetizing Inductance (Lm) for Induction Motor 2

Default: Depending on the model power

Settings 0.0–6553.5 mH

05-21 Stator Inductance (Lx) for Induction Motor 2

Default: Depending on the model power

Settings 0.0–6553.5 mH

05-22 Induction Motor 1 / 2 Selection

Default: 1

Settings 1: Motor 1

2: Motor 2

- Set 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 an Induction Motor

Default: 0

Settings 0: Disabled

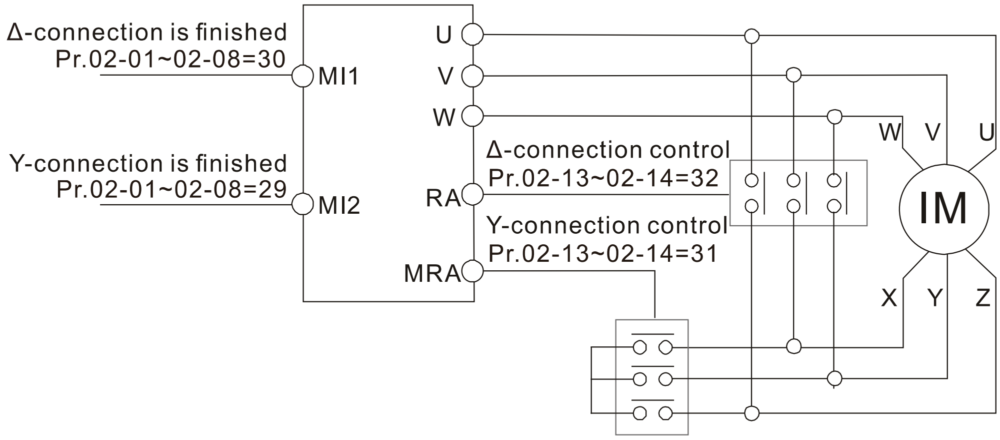
1: Enabled

✍ 05-25 Delay Time for Y-Connection / Δ-Connection Switch for an Induction Motor

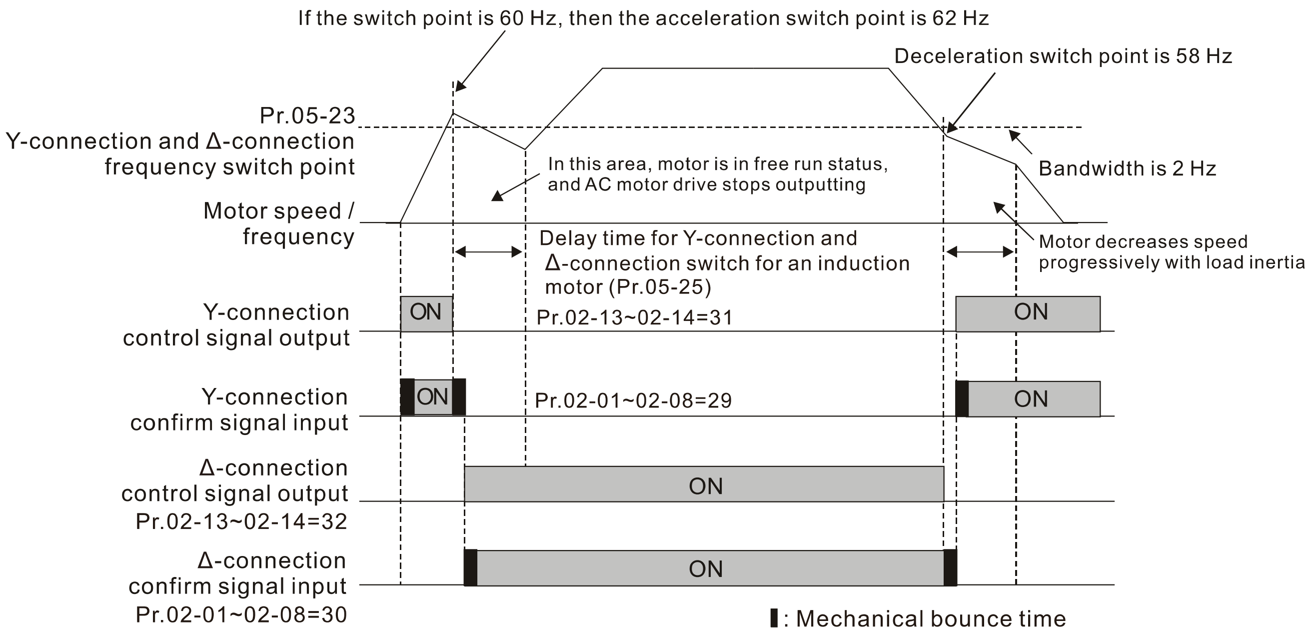
Default: 0.200

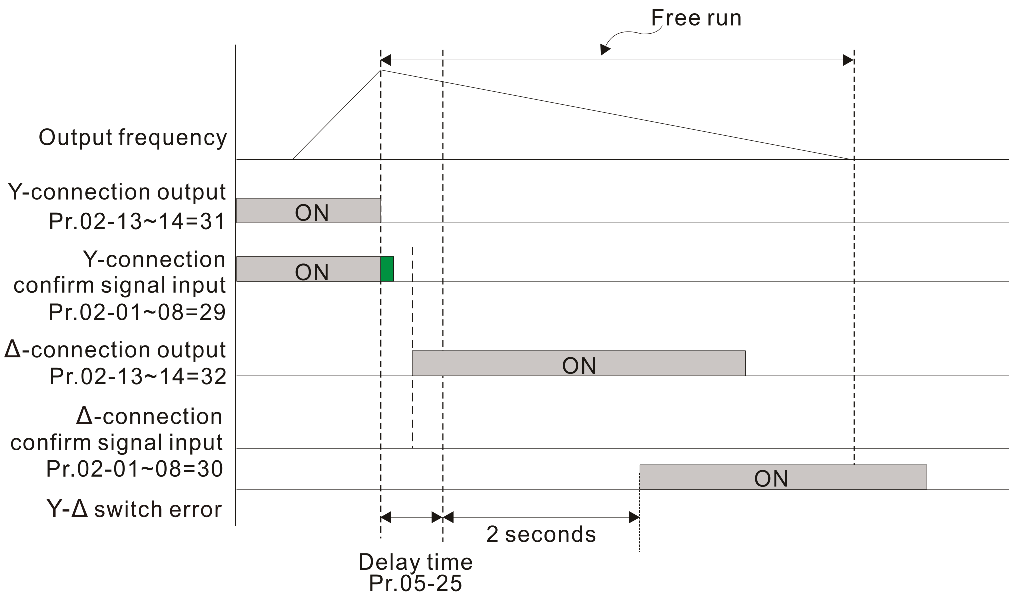
Settings 0.000–60.000 sec.

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





05-26 Accumulative Watt-second of Motor in Low Word (W-sec)

Default: Read only

Settings 0.0–6553.5

05-27 Accumulative Watt-second of Motor in High Word (W-sec)

Default: Read only

Settings 0.0–6553.5

05-28 Accumulative Watt-hour of Motor (W-Hour)

Default: Read only

Settings 0.0–6553.5

05-29 Accumulative Kilo Watt-hour of Motor in Low Word (KW-Hour)

Default: Read only

Settings 0.0–6553.5

05-30 Accumulative Kilo Watt-hour of Motor in High Word (KW-Hour)

Default: Read only

Settings 0–65535

- These parameters 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 × 1000000 + Pr.05-29 × 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 × 1000000 + 150 × 1000 + 40 = 76150400 Wh = 76150.4 kWh

05-31 Accumulated Motor Running Time (Minutes)

Default: 0

Settings 0–1439

05-32 Accumulated Motor Running Time (Days)

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 and Permanent Magnet Motor Selection

Default: 0

Settings 0: Induction Motor

1: SPM Permanent Magnet Motor

2: IPM Permanent Magnet Motor

05-34 Full-load current of Permanent Magnet Motor

Default: Depending on the model power

Settings Depending on the model power

Set 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 22.5A.

The setting range is between 40%–120% of rated current.

25 × 40% = 10 A and 25 × 120% = 30 A

05-35 Rated Power of Permanent Magnet Motor

Default: Depending on the model power

Settings 0.00–655.35 kW

Set the rated power for the permanent magnet synchronous motor. The default is the drive's power value.

05-36 Rated speed of Permanent Magnet Motor

Default: 2000

Settings 0–65535 rpm

05-37 Pole number of Permanent Magnet Motor

Default: 10

Settings 0–65535

05-38 Inertia of Permanent Magnet Motor

Default: Depending on the motor power

Settings 0.0–6553.5 kg-cm^2

Default values are as below:

Low Inertia Models

Rated Power (kW)	0.1	0.2	0.4	0.4	0.75	1	2
Rotor Inertia (kg.cm^2)	3.70E-02	1.77E-01	2.77E-01	6.80E-01	1.13	2.65	4.45

Medium / High Inertia Models

Rated Power (kW)	0.5	1	1.5	2	2	0.3	0.6	0.9
Rotor Inertia (kg.cm^2)	8.17	8.41	11.2	14.6	34.7	8.17	8.41	11.2

NOTE: The information for motor inertia refers to Pr.11-01.

05-39 Stator Resistance of PM Motor

Default: 0.000

Settings 0.000–65.535 W

05-40 Permanent Magnet Motor Ld

Default: 0.00

Settings 0.00–655.35 mH

05-41 Permanent Magnet Motor Lq

Default: 0.00

Settings 0.00–655.35 mH

✎ 05-42 PG Offset angle of PM Motor

Default: 0.0

Settings 0.0–360.0°

📖 When you set Pr.05-00 as 4, the drive detects the offset angle and writes it into Pr.05-42.

✎ 05-43 Ke parameter of PM Motor

Default: 0

Settings 0–65535 V / krpm

06 Protection Parameters

✔ You can set this parameter during operation.

✔ **06-00** Low Voltage Level

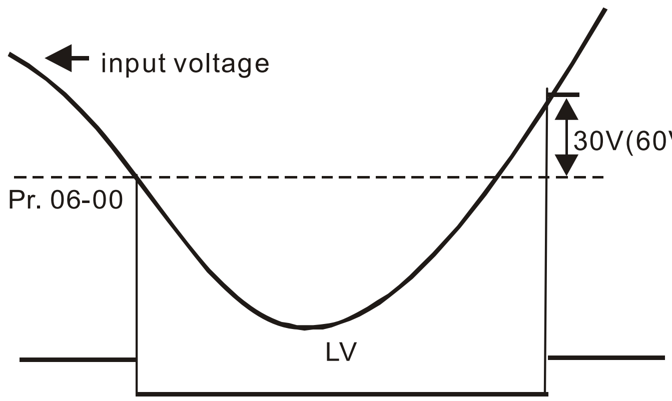
Default: 360.0

Settings 300.0–440.0 V_{DC}

📖 Set the Low Voltage (Lv) level. When the DC bus voltage is lower than Pr.06-00, a Lv fault is triggered, and the drive stops output and the motor coasts to a stop.

📖 If the Lv fault is triggered during operation, the drive stops output and the motor coasts to a stop. There are three Lv faults: LvA (Lv during acceleration), Lvd (Lv during deceleration), and Lvn (Lv in constant speed) that are triggered according to the status of acceleration or deceleration. You must press RESET to clear the Lv fault. The drive automatically restarts if you set to restart after momentary power loss (refer to Pr.07-06 Restart after Momentary Power Loss and Pr.07-07 Allowed Power Loss Duration for details).

📖 If the Lv fault is triggered when the drive is in STOP status, the drive displays LvS (Lv during stop), which is not recorded, and the drive restarts automatically when the input voltage is higher than low voltage level 60V.



✔ **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 brake resistor). Use this setting when braking units or brake resistors are connected to the drive.

📖 Setting Pr.06-01 to a value > 0.0 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:

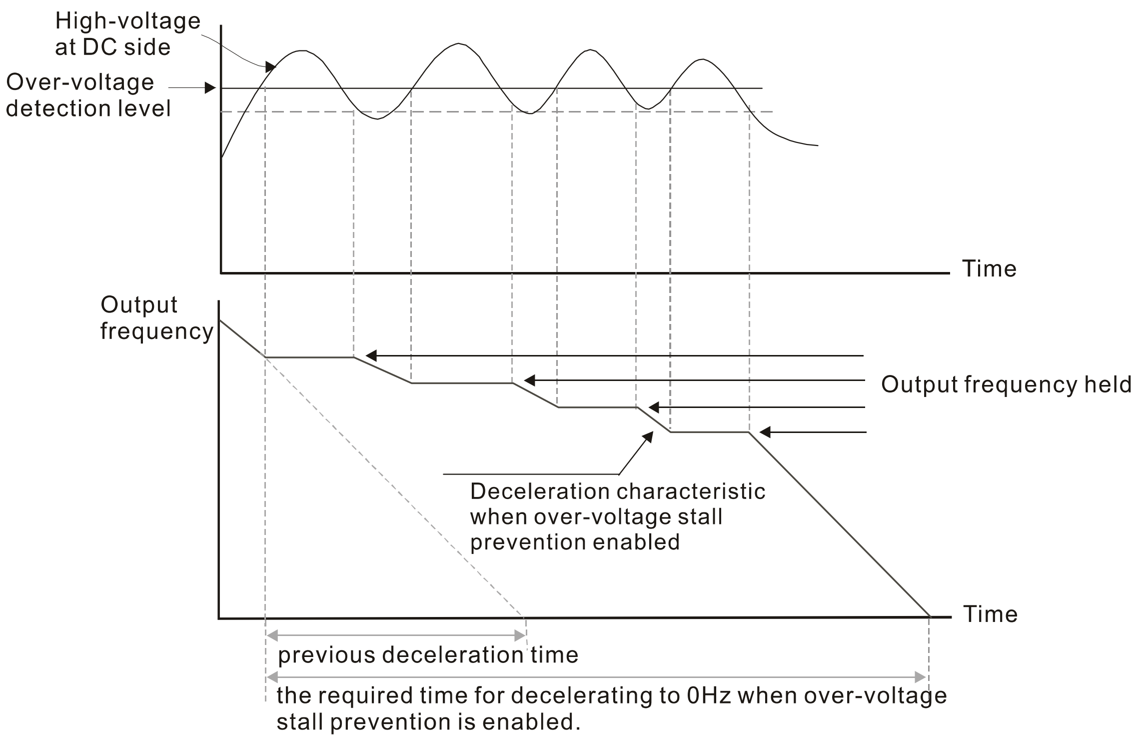
- Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4
- Pr.02-13–Pr.02-14 Multiple-function Output (Relay 1 and Relay 2)
- Pr.02-16–Pr.02-17 Multiple-function output (MO1 and MO2)
- Pr.06-02 Selection for Over-voltage Stall Prevention.

06-02 Selection for Over-Voltage Stall Prevention

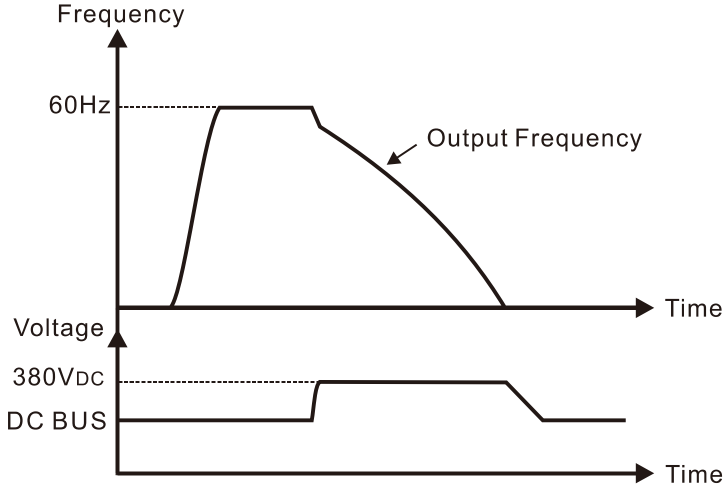
Default: 0

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

- Use this function when you are unsure about the load inertia. When stopping under normal load, the over-voltage does not occur during deceleration and meet the deceleration time setting. Sometimes it may not stop due to over-voltage during decelerating to STOP when the load regenerative inertia increases. In this case, the AC motor drive extends the deceleration time automatically until the drive stops.
- Normal condition: DC bus < Pr.06-01 Over-voltage stall prevention
  1. Pr.06-02 = 0:
     During deceleration the motor exceeds the synchronous speed due to load inertia. In this case, the motor becomes an electrical generator. The DC bus voltage may exceed its maximum allowable value due to motor regeneration in some situations, such as motor's loading inertia being too high or drive's deceleration time being set too short. When you enable traditional over-voltage stall prevention and the DC bus voltage detected is too high, the drive stops decelerating (output frequency remains unchanged) until the DC bus voltage drops below the setting value.



2. Pr.06-02 = 1:
   To use smart over-voltage stall prevention during deceleration, the drive maintains the DC bus voltage when decelerating and prevents the drive from ov.



230V Series

📖 When you enable the over-voltage stall prevention, the drive's deceleration time is longer than the setting.

📖 If you encounter any problem with the deceleration time, refer to the following guides for troubleshooting.

1. Increase the deceleration time to a proper value.
2. Install a brake resistor (refer to Section 7-1 Brake Resistors and Brake Units Used in AC motor Drives for details) to dissipate the electrical energy that is regenerated from the motor.

📖 Related parameters:

- Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4
- Pr.02-13–Pr.02-14 Multiple-function Output (Relay 1 and Relay 2)
- Pr.02-16–Pr.02-17 Multiple-function Output (MO1 and MO2)
- Pr.06-01 Over-voltage Stall Prevention.

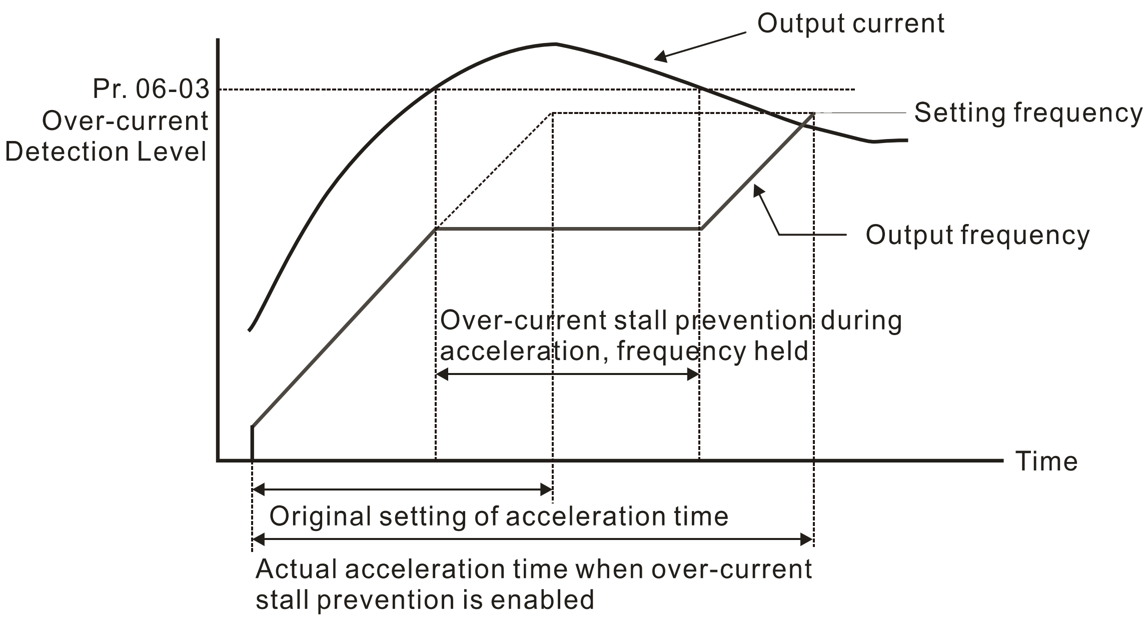
✓ 06-03 Over-Current Stall Prevention during Acceleration

		Default:
Settings	Light duty: 0–160% (100% corresponds to the rated current of the drive)	120
	Heavy duty: 0–180% (100% corresponds to the rated current of the drive)	150

📖 This parameter only works in VF, VFPG, and SVC control mode.

📖 If the motor load is too large or the drive's acceleration time is too short, the output current of the drive may be too high during acceleration, and it may cause motor damage or trigger the drive's protection functions (oL or oc). Use this parameter to prevent these situations.

📖 During acceleration, the output current of the drive may increase abruptly and exceed the setting value of Pr.06-03. In this case, the drive stops accelerating and keeps the output frequency constant, and then continues to accelerate until the output current decreases.

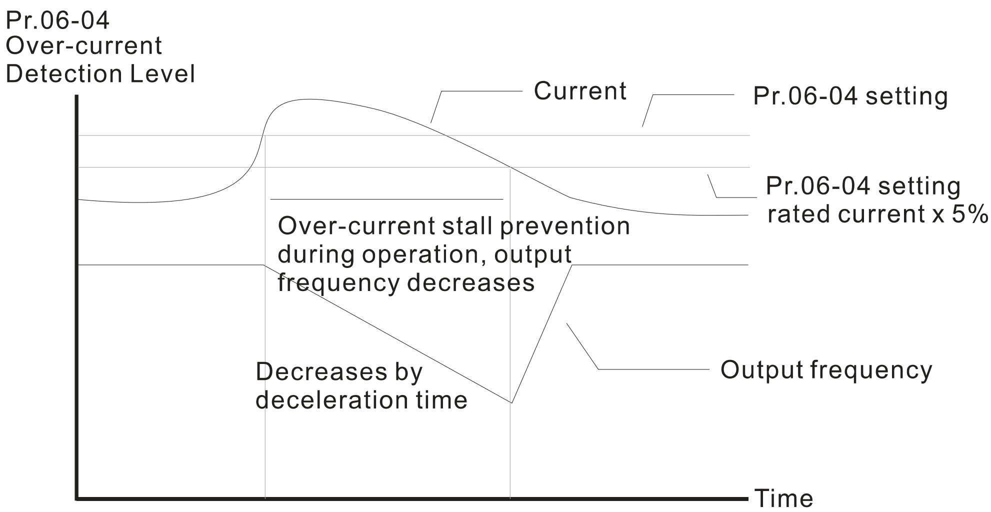


- When you enable the over-current stall prevention, the drive's acceleration time is longer than the setting.
- When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the Pr.06-03 setting value.
- If you encounter any problem with the acceleration time, refer to the following guides for troubleshooting.
  1. Increase the acceleration time to a proper value.
  2. Set Pr.01-44 Auto Acceleration and Auto-Deceleration Setting to 1, 3 or 4 (auto-acceleration).
  3. Related parameters:
     - Pr.01-12, Pr.01-14, Pr.01-16, Pr.01-18 Acceleration Time 1–4
     - Pr.01-44 Auto Acceleration and Auto-Deceleration Setting
     - Pr.02-13–02-14 Multi-function Output 1 (Relay 1 and Relay 2)
     - Pr.02-16–02-17 Multi-function Output (MO1 and MO2)

06-04 Over-Current Stall Prevention during Operation

Settings	Default:
Light duty: 0–160% (100% corresponds to the rated current of the drive)	120
Heavy duty: 0–180% (100% corresponds to the rated current of the drive)	150

- This parameter only works in VF, VFPG, 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 decelerates according to the Pr.06-05 setting 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 Accel. /Decel. Time Selection of Stall Prevention at Constant Speed

Default: 0

Settings
0: By current acceleration / deceleration time
1: By the first acceleration / deceleration time
2: By the second acceleration / deceleration time
3: By the third acceleration / deceleration time
4: By the fourth acceleration / deceleration time
5: By Auto-acceleration / auto-deceleration

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

06-06 Over-Torque Detection Selection (OT1)
06-09 Over-Torque Detection Selection (OT2)

Default: 0

Settings
0: No function
1: Over-torque detection during constant speed operation, continue to operate after detection
2: Over-torque detection during constant speed operation, stop operation after detection
3: Over-torque detection during operation, continue to operation after detection
4: Over-torque detection during operation, stop operation after detection

- When you set Pr.06-06 and Pr.06-09 to 1 or 3, a warning message displays, but there is no error record.
- When you set Pr.06-06 and Pr.06-09 to 2 or 4, an error message displays and there is an error record.

06-07 Over-Torque Detection Level (OT1)

Default: 120

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

06-08 Over-Torque Detection Time (OT1)

Default: 0.1

Settings 0.0–60.0 sec.

06-10 Over-Torque Detection Level (OT2)

Default: 120

Settings 10–250%

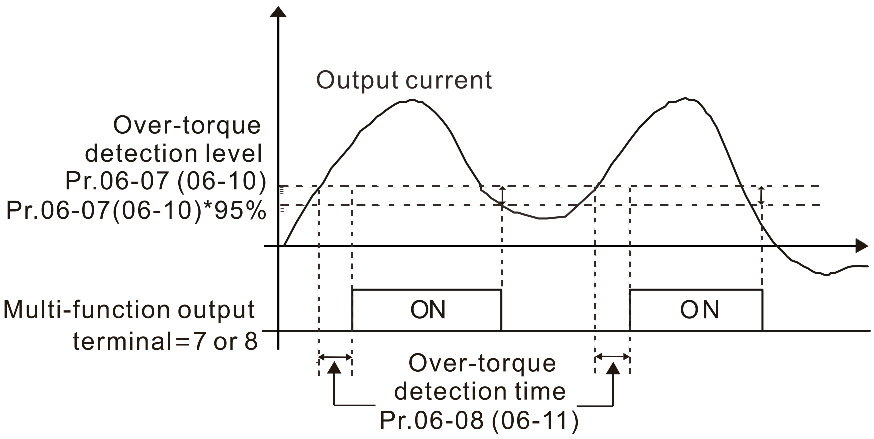
(100% corresponds to the rated current of the drive)

06-11 Over-Torque Detection Time (OT2)

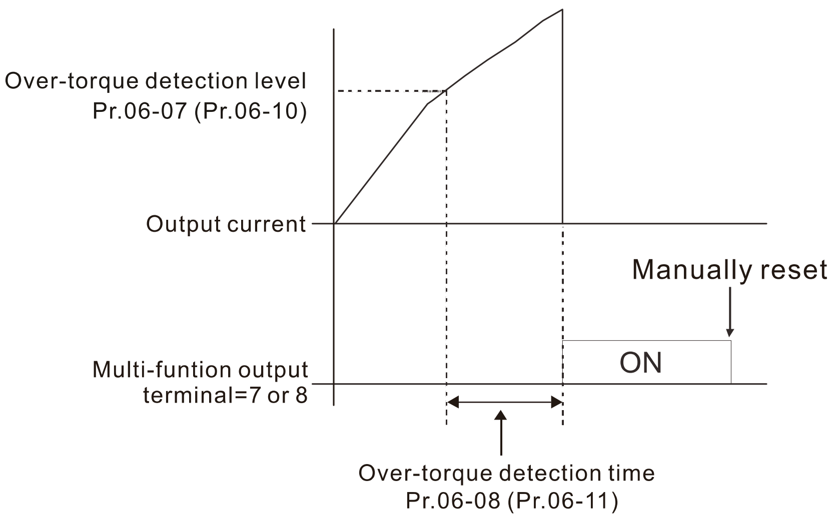
Default: 0.1

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 after over-torque detection. 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 does not run until you manually reset it.



06-12 Current Limit

Default: 170

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

- Pr.06-12 sets the maximum output current of the drive. Pr.06-12 and Pr.11-17–Pr.11-20 are used to set the drive's output current limit. When the drive is in VF, SVC or VFPG control mode, output frequency will decrease as the output current reaches current limit. It is a current stall prevention.

✎ 06-13 Electronic Thermal Relay Selection 1 (Motor 1)
✎ 06-27 Electronic Thermal Relay Selection 2 (Motor 2)

Default: 2

Settings 0: Inverter motor
(fan doesn't run with the axel synchronously)
1: Standard motor
(fan runs with the axel synchronously)
2: Electronic thermal relay disabled

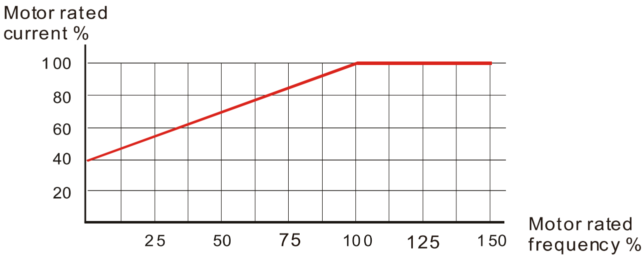
- Prevent self-cooled motor from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.
- Setting the parameter to 0 is suitable for an inverter motor (motor fan using an independent power supply). For this kind of motor, there is no significant correlation between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

✎ 06-14 Electronic Thermal Relay Action Time 1 (Motor 1)
✎ 06-28 Electronic Thermal Relay Action Time 2 (Motor 2)

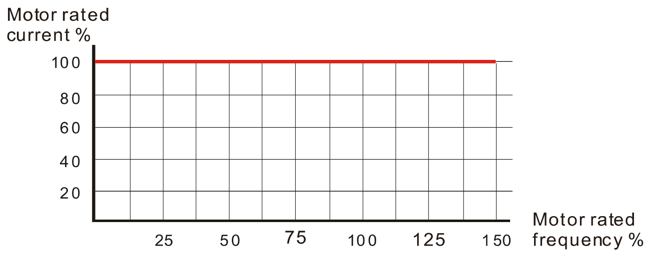
Default: 60.0

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 coasts to stop.
- Use this parameter to set the action time of the 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 the motor from overheating.

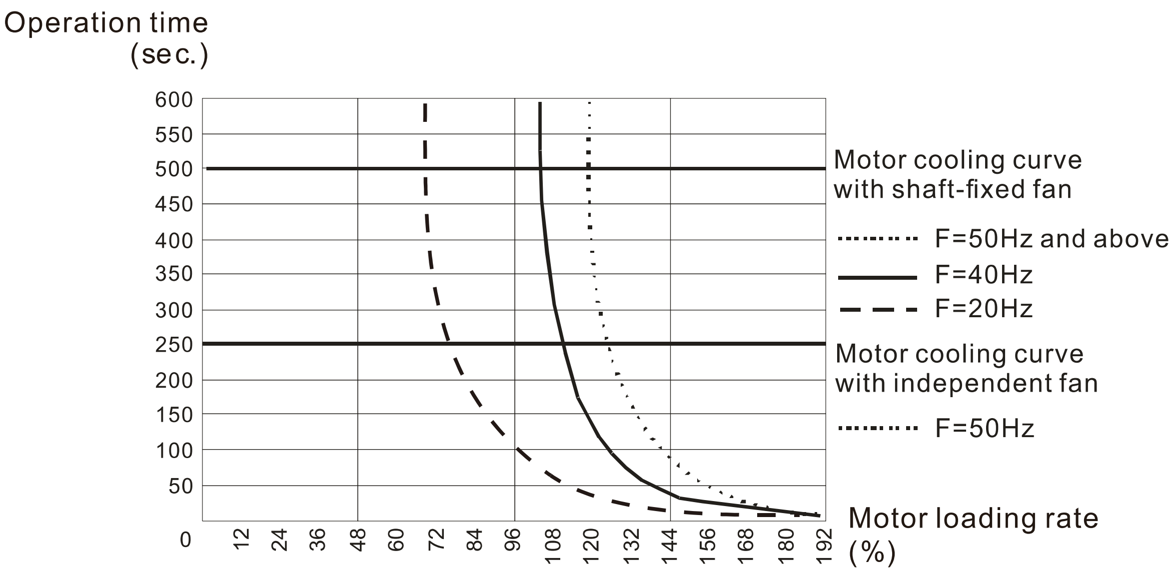


Motor cooling curve with shaft-fixed fan



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 is set to 0 (using inverter motor):
     When the output current of motor drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in 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 Pr.06-28.
  2. Pr.06-13 or Pr.06-27 is set to 1 (using standard motor):
     When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in 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 Pr.06-28.
  3. If the motor's rated current (Pr.05-01) is not set, then set 90% of the drive's rated current (Pr.00-01) as the default value of this parameter.
- The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following diagram: (The motor cooling curve with shaft-fixed fan and motor cooling curve with independent fan F = 50 Hz are the same one.)



✗ 06-15 Temperature Level Overheat (OH) Warning

Default: 105.0

Settings 0.0–110.0°C

- If Pr.06-15 is set to 110ºC, when the temperature reaches 110ºC, the drive stops with an IGBT over-heat fault.
- For Frame C and above, when IGBT temperature is above Pr.06-15 minus 15ºC, the cooling fan enhances performance to 100%; however, when IGBT temperature is below 35ºC of Pr.06-15 and the temperature of CAP is below 10ºC of capacitor oH warning level (Pr.06-51), the cooling fan resets. The temperature 35ºC is the criterion if Pr.06-15 is set below 35ºC.

✗ 06-16 Stall Prevention Limit Level

Default: 50

Settings 0–100% (refer to Pr.06-03)

- When operation frequency is larger than Pr.01-01; e.g. Pr06-03=150%, Pr. 06-04=100% and Pr. 06-16=80%:
  Calculate the Stall Prevention Level during acceleration: Pr.06-03 x Pr.06-16=150 x 80% = 120%.
  Calculate the Stall Prevention Level at constant speed: Pr.06-04 x Pr.06-16=100 x 80% = 80%.

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

Default: 0

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: Stop mid-low voltage (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 1 (EoL1)
23: Electronics thermal relay 2 (EoL2)
24: Motor overheat (oH3) (PTC / PT100)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Low current (uC)
29: Home limit error (LMIT)
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: Ground current detection error (Hd3)
40: Auto tuning error (AUE)
41: PID feedback loss (AFE)
42: PG feedback error (PGF1)
43: PG feedback loss (PGF2)
44: PG feedback stall (PGF3)
45: PG slip error (PGF4)
48: Analog current input loss (ACE)
49: External fault input (EF)
50: Emergency stop (EF1)
51: External Base Block (bb)
52: Password error (PcodE)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (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)
65: PG Card Error (PGF5)

68: Sensorless estimated speed have wrong direction
69: Sensorless estimated speed is over speed
70: Sensorless estimated speed deviated
73: External safety gate S1
82: U phase output phase loss (OPHL)
83: V phase output phase loss (OPHL)
84: W phase output phase loss (OPHL)
85: PG-02U ABZ hardware disconnection
86: PG-02U UVW hardware disconnection
89: Initial rotor position detection error
90: Inner PLC function is forced to stop
101: CANopen software disconnect1 (CGdE)
102: CAN open software disconnect2 (CHbE)
104: CANopen hardware disconnect (CbFE)
105: CANopen index setting error (CIdE)
106: CANopen station address error (CAdE)
107: CANopen memory error (CFrE)
111: Internal communication overtime error (InrCOM)
112: PM sensorless shaft Lock error

- The parameters record when the fault occurs and forces a stop.
- When low-voltage at stop fault (LvS) occurs, the fault is not recorded. When low-voltage during operation faults (LvA, Lvd, Lvn) occur, the faults are recorded.
- 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 Pr.06-23–Pr.06-26 to 35–38) for the specific requirement. When the fault occurs, the corresponding terminals are activated. 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 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)	●						

Fault Code	bit0	bit1	bit2	bit3	bit4	bit5	bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
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: Stop mid-low voltage (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 1 (EoL1)			●				
23: Electronics thermal relay 2 (EoL2)			●				
24: Motor overheat (oH3) (PTC / PT100)			●				
26: Over-torque 1 (ot1)			●				
27: Over-torque 2 (ot2)			●				
28: Low current (uC)	●						
29: Home limit error (LMIT)						●	
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: Ground current detection error (Hd3)				●			
40: Auto tuning error (AUE)				●			
41: PID feedback loss (AFE)					●		
42: PG feedback error (PGF1)					●		
43: PG feedback loss (PGF2)					●		
44: PG feedback stall (PGF3)					●		
45: PG slip error (PGF4)					●		

Fault Code	bit0 current	bit1 Volt.	bit2 OL	bit3 SYS	bit4 FBK	bit5 EXI	bit6 CE
48: Analog current input loss (ACE)					●		
49: External fault input (EF)						●	
50: Emergency stop (EF1)						●	
51: External Base Block (bb)						●	
52: Password error (PcodE)				●			
54: Illegal command (CE1)							●
55: Illegal data address (CE2)							●
56: Illegal data value (CE3)							●
57: Data is written to read-only address (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)						●	
65: PG Card Error (PGF5)						●	
68: Sensorless estimated speed have wrong direction						●	
69: Sensorless estimated speed is over speed						●	
70: Sensorless estimated speed deviated						●	
73: External safety gate S1				●			
82: U phase output phase loss (OPHL)	●						
83: V phase output phase loss (OPHL)	●						
84: W phase output phase loss (OPHL)	●						
85: PG-02U ABZ hardware disconnection					●		
86: PG-02U UVW hardware disconnection					●		
89: Initial rotor position detection error					●		
90: Inner PLC function is forced to stop				●			
101: CANopen software disconnect1 (CGdE)							●
102: CAN open software disconnect2 (CHbE)							●
104: CANopen hardware disconnect (CbFE)							●
105: CANopen index setting error (CIdE)							●
106: CANopen station address error (CAdE)							●
107: CANopen memory error (CFrE)							●
111: Internal communication overtime error (InrCOM)							●
112: PM sensorless shaft Lock error					●		

✓ 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

- Define how the drive operates after PTC detection.

✓ 06-30 PTC Level

Default: 50.0

Settings 0.0–100.0%

- Sets AVI / ACI / AUI analog input function Pr.03-00–03-02 to 6 [thermistor (PTC) input value].
- Use this to set the PTC level, the corresponding value for 100% is the analog input maximum value.

06-31 Frequency Command at 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 Bus Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

- When a malfunction occurs, check the current DC bus 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 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.

06-39 Torque Command at Malfunction

Default: Read only

Settings -32767–32767%

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

06-40 Status of The Multi-Function Input Terminal at Malfunction
06-41 Status of The Multi-Function Output Terminal at Malfunction

Default: Read only

Settings 0000h–FFFFh

📖 When a malfunction occurs, check the current torque command. 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.

✔ 06-45 Output Phase Loss Detection Action (OPHL)

Default: 3

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

📖 The OPHL protection is enabled when Pr.06-45 is not set to 3.

06-46 Detection Time for Output Phase Loss

Default: 0.500

Settings 0.000–65.535 sec.

06-47 Current Detection Level for Output Phase Loss

Default: 1.00

Settings 0.00–100.00%

06-48 DC Brake Time for Output Phase Loss

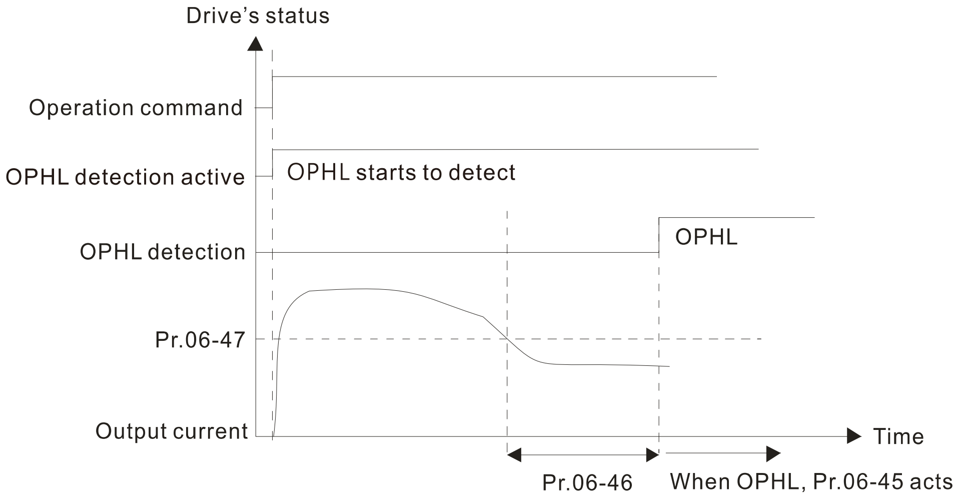
Default: 0.000

Settings 0.000–65.535 sec.

- Setting Pr.06-48 to 0 disables the OPHL detection function before operation.
- The statuses of output phase loss detection are as following:

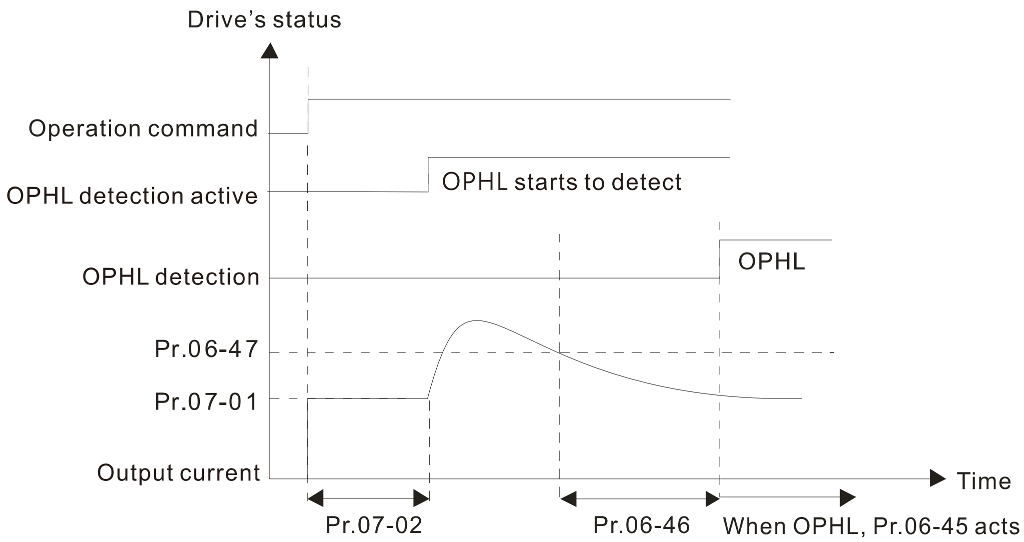
• Status 1: The drive is in operation

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



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

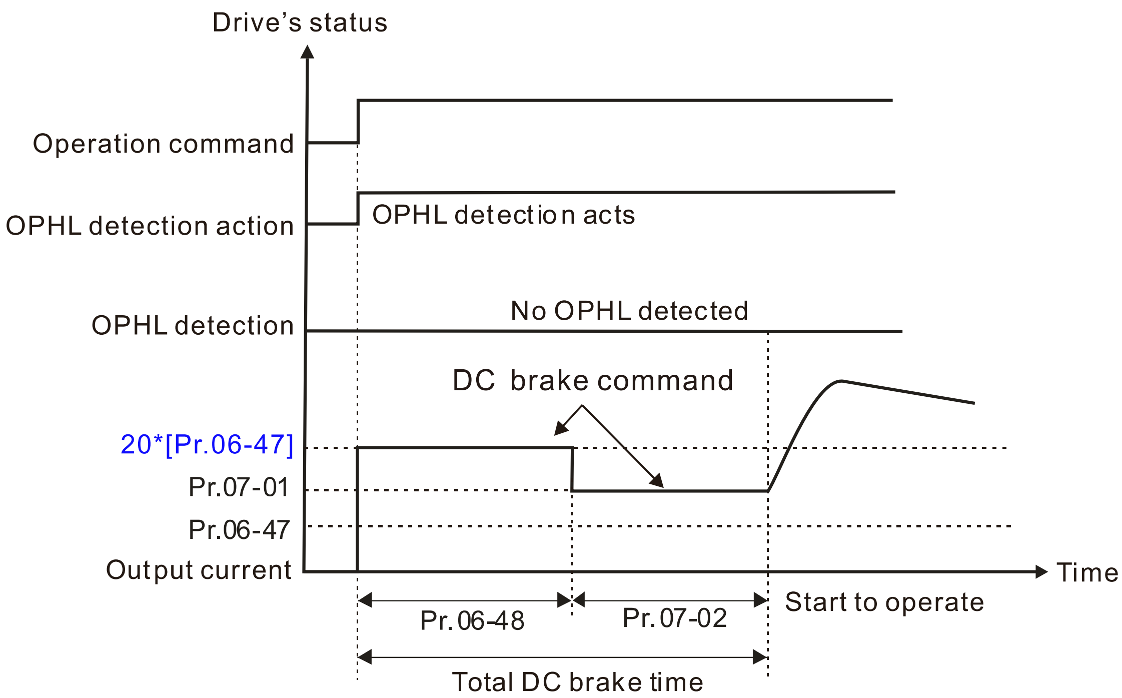
After the drive starts, the DC brake operates according to Pr.07-01 and Pr.07-02. During this period, OPHL detection is not active. After the DC brake action is completed, the drive starts to run, and enables the OPHL protection as mentioned above for status 1.



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

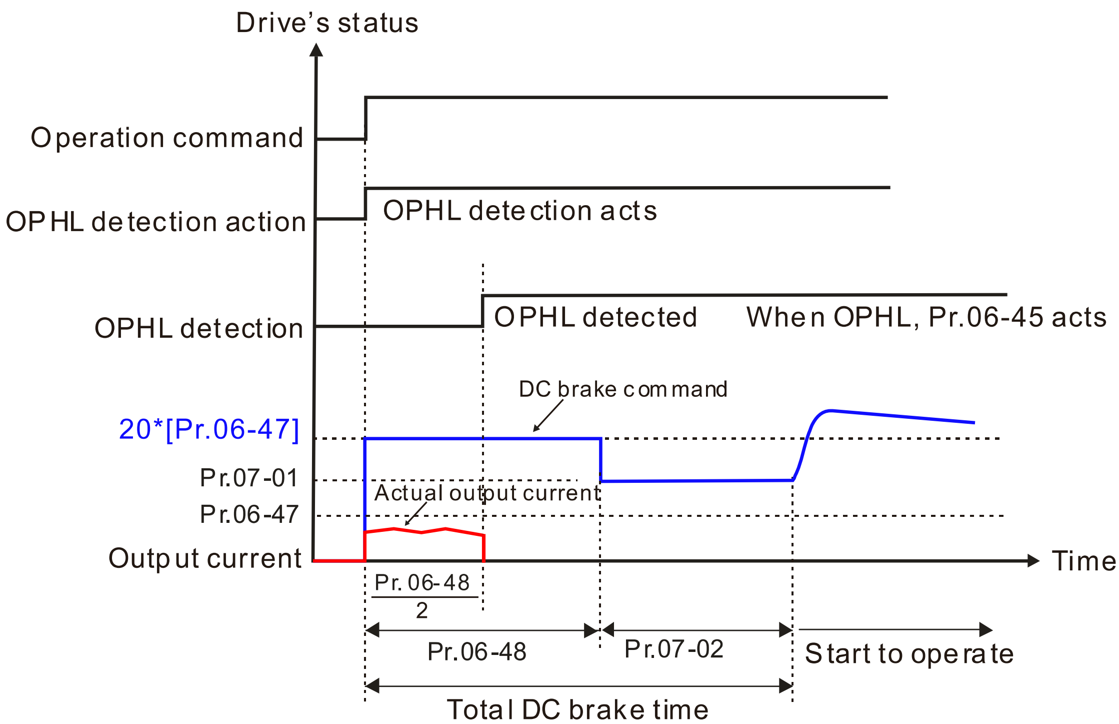
When the drive starts, it executes Pr.06-48 first, and then executes Pr.07-02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the Pr.06-47 setting value in Pr.06-48 setting time; the other is the Pr.07-02 setting value in Pr.07-01 setting time. The total DC brake time T = Pr.06-48 + Pr.07-02.

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)

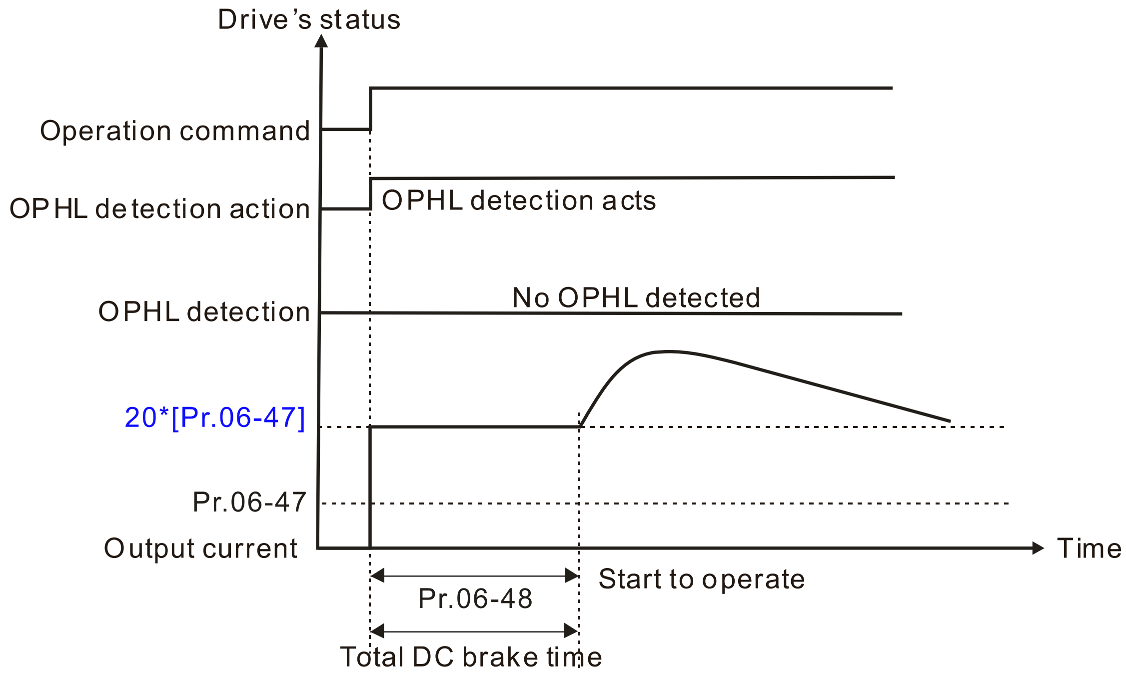
In this period, if an OPHL occurs within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.



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

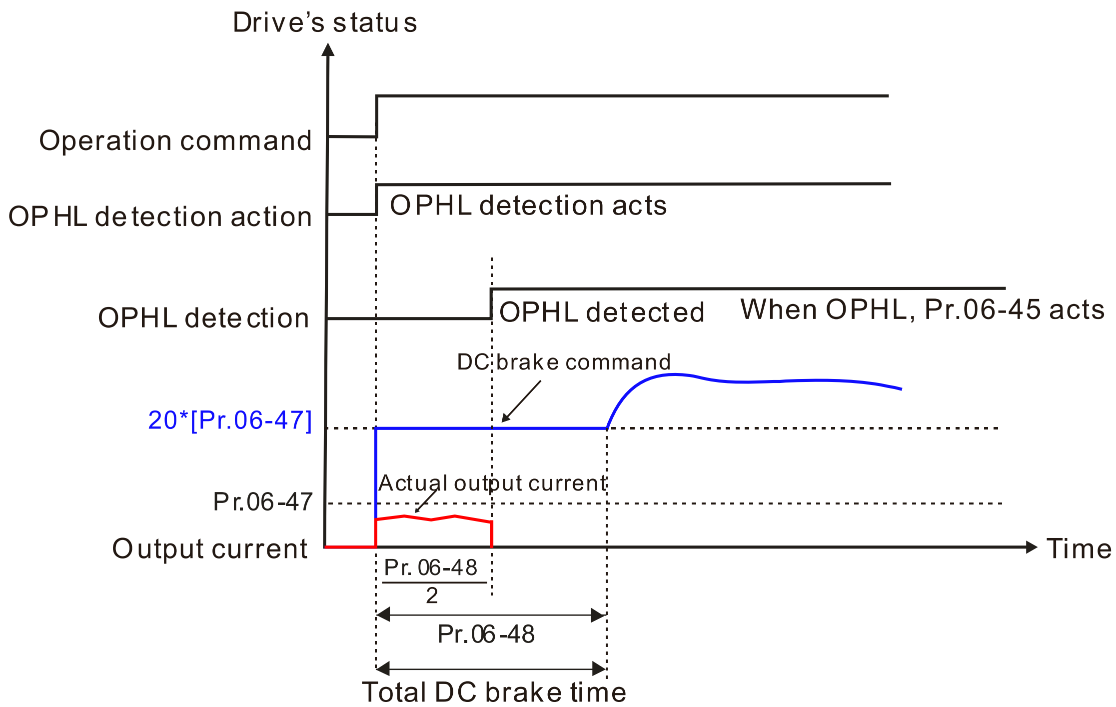
When the drive starts, it executes Pr.06-48 as the DC brake. The DC brake current level is 20 times the Pr.06-47 setting value.

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)

In this period, if an OPHL occurs 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.



✓ 06-49 Lvx Auto-Reset

Default: 0

Settings 0: Disabled

1: Enabled

✓ 06-50 Time for Input Phase Loss Detection

Default: 0.2

Settings 0.00–600.00 sec.

✓ 06-52 Ripple of Input Phase Loss

Default: 60.0

Settings 0.0–320.0 V_{DC}

✓ 06-53 Input Phase Loss Detection Action (OrP)

Default: 0

Settings 0: Fault and ramp to stop

1: Fault and coast to stop

- When the drive detects the DC bus ripple exceeds the setting for Pr.06-52, and lasts for the time of Pr.06-50 plus 30 seconds, the drive executes the input phase loss protection according to Pr.06-53.
- During the time of Pr.06-50 plus 30 seconds, if the DC bus ripple drops lower than the setting for Pr.06-52, the Orp protection recalculates.

✓ 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

- Refer to Pr.00-01 (Maximum Operation Frequency) for allowable maximum output frequency in each control mode.
- The corresponded carrier frequency lower limit under each control mode:
  - VF, SVC, VFPG, and PM Sensorless: Maximum operation frequency (Pr.01-00) × 10 minimum sampling point limit.
  - FOCPG, IMFOC Sensorless, and IPM Sensorless: Maximum operation frequency (Pr.01-00) × 20 minimum sampling point limit.
  - Example: Maximum operation frequency (Pr.01-00) is 400 Hz, the minimum sampling point limit of VF, SVC, VFPG, and PM Sensorless is 4 kHz (=400 Hz × 10). The minimum sampling point limit of FOCPG, IMFOC Sensorless, and IPM Sensorless is 8kHz (=400 Hz × 20).
- Refer to Section 9-7 Derating for Ambient Temperature, Altitude and Carrier Frequency for the derating ratio.
- Setting 0:

- Actual over-current stall prevention level = derating ratio × over-current stall prevention level (Pr.06-03 and 06-04)
- Rated current derating level: derating ratio × rated current (Pr.00-01)
- When the operating point is greater than the derating curve, the carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and overload time.
- Applicable conditions: 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.
- Take VFD055CT43F21A3 Light Duty for example: ambient temperature 50ºC, UL Open Type, and independent installation. When the carrier frequency is set to 15 kHz, it corresponds to 72% of the derating ratio. When the output current is higher than this value, it automatically decreases the carrier frequency according to the ambient temperature, output current and overload time (for example: set Pr.06-03 to 120%). At this time, the over-current stall prevention level is 67% (=56% × 120%) of the rated current (Pr.00-01).

📖 Setting 1:

- Actual over-current stall prevention level = derating ratio × over-current stall prevention level (Pr.06-03 and 06-04)
- When the operating point is greater than the derating curve, the carrier frequency (Fc) output by the drive is fixed to the default value.
- Applicable conditions: Select this mode if the change of carrier frequency and motor noise caused by ambient temperature and frequent overload are not acceptable. Refer to Pr.00-17.
- Take VFD055CT43F21A3 Heavy Duty for example: ambient temperature 50ºC, UL Open Type, and independent installation. When the carrier frequency is set to 15 kHz, it corresponds to 56% of the derating ratio. When the output current is higher than 12% of the rated output current, the carrier frequency unchanged. However, if the overload continues for a long time, the oH1 fault (IGBT overheating) or oL fault (the drive overload) will be triggered due to the IGBT temperature rise, and the drive will eventually stop.

📖 Setting 2:

- Actual over-current stall prevention level = over-current stall prevention level (Pr.06-03 and 06-04)
- Rated current derating level: derating ratio × rated current (Pr.00-01)
- The protection method and action are set to 0, the carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and overload time, but does not change the over-current stall prevention level limit. The overload capacity is 180% rated current (Pr.00-01) in heavy duty and 200% rated current (Pr.00-01) in super heavy duty.
- Applicable conditions: It can provide a higher starting output current than Pr.06-55 = 0 when the carrier frequency (Pr.00-17) setting is greater than the default.

- Take VFD055CT43F21A3 Light Duty for example: ambient temperature 50ºC, UL Open

Type, and independent installation. When the carrier frequency is set to 15 kHz, it corresponds to 56% of the derating ratio. When the output current is higher than this value, the carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and overload time. If Pr.06-03 is 120%, the over-current stall prevention level is 120% of the rated current (Pr.00-01).

- The ambient temperature 60ºC corresponds to 72% × 80% of the rated output current.

📖 Use with the settings for Pr.00-16 and Pr.00-17.

📖 The ambient temperature also affects the derating; refer to Section 9-7 “Ambient Temperature Derating Curve”. Take VFD055CT43F21A3 Heavy Duty for example: ambient temperature 50ºC, UL Open Type, and independent installation. When the carrier frequency is set to 15 kHz, it corresponds to 56% of the rated output current. If the ambient temperature is 60ºC, it corresponds to 44.8% (= 56% × 100% - (60-50) × 2%) of the rated output current.

✎ 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: PT100 voltage level 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 (AVI, AUI, and ACI voltage 0–10 V) and select PT100 mode.

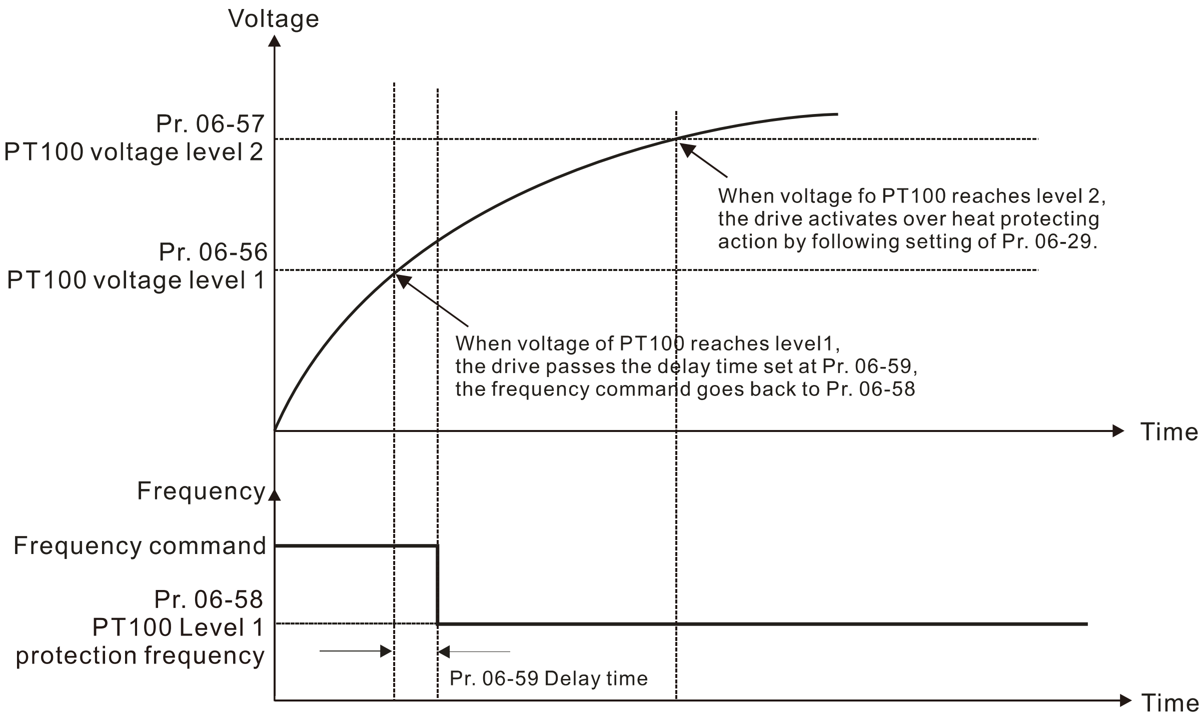
(2) Select one of the voltage type analog inputs below: (a) AVI (Pr.03-00=11), (b) AUI (Pr.03-02=11), or (c) ACI (Pr.03-01=11 and Pr.03-29=1).

(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.

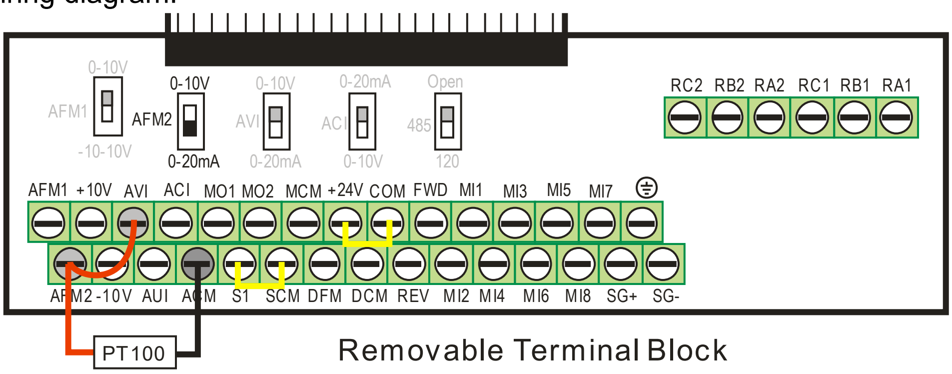
(4) The AFM2 outputs constant voltage or current, then Pr.03-23 = 23. You must switch AFM2 SW2 to 0–20 mA for the external I/O board, and set AFM2 output level to 45% (Pr.03-33 = 45%) of 20 mA = 9 mA.

(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:



When Pr.06-58 = 0.00 Hz, PT100 function is disabled.

Case:

When using PT100, if the motor temperature is higher than 135ºC (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 AVI to "short circuit"
3. Set Pr.03-00 = 11, Pr.03-23 = 23 or Pr.03-33 = 45% (9 mA)

4. Refer to the RTD temperature and resistance comparison table
   Temperature = 135ºC, resistance = 151.71 Ω; input current: 9 mA, voltage: about 1.37 V_{DC}
   Temperature = 150ºC, resistance = 157.33 Ω; input current: 9 mA, voltage: about 1.42 V_{DC}
5. When the RTD temperature > 135ºC, the drive decelerates to the specified operation frequency automatically. Then, Pr.06-56 = 1.37 V and Pr.06-58 = 10 Hz. (When Pr.06-58 = 0, it disables the specified operation frequency.)
6. When the RTD temperature > 150ºC, the drive outputs a fault, decelerates to STOP, and displays the warning "oH3". Then, Pr.06-57 = 1.42 V and Pr.06-29 = 1 (fault and ramp to stop).

06-60 Software Detection GFF Current Level

Default: 60.0

Settings 0.0–200.0%

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 of Fault Record 1 (Minute)
06-66 Operation Time of Fault Record 2 (Minute)
06-68 Operation Time of Fault Record 3 (Minute)
06-70 Operation Time of Fault Record 4 (Minute)

Default: Read only

Settings 0–1439 min.

📖 If there are any malfunctions when the drive operates, Pr.06-17–Pr.06-22 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 another 1000 minutes.

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

	1st fault	2nd fault	3rd fault	4th fault	5th fault	6th fault
Pr.06-17	ocA	ocd	ocn	ocA	ocd	ocn
Pr.06-18	0	ocA	ocd	ocn	ocA	ocd
Pr.06-19	0	0	ocA	ocd	ocn	ocA
Pr.06-20	0	0	0	ocA	ocd	ocn
Pr.06-21	0	0	0	0	ocA	ocd
Pr.06-22	0	0	0	0	0	ocA
Pr.06-63	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

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

06-71 Low Current Setting Level

Default: 0.0

Settings 0.0–100.0%

06-72 Low Current Detection Time

Default: 0.00

Settings 0.00–360.00 sec.

06-73 Low Current Action

Default: 0

Settings 0: No function

1: Fault and coast to stop

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

3: Warn and continue operation

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

07 Special 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

✓ You can set this parameter during operation.

✓ 07-00 Software Brake Chopper Action Level

Default: 760.0

Settings 700.0–900.0 V_{DC}

📖 Set the DC bus voltage at which the brake chopper is activated. Choose a suitable brake resistor to achieve the best deceleration. Refer to Chapter 7 Optional Accessories for information about brake resistors.

📖 This parameter is only valid for 460V models of 30 kW and below.

✓ 07-01 DC Brake Current Level

Default: 0

Settings 0–100%

📖 100% corresponds to the rated current of the drive (Pr.00-01 x 1.414).

📖 Set the level of the DC brake current output to the motor at start-up and stop. It is recommended that you start with a low DC brake current level and then increase until you reach the proper holding torque. However, the DC brake current cannot exceed the motor's rated current to prevent the motor from burnout. 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 Start-Up

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 stop to get a stable start before motor operation. This parameter determines the duration of the DC brake current output to the motor when the drive starts up. Setting this parameter to 0.0 disables the DC brake at start-up.

✓ 07-03 DC Brake Time at STOP

Default: 0.0

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.

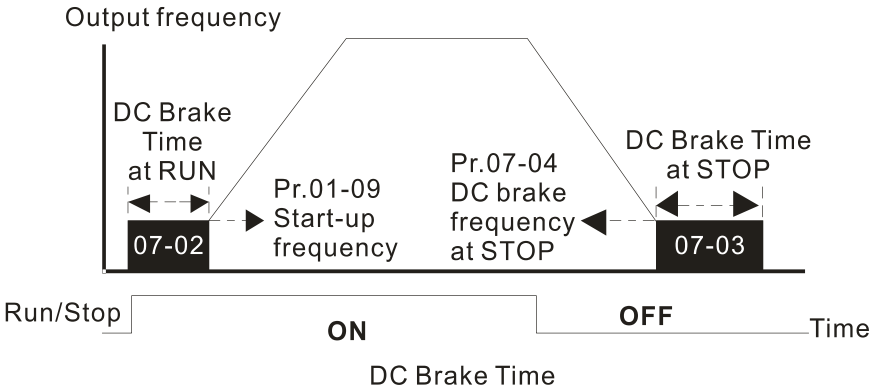
- This parameter determines the duration of the DC brake current output to the motor when braking. To enable the DC brake at STOP, you must set Pr.00-22 (Stop Method) to 0 (ramp to stop). Set this parameter to 0.0 to disable the DC brake at stop .
- Related parameters: Pr.00-22 Stop Method, Pr.07-04 DC Brake Frequency at STOP.

07-04 DC Brake Frequency at STOP

Default: 0.00

Settings 0.00–599.00 Hz

- Determine 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 for the DC brake begins at the minimum frequency.



- 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 running status and in unknown rotation direction before the drive starts up. Execute the DC brake before you start the motor.
- Use the DC Brake at STOP when you need to brake the motor quickly or to control the positioning, such as with cranes or cutting machines.

07-05 Voltage Increasing Gain

Default: 100

Settings 1–200%

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

07-06 Restart after Momentary Power Loss

Default: 0

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

- Determine 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 voltages after the drive 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.
- In PG control mode, the AC motor drive executes the speed tracking function automatically according to the PG speed when this setting is NOT set to 0.
- 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.

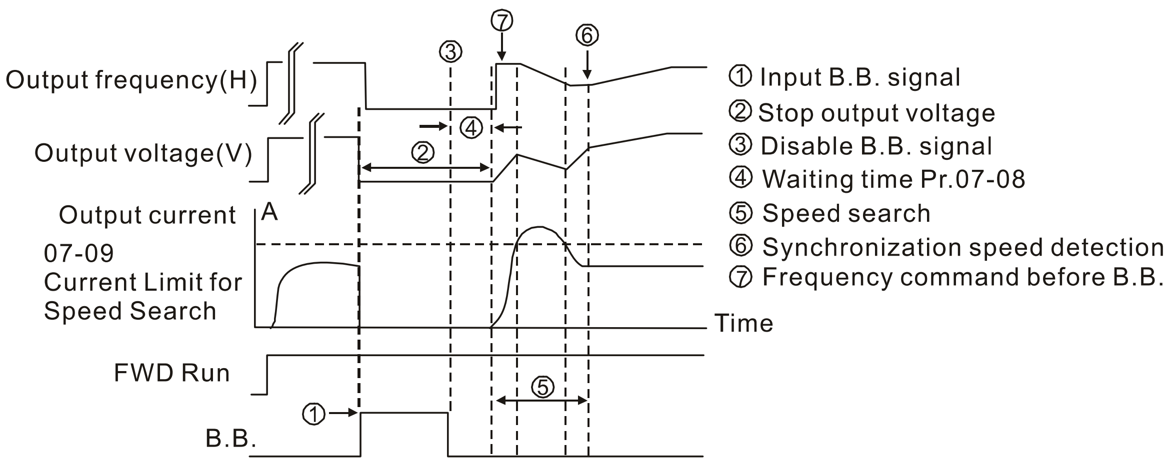
- Determine the maximum time of allowable power loss. If the duration of a power loss exceeds this parameter setting, the AC motor drive stops output after the power recovers.
- Pr.07-06 is valid when the maximum allowable power loss time is ≤ 20 seconds and the AC motor drive displays “Lv”. If the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is ≤ 20 seconds, Pr.07-06 is invalid after the power recovers.

07-08 Base Block Time

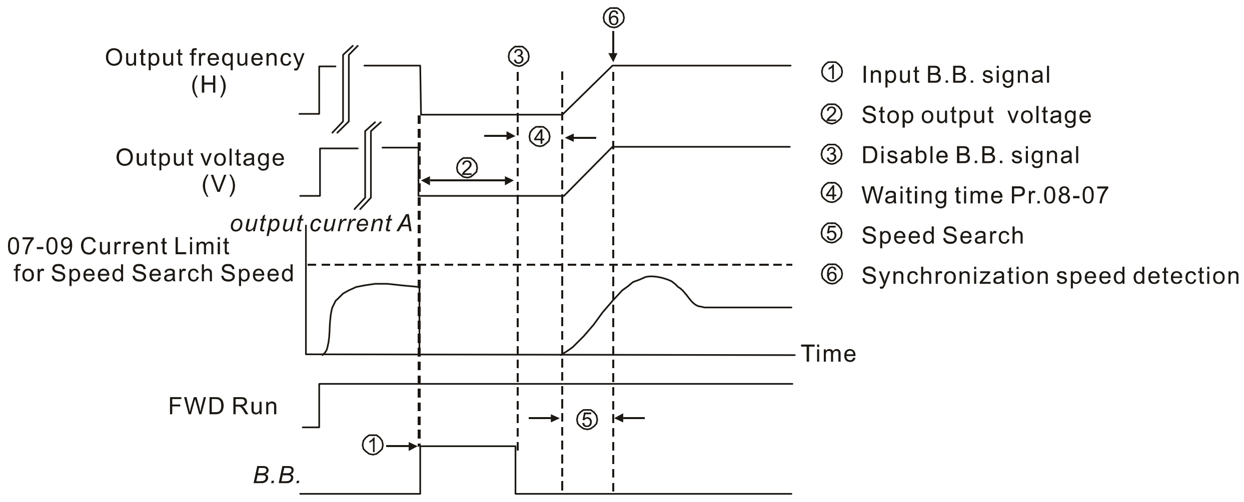
Default: Depending on the model power

Settings 0.0–5.0 sec.

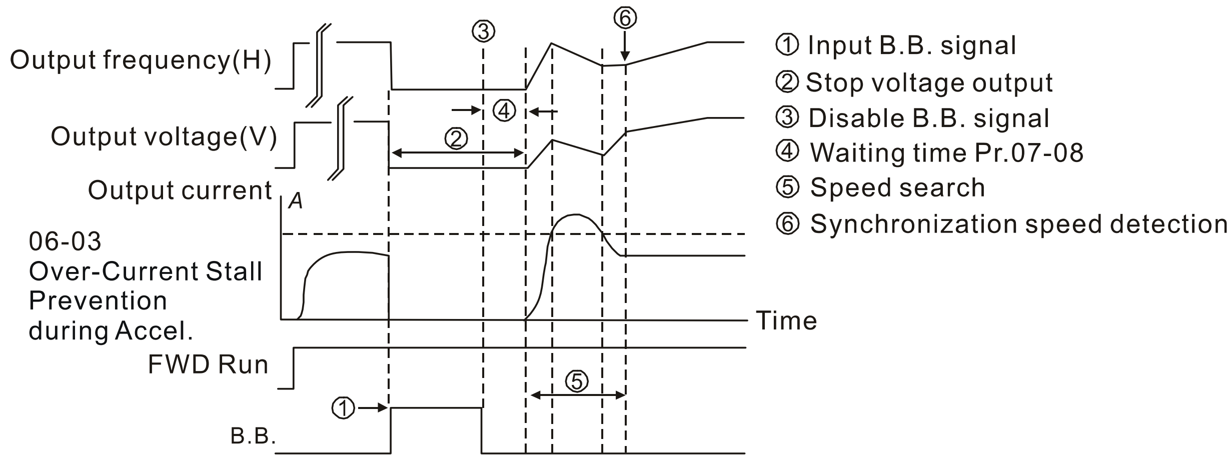
- When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by Pr.07-08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual voltage at the output side to decrease to 0 V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



B.B. 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 of Speed Tracking

Default: 100

Settings 20–200%

- The AC motor drive executes speed tracking only when 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

- In PG control mode, the AC motor drive executes the speed tracking function automatically according to the PG speed when this setting is NOT set to 0.
- Faults include: bb, oc, ov and occ. To restart after oc, ov and occ, you can NOT 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. If Pr.07-11 is set to 0, the drive resets or restarts automatically after faults occur. The drive starts according to the Pr.07-10 setting after restarting after fault.
- If the number of faults exceeds the Pr.07-11 setting, the drive does not reset and restart until you press “RESET” manually and execute the operation command again.

07-12 Speed Tracking during Start-Up

Default: 0

Settings 0: Disabled
1: Speed tracking by the maximum output frequency
2: Speed tracking by the current frequency command at start-up
3: Speed tracking by the minimum output frequency

- When using SynRM, only Pr.07-12 = 3 (speed tracking by the minimum output frequency) is enabled.
- 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. If you can use the speed feedback function (PG + Encoder), this speed tracking function will be faster and more accurate. Set Pr.07-09 as the tartget of the output current (the maximum current of speed tracking).

07-13 dEb Function Selection

Default: 0

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

- dEb (Deceleration Energy Backup) lets the motor decelerate to stop when momentary power loss occurs. When the power loss is instantaneous, use this function to let the motor decelerate to zero speed. If the power recovers at this time, the drive restarts the motor after the dEb return time.
- Lv 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.

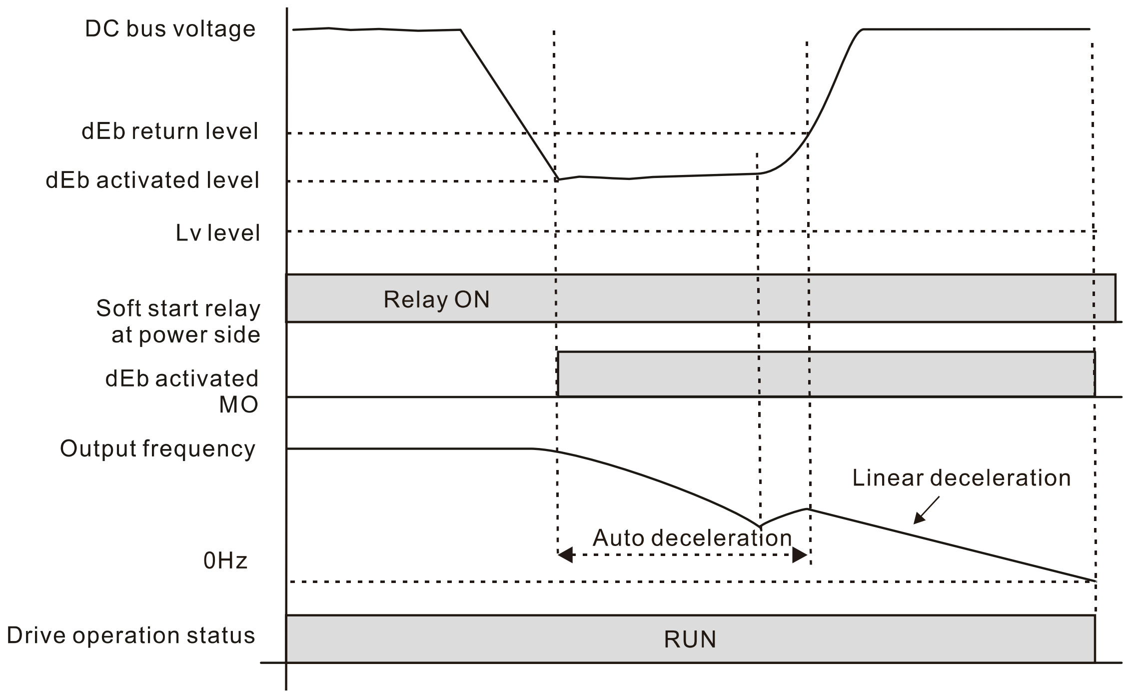
- The B.B. function does not work when executing dEb. The B.B. function is enabled after the dEb function finishes.
- Even though the Lv warning does not display during dEb operation, if the DC bus voltage is lower than the Lv level, MOx = 10 (Low voltage warning) still operates.
- The following explains the dEb action:

  When the DC voltage drops below the dEb setting level, the dEb function starts to work (soft start relay remains closed), and the drive executes auto-deceleration.

  - Situation 1: Momentary power loss, or too low and unstable power voltage, 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.

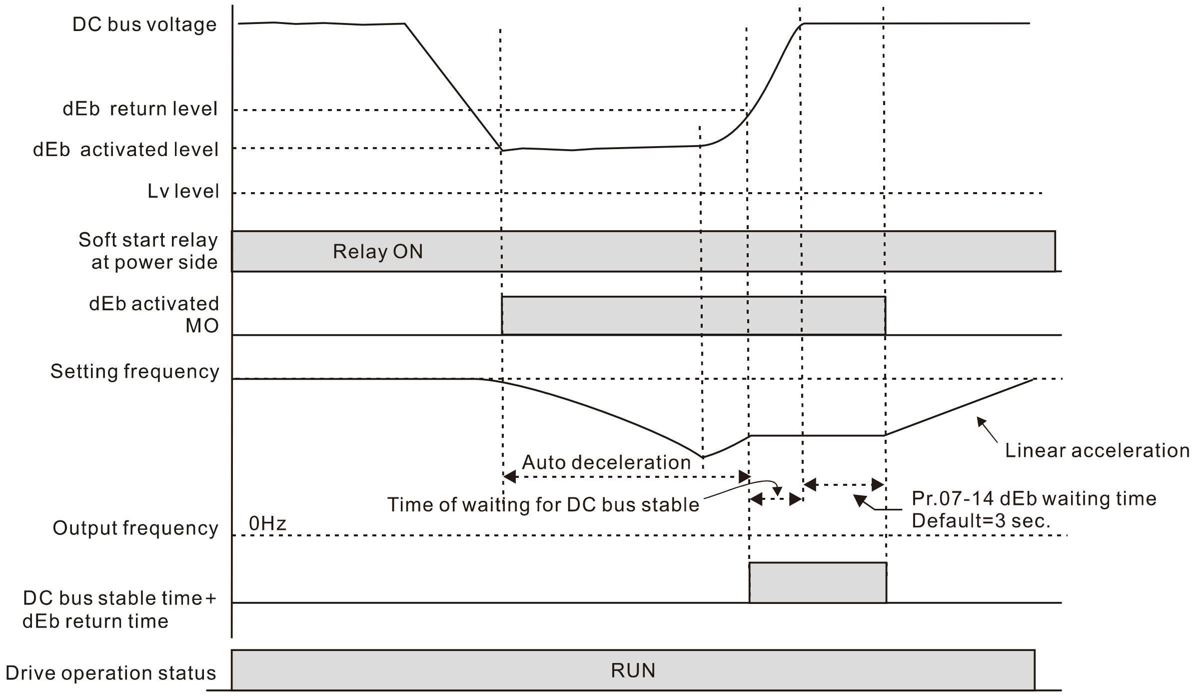
    When the power recovers and DC bus voltage exceeds the dEb return level, the drive linearly decelerates to 0 Hz and stops. The keypad displays the "dEb" warning until you manually reset it, so you can see the reason for the stop.



  - Situation 2: Momentary power loss, or too low and unstable power voltage, 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.

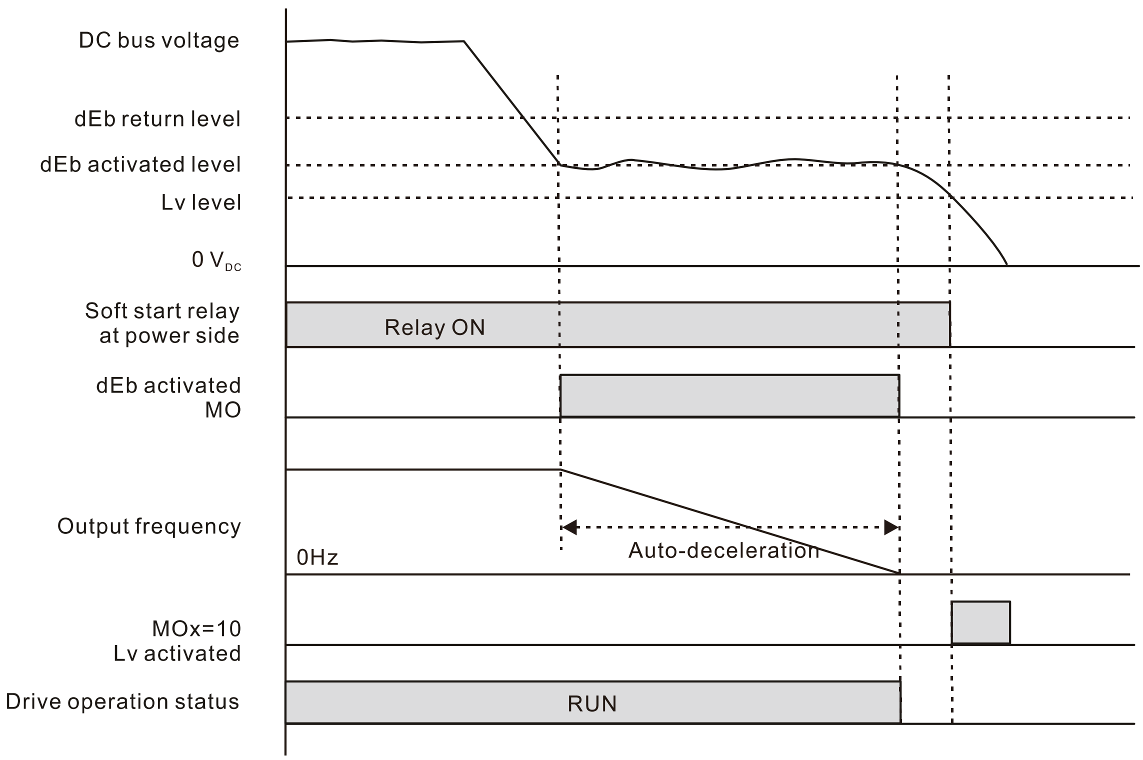
    During the dEb deceleration (includes 0 Hz run), if the power recovers to a voltage higher than dEb return level, the drive maintains the frequency for the set time of Pr.07-14 (default = 3 sec.) and then accelerates again. The "dEb" warning on the keypad is automatically cleared.



- Situation 3: Unexpected power 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 the drive stops after decelerating to the lowest operating 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 then the drive disconnects the soft start relay. The keypad displays “dEb” warning until the drive completely runs out of power.
- Situation 5:
  Pr.07-13=2 “dEb low voltage control, when the speed is lower than 1/4 rated motor speed, DC bus voltage rises to $350V_{DC}$ / $700V_{DC}$, 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 accelerate linearly, and the dEb warning on the keypad is automatically cleared.

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

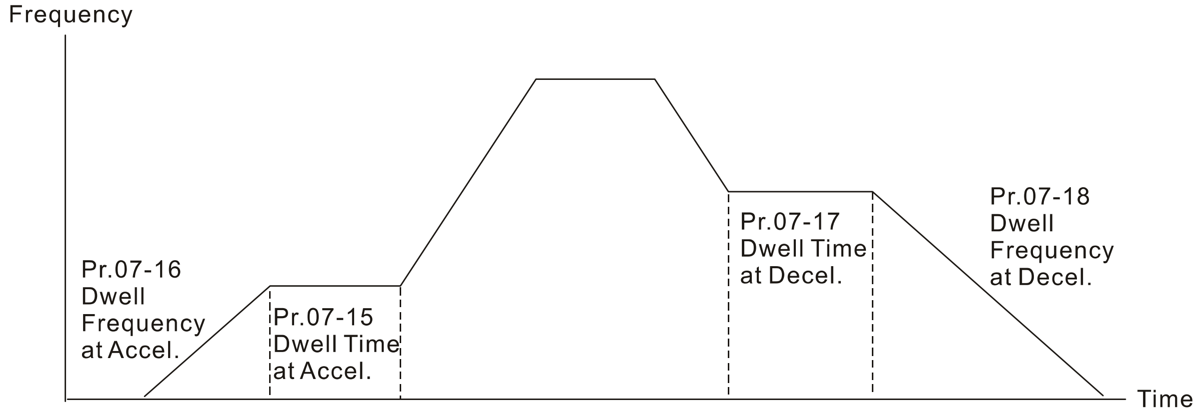
Settings 0.00–600.00 sec.

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, such as crane or elevator.
- For heavy load applications, 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 the AC motor drive stops for one minute
2: Fan is ON when the AC motor drive runs; fan is OFF when the AC motor drive stops.
3: Fan turns ON when temperature (IGBT) reaches around 60°C.
4: Fan always OFF

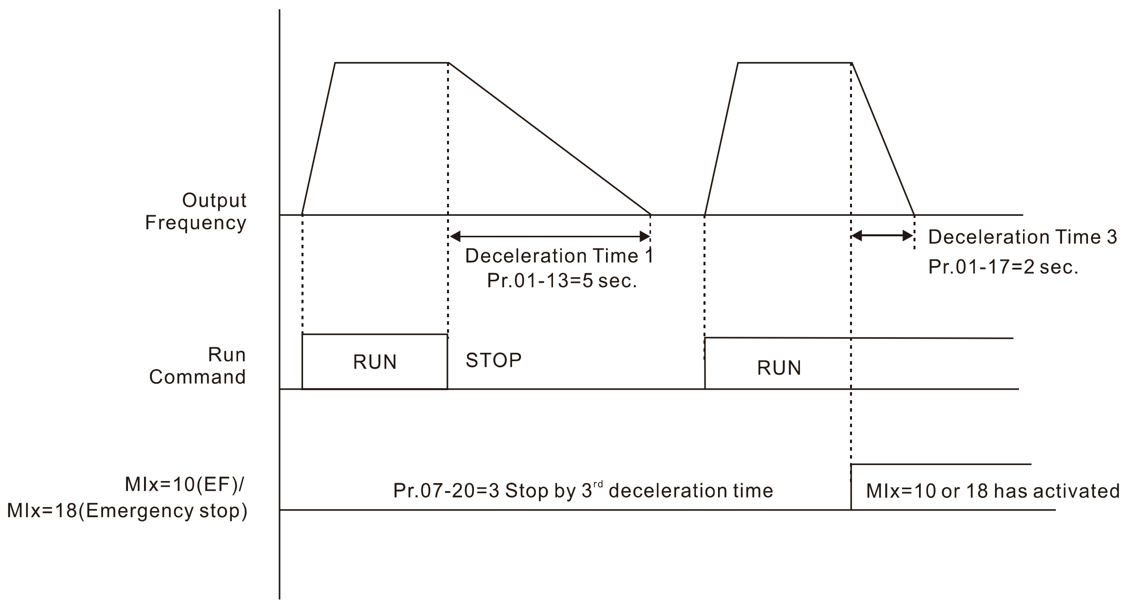
- Use this parameter to control the fan.
- 0: Fan runs immediately when the drive power is turned ON.
- 1: Fan runs when the AC motor drive runs. One minute after the AC motor drive stops, the fan is
  - OFF.
- 2: Fan runs when the AC motor drive runs and stops immediately when AC motor drive stops.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

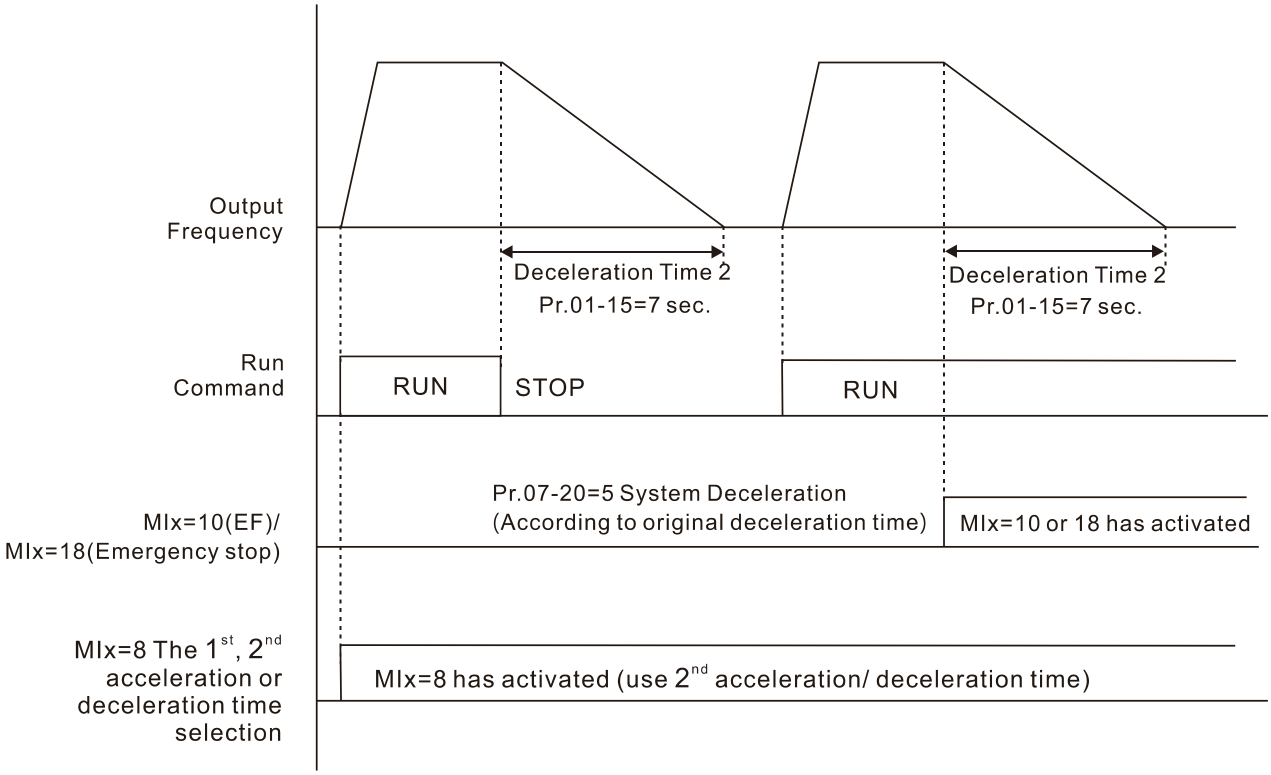
✔ 07-20 Emergency Stop (EF) & Force to Stop Selection

Default: 0

Settings 0: Coast to stop
1: Stop by the first deceleration time
2: Stop by the second deceleration time
3: Stop by the third deceleration time
4: Stop by the fourth deceleration time
5: System deceleration
6: Automatic deceleration

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





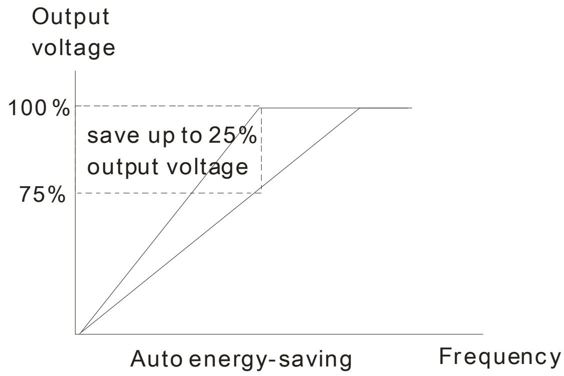
07-21 Automatic Energy-Saving Selection

Default: 0

Settings 0: Disabled

1: Enabled

- When Pr.07-21 is set to 1, the acceleration and deceleration will operate with full voltage. During constant speed operation, it will auto calculate the best voltage value by the load power for the load. This function is not suitable for the ever-changing load or near full-load during operation.
- When the output frequency is constant, i.e. constant operation, the output voltage will auto decrease by the load reduction. Therefore, the drive will operate with min. power, multiplication of voltage and current.



07-22 Energy-Saving Gain

Default: 100

Settings 10–1000%

- When Pr.07-21 is set to 1, this parameter can be used to adjust the gain of energy-saving. The factory setting is 100%. If the result is not good, it can adjust by decreasing the setting. If the motor oscillates, it should increase the setting.

✎ 07-23 Automatic Voltage Regulation (AVR) Function

Default: 0

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

- The rated voltage of the motor is usually 220V/200VAC 60Hz/50Hz and the input voltage of the AC motor drive may vary between 180V to 264 VAC 50Hz/60Hz. Therefore, when the AC motor drive is used without AVR function, the output voltage will be the same as the input voltage. When the motor runs at voltages exceeding the rated voltage with 12% - 20%, its lifetime will be shorter and it can be damaged due to higher temperature, failing insulation and unstable torque output.
- AVR function automatically regulates the AC motor drive output voltage to the motor rated voltage. For instance, if V/f curve is set at 200 VAC/50Hz and the input voltage is at 200V to 264VAC, then the motor Output Voltage will automatically be reduced to a maximum of 200VAC/50Hz. If the input voltage is at 180V to 200VAC, output voltage to motor and input power will be in direct proportion.
- Setting 0: when AVR function is enabled, the drive will calculate the output voltage by actual DC-bus voltage. The output voltage won't be changed by DC bus voltage.
- Setting 1: when AVR function is disabled, the drive will calculate the output voltage by DC-bus voltage. The output voltage will be changed by DC bus voltage. It may cause insufficient/over current.
- Setting 2: the drive will disable the AVR during deceleration, such as operated from high speed to low speed.
- 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.
- When it is in FOCPG or TQCPG, it is recommended to set to 0 (enable AVR).

✎ 07-24 Torque Command Filter Time

Default: 0.500

Settings 0.001–10.000 sec.

- Only applicable in IMVF and PMSVC control modes.
- When the time constant setting is too large, the control is stable but the control response is slow. When the time constant setting is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

✎ 07-25 Slip Compensation Filter Time

Default: 0.100

Settings 0.001–10.000 sec.

- Only applicable in IMSVC control mode.
- Change the compensation response time with Pr.07-24 and Pr.07-25.
- If you set Pr.07-24 and Pr.07-25 to 10 seconds, the compensation response time is the slowest; however, the system may be unstable if you set the time too short.

07-26 Torque Compensation Gain

Default: 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 the drive output voltage is absorbed by the stator winding resistor; therefore, the air gap magnetic field is insufficient. This causes insufficient voltage at motor induction and results in excessive output current but insufficient output torque. Auto-torque compensation can automatically adjust the output voltage according to the load and keep the air gap magnetic fields stable to get the optimal operation
- In the V/F control, the voltage decreases in direct proportion with decreasing frequency. The torque decreases at low speed because of a decreasing AC impedance and an unchanged DC resistance. The auto-torque compensation function increases the output voltage at low frequency to get a higher starting torque.
- When the compensation gain is set too large, it may cause motor over-flux and result in a too large output current of the drive, motor overheating or trigger the drive's protection function.
- This parameter affects the output current when the drive runs. But the effect is smaller at the low-speed area.
- Set this parameter higher when the no-load current is too large, but the motor may vibrate if the setting is too high. If the motor vibrates when operating, reduce the setting.

07-27 Slip Compensation Gain

Default: 0.00 (Default value is 1.00 in SVC mode)

Settings 0.00–10.00

- Only applicable in IMSVC control modes.
- The induction motor needs constant slip to produce electromagnetic torque. It can be ignored at higher motor speeds, such as rated speed or 2–3% of slip.
- However, during the drive operation, the slip and the synchronous frequency are in reverse proportion to produce the same electromagnetic torque. The slip is larger with the reduction of synchronous frequency. Moreover, 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 for Induction Motor 1 (A)), the drive compensates the frequency according to this parameter.
- This parameter is set to 1.00 automatically when Pr.00-11 (Speed Control Mode) is changed from V/F mode to vector mode. Otherwise, it is automatically set to 0.00. Apply the slip compensation after load and acceleration. Increase the compensation value from small to large gradually; add the output frequency to the [motor rated slip × 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

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 Oscillation Compensation Factor

Default: 1000

Settings 0–10000

0: Disabled

If there are current wave motions which cause severe motor oscillation in some specific area, setting this parameter can effectively improve this situation. (When running with high frequency or PG, 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.

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08 High-function PID Parameters

✓ You can set this parameter during operation.

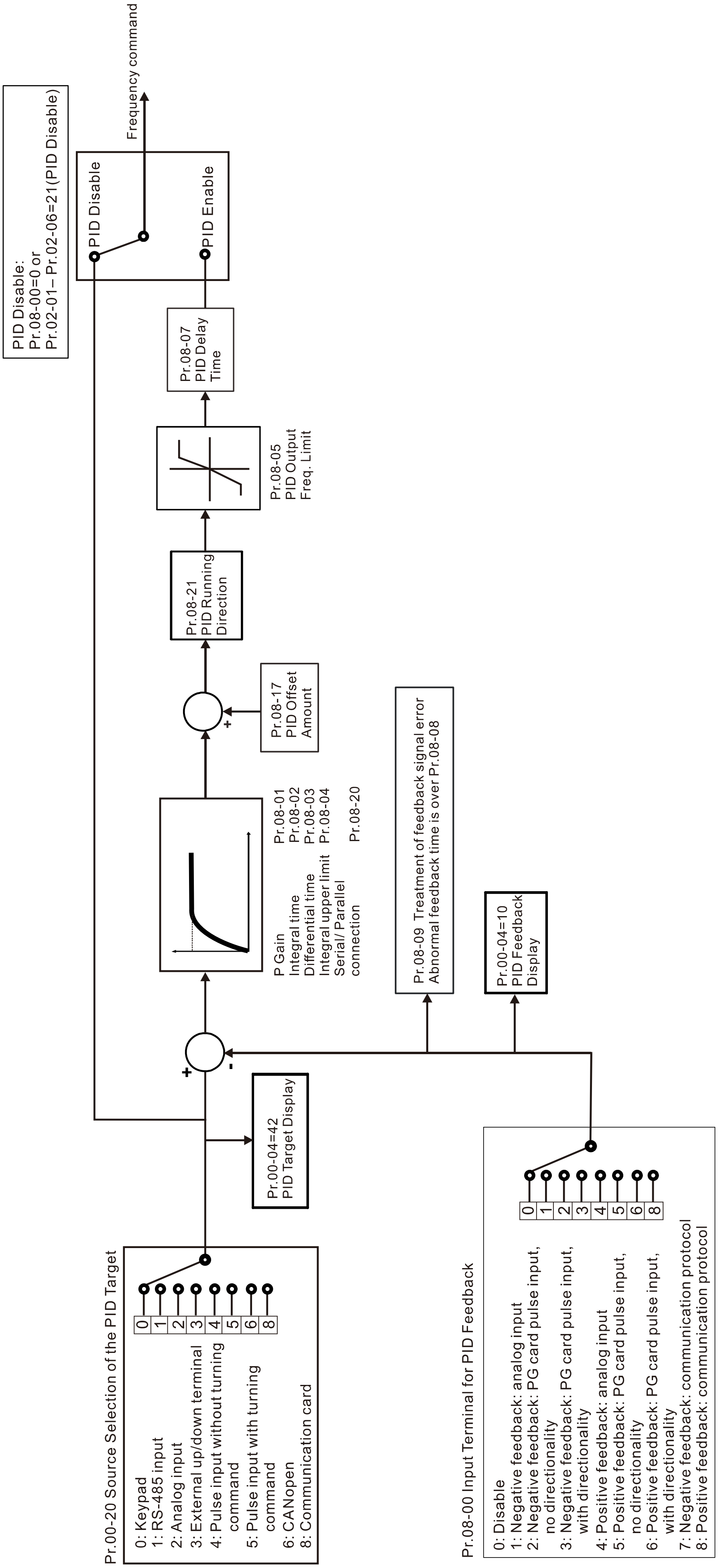
✓ **08-00** Terminal Selection of PID Feedback

Default: 0

Settings 0: No function
1: Negative PID feedback: by analog input (Pr.03-00)
2: Negative PID feedback: by PG card pulse input, without direction (Pr.10-02)
3: Negative PID feedback:by PG card pulse input, with direction (Pr.10-02)
4: Positive PID feedback: by analog input (Pr.03-00)
5: Positive PID feedback: by PG card pulse input, without direction (Pr.10-02)
6: Positive PID feedback: by PG card pulse input, with direction (Pr.10-02)
7: Negative PID feedback: by communication protocols
8: Positive PID feedback: by communication protocols

- Pr.08-00 ≠ 0 enables the PID function.
- Negative feedback:
  Error = + Target value (set point) – Feedback. Use negative feedback when the detection value increases if the output frequency increases.
- Positive feedback:
  Error = - Target value (set point) + Feedback. Use positive feedback when the detection value decreases if the output frequency increases.
- When Pr.08-00 ≠ 7 or ≠ 8, the input value is disabled. The setting value does not remain when the drive is powered off.
- When Pr.08-00 ≠ 0, the related applicable parameters include:
  - Pr.00-20 (Master frequency command source (AUTO) / Source selection of the PID target)
  - Pr.03-00–03-02:
    When Pr.00-20 = 2 (External analog input), set Pr.03-00–03-02 = 4 (PID target value)
    When Pr.08-00 = 1 or 4, set Pr.03-00–03-02 = 5 (PID feedback signal)

  Refer to the following description for details.


PID Disable:
Pr.08-00=0 or
Pr.02-01~ Pr.02-06=21(PID Disable)
Frequency command
PID Disable
PID Enable
Pr.08-07
PID Delay
Time
Pr.08-05
PID Output
Freq. Limit
Pr.08-21
PID Running
Direction
Pr.08-17
PID Offset
Amount
+
P Gain Pr.08-01
Integral time Pr.08-02
Differential time Pr.08-03
Integral upper limit Pr.08-04
Serial / Parallel connection Pr.08-20
Pr.08-09 Treatment of feedback signal error
Abnormal feedback time is over Pr.08-08
Pr.00-04=10
PID Feedback
Display
+
-
Pr.00-04=42
PID Target Display
Pr.00-20 Source Selection of the PID Target
0: Keypad
1: RS-485 input
2: Analog input
3: External up/down terminal
4: Pulse input without turning command
5: Pulse input with turning command
6: CANopen
8: Communication card
0 1 2 3 4 5 6 8
Pr.08-00 Input Terminal for PID Feedback
0: Disable
1: Negative feedback: analog input
2: Negative feedback: PG card pulse input, no directionality
3: Negative feedback: PG card pulse input, with directionality
4: Positive feedback: analog input
5: Positive feedback: PG card pulse input, no directionality
6: Positive feedback: PG card pulse input, with directionality
7: Negative feedback: communication protocol
8: Positive feedback: communication protocol
0 1 2 3 4 5 6 8

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

Default: 0

Settings
- 0: Digital keypad
- 1: RS-485 communication input
- 2: External analog input (Refer to Pr.03-00–03-02)
- 3: External UP / DOWN terminal (multi-function input terminals)
- 4: Pulse input without direction command (refer to Pr.10-16 without considering direction), use with PG card
- 5: Pulse input with direction command (refer to Pr.10-16), use with PG card
- 6: CANopen communication card
- 8: Communication card (does not include CANopen card)

⌁ 03-00 AVI Analog Input Selection

Default: 1

⌁ 03-01 ACI Analog Input Selection

Default: 0

⌁ 03-02 AUI Analog Input Selection

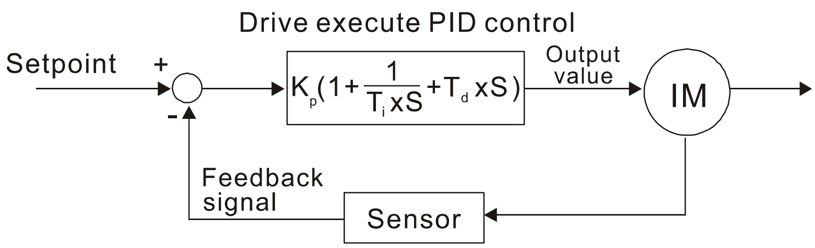
Default: 0

Settings
- 0: No function
- 1: Frequency command (speed limit under torque control mode)
- 4: PID target value
- 5: PID feedback signal

Common applications for PID control:

- Flow control: Use a flow sensor to feedback the flow data and perform accurate flow control.
- Pressure control: Use a pressure sensor to feedback the pressure data and perform precise pressure control.
- Air volume control: Use an air volume sensor to feedback the air volume data to achieve excellent air volume regulation.
- Temperature control: Use a thermocouple or thermistor to feedback temperature data for comfortable temperature control.
- Speed control: Use a speed sensor to feedback motor shaft speed or input another machine speed as a target value for synchronous control.

PID control loop:



K_P Proportional Gain (P), T_i Integral Time (I), T_d Differential Time (D), S Calculation

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 increases the overshoot.
- Decrease: Smaller overshoot, but excessive adjustment slows down the transient response.

📖 Integral time (I):

The controller output is proportional to the integral of the controller input. When an automatic control system is in a steady state and a steady-state error occurs, the system is called a System with Steady-state Error 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.

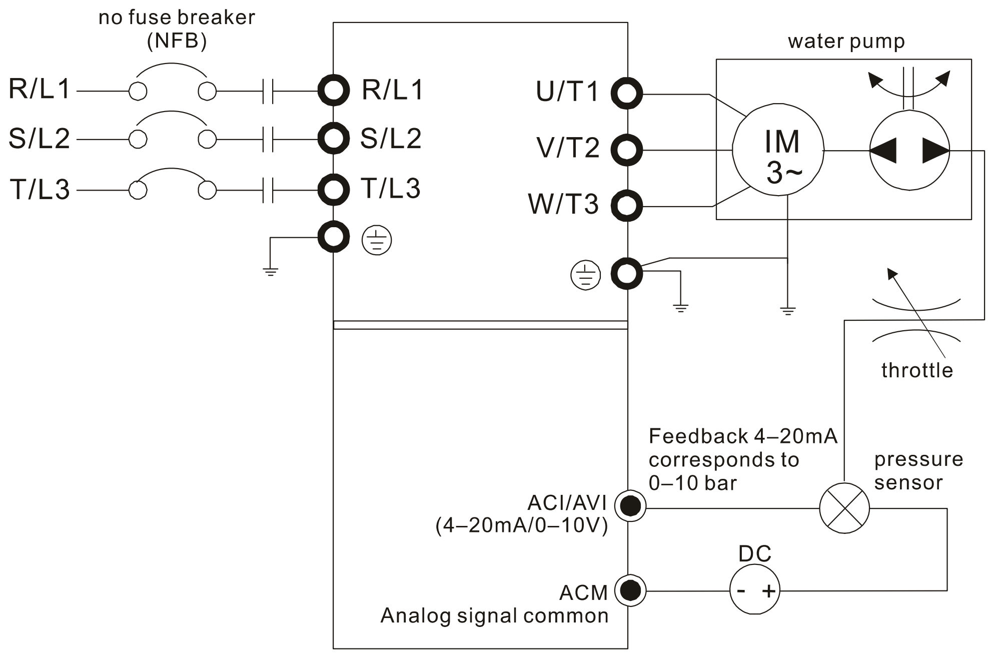
📖 Differential control (D):

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, 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 oscillation in the system, increase Pr.08-01 (Proportional Gain (P))
  If there is no oscillation in the system, decrease Pr.08-02 (Integral Time (I))
  If there is no oscillation in the system, increase Pr.08-03 (Differential Time (D))

📖 Refer to Pr.08-00 to Pr.08-21 for PID parameter settings.

✓ 08-01 Proportional Gain (P)

Default: 1.0

Settings 0.0–500.0

📖 Set the proportional gain to determine the deviation response speed. The higher the proportional gain, the faster the response speed. Eliminates the system deviation; usually used to decrease the deviation and get faster response speed, it also reduces the steady-state error. If you set the value too high, overshoot occurs and 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.
0.0: No integral

📖 Use the integral controller to eliminate the deviation during stable system operation. The integral control does not stop working until the deviation 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 deviation 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 I controller gain, with faster response and rapid external control.
- When the integral time is too short, it may cause overshoot or oscillation for the output frequency and system.
- Set Integral Time to 0.00 to disable the I controller.

✓ 08-03 Differential Time (D)

Default: 0.00

Settings 0.00–1.00 sec.

- Use the differential controller to show the system deviation change, as well as to preview the change in the deviation. You can use the differential controller to eliminate the deviation 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.
- Set the D controller gain to determine the deviation 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 deviation 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%

- Define an upper bound for the integral gain (I) and therefore limits the master frequency. The formula is: Integral upper bound = Maximum Operation Frequency (Pr.01-00) × Pr.08-04 %.
- An excessive integral value causes a slow response due to sudden load changes and may cause motor stall or machine damage. If so, decrease it to a proper value.

✓ 08-05 PID Output Frequency Limit

Default: 100.0

Settings 0.0–110.0%

- Define the percentage of the output frequency limit during the PID control. The formula is Output Frequency Limit = Maximum Operation Frequency (Pr.01-00) × Pr.08-05 %.

08-06 PID Feedback Value by Communication Protocol

Default: Read only

Settings -200.00–200.00%

- Use communications to set the PID feedback value when the PID feedback input is set to communications (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

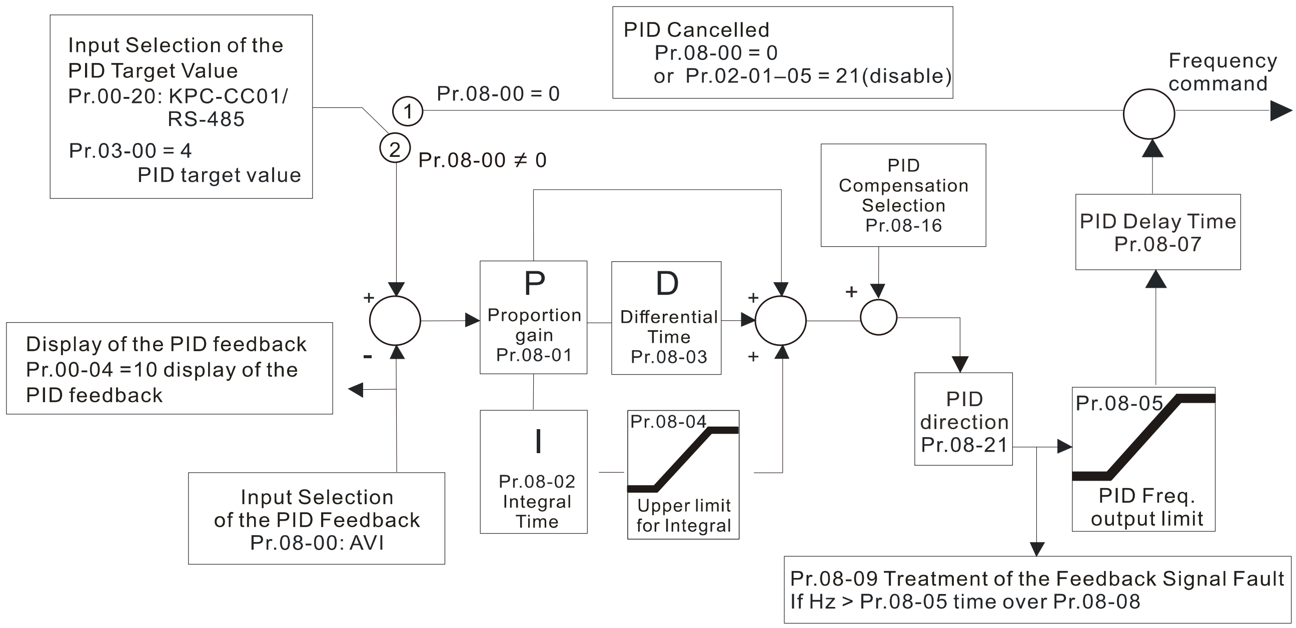
- Pr.08-07 determines the primary low pass filter time when in PID control. Setting a large time constant may slow down the drive's response speed.
- PID control output frequency is filtered with a primary low pass function. This function can filter a mix frequencies. A long primary low pass time means 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 oscillation.
- PI Control:

  Controlled only by the P action, so the deviation cannot be entirely eliminated. In general, to eliminate residual deviations, the P + I controls. 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 responde when there is rapid variation. You can use the P action by itself to control the loading system with the integral components.
- PD Control:

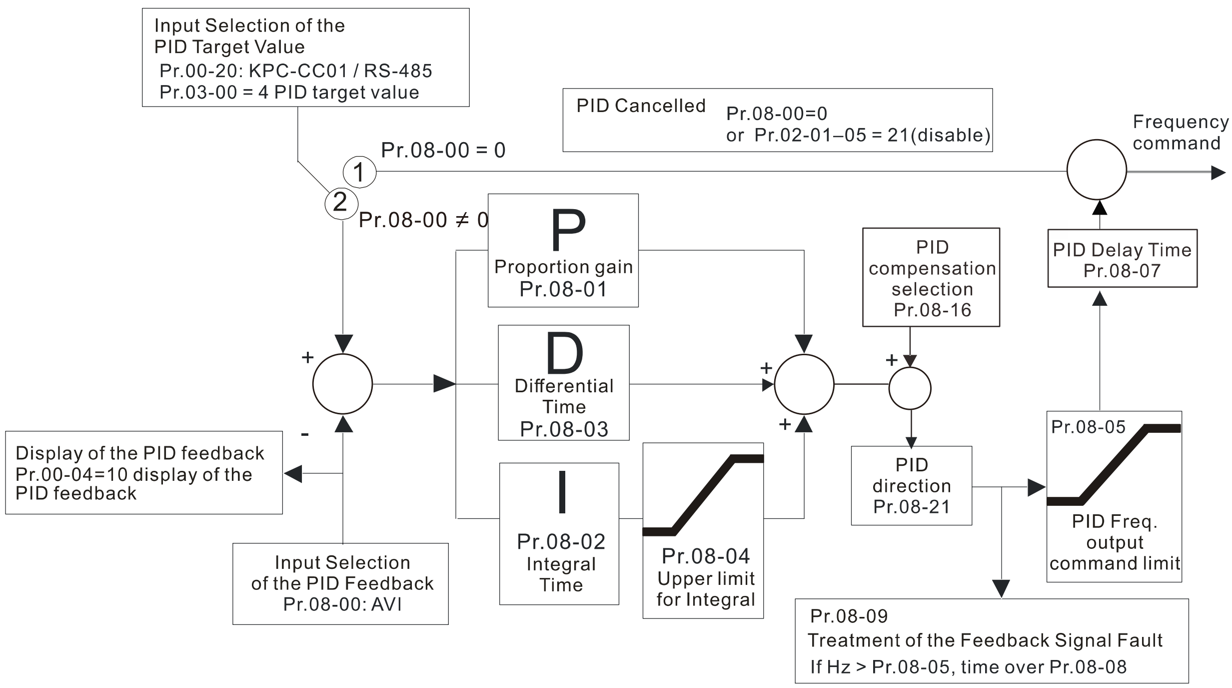
  When deviation occurs, the system immediately generates an operation load that is greater than the load generated only by the D action to restrain deviation increment. If the deviation is small, the effectiveness of the P action decreases as well. The control objects include applications with integral component loads, which are controlled by the P action only. Sometimes, if the integral component is functioning, the whole system may oscillate. In this case, use the PD control to reduce the P action's oscillation 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 oscillation; 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.

- Valid only when the feedback signal is ACI (4–20 mA).
- This parameter sets the detection time for abnormal PID signal feedback. You can also use it when the system feedback signal response is extremely slow. (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

- Valid only when the feedback signal is ACI (4–20 mA).
- Set the treatments when the PID feedback signal is abnormal.

08-10 Sleep Frequency

Default: 0.00

Settings 0.00–599.00 Hz

08-11 Wake-Up Frequency

Default: 0.00

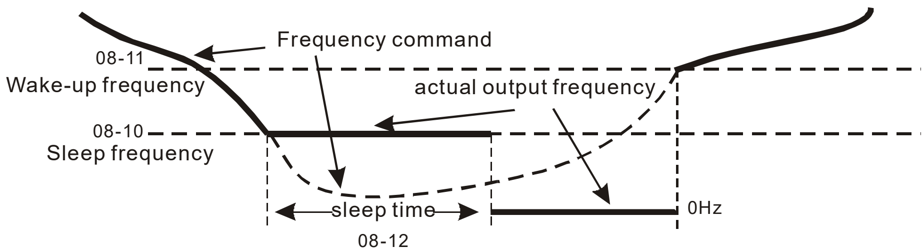
Settings 0.00–599.00 Hz

08-12 Sleep Time

Default: 0.0

Settings 0.0–6000.0 sec.

- If the command frequency falls below the sleep frequency, for the specified time in Pr. 08-12, then the drive will shut off the output and wait until the command frequency rises above Pr.08-11.



Sleep Function

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.

08-15 Filter Time for PID Feedback

Default: 5.0

Settings 0.1–300.0 sec.

- When the PID control function is normal, it should calculate within a period of time and close to the setpoint 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, the PID control fault occurs. The treatment will be done as Pr.08-09 setting.

✓ 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.03-00–03-02) 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 operaiton frequency Pr.01-00 = 60.00 Hz, Pr.08-17 = 10.0%, the PID compensation value increases the output frequency 6.00Hz. 60.00Hz × 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 are between 0.00–599.00 Hz.
- 1: The unit for Pr.08-10 and that for Pr.08-11 switch to percentage. The settings are between 0.00–200.00%.

✓ 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. Defines the wake-up integral frequency limit = (Pr.01-00 × Pr.08-19%)
- Reduce 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.

08-23 PID Control Flag

Default: 0000h

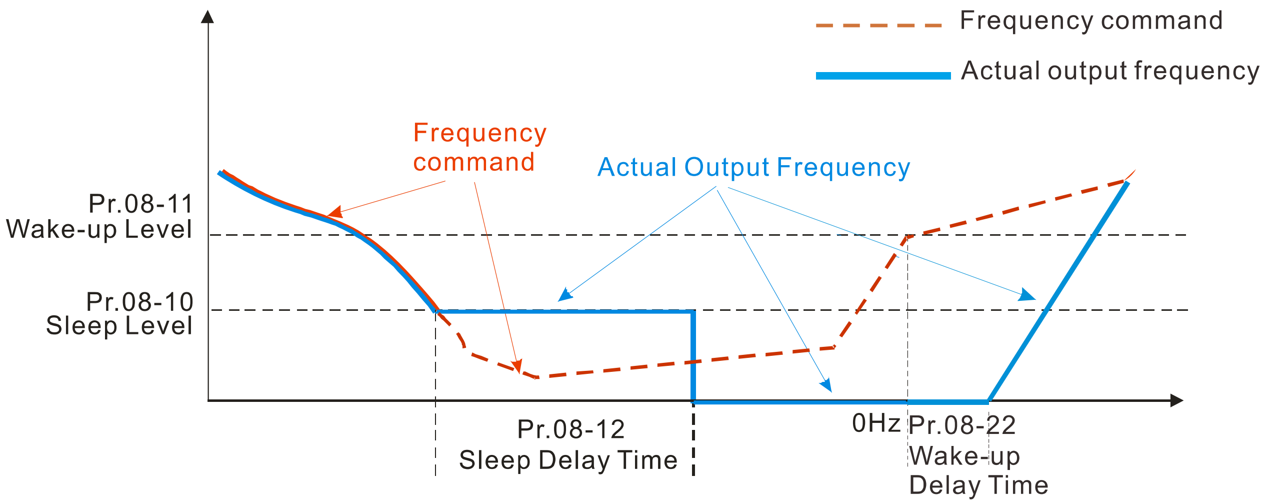
Settings bit0 = 1, PID running in reverse follows the setting for Pr.00-23.
bit0 = 0, PID running in reverse refer to PID's calculated value.
bit1 = 1, two decimal places for PID Kp
bit1 = 0, one decimal place for PID Kp

- bit0 = 1: PID running in reverse function is valid only when Pr.08-21=1.
- bit0 = 0, if the PID calculated value is positive, the direction is forward. If the PID calculated value is negative, the direction is reverse.

There are three scenarios for the sleep and wake-up frequency. Refer to following explanations:

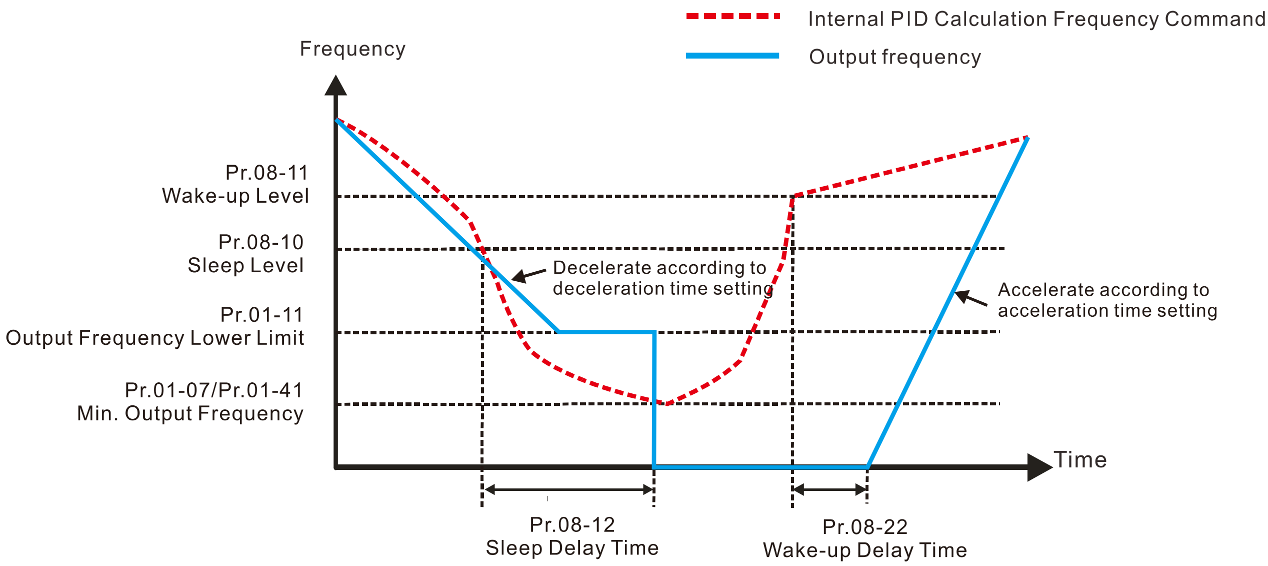
1) Frequency Command (PID is not in use, Pr.08-00 = 0. Works only in VF mode)

When the output frequency ≤ the sleep frequency, and the drive reaches the preset sleep time, then the the drive is in sleep mode (0 Hz). 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, it starts to catch up to reach the frequency command value by the acceleration time.



2) Internal PID Calculation Frequency Command (PID is in use, Pr.08-00 ≠ 0 and Pr.08-18=0.)

When the PID calculation Frequency command 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, then the drive is in sleep mode (0Hz). If the drive does not reach the preset sleep time, it remains at the lower frequency limit (if there is a preset lower limit.), or it remains at the minimum output frequency set at Pr.01-07 and waits until it reaches the sleep time before it going into sleep mode (0Hz). When the PID 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 to catch up to reach the PID Frequency command value by the acceleration time.



3) PID Feedback Value Rate Percentage (PID is in use, Pr.08-00 ≠ 0 and Pr.08-18 = 1)

When the PID feedback value reaches the sleep level percentage, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0 Hz). If the drive does not reach the preset sleep time, it remains at the lower frequency limit (if there is a preset of lower limit.), or it remains at the minimum output frequency set for Pr.01-07 and waits until it reaches the sleep time before going into sleep mode (0 Hz).

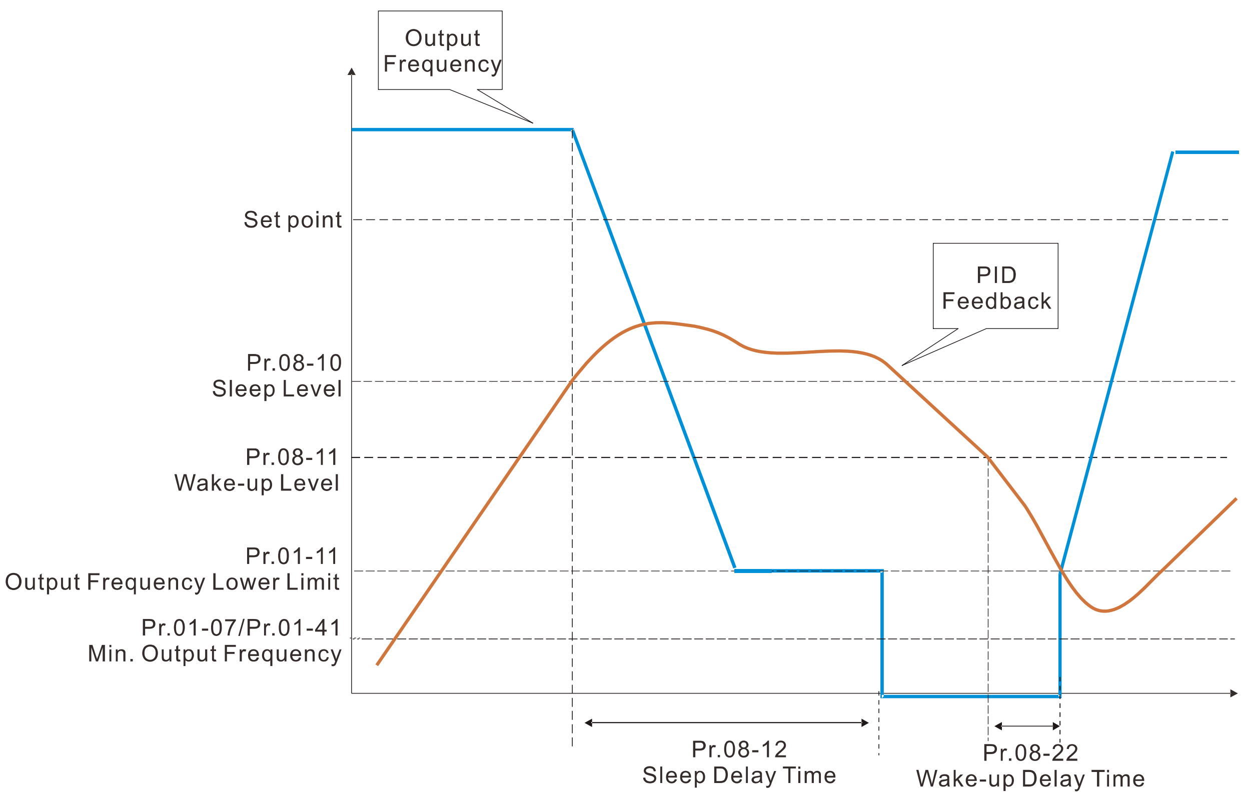
When the PID feedback value reaches the wake-up percentage, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.

Example 01: PID negative feedback

- Pr.08-10 must > Pr.08-11
- 30kg is the reference
- Set the parameter:

Pr.03-00 = 5 (AVI is PID feedback)
Pr.08-00 = 1 (PID negative feedback: AVI simulation input function select)
Pr.08-10 = 40% (Sleep reference: 12kg = 40%*30kg)
Pr.08-11 = 20% (Wake-up reference: 6kg = 20%*30kg)
Case 01: If feedback >12kg, frequency decreases.
Case 02: If feedback <6kg, frequency increases.

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
- 30kg is the reference
- Set the parameter:

  Pr.03-00 = 5 (AVI is PID feedback)

  Pr.08-00 = 4 (PID positive feedback: AVI simulation input function select)

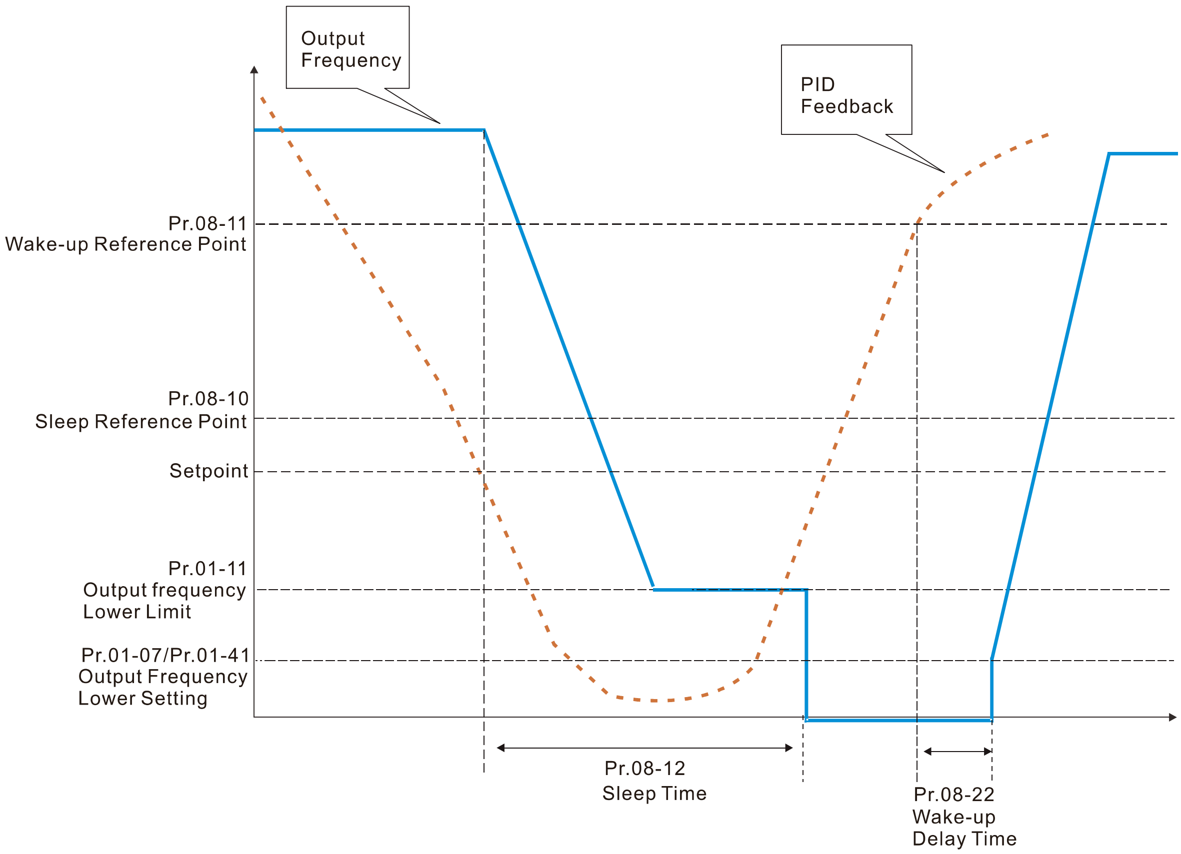
  Pr.08-10 = 110% (Sleep reference: 33kg = 110%*30kg)

  Pr.08-11 = 120% (Wake-up reference: 36kg = 120%*30kg)

  Case 01: If feedback <33kg, frequency decreases.

  Case 02: If feedback >36kg, frequency increases.

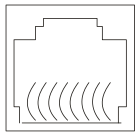
Area	PID Physical quantity
Sleep area	> 36 kg, the drive goes into sleep, the motor goes into sleep
Excessive area	between 33 kg and 36 kg, the drive remains in the current state
Wake-up area	< 33 kg, the drive wakes-up



09 Communication Parameters

When using the communication interface, the diagram on the right shows the communication port pin definitions. We recommend that you connect the AC motor drive to your PC by using Delta IFD6530 orIFD6500 as a communication converter.

8 ← 1



RS-485

Modbus RS-485

Pin 1–2,7,8: Reserved
Pin 3, 6: SGND
Pin 4: SG-
Pin 5: SG+

You can set this parameter during the operation.

09-00 COM1 Communication Address

Default: 1

Settings 1–254

Set the communication address for the drive if the AC motor drive is controlled through RS-485 serial communication. The communication address for each AC motor drive must be unique.

09-01 COM1 Transmission Speed

Default: 9.6

Settings 4.8–115.2 Kbps

Set the transmission speed between the computer and the AC motor drive.

09-02 COM1 Transmission Fault Treatment

Default: 3

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

Determine the treatment when an error is detected that the host controller does not continuously transmit data to the AC motor drive during Modbus communication. The detection time is based on the Pr.09-03 setting.

09-03 COM1 Time-Out Detection

Default: 0.0

Settings 0.0–100.0 sec.

Set the communication time-out value.

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.

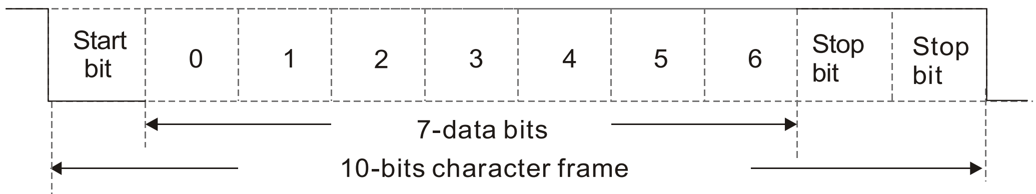
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

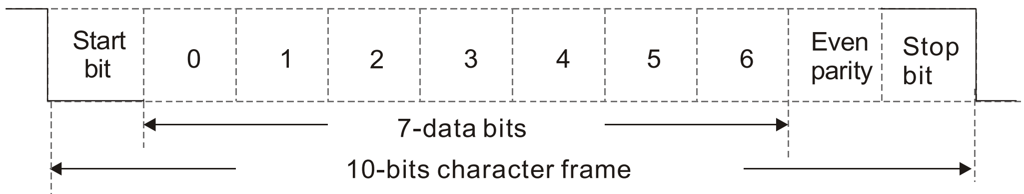
2. Data Format

10-bit character frame (For ASCII):

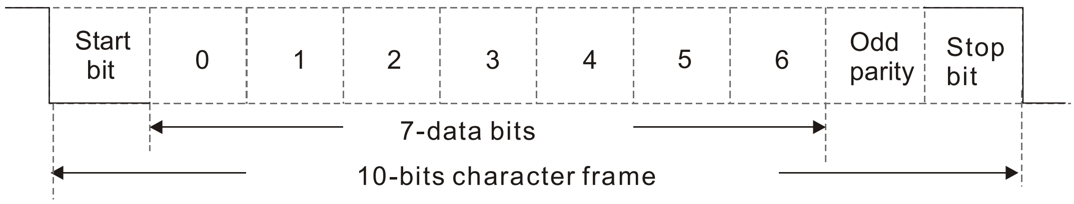
(7, N, 2)



(7, E, 1)

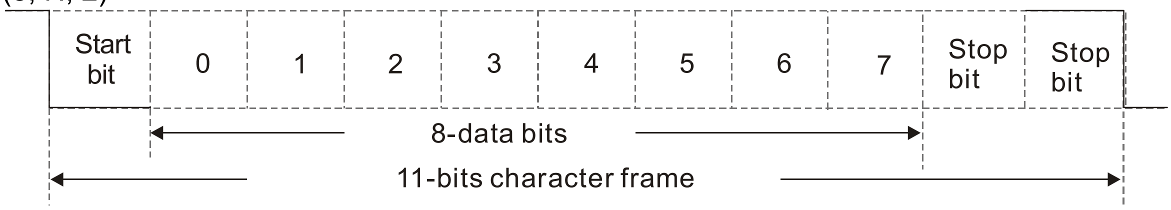


(7, O, 1)

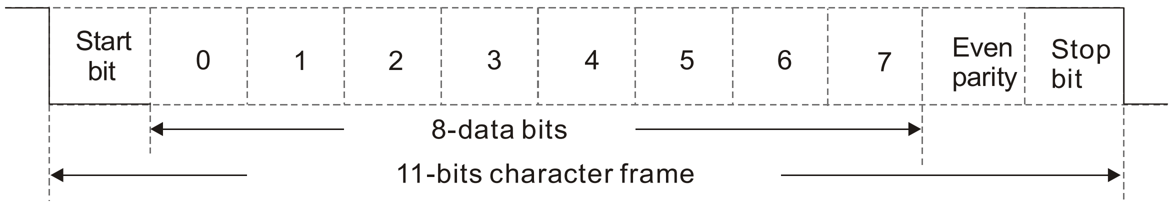


11-bit character frame (For RTU):

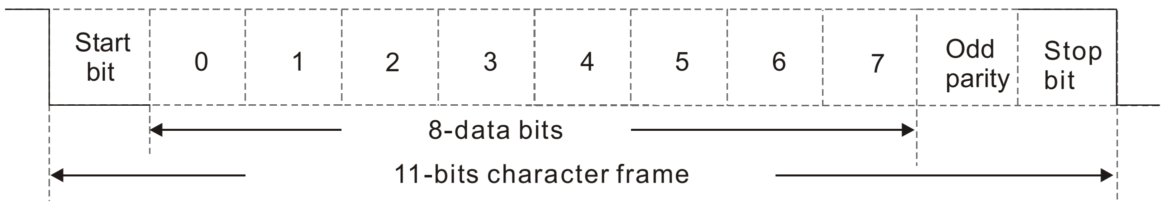
(8, N, 2)



(8, E, 1)



(8, O, 1)



3. Communication Protocol

3.1 Communication Data Frame:

ASCII mode:

STX	Start character = ‘:’ (3AH)
Address High	Communication address:
Address Low	one 8-bit address consists of 2 ASCII codes
Function High	Command code:
Function Low	one 8-bit command consists of 2 ASCII codes
DATA (n-1)	Contents of data:
…….	n x 8-bit data consists of 2n ASCII codes
DATA 0	n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
LRC Check High	LRC checksum:
LRC Check Low	one 8-bit checksum consists of 2 ASCII codes
END High	End characters:
END Low	END1= CR (0DH), END0= LF(0AH)

RTU mode:

START	Defined by a silent interval of larger than / equal to 10 ms
Address	Communication address: 8-bit binary address
Function	Command code: 8-bit binary command
DATA (n-1)	Contents of data: N × 8-bit data, n ≤ 16
…….	
DATA 0	
CRC Check Low	CRC checksum: one 16-bit CRC checksum consists of 2 8-bit binary characters
CRC Check High	
END	Defined by a silent interval of larger than / equal to 10 ms

3.2 Communication Address (Address)

00H: broadcast to all AC motor drives

01H: AC motor drive of address 01

0FH: AC motor drive of address 15

10H: AC motor drive of address 16

:

FEH: AC motor drive of address 254

3.3 Function (Function code) and DATA (Data characters)

(01) 03H: read data from a register

06H: write to a single register

Example: Reading two continuous data from register address 2102H, AMD address is 01H.

ASCII mode:

Command Message:

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting register	'2'
	'1'
	'0'
	'2'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'7'
END	CR
	LF

Response Message

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of register (count by byte)	'0'
	'4'
Content of starting register 2102H	'1'
	'7'
	'7'
	'0'
Content of register 2103H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Command Message:

Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by word)	00H
	02H
CRC Check Low	6FH
CRC Check High	F7H

Response Message

Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	00H
CRC Check Low	FEH
CRC Check High	5CH

(02) 06H: single write, write single data to a register.

Example: Writing data 6000 (1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command Message:

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Target register	‘0’
	‘1’
	‘0’
	‘0’
Register content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

Response Message

STX	‘:’
Address	‘0’
	‘1’
Function	‘0’
	‘6’
Target register	‘0’
	‘1’
	‘0’
	‘0’
Register content	‘1’
	‘7’
	‘7’
	‘0’
LRC Check	‘7’
	‘1’
END	CR
	LF

RTU mode:

Command Message:

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low	86H
CRC Check High	22H

Response Message

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low	86H
CRC Check High	22H

(03) 10H: write multiple registers (can write at most 20 sets of data simultaneously).
Example: Set the multi-step speed of an AC motor drive (address is 01H),
Pr.04-00 = 50.00 (1388H), Pr.04-01 = 40.00 (0FA0H).

ASCII Mode

Command Message:

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘5’
	‘0’
	‘0’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
Number of register (count by byte)	‘0’
	‘4’
The first data content	‘1’
	‘3’
	‘8’
	‘8’
The second data content	‘0’
	‘F’
	‘A’
	‘0’
LRC Check	‘9’
	‘A’
END	CR
	LF

Response Message

STX	‘:’
ADR 1	‘0’
ADR 0	‘1’
CMD 1	‘1’
CMD 0	‘0’
Target register	‘0’
	‘5’
	‘0’
	‘0’
Number of register (count by word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘E’
	‘8’
END	CR
	LF

RTU mode:

Command Message:

ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
Quantity of data (byte)	04
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	‘9’
CRC Check High	‘A’

Response Message:

ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

3.4 Checksum

(1) ASCII mode (LRC Check):

LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.

Example:

01H + 03H + 21H + 02H + 00H + 02H = 29H, the 2's-complement negation of 29H is D7H.

(2) RTU mode (CRC Check):

CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1: Load a 16-bit register (called CRC register) with FFFFh.

Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3: Examine the LSB of CRC register.

Step 4: If the LSB of CRC register is 0, shift the CRC register one bit to the right, fill MSB with zero, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right, fill MSB with zero, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

Step 5: Repeat step 3 and 4 until you perform eight shifts. This processes a complete 8-bit byte.

Step 6: Repeat step 2 through 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, that is, the lower order byte is transmitted first.

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

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)

Modbus address	R/W	Function	
2000H	RW	bit1–0	00B: No function
			01B: Stop
			10B: Run
			11B: JOG + RUN
		bit3–2	Reserved
		bit5–4	00B: No function
			01B: FWD
			10B: REV
			11B: Change direction
		bit7–6	00B: 1st acceleration / deceleration
			01B: 2nd acceleration / deceleration
			10B: 3rd acceleration / deceleration
			11B: 4th acceleration / deceleration
		bit11–8	000B: Master speed
			0001B: 1st Step speed frequency
			0010B: 2nd Step speed frequency
			0011B: 3rd Step speed frequency
			0100B: 4th Step speed frequency
			0101B: 5th Step speed frequency
			0110B: 6th Step speed frequency
			0111B: 7th Step speed frequency
			1000B: 8th Step speed frequency
			1001B: 9th Step speed frequency
			1010B: 10th Step speed frequency
			1011B: 11th Step speed frequency

Modbus address	R/W	Function	
			1100B: 12th Step speed frequency
			1101B: 13th Step speed frequency
			1110B: 14th Step speed frequency
			1111B: 15th Step speed frequency
		bit12	1: Enable bit06–11 function
		bit15	Reserved
2001H	RW	Frequency command (XXX.XX Hz)	
2002H	RW	bit0	1: E.F. ON
		bit1	1: Reset
		bit2	1: Base block (B.B) ON
		bit15–3	Reserved

Status monitor read only (21xx)

Modbus address	R/W	Function	
2100H	R	High byte: Warn Code Low Byte: Error Code	
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.	

Modbus address	R/W	Function
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)
210BH	R	Output torque (XXX.X %)
210CH	R	Actual motor speed (XXXXX rpm)
210DH	R	Number of PG feedback pulses (0–65535)
210EH	R	Number of PG2 pulse commands (0–65535)
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)
2206H	R	Display actual motor speed kW of U, V, W (XXXX.X kW)
2207H	R	Display motor speed in rpm estimated by the drive or encoder feedback (XXXXX rpm)
2208H	R	Display positive/negative output torque in %, estimated by the drive (t0.0: positive torque, -0.0: negative torque) (XXX.X %)
2209H	R	Display PG feedback (see NOTE 1 in Pr.00-04)
220AH	R	PID feedback value after enabling PID function (XXX.XX %)

Modbus address	RW	Function
220BH	R	Display signal of AVI analog input terminal, 0–10 V corresponds to 0.00–100.00% (1.) (see NOTE 2 in Pr.00-04)
220CH	R	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)
220DH	R	Display signal of AUI analog input terminal, -10 V–10 V corresponds to -100.00–100% (3.) (see NOTE 2 in Pr.00-04)
220EH	R	IGBT temperature of drive power module (XXX.XºC)
220FH	R	The temperature of capacitance (XXX.XºC)
2210H	R	The status of digital input (ON/OFF), refer to Pr.02-12 (see NOTE 3 in Pr.00-04)
2211H	R	The status of digital output (ON/OFF), refer to Pr.02-18 (see NOTE 4 in Pr.00-04)
2212H	R	The multi-step speed that is executing (S)
2213H	R	The corresponding CPU pin status of digital input (d.) (see NOTE 3 in Pr.00-04)
2214H	R	The corresponding CPU pin status of digital output (O.) (see NOTE 4 in Pr.00-04)
2215H	R	Number of actual motor revolution (PG1 of PG card) (P.) it starts from 9 when the actual operation direction is changed or the keypad displays at stop is 0. The maximum is 65535
2216H	R	Pulse input frequency (PG2 of PG card) (XXX.XX Hz)
2217H	R	Pulse input position (PG card PG2), the maximum setting is 65535.
2218H	R	Position command tracing error
2219H	R	Display times of counter overload (XXX.XX %)
221AH	R	GFF (XXX.XX%)
221BH	R	DCBUS voltage ripples (XXX.X V)
221CH	R	PLC register D1043 data (C)
221DH	R	Number of poles of a permanent magnet motor
221EH	R	User page displays the value in physical measure
221FH	R	Output Value of Pr.00-05 (XXX.XX Hz)
2220H	R	Number of motor turns when drive operates (saves when drive stops, and resets to zero when operating)
2221H	R	Operating position of the motor (saves when drive stops, and resets to zero when operating)
2222H	R	Fan speed of the drive (XXX%)
2223H	R	Control mode of the drive 0: speed mode 1: torque mode
2224H	R	Carrier frequency of the drive (XX kHz)
2225H	R	Reserved

<table>
<tr><th>Modbus address</th><th>RW</th><th colspan="2">Function</th></tr>
<tr><td rowspan="5">2226H</td><td rowspan="5">R</td><td colspan="2">Drive status</td></tr>
<tr><td>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>2227H</td><td>R</td><td colspan="2">Drive’s estimated output torque (positive or negative direction) (XXXX Nt-m)</td></tr>
<tr><td>2228H</td><td>R</td><td colspan="2">Torque command (XXX.X%)</td></tr>
<tr><td>2229H</td><td>R</td><td colspan="2">kWh display (XXXX.X)</td></tr>
<tr><td>222AH</td><td>R</td><td colspan="2">PG2 pulse input in Low Word</td></tr>
<tr><td>222BH</td><td>R</td><td colspan="2">PG2 pulse input in High Word</td></tr>
<tr><td>222CH</td><td>R</td><td colspan="2">Motor actual position in Low Word</td></tr>
<tr><td>222DH</td><td>R</td><td colspan="2">Motor actual position in High Word</td></tr>
<tr><td>222EH</td><td>R</td><td colspan="2">PID reference (XXX.XX%)</td></tr>
<tr><td>222FH</td><td>R</td><td colspan="2">PID offset (XXX.XX%)</td></tr>
<tr><td>2230H</td><td>R</td><td colspan="2">PID output frequency (XXX.XX Hz)</td></tr>
<tr><td>2231H</td><td>R</td><td colspan="2">Hardware ID</td></tr>
</table>

Remote IO (26xx)

Modbus address	RW	Function
2600H	R	Each bit corresponds to different terminal input contact
2640H	RW	Each bit corresponds to different terminal output contact
2660H	R	AVI proportional value
2661H	R	ACI proportional value
2662H	R	AUI proportional value
266AH	R	Extension card AI10, 0.0–100.0% (EMC-A22A)
266BH	R	Extension card AI11, 0.0–100.0% (EMC-A22A)
26A0H	RW	AFM1 output proportional value
26A1H	RW	AFM2 output proportional value
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 (bit 7) of the command code to 1 (function code AND 80H) then responds to the control system to signal that an error occurred.

If the keypad displays "CE-XX" as a warning message, "XX" is the error code at that time. Refer to the table of error codes for communication error for reference.

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:

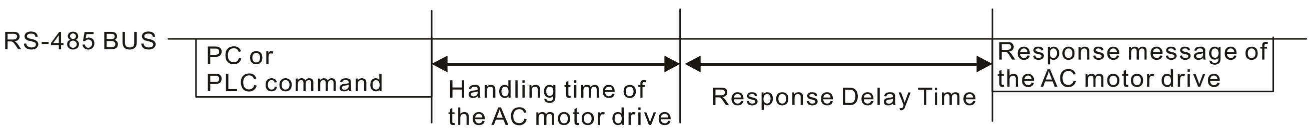
Error code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Failure to execute this function code

09-09 Response Delay Time

Default: 2.0

Settings 0.0–200.0 ms

If the host controller does not finish the transmitting / receiving process, you can use this parameter to set the response delay time after the AC motor drive receives communication command as shown in the following picture.



09-10 Main Frequency of the Communication

Default: 60.00

Settings 0.00–599.00 Hz

When you set Pr.00-20 to 1 (RS-485 serial communication input), the AC motor drive saves the last Frequency command into Pr.09-10 when there is abnormal power off or momentary power loss. When power is restored, the AC motor drive operates with the frequency in Pr.09-10 if no new Frequency command 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: 0000h

Settings 0000–FFFFh

📖 There is a group of block transfer parameter available in the AC motor drive (Pr.09-11 to Pr.09-20). User can use them (Pr.09-11 to Pr.09-20) to save those parameters that you want to read.

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 Keypd	Digital keypad controls the drive action regardless decoding method 1 or 2.	
	External Terminal	External terminal controls the drive action regardless 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 the drive action regardless decoding method 1 or 2.	

09-31 Internal Communication Protocol

Default: 0

Settings 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: 0

Settings 0–65535

- Define whether the Frequency command or the Speed command must be cleared to zero or not before the PLC starts the next scan.

bit	Description
bit0	Before PLC scans, set the PLC target frequency = 0
bit1	Before PLC scans, set the PLC target torque = 0
bit2	Before PLC scans, set the speed limit of torque control mode = 0

09-35 PLC Address

Default: 2

Settings 1–254

09-36 CANopen Slave Address

Default: 0

Settings 0: Disabled
1–127

09-37 CANopen Speed

Default: 0

Settings 0: 1 Mbps
1: 500 Kbps
2: 250 Kbps
3: 125 Kbps
4: 100 Kbps (Delta only)
5: 50 Kbps

09-39 CANopen Warning Record

Default: Read 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: Can bus off
bit6: Error protocol of CANopen
bit8: The setting values of CANopen indexes are failed
bit9: The setting value of CANopen address is failed
bit10: The checksum value of CANopen indexes is failed

09-40 CANopen Decoding Method

Default: 1

Settings
0: Disabled (Delta-defined decoding method)
1: Enabled (CANopen standard DS402 protocol)

09-41 CANopen 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: Disabled
1: Enabled

09-46 CANopen Master Address

Default: 100

Settings 0–127

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

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 Additional Settings for Communication Card Speed (for DeviceNet)

Default: 0

Settings
0: Standard DeviceNet
In this mode, the baud rate can only be 125 Kbps, 250 Kbps or 500 Kbps in standard DeviceNet speed
1: Non-standard DeviceNet
In this mode, DeviceNet baud rate can be same as that for CANopen (0–8).

- Use this parameter with Pr.09-71.
- 0: The baud rate can only be set to 125 Kbps, 250 Kbps and 500 Kbps as a standard DeviceNet speed.
- 1: The DeviceNet communication rate can be the same as that for CANopen (setting 0–8).

✍ 09-75 Communication Card IP Configuration (for EtherNet)

Default: 0

Settings 0: Static IP
1: Dynamic IP (DHCP)

- 0: Set the IP address manually.
- 1: IP address is dynamically set by the host controller.

✍ 09-76 Communication Card IP Address 1 (for EtherNet)
✍ 09-77 Communication Card IP Address 2 (for EtherNet)
✍ 09-78 Communication Card IP Address 3 (for EtherNet)
✍ 09-79 Communication Card IP Address 4 (for EtherNet)

Default: 0

Settings 0–65535

✍ 09-80 Communication Card Address Mask 1 (for EtherNet)
✍ 09-81 Communication Card Address Mask 2 (for EtherNet)
✍ 09-82 Communication Card Address Mask 3 (for EtherNet)
✍ 09-83 Communication Card Address Mask 4 (for EtherNet)

Default: 0

Settings 0–65535

09-84 Communication Card Gateway Address 1 (for EtherNet)
09-85 Communication Card Gateway Address 2 (for EtherNet)
09-86 Communication Card Gateway Address 3 (for EtherNet
09-87 Communication Card Gateway Address 4 (for EtherNet)

Default: 0

Settings 0–65535

09-88 Communication Card Password (Low Word) (for EtherNet)
09-89 Communication Card Password (High Word) (for EtherNet)

Default: 0

Settings 0–99

09-90 Reset Communication Card (for EtherNet)

Default: 0

Settings 0: Disabled

1: Reset to default

09-91 Additional Settings for the Communication Card (for EtherNet)

Default: 0

Settings bit0: Enable IP filter

bit1: Enable internet parameters (1 bit).

When the IP address is set, this bit is enabled. After updating the parameters for the communication card, this bit changes to disabled.

bit2: Enable login password (1 bit).

When you enter the login password, this bit is enabled. After updating the parameters for the communication card, this bit changes to disabled.

09-92 Communication Card Status (for EtherNet)

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.

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10 Speed Feedback Control Parameters

In this parameter group, ASR is the abbreviation for Adjust Speed Regulator and PG is the abbreviation for Pulse Generator.

✔ You can set this parameter during operation.

10-00 Encoder Type Selection

Default: 0

Settings 0: Disabled
1: ABZ
2: ABZ (Delta encoder for PM motor)
3: Resolver
4: ABZ / UVW
5: MI8 single-phase pulse input

- When using PG extension card EMC-PG01L or EMC-PG01O, set Pr.10-00 = 1. These extension cards are applicable for induction motor (IM).
- When using EMC-PG01U, set Pr.10-00 = 2 (Delta encoder), and make sure SW1 is switched to D (Delta type). If the setting for Pr.10-00, Pr.10-01 and Pr.10-02 has changed, turn off the drive's power and reboot to prevent permanent magnetic motor (PM) stall. This mode is recommended to use for PM.
- When using EMC-PG01U, set Pr.10-00 = 4 (Standard ABZ / UVW Encoder), and make sure SW1 is switched to S (Standard Type). This mode is applicable for both IM and PM.
- When using EMC-PG01R, set Pr.10-00 = 3, and set Pr.10-01 to 1024 ppr, then set Pr.10-30 after verifying the pole numbers of the resolver. This mode is applicable for both IM and PM.
- When using MI8 single-phase pulse input as frequency command, the Pr.10-02 must set to "5: Single-phase input". The drive calculates the MI8 single-phase pulse input speed when the control modes are VF, VFPG, SVC, IM/PM FOC Sensorless and IM/PM TQC Sensorless. If you use the MI8 single-phase pulse input for speed feedback in closed-loop control, you can only use it in VFPG closed-loop control mode.

10-01 Encoder Pulse

Default: 600

Settings 1–20000

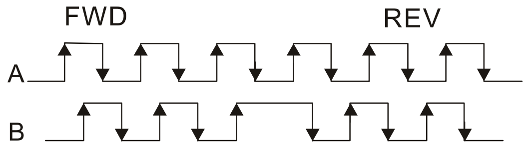
- This parameter sets the encoder pulses per revolution (ppr). It is a feedback control signal source when using PG. The encoder sets the number of pulses for the motor rotating through one rotation. The A / B phase cycle generates the pulse number.
- This setting is also the encoder resolution. The speed control is more accurate with higher resolution.
- If you set this parameter incorrectly, it may cause motor stall, drive over-current, or a permanent magnetic pole origin detection error for the PM in closed-loop control. When using the PM, you must perform the magnetic pole origin detection (Pr.05-00 = 4) again if you modify the content of this parameter.

10-02 Encoder Input Type Setting

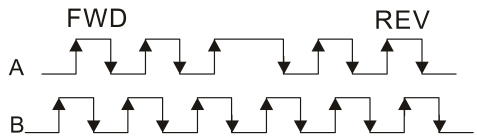
Default: 0

Settings 0: Disabled

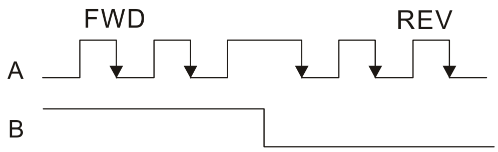
1: Phase A leads in a forward run command and phase B leads in a reverse run command



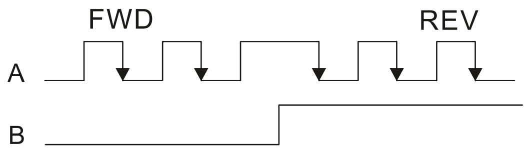
2: Phase B leads in a forward run command and phase A leads in a reverse run command



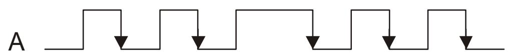
3: Phase A is a pulse input and phase B is a direction input. (L = reverse direction, H = forward direction)



4: Phase A is a pulse input and phase B is a direction input. (L = forward direction, H = reverse direction)



5: Single-phase input



📖 Position control: the PG2 pulse affects the PG1 pulse tracking position.

1. When PG2 is single-pulse, and PG1 is A / B phase pulse, the frequency of position control should be (input pps × 2) ÷ (PG1 ppr × 4) at constant speed.
2. When PG2 and PG1 are either single-pulse (or both A / B phase pulse), the frequency of position control should be (input pps × 2) ÷ (PG1 ppr × 2) at constant speed.
3. Due to the edge trigger of the pulse input, the input of A / B phase pulse should be read as 4 times of the frequency; and the single-phase input should be read as twice of the frequency. For inputs with the same pps, the single-phase tracking frequency will be half of the double-phase frequency.

📖 Velocity control: PG2 acts according to the setting for Pr.10-01 (PG1 ppr), and will not be affected by PG1 pulse (single-phase input or A / B phase pulse). When the setting for Pr.10-00, Pr.10-01 and Pr.10-02 are changed, cycle the power of the motor drive.

1. The speed formula is (input ppr) ÷ (PG1 ppr), when PG1 ppr = 2500, PG2 is single-phase input, and the input pps is 1000 (1000 pulse per second), the speed should be (1000 ÷ 2500) = 0.40 Hz.

2. The same pps inputs of A/B phase pulse or single-phase pulse input should get the same frequency command.

10-03 Output Setting for Frequency Division (Denominator)

Default: 1

Settings 1–255

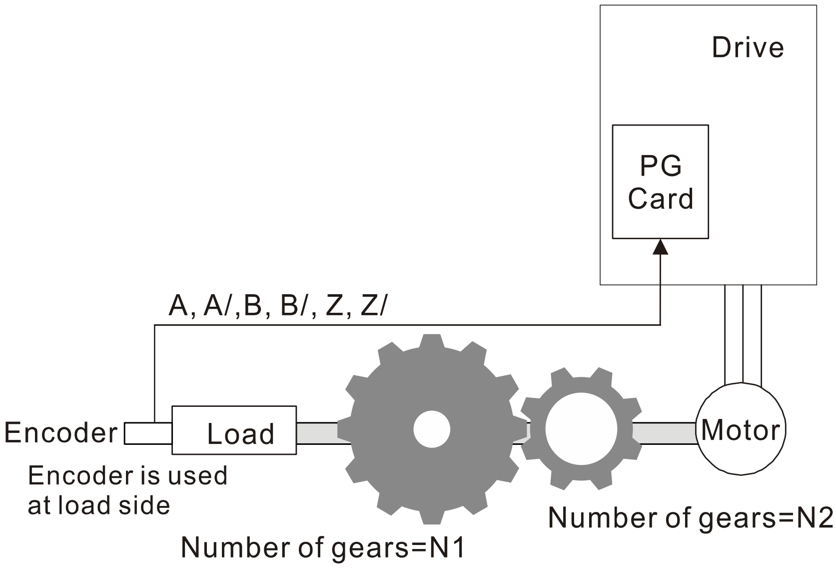
Set the denominator for the frequency division of the PG card feedback and output. When you set it to 2 with feedback 1024 ppr, PG OUT (pulse output) of PG card is 1024 ÷ 2 = 512 ppr.

10-04 Mechanical Gear at Load Side A1
10-05 Mechanical Gear at Motor Side B1
10-06 Mechanical Gear at Load Side A2
10-07 Mechanical Gear at Motor Side B2

Default: 100

Settings 1–65535

Use Pr.10-04–Pr.10-07 with the multi-function input terminal setting 48 to switch to Pr.10-04–Pr.10-05 or Pr.10-06–Pr.10-07, as shown in the diagram below.



Gear ratio: $\frac{N1}{N2} = \frac{A1}{B1}$ or $\frac{A2}{B2}$

MIx=48 ON= $\frac{A2}{B2}$, OFF= $\frac{A1}{B1}$

A1 = Mechanical Gear A1 at Load Side (Pr.10-04)
B1 = Mechanical Gear B1 at Motor Side (Pr.10-05)
A2 = Mechanical Gear A2 at Load Side (Pr.10-06)
B2 = Mechanical Gear B2 at Motor Side (Pr.10-07)

10-08 Treatment for Encoder / Speed Observer Feedback Fault

Default: 2

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

10-09 Detection Time of Encoder / Speed Observer Feedback Fault

Default: 1.0

Settings 0.0–10.0 sec. (0: Disabled)

When there is an encoder loss, an encoder signal error, a pulse signal setting error or a signal error, if the duration exceeds the detection time for the encoder feedback fault (Pr.10-09), the encoder signal error occurs. Refer to Pr.10-08 for encoder feedback fault treatment.

When the speed controller signal is abnormal or the direction of operation and speed observer are different, if time exceeds the detection time for the encoder feedback fault (Pr.10-09), reverse direction of the speed feedback fault (SdRv, fault no. 68) occurs. Refer to chapter 14 for the troubleshooting.

10-10 Encoder Stall Level

Default: 115

Settings 0–120% (0: Disabled)

Determine the maximum feedback signal allowed before a fault occurs. The maximum operation frequency for Pr.01-00 = 100%

10-11 Detection Time of Encoder / Speed Observer Stall

Default: 0.1

Settings 0.0–2.0 sec.

10-12 Encoder / Speed Observer Stall Action

Default: 2

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

When the drive output frequency exceeds the setting of the encoder / speed observer stall level (Pr.10-10), and if the accumulation time exceeds the detection time of speed observer stall (Pr.10-11), then the over speed rotation feedback (SdOr, fault no. 69) fault occurs. Refer to Chapter 14 for fault treatment.

10-13 Encoder / Speed Observer Slip Range

Default: 50

Settings 0–50% (0: Disabled)

10-14 Detection Time of Encoder / Speed Observer Slip

Default: 0.5

Settings 0.0–10.0 sec.

10-15 Treatment for Encoder Stall and Slip Error

Default: 2

Settings 0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop

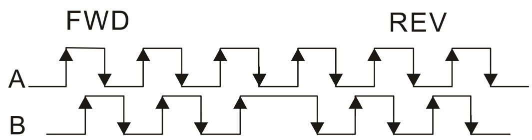
Start to accumulate time when the difference between rotational speed and motor frequency exceeds the setting of speed observer slip range (Pr.10-13). If the accumulation time exceeds the detection time of speed observer slip (Pr.10-14), then the large deviation of speed feedback (SdDe, fault no. 70) fault occurs. Refer to Chapter 14 for fault treatment.

10-16 Pulse Input Type Setting

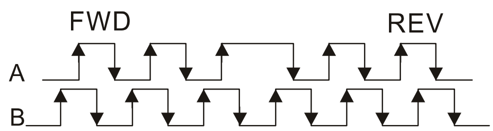
Default: 0

Settings 0: Disabled

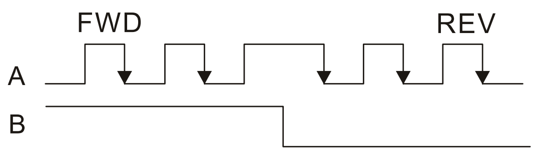
1: Phase A leads in a forward run command and phase B leads in a reverse run command



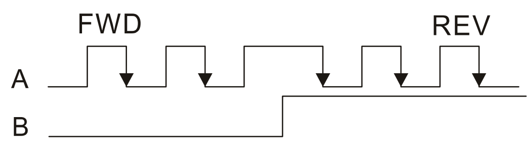
2: Phase B leads in a forward run command and phase A leads in a reverse run command



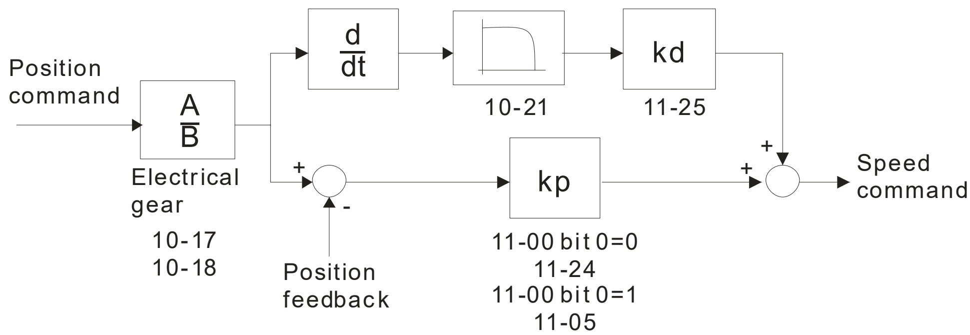
3: Phase A is a pulse input and phase B is a direction input.
(L=reverse direction, H=forward direction)



4: Phase A is a pulse input and phase B is a direction input.
(L=forward direction, H=reverse direction)



- When this setting is different from Pr.10-01 setting and the source of the frequency command is pulse input (Pr.00-20 is set to 4 or 5), it may have 4 times frequency problem.
  Example: Assume that Pr.10-01 = 1024, Pr.10-02 = 1, Pr.10-16 = 3, Pr.00-20 = 5, MI=37 and ON, it needs 4096 pulses to rotate the motor a revolution.
- Assume that Pr.10-01 = 1024, Pr.10-02 = 1, Pr.10-16 = 1, Pr.00-20 = 5, MI = 37 and ON, it needs 1024 pulses to rotate the motor a revolution.
- Position control diagram



✔ 10-17 Electrical Gear A
✔ 10-18 Electrical Gear B

Default: 100

Settings 1–65535

- Rotation speed = pulse frequency/encoder pulse (Pr.10-00) x PG Electrical Gear A / PG Electrical Gear B.

10-19 Positioning for Encoder Position

Default: 17

Settings -32767–2400 bit

- This parameter determines the internal position in the position mode.
- It needs to be used with multi-function input terminal setting =35 (enable position control).
- When it is set to 0, it is the Z-phase position of encoder.

10-20 Range for Encoder Position Attained

Default: 10

Settings 0–65535 pulse

- This parameter determines the range for internal positioning position attained.

  For example:

  When the position is set by Pr.10-19 Positioning for Encoder Position and Pr.10-20 is set to 1000, it reaches the position if the position is within 990-1010 after finishing the positioning.

✔ 10-21 Filter Time (PG2)

Default: 0.100

Settings 0.000–65.535 sec.

- When you set Pr.00-20 to 5 and the multi-function input terminal to 37 (OFF), the system treats the pulse command as a Frequency command. Use this parameter to suppress the speed command jump.

✔ 10-22 Speed Mode (PG2)

Default: 0.100

Settings 0: Electronic frequency

1: Mechanical frequency (based on pole pair)

✔ 10-24 FOC & TQC Function Control

Default: 0

Settings 0–65535

- Only bit = 0 is used for closed-loop; other bits are used for open-loop.

bit no.	Description
0	ASR control at sensorless torque (0: use PI as ASR; 1: use P as ASR)
11	Activate DC braking when executing zero torque command (0: ON; 1: OFF)
12	FOC Sensorless mode, cross zero means speed goes from negative to positive or positive to negative (forward to reverse direction or reverse to forward direction). (0: determined by stator frequency; 1: determined by speed command)
15	Direction control in open-loop torque (0: Switch ON direction control; 1: Switch OFF direction control)

✓ 10-25 FOC Bandwidth for Speed Observer

Default: 40.0

Settings 20.0–100.0 Hz

📖 Setting speed observer to higher bandwidth could shorten the speed response time but will create greater noise interference during the speed observation.

✓ 10-26 FOC Minimum Stator Frequency

Default: 2.0

Settings 0.0–10.0% fN

📖 Set the stator frequency lower limit in operation status. This setting ensures the stability and accuracy of observer and avoids interferences from voltage, current and motor parameters. fN is the motor rated frequency.

✓ 10-27 FOC Low Pass Filter Time Constant

Default: 50

Settings 1–1000 ms

📖 Set the low pass filter time constant of a flux observer at start-up. If you cannot activate the motor during high speed operation, lower the setting for this parameter.

✓ 10-28 FOC Gain of Excitation Current Rise Time

Default: 100

Settings 33–300%Tr (Tr: rotor time constant)

📖 This parameter sets the drive's excitation current rise time when activates at senslorless torque mode. When the drive's activation time is too long at torque mode, please adjust this parameter to a shorter time constant.

✓ 10-29 Top Limit of Frequency Deviation

Default: 20.00

Settings 0.00–200.00 Hz

📖 Limit the maximum frequency deviation.

📖 If you set this parameter too high, an abnormal PG feedback malfunction occurs.

📖 If the application needs a higher setting for Pr.10-29, note that a higher setting results in larger motor slip, which causes a PG Error (PGF3, PGF4). In this case, you can set Pr.10-10 and Pr.10-13 to 0 to disable PGF3 and PGF4 detection, but you must make sure the PG wiring and application are correct; otherwise, it may lose the instant PG protection. Setting Pr.10-29 too high is not commonly done.

10-30 Resolver Pole Pair

Default: 1

Settings 1–50

📖 To use Pr.10-30 function, user must set Pr.10-00=3(Resolver Encoder) first.

10-31 I/F Mode, Current Command

Default: 40

Settings 0–150% rated current of the motor

- Set 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 Sensorless Obeserver Bandwidth for High Speed Zone

Default: 5.00

Settings 0.00–600.00 Hz

- Set 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 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 Observer Low-pass Filter Gain

Default: 1.00

Settings 0.00–655.35

- Changing the setting affects 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 bandwidth.

10-35 ARM (Kp) Gain

Default: 1.00

Settings 0.00–3.00

10-36 ARM (Ki) Gain

Default: 0.20

Settings 0.00–3.00

- Active Magnetic Regulator Kp / Ki, affects the response of magnetic regulation in the low magnetic area.
- If entering the low magnetic area and the input voltage (or DC bus) plummets (e.g. an unstable power net causes instant insufficient voltage, or a sudden load that makes DC bus drop), which causes the ACR diverge and oc, then increase the gain. If the Id value of a spur creates large noise in high-frequency output current, decrease the gain to reduce the noise. Decrease the gain will slow down the response.

10-37 PM Sensorless Control Word

Default: 0000h

Settings 0000–FFFFh

bit No.	Function	Description
2	Choose a control mode to statrt	0 :Start by IF mode 1: Start by VF mode
3	Choose a mode to stop	0 :Stop by IF mode 1 :Stop by VF mode
5	Choose a control mode to stop	0: When lower than Pr.10-40, ramp to stop 1: When lower than Pr.10-40, coast to stop

10-39 Frequency Point when switch from I/F mode to PM Sensorless mode

Default: 20.00

Settings 0.00–599.00 Hz

- Set the frequency for switching from low frequency to high frequency, and sets the switch point for high and low frequencies of the speed observer.
- If the switch frequency is too low, the motor does not generate enough back-EMF to let the speed observer measure the right position and speed of the rotor, causing stall and oc when running at the switch frequency.
- The active range of I/F is too wide if the switch frequency is too high, this generates a larger current and cannot save energy. (If the current value for Pr.10-31 is too high, the high switch frequency makes the drive continue to output with Pr.10-31 setting value.)

10-40 Frequency Point when switch from PM Sensorless Observation mde to I/F mode

Default: 20.00 / 40.00

Settings 0.00–599.00 Hz / 30.00–599.00 Hz

- Set the frequency for switching from high frequency to low frequency, and sets the switch point for high and low frequencies of the speed observer.
- If the switch frequency is too low, the motor does not generate enough back-EMF to let the speed observer measure the right position and speed of the rotor when running at the switch frequency.
- The active range of I/F is too wide if the switch frequency is too high, this generates a larger current and cannot save energy. (If the current value for Pr.10-31 is too high, the high switch frequency makes the drive continue to output with Pr.10-31 setting value.)

10-41 I/F Mode, Low Pass-Filter Time

Default: 0.2

Settings 0.0–6.0 sec.

- Set 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: 10

Settings 0–50 ms

- The angle detection is fixed to 3: Use the pulse injection method to start. 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.

10-43 PG Card Version

Default: Read only

Settings 0.00–655.35

- Corresponding versions for reference:

PG02U	21.XX
PG01U	31.XX
PG01O / PG01L	11.XX
PG02O / PG02L	14.XX
PG01R	41.XX

✎ 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 state at start-up, this increases the accuracy when estimating angles. In order to put the motor in static state, set the three-phase drive output to 0V to the motor. The Pr.10-49 setting time is the length of time when three-phase output at 0V.
- 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 state in 0.2 seconds, increase this setting value appropriately.
- If Pr.10-49 is too high, the start-up time is longer. If it is too low, then the braking performance is weak.

✎ 10-50 Reverse Angle Limit (Electrical Angle)

Default: 10.00

Settings 0.00–30.00 degree

- When the drive is running forward, if a sudden reverse run occurs and the reverse angle exceeds the setting for Pr.10-50, then a SdRv error occurs.
- This parameter is valid only when the setting of Pr.07-28 =11 (enable textile machine).
- This parameter limits the reverse angle if the estimated tolerance of start-up angle detection is larger, and causes a reverse run of the motor.
- Decrease the parameter setting to prevent large reverse angle. Increase the parameter setting if you have a higher tolerance. If the load is too large at this moment, it may cause oc.

10-51 Injection Frequency

Default: 500

Settings 0–1200 Hz

- This parameter is a high frequency injection command in IPM sensorless control mode and you usually 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 of 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.

10-52 Injection Magnitude

Default: 15.0 / 30.0

Settings 0.0–200 V

- The parameter is the magnitude command for the high frequency injection signal in IPM Sensorless 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 when the motor's parameter is "Auto". 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.

10-53 PM Initial Rotor Position Detection Method

Default: 0

Settings 0: Disabled
1: Force attracting the rotor to zero degrees
2: High frequency injection
3: Pulse injection

- When Pr.00-11 = 2 (PMSVC) or Pr.00-11 = 6 (PM Sensorless), for IPM, the setting value is suggested to be 2; for SPM, the setting value is suggested to be 3. You can choose the setting 1 if the result is not good of setting as 2 or 3.

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11 Advanced Parameters

In this parameter group, ASR is the abbreviation for Adjust Speed Regulator.

⚡ You can set this parameter during operation.

11-00 System Control

Default: 0

Settings bit 0: Auto tuning for ASR and APR
bit 1: Inertia estimate (only for FOCPG mode)
bit 2: Zero servo
bit 3: Dead Time compensation closed
bit 7: Selection to save or not save the freqeuncy
bit 8: Maximum speed of point to point position control

📖 bit 0=0: Pr.11-06 to 11-11 will be valid and Pr.11-03~11-05 are invalid.

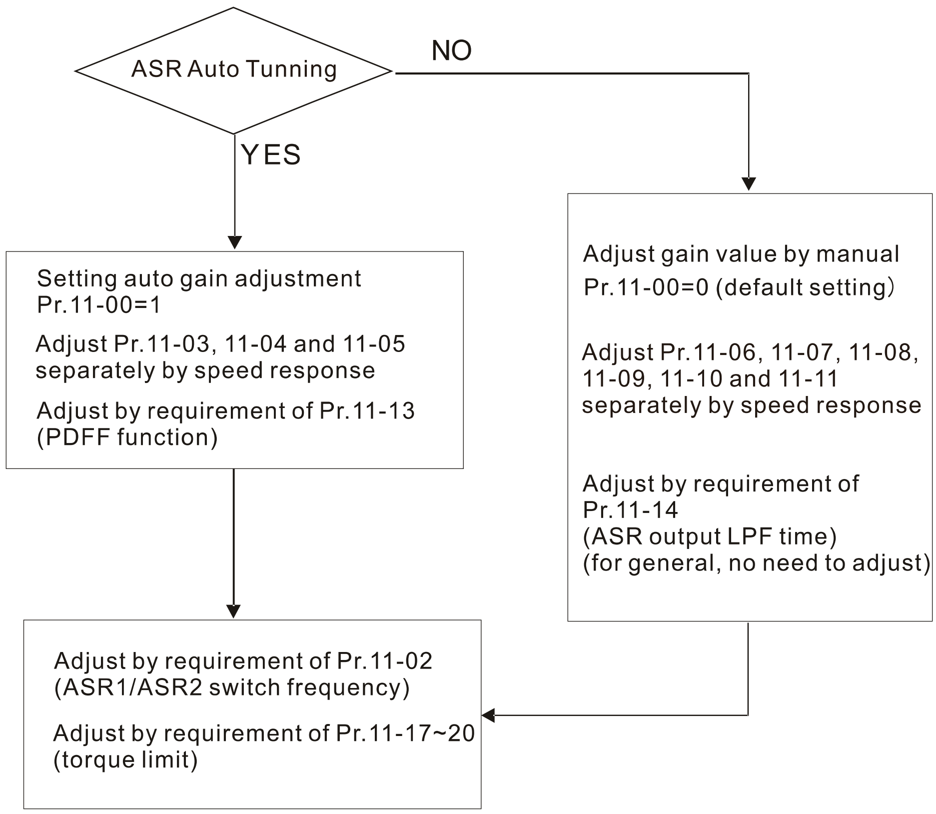
bit 0=1: system will generate an ASR setting. At this moment, Pr.11-06~11-11 will be invalid and Pr.11-03~11-05 are valid.

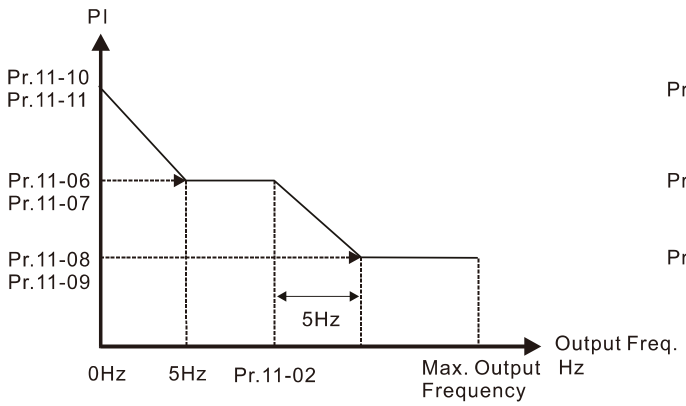
📖 bit 1=0: no function.

bit 1=1: Inertia estimate function is enabled. (Bit 1 setting would not activate the estimation process, please set Pr.05-00=12 to begin FOC/TQC Sensorless inertia estimating)

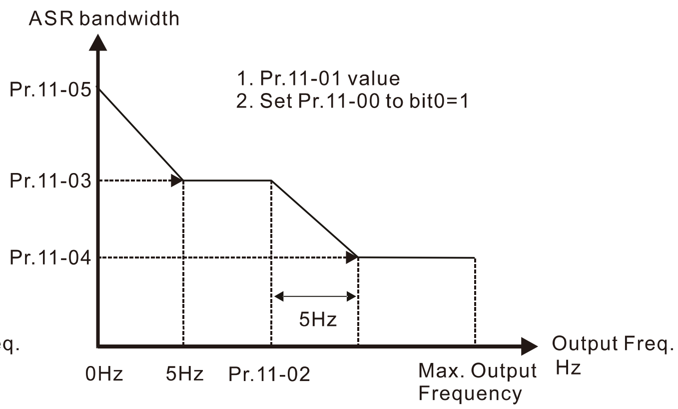
📖 bit 2=0: no function.

bit 2=1: when frequency command is less than Fmin (Pr.01-07), it will use zero servo function.





ASR adjustment- manual gain



ASR adjustment- auto gain

- bit 7=0: frequency is saved before power turns off. When power turns on again, the display frequency will be the memorized frequency.
  bit 7=1: frequency is not saved before power turns off. When power turns ON again, the display frequency will be 0.00 Hz.
- bit 8=0: maximum speed for point-to-point position control is control by the setting of Pr.11-43.
  bit 8=1: maximum speed for point-to-point position control is control by the multi-step speed setting of the external terminal device. When multi-step speed of the external device is set to 0, the maximum operation speed will bet the setting of Pr.11-43.

11-01 Per Unit of System Inertia

Default: 256

Settings 1–65535 (256 = 1PU)

- To get the system inertia per unit from Pr.11-01, you need to set Pr.11-00 to bit1 = 1 and execute continuous forward / reverse running.
- If the Iq current command from ASR has high-frequency glitch, then decrease the setting. If the response time of sudden loading is too slow, then increase the setting.
  The base values of induction motor system inertia are listed below:

Power	Setting	Power	Setting
11kW	35.8	37 kW	202.5
15 kW	74.3	45 kW	355.5
18.5 kW	95.3	55 kW	410.8
22 kW	142.8	75 kW	494.8
30 kW	176.5	90 kW	1056.5

The base value for induction motor system inertia is set by Pr.05-38 and the unit is in 0.001kg-m^2.

11-02 ASR1 / ASR2 Switch Frequency

Default: 7.00

Settings 5.00–599.00 Hz

- Set the low-speed and high-speed ASR switching point in the FOC area. Provides flexibility to meet two needs: give a high response in the high-speed region of the estimator switch point, and give a lower response in the low-speed region of the estimator switch point. The recommended switching point is higher than Pr.10-39.
- A low setting does not cover Pr.10-39. If the setting is too high, the high-speed range is too narrow.

11-03 ASR1 Low-speed Bandwidth
11-04 ASR2 High-speed Bandwidth
11-05 Zero-speed Bandwidth

Default: 10

Settings 1–40Hz (IM)/ 1–100Hz (PM)

- After estimating inertia and setting Pr.11-00 bit0 = 1 (auto-tuning), you can adjust Pr.11-03, Pr.11-04 and Pr.11-05 separately by speed response. The larger the setting value, the faster the response. Pr.11-02 is the switch frequency between the low-speed / high-speed bandwidth.

11-06 ASR 1 Gain

Default: 10

Settings 0–40 Hz (IM) / 1–100 Hz (PM)

11-07 ASR 1 Integral Time

Default: 0.100

Settings 0.000–10.000 sec.

11-08 ASR 2 Gain

Default: 10

Settings 0–40 Hz (IM) / 0–100 Hz (PM)

11-09 ASR 2 Integral Time

Default: 0.100

Settings 0.000–10.000 sec.

11-10 ASR Gain of Zero Speed

Default: 10

Settings 0–40 Hz (IM) / 0–100 Hz (PM)

11-11 ASR Integral Time of Zero Speed

Default: 0.1

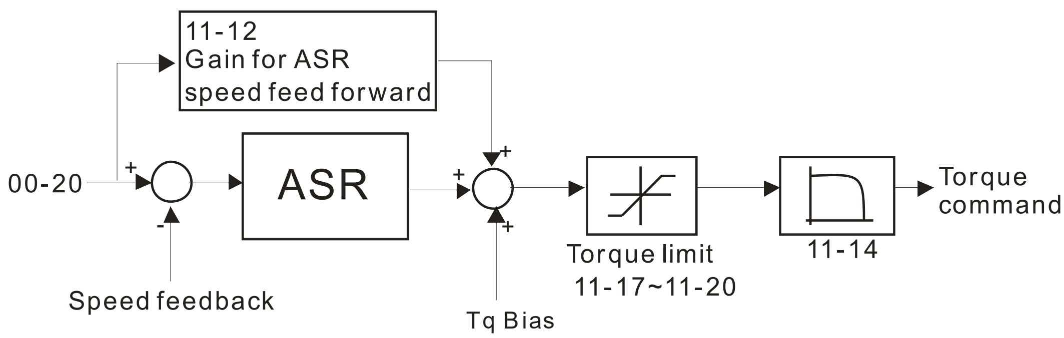
Settings 0.000–10.000 sec.

11-12 ASR Speed Feed Forward Gain

Default: 0

Settings 0–150%

- This parameter is valid only when Pr.11-00 bit0 = 1.
- Increase the setting for Pr.11-12 to reduce the command tracking difference, and improve the speed response. Use this function for speed tracking applications.
- Set Pr.11-01 correctly to get excellent improvement of the speed response.

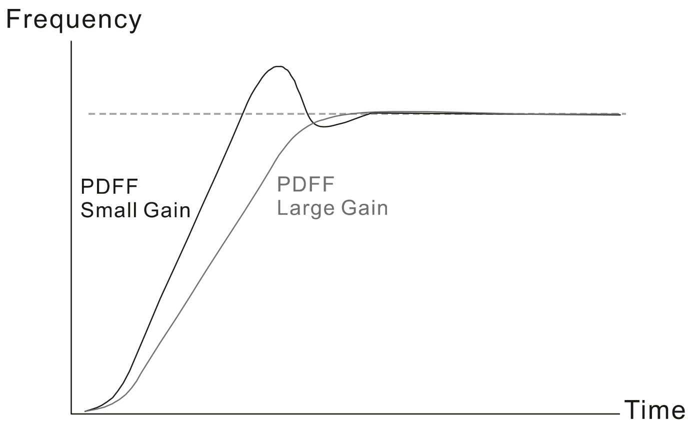


✎ 11-13 PDFF Gain Value

Default: 30

Settings 0–200%

- After finishing estimating and set Pr.11-00 to bit 0=1 (auto tuning), using Pr.11-13 to reduce overshoot. Please adjust PDFF gain value by actual situation.
- This parameter will be invalid when Pr.05-24 is set to 1.



✎ 11-14 ASR Output Low-Pass Filter Time

Default: 0.004

Settings 0.000–0.350 sec.

- Set the ASR command filter time.

✎ 11-15 Notch Filter Depth

Default: 0

Settings 0–20 dB

✎ 11-16 Notch Filter Frequency

Default: 0.00

Settings 0.00–200.00 Hz

- This parameter is used to set resonance frequency of mechanical system. It can be used to suppress the resonance of mechanical system.
- The larger number you set Pr.11-15, the better suppression resonance function you will get.
- The notch filter frequency is the resonance of mechanical frequency.

✎ 11-17 Forward Motor Torque Limit Quadrant I
✎ 11-18 Forward Regenerative Torque Limit Quadrant II
✎ 11-19 Reverse Motor Torque Limit Quadrant III
✎ 11-20 Reverse Regenerative Torque Limit Quadrant IV

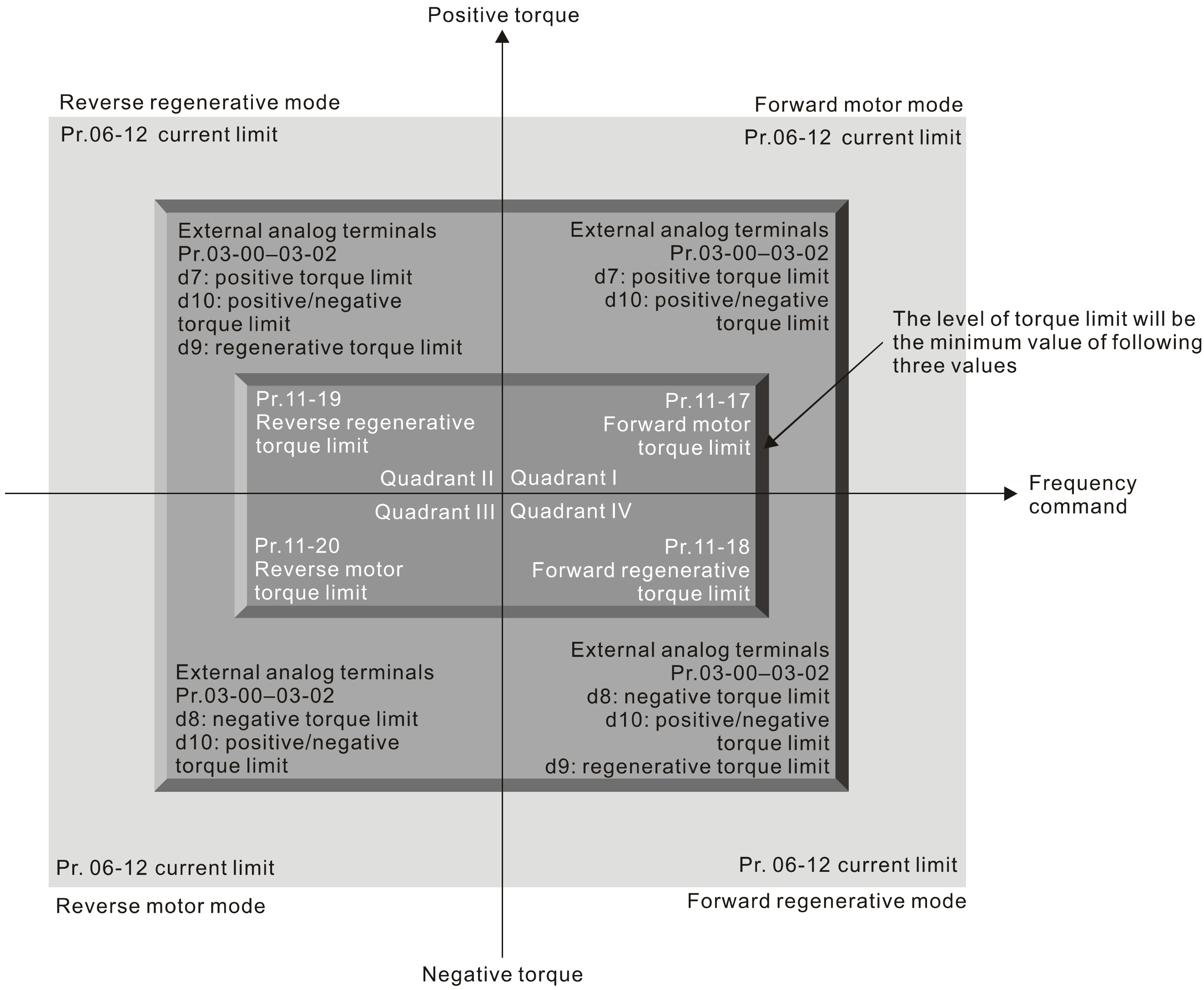
Default: 500

Settings 0–500%

- FOCPG & FOC Sensorless mode:

  The motor rated current = 100%. The setting values for Pr.11-17–Pr.11-20 compare with Pr.03-00 = 7, 8, 9, 10. The minimum value of the result after comparing is the torque limit. The diagram below illustrates the torque limit.

- TQCPG and TQC Sensorless mode:
  The function of Pr.11-17–Pr.11-20 is the same as FOC; however, in this case, the torque limit and the torque command executes the output torque limit at the same time. Therefore, the minimum value between Pr.11-17–11-20 and Pr.06-12 becomes the current output torque limit.
- VF, VFPG and SVC mode:
  Pr.11-17–Pr.11-20 limit the output current, the percentage base value is the drive's rated current (not the motor's rated current). The minimum value between Pr.11-17–11-20 and Pr.06-12 becomes the current output limit. In acceleration and steady state operation, when the output current reaches the limit, the ocA (over-current during acceleration) protection or over-current stall prevention under steady-state operation acts. The output frequency drops, and recovers when the output current is lower than the limit value.
- Refer to Pr.11-34 for calculation equation for the motor rated torque.



- In IM: VF, VFDPG, SVC / PM, PMSVC modes, their 100% base values are the drive's rated current, but for other control modes, 100% base values are the motor's rated current.

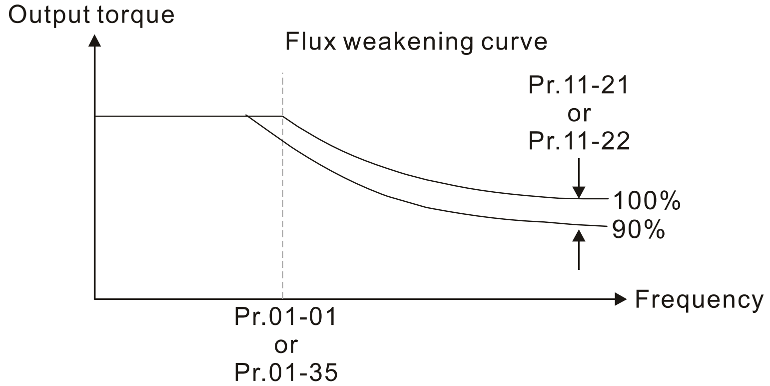
11-21 Flux Weakening Curve for Motor 1 Gain Value
11-22 Flux Weakening Curve for Motor 2 Gain Value

Default: 90

Settings 0–200%

- Pr.11-21 and 11-22 are used to adjust the output voltage of flux weakening curve.
- For the spindle application, the adjustment method is

  1. It is used to adjust the output voltage when exceeding rated frequency.
  2. Monitor the output voltage
  3. Adjust Pr.11-21 (motor 1) or Pr.11-22 (motor 2) setting to make the output voltage reach motor rated voltage.
  4. The larger number it is set, the larger output voltage you will get.



11-23 Speed Response of Flux Weakening Area

Default: 65

Settings 0–150%

- Control the speed in the flux weakening area. The larger the value, the faster the acceleration / deceleration. In normal condition, you do not need to adjust this parameter.

11-24 APR Gain

Default: 10.00

Settings 0.00–40.00 Hz (IM) / 0.00–100.00 Hz (PM)

- Kip gain of internal position is determined by Pr.11-05.

11-25 Gain Value of APR Feed Forward

Default: 30

Settings 0–100

- Use this parameter to improve the drive's tracking characteristics of position control and reduce the phase lag error. The higher the APR feedforward gain value, the less the pulse-train tracking error, and the faster the position control response. However, setting the APR feedforward gain too high may cause overshoot.

11-26 APR Curve Time

Default: 3.00

Settings 0.00–655.35 sec.

- It is valid when the multi-function input terminal is set to 35 (ON). The larger it is set, the longer the position time will be.

11-27 Max. Torque Command

Default: 100

Settings 0–500%

Determine the upper limit of the torque command (motor rated torque is 100%).

11-28 Source of Torque Offset

Default: 0

Settings 0: Disabled
1: Analog signal input (Pr.03-00)
2: RS-485 communication (Pr.11-29)
3: Controlled by external terminals (Pr.11-30–Pr.11-32)

Specify the torque offset source.

When set to 3 (external terminal control), the torque offset sources are Pr.11-30, Pr.11-31 or Pr.11-32 according to the multi-function input terminal settings 31, 32 or 33. Refer to the following chart:

Normally open (N.O.) contact: ON= contact closed, OFF= contact open

Pr.11-32	Pr.11-31	Pr.11-30	Torque Offset
MIx = 33 (Low)	MIx = 32 (Mid)	MIx = 31 (High)	
OFF	OFF	OFF	None
OFF	OFF	ON	Pr.11-30
OFF	ON	OFF	Pr.11-31
OFF	ON	ON	Pr.11-30 + Pr.11-31
ON	OFF	OFF	Pr.11-32
ON	OFF	ON	Pr.11-30 + Pr.11-32
ON	ON	OFF	Pr.11-31 + Pr.11-32
ON	ON	ON	Pr.11-30 + Pr.11-31 + Pr.11-32

11-29 Torque Offset Setting

Default: 0.0

Settings -100.0–100.0%

Determine the torque offset command. The motor rated torque is 100%.

11-30 High Torque Offset

Default: 30.0

Settings -100.0–100.0%

11-31 Middle Torque Offset

Default: 20.0

Settings -100.0–100.0%

11-32 Low Torque Offset

Default: 10.0

Settings -100.0–100.0%

When Pr.11-28 is set to 3, the torque offset sources are Pr.11-30, Pr.11-31 or Pr.11-32 according to the multi-function input terminals settings 31, 32 or 33. The motor rated torque is 100%.

✔ 11-33 Source of Torque Command

Default: 0

Settings 0: Digital keypad
1: RS-485 communication (Pr.11-34)
2: Analog signal input (Pr.03-00–03-02)
3: CANopen
5: Communication extension card

- When Pr.11-33 is set to 0 or 1, you can set the torque command in Pr.11-34.
- When Pr.11-33 is set to 2, 3 or 5, Pr.11-34 only displays the torque command.

✔ 11-34 Torque Command

Default: 0.0

Settings -100.0–100.0% (Pr.11-27 = 100%)

- This parameter sets the torque command.
  When Pr.11-27 is 250% and Pr.11-34 is 100%, the actual torque command = 250 × 100% = 250% of the motor rated torque.
- The drive saves the setting before power is OFF.
- The calculation equation for the motor rated torque:
  - Motor rated torque: $T(N.M)=\dfrac{P(W)}{\omega(rad/s)}$;
  - P(W) value = Pr.05-02 (Pr.05-14);
  - ω(rad/s) value = Pr.05-03 (Pr.05-15);
  - $\dfrac{RPM\times 2\pi}{60}=rad/s$

✔ 11-35 Filter Time of Torque Command

Default: 0.000

Settings 0.000–1.000 sec.

- When time constant is too large, the control is stable, but the response is getting worse; when it's too small, has quick response, but the control may be unstable. If you have no idea about the best setting, you can adjust the setting according to the situation of unstable control or delayed response.

11-36 Speed Limit Selection

Default: 0

Settings 0: Set by Pr.11-37 (Forward Speed Limit) and Pr.11-38 (Reverse Speed Limit)
1: Set by Pr.00-20 (Source of Master Frequency Command) and Pr.11-37, Pr.11-38
2: Set by Pr.00-20 (Source of Master Frequency Command).

- Speed limit function: when you use the torque control mode, if the torque command is greater than the load, the motor accelerates until the motor speed equals the speed limit. At this moment, it switches to speed control mode to stop acceleration.

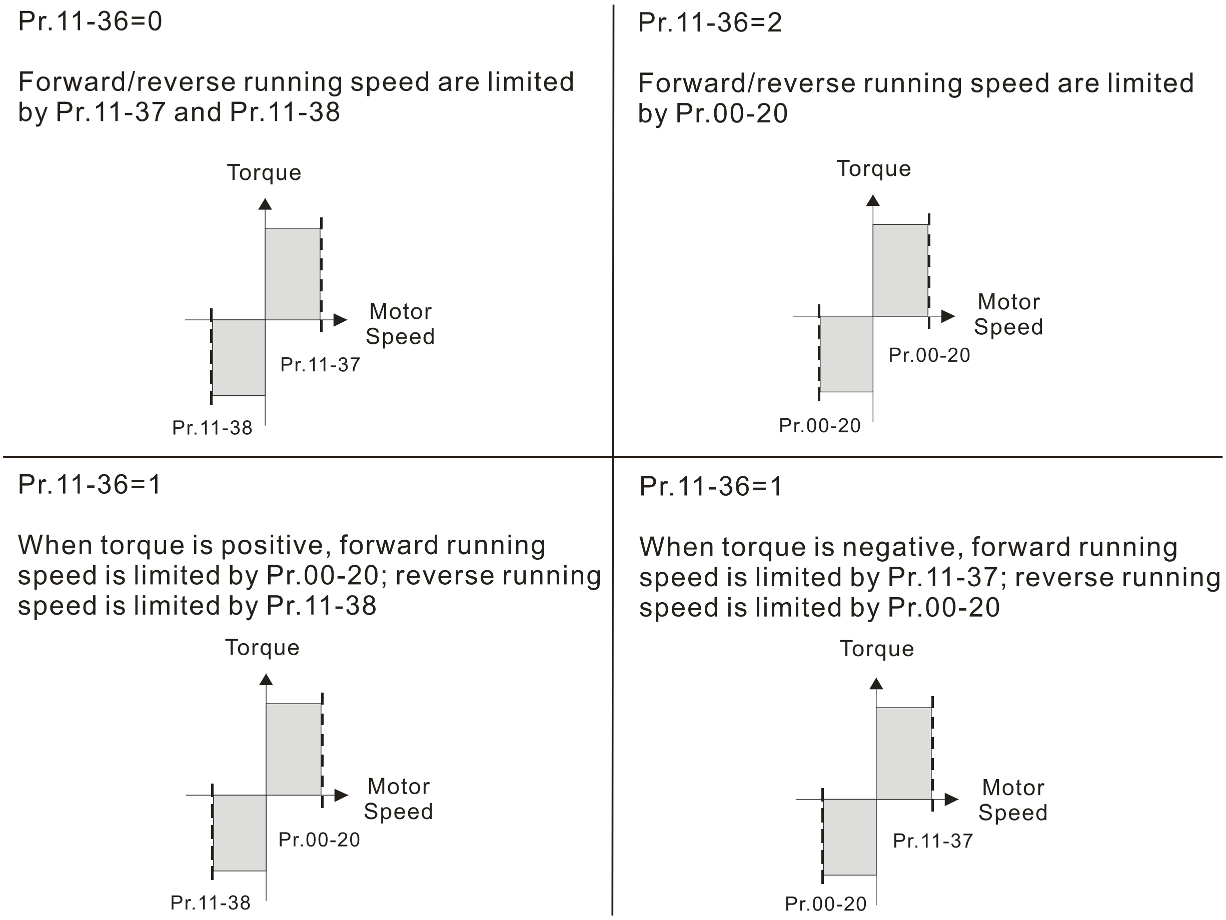
📖 Pr.11-36 = 1:

- When the torque command is positive, the forward speed limit is Pr.00-20 and the reverse speed limit is Pr.11-38.
- When the torque command is negative, the forward speed limit is Pr.11-37 and the reverse speed limit is Pr.00-20.

Example:

In an unwinding application, if the torque command direction is different from the motor operating direction, the load drives the motor. In this case, the speed limit must be Pr.11-37 or Pr.11-38. Only in normal applications, when the motor drives the load and the torque command is in the same direction as the speed limit, you can set the speed limit according to Pr.00-20.

📖 In torque control mode, the F page of keypad displays the present speed limit value. For details on the keypad display, refer to the LED Function Description in Chapter10 "Digital Keypad".



11-37 Forward Speed Limit (Torque Mode)

11-38 Reverse Speed Limit (Torque Mode)

Default: 10

Settings 0–120%

📖 Limit the speed for forward and reverse running in torque mode (Pr.01-00 maximum operation frequency = 100%).

11-39 Zero Torque Command Mode

Default: 0

Settings 0: Torque mode
1: Speed mode

- This parameter is only valid in TQCPG IM and TQCPG PM, and it defines the mode when the speed limit is 0% or 0 Hz.
- When you set Pr.11-39 to 0, and the speed limit is 0% or 0 Hz, the motor generates an excitation current, and the torque command Pr.11-34 limits the torque.
- When you set Pr.11-39 to 1, and the speed limit is 0% or 0 Hz, the AC motor drive can generate output torque through the speed controller (the torque limit is Pr.06-12), and the control mode changes from TQC + PG to FOC + PG mode. The motor has a holding torque. If the speed command is not 0, the drive automatically changes it to 0.

11-40 Position Control Command Source

Default: 0

Settings 0: External terminal
2: RS-485
3: CANopen
5: Communication card

11-42 System Control Flag

Default: 0000h

Settings 0000–FFFFh

bit No.	Function	Description
0	Current limit selection of the speed control in torque mode	0: The speed control in torque mode, the maximum current limit is the torque command. 1: The speed control in torque mode, the maximum current limit is Pr.06-12.
1	FWD / REV action control	0: FWD / REV cannot be controlled by Pr.02-12 bit0 & 1 1: FWD / REV can be controlled by Pr.02-12 bit0 & 1

11-43 Max. Frequency of Point-to-Point Position Control

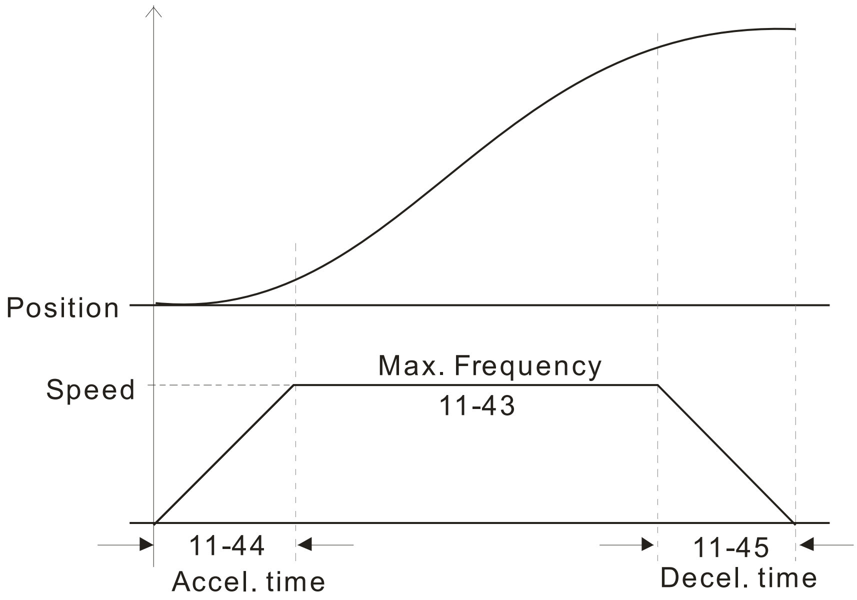
Default: 10.00

Settings 0.00–599.00 Hz

11-44 Accel. Time of Point-to Point Position Control
11-45 Decel. Time of Point-to Point Position Control

Default: 1.00

Settings 0.00–655.35 sec.


Position
Speed
Max. Frequency
11-43
11-44
Accel. time
11-45
Decel. time

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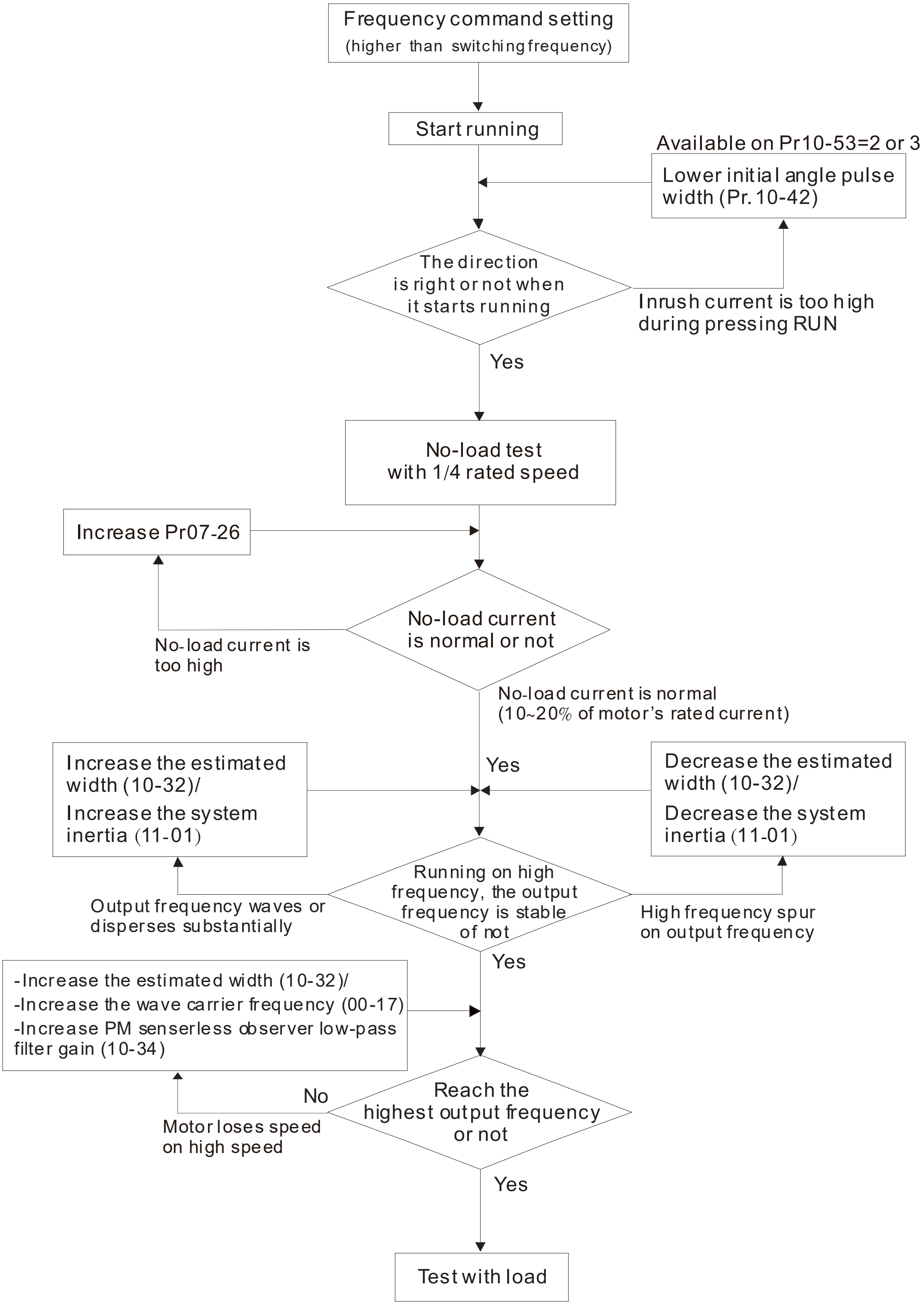
12-2 Adjustment & Application

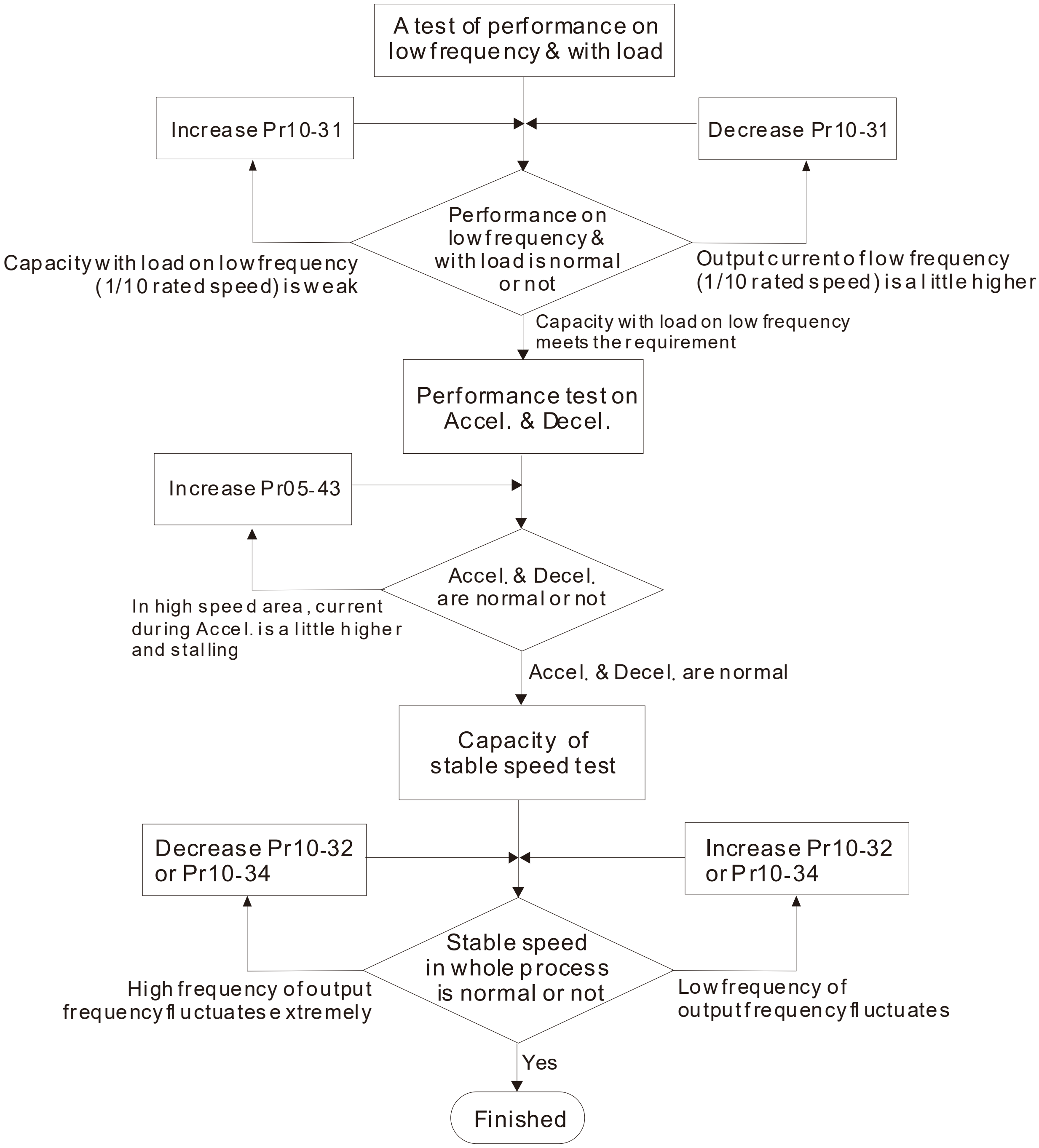
12-2-1 Standard PM Motor Adjustment Procedure

- Pr00-11=2 SVC (Pr05-33=1 or 2)

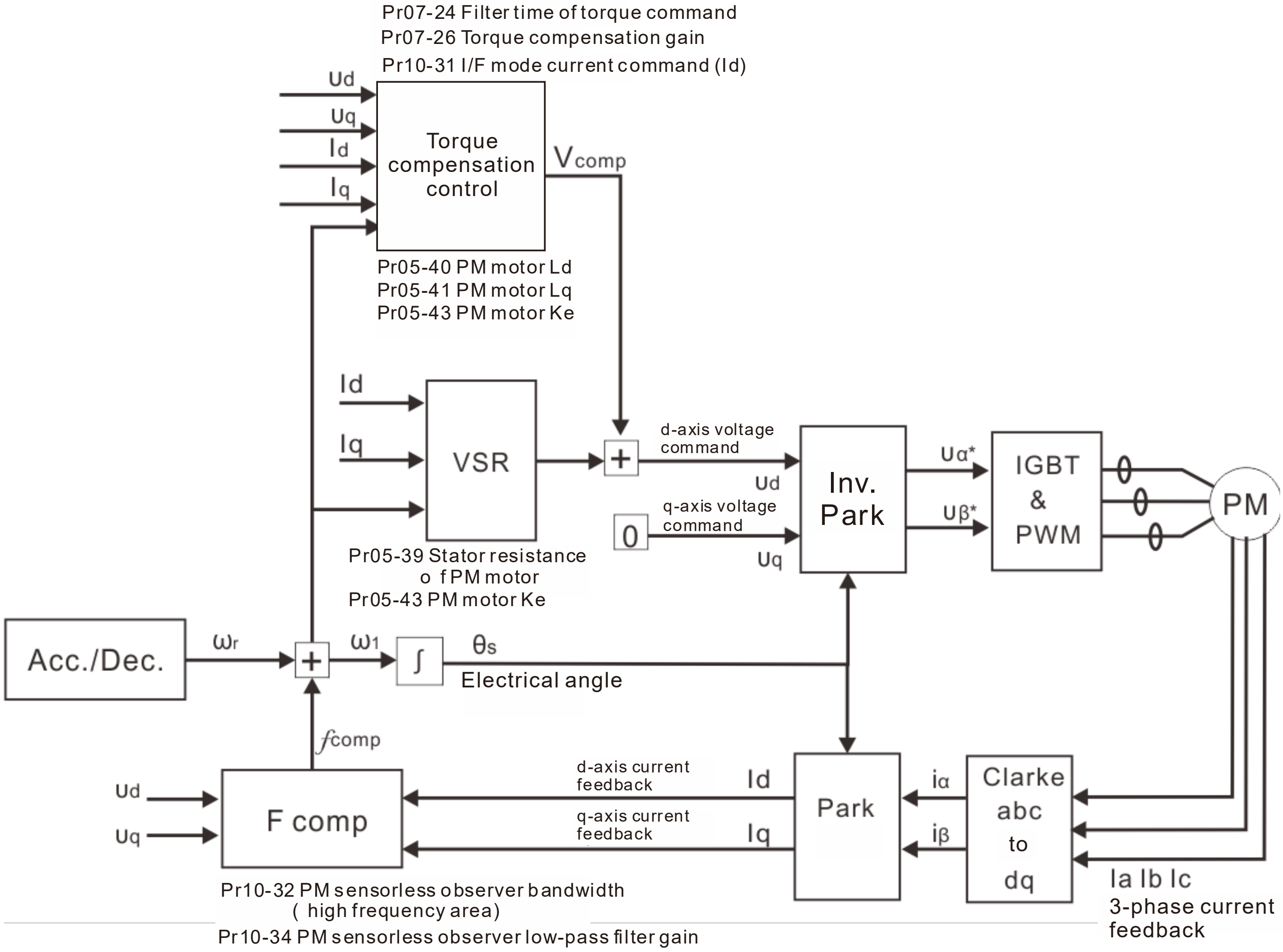
Flow chart of adjustment when starting up WITHOUT load



Flow chart of adjustment when starting up WITH load



PMSVC control diagram



Adjustment procedure

1. Set up PM motor control

   Pr05-33=1 or 2

2. Set up motor parameter according to the nameplate on the motor

   Pr01-01 Output Frequency of Motor 1 (base frequency and motor rated frequency)

   Pr01-02 Output Voltage of Motor 1 (base frequency and motor rated frequency)

   Pr05-34 Full-load current of Permanent Magnet Motor

   Pr05-35 Rated Power of Permanent Magnet Motor

   Pr05-36 Rated speed of Permanent Magnet Motor

   Pr05-37 Pole number of Permanent Magnet Motor

3. Execute Auto-tuning

   Set upPr05-00=13 for IPM motor tuning and press Run(static-tuning). When the tuning is done, the following parameters will be obtained.

   Pr05-39 Stator Resistance of PM Motor

   Pr05-40 Permanent Magnet Motor Ld

   Pr05-41 Permanent Magnet Motor Lq

   Pr05-43 (V/1000rpm), the Ke parameter of PM motor (this can be calculated automatically according to power, current and speed of motor).

   Pr10-52 Injection magnitude

10-52 Injection Magnitude

Factory Setting:15/30V

Settings 0.0~200.0V

- The parameter can be got while motor parameter executes auto-tuning. The parameter will influence the accuracy of angle detection.
- When the ratio of salient pole (Lq/Ld) is lower, increase Pr10-52 to make angle detection be accurate.

4. Set up speed control mode: Pr00-10=0, Pr00-11=2 SVC.
5. It is suggested that cutting off the power after finishing tuning, and then re-power on.
6. The ration of PMSVC control mode is 1:20.
7. When PMSVC control mode is under 1/20 rated speed, load bearing capacity=100% motor rated torque.
8. PMSVC control mode is not applicable for zero speed control.
9. Start-up with load and forward/reverse load bearing capacity of PMSVC control mode=100% rated torque of motor.
10. Set up the speed estimators related parameters

10-31 I/F Mode Current Command / Low-speed Current Command under PMSVC Control

Factory Setting:40

Settings 0~150% of motor's rated current

- The parameter is the current command of the drive in low-speed area (low-speed area: frequency command < Pr10-39).
- When it is stalling on heavy duty start-up or forward/reverse with load, adjust the parameter (to increase it). If inrush current too higher to cause oc stall, then decrease it.

10-32 PM FOC Sensorless Speed Estimator Bandwidth

Factory Setting:5.00

Settings 0.00~600.00Hz

- The parameter is speed estimator bandwidth. Adjust the parameter will influence the stability and the accuracy of speed for motor.
- If there is low frequency vibrates (the waveform is similar to sine wave) during the process, then increase the bandwidth. If there is high frequency vibrates (the waveform vibrates extremely and is like spur), then decrease the bandwidth.

10-34 PM Sensorless Observer Low-pass Filter Gain

Factory Setting:1.00

Settings 0.00~655.35

- Adjust the parameter will influence the speed estimator's speed of response.
- If there is low frequency vibrates (the waveform is similar to sine wave) during the process, then increase the gain. If there is high frequency vibrates (the waveform vibrates extremely and is like spur), then decrease the gain.

10-39 Frequency Point when switch from I/F Mode to PM Sensorless Mode

Factory Setting:20.00

Settings 0.00~599.00Hz

- The parameter is the switch point which is from low frequency to high frequency. It will influence high/low frequency area of speed observer.
- If the switch point is too low, motor will generate not enough back emf to let the speed estimator measure the right rotator's position and speed, and cause stall and oc when the frequency of switch point is running.
- If the switch point is too high, the active area of I/F will too wide, and then it will generate larger current to make it cannot save energy. (The reason is that if the current of Pr10-31 sets too high, and the high switch point will make the drive keeps outputting with the setting value of Pr10-31)

10-42 Voltage pulse width

Factory Setting:10

Settings 0~50 ms

- The angle detection is 3:6-pulse. The parameter influences the value of pulse during the angle detection. The larger the pulse is, the higher of the accuracy of rotator's position. But it might cause oc easily.
- Increase the parameter when the running direction and the command are opposite while start-up. If oc occurs in the start-up moment, then decrease the parameter.

10-49 Zero voltage time while start up

Factory Setting: 0.000

Settings 0.000~60.000 sec.

- When the motor is in static status at the startup, the accuracy to estimate angles will be increased. In order to make the motor in "static status", the drive 3 phase U, V, W output 0V to motor to reach this goal. The Pr10-49 setting time is the length of time when three-phase output 0V.
- It is possible that even when this parameter is being applied but the motor at the installation site cannot go in to the "static status" caused by the inertia or by any external force. So, if the motor doesn't go into a completer "static status" in 0.2 sec, increase appropriately this setting value.
- This parameter is functional only when the setting of Pr07-12 Speed Search during Startup ≠0.
- If Pr10-49 sets too high, the start-up time will be longer obviously. If is too low, then the braking performance will be weak.

10-51 Injection Frequency

Factory Setting: 500Hz

Settings 0~1200Hz

- This parameter is a High Frequency Injection Command when the motor drive is under IPM HFI sensor-less control mode and it doesn't often need to be adjusted. But, if a motor's rated frequency (i.e. 400Hz) is too close to the frequency setting of this parameter (i.e. 500Hz), the accuracy of angles detected will be affected. Therefore, refer to the setting of Pr01-01 before adjusting this parameter.
- If the setting value of Pr00-17 is lower Pr10-51*10, then increase the frequency of carrier wave.

10-52 Injection Magnitude

Factory Setting: 15/30V

Settings 0.0~200.0V

- The parameter is magnitude command of high frequency injection signal when IPM HFI sensorless control mode.
- Increase the parameter can get the more accurate estimated value of angle. But the noise of electromagnetic might be louder if the setting value is too high.
- To get the parameter when motor's parameter is "Auto". And the parameter will influence the accuracy of angel's estimation.
- When the ratio of salient pole (Lq/Ld) is lower, increase Pr10-52 to make angle detection be accurate.

10-53 PM Motor Initial Rotor Position Detection Method

Factory Setting: 0

Settings 0: No function
1: DC injection
2: High frequency injection
3: Pulse injection
4~5: Reserved

- It is suggested to set as "2" if it's IPM; set as "3" if it's SPM. If there is bad effect when set as "2" or "3", then set as "1".

11. Parameters for speed adjustment

07-26 Torque Compensation Gain (V/F and SVC control mode)

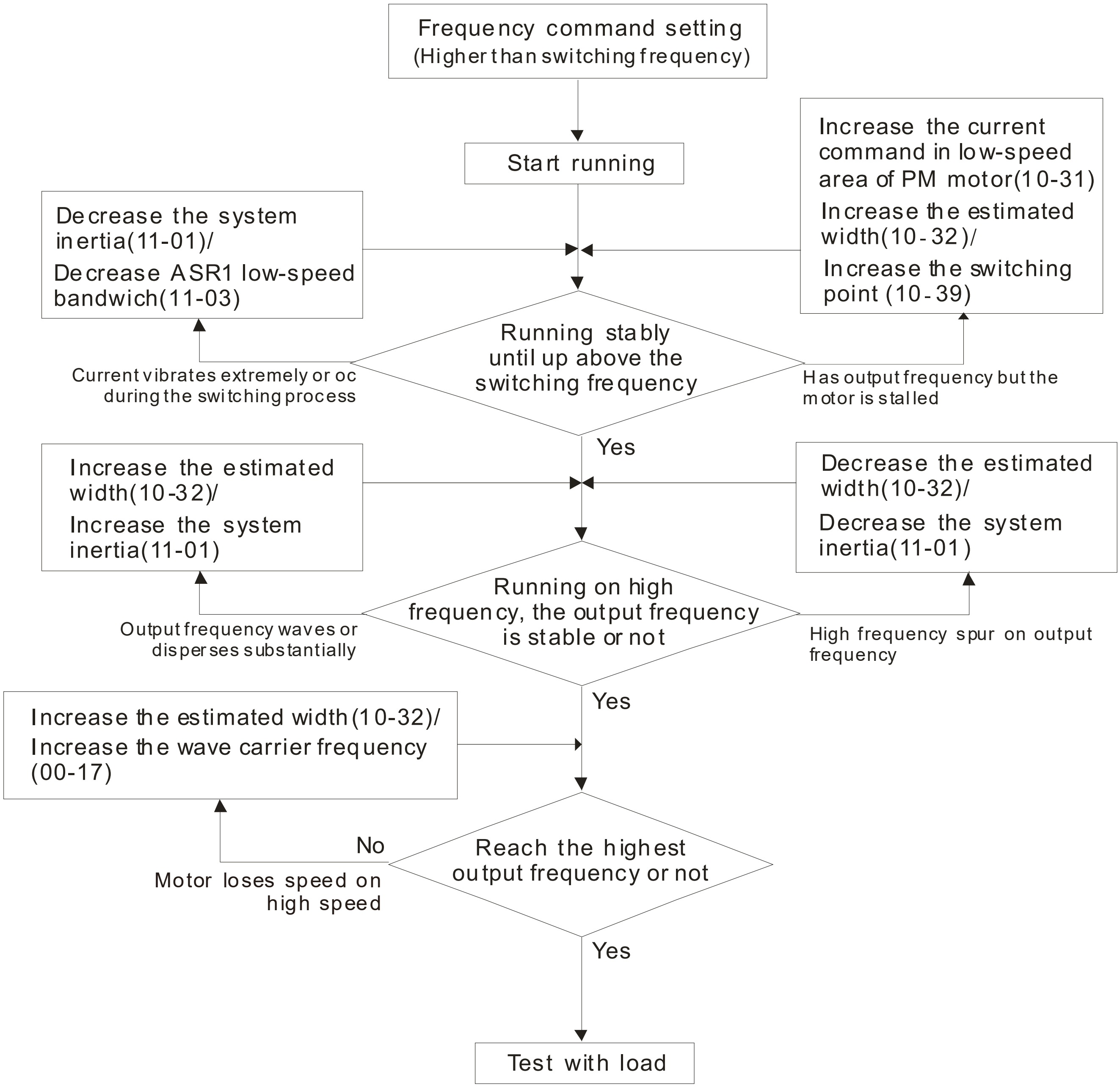
Factory Setting: 0

Settings 0~10

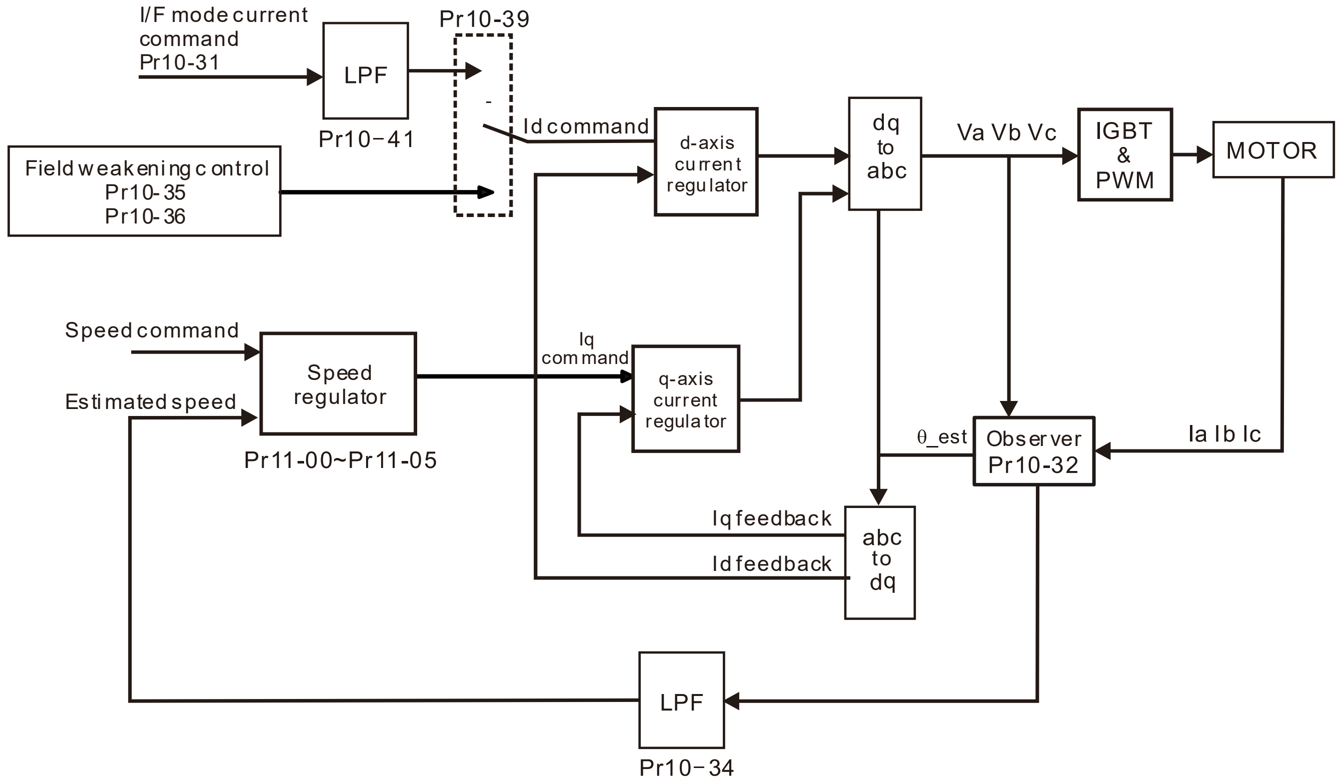
- The parameter influences the output current during the running process. There will be less effect on the low speed area.
- Increase the setting value if the current with no-load is too high. But it might also cause the motor to vibrate. If the motor vibrates during the operation, decrease the setting value.

● Pr00-11=6 PM Sensorless (I/F + FOC)

Flow chart of speed estimator performance adjustment



PM FOC sensorless control diagram



Adjustment procedure

1. Sep up PM motor control

   Pr05-33=1 or 2

2. Set up motor parameter according to the nameplate on the motor

   Pr01-01 Output Frequency of Motor 1 (base frequency and motor rated frequency

   Pr01-02 Output Voltage of Motor 1 (base frequency and motor rated frequency)

   Pr05-34 Full-load current of Permanent Magnet Motor

   Pr05-35 Rated Power of Permanent Magnet Motor

   Pr05-36 Rated speed of Permanent Magnet Motor

   Pr05-37 Pole number of Permanent Magnet Motor

3. Execute Auto-tuning

   Set upPr05-00=13 for IPM motor tuning and press Run(static-tuning). When the tuning is done, the following parameters will be obtained.

   Pr05-39 Stator Resistance of PM Motor

   Pr05-40 Permanent Magnet Motor Ld

   Pr05-41 Permanent Magnet Motor Lq

4. Set up Pr00-11=6 for PM sensorless control (I/F+FOC)

5. Adjust the parameters which are related to speed estimator and ASR to make the best operational performance.

6. Set up the speed estimator related parameters

10-31 I/F Mode Current Command / Low-speed Current Command under PMSVC Control

Factory Setting: 40

Settings 0~150% of motor's rated current

- The parameter is the current command of the drive in low-speed area (low-speed area: frequency command < Pr10-39).
- When it is stalling on heavy duty start-up or forward/reverse with load, adjust the parameter (to increase it). If inrush current too higher to cause oc stall, then decrease it.

10-32 PM FOC Sensorless Speed Estimator Bandwidth

Factory Setting: 5.00

Settings 0.00~600.00Hz

- The parameter is speed estimator bandwidth. Adjust the parameter will influence the stability and the accuracy of speed for motor.
- If there is low frequency vibrates (the waveform is similar to sine wave) during the process, then increase the bandwidth. If there is high frequency vibrates (the waveform vibrates extremely and is like spur), then decrease the bandwidth.

10-34 PM Sensorless Observer Low-pass Filter Gain

Factory Setting: 1.00

Settings 0.00~655.35

- Adjust the parameter will influence the speed estimator's speed of response.
- If there is low frequency vibrates (the waveform is similar to sine wave) during the process, then increase the gain. If there is high frequency vibrates (the waveform vibrates extremely and is like spur), then decrease the gain.

10-35 AMR (Kp)

Factory Setting: 1.00

Settings 0.00~3.00

10-36 AMR (Ki)

Factory Setting: 0.20

Settings 0.00~3.00

- Active Magnetic regulator--- Kp and Ki. These two parameters will influence magnetic flux control of field weakening region.
- Increase the parameter if the input power has rapid change (ex. unstable electrical grid makes voltage be insufficient in a sudden) while enter the field weakening region, and ACR diverges to cause oc (ex. during the application of Press, there are other Press is working, and DC BUS decreases extremely in a sudden). If Id has spur and cause high frequency noise of output current to be too big, then decrease the parameter to lower the noise, but this also might cause a slow response.

10-39 Frequency Point when switch from I/F Mode to PM Sensorless Mode

Factory Setting: 20.00

Settings 0.00~599.00Hz

- The parameter is the switch point which is from low frequency to high frequency. It will influence high/low frequency area of speed observer.
- If the switch point is too low, motor will generate not enough back emf to let the speed estimator measure the right rotator's position and speed, and cause stall and oc when the frequency of switch point is running.
- If the switch point is too high, the active area of I/F will too wide, and then it will generate larger current to make it cannot save energy. (The reason is that if the current of Pr10-31 sets too high, and the high switch point will make the drive keeps outputting with the setting value of Pr10-31)

10-40 Frequency Point when Switch from PM Sensorless Observation to I/F Mode

Factory Setting: 20.00

Settings 0.00~599.00Hz

- The parameter is the switch point which is from high frequency to low frequency. It will influence high/low frequency area of speed observer.
- If the switch point is too low, motor will generate not enough back emf to let the speed estimator measure the right rotator's position and speed, and cause stall and oc when the frequency of switch point is running.
- If the switch point is too high, the active area of I/F will too wide, and then it will generate larger current to make it cannot save energy. (The reason is that if the current of Pr10-31 sets too high, and the high switch point will make the drive keeps outputting with the setting value of Pr10-31)

10-41 I/F Mode and Low Pass-filter time of Id

Factory Setting: 0.2

Settings 0.0~6.0 sec

- The parameter is the filter time of Pr10-31. This can make the magnetic field of I/F increases to current command value progressively and smoothly.
- If Id has to be higher slowly, then increase the parameter to avoid Step of current occurring on start-up. If decrease (the minimum is 0) it, the speed of current to rise will be fast, and occurs Step.

10-42 Voltage pulse width

Factory Setting:10

Settings 0~50 ms

- The angle detection is 3:6-pulse. The parameter influences the value of pulse during the angle detection. The larger the pulse is, the higher of the accuracy of rotator's position. But it might cause oc easily.
- Increase the parameter when the running direction and the command are opposite while start-up. If oc occurs in the start-up moment, then decrease the parameter.

7. ASR parameters

11-00 System Control

Factory Setting: 0

Settings bit 0: Auto tuning for ASR and APR

bit 1: Inertia estimation (only in FOCPG mode)

- bit 0=0: Pr.11-06 to 11-11 will be valid and Pr.11-03~11-05 are invalid.

  bit 0=1: system will generate an ASR setting. At this moment, Pr.11-06~11-11 will be invalid and Pr.11-03~11-05 are valid.

11-01 Per-unit of System Inertia

Factory Setting: 256

Settings 1~65535 (256=1PU)

- Decrease the setting value if there is high frequency spur which occurs on Iq current command of ASR. If the response of sudden load is too slow, then increase the setting value.

~ 11-02 ASR1/ASR2 Switch Frequency

Factory Setting: 7.00

Settings 5.00~599.00Hz

- Low-speed / high speed switch point of ASR in FOC area. This provides higher response in high speed area and lower response in low speed area to meet customers demand. It is suggested that the switch point should > Pr10-39.
- If the setting value is too low, it will not cover Pr10-39. If it’s too high, the range of high speed will be too narrow.

~ 11-03 ASR1 Low-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

~ 11-04 ASR2 High-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

~ 11-05 Zero-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

- After estimating inertia and set Pr.11-00 to bit 0=1 (auto tuning), user can adjust parameters Pr.11-03, 11-04 and 11-05 separately by speed response. The larger number you set, the faster response you will get. Pr.11-02 is the switch frequency for low-speed/high-speed bandwidth.
- Position control pulse command (MIx=37) and P2P position control Kp gain can adjust Pr11-05. The higher the value, the lower the steady-state error.

~ 11-06 ASR (Auto Speed Regulation) control (P) 1

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

11-07 ASR (Auto Speed Regulation) control (I) 1

Factory Setting: 0.100

Settings 0.000~10.000 sec.

11-08 ASR (Auto Speed Regulation) control (P) 2

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

11-09 ASR (Auto Speed Regulation) control (I) 2

Factory Setting: 0.100

Settings 0.000~10.000 sec.

11-10 ASR (Auto Speed Regulation) Control (P) of Zero Speed

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

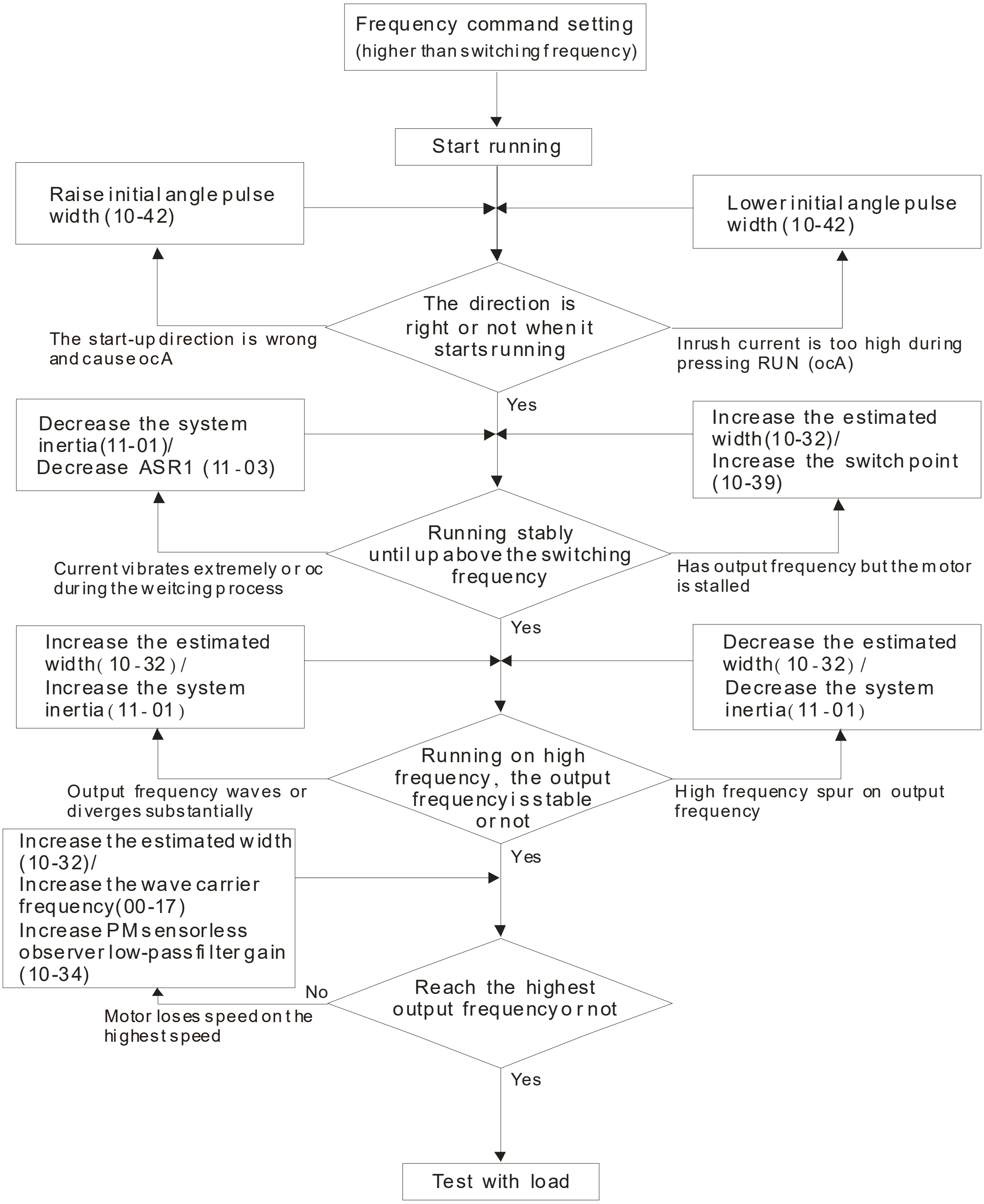
11-11 ASR (Auto Speed Regulation) Control (I) of Zero Speed

Factory Setting: 0.100

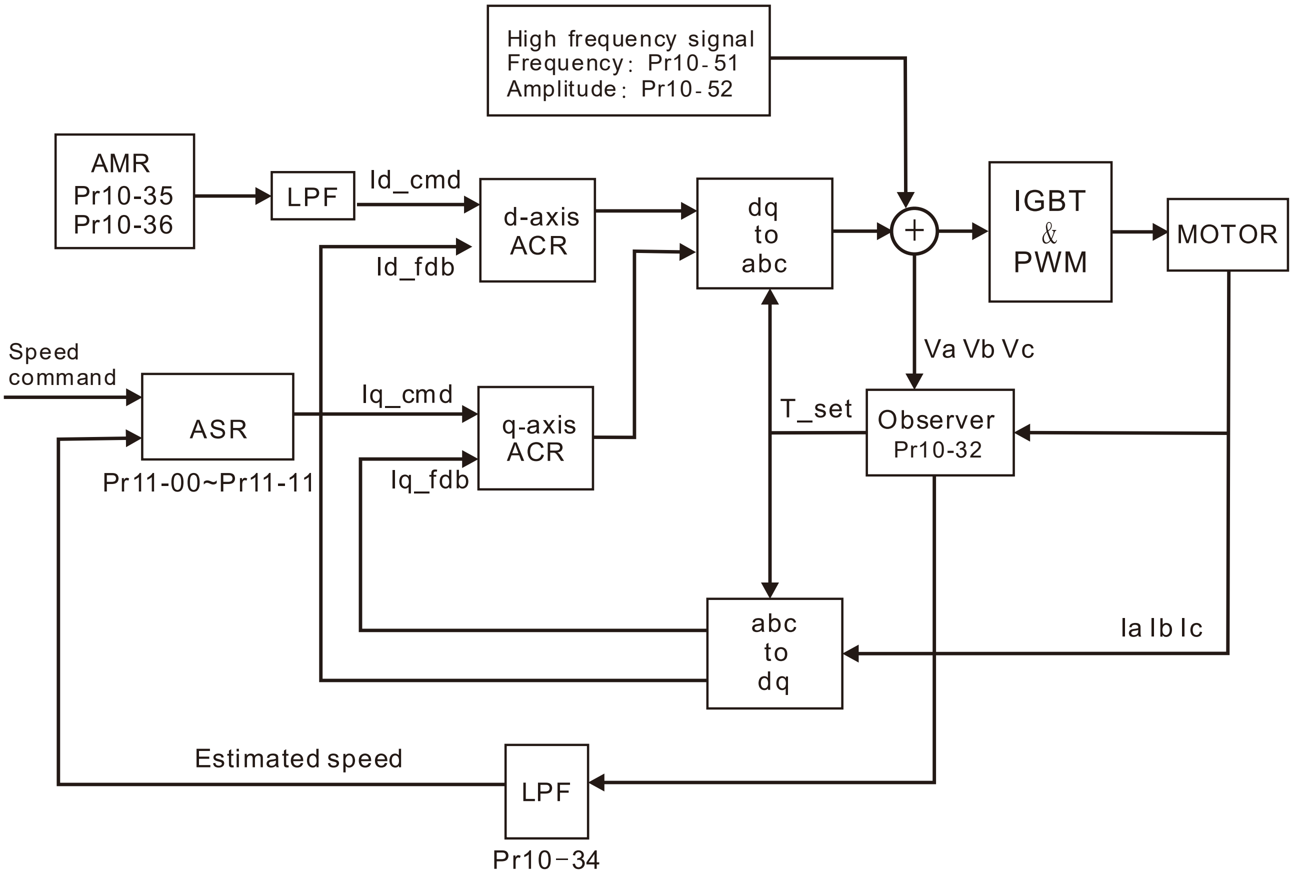
Settings 0.000~10.000 sec.

● Pr00-11=7 IPM Sensorless

Flow chart of adjustment when starting up with light duty



IPM sensorless control diagram



Adjustment procedure

1. Sep up PM motor control

    Pr05-33=1 or 2

2. Set up motor parameter according to the nameplate on the motor

    Pr01-01 Output Frequency of Motor 1 (base frequency and motor rated frequency

    Pr01-02 Output Voltage of Motor 1 (base frequency and motor rated frequency)

    Pr05-34 Full-load current of Permanent Magnet Motor

    Pr05-35 Rated Power of Permanent Magnet Motor

    Pr05-36 Rated speed of Permanent Magnet Motor

    Pr05-37 Pole number of Permanent Magnet Motor

3. Execute Auto-tuning

    Set upPr05-00=13 for IPM motor tuning and press Run(static-tuning). When the tuning is done, the following parameters will be obtained.

    Pr05-39 Stator Resistance of PM Motor

    Pr05-40 Permanent Magnet Motor Ld

    Pr05-41 Permanent Magnet Motor Lq

    PM motor inertia (E-4 kg-m2) Pr05-38 (power, current and speed of motor auto calculates to get this value)

    PM motor Ke (V/1000rpm) Pr05-43 (power, current and speed of motor auto calculates to get this value)

10-52 Injection Magnitude

Factory Setting: 15/30V

Settings 0.0~200.0V

- The parameter is magnitude command of high frequency injection signal when IPM HFI sensorless control mode.
- Increase the parameter can get the more accurate estimated value of angle. But the noise of electromagnetic might be louder if the setting value is too high.
- To get the parameter when motor's parameter is "Auto". And the parameter will influence the accuracy of angel's estimation.
- When the ratio of salient pole (Lq/Ld) is lower, increase Pr10-52 to make angle detection be accurate.

1. Set speed control mode: Pr00-10=0, Pr00-11-7 (IPM Sensorless).
2. It is suggested that cutting off the power after finishing tuning, and then re-power on.
3. Start-up with load should adjust the appropriate inertia value Pr11-01 first, and adjust the suitable high/low speed ASR Kp, Ki according to speed response of system.
4. Light-duty start-up related parameters

10-32 PM FOC Sensorless Speed Estimator Bandwidth

Factory Setting: 5.00

Settings 0.00~600.00Hz

- The parameter is speed estimator bandwidth. Adjust the parameter will influence the stability and the accuracy of speed for motor.
- If there is low frequency vibrates (the waveform is similar to sine wave) during the process, then increase the bandwidth. If there is high frequency vibrates (the waveform vibrates extremely and is like spur), then decrease the bandwidth.

10-34 PM Sensorless Observer Low-pass Filter Gain

Factory Setting: 1.00

Settings 0.00~655.35

- Adjust the parameter will influence the speed estimator's speed of response.
- If there is low frequency vibrates (the waveform is similar to sine wave) during the process, then increase the gain. If there is high frequency vibrates (the waveform vibrates extremely and is like spur), then decrease the gain.

10-35 AMR (Kp)

Factory Setting: 1.00

Settings 0.00~3.00

10-36 AMR (Ki)

Factory Setting: 0.20

Settings 0.00~3.00

- Active Magnetic regulator--- Kp and Ki. These two parameters will influence magnetic flux control of field weakening region.

- Increase the parameter if the input power has rapid change (ex. unstable electrical grid makes voltage be insufficient in a sudden) while enter the field weakening re)gion, and ACR diverges to cause oc (ex. during the application of Press, there are other Press is working, and DC BUS decreases extremely in a sudden). If Id has spur and cause high frequency noise of output current to be too big, then decrease the parameter to lower the noise, but this also might cause a slow response.

10-39 Frequency Point when switch from I/F Mode to PM Sensorless Mode

Factory Setting:20.00

Settings 0.00~599.00Hz

- The parameter is the switch point which is from low frequency to high frequency. It will influence high/low frequency area of speed observer.
- If the switch point is too low, motor will generate not enough back emf to let the speed estimator measure the right rotator's position and speed, and cause stall and oc when the frequency of switch point is running.
- If the switch point is too high, the active area of I/F will too wide, and then it will generate larger current to make it cannot save energy. (The reason is that if the current of Pr10-31 sets too high, and the high switch point will make the drive keeps outputting with the setting value of Pr10-31)

10-40 Frequency Point when Switch from PM Sensorless Observation Mode to I/F Mode

Factory Setting: 20.00

Settings 0.00~599.00Hz

- The parameter is the switch point which is from high frequency to low frequency. It will influence high/low frequency area of speed observer.
- If the switch point is too low, motor will generate not enough back emf to let the speed estimator measure the right rotator's position and speed, and cause stall and oc when the frequency of switch point is running.
- If the switch point is too high, the active area of I/F will too wide, and then it will generate larger current to make it cannot save energy. (The reason is that if the current of Pr10-31 sets too high, and the high switch point will make the drive keeps outputting with the setting value of Pr10-31)

10-42 Voltage pulse width

Factory Setting:10

Settings 0~50 ms

- The angle detection is 3:6-pulse. The parameter influences the value of pulse during the angle detection. The larger the pulse is, the higher of the accuracy of rotator's position. But it might cause oc easily.
- Increase the parameter when the running direction and the command are opposite while start-up. If oc occurs in the start-up moment, then decrease the parameter.

10-49 Zero voltage time while start up

Factory Setting: 0.000

Settings 0.000~60.000 sec.

- When the motor is in static status at the startup, the accuracy to estimate angles will be increased. In order to make the motor in "static status", the drive 3 phase U, V, W output 0V to motor to reach this goal. The Pr10-49 setting time is the length of time when three-phase output 0V.
- It is possible that even when this parameter is being applied but the motor at the installation site cannot go in to the "static status" caused by the inertia or by any external force. So, if the motor doesn't go into a completer "static status" in 0.2 sec, increase appropriately this setting value.
- This parameter is functional only when the setting of Pr07-12 ≠0.
- If Pr10-49 sets too high, the start-up time will be longer obviously. If is too low, then the braking performance will be weak.

10-50 Reverse Angle Limit (Electrical angle)

Factory Setting: 10.00

Settings 0.00~30.00 degree

- While forward run is starting, if there is a sudden reverse run and the reverse angle is larger than the Pr10-50 setting, then drive will have a ScRv error.
- This parameter is valid only when Pr07-28 =11 Enable textile machine's function.
- If the estimated angle error of start-up is too large to cause the motor reverse, the parameter can limit the degree of the reverse.
- Decrease the setting value to let the reverse angle not to be large; or increase it for high error tolerance, but it might cause oc easily if there is large load.

10-51 Injection Frequency

Factory Setting: 500Hz

Settings 0~1200Hz

- This parameter is a High Frequency Injection Command when the motor drive is under IPM HFI sensor-less control mode and it doesn't often need to be adjusted. But, if a motor's rated frequency (i.e. 400Hz) is too close to the frequency setting of this parameter (i.e. 500Hz), the accuracy of angles detected will be affected. Therefore, refer to the setting of Pr01-01 before adjusting this parameter.
- If the setting value of Pr00-17 is lower Pr10-51*10, then increase the frequency of carrier wave.

5. ASR parameters

11-00 System Control

Factory Setting: 0

Settings bit 0: Auto tuning for ASR and APR

bit 1: Inertia estimation (only in FOCPG mode)

- bit 0=0: Pr.11-06 to 11-11 will be valid and Pr.11-03~11-05 are invalid.

bit 0=1: system will generate an ASR setting. At this moment, Pr.11-06~11-11 will be invalid and Pr.11-03~11-05 are valid.

11-01 Per-unit of System Inertia

Factory Setting: 256

Settings 1~65535 (256=1PU)

- Decrease the setting value if there is high frequency spur which occurs on Iq current command of ASR. If the response of sudden load is too slow, then increase the setting value.

✎ 11-02 ASR1/ASR2 Switch Frequency

Factory Setting: 7.00

Settings 5.00~599.00Hz

- Low-speed / high speed switch point of ASR in FOC area. This provides higher response in high speed area and lower response in low speed area to meet customers demand. It is suggested that the switch point should >Pr10-39.
- If the setting value is too low, it will not cover Pr10-39. If it's too high, the range of high speed will be too narrow.

✎ 11-03 ASR1 Low-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

✎ 11-04 ASR2 High-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

✎ 11-05 Zero-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

- After estimating inertia and set Pr.11-00 to bit 0=1 (auto tuning), user can adjust parameters Pr.11-03, 11-04 and 11-05 separately by speed response. The larger number you set, the faster response you will get. Pr.11-02 is the switch frequency for low-speed/high-speed bandwidth.
- Position control pulse command (MIx=37) and P2P position control Kp gain can adjust Pr11-05. The higher the value, the lower the steady-state error.

✎ 11-06 ASR (Auto Speed Regulation) control (P) 1

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

✎ 11-07 ASR (Auto Speed Regulation) control (I) 1

Factory Setting: 0.100

Settings 0.000~10.000 sec.

✎ 11-08 ASR (Auto Speed Regulation) control (P) 2

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

11-09 ASR (Auto Speed Regulation) control (I) 2

Factory Setting: 0.100

Settings 0.000~10.000 sec.

11-10 ASR (Auto Speed Regulation) Control (P) of Zero Speed

Factory Setting: 10

Settings 0~40 Hz (IM)/ 0~100Hz (PM)

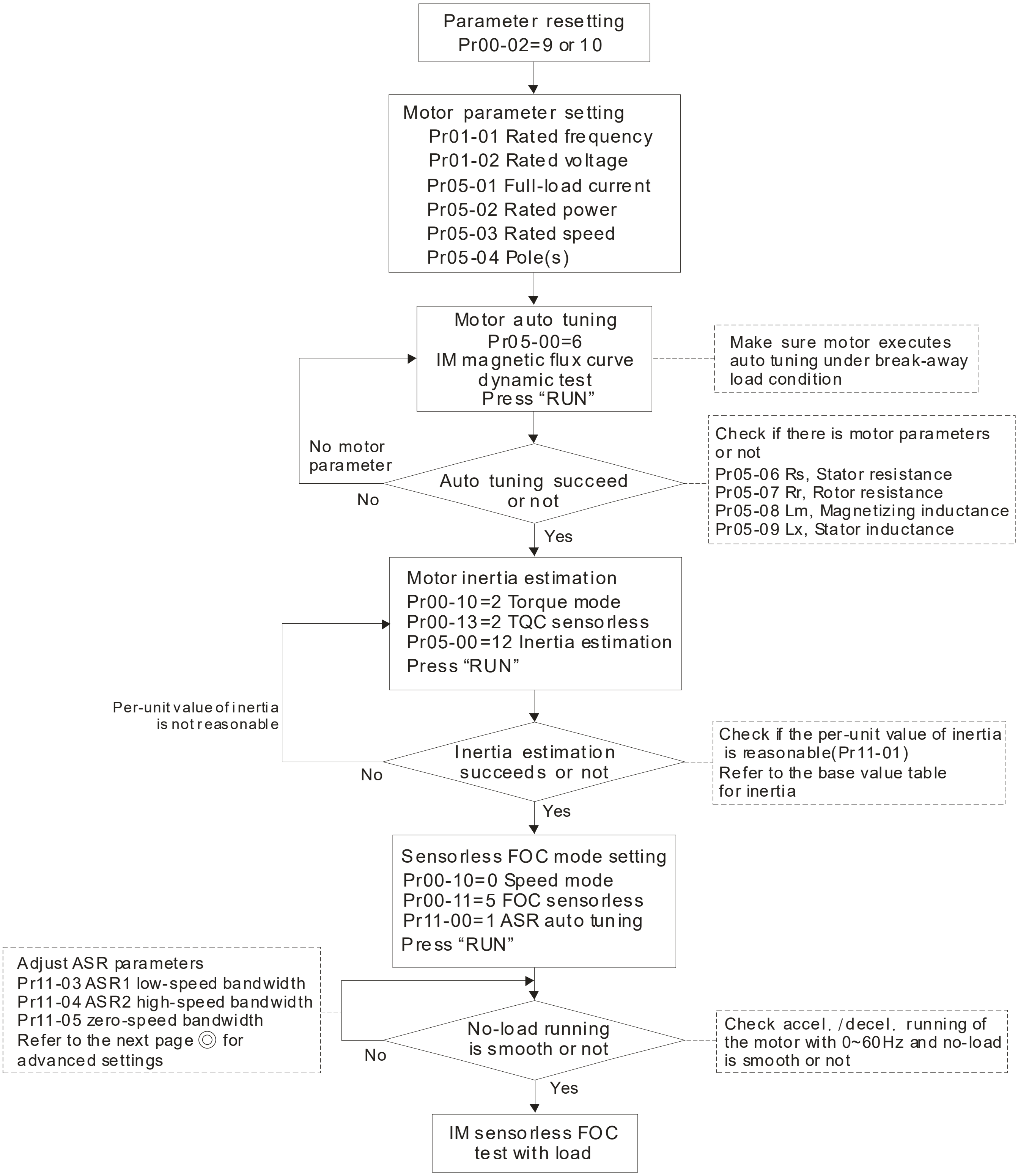
11-11 ASR (Auto Speed Regulation) Control (I) of Zero Speed

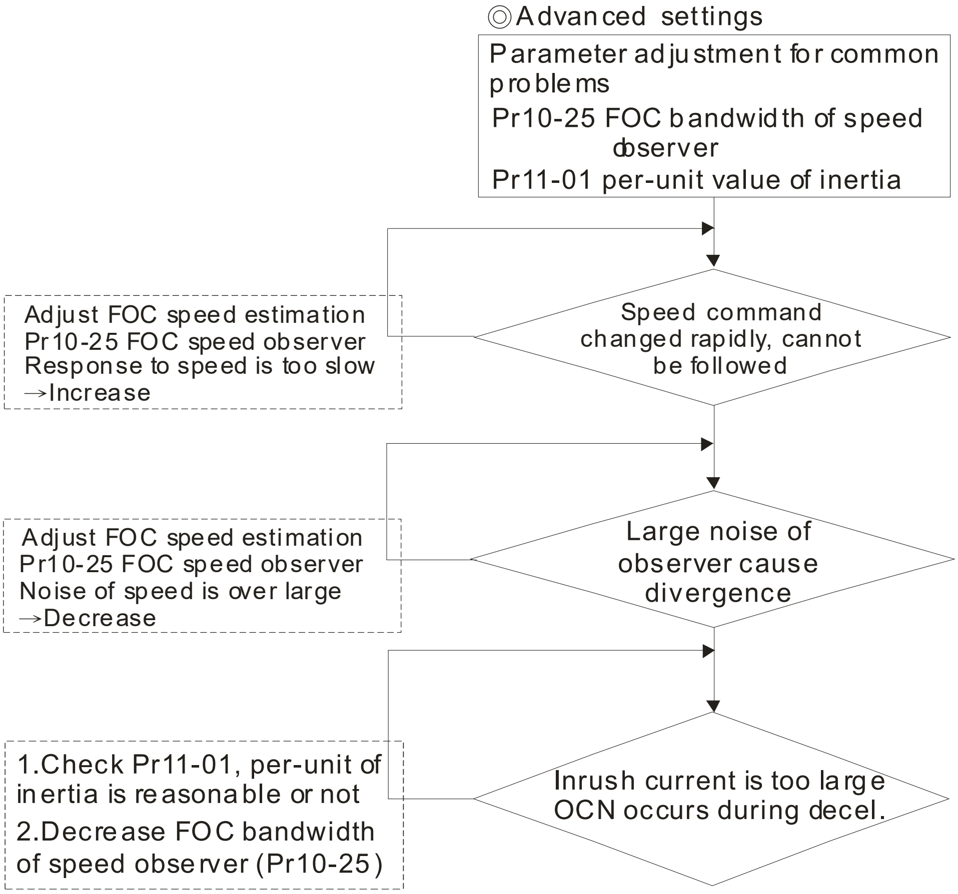
Factory Setting: 0.100

Settings 0.000~10.000 sec.

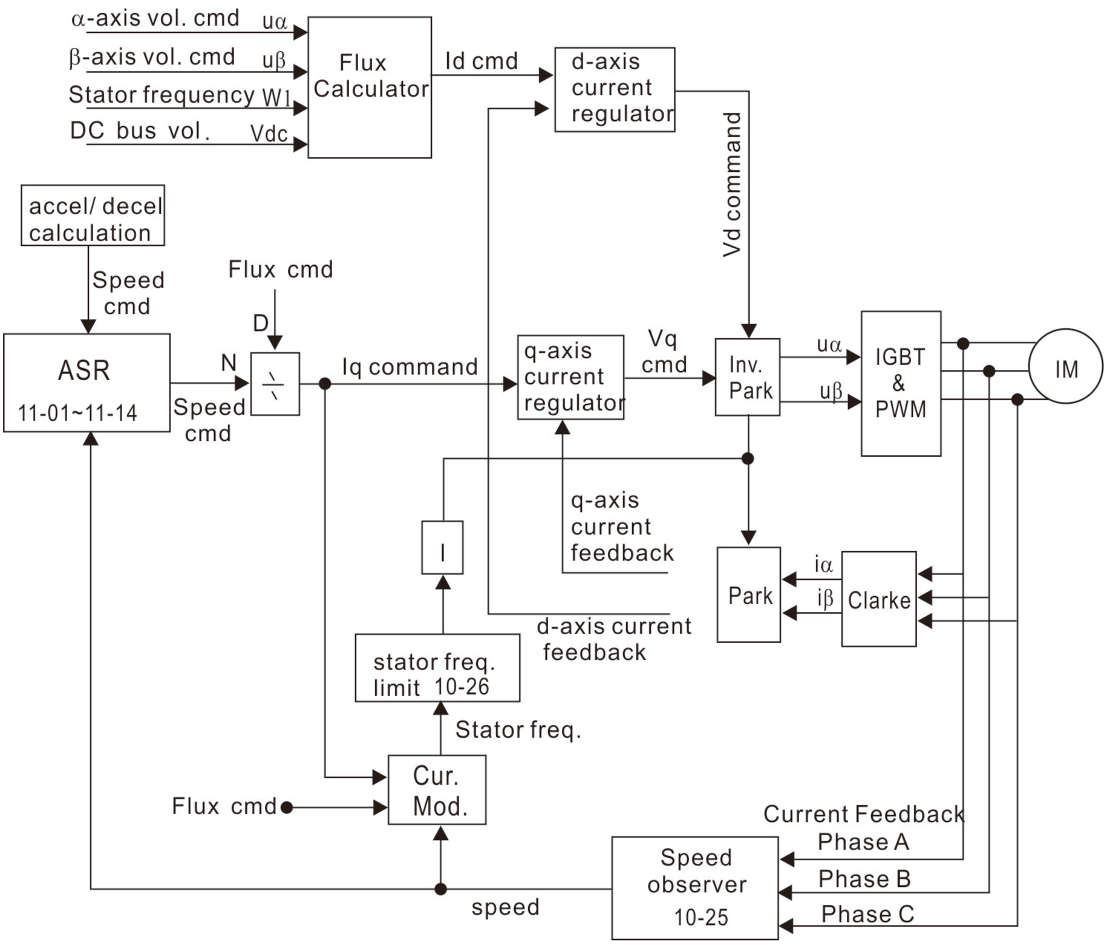
12-2-2 Standard IM Motor Adjustment Procedure

Flow chart





FOC sensorless control diagram



Adjustment procedure

1. Parameter reset **Pr00-02=10 or 9**
   (By doing this, avoid other parameters which are not related to influence motor)

2. Set up motor parameter according to the nameplate on the motor
   Pr01-01 Output Frequency of Motor 1 (base frequency and motor rated frequency)
   Pr01-02 Output Voltage of Motor 1 (base frequency and motor rated frequency)
   Pr05-01 Full-lad current
   Pr05-02 Rated power
   Pr05-03 Rated speed
   Pr05-04 Poles

3. Press "RUN" to start auto tuning of IM magnetic flux curve dynamic test for Pr05-00=1 or 6 (motor is running). Make sure the motor executes auto tuning under break-away load condition. And check if there are motor parameters after auto tuning.
   Pr05-06 Rs Stator resistance
   Pr05-07 Rr Rotor resistance
   Pr05-08 Lm Magnetizing inductance
   Pr05-09 Lx Stator inductance

4. Execute motor inertia estimation (optional). Press "RUN" to start it after finishing the setting of the parameters mentioned below.
   Pr00-10=2 Torque mode
   Pr00-13=2 TQC sensorless
   Pr05-00=12 FOC sensorless inertia estimation (motor is running)
   - After inertia estimation is finished, check Pr11-01 whether the value is reasonable or not according to the base value table below. (Unit: 0.001kg-m^2)

Power	Setting	Power	Setting	Power	Setting	Power	Setting
1Hp	2.3	15Hp	74.3	60HP	410.8	215HP	2800.0
2Hp	4.3	20Hp	95.3	75HP	494.8	300HP	3550.0
3Hp	8.3	25Hp	142.8	100HP	1056.5		
5Hp	14.8	30Hp	176.5	125HP	1275.3		
7.5Hp	26.0	40Hp	202.5	150HP	1900.0		
10Hp	35.8	50Hp	355.5	175HP	2150.0		

5. Execute running with IM sensorless FOC mode, set up the following parameter,
   Pr00-10 = 0, set as speed mode
   Pr00-11 = 5, set as FOC sensorless mode
   Pr11-00-bit0 =1, ASR gain auto tuning

   Press "RUN" and start the **test with no-load**. Speed up the motor to the rated speed, and then lower the speed to stop, check the motor runs smoothly or not. **The setting of IM sensorless FOC is successful if the motor runs smoothly. But if the motor runs unsmoothly or low-frequency start up is failed, then refer to the following steps.**

6. Set up Pr11-00-bit0=1, and adjust ASR parameter according to speed response.

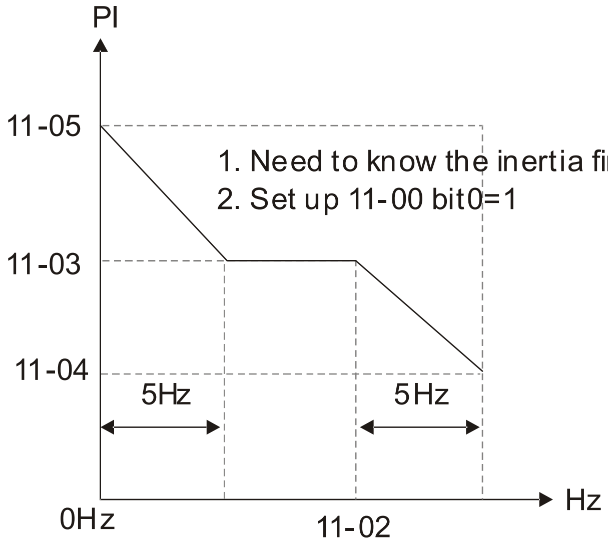
Pr11-00-bit0 =1, ASR gain will auto adjust

Pr11-03 ASR1 low-speed bandwidth (When speed up in low speed cannot follow the accel. command, increase the low-speed bandwidth)

Pr11-04 ASR2 high-speed bandwidth (When speed up in high speed cause vibration or cannot follow the accel. Command, increase high-speed bandwidth)

Pr11-05 Zero-speed bandwidth (If the response of start-up is slow or incapable, increase zero-speed bandwidth)

- The bigger setting value of ASR bandwidth is, the faster response is.
- It is suggested that low-speed bandwidth cannot be set too high, or the observer will diverge.



(PI adjustment- Auto gain)

7. Adjust the setting of FOC speed observer and per-unit value of inertia (common problems)
   - Pr10-25: Set up FOC bandwidth of speed observer

     Situation 1. Speed command changed rapidly, but speed response cannot follow. (Speed response is too slow→ Increase the setting value)

     Situation 2. The noise of observer is too large, and the running is diverged. (Speed noise is too large→Decrease)
   - Pr11-01: Set up per-unit value of inertia

     Situation 1. When start- up, inrush current is too high in a sudden, and cause oc.

     Situation 2. During the running or stop, OCN occurs and the motor runs randomly.
     - Check Pr11-01 whether the per-unit of inertia is too large.
     - Decrease Pr10-25 or Pr11-05.

8. Related parameters

00-11 Control of Speed Mode

Factory Setting: 0

Settings 0: VF (IM V/f control)
1: VFPG (IM V/f control+ Encoder)
2: SVC(IM sensorless vector control)
3: FOCPG (IM FOC vector control+ encoder)
4: FOCPG（PM FOC vector control + Encoder）
5: FOC Sensorless (IM field oriented sensorless vector control)
6 : PM Sensorless (PM field oriented sensorless vector control)
7: IPM Sensorless (IPM field oriented sensorless vector control)

01-01 Output Frequency of Motor 1 (base frequency and motor rated frequency)

Factory Setting: 60.00/50.00

Settings 0.00~599.00Hz

- This value should be set according to the rated frequency of the motor as indicated on the motor nameplate. If the motor is 60Hz, the setting should be 60Hz. If the motor is 50Hz, it should be set to 50Hz.

01-02 Output Voltage of Motor 1（base frequency and motor rated frequency）

Factory Setting: 400.0

Settings 460V series: 0.0~510.0V

- This value should be set according to the rated voltage of the motor as indicated on the motor nameplate. If the motor is 440V, the setting should be 440.0. If the motor is 400V, it should be set to 400.0.
- There are many motor types in the market and the power system for each country is also difference. The economic and convenience method to solve this problem is to install the AC motor drive. There is no problem to use with the different voltage and frequency and also can amplify the original characteristic and life of the motor.

05-00 Motor Auto Tuning

Factory Setting: 0

Settings 0: No function
1: Rolling test for induction motor (Rs, Rr, Lm, Lx, no-load current)
2: Rolling test for induction motor
3: No function
4: Rolling test for PM motor magnetic pole
5: Rolling test for PM(SPM) motor
6: Rolling test for IM motor flux curve
12: FOC Sensorless inertia estimation
13: High frequency and blocked rotor test for IPM/SPM motor parameter

05-02	Rated Power of Induction Motor 1(kW)

Factory Setting: #.##

Settings 0~655.35 kW

It is used to set rated power of the motor 1. The factory setting is the power of the drive.

05-04	Pole Number of Induction Motor 1

Factory Setting: 4

Settings 2~64

It is used to set the number of motor poles (must be an even number).

05-05	No-load Current of Induction Motor 1 (A)

Unit: Amper

Factory Setting: #.##

Settings 0 to the factory setting in Pr.05-01

The factory setting is 40% of rated current.

To make sure the motor runs properly, set up Pr01-01 and 05-03 before setting Pr05-04. The maximum number of poles to be set depends on Pr01-01 and 05-03.
Example: When Pr01-01=20Hz, Pr05-03=39rpm. According to formula, 120 x 20Hz / 30rpm = 61.5, chop off the digits in units to let it be even number, 60. Thus the maximum of Pr05-04 can be 60 poles.

05-05	No-load Current of Induction Motor 1 (A)

Unit: Amper

Factory Setting: #.##

Settings 0 to the factory setting in Pr.05-01

The factory setting is 40% of rated current.

05-06	Stator Resistance(Rs) of Induction Motor 1
05-07	Rotor Resistance(Rr) of Induction Motor 1

Factory Setting: #.###

Settings 0~65.535Ω

05-08	Magnetizing Inductance(Lm) of Induction Motor 1
05-09	Stator inductance(Lx) of Induction Motor 1

Factory Setting: #.#

Settings 0~6553.5mH

10-25	FOC Bandwidth of Speed Observer

Factory Setting:40.0

Settings 20.0~100.0Hz

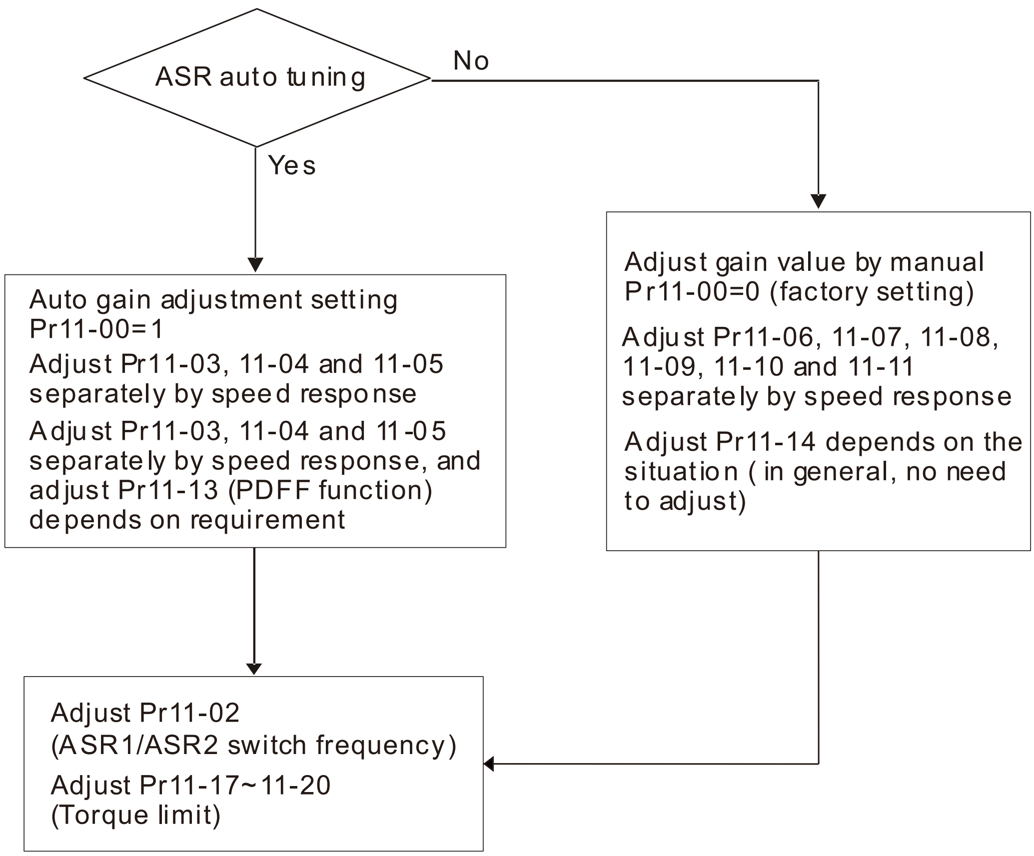
Setting speed observer to higher bandwidth could shorten the speed response time but will create greater noise interference during the speed observation.

11-00 System Control

Factory Setting: 0

Settings 0: Auto tuning for ASR and APR
1: Inertia estimate (only in FOCPG mode)
2: Zero servo
3: Dead time compensation closed
7: Selection to save or not save the frequency
8: Maximum speed of point to point position control

📖 bit 0=0: Pr.11-06 to 11-11 will be valid and Pr.11-03~11-05 are invalid.
bit 0=1: System will generate an ASR setting. At this moment, Pr.11-06~11-11 will be invalid and Pr.11-03~11-05 are valid.



11-01 Per Unit of System Inertia

Factory Setting: 256

Settings 1~65535（256=1PU）

📖 To get the system inertia from Pr.11-01, user needs to set Pr.11-00 to bit1=1 and execute continuous forward/reverse running.

Unit of induction motor system inertia is 0.001kg-m^2:

Power	Setting
11kW	35.8
15 kW	74.3
18.5 kW	95.3
22 kW	142.8
30 kW	176.5

Power	Setting
37 kW	202.5
45 kW	355.5
55 kW	410.8
75 kW	494.8
90 kW	1056.5

The base value for induction motor system inertia is set by Pr.05-38 and the unit is in 0.001kg-m^2.

11-02 ASR1/ASR2 Switch Frequency

Factory Setting: 7.00

Settings 5.00~599.00Hz

11-03 ASR1 Low-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

11-04 ASR2 High-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

11-05 Zero-speed Bandwidth

Factory Setting: 10

Settings 1~40Hz (IM)/ 1~100Hz (PM)

- After estimating inertia and set Pr.11-00 to bit 0=1 (auto tuning), user can adjust parameters Pr.11-03, 11-04 and 11-05 separately by speed response. The larger number you set, the faster response you will get. Pr.11-02 is the switch frequency for low-speed/high-speed bandwidth.

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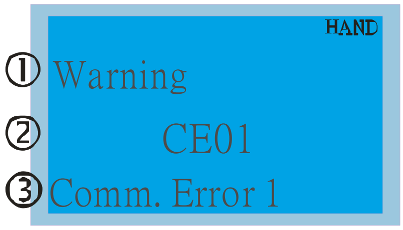
Chapter 13 Warning Codes



① Display error signal

② Abbreviate error code
The code is displayed as shown on KPC-CE01.

③ Display error description

ID No.	Display on LCM Keypad	Descriptions
1	HAND Warning CE01 Comm. Error 1	Modbus function code error
2	HAND Warning CE02 Comm. Error 2	Address of Modbus data is error
3	HAND Warning CE03 Comm. Error 3	Modbus data error
4	HAND Warning CE04 Comm. Error 4	Modbus communication error
5	HAND Warning CE10 Comm. Error 10	Modbus transmission time-out
7	HAND Warning SE1 Save Error 1	Keypad COPY error 1 Keypad simulation error, including communication delays, communication error (keypad recived error FF86) and parameter value error.
8	HAND Warning SE2 Save Error 2	Keypad COPY error 2 Keypad simulation done, parameter write error
9	HAND Warning oH1 Over heat 1 warn	IGBT over-heating warning
10	HAND Warning oH2 Over heat 2 warn	Capacity over-heating warning

ID No.	Display on LCM Keypad	Descriptions
11	HAND Warning PID PID FBK Error	PID feedback error
12	HAND Warning ANL Analog loss	ACI signal error When Pr03-19 is set to 1 and 2.
13	HAND Warning uC Under Current	Low current
15	HAND Warning PGFB PG FBK Warn	PG feedback error
17	HAND Warning oSPD Over Speed Warn	Over-speed warning
18	HAND Warning DAvE Deviation Warn	Over speed deviation warning
19	HAND Warning PHL Phase Loss	Phase loss
20	HAND Warning ot1 Over Torque 1	Over torque 1
21	HAND Warning ot2 Over Torque 2	Over torque 2
22	HAND Warning oH3 Motor Over Heat	Motor over-heating
24	HAND Warning oSL Over Slip Warn	Over slip
25	HAND Warning tUn Auto tuning	Auto tuning processing

ID No.	Display on LCM Keypad	Descriptions
28	HAND Warning OPHL Output PHL Warn	Output phase loss
30	HAND Warning SE3 Copy Model Err 3	Keypad COPY error 3 Keypad copy between different power range drive
36	HAND Warning CGdn Guarding T-out	CAN guarding time-out 1
37	HAND Warning CHbn Heartbeat T-out	CAN heartbeat time-out 2
39	HAND Warning CbFn Can Bus Off	CAN bus off
40	HAND Warning CIdn CAN/S Idx exceed	CAN index error
41	HAND Warning CAdn CAN/S Addres set	CAN station address error
42	HAND Warning CFrn CAN/S FRAM fail	CAN memory error
43	HAND Warning CSdn SDO T-out	CAN SDO transmission time-out
44	HAND Warning CSbn Buf Overflow	CAN SDO received register overflow
46	HAND Warning CPtn Error Protocol	CAN format error
47	HAND Warning PIra RTC Adjust	Adjust RTC

ID No.	Display on LCM Keypad	Descriptions
50	HAND Warning PLod Opposite Defect	PLC download error
51	HAND Warning PLSv Save mem defect	Save error of PLC download
52	HAND Warning PLdA Data defect	Data error during PLC operation
53	HAND Warning PLFn Function defect	Function code of PLC download error
54	HAND Warning PLor Buf overflow	PLC register overflow
55	HAND Warning PLFF Function defect	Function code of PLC operation error
56	HAND Warning PLSn Check sum error	PLC checksum error
57	HAND Warning PLEd No end command	PLC end command is missing
58	HAND Warning PLCr PLC MCR error	PLC MCR command error
59	HAND Warning PLdF Download fail	PLC download fail
60	HAND Warning PLSF Scane time fail	PLC scan time exceed
61	HAND Warning PCGd CAN/M Guard err	CAN Master guarding error

ID No.	Display on LCM Keypad	Descriptions
62	HAND Warning PCbF CAN/M bus off	CAN Master bus off
63	HAND Warning PCnL CAN/M Node Lack	CAN Master node error
64	HAND Warning PCCt CAN/M Cycle Time	CAN/M cycle time-out
65	HAND Warning PCSF CAN/M SDO over	CAN/M SDOover
66	HAND Warning PCSd CAN/M Sdo Tout	CAN/M SDO time-out
67	HAND Warning PCAd CAN/M Addres set	CAN/M station address error
68	HAND Warning PCTo CAN/M T-Out	PLC/CAN Master Slave communication time out
70	HAND Warning ECid ExCom ID failed	Duplicate MAC ID error Node address setting error
71	HAND Warning ECLv ExCom pwr loss	Low voltage of communication card
72	HAND Warning ECtt ExCom Test Mode	Communication card in test mode
73	HAND Warning ECbF ExCom Bus off	DeviceNet bus-off
74	HAND Warning ECnP ExCom No power	DeviceNet no power

ID No.	Display on LCM Keypad	Descriptions
75	HAND Warning ECFF ExCom Facty def	Factory default setting error
76	HAND Warning ECiF ExCom Inner err	Serious internal error
77	HAND Warning ECio ExCom IONet brk	IO connection break off
78	HAND Warning ECPP ExCom Pr data	Profibus parameter data error
79	HAND Warning ECPi ExCom Conf data	Profibus configuration data error
80	HAND Warning ECEF ExCom Link fail	Ethernet Link fail
81	HAND Warning ECto ExCom Inr T-out	Communication time-out for communication card and drive
82	HAND Warning ECCS ExCom Inr CRC	Check sum error for Communication card and drive
83	HAND Warning ECrF ExCom Rtn def	Communication card returns to default setting
84	HAND Warning ECo0 ExCom MTCP over	Modbus TCP exceed maximum communication value
85	HAND Warning ECo1 ExCom EIP over	EtherNet/IP exceed maximum communication value
86	HAND Warning ECiP ExCom IP fail	IP fail

ID No.	Display on LCM Keypad	Descriptions
87	HAND Warning EC3F ExCom Mail fail	Mail fail
88	HAND Warning Ecby ExCom Busy	Communication card busy
90	HAND Warning CPLP CopyPLCPassWd	Copy PLC password error
91	HAND Warning CPL0 CopyPLCModeRd	Copy PLC Read mode error
92	HAND Warning CPL1 CopyPLCModeWt	Copy PLC Write mode error
93	HAND Warning CPLv CopyPLCVersion	Copy PLC Version error
94	HAND Warning CPLS CopyPLCSize	Copy PLC Capacity size error
95	HAND Warning CPLF CopyPLCFunc	Copy PLC and the PLC function must be disable
96	HAND Warning CPLt CopyPLCTimeOut	Copy PLC time out
101	HAND Warning ictn InrCOM Time Out	Internal communication is off

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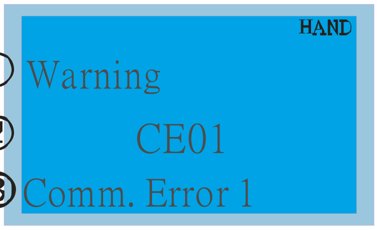
Chapter 14 Fault Codes and Descriptions

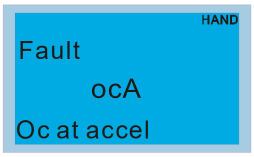
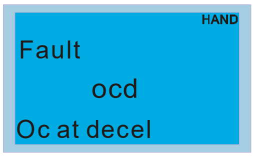
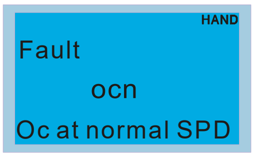
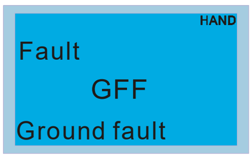
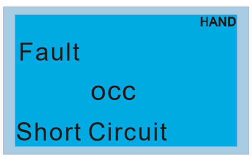


① Display error signal

② Abbreviate error code
The code is displayed as shown on KPC-CE01.

③ Display error description

* Refer to setting of Pr06-17~Pr06~22.

ID*	Fault Name	Fault Descriptions	Corrective Actions
1		Over-current during acceleration (Output current exceeds triple rated current during acceleration.)	1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Acceleration Time too short: Increase the Acceleration Time. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
2		Over-current during deceleration (Output current exceeds triple rated current during deceleration.)	1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Deceleration Time too short: Increase the Deceleration Time. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
3		Over-current during steady state operation (Output current exceeds triple rated current during constant speed.)	1. Short-circuit at motor output: Check for possible poor insulation at the output. 2. Sudden increase in motor loading: Check for possible motor stall. 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model.
4		Ground fault	When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current, the AC motor drive power module may be damaged. NOTE: The short circuit protection is provided for AC motor drive protection, not for protecting the user. 1. Check the wiring connections between the AC motor drive and motor for possible short circuits, also to ground. 2. Check whether the IGBT power module is damaged. 3. Check for possible poor insulation at the output.
5		Short-circuit is detected between upper bridge and lower bridge of the IGBT module	Return to the factory

ID*	Fault Name	Fault Descriptions	Corrective Actions
6	HAND Fault ocS Oc at stop	Hardware failure in current detection	Return to the factory
7	HAND Fault ovA Ov at accel	DC BUS over-voltage during acceleration (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the acceleration time or add an optional brake resistor.
8	HAND Fault ovd Ov at decel	DC BUS over-voltage during deceleration (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.
9	HAND Fault ovn Ov at normal SPD	DC BUS over-voltage at constant speed (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.
10	HAND Fault ovS Ov at stop	Hardware failure in voltage detection	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients.
11	HAND Fault LvA Lv at accel	DC BUS voltage is less than Pr.06-00 during acceleration	1. Check if the input voltage is normal 2. Check for possible sudden load
12	HAND Fault Lvd Lv at decel	DC BUS voltage is less than Pr.06-00 during deceleration	1. Check if the input voltage is normal 2. Check for possible sudden load
13	HAND Fault Lvn Lv at normal SPD	DC BUS voltage is less than Pr.06-00 in constant speed	1. Check if the input voltage is normal 2. Check for possible sudden load
14	HAND Fault LvS Lv at stop	DC BUS voltage is less than Pr.06-00 at stop	1. Check if the input voltage is normal 2. Check for possible sudden load

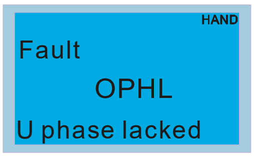
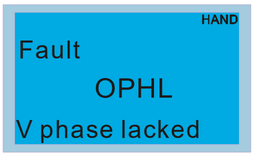
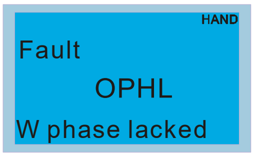
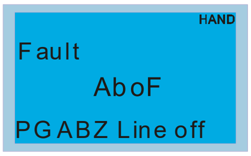
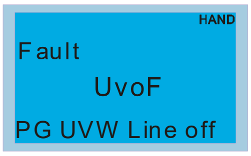
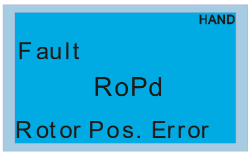
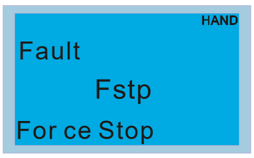
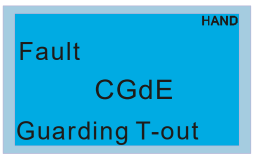
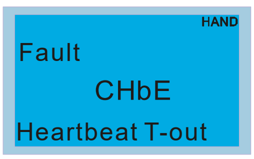
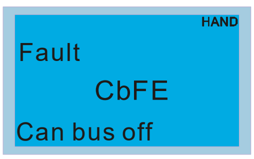
ID*	Fault Name	Fault Descriptions	Corrective Actions
15	HAND Fault OrP Phase lacked	Phase Loss	Check Power Source Input if all 3 input phases are connected without loose contacts. For models 40hp and above, please check if the fuse for the AC input circuit is blown.
16	HAND Fault oH1 IGBT over heat	IGBT overheating IGBT temperature exceeds protection level	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins. 4. Check the fan and clean it. 5. Provide enough spacing for adequate ventilation.
17	HAND Fault oH2 Heat Sink oH	Heatsink overheating Capacitance temperature exceeds cause heatsink overheating.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure heat sink is not obstructed. Check if the fan is operating 3. Check if there is enough ventilation clearance for AC motor drive.
18	HAND Fault tH1o Thermo 1 open	IGBT Hardware Error	Return to the factory
19	HAND Fault tH2o Thermo 2 open	Capacitor Hardware Error	Return to the factory
21	HAND Fault oL Over load	Overload The AC motor drive detects excessive drive output current.	1. Check if the motor is overloaded. 2. Take the next higher power AC motor drive model.
22	HAND Fault EoL1 Thermal relay 1	Electronics thermal relay 1 protection	1. Check the setting of electronics thermal relay (Pr.06-14) Take the next higher power AC motor drive model
23	HAND Fault EoL2 Thermal relay 2	Electronics thermal relay 2 protection	1. Check the setting of electronics thermal relay (Pr.06-28) 2. Take the next higher power AC motor drive model

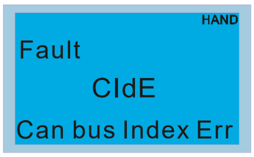
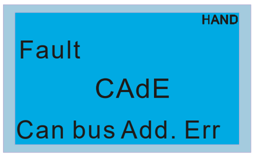
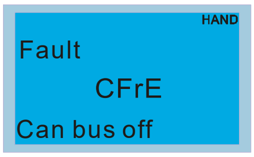
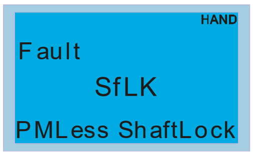
ID*	Fault Name	Fault Descriptions	Corrective Actions
24	HAND Fault oH3 Motor over heat	Motor overheating The AC motor drive detecting internal temperature exceeds the setting of Pr.06-30 (PTC level) or Pr.06-57 (PT100 level 2).	1. Make sure that the motor is not obstructed. 2. Ensure that the ambient temperature falls within the specified temperature range. 3. Change to a higher power motor.
26	HAND Fault ot1 Over torque 1	These two fault codes will be displayed when output current exceeds the over-torque detection level (Pr.06-07 or Pr.06-10) and exceeds over-torque detection (Pr.06-08 or Pr.06-11) and it is set to 2 or 4 in Pr.06-06 or Pr.06-09.	1. Check whether the motor is overloaded. 2. Check whether motor rated current setting (Pr.05-01) is suitable 3. Take the next higher power AC motor drive model.
27	HAND Fault ot2 Over torque 2		
28	HAND Fault uC Under torque	Low current detection	Check Pr.06-71, Pr.06-72, Pr.06-73.
29	HAND Fault LMIT Limit Error	Limit error	
30	HAND Fault cF1 EEPROM write err	Internal EEPROM can not be programmed.	1. Press “RESET” key to the factory setting 2. Return to the factory.
31	HAND Fault cF2 EEPROM read err	Internal EEPROM can not be read.	1. Press “RESET” key to the factory setting 2. Return to the factory.
33	HAND Fault cd1 Ias sensor err	U-phase error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
34	HAND Fault cd2 Ibs sensor err	V-phase error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
35	HAND Fault cd3 Ics sensor err	W-phase error	Reboots the power. If fault code is still displayed on the keypad please return to the factory

ID*	Fault Name	Fault Descriptions	Corrective Actions
36	HAND Fault Hd0 cc HW error	CC (current clamp)	Reboots the power. If fault code is still displayed on the keypad please return to the factory
37	HAND Fault Hd1 Oc HW error	OC hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
38	HAND Fault Hd2 Ov HW error	OV hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
39	HAND Fault Hd3 occ HW error	Occ hardware error	Reboots the power. If fault code is still displayed on the keypad please return to the factory
40	HAND Fault AUE Auto tuning err	Auto tuning error	1. Check cabling between drive and motor 2. Try again.
41	HAND Fault AFE PID Fbk error	PID loss (ACI)	1. Check the wiring of the PID feedback 2. Check the PID parameters settings
42	HAND Fault PGF1 PG Fbk error	PG feedback error	Check if encoder parameter setting is accurate when it is PG feedback control.
43	HAND Fault PGF2 PG Fbk loss	PG feedback loss	Check the wiring of the PG feedback
44	HAND Fault PGF3 PG Fbk over SPD	PG feedback stall	1. Check the wiring of the PG feedback 2. Check if the setting of PI gain and deceleration is suitable 3. Return to the factory
45	HAND Fault PGF4 PG Fbk deviate	PG slip error	1. Check the wiring of the PG feedback 2. Check if the setting of PI gain and deceleration is suitable 3. Return to the factory

ID*	Fault Name	Fault Descriptions	Corrective Actions
48	HAND Fault ACE ACI loss	ACI loss	1. Check the ACI wiring 2. Check if the ACI signal is less than 4mA
49	HAND Fault EF External fault	External Fault	1. Input EF (N.O.) on external terminal is closed to GND. Output U, V, W will be turned off. 2. Give RESET command after fault has been cleared.
50	HAND Fault EF1 Emergency stop	Emergency stop	1. When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output U, V, W and the motor coasts to stop. 2. Press RESET after fault has been cleared.
51	HAND Fault bb Base block	External Base Block	1. When the external input terminal (B.B) is active, the AC motor drive output will be turned off. 2. Deactivate the external input terminal (B.B) to operate the AC motor drive again.
52	HAND Fault Pcod Password error	Password is locked.	Keypad will be locked. Turn the power ON after power OFF to re-enter the correct password. See Pr.00-07 and 00-08.
54	HAND Fault CE1 PC err command	Illegal function code	Check if the function code is correct (function code must be 03, 06, 10, 63)
55	HAND Fault CE2 PC err address	Illegal data address (00H to 254H)	Check if the communication address is correct
56	HAND Fault CE3 PC err data	Illegal data value	Check if the data value exceeds max./min. value
57	HAND Fault CE4 PC slave fault	Data is written to read-only address	Check if the communication address is correct
58	HAND Fault CE10 PC time out	Modbus transmission time-out	

ID*	Fault Name	Fault Descriptions	Corrective Actions
60	HAND Fault bF Braking fault	Brake resistor fault	If the fault code is still displayed on the keypad after pressing “RESET” key, please return to the factory.
61	HAND Fault ydc Y-delta connect	Y-connection/Δ-connection switch error	1. Check the wiring of the Y-connection/Δ-connection 2. Check the parameters settings
62	HAND Fault dEb Dec. Energy back	When Pr.07-13 is not set to 0 and momentary power off or power cut, it will display dEb during accel./decel. stop.	1. Set Pr.07-13 to 0 2. Check if input power is stable
63	HAND Fault oSL Over slip error	It will be displayed when slip exceeds Pr.05-26 setting and time exceeds Pr.05-27 setting.	1. Check if motor parameter is correct (please decrease the load if overload 2. Check the settings of Pr.05-26 and Pr.05-27
64	HAND Fault ryF MC Fault	Electric valve switch error when executing Soft Start. (This warning is for frame E and higher frame of AC drives) Do not disconnect RST when drive is still operating.	
65	HAND Fault PGF5 PG HW Error	Hardware error of PG Card Check if PG Card is insert to the right slot and parameter settings for encoder are accurate.	
68	HAND Fault SdRv SpdFbk Dir Rev	Rotaing direction is different from the commanding direction deteced by the sensorless. Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct.	
69	HAND Fault SdOr SpdFbk over SPD	Overspeed rotation detected by the sensorless Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. Verify if the gains of the speed circuit is reasonable.	
70	HAND Fault SdDe SpdFbk deviate	Big difference between the rotating speed and the command deteced by the sensorless Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. Verify if the gains of the speed circuit is reasonable.	
73	HAND Fault S1 S1-emergy stop	Emergency stop for external safety	

ID*	Fault Name	Fault Descriptions	Corrective Actions
82		Output phase loss (Phase U)	
83		Output phase loss (Phase V)	
84		Output phase loss (Phase W)	
85		PG card ABZ signal loss Solution Verify if the parameter setting of PG card and PG card cable is correct.	
86		PG card UVW signal loss Solution Verify if the parameter setting of PG card and PG card cable is correct.	
89		Rotor position detection error Solution Verify if the UVW output cable are loss. Verify if the motor internal coil is broken. Verify if the drive UVW output are normal.	
90		Internal PLC forced to stop Verify the setting of Pr.00-32	
101		CANopen guarding error	
102		CANopen heartbeat error	
104		CANopen bus off error	

ID*	Fault Name	Fault Descriptions	Corrective Actions
105		CANopen index error	
106		CANopen station address error	
107		CANopen memory error	
111		Internal communication time-out	
112		Motor Shaft lock error(Motor does not turn but the output frequency is not zero) Solution Verify if the motor parameter setting is correct.	

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Chapter 15 CANopen Overview

The built-in CANopen function is a kind of remote control. Master 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). And 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.

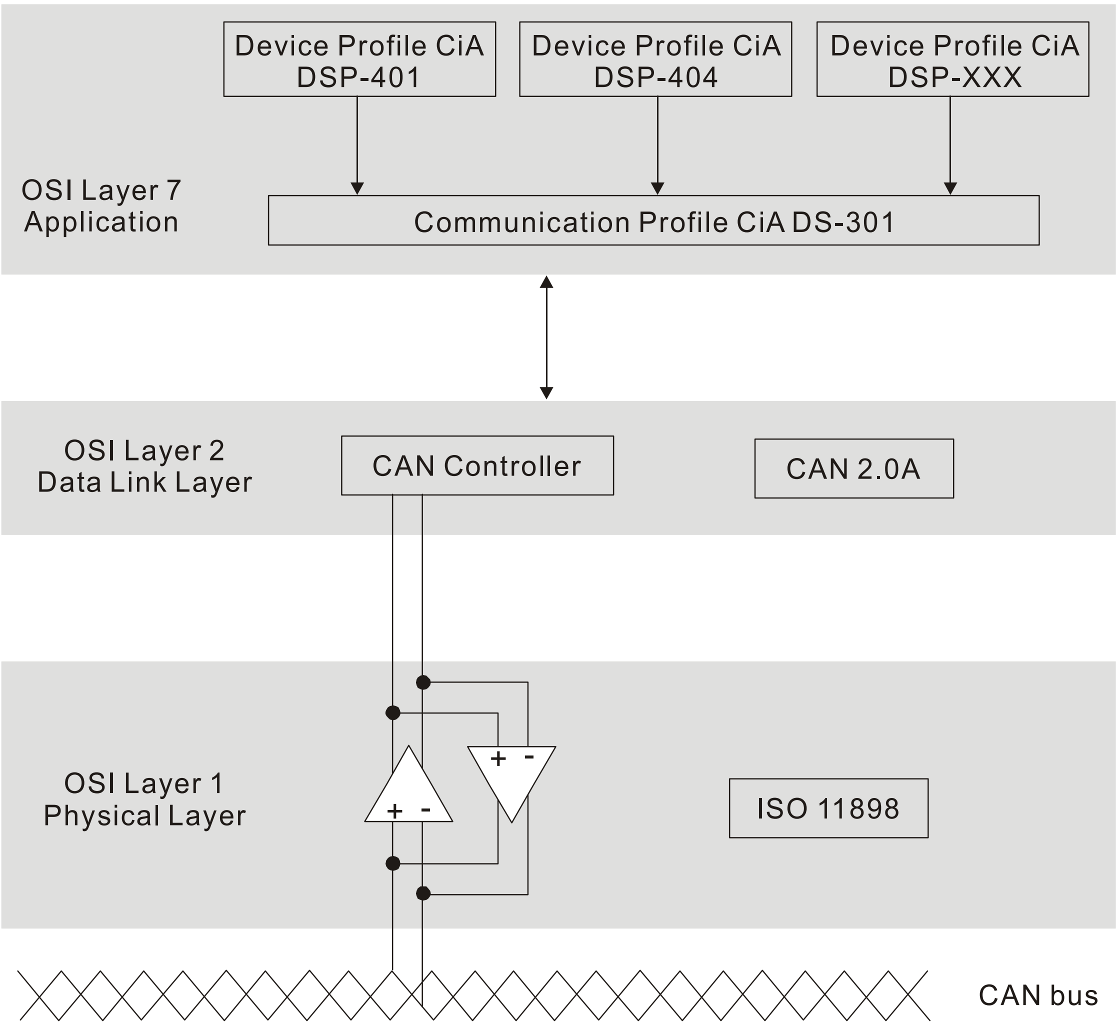
Delta CANopen not supporting service:

- Time Stamp service

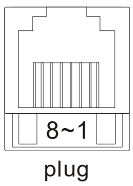
15-1 CANopen Overview

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 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).



RJ-45 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-

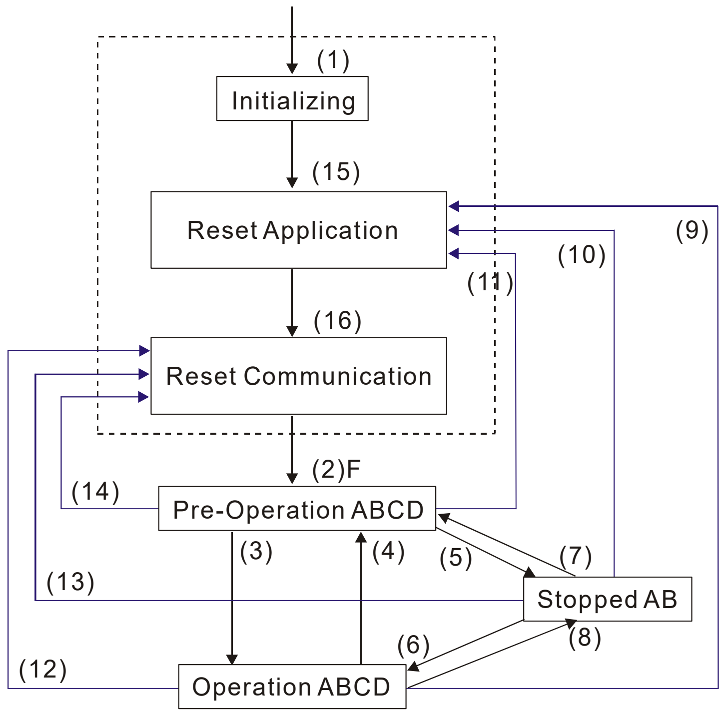
CANopen Communication Protocol

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. Only one NMT master is in a network, and other nodes are regarded as slaves. All CANopen nodes have a present NMT state, and NMT master can control the state of the slave nodes. The state diagram of a node is shown as follows:



(1) After power is applied, it is auto in initialization state
(2) Enter pre-operational state automatically
(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) Enter reset application state automatically
(16) Enter reset communication state automatically

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)

SDO is used to access the Object Dictionary in every CANopen node by Client/Server model. One SDO has two COB-ID (request SDO and response SDO) to upload or download data between two nodes. No data limit for SDOs to transfer data. But it needs to transfer by segment when data exceeds 4 bytes with an end signal in the last segment.

The Object Dictionary (OD) is a group of objects in 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 of OD is the index and sub-index, each object has a unique index in OD, and has sub-index if necessary. The request and response frame structure of SDO communication is shown as follows:

PDO (Process Data Object)

PDO communication can be described by the producer/consumer model. Each node of the network will listen to the messages of the transmission node and distinguish if the message has to be processed or not after receiving the message. 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 a RxPDO. PDOs are transmitted in a non-confirmed mode.

PDO Transmission type is defined in the PDO communication parameter index (1400h for the 1st RxPDO or 1800h for the 1st TxPDO), and 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				○	

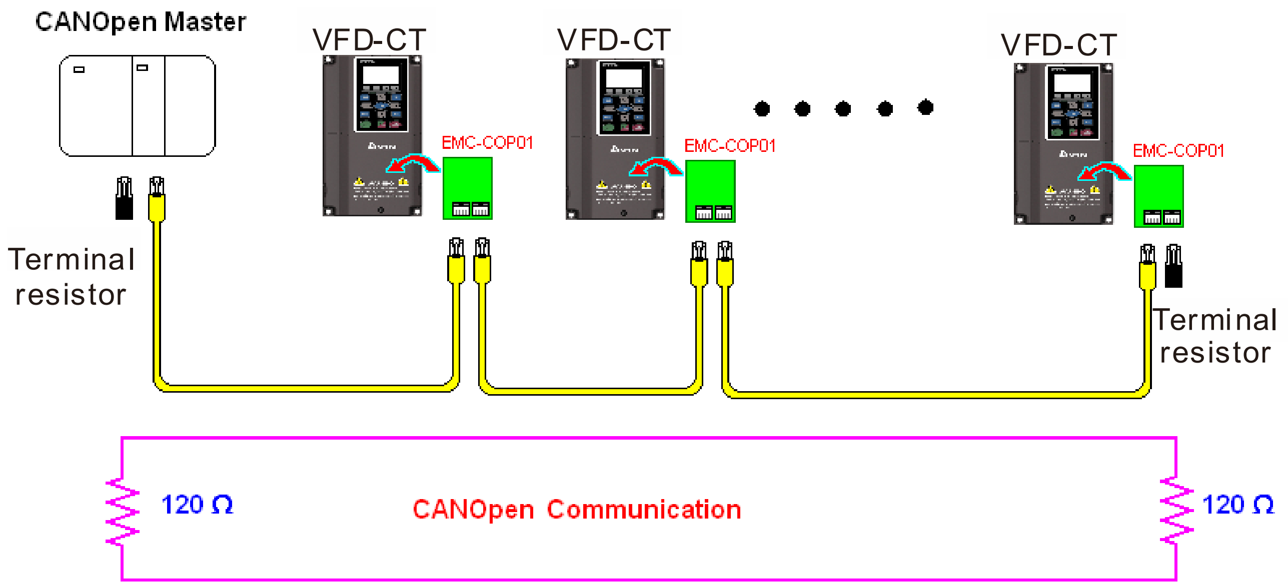
Type number 1-240 indicates the number of SYNC message between two PDO transmissions.
Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.
Type number 253 indicates the data is updated immediately after receiving RTR.
Type number 254: Delta CANopen doesn’t support this transmission format.
Type number 255 indicates the data is asynchronous transmission.
All PDO transmission data must be mapped to index via Object Dictionary.

EMCY (Emergency Object)

When errors occurred inside the hardware, an emergency object will be triggered an emergency object will only be sent when an error is occurred. As long as there is nothing wrong with the hardware, there will be no emergency object to be served as a warning of an error message.

15-2 Wiring for CANopen

An external adapter card: EMC-COP01 is used for CANopen wiring; establish CANopen to VFD CT2000 connection. The link is enabled by using RJ45 cable. The two farthest ends must be terminated with 120Ω terminating resistors.



15-3 CANopen Communication Interface Description

15-3-1 CANopen Control Mode Selection

There are two control modes for CANopen; Pr.09-40 set to 1 is the factory setting mode DS402 standard and Pr.09-40 set to 0 is Delta's standard setting mode.

Actually, there are two control modes according to Delta's standard, one is the old control mode (Pr09-30=0).

This control mode can only control the motor drive under frequency control. Another mode is a new standard (Pr09-30=1)

This new control mode allows the motor drive to be controlled under all sorts of mode. Currently, C2000 support speed, torque, position and home mode.

The definition of relating control mode are:

CANopen Control Mode Selection	Control Mode							
	Speed		Torque		Position		Home	
	Index	Description	Index	Description	Index	Description	Index	Description
DS402 standard Pr. 09-40=1	6042-00	Target rotating speed (RPM)	6071-00	Target Torque (%)	607A-00	Target Position	-----	-----
	-----	-----	6072-00	Max. Torque Limit(%)	-----	-----	-----	-----
Delta Standard (Old definition) P09-40=0, P09-30=0	2020-02	Target rotating speed (Hz)	-----	-----	-----	-----	-----	-----
Delta Standard (New definition) P09-40=0, P09-30=1	2060-03	Target rotating speed (Hz)	2060-07	Target Torque (%)	2060-05	Target Position	-----	-----
	2060-04	Torque Limit (%)	2060-08	Speed Limit (Hz)	-----	-----	-----	-----

CANopen Control Mode Selection	Operation Control	
	Index	Description
DS402 standard Pr. 09-40=1	6040-00	Operation Command
	-----	-----
Delta Standard (Old definition) P09-40=0, P09-30=0	2020-01	Operation Command
Delta Standard (New definition) P09-40=0, P09-30=1	2060-01	Operation Command
	-----	-----

CANopen Control Mode Selection	Other	
	Index	Description
DS402 standard Pr. 09-40=1	605A-00	Quick stop processing mode
	605C-00	Disable operation processing mode
Delta Standard (Old definition) P09-40=0, P09-30=0	-----	-----
Delta Standard (New definition) P09-40=0, P09-30=1	-----	-----
	-----	-----

However, you can use some index regardless DS402 or Delta's standard.

For example:

1. Index which are defined as RO attributes.
2. Index correspond to parameters such as (2000 ~200B-XX)
3. Accelerating/Decelerating Index: 604F 6050

15-3-2 DS402 Standard Control Mode

15-3-2-1 Related set up of ac motor drive (by following DS402 standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (refer to chapter 15-2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr.00.20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Source of torque setting is set by Pr.11-33. (Choose source of torque commend from CANopen setting.)
5. CANopen station setting: set Pr.09-36 (Choose source of position commend from CANopen setting.)
6. Set DS402 as control mode: Pr09-40=1
7. CANopen station setting: set Pr.09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled.) (Note: If error arise (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
8. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))
9. Set multiple input functions to Quick Stop (it can also be enable or disable, default setting is disable). 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 status as described below.

3 blocks

Power Disable: That means without PWM output
Power Enable: That means with PWM output
Fault: One or more than one error has occurred.

9 statuses

Start: Power On
Not ready to switch on: The motor drive is initiating.
Switch On Disable: When the motor drive finishes the initiation, it will be at this mode.
Ready to switch on: Warming up before running.
Switch On: The motor derive has the PWM output now, but the reference commend is not effective.
Operate Enable: Able to control normally.
Quick Stop Active: When there is a Quick Stop request, you have to stop running the motor drive.

Fault Reaction Active: The motor drive detects conditions which might trigger error(s).
Fault: One or more than errors has occurred to the motor drive.

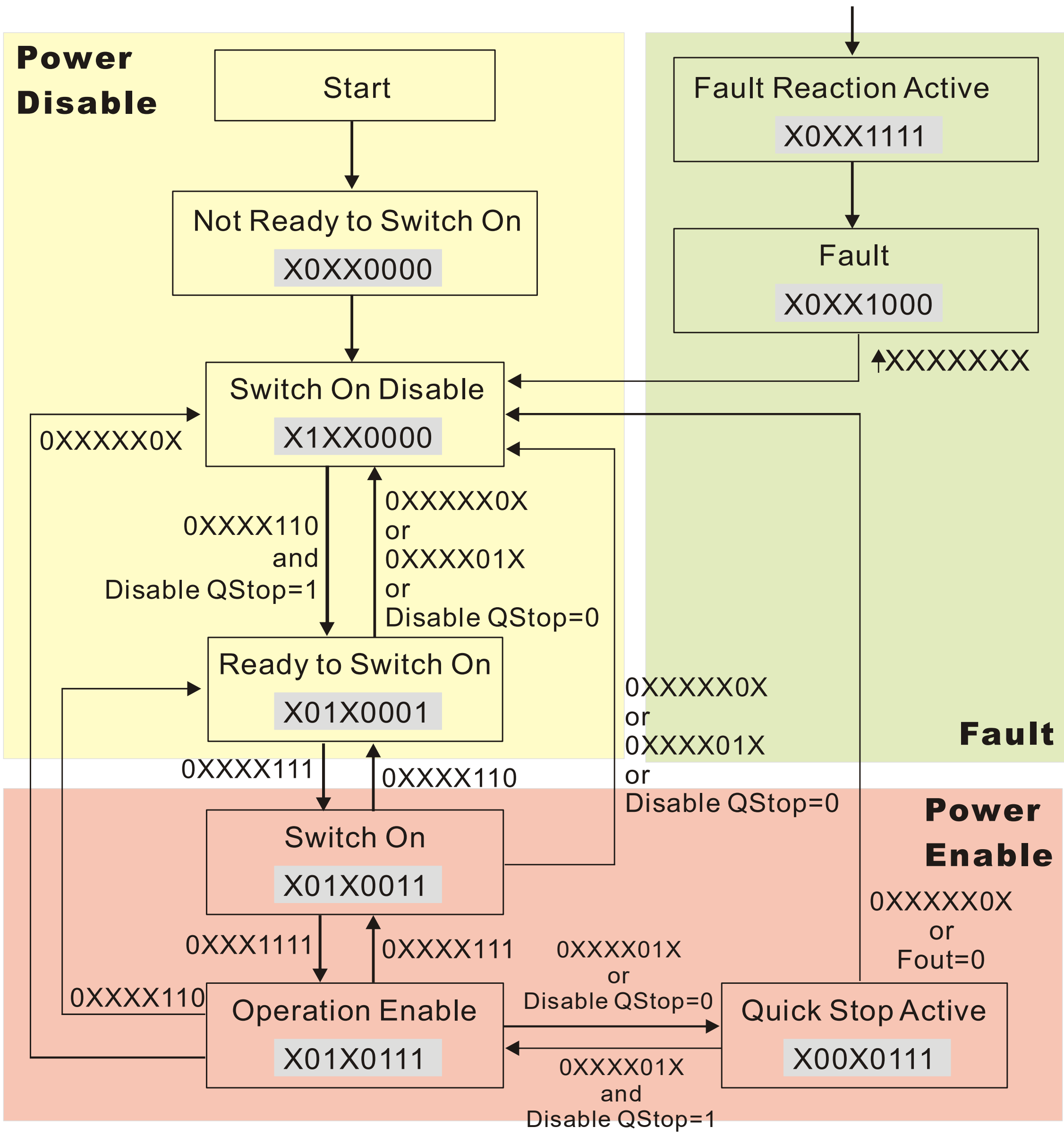
Therefore, when the motor drive is turned on and finishes the initiation, it will remain at Ready to Switch on status. To control the operation of the motor drive, you need to change this status to Operate Enable status. The way to change it is to commend the control word's bit0 ~ bit3 and bit7 of the Index 6040H and to 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 the motor drive can be switched to Operation Enable. The Index 605A decides the dashed line of Operation Enable when the control mode changes from Quick Stop Active. (When the setting value is 1~3, this dashed line is active. But when the setting value of 605A is not 1~3, once he motor derive is switched to Quick Stop Active, it will not be able to switch back to Operation Enable.)

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
605Ah	0	Quick stop option code	2	RW	S16		No		0 : disable drive function 1 :slow down on slow down ramp 2: slow down on quick stop ramp 5 slow down on slow down ramp and stay in QUICK STOP 6 slow down on quick stop ramp and stay in QUICK STOP 7 slow down on the current limit and stay in Quick stop

Besides, when the control section switches from Power Enable to Power Disable, use 605C to define parking method.

Index	Sub	Definition	Factory Setting	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)

Control mode of C2000, supporting speed, torque, position and home control are described as below:

Speed mode

1. Let Ac Motor Drive be at the speed control mode: Set Index6060 to 2.
2. Switch to Operation Enable mode: Set 6040=0xE, then set 6040 = 0xF.
3. To set target frequency: Set target frequency of 6042, since the operation unit of 6042 is rpm, there is a transformation:

$n = f \times \frac{120}{p}$ n: rotation speed (rpm) (rounds/minute) P: motor’s pole number (Pole)

f: rotation frequency (Hz)

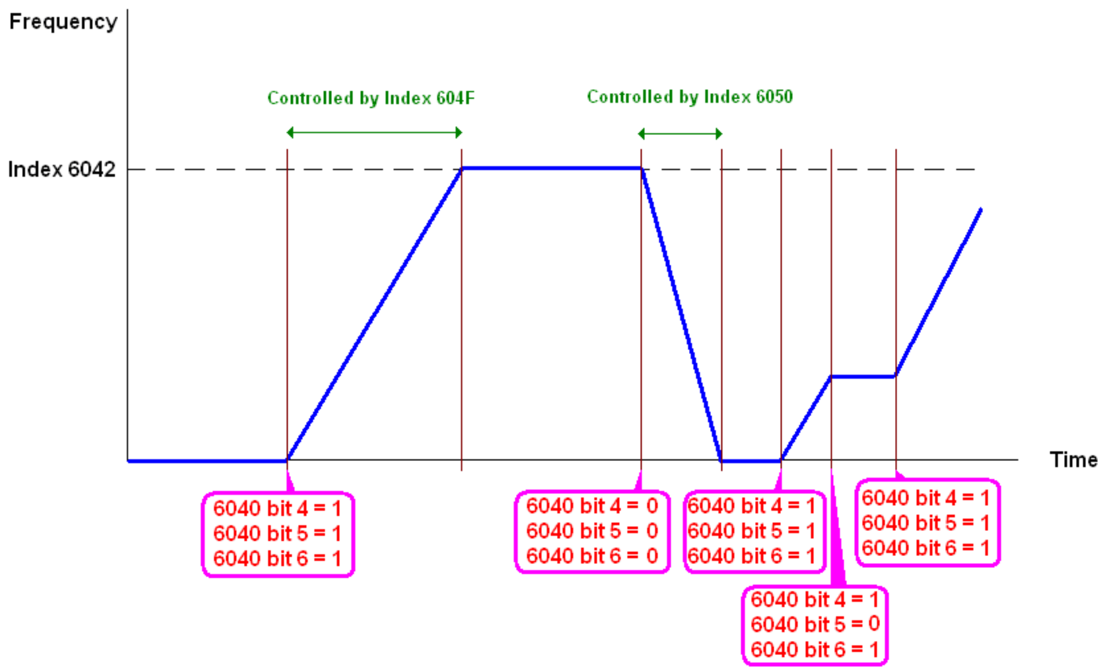
For example:

Set 6042H = 1500 (rpm), if the motor drive's pole number is 4 (Pr05-04 or Pr05-16), then the motor drive's operation frequency is 1500(120/4)=50Hz.

Besides, the 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter clockwise

4. To set acceleration and deceleration: Use 604F(Acceleration) and 6050(Deceleration).
5. Trigger an ACK signal: In the speed control mode, the bit 6~4 of Index 6040 needs to be controlled. It is defined as below:

	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
Speed mode (Index 6060=2)	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0Hz.



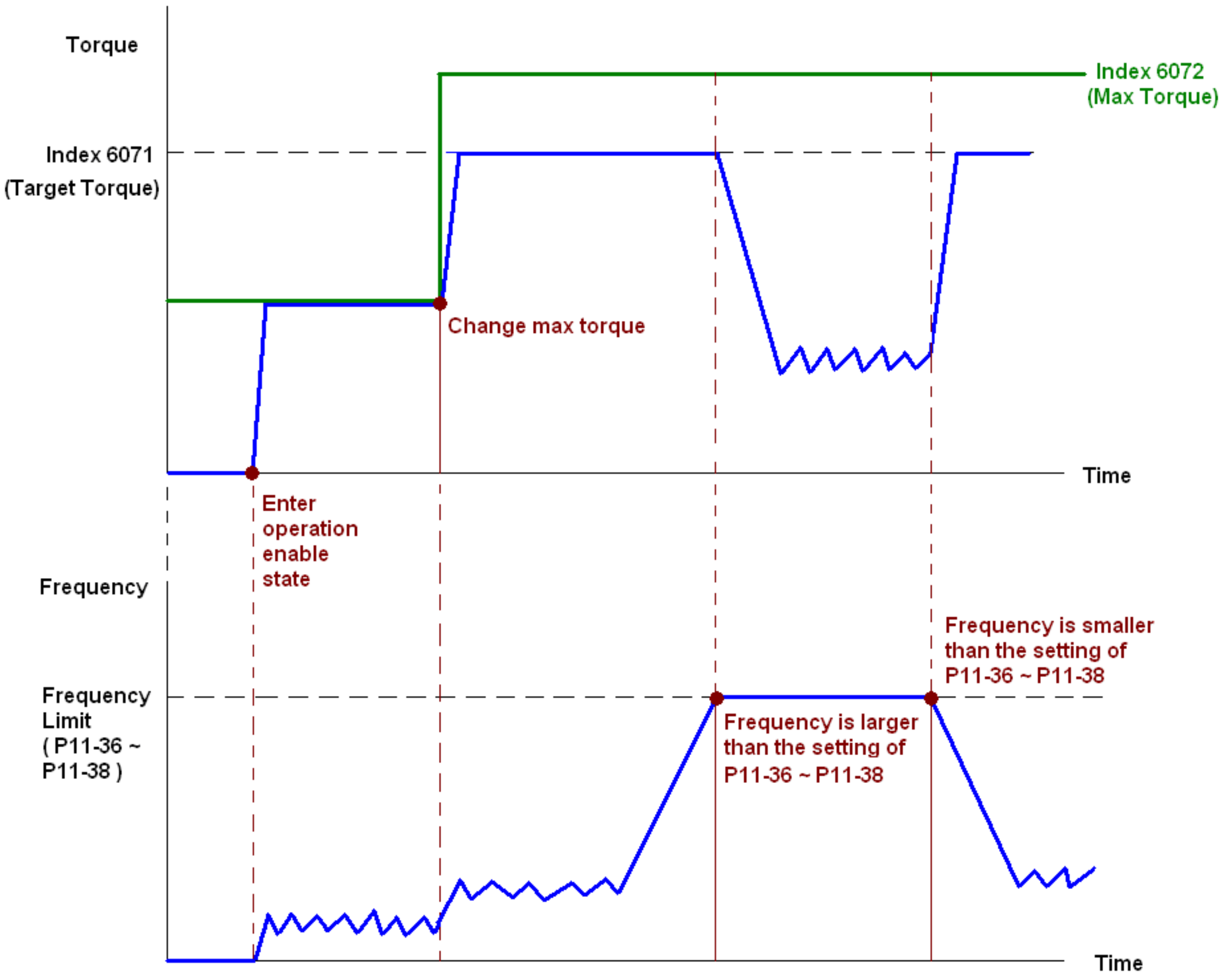
NOTE 01: To know the current rotation speed, read 6043. (unit: rpm)

NOTE 02: To know if the rotation speed can reach the targeting value; read bit 10 of 6041. (0: Not reached; 1: Reached)

Torque mode

1. Let Ac Motor Drive be at the torque control mode: Set Index6060 = 4.
2. Switch the current mode to Operation Enable, set 6040 = 0xE, then set 6040 = 0xF.
3. To set targeting torque: Set 6071 as targeting torque and 6072 as the largest output torque.

Torque mode (Index 6060=4)	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
	X	X	X	RUN to reach the targeting torque.



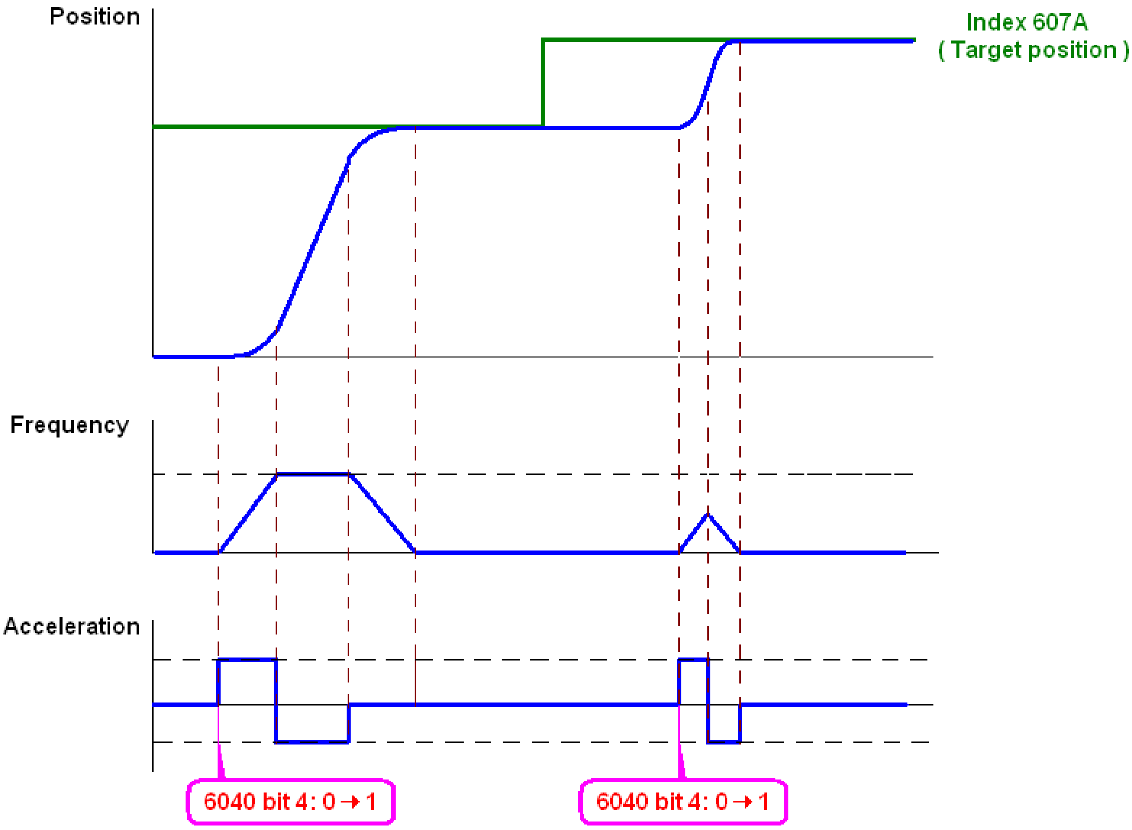
NOTE: The standard DS402 doesn't regulate the highest speed limit. Therefore if the motor drive defines the control mode of DS402, the highest speed will go with the setting of Pr11-36 to Pr11-38.

NOTE 01: To know the current torque, read 6077 (unit: 0.1%).

NOTE02: To know if reaching the targeting torque, read bit 10 of 6041. (0: Not reached; 1: Reached)

Position mode

1. Set the parameter of a trapezium curve to define position control (Pr11-43 Max. Frequency of Point- to-Point Position Control, Pr11-44 Accel. Time of Point-to Point Position Control and Pr11-45 Decel. Time of Point-to Point Position Control)
2. Let Ac Motor Drive be at the position control mode: Then set Index 6060 = 1.
3. Switch the current mode to Operation Enable, set 6040 = 0xE and then set 6040 = 0xF.
4. To set targeting position: set 607A as the targeting position.
5. Trigger an ACK signal: Set 6040 = 0x0F then set 6040 = 0x1F. (Bit4 changes from 0 to 1).



NOTE 01: To know the current position, read 6064.

NOTE 02: To know if the position reaches the targeting position, read bit 10 of 6041. (0: reached, 1: Not reached)

NOTE 03: To know if the position is over the limited area, read bit 11 of 6041 (0: in the limit, 1: over the limit)

Home mode

1. Set Pr00-12 to choose a home method.
2. Set the left and right limits correspond to the position of MI terminal.
3. To switch Ac Motor Drive control mode to Home mode: Set Index 6060 = 6.
4. To switch from current mode to Operation Enable: Set 6040 = 0xE, then set 6040 = 0xF.
5. To trigger an ACK signal: Set 6040 = 0x0F, then set 6040 = 0x1F (Bit4 changes from 0 to 1 and the motor drive will be back to home.)

Note 01: To know if the home mode is completed, read bit 12 of 6041. (0: reached, 1: Not reached)

15-3-3 By using Delta Standard (Old definition, only support speed mode)

15-3-3-1 Various mode control method (by following DS402 standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (Refer to chapter 15.2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr.00.20 to 6. (Choose source of frequency commend from

CANopen setting.)

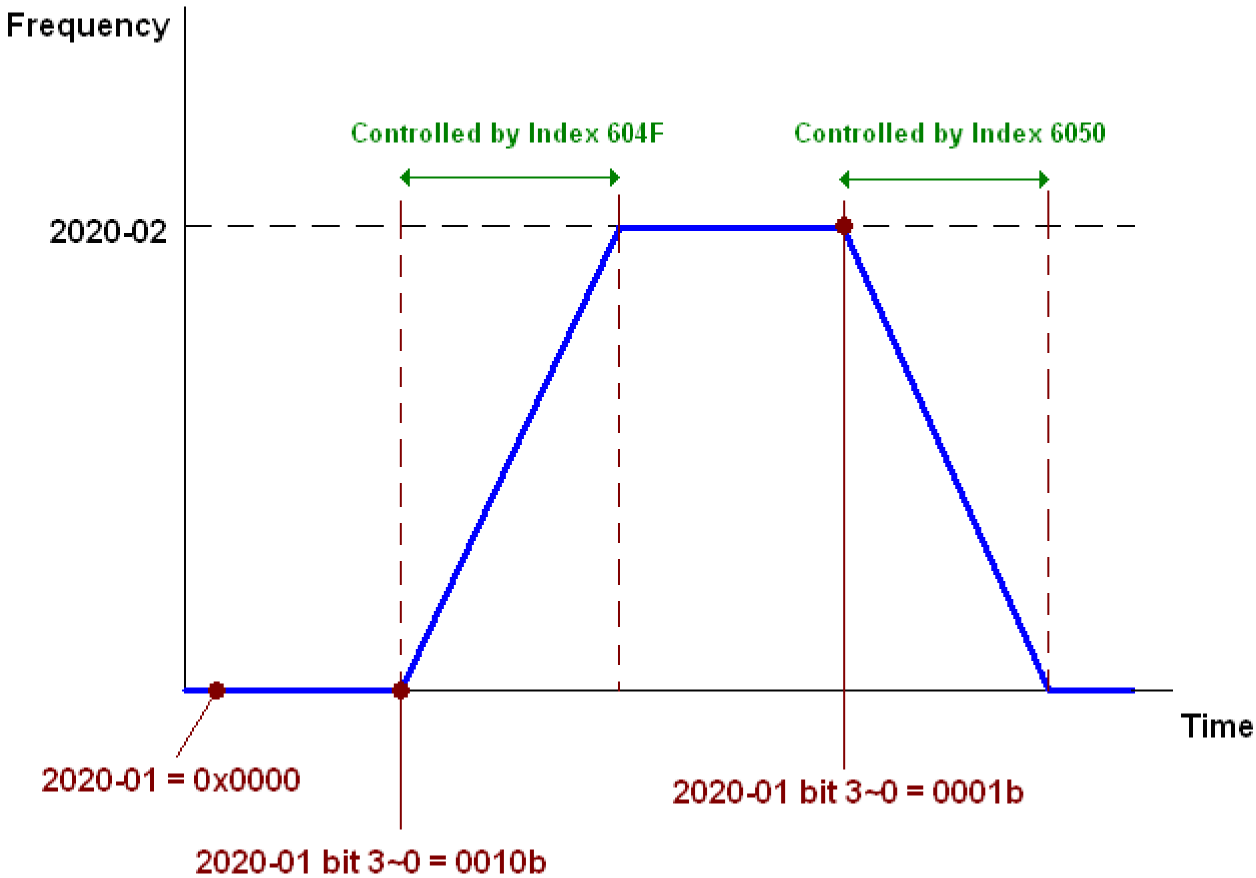
4. Set Delta Standard (Old definition, only support speed mode) as control mode: Pr. 09-40 = 0 and 09-30 = 0.

   CANopen station setting: set Pr.09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled.) (Note: If error arised (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)

5. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))

15-3-3-2 By speed mode

1. Set the target frequency: Set 2020-02, the unit is Hz, with a number of 2 decimal places. For example 1000 is 10.00.
2. Operation control: Set 2020-01 = 0002H for Running, and set 2020-01 = 0001H for Stopping.



15-3-4 By using Delta Standard (New definition)

15-3-4-1 Related set up of ac motor drive (Delta New Standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (Refer to chapter 15.2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr.00.20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Source of torque setting is set by Pr.11-33. (Choose source of torque commend from

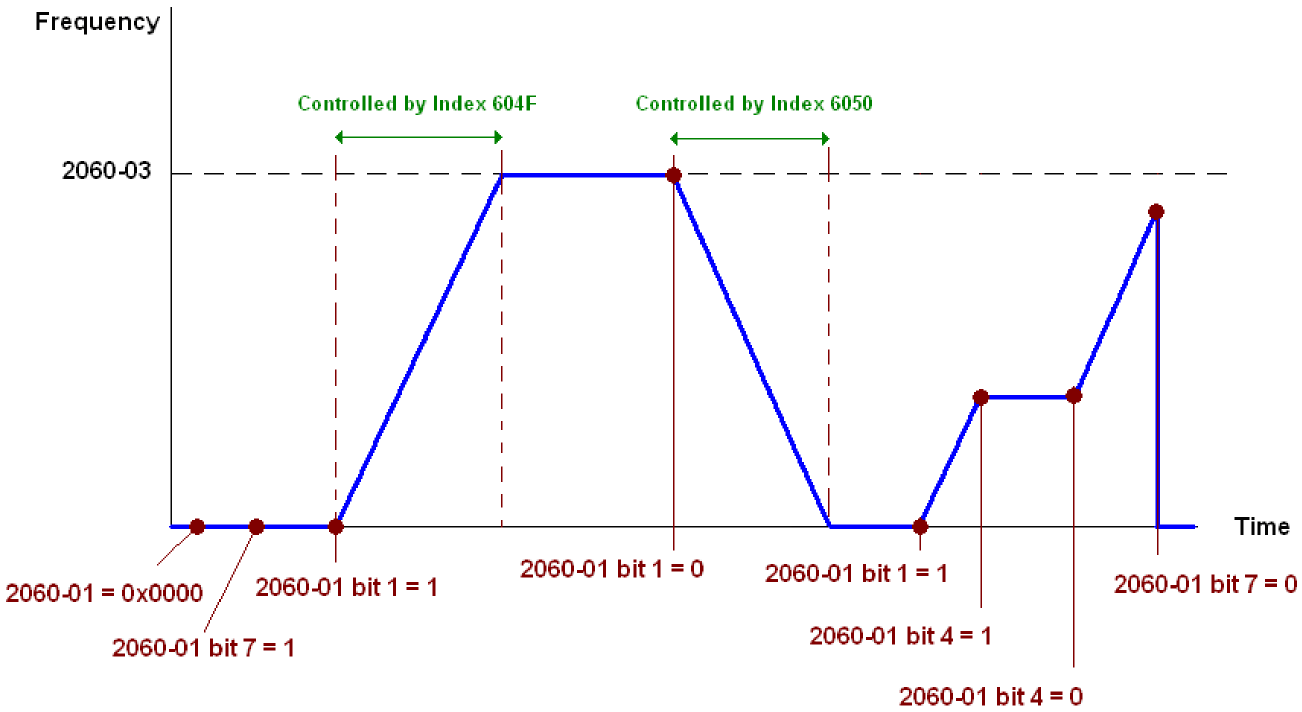
CANopen setting.)

5. CANopen station setting: set Pr.09-36 (Choose source of position commend from CANopen setting.)
6. Set Delta Standard (Old definition, only support speed mode) as control mode: Pr. 09-40 = 0 and 09-30 = 0.
7. CANopen station setting: set Pr.09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled.) (Note: If error arised (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
8. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))

15-3-4-2 Various mode control method (Delta New Standard)

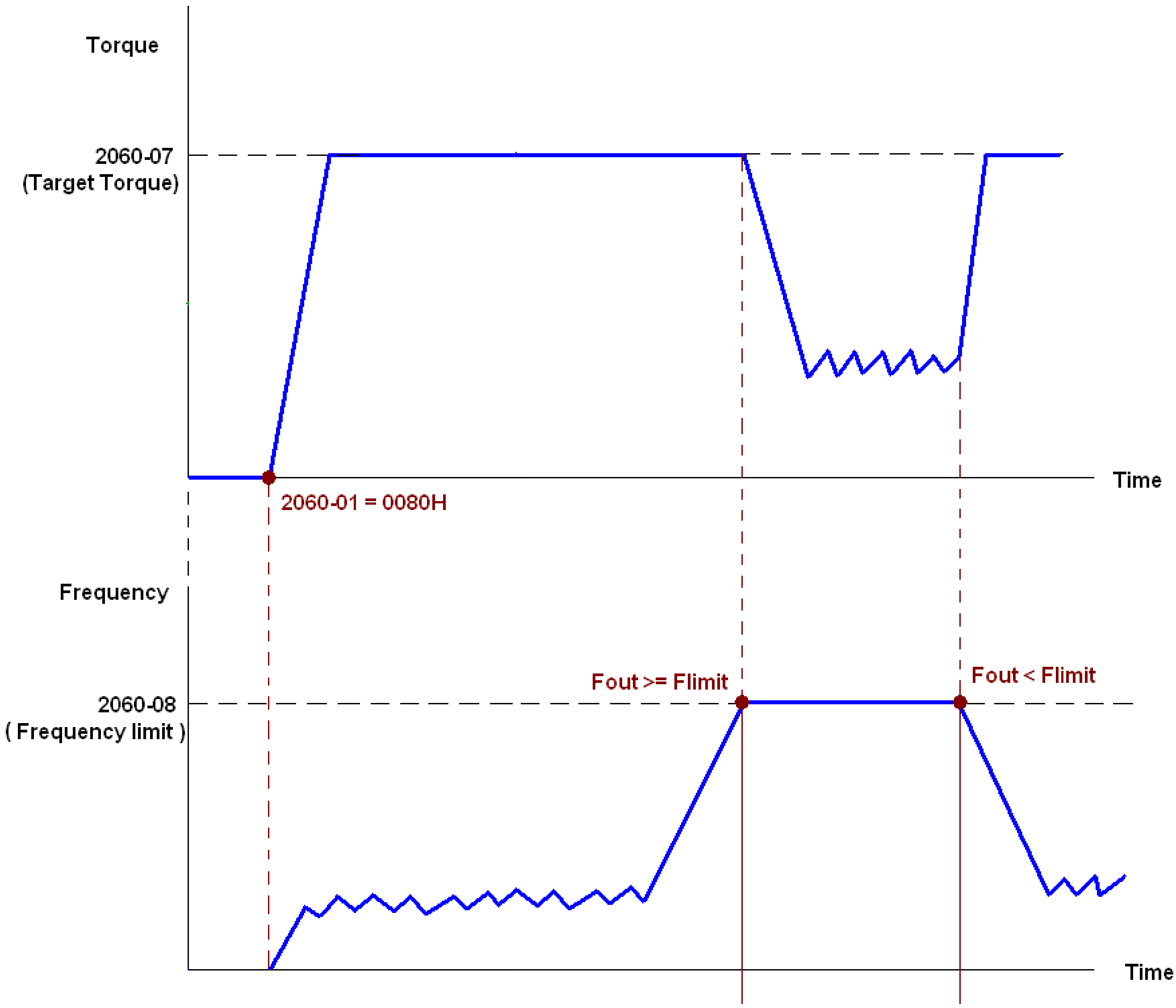
Speed Mode

1. Let Ac Motor Drive be at the speed control mode: Set Index6060 = 2.
2. Set the target frequency: set 2060-03, unit is Hz, with a number of 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.



Torque Mode

1. Let Ac Motor Drive be at torque control mode: set Index 6060 = 4.
2. Set target torque: set 2060-07, unit is %, a number of 1 decimal place. For example 100 is 10.0%.
3. Operation control: Set 2060-01 = 0080H for Server on, then the motor drive will start to run to reach target torque.



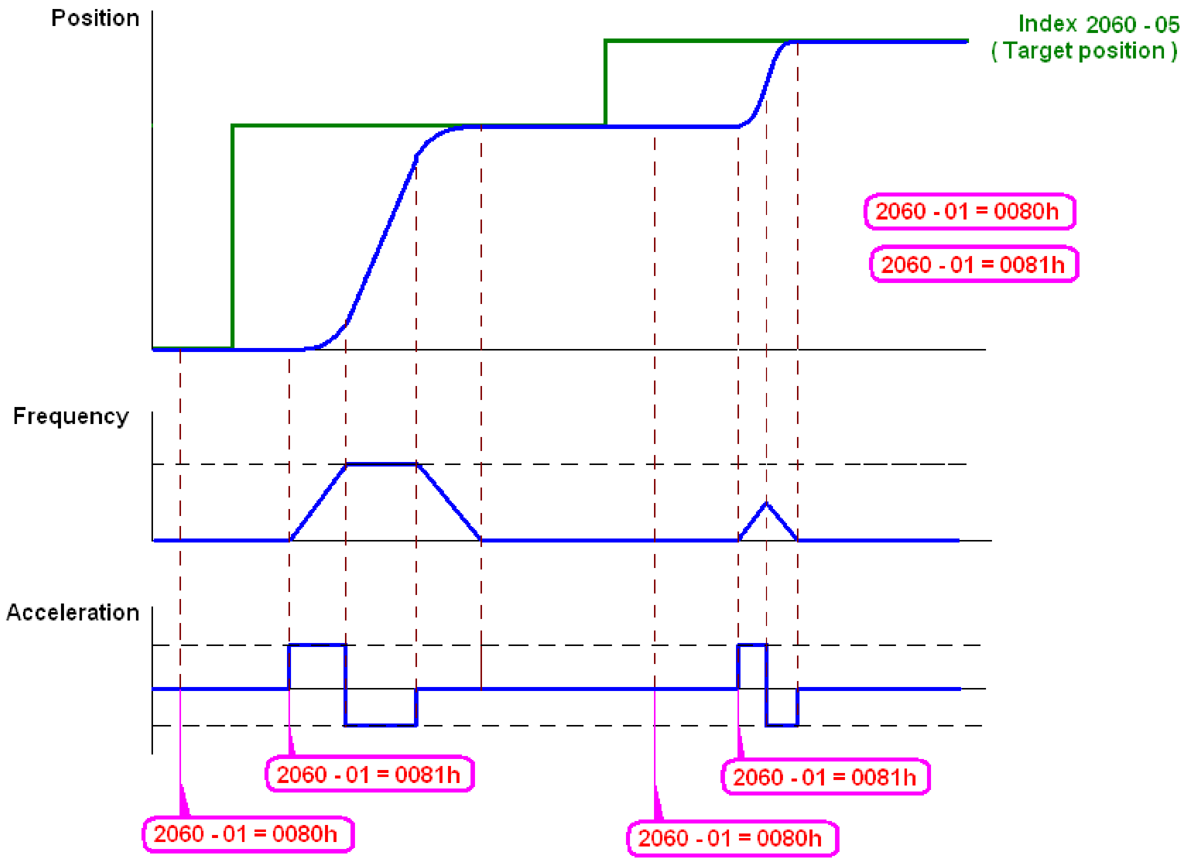
Note01 To know what the current torque is, read 2061-07 (unit is 0.1%).

Note02 To know if the torque can reach the setting value, read the bit 0 of 2061-01 (0: Not reached, 1: Reached).

Note 03: When doing torque output and if the motor drive's speed reaches the speed limit, the output torque will decrease to ensure the speed is under the limit.

Position Mode

1. Set the parameter of a trapezium curve to define position control (Pr11-43 Max. Position Control Frequency), Pr11-44 Accel. Time of Position Control, Pr11-45 Decel. Time of Position Control)
2. Let Ac motor drive be at the position control mode, set Index 6060 = 1.
3. Set 2060-01 = 0080h, then motor drive will have server on.
4. Set target position: set 2060-05 = target position.
5. Set 2060-01 =0081h to trigger the motor drive to run to the target position.
6. To move to another position, simply repeat step 3 to 5.



NOTE01: To know the current position, read 2061-05.

NOTE02: To know if reaching the target position, read bit 0 of 2061 (0: Not reached, 1: Reached).

Home Mode

1. Set Pr00-12 to choose how to return home.
2. Set the left and right limits correspond to the position of MI terminal.
3. To switch C2000 control mode to Home mode: Set Index 6060 = 6.
4. Set 2060-01 = 0080h, then motor drive will have server on.
5. Set the ACK signal: set 2060-01 = 0081h, then the motor drive will start to go back home.

NOTE 01: To know if returning home is completed, read bit12 of 6041 (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. To set the DO to be controlled, define this DO to be controlled by CANopen. For example, set Pr02-14 to control RY2.
2. To set the DO to be controlled, define this AO to be controlled by CANopen. For example, set Pr03-23 to control AFM2.
3. To control the mapping index of CANopen. If you want to control DO, then you will need to control Index2026-41. If you want to control AO, then you will need to control 2026-AX. If you want to set RY2 as ON, set the bit 1 of Index 2026-41 =1, then RY2 will output 1. If you want to control AFM2 output = 50.00%, then you will need to set Index 2026-A2 =5000, then AFM2 will output 50%.

Mapping table of CANopen DI DO AI AO:

DI:

Terminal	Related Parameters	R/W	Mapping Index
FWD	==	RO	2026-01 bit 0
REV	==	RO	2026-01 bit 1
MI 1	==	RO	2026-01 bit 2
MI 2	==	RO	2026-01 bit 3
MI 3	==	RO	2026-01 bit 4
MI 4	==	RO	2026-01 bit 5
MI 5	==	RO	2026-01 bit 6
MI 6	==	RO	2026-01 bit 7
MI 7	==	RO	2026-01 bit 8
MI 8	==	RO	2026-01 bit 9
MI 10	==	RO	2026-01 bit 10
MI 11	==	RO	2026-01 bit 11
MI 12	==	RO	2026-01 bit 12
MI 13	==	RO	2026-01 bit 13
MI 14	==	RO	2026-01 bit 14
MI 15	==	RO	2026-01 bit 15

DO：

Terminal	Related Parameters	R/W	Mapping Index
RY1	P2-13 = 50	RW	2026-41 bit 0
RY2	P2-14 = 50	RW	2026-41 bit 1
	P2-15 = 50	RW	2026-41 bit 2
MO1	P2-16 = 50	RW	2026-41 bit 3
MO2	P2-17 = 50	RW	2026-41 bit 4
MO3	P2-18 = 50	RW	2026-41 bit 5
MO4	P2-19 = 50	RW	2026-41 bit 6

MO5	P2-20 = 50	RW	2026-41 bit 7
MO6	P2-21 = 50	RW	2026-41 bit 8
MO7	P2-22 = 50	RW	2026-41 bit 9
MO8	P2-23 = 50	RW	2026-41 bit 10

AI：

Terminal	Related Parameters	R/W	Mapping Index
AVI	==	RO	Value of 2026-61
ACI	==	RO	Value of 2026-62
AUI	==	RO	Value of 2026-63

AO：

Terminal	Related Parameters	R/W	Mapping Index
AFM1	P3-20 = 20	RW	Value of 2026-A1
AFM2	P3-23 = 20	RW	Value of 2026-A2

15-4 CANopen Supporting Index

C2000 Index:

Parameter index corresponds to each other as following:

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

C2000 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	Bit 1~0	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
						Bit14~13	00B: no function
							01B: Operation command by the digital keypad

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
							10B: Operation command by Pr. 00-21 setting
							11B: Switch the source of operation command
						Bit 15	Reserved
	2	Freq. command (XXX.XXHz)	0	RW	U16		
	3	Other trigger	0	RW	U16	Bit0	1: E.F. ON
						Bit1	1: Reset
						Bit15~2	Reserved
2021H	0	Number	DH	R	U8		
	1	Error code	0	R	U16		
	2	AC motor drive status	0	R	U16	Bit 1~0	00B: stop
							01B: decelerate to stop
							10B: waiting for operation command
							11B: in operation
						Bit 2	1: JOG command
						Bit 4~3	00B: forward running
							01B: switch from reverse running to forward running
							10B: switch from forward running to reverse running
							11B: reverse running
						Bit 7~5	Reserved
						Bit 8	1: master frequency command controlled by communication interface
						Bit 9	1: master frequency command controlled by analog signal input
						Bit 10	1: operation command controlled by communication interface
						Bit 15~11	Reserved
	3	Freq. command (XXX.XXHz)	0	R	U16		
	4	Output freq. (XXX.XXHz)	0	R	U16		
	5	Output current (XX.XA)	0	R	U16		
	6	DC bus voltage (XXX.XV)	0	R	U16		
	7	Output voltage (XXX.XV)	0	R	U16		
	8	the current segment run by the multi-segment speed commend	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		
	E	Number of PG feed back pulses (0~65535)	0	R	U16		
	F	Number of PG2 pulse commands (0~65535)	0	R	U16		
	10	power output (X.XXXKWH)	0	R	U16		
2022H	0	Reserved	0	R	U16		
	1	Display output current	0	R	U16		

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	2	Display counter value	0	R	U16		
	3	Display actual output frequency (XXX.XXHz)	0	R	U16		
	4	Display DC-BUS voltage (XXX.XV)	0	R	U16		
	5	Display output voltage (XXX.XV)	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		
	A	Display PG feedback	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 analog input terminal, 0-10V corresponds to 0-100% (To 2 decimal places)	0	R	U16		
	D	Display signal of ACI analog input terminal, 4-V20mA/0-10V corresponds to 0-100% (To 2 decimal places)	0	R	U16		
	E	Display signal of AUI analog input terminal, -10V~10V 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		
	16	Number of actual motor revolution (PG1 of PG card). it will start from 9 when the actual operation direction is changed or keypad display at stop is 0. Max. is 65535	0	R	U16		
	17	Pulse input frequency (PG2 of PG card)	0	R	U16		
	18	Pulse input position (PG card PG2), maximum setting is 65535.	0	R	U16		
	19	Position command tracing error	0	R	U16		
	1A	Display times of counter overload (0.00~100.00%)	0	R	U16		

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
	1B	Display GFF in %	0	R	U16		
	1C	Display DCbus voltage ripples (Unit: Vdc)	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 1: torque mode	0	R	U16		
	25	Carrier frequency of the drive	0	R	U16		

CANopen Remote IO mapping

Index	Sub	R/W	Definition
2026H	01h	R	Each bit corresponds to the different input terminals
	02h	R	Each bit corresponds to the different input terminals
	03h~40h	R	Reserved
	41h	RW	Each bit corresponds to the different output terminals
	42h~60h	R	Reserved
	61h	R	AVI (%)
	62h	R	ACI (%)
	63h	R	AUI (%)
	64h~A0h	R	Reserved
	A1h	RW	AFM1 (%)
	A2h	RW	AFM2 (%)

Delta Standard Mode (New definition)

Index	sub	R/W	Size	Descriptions			Speed Mode	Position Mode	Home Mode	Torque Mode
				bit	Definition	Priority				
2060h	00h	R	U8							
	01h	RW	U16	0	Ack	4	0:fcmd =0 1:fcmd = Fset(Fpid)	Pulse 1: Position control	Pulse 1: Return to home	
				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 declaration 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			

Index	sub	R/W	Size	Descriptions			Speed Mode	Position Mode	Home Mode	Torque Mode
				bit	Definition	Priority				
				7	Power		0:Power OFF 1:Power ON	0:Power OFF 1:Power ON	0:Power OFF 1:Power ON	0:Power OFF 1:Power ON
				14~8	Cmd SW		Multi-step frequency switching	Multi-step position switching		
				15			Pulse 1: Fault code cleared	Pulse 1: Fault code cleared	Pulse 1: Fault code cleared	Pulse 1: Fault code cleared
	02h	RW	U16							
	03h	RW	U16				Speed command (unsigned decimal)			
	04h	RW	U16							
	05h	RW	S32					Position command		
	06h	RW								
	07h	RW	U16							Torque command (signed decimal)
	08h	RW	U16							Speed limit (unsigned decimal)
2061h	01h	R	U16	0	Arrive		Frequency attained	Position attained	Homing complete	Torque attained
				1	Dir		0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run	0: Motor FWD run 1: Motor REV run
				2	Warn		Warning	Warning	Warning	Warning
				3	Error		Error detected	Error detected	Error detected	Error detected
				4						
				5	JOG		JOG	JOG	JOG	JOG
				6	QStop		Quick stop	Quick stop	Quick stop	Quick stop
				7	Power On		Switch ON	Switch ON	Switch ON	Switch ON
				15~8						
	02h	R								
	03h	R	U16				Actual output frequency	Actual output frequency	Actual output frequency	Actual output frequency
	04h	R								
	05h	R	S32				Actual position (absolute)	Actual position (absolute)	Actual position (absolute)	Actual position (absolute)
	06h	R								
	07h	R	S16				Actual torque	Actual torque	Actual torque	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: 100ms, and check if the setting is set to 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

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	Note
									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		1: Profile Position Mode 2: Velocity Mode 4: Torque Profile Mode 6: Homing Mode
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above
6064h	0	pp Position actual value	0	RO	S32		Yes	pp	
6071h	0	tq Target torque	0	RW	S16	0.1%	Yes	tq	Valid unit: 1%
6072h	0	tq Max torque	150	RW	U16	0.1%	No	tq	Valid unit: 1%
6075h	0	tq Motor rated current	0	RO	U32	mA	No	tq	
6077h	0	tq torque actual value	0	RO	S16	0.1%	Yes	tq	
6078h	0	tq current actual value	0	RO	S16	0.1%	Yes	tq	
6079h	0	tq DC link circuit voltage	0	RO	U32	mV	Yes	tq	
607Ah	0	pp Target position	0	RW	S32	1	Yes	pp	

15-5 CANopen Fault Code

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
1	HAND Fault ocA Oc at accel	0001H	Over-current during acceleration	1	2213H
2	HAND Fault ocd Oc at decel	0002H	Over-current during deceleration	1	2213H
3	HAND Fault ocn Oc at normal SPD	0003H	Over-current during steady status operation	1	2214H
4	HAND Fault GFF Ground fault	0004H	Ground fault. When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current. NOTE: The short circuit protection is provided for AC motor drive protection, not for protection of the user.	1	2240H
5	HAND Fault occ Short Circuit	0005H	Short-circuit is detected between upper bridge and lower bridge of the IGBT module.	1	2250H
6	HAND Fault ocS Oc at stop	0006H	Over-current at stop. Hardware failure in current detection	1	2214H
7	HAND Fault ovA Ov at accel	0007H	Over-current during acceleration. Hardware failure in current detection	2	3210H
8	HAND Fault ovd Ov at decel	0008H	Over-current during deceleration. Hardware failure in current detection.	2	3210H
9	HAND Fault ovn Ov at normal SPD	009H	Over-current during steady speed. Hardware failure in current detection.	2	3210H
10	HAND Fault ovS Ov at stop	000AH	Over-voltage at stop. Hardware failure in current detection	2	3210H

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
11	HAND Fault LvA Lv at accel	000BH	DC BUS voltage is less than Pr.06.00 during acceleration.	2	3220H
12	HAND Fault Lvd Lv at decel	000CH	DC BUS voltage is less than Pr.06.00 during deceleration.	2	3220H
13	HAND Fault Lvn Lv at normal SPD	000DH	DC BUS voltage is less than Pr.06.00 in constant speed.	2	3220H
14	HAND Fault LvS Lv at stop	000EH	DC BUS voltage is less than Pr.06-00 at stop	2	3220H
15	HAND Fault OrP Phase Lacked	000FH	Phase Loss Protection	2	3130H
16	HAND Fault oH1 IGBT over heat	0010H	IGBT overheat IGBT temperature exceeds protection level. 1~15HP: 90℃ 20~100HP: 100℃	3	4310H
17	HAND Fault oH2 Hear Sink oH	0011H	Heat sink overheat Heat sink temperature exceeds 90oC	3	4310H
18	HAND Fault tH1o Thermo 1 open	0012H	Temperature detection circuit error (IGBT) IGBT NTC	3	FF00H
19	HAND Fault tH2o Thermo 2 open	0013H	Temperature detection circuit error (capacity module) CAP NTC	3	FF01H
21	HAND Fault oL Inverter oL	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	HAND Fault EoL1 Thermal relay 1	0016H	Electronics thermal relay 1 protection	1	2310H

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
23	HAND Fault EoL2 Thermal relay 2	0017H	Electronics thermal relay 2 protection	1	2310H
24	HAND Fault oH3 Motor over heat	0018H	Motor overheating The AC motor drive detecting internal temperature exceeds the setting of Pr.06-30 (PTC level) or Pr.06-57 (PT100 level 2).	3	FF20H
26	HAND Fault ot1 Over torque 1	001AH	These two fault codes will be displayed when output current exceeds the over-torque detection level (Pr.06.07 or Pr.06.10) and exceeds over-torque detection (Pr.06.08 or Pr.06.11) and it is set 2 or 4 in Pr.06-06 or Pr.06-09.	3	8311H
27	HAND Fault ot2 Over torque 2	001BH		3	8311H
28	HAND Fault uC Under torque 1	001CH	Low current	1	8321H
29	HAND Fault LMIT Limit Error	001DH	Limit error	1	7320H
30	HAND Fault cF1 EEPROM write Err	001EH	Internal EEPROM can not be programmed.	5	5530H
31	HAND Fault cF2 EEPROM read Err	001FH	Internal EEPROM can not be read.	5	5530H
33	HAND Fault cd1 Ias sensor Err	0021H	U-phase error	1	FF04H
34	HAND Fault cd2 Ibs sensor Err	0022H	V-phase error	1	FF05H
35	HAND Fault cd3 Ics sensor Err	0023H	W-phase error	1	FF06H

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
36	HAND Fault Hd0 cc HW Error	0024H	cc (current clamp) hardware error	5	FF07H
37	HAND Fault Hd1 oc HW Error	0025H	oc hardware error	5	FF08H
38	HAND Fault Hd2 ov HW Error	0026H	ov hardware error	5	FF09H
39	HAND Fault Hd3 GFF HW Error	0027H	GFF hardware error	5	FF0AH
40	HAND Fault AUE Auto tuning Err	0028H	Auto tuning error	1	FF21H
41	HAND Fault AFE PID Fbk Error	0029H	PID loss (ACI)	7	FF22H
42	HAND Fault PGF1 PG Fbk Error	002AH	PG feedback error	7	7301H
43	HAND Fault PGF2 PG Fbk Loss	002BH	PG feedback loss	7	7301H
44	HAND Fault PGF3 PG Fbk Over SPD	002CH	PG feedback stall	7	7301H
45	HAND Fault PGF4 PG Fbk deviate	002DH	PG slip error	7	7301H
48	HAND Fault ACE ACI loss	0030H	ACI loss	1	FF25H

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
49	HAND Fault EF External Fault	0031H	External Fault When input EF (N.O.) on external terminal is closed to GND, AC motor drive stops output U, V, and W.	5	9000H
50	HAND Fault EF1 Emergency stop	0032H	Emergency stop When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output U, V, W and the motor coasts to stop.	5	9000H
51	HAND Fault bb Base block	0033H	External Base Block When the external input terminals MI1 to MI16 are set as bb and active, the AC motor drive output will be turned off	5	9000H
52	HAND Fault Pcod Password Error	0034H	Password will be locked if three fault passwords are entered	5	FF26H
54	HAND Fault cE1 Modbus CMD err	0036H	Illegal function code	4	7500H
55	HAND Fault cE2 Modbus ADDR err	0037H	Illegal data address (00H to 254H)	4	7500H
56	HAND Fault cE3 Modbus DATA err	0038H	Illegal data value	4	7500H
57	HAND Fault cE4 Modbus slave FLT	0039H	Data is written to read-only address	4	7500H
58	HAND Fault cE10 Modbus time out	003AH	Modbus transmission timeout.	4	7500H
60	HAND Fault bF Braking fault	003CH	Brake resistor fault	5	7110H

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
61	HAND Fault ydc Y-delta connect	003DH	Motor Y-Δ switch error	2	3330H
62	HAND Fault dEb Dec. Energy back	003EH	Energy regeneration when decelerating	2	FF27H
63	HAND Fault oSL Over slip Error	003FH	Over slip error. Slip exceeds Pr.05.26 limit and slip duration exceeds Pr.05.27 setting.	7	FF28H
64	HAND Fault ryF MC Fault	0040H	Electric valve switch error when executing Soft Start. (This warning is for frame E and higher frame of AC drives) Do not disconnect RST when drive is still operating.	5	7110H
65	HAND Fault PGF5 PG HW Error	0041H	PG Card Error	5	FF29H
68	HAND Fault SdRv SpdFbk Dir Rev	0044H	Rotaing direction is different from the commanding direction deteced by the sensorless. Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct.	7	8400H
69	HAND Fault SdOr SpdFbk over SPD	0045H	Overspeed rotation detected by the sensorless Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. Verify if the gains of the speed circuit is reasonable.	7	8400H
70	HAND Fault SdDe SpdFbk deviate	0046H	Big difference between the rotating speed and the command deteced by the sensorless Solution Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. Verify if the gains of the speed circuit is reasonable.	7	8400H
73	HAND Fault S1 S1-Emergy stop	0049H	external safety emergency stop	5	FF2AH

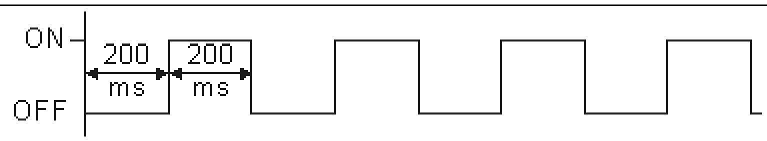
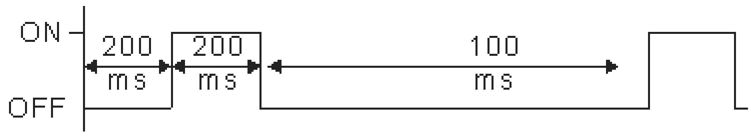
Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
82	HAND Fault OPHL U phase lacked	0052H	U phase output phase loss	2	2331H
83	HAND Fault OPHL U phase lacked	0053H	V phase output phase loss	2	2332H
84	HAND Fault OPHL U phase lacked	0054H	W phase output phase loss	2	2333H
85	HAND Fault AboF PG ABZ Line off	0055H	PG card ABZ signal loss Solution Verify if the parameter setting of PG card and PG card cable is correct.	5	7301H
86	HAND Fault UvoF PG UVW Line off	0056H	PG card UVW signal loss Solution Verify if the parameter setting of PG card and PG card cable is correct.	5	7301H
89	HAND Fault RoPd Rotor Pos. Error	0059H	Rotor position detection error Solution Verify if the UVW output cable are loss. Verify if the motor internal coil is broken. Verify if the drive UVW output are normal.	7	FF30H
90	HAND Fault Fstp For ce Stop	005AH	Internal PLC forced to stop Verify the setting of Pr.00-32	7	FF2EH
101	HAND Fault CGdE Guarding T-out	0065H	Guarding time-out 1	4	8130H
102	HAND Fault CHbE Heartbeat T-out	0066H	Heartbeat time-out	4	8130H
104	HAND Fault CbFE CAN/S bus off	0068H	CAN bus off	4	8140H
105	HAND Fault CIdE CAN/S Idx exceed	0069H	CAN index exceed	4	8100H

Setting *	Display	Fault code	Description	CANopen fault code (bit 0~7)	CANopen fault register
106	HAND Fault CAdE CAN/S add. set	006AH	CAN address error	4	8100H
107	HAND Fault CFrE Can bus off	006BH	CAN frame fail	4	8100H
111	HAND Fault ictE InrCom Time Out	006FH	Internal communication time-out	4	7500H
112	HAND Fault SfLK PMLess ShaftLock	0070H	Motor Shaft lock error(Motor does not turn but the output frequency is not zero) Solution Verify if the motor parameter setting is correct.	7	FF31H

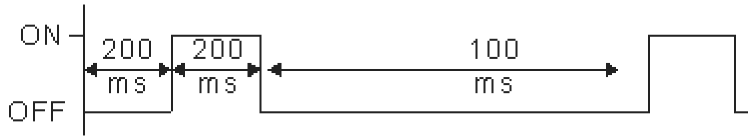
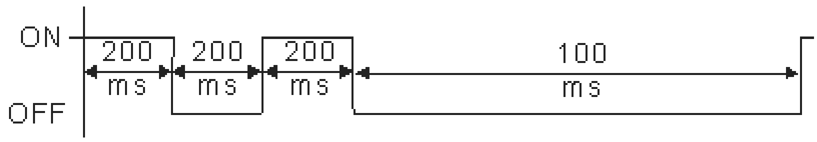
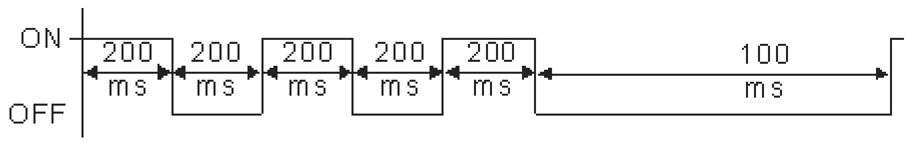
15-6 CANopen LED Function

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 CT2000'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

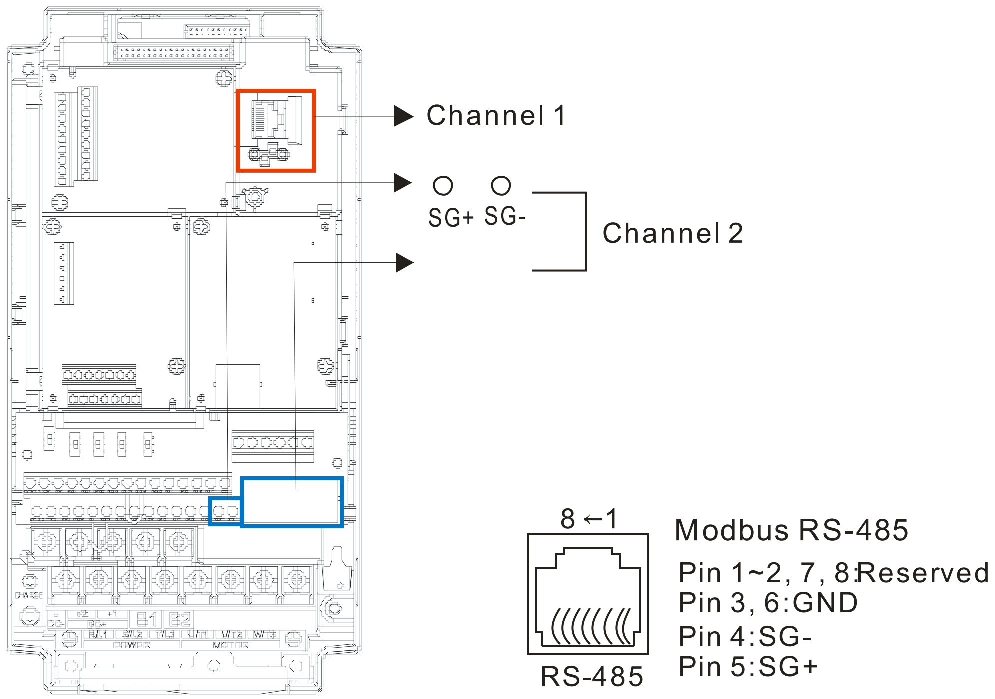
WPLSoft is Delta's program editing software for the DVP and CT2000 programmable controllers in the Windows operating system environment. Apart from general PLC program design general Windows editing functions (such as cut, paste, copy, multiple windows, etc.), WPLSoft also provides many Chinese/English 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
Suitable PLC models	Delta's full DVP-PLC series, VFD-CT2000 series

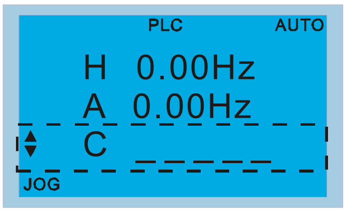
16-2 Notes before PLC use

1. The PLC has a preset communications format of 7,N,2,9600, with node 2; the PLC node can be changed in parameter 09-35, but this address may not be the same as the converter's address setting of 09-00.
2. The CT2000 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 parameter 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.
6. When parameter 00-04 is set as 28, the displayed value will be the value of PLC register D1043 (see figure below):

Digital Keypad KPC-CC01	Digital Keypad KPC-CE01
Can display 0~65535	0~9999

	 When more than 9999 

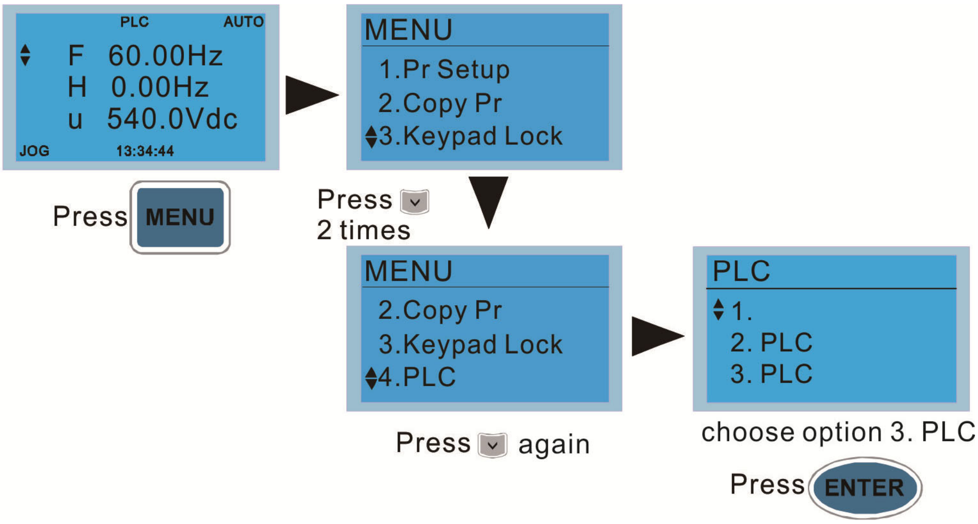
7. In the PLC Run and PLC Stop mode, the content 9 and 10 of parameter 00-02 cannot be set and cannot be reset to the default value.
8. The PLC can be reset to the default value when parameter 00-02 is set as 6.
9. The corresponding MI function will be disabled when the PLC writes to input contact X.
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 parameter 00-20 or the Hand ON/OFF configuration.
12. When the PLC controls converter frequency (TORQ commands), torque commands will be entirely controlled by the PLC, and will not be affected by the setting of parameter 11-33 or the Hand ON/OFF configuration.
13. When the PLC controls converter frequency (POS commands), position commands will be entirely controlled by the PLC, and will not be affected by the setting of parameter 11-40 or the Hand ON/OFF configuration.
14. When the PLC controls converter 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).

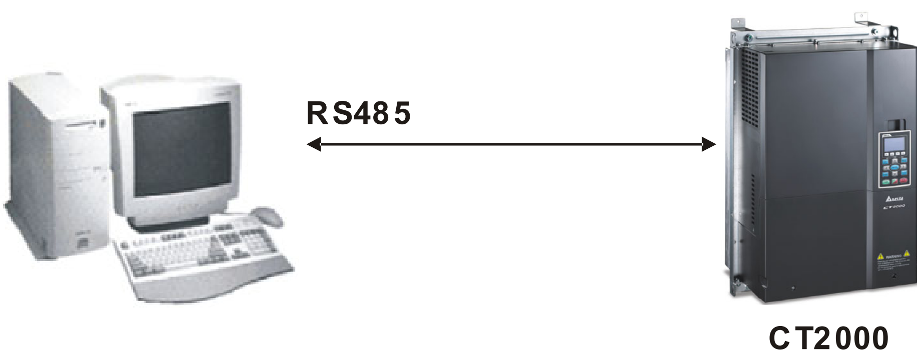


NOTE

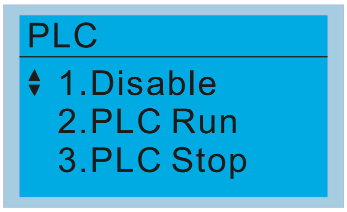
If the optional KPC-CE01 digital keypad is used, employ the following method:

Switch to the main PLC2 screen: After powering up the drivers, press the  key on the KPC-CE01 once to switch to the function screen, which will then display "PrSET." After using the  up or down button to switch to the "PLC" screen, and then press  to enter PLC function settings. Afterwards, press the Up key to switch to "PLC2," and then press . The screen will now display "PLSn" and flash, indicating that the internal PLC currently has no program, and this error message can be ignored. If the PLC has an editing program, the screen will display "End," and will jump back to "PLC2" after 1 to 2 seconds. When no program has been downloaded to the drivers, the program can continue to run even if a PLC warning message appears.

2. Wiring: Connect the driver's RJ-45 communications interface to a PC via the RS485



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)

Optional product: PLC function display method on KPC-CE01 digital keypad	PLC 0 : Do not implement PLC functions PLC 1 : Initiate PLC Run PLC 2 : Initiate PLC Stop

- When the external multifunctional input terminals (MI1 to 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		PLC Mode select bit1(52)	PLC Mode select bit0 (51)
Using KPC-CC01	Using KPC-CE01		
Disable	PLC 0	OFF	OFF
PLC Run	PLC 1	OFF	ON
PLC Stop	PLC 2	ON	OFF
Maintain previous state	Maintain previous state	ON	ON

Use of KPC-CE01 digital keypad to implement PLC functions

☑ When the PLC screen switches to the PLC1 screen, this will trigger one PLC action, and the PLC program start/stop can be controlled by communications via the WPL.

☑ When the PLC screen switches to the PLC2 screen, this will trigger one PLC stop, and the PLC program start/stop can be controlled by communications via the WPL.

☑ The external terminal control method is the same as shown in the table above.

NOTE

- When input/output terminals (FWD REV MI1 to MI8 MI10 to 15, Relay1, Relay2 RY10 to RY15, MO1 to MO2 MO10 to 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 parameter 02-52, 02-53, and 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.
- Parameter 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: Expansion card EMC-D611A (D1022=4)

3: Expansion 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		MO1	MO2											
2						MO10	MO11									
3						RY10	RY11	RY12	RY13	RY14	RY15					

1: Control I/O |

2: Expansion card EMC-D42A (D1022=5)

3: Expansion card EMC-R6AA (D1022=6)

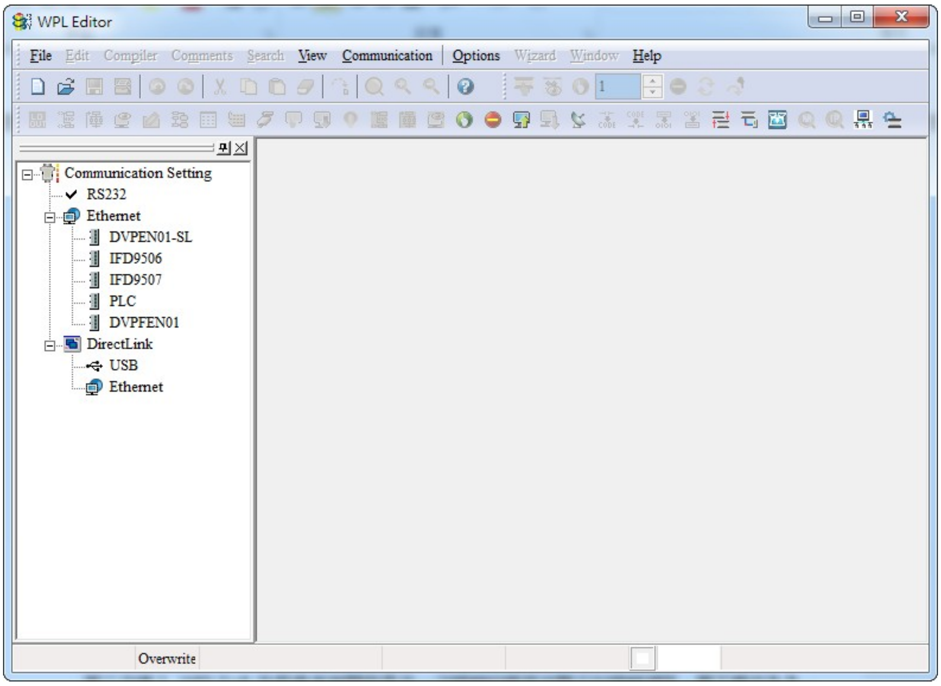
16-3-3 Installation WPLSoft

See Delta's website for WPLSoft editing software:
http://www.delta.com.tw/industrialautomation/download.

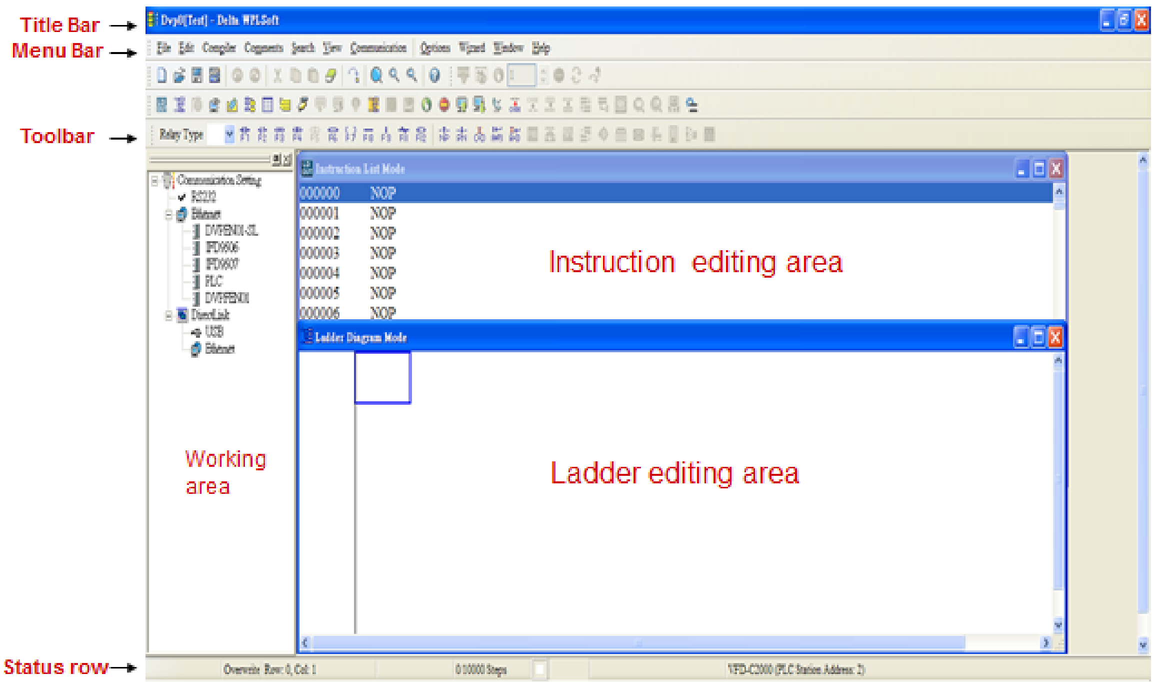
16-3-4 Program writing

After completing installation, the WPLSoft program will be installed in the designated subfolder "C:\Program Files\Delta Industrial Automation\WPLSoft x.xx." The editing software can now be run by clicking on the WPL icon using the mouse.

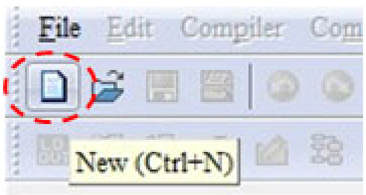
The WPL editing window will appear after 3 seconds (see figure below). When running WPLSoft for the first time, before "New file" has been used, only the "File (F)," "Communications (C)," View (V)," "Options (O)," and "Help (H)" columns will appear on the function toolbar.



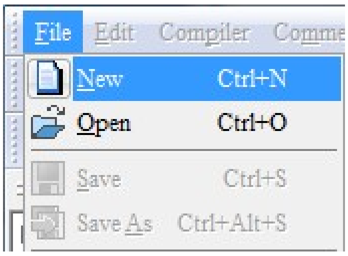
After running WPLSoft for the second time, the last file edited will open and be displayed in the editing window. The following figure provides an explanation of the WPLSoft editing software window:



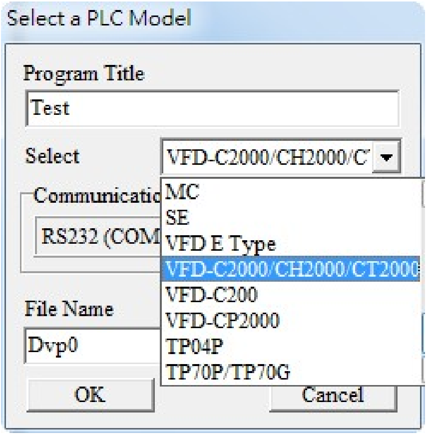
Click on the  icon on the toolbar in the upper left part of the screen: opens new file (Ctrl+N)



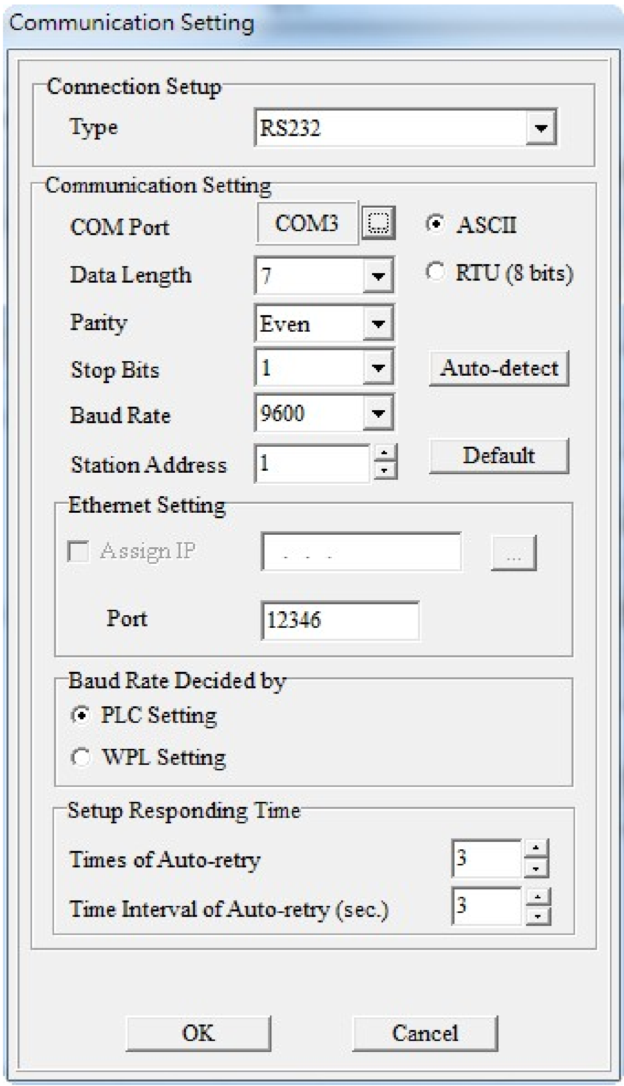
You can also use "File (F)"=> New file (N) (Ctrl+N)



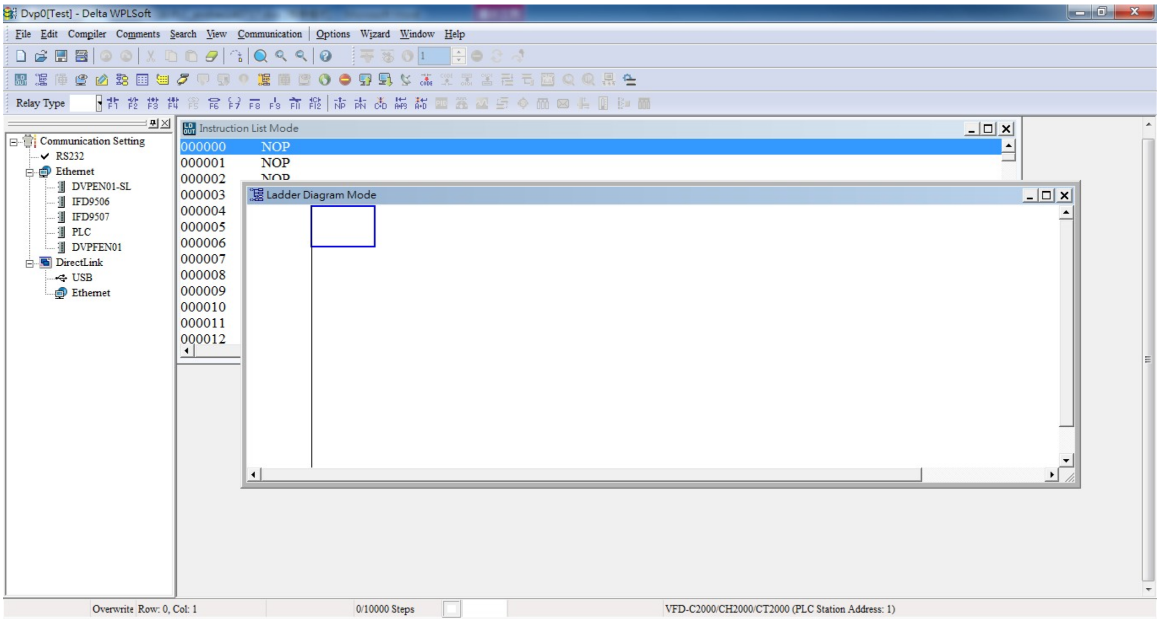
The "Device settings" window will appear after clicking. You can now enter the project title and filename, and select the device and communication settings to be used



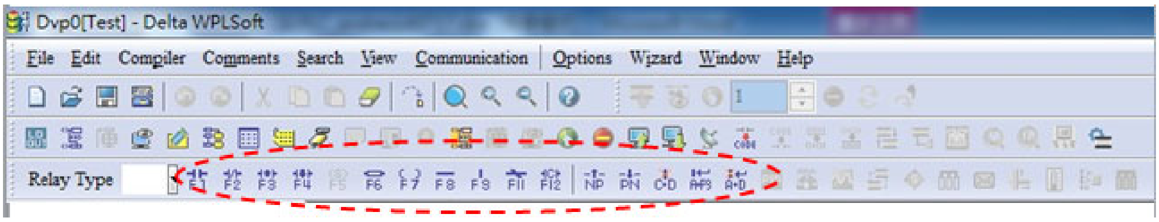
Communications settings: Perform settings in accordance with the desired communications method

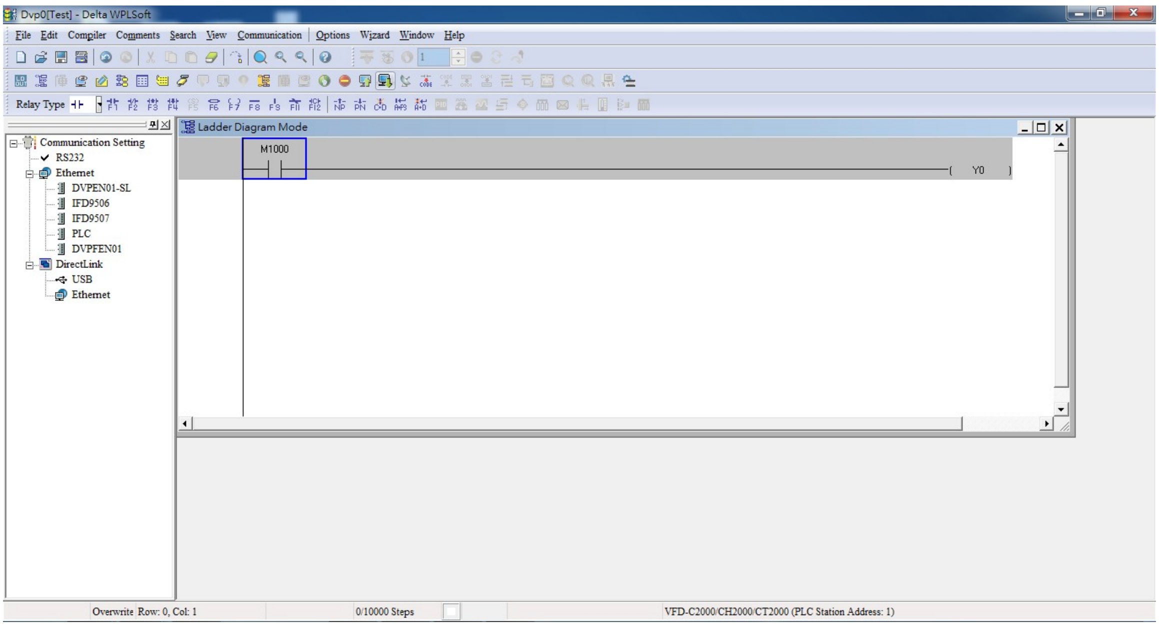


Press Confirm after completing settings and begin program editing. There are two program editing methods; you can choose whether to perform editing in the command mode or the ladder diagram mode.



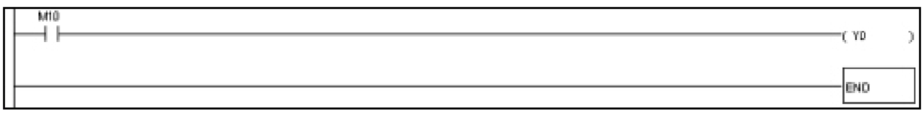
In ladder diagram mode, you can perform program editing using the buttons on the function icon row





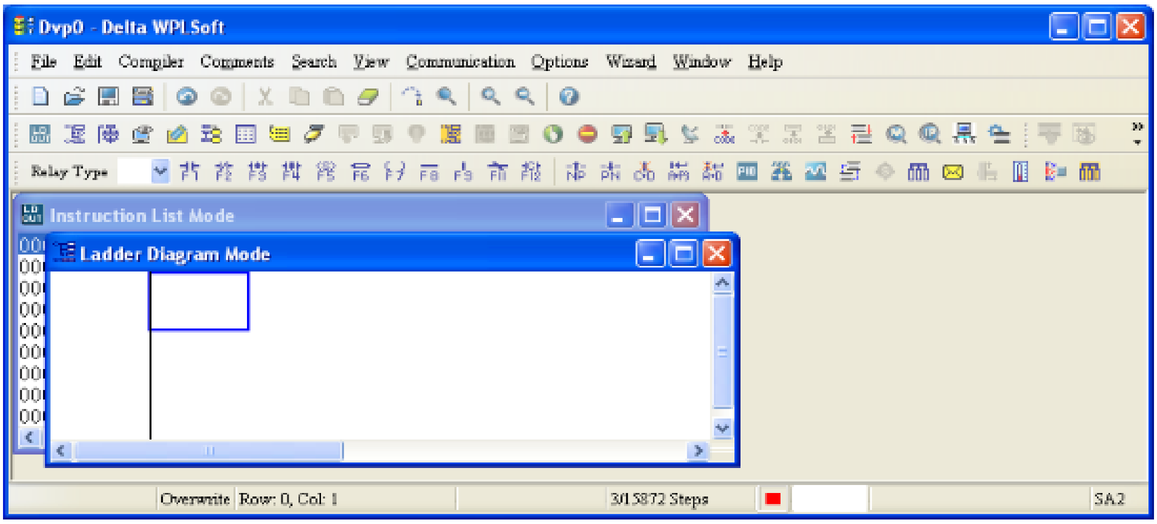
Basic Operation

Example: Input the ladder diagram in the following figure

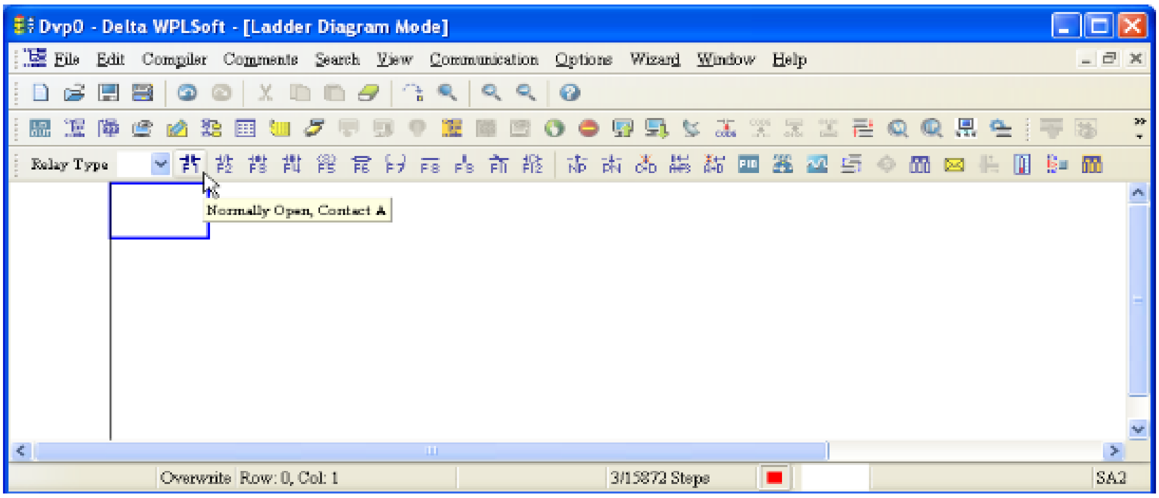


Mouse operation and keyboard function key (F1 to F12) operation

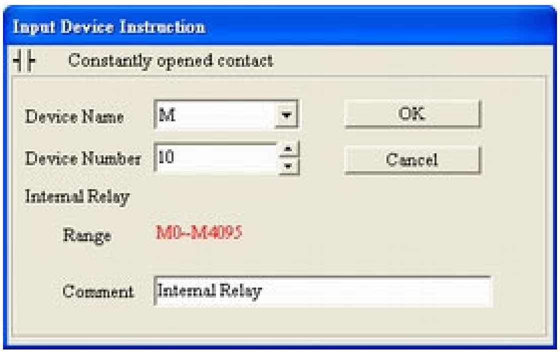
1. The following screen will appear after a new file has been established:



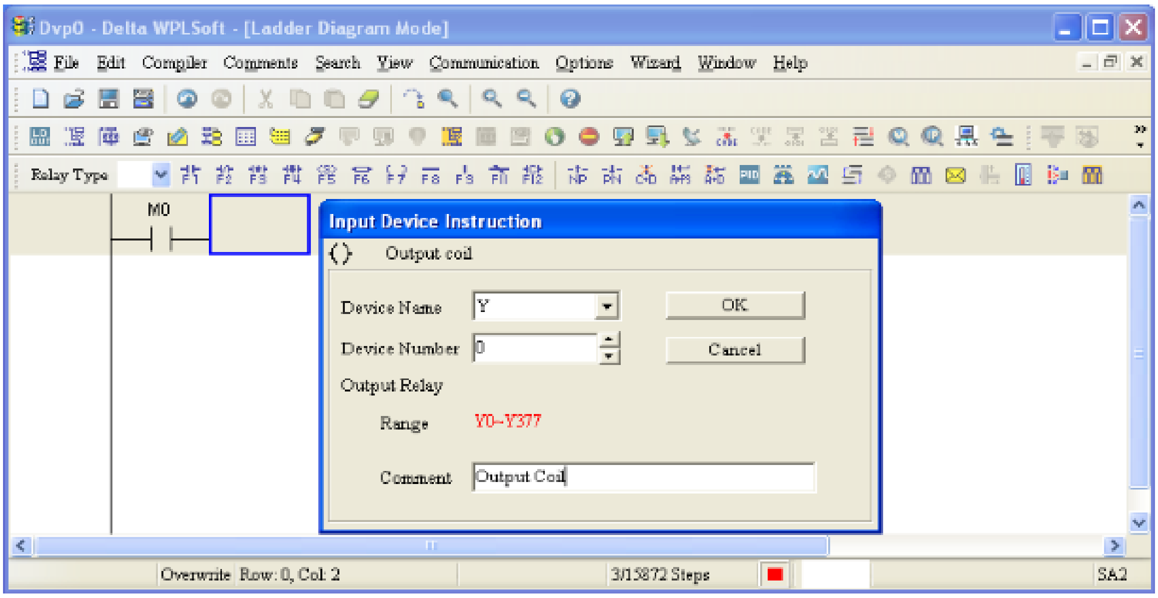
2. Use the mouse to click on the always-open switch icon  or press the function key F1:



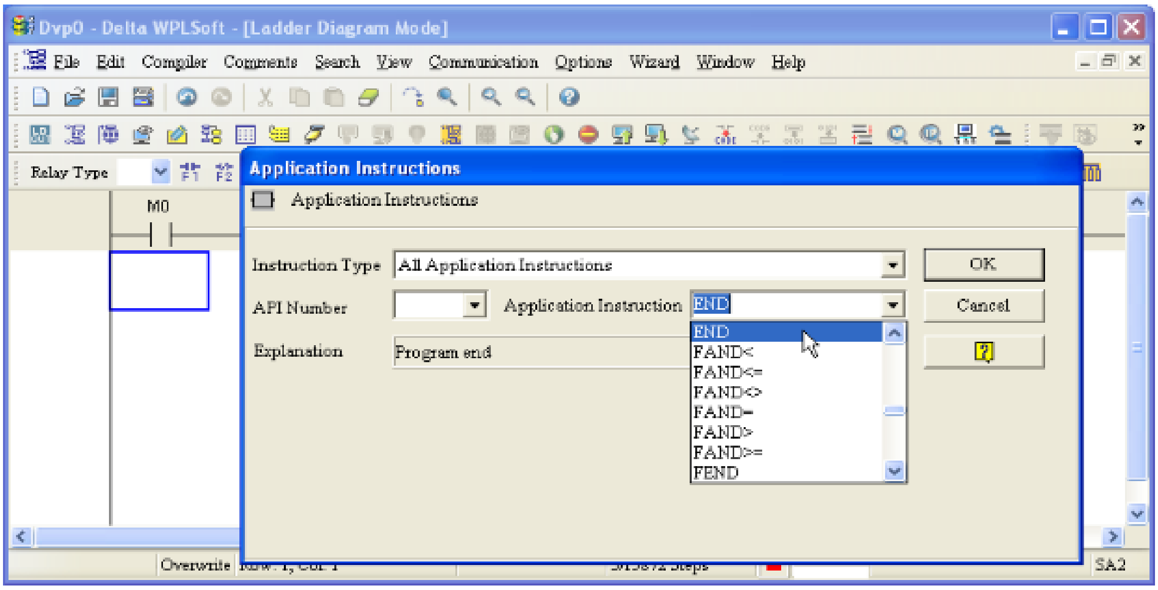
3. After the name of the input device and the comment dialog box have appeared, the device name (such as "M"), device number (such as "10"), and input comments (such as "auxiliary contact") can be selected; press the Confirm button when finished.

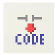


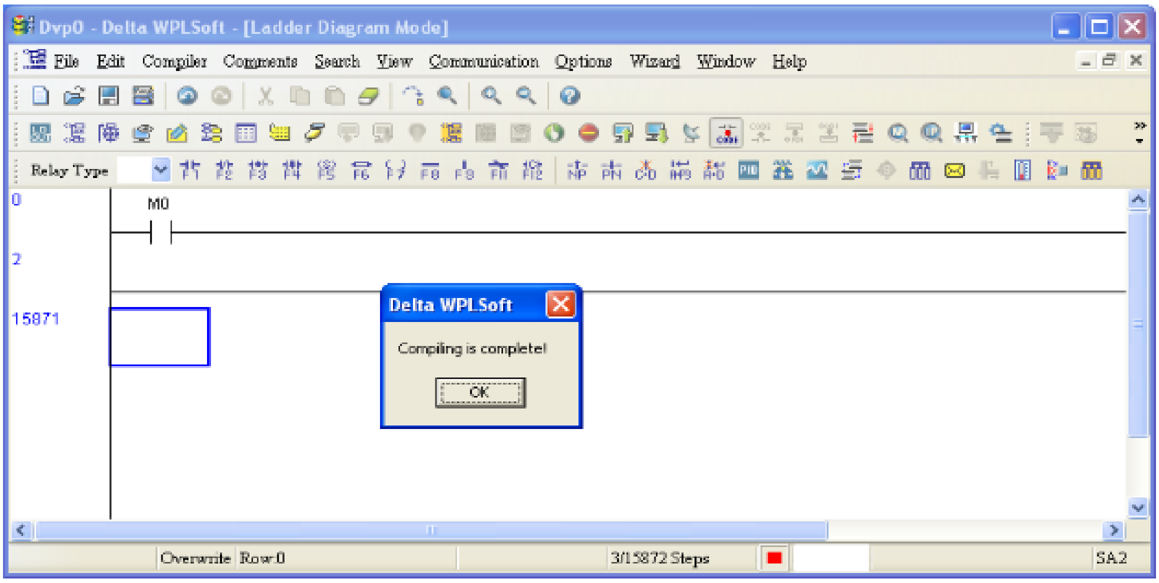
4. Click on the output coil icon  or press function key F7. After the name of the input device and the comment dialog box have appeared, the device name (such as "Y"), device number (such as "0"), and input comments (such as "output coil") can be selected; press the Confirm button when finished.



5. Click on application command icon  or press function key F6. Click on "All application commands" in the function classification field, and click on the End command in the application command pull-down menu, or use the keyboard to key in "End" in that field, and press the confirm button.



6. Click on the  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.

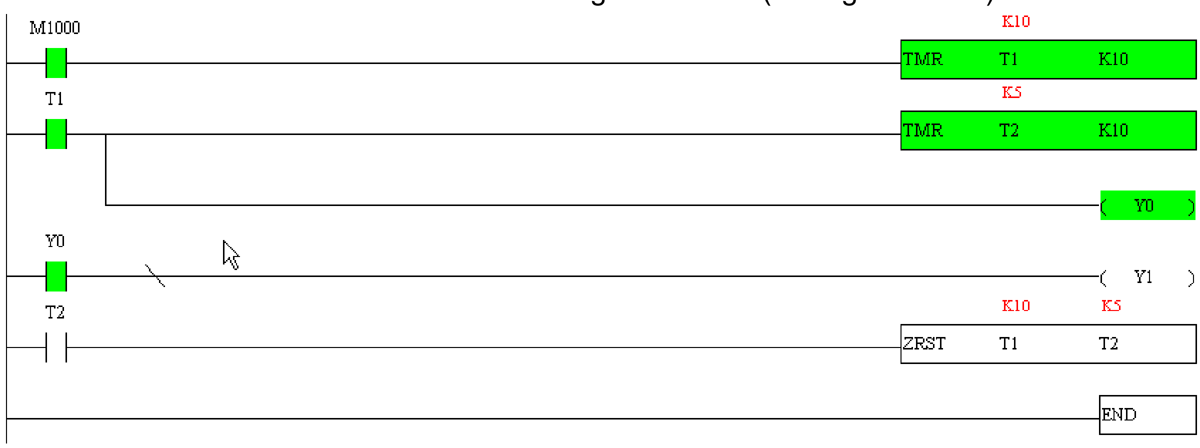


16-3-5 Program download

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

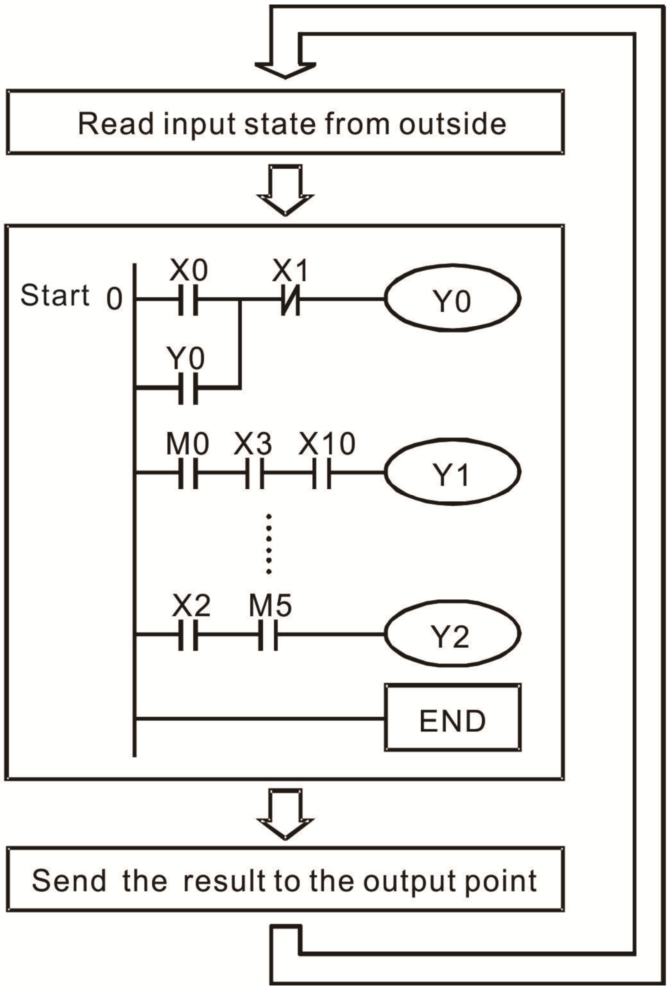
While confirming that the PLC is in the Run mode, after downloading a program, click on  in the communications menu and select start ladder diagram control (see figure below)



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 NO contact (Normal Open, or contact a) can be used to directly read the value of the corresponding bit, and an NC 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.

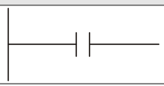
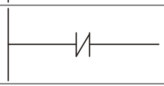
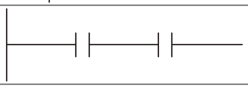
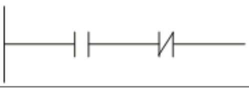
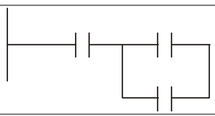
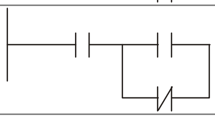
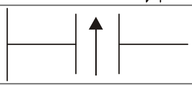
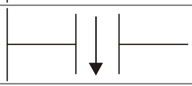
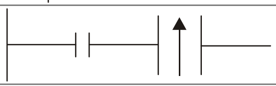
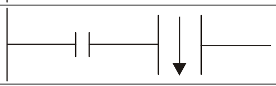
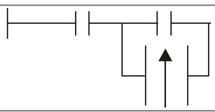
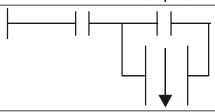
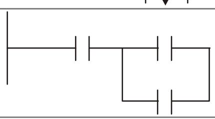
The various internal devices in a PLC all account for a certain quantity of storage units in the PLC's storage area. When these devices are used, the content of the corresponding storage area is red in the form of bits, bytes, or words.

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 the main computer and in expansion devices.
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 NO 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 the main computer and in expansion devices.
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.

Device type	Description of Function
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 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.

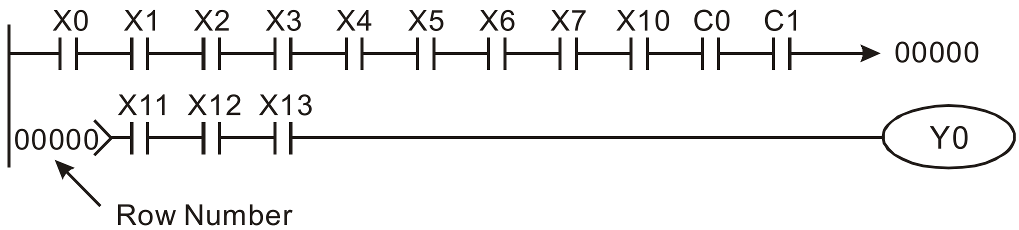
Ladder diagram images and their explanation

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

Ladder diagram structures	Explanation of commands	Command	Using Device
	Block parallel	ORB	N/A
	Multiple outputs	MPS MRD MPP	N/A
	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

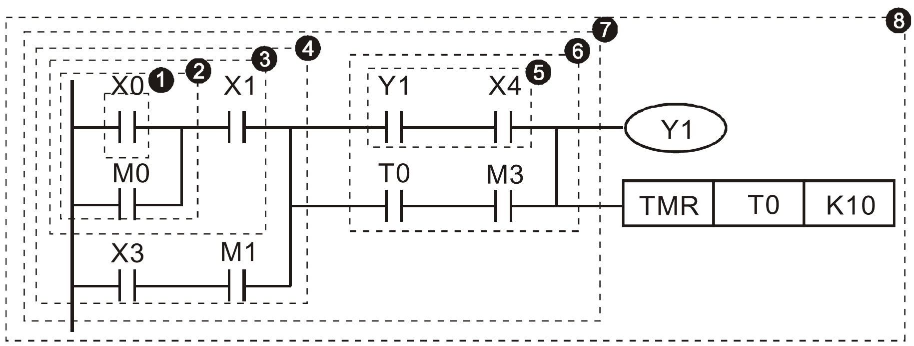
The program editing method begins from the left busbar and proceeds to the right busbar (the right busbar is omitted when editing using WPLSoft). Continue to the next row after completing each row; there is a maximum of 11 contacts on each row. If this is not sufficient, a continuous line will be will 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.

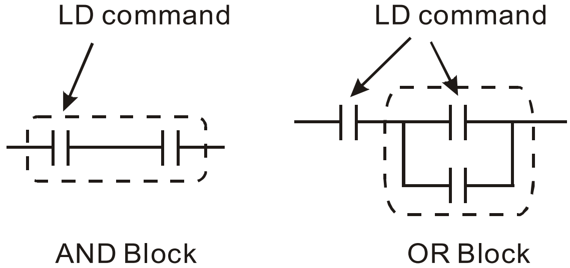
Explanation of command sequence

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

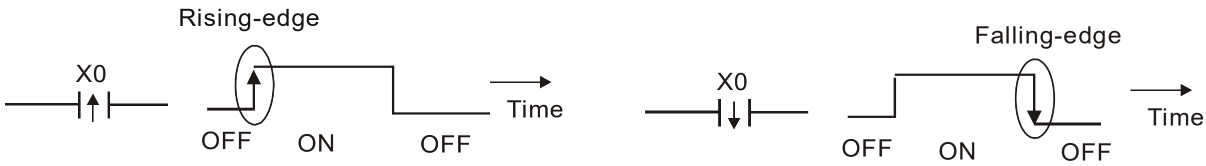


Explanation of basic structure of ladder diagrams

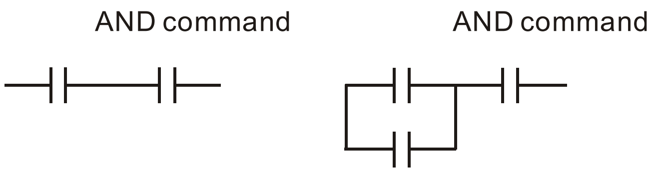
LD (LDI) command: An LD or LDI command is given at the start of a block.



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):

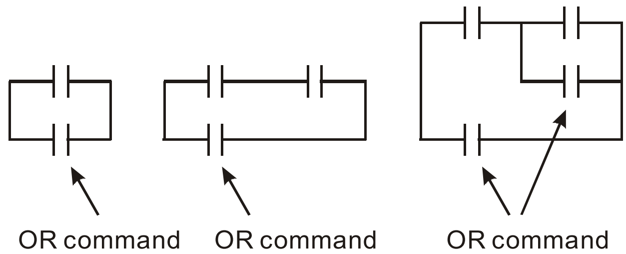


AND (ANI) command: A series configuration in which a single device is connected with one device or a block.



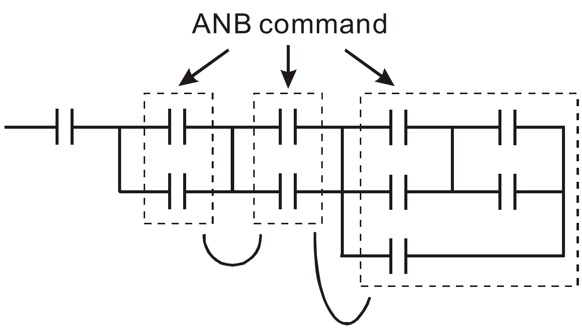
ANDP, ANDF also have structures like this, but their action occurs at the rising and falling edge.

OR (ORI) command: A single device is connected with one device or a block.

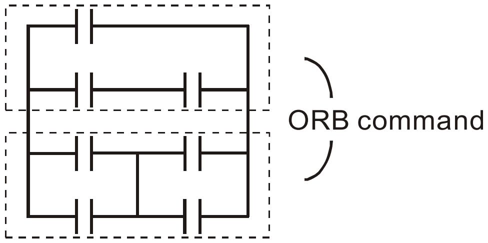


ORP, ORF also have identical structures, but their action occurs at the rising and falling edge.

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.



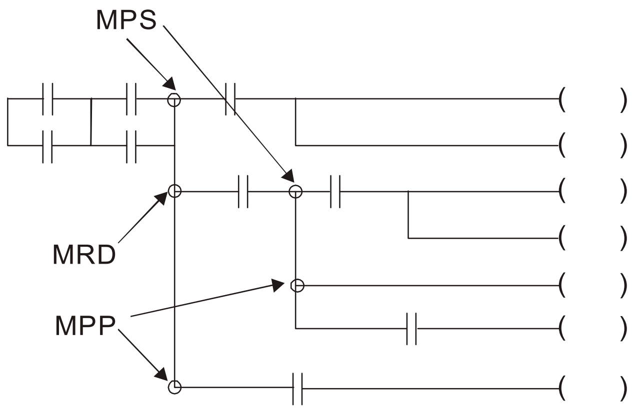
In the case of ANB and ORB operations, if a number of blocks are connected, they should be combined to form a block or network from the top down or from left to right.

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:



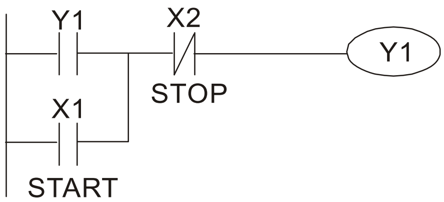
16-4-4 Commonly-used basic program design examples

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 must therefore be designed to maintain continued operation in these situations; this protective circuit may employ one of the following methods:

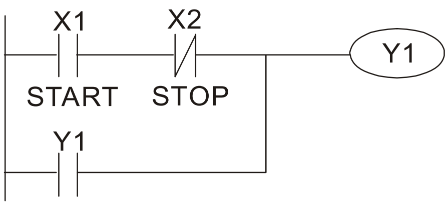
Example 1: Priority stop protective circuit

When the start NO contact X1=On, and the stop NC 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 NO contact X1=On, and the stop NC 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.

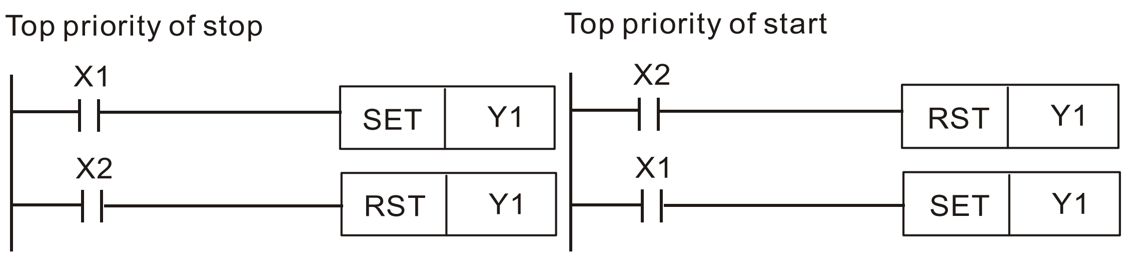


Example 3: Setting (SET) and reset (RST) command protective circuit

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.

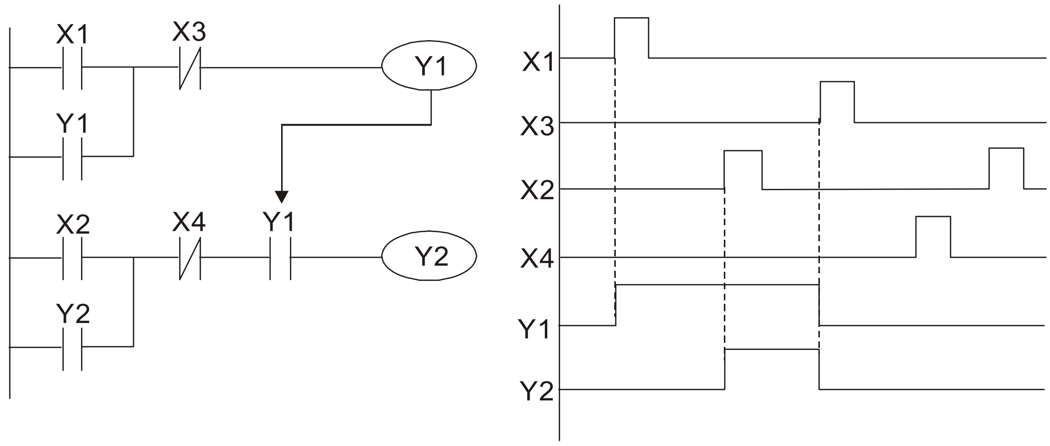
Priority start occurs when the SET command is placed after the RST command. When X1 and X2 are both actuated, Y1 will be electrified, and this is therefore priority start.



Commonly-used control circuits

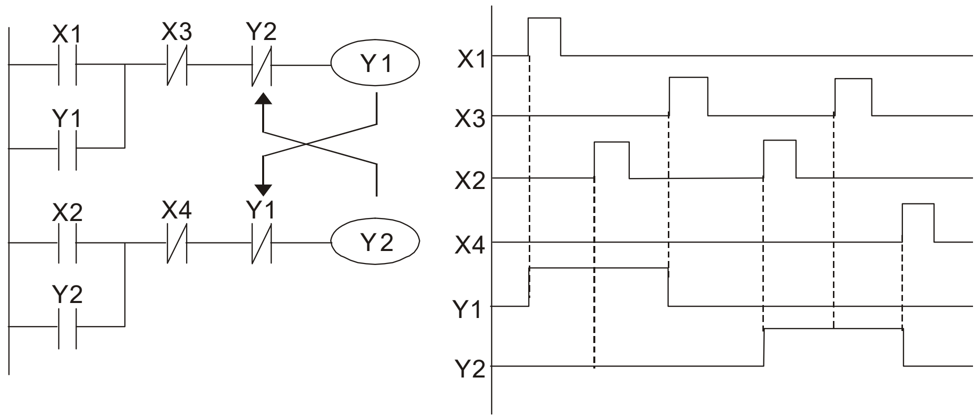
Example 4: Conditional control

X1, X3 are respectively start/stop Y1, and X2, X4 are respectively start/stop Y2; all have protective circuits. Because Y1's NO contact is in series 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.



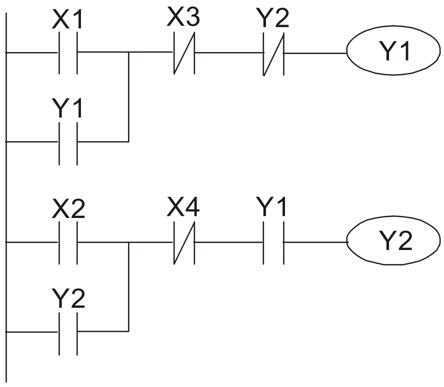
Example 5: Interlocking control

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

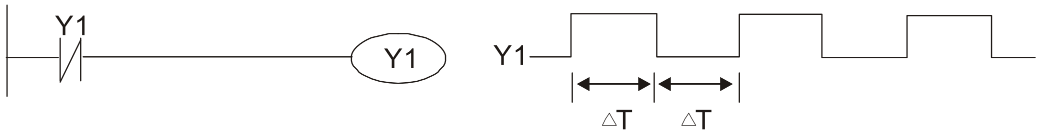
If the NC contact of Y2 in the interlocking control configuration of example 5 is put in series with the Y1 circuit, so that it is an AND condition for actuation of Y1 (see figure below), not only is Y1 a condition for the actuation of Y2 in this circuit, the actuation of Y2 will also stop the actuation of Y1. This configuration confirms the actuation order of Y1 and Y2.



Example 7: Oscillating circuit

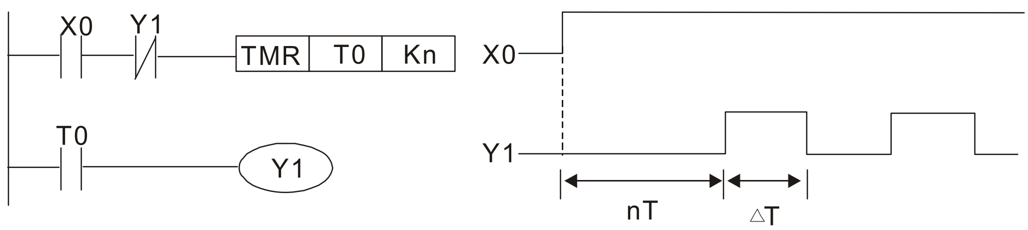
Oscillating circuit with a period of ΔT+ΔT

The figure below shows a very simple ladder diagram. When starting to scan the Y1 NC contact, because the Y1 coil has lost power, the Y1 NC contact will be closed. When the Y1 coil is then scanned, it will be electrified, and the output will be 1. When the Y1 NC contact is scanned in the scanning cycle, because Y1 coil is electrified, the Y1 NC 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).



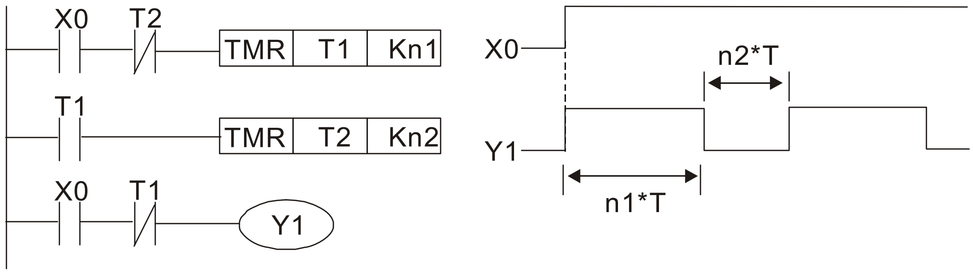
Oscillating circuit with a period of nT+ΔT

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.



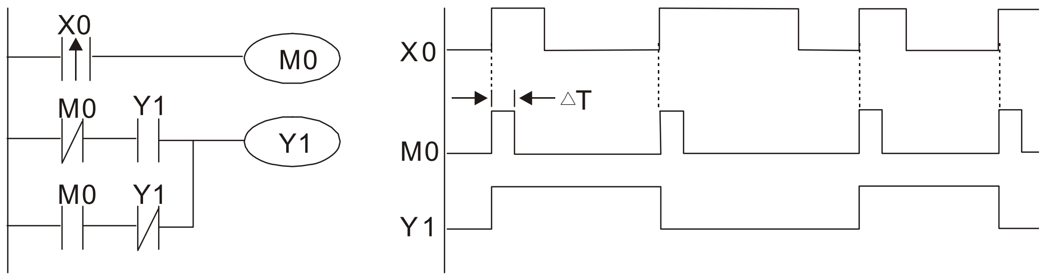
Example 8: Flashing circuit

The following figure shows an oscillating circuit of a type commonly used to cause an indicator light to flash or a 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.



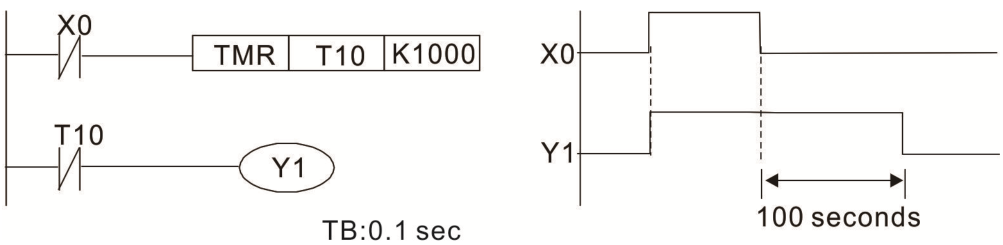
Example 9: Triggering circuit

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, and NC contact M0 and NC 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

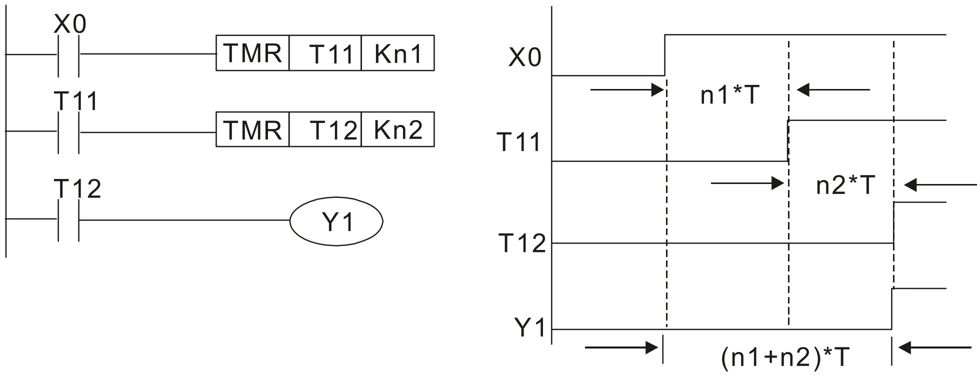
When input X0 is On, because the corresponding NC contact will be Off, the timer T10 will be in no power status, and output coil Y1 will be electrified. T10 will receive power and begin timing only after input X0 is Off, and output coil Y1 will be delayed for 100 sec. (K1000*0.1 sec. =100 sec.) before 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 us);	Applications command (1-several tens of us)
Programming language	Command + ladder diagram	
Program capacity	10000 steps	
Input/output terminal	Input (X): 10, output (Y): 4	This number of contacts constitutes CT2000 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; EMCD611A
Communication Expansion Module	Optional Accessories	EMC-COP01,(CANopen)

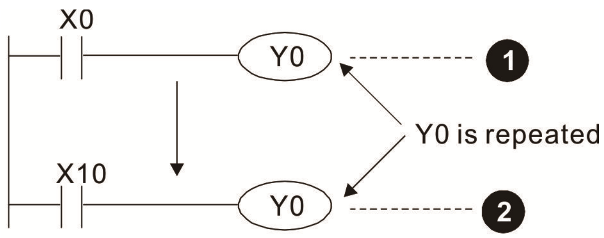
16-5-1 Introduction to device functions

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 is 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 is 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

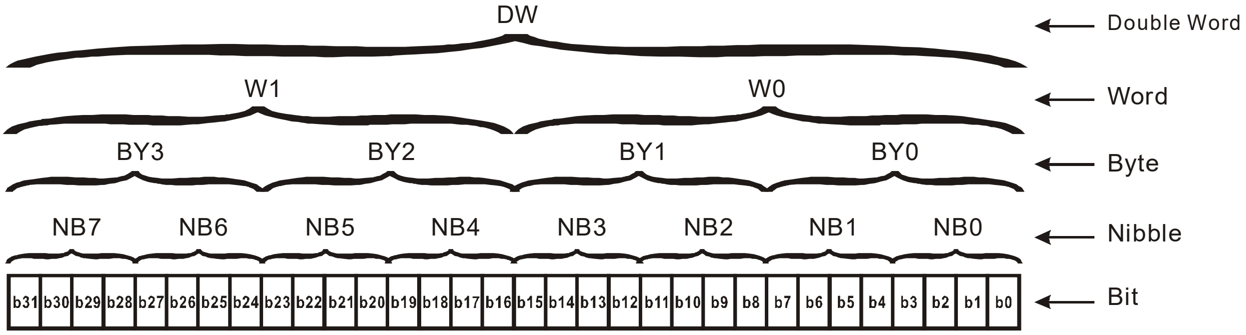
The PLC can use five types of numerical values to implement calculations based on its control tasks; the following is an explanation of the missions and functions of different numerical values.

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 a 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

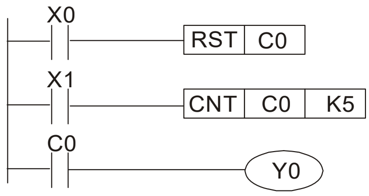
When a counter's counting pulse input signal goes Off→On, if the counter's current value is equal to the set value, the output coil will come On. The setting value will be a decimal K values, and the data register D can also serve as a setting value.

16-bit counter C0-C79:

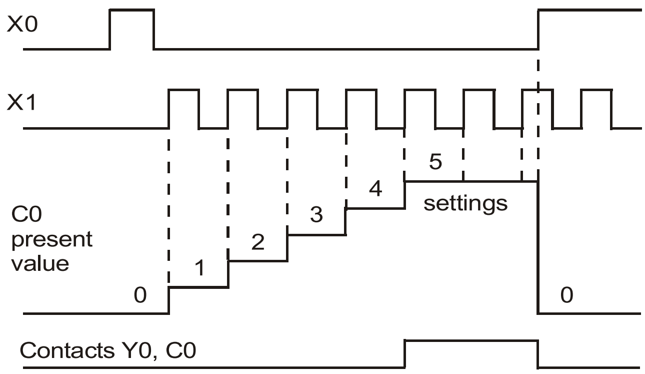
- ☑ 16-bit counter setting range: K0-K32,767. (when K0 and K1 are identical, the output contact will immediately be On during the first count.)
- ☑ The current counter value will be cleared from an ordinary counter when power is shut off to the PLC.
- ☑ If the MOV command or WPLSoft is used to transmit 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 或 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 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 ，5ms On/5ms Off	RO
M1012	100 ms clock pulse ，50ms On / 50ms 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

Special M	Description of Function	R/W *
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	Driver frequency = set frequency (ON) Driver frequency =0(OFF)	RW
M1026	Driver operating direction FWD(OFF)/REV(ON)	RW
M1027	Driver 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	MI8 count begins	RW
M1039	Reset MI8 count value	RW
M1040	Hardware power (Servo On)	RW
M1041	--	--
M1042	Quick stop	RW
M1043	--	--
M1044	Pause	RW
M1045 ~ M1047	--	--
M1048	Move to new position	RW
M1049	--	--
M1050	Absolute position/relative position (0: relative/1: absolute)	RW
M1051	--	--
M1052	Lock frequency (lock, frequency locked at the current operating frequency)	RW
M1053	--	--
M1054	Compulsory reset of absolute position	RW
M1055	Search Origin	RW
M1056	Hardware already has power (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	Torque attained	RO
M1064	Target reached	RO
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

Special M	Description of Function	R/W *
M1069	--	--
M1070	Return home complete	RO
M1071	Homing error	RO
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

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 (0.000~600.00Hz)	RO
D1021	Output current (####.#A)	RO
D1022	AI AO DI DO Expansion card number 0：No expansion card 4：AC input card (6 in) (EMC-D611A) 5：I/O Card (4 in 2 out) (EMC-D42A) 6：Relay card(6 out) (EMC-R6AA)	RO
D1023	Communication expansion card number 0：No expansion card 1：DeviceNet Slave 2：Profibus-DP Slave 3：CANopen Slave 4：Modbus-TCP Slave 5：EtherNet/IP Slave	RO
D1024 ~ D1026	--	--
D1027	PID calculation frequency command (frequency command after PID calculation)	RO
D1028	AVI value (0.00~100.00%)	RO
D1029	ACI value (0.0~100.00%)	RO
D1030	AUI value (-100.0~100.00%)	RO
D1031	--	--

Special D	Description of Function	R/W *
~ D1035		
D1036	Servo error bit	RO
D1037	Driver output frequency	RO
D1038	DC BUS voltage	RO
D1039	Output voltage	RO
D1040	Analog output value AFM1(-100.00~100.00%)	RW
D1041 ~ D1042	--	--
D1043	Can be user-defined (will be displayed on panel when parameter 00-04 is set as 28; display method is C xxx)	RW
D1044	--	-
D1045	Analog output value AFM2(-100.00~100.00%)	RW
D1046 ~ D1049	--	--
D1050	Actual Operation Mode 0：Speed 1：Position 2：Torque 3：Homing Origin	RO
D1051	Actual position (Low word)	RO
D1052	Actual position (High word)	RO
D1053	Actual torque	RO
D1054	MI8 current calculated count value (L Word)	RO
D1055	MI8 current calculated count value (H Word)	RO
D1056	Rotational speed corresponding to MI8	RO
D1057	MI8's rotational speed ratio	RW
D1058	MI8 refresh rate (ms) corresponding to rotational speed	RW
D1059	Number of nibbles of rotational speed corresponding to MI8 (0-3)	RW
D1060	Operation Mode setting 0：Speed 1：Position 2：Torque 3：Homing Origin	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	Target L	RO
D1104	Target H	RO
D1105	Target torque	RO
D1106	--	--
D1107	π(Pi) Low word	RO
D1108	π(Pi) High word	RO

Special D	Description of Function	R/W *
D1109	Random number	RO
D1110	Internal node communications number (set number of slave stations to be controlled)	RW
D1111	Encoder Pulses L	RO
D1112	Encoder Pulses H	RO
D1113	--	RO
D1114	--	--
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	--	--
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

Special D	Description of Function	R/W *
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
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	--	--

The following is CANopen Master's special D (can be written in only with PLC in Stop state)

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

Special D	Description of Function	PDO Map	Power off Memory	Default:	R/W
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 (bit 0-bit 7 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	-	-		-
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 CT2000 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 and

Slave station no. 1	D2000	Node ID
	D2001	Slave station no. 1 torque restrictions
	~	~
	D2099	Address 4(H) corresponding to receiving channel 4
Slave station no. 2	D2100	Node ID
	D2101	Slave station no. 2 torque restrictions
	~	~
	D2199	Address 4(H) corresponding to receiving channel 4
Slave station no. 3	D2200	Node ID
	D2201	Slave station no. 3 torque restrictions
	~	~
	D2299	Address 4(H) corresponding to receiving channel 4
	⇩	
Slave station no. 8	D2700	Node ID
	D2701	Slave station no. 8 torque restrictions
	~	~
	D2799	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

Torque control

Slave station number n=0-7

Special D	Description of Function	Default:	CAN Index	PDO Default:				R/W
				1	2	3	4	
D2017+100*n	Target torque of slave station number n	0	6071H-0010H				●	RW
D2018+100*n	Actual torque of slave station number n	0	6077H-0010H				▲	R
D2019+100*n	Actual current of slave station number n	0	6078H-0010H					R

Position control

Slave station number n=0-7

Special D	Description of Function	Default:	CAN Index	PDO Default:				R/W
				1	2	3	4	
D2020+100*n	Target of slave station number n (L)	0	607AH-0020H			●		RW
D2021+100*n	Target of slave station number n (H)	0						RW
D2022+100*n	Actual position of slave station number n (L)	0	6064H-0020H			▲		R
D2023+100*n	Actual position of slave station number n (H)	0						R
D2024+100*n	Speed chart of slave station number n (L)	10000	6081H-0020H					RW
D2025+100*n	Speed chart of slave station number n (H)	0						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	1000~1099	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 CT2000 can match PLC and driver parameters; this method employs different addresses, drivers (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

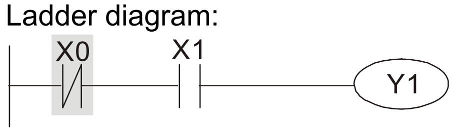
Command	Function					
LDI	Load contact b					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

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

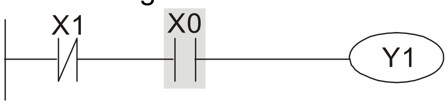
Command	Function					
AND	Connect contact a in series					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

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

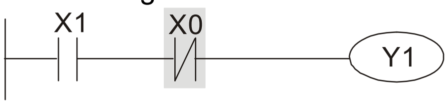
Command	Function					
ANI	Connect contact b in series					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

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

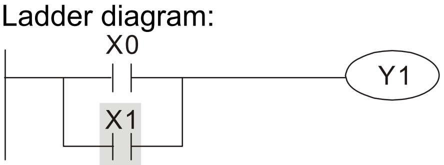
Command	Function					
OR	Connect contact a in parallel					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

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

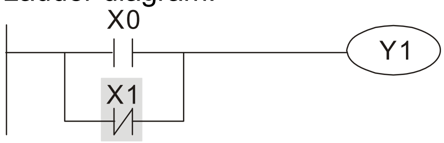
Command	Function					
ORI	Connect contact b in parallel					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	✓	✓	✓	✓	✓	—

Explanation

The ORI command is used to establish a parallel connection to contact 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
ORI	**X1**	Create series connection to contact b of X1
OUT	Y1	Drive Y1 coil

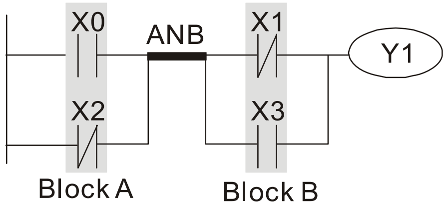
Command	Function
ANB	Series circuit block
Operand	N/A

Explanation

ANB performs an "AND" operation on the previously 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

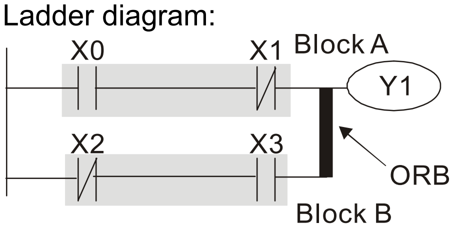
Command	Function
ORB	Parallel circuit block
Operand	N/A

Explanation

ORB performs an "OR" operation on the previously 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)

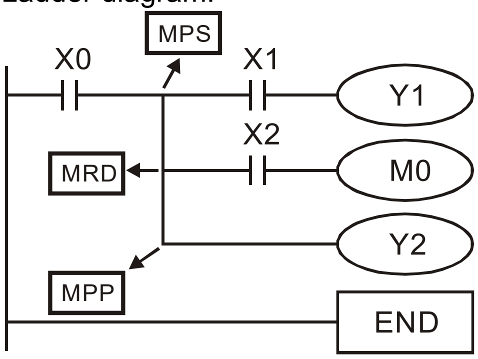
Command	Function
MRD	Read stack (pointer does not change)
Operand	N/A

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:



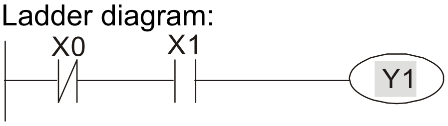
Command code:		Description:
LD	X0	Load Contact a of X0
MPS		Save to stack
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil
MRD		Read stack (pointer does not change)
AND	X2	Create series connection to contact a of X2
OUT	M0	Drive M0 coil
MPP		Read stack
OUT	Y2	Drive Y2 coil
END		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 (NO)	Contact b (NC)
FALSE	Off	Not conducting	Conducting
TRUE	On	Conducting	Not conducting

Example: Ladder diagram:

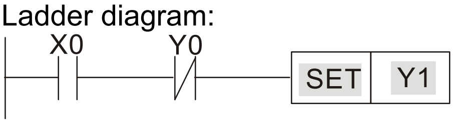


Command code:		Description:
LD	X0	Load Contact b of X0
AND	X1	Establish parallel connection to contact a of X1
OUT	**Y1**	Drive Y1 coil

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
AN	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

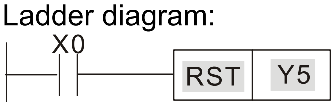
When the RST command is driven, the action of the designated element will be as follows:

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 ill 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

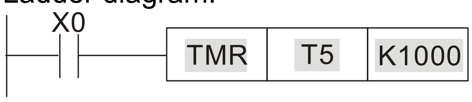
When the TMR command is executed, the designated timer coil will be electrified, and the timer will begin timing. The contact's action will be as follows when the timing value reaches the designated set value (timing value >= set value):

NO (Normally Open) contact	Closed
NC (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

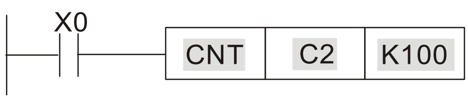
When the CNT command is executed from Off→On, this indicates that the designated counter coil goes from no power → electrified, and 1 will be added to the counter's count value; when the count reaches the designated value (count value = set value), the contact will have the following action:

NO (Normally Open) contact	Closed
NC (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:

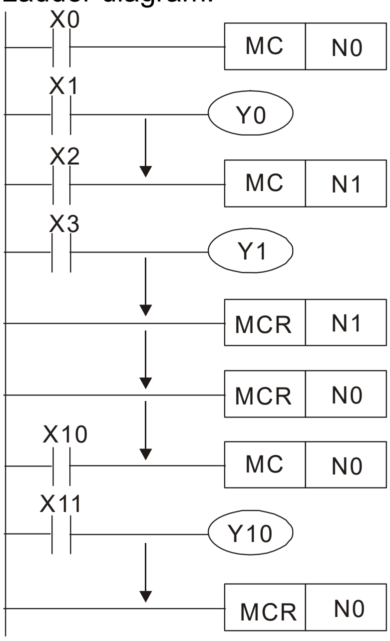
Determination of commands	Description
Ordinary timer	The timing value will revert to 0, the coil will lose power, and the contact will not operate
Counter	The coil will lose power, and the count value and contact will stay in their current state
Coil driven by OUT command	None receive power
Elements 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:

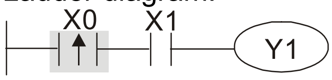


Command code:		Description:
LD	X0	Load Contact a of X0
MC	**N0**	Connection of N0 common series contact
LD	X1	Load Contact a of X1
OUT	Y0	Drive Y0 coil
:		
LD	X2	Load Contact a of X2
MC	**N1**	Connection of N1 common series contact
LD	X3	Load Contact a of X3
OUT	Y1	Drive Y1 coil
:		
MCR	**N1**	Release 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:



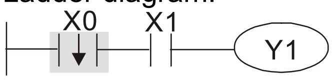
Command code:		Description:
LDP	**X0**	Start of X0 forward edge detection action
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

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:

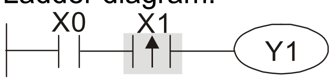


Command code:		Description:
LDF	**X0**	Start of X0 reverse edge detection action
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

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:

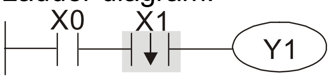


Command code:		Description:
LD	X0	Load Contact a of X0
ANDP	**X1**	X1 Forward edge detection series connection
OUT	Y1	Drive Y1 coil

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:

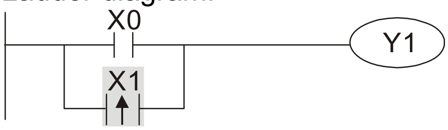


Command code:		Description:
LD	X0	Load Contact a of X0
ANDF	**X1**	X1 Reverse edge detection series connection
OUT	Y1	Drive Y1 coil

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:

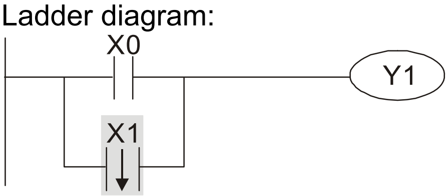


Command code:		Description:
LD	X0	Load Contact a of X0
ORP	**X1**	X1 Forward edge detection parallel connection
OUT	Y1	Drive Y1 coil

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:



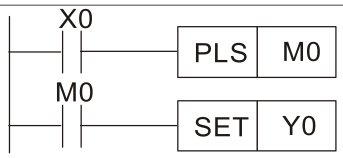
Command code:		Description:
LD	X0	Load Contact a of X0
ORF	**X1**	X1 Reverse edge detection parallel connection
OUT	Y1	Drive Y1 coil

Command	Function					
PLS	Upper differential output					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	—	✓	✓	—	—	—

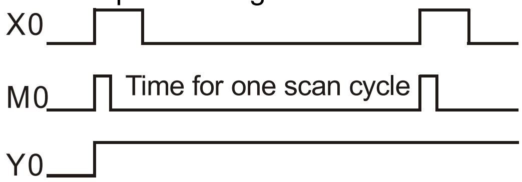
Explanation: Upper differential output commands. When X0=Off→On (positive edge-triggered), the PLS command will be executed, and M0 will send one pulse, with a pulse length consisting of one scanning period.

Example: Ladder diagram:

Command code:		Description:
LD	X0	Load Contact a of X0
PLS	**M0**	M0 Upper differential output



Time sequence diagram:



LD	M0	Load Contact a of M0
SET	Y0	Y0 Action continues (ON)

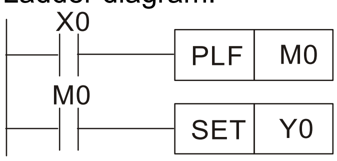
Command	Function					
PLF	Lower differential output					
Operand	X0~X17	Y0~Y17	M0~M799	T0~159	C0~C79	D0~D399
	—	✓	✓	—	—	—

Explanation

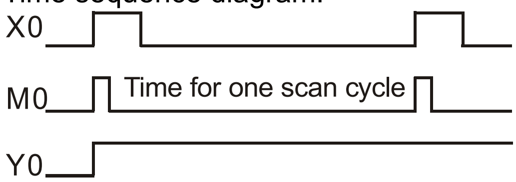
Lower differential output command. When X0= On→Off (negative edge-triggered), the PLF command will be executed, and M0 will send one pulse, with pulse length consisting of one scanning period.

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.

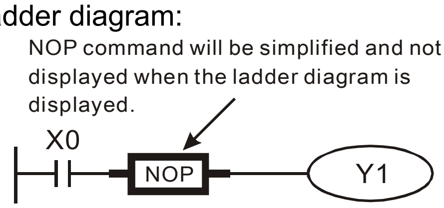
Command	Function
NOP	No action
Operand	N/A

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 instead of a command that is deleted without changing the program length.

Example

Ladder diagram:

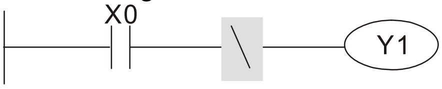


Command code:		Description:
LD	X0	Load Contact b of X0
NOP		No action
OUT	Y1	Drive Y1 coil

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:

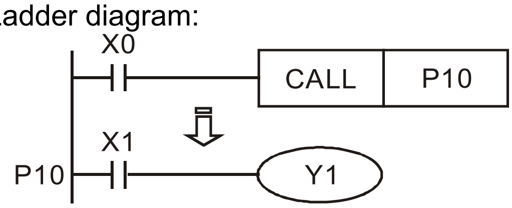


Command code:		Description:
LD	X0	Load Contact a of X0
INV		Inverse of operation results
OUT	Y1	Drive Y1 coil

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		P command	Function	STEPS	
		16 bit	32 bit			16bit	32bit
Circuit control	01	CALL	-	✓	Call subprogram	3	-
	2	SRET	-	-	Conclusion of subprogram	1	-
	06	FEND	-	-	Conclusion a 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
	15	BMOV	–	✓	Send all	7	–
Four logical operations	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	-
	49	–	DFLT	✓	BIN whole number → binary floating point number transformation	-	9
communication	150	MODRW	–	✓	MODBUS read/write	7	–
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 → Diameter	–	9
	117	–	DDEG	✓	Diameter → 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	–	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
	133	–	DASIN	✓	Binary floating point number ASIN operation	–	9
	134	–	DACOS	✓	Binary floating point number ACOS operation	–	9

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16bit	32bit
	135	–	DATAN	✓	Binary floating point number ATAN operation	–	9
Floating point operation	136	–	DSINH	✓	Binary floating point number SINH operation	–	9
	137	–	DCOSH	✓	Binary floating point number COSH operation	–	9
	138	–	DTANH	✓	Binary floating point number TANH operation	–	9
Calendar	160	TCMP	–	✓	Compare calendar data	11	–
	161	TZCP	–	✓	Compare calendar data range	9	–
	162	TADD	–	✓	Calendar data addition	7	–
	163	TSUB	–	✓	Calendar data subtraction	7	–
	166	TRD	–	✓	Calendar data read	3	–
GRAY code	170	GRY	DGRY	✓	BIN→GRY code transformation	5	9
	171	GBIN	DGBIN	✓	GRY code →BIN transformation	5	9
Contact form logical operation	215	LD&	DLD&	-	Contact form logical operation LD#	5	9
	216	LD|	DLD|	-	Contact form logical operation LD#	5	9
	217	LD^	DLD^	-	Contact form logical operation LD#	5	9
	218	AND&	DAND&	-	Contact form logical operation AND#	5	9
	219	ANDI	DANDI	-	Contact form logical operation AND#	5	9
	220	AND^	DAND^	-	Contact form logical operation AND#	5	9
	221	OR&	DOR&	-	Contact form logical operation OR#	5	9
	222	OR|	DOR|	-	Contact form logical operation OR#	5	9
	223	OR^	DOR^	-	Contact form logical operation OR#	5	9
Contact form compare command	224	LD＝	DLD＝	-	Contact form compare LD*	5	9
	225	LD＞	DLD＞	-	Contact form compare LD*	5	9
	226	LD＜	DLD＜	-	Contact form compare LD*	5	9
	228	LD＜＞	DLD＜＞	-	Contact form compare LD*	5	9
	229	LD＜＝	DLD＜＝	-	Contact form compare LD*	5	9
	230	LD＞＝	DLD＞＝	-	Contact form compare LD*	5	9
	232	AND＝	DAND＝	-	Contact form compare AND*	5	9
	233	AND＞	DAND＞	-	Contact form compare AND*	5	9
	234	AND＜	DAND＜	-	Contact form compare AND*	5	9
	236	AND＜＞	DAND＜＞	-	Contact form compare AND*	5	9
	237	AND＜＝	DAND＜＝	-	Contact form compare AND*	5	9
	238	AND＞＝	DAND＞＝	-	Contact form compare AND*	5	9
	240	OR＝	DOR＝	-	Contact form compare OR*	5	9
	241	OR＞	DOR＞	-	Contact form compare OR*	5	9
	242	OR＜	DOR＜	-	Contact form compare OR*	5	9
	244	OR＜＞	DOR＜＞	-	Contact form compare OR*	5	9
	245	OR＜＝	DOR＜＝	-	Contact form compare OR*	5	9
	246	OR＞＝	DOR＞＝	-	Contact form compare OR*	5	9

Classification	API	Command code 16 bit	Command code 32 bit	P command	Function	STEPS 16bit	STEPS 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	–
	262	–	DPOS	✓	Set target	-	5
	263	TORQ	–	✓	Set target torque	5	-
	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

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
CT2000 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.

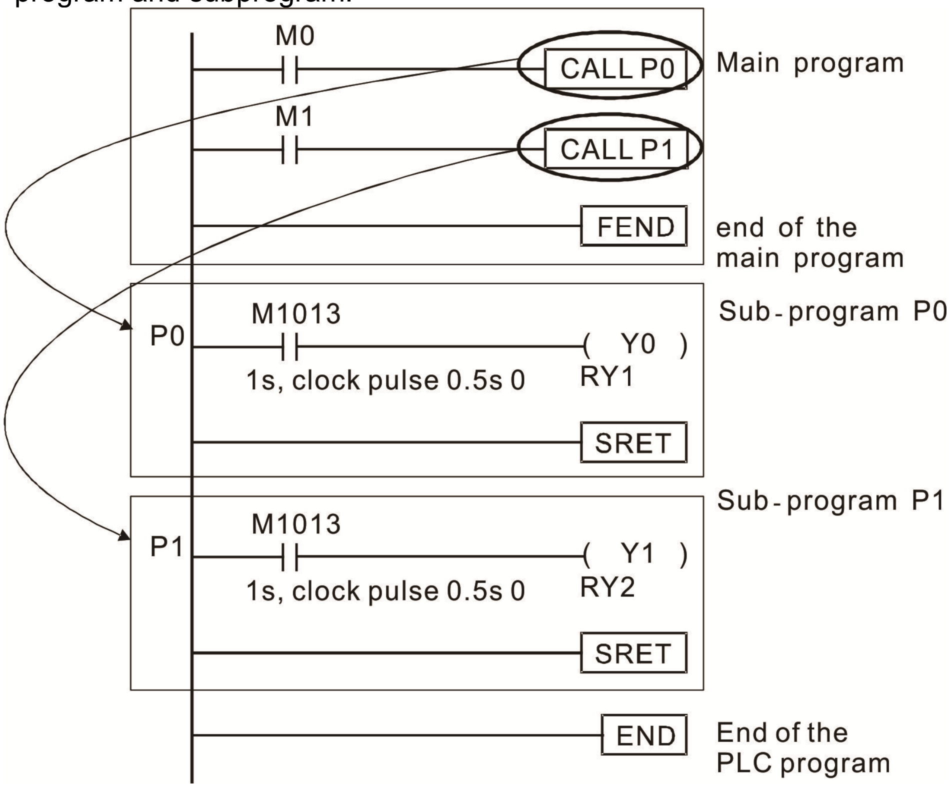
API		FEND		–	Conclusion a main program
06					

	Bit device			Word device								16-bit command (1 STEP)			
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	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	D	CMP	P	S1 S2 D	Compares set output
10					

	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

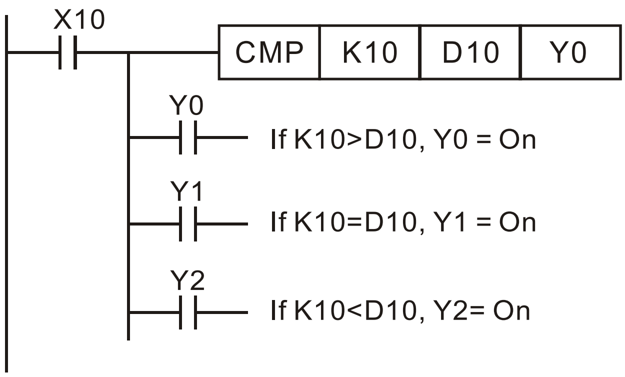
Flag signal: none

Explanation

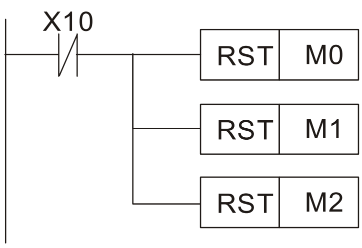
- S1: Compare value 1. S2: Compare value 2. D: Results of comparison.
- Compares the size of the content of operand S1 and S2; the results of comparison are expressed in D.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

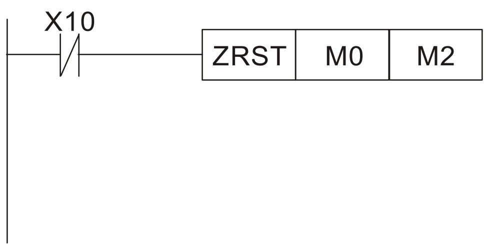
Example

- 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	D	ZCP	P	S1 S2 S D	Range comparison
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

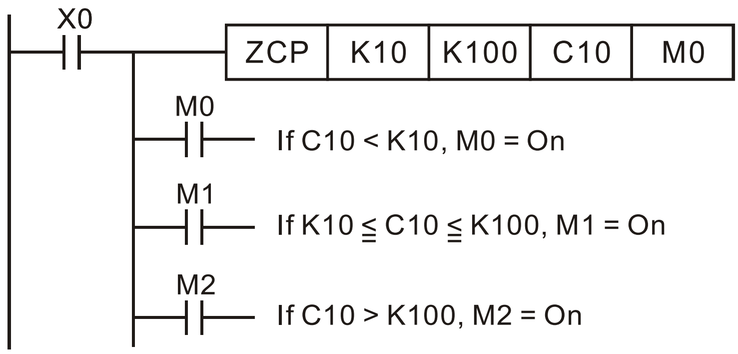
Flag signal: none

Explanation

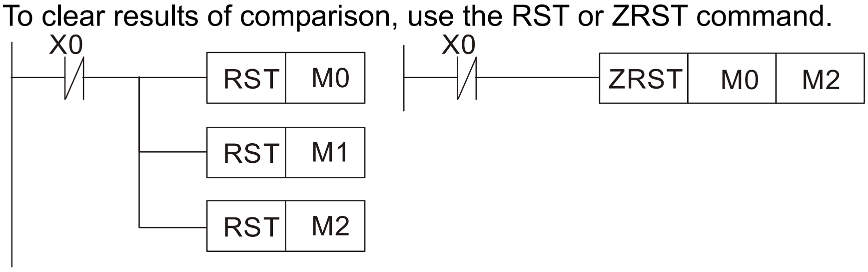
- S1: Lower limit of range comparison. S2: Upper limit of range comparison. S : Comparative value. D: Results of comparison.
- When the comparative value S is compared with the lower limit S1 and upper limit S2, the results of comparison are expressed in D.
- When lower limit S1 > upper limit S2, the 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		MOV			
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

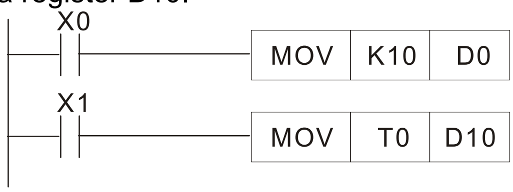
Flag signal:

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

1. When X0=Off, the content of D10 will not change; if X0=On, the value K10 will be sent to data register D10.
2. 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 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

—	—	—	—

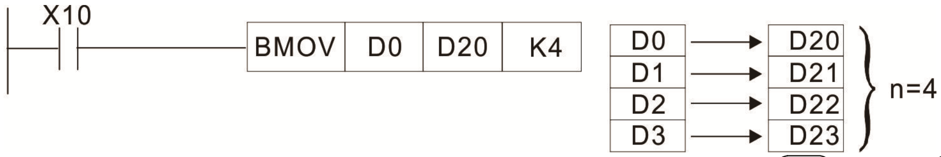
Flag signal: none

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 by n exceeds the range used by that device, only points within the valid range will be sent.

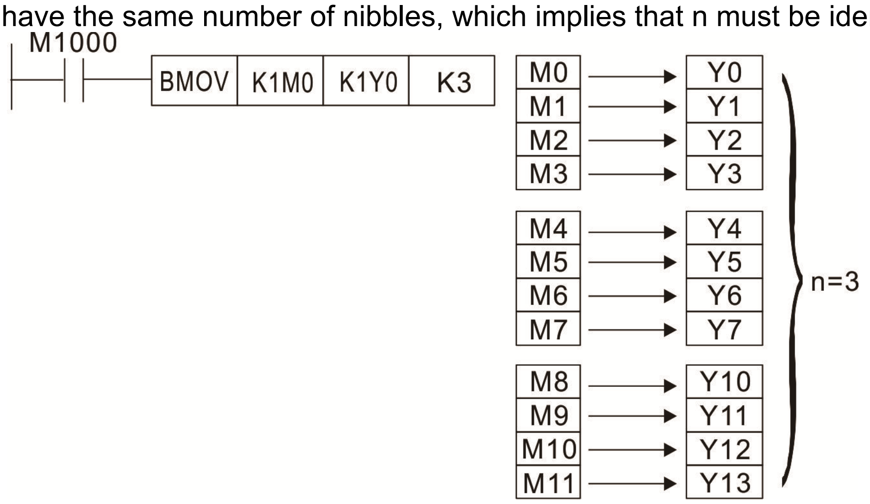
Example 1

3. When X10=On, the content of registers D0-D3 will be sent to the four registers D20 to D23.



Example 2

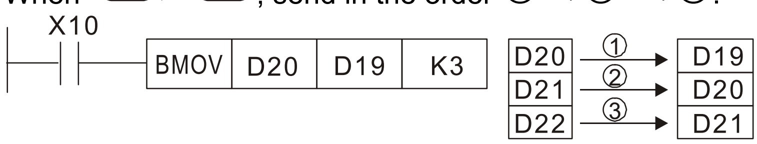
4. If the designated bit devices KnX, KnY, and KnM are sent, (S) and (D) must have the same number of nibbles, which implies that n must be identical.



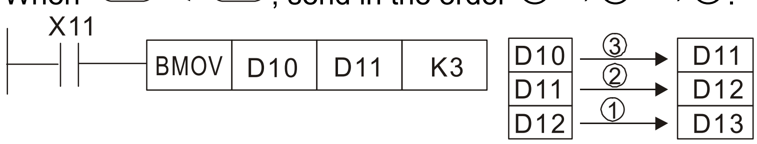
Example 3

5. 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					
20	D	ADD	P	S1 S2 D	BIN addition

	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

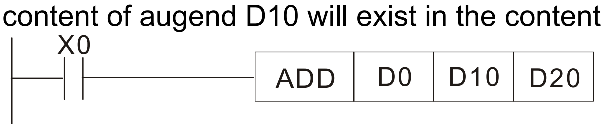
Explanation

- 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.

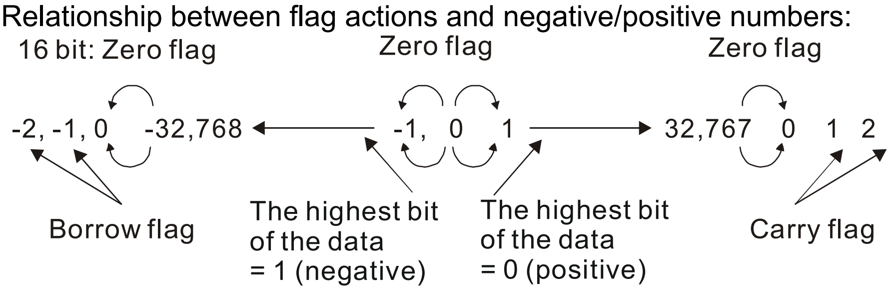
Example

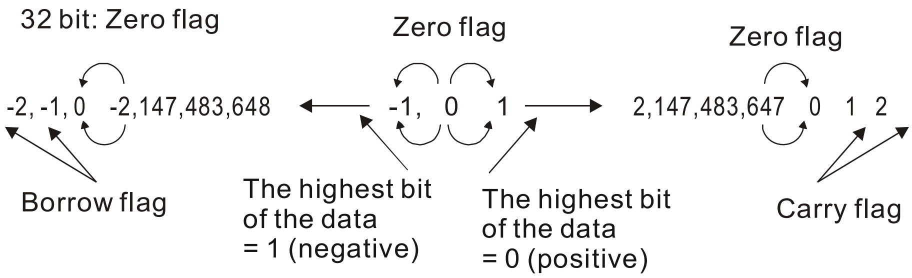
6. 16-bit BIN addition: When X0=On, the result of the content of addend D0 plus the content of augend D10 will exist in the content of D20.



Remark

7. Relationship between flag actions and negative/positive numbers:





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

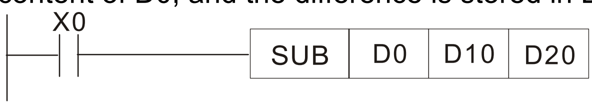
Explanation

- 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

8. 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

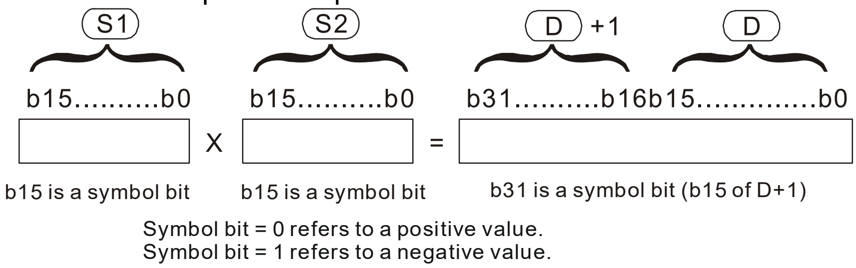
32-bit command (13 STEP)
DMUL Continuous execution type; DMULP Pulse execution type

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).

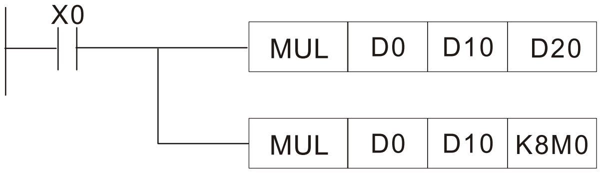
16-bit BIN multiplication operation:



When (D) is a bit device, K1-K4 can be designated as a hexadecimal number, which will occupy 2 consecutive units.

Example

9. 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)

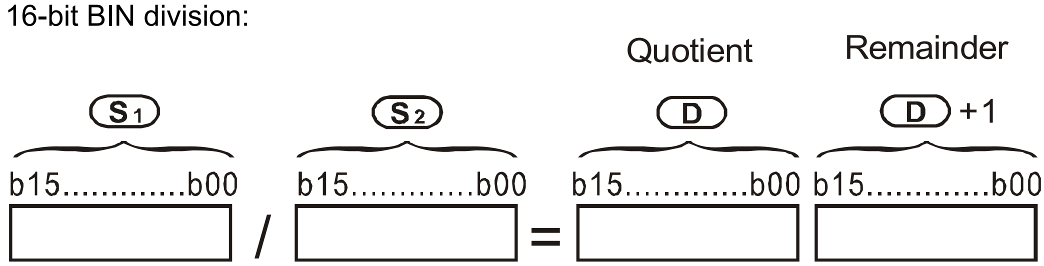
DDIV	Continuous execution type	DDIVP	Pulse execution type

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.

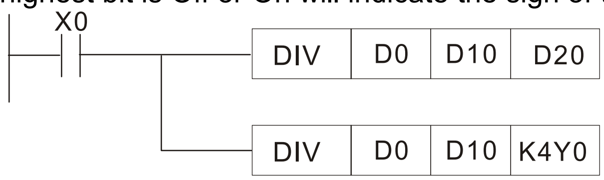
16-bit BIN division:



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

10. 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

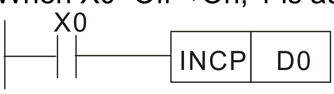
Flag signal: none

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

11. 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

12. 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

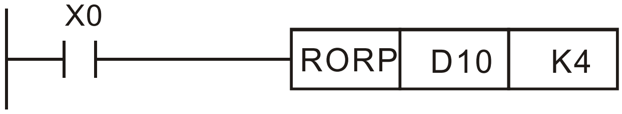
Flag signal: M1022 Carry flag

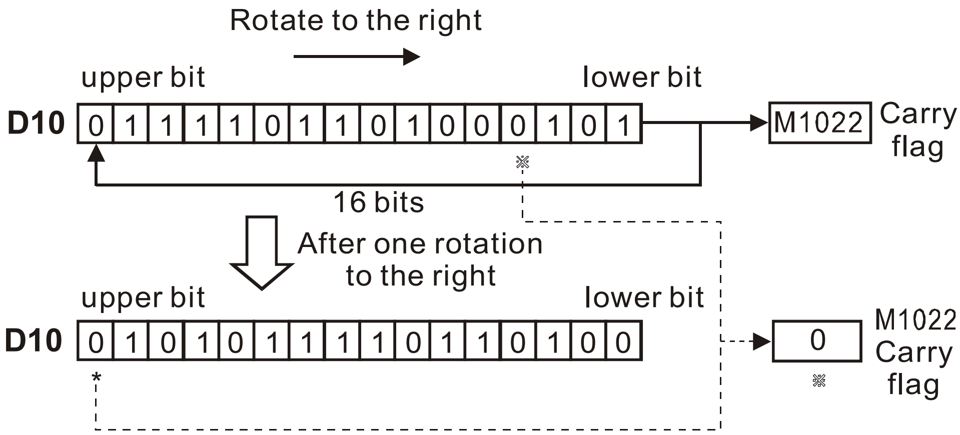
Explanation

- (D): Device to be rotated. (n): Number of bits for one rotation.
- Rotates the device designated by (D) to the right (n) bits.
- This command is ordinarily used as a pulse execution type command (RORP).

Example

13. 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				
31	D	ROL	P	D n — Left 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=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

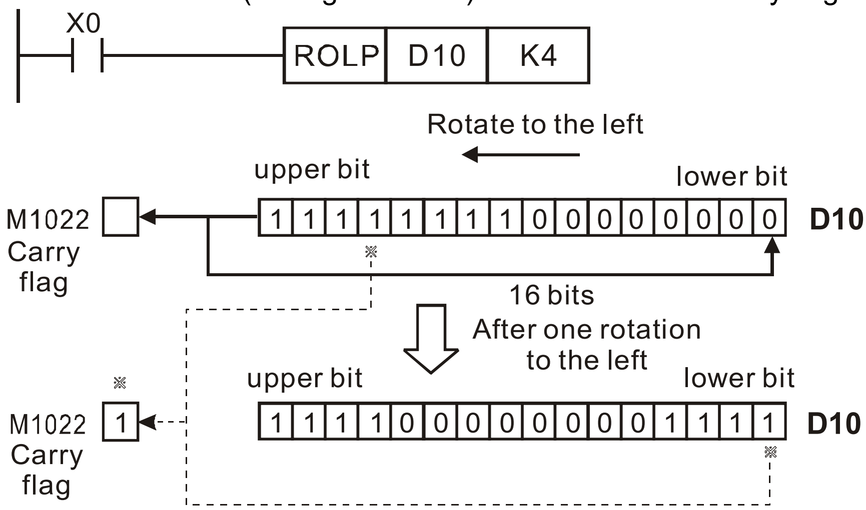
Flag signal: M1022 Carry flag

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

14. 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

–	–	–	–

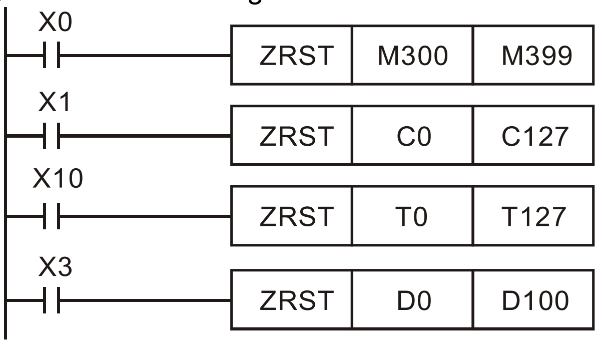
Flag signal: none

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.

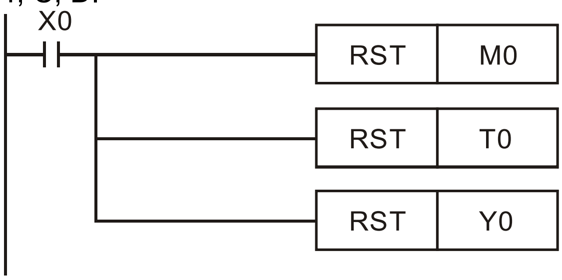
Example

15. When X0 is On, auxiliary relays M300 - M399 will be cleared and changed to Off.
16. When X1 is On, 16-bit counters C0 - C127 will all be cleared. (Writes 0, and clears and changes contact and coil to Off).
17. When X10 is On, timer T0 - T127 will all be cleared. (Writes 0, and clears and changes contact and coil to Off).
18. When X3 is On, the data in data registers D0 - D100 will be cleared and set as 0.



Remark

19. Devices can independently use the clear command (RST), such as bit device Y, M and word device T, C, D.



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

–	–	–	–

32-bit command (9steps)

DFLT	Continuous execution type	DFLTP	Pulse execution type

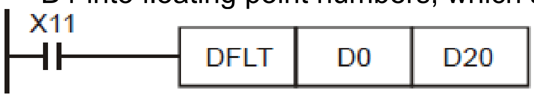
Flag signal: none

Explanation

- **S**: Transformation source device. **D**: Device storing transformation results.
- Transforms BIN whole number into a binary decimal value.

Example

20. 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 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	MODRWP	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 P9-31 = -12) before using this command, and the corresponding communications speed and format must also be set (set P09-01 and P09-04). 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 CT2000 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

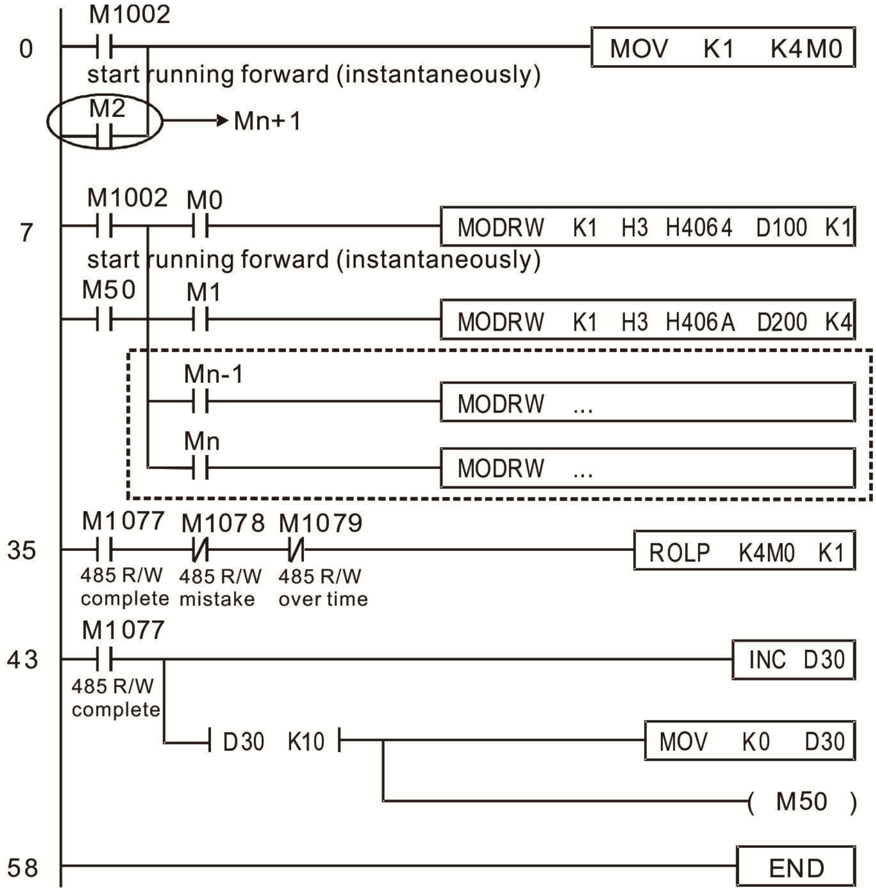
Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length:
1	Reads 4 sets of data comprising the converter slave device parameters P01-00 to P01-03, and saves the read data in D0 to D3	K10	H3	H100	D0	K4
2	Reads 3 sets of data comprising the converter slave device 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 parameters P05-00 to P05-03, 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					
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

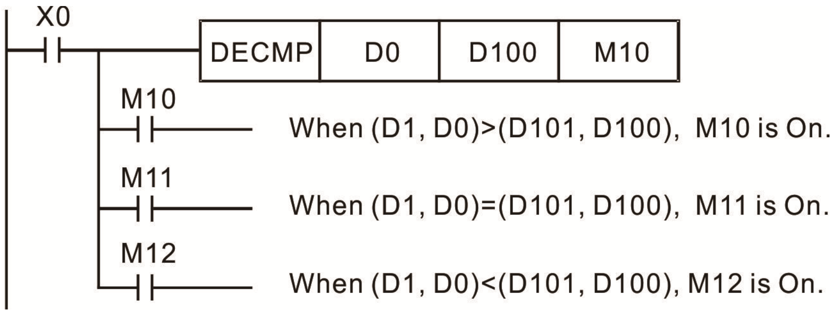
Flag signal: none

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	DEZCPP	Pulse execution type

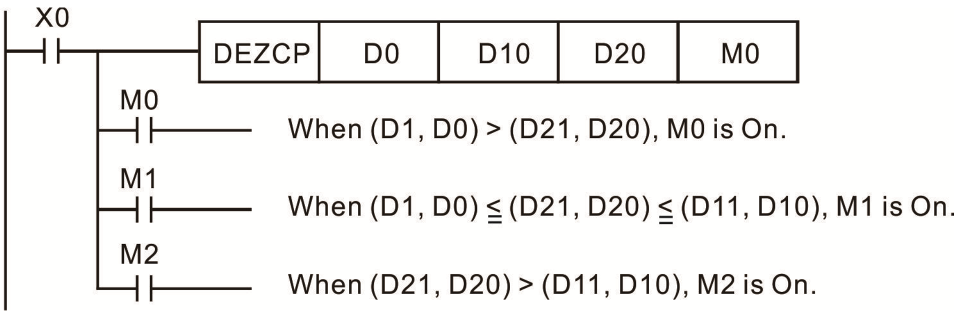
Flag signal: none

Explanation

- **S₁**: Lower limit of binary floating point number in range comparison. **S₂**: 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 → Diameter

	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	脈波執行型

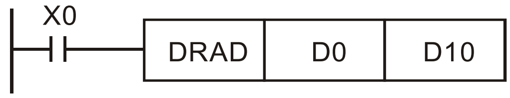
Flag signal: none

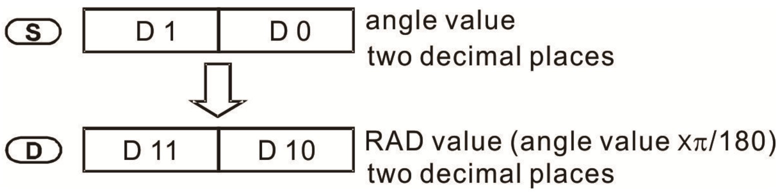
Explanation

- **S**: data source (angle). **D**: result of transformation (diameter).
- Uses the following formula to convert angles to radians.
- Diameter ＝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					
117	D	DEG	P	S D	Diameter → 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

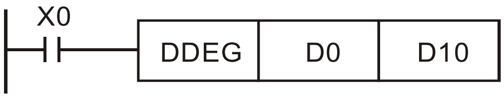
Flag signal: none

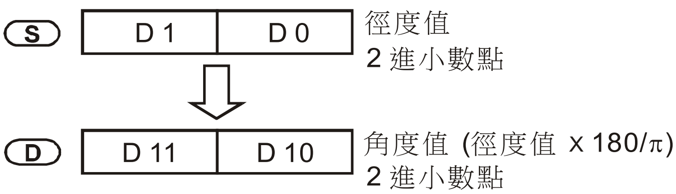
Explanation

- **S**: data source (diameter). **D**: results of transformation (angle).
- Uses the following formula to convert radians to an angle.
- Angle ＝Diameter × (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

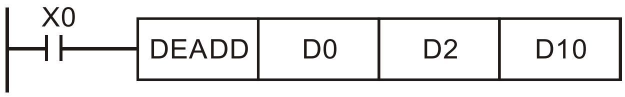
Flag signal: none

Explanation

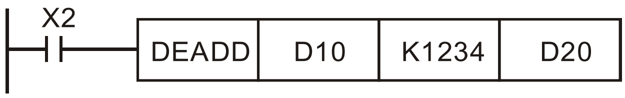
- **S_1**: addend. **S_2**: augend. **D**: sum.
- When the content of the register designated by **S_2** is added to the content of the register designated by **S_1**, and the result is stored in the register designated by **D**. Addition is performed entirely using binary floating-point numbers.
- **If 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

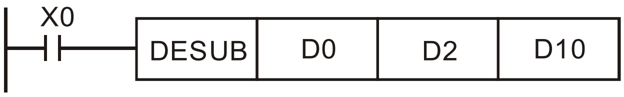
Flag signal: none

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

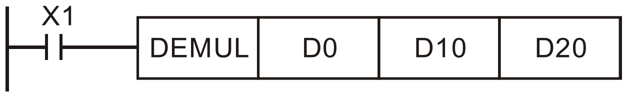
Flag signal: none

Explanation

- S_1: multiplicand. S_2: 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

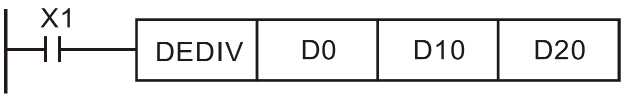
Flag signal: none

Explanation

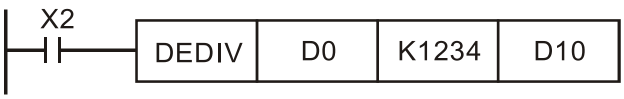
- **S**$_1$: dividend. **S**$_2$: divisor. **D**: quotient and remainder.
- When the content of the register designated by **S**$_1$ is divided by the content of the register designated by **S**$_2$, the quotient will be stored in the register designated by **D**; division is performed entirely using 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

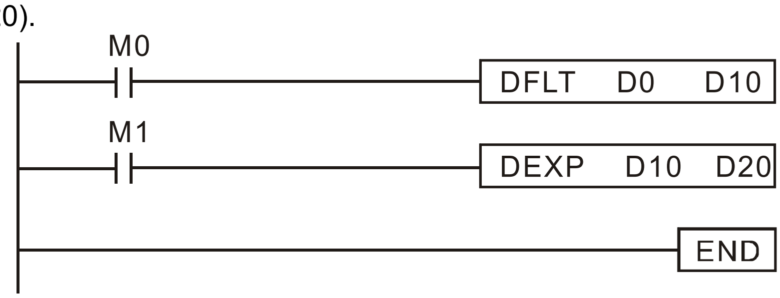
Flag signal: none

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

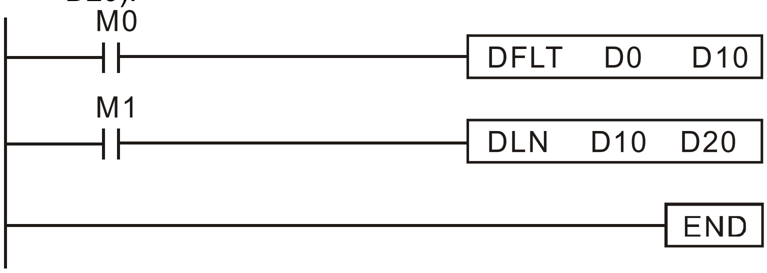
Flag signal: none

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	DESQR P	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).

$\sqrt{(D1, D0)} \longrightarrow (D11, D10)$

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

–	–	–	–

32-bit command (9 STEP)

DINT	Continuous execution type	DINTP	Pulse execution type

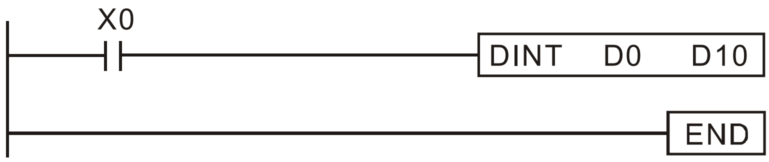
Flag signal: none

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)

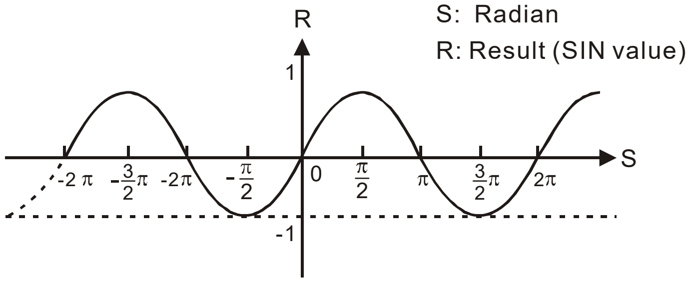
DSIN	Continuous execution type	DSINP	Pulse execution type

Flag signal: none

Explanation

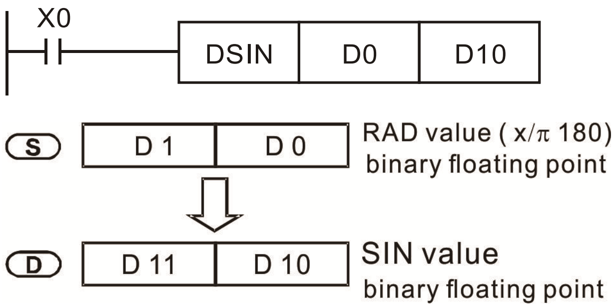
- **S**: the designated source value. **D**: the SIN value result.
- **S** is the designated source in radians.
- The value in radians (RAD) is equal to (angle ×π/180).
- The SIN obtained from the source value designated by **S** is stored in **D**.

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)

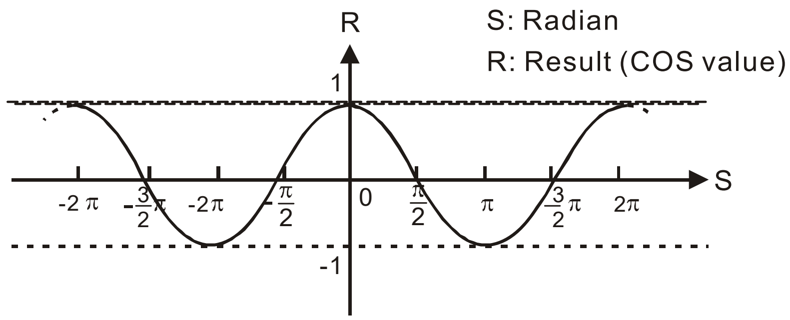
DCOS	Continuous execution type	DCOSP	Pulse execution type

Flag signal: none

Explanation

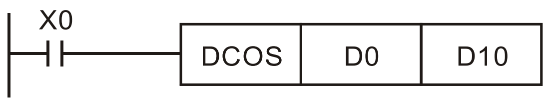
- **S**: the designated source value. **D**: the COS value result.
- **The source designated by S can be given as radians or an angle; this is decided by flag M1018.**
- When M1018=Off, the operation is in radians mode, where the radians (RAD) value is equal to (angle ×π/180).
- When M1018=On, the operation 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**.

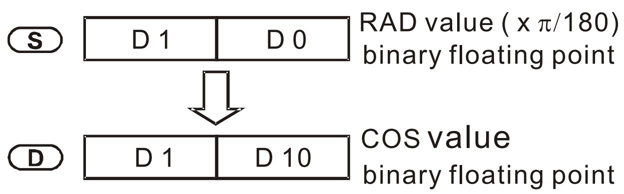
The following figure displays the relationship between the arc and SIN results:



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			
—	—	—	—

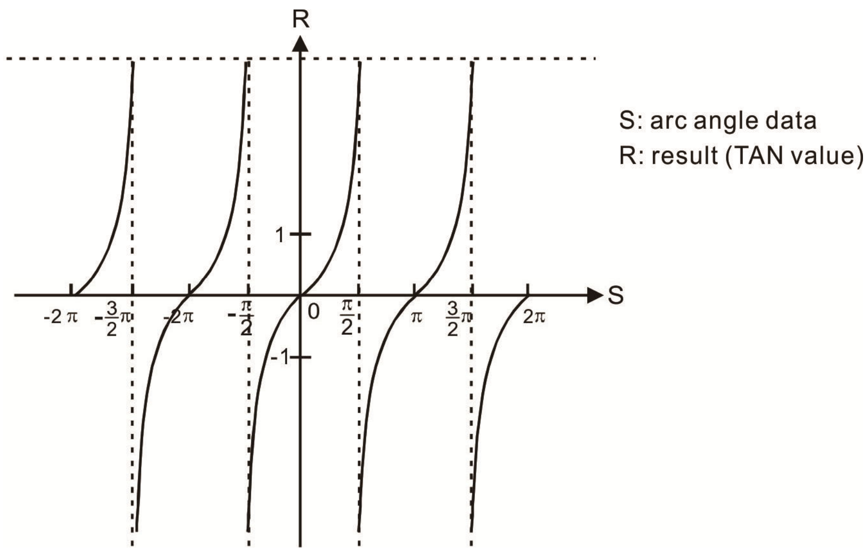
32-bit command (9 STEP)			
DTAN	Continuous execution type	DTANP	Pulse execution type

Flag signal: none

Explanation

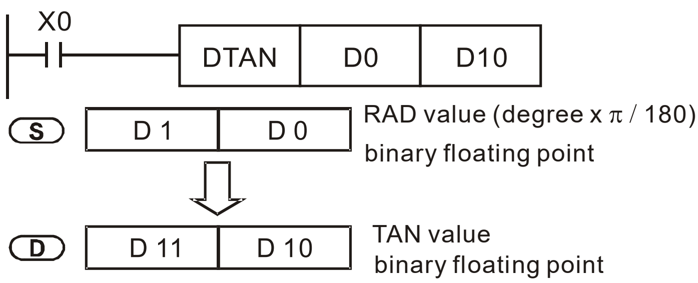
- **S**: the designated source value. **D**: the TAN value result.
- The source designated by **S** can be given as radians or an angle; this is decided by flag M1018.
- When M1018=Off, the operation is in radians mode, where the radians (RAD) value is equal to (angle ×π/180).
- When M1018=On, the operation 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 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)

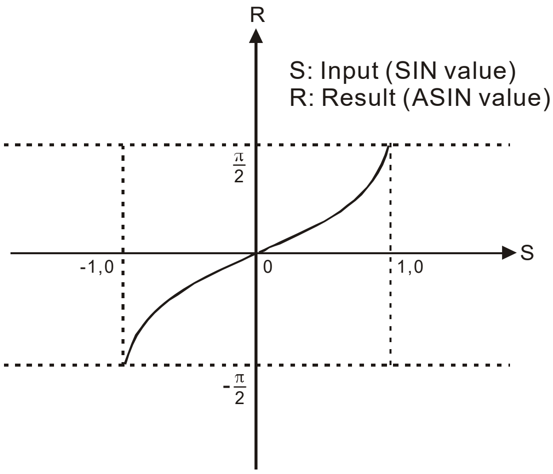
DASIN	Continuous execution type	DASINP	Pulse execution type

Flag signal: none

Explanation

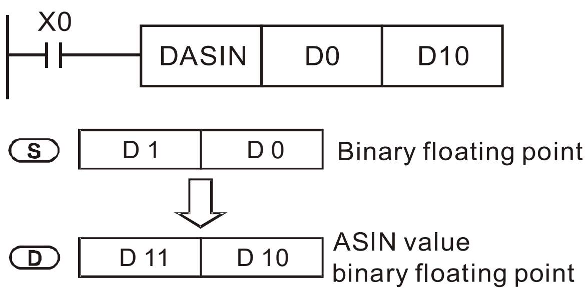
- **S**: the designated source (binary floating point number). **D**: the ASIN value result.
- ASIN value $=\sin^{-1}$

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)

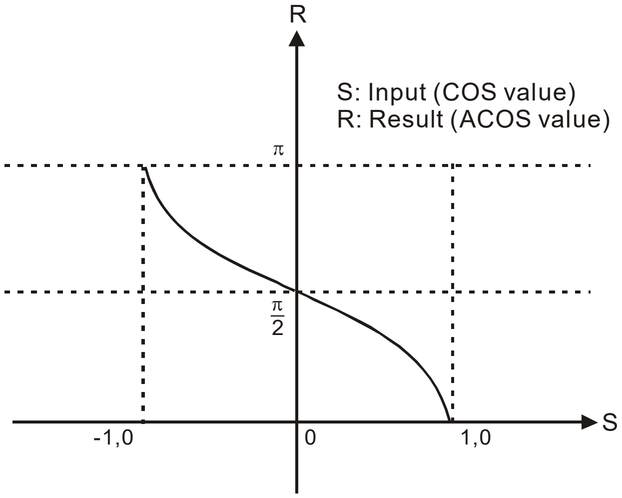
DACOS	Continuous execution type	DACOSP	Pulse execution type

Flag signal: none

Explanation

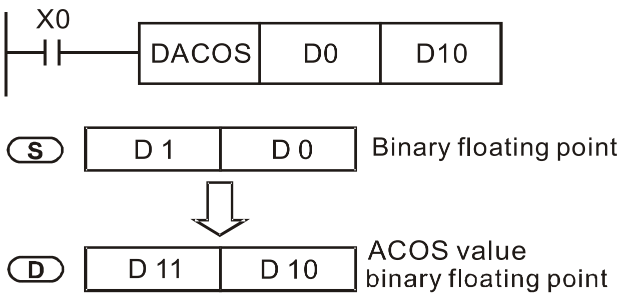
- **S**: the designated source (binary floating point number). **D**: the ACOS value result.
- ACOS value =cos^{-1}

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)

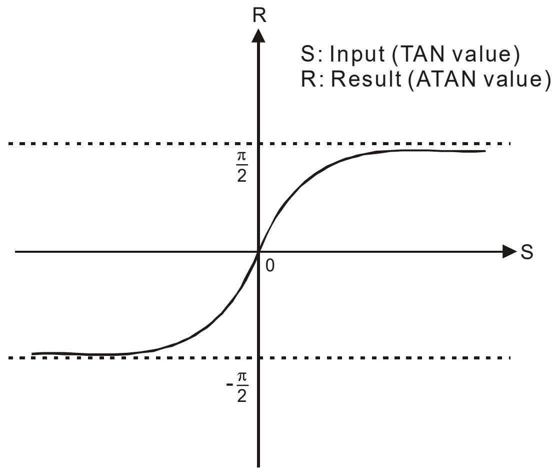
DATAN	Continuous execution type	DATANP	Pulse execution type

Flag signal: none

Explanation

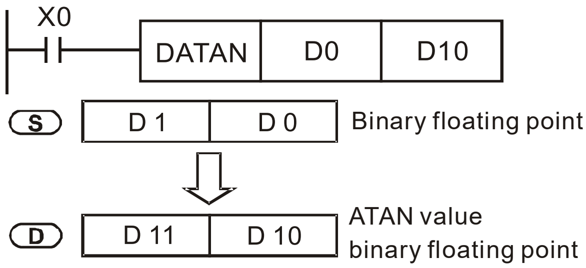
- **S**: the designated source (binary floating point number). **D**: the ATAN value result.
- ATAN value =tan[-1]

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

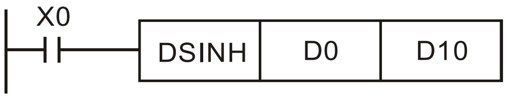
Flag signal: none

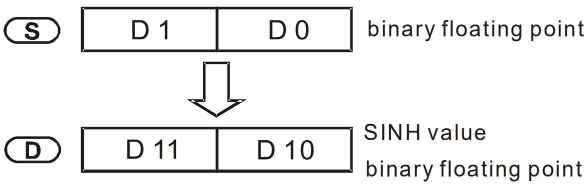
Explanation

- **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

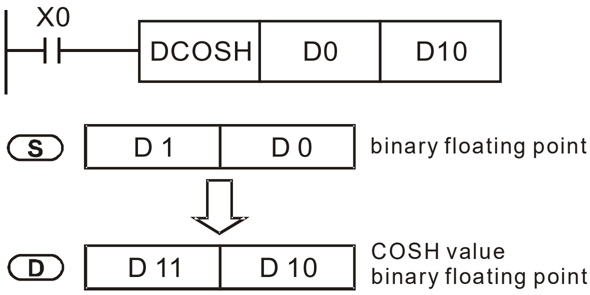
Flag signal: none

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

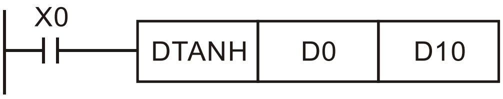
Flag signal: none

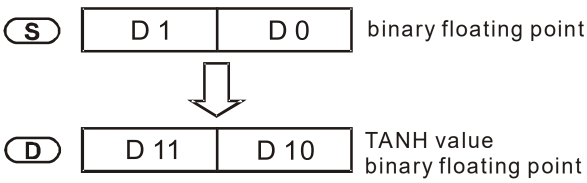
Explanation

- **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		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

–	–	–	–

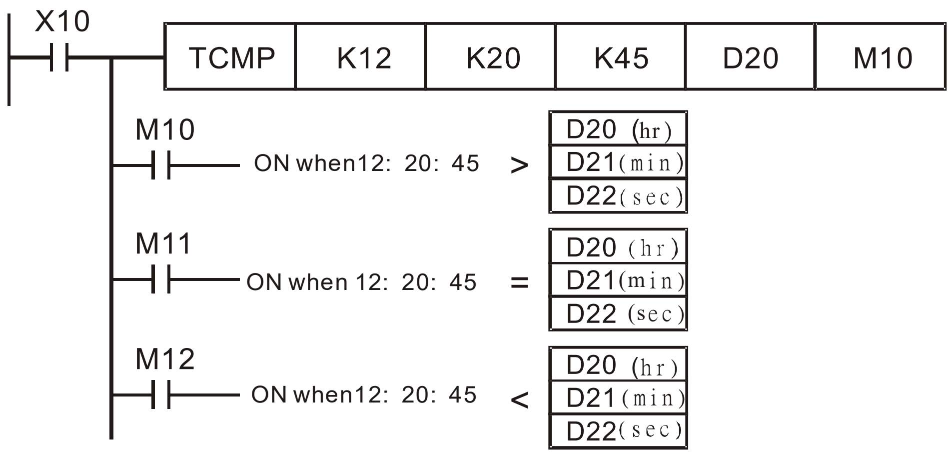
Flag signal: none

Explanation

- **S₁**: Sets the hours of the comparison time, setting range is "K0-K23." **S₂**: Sets the minutes of the comparison time, setting range is "K0-K59." **S₃**: 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 **S₁** - **S₃** 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		TZCP	S1 S2 S D	Comparison of calendar data
161		P		

	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			
—	—	—	—

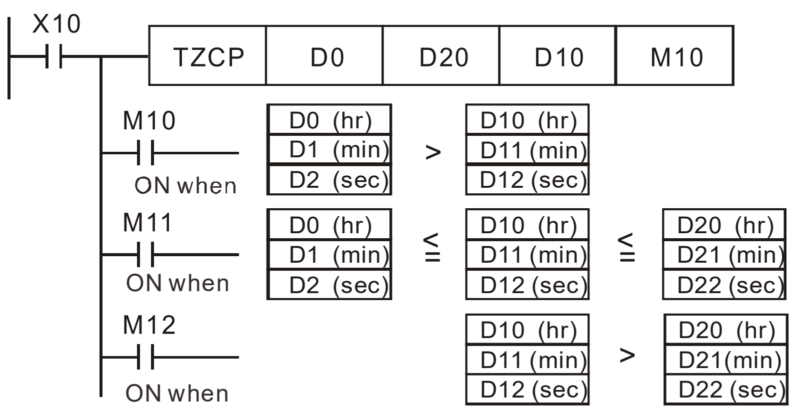
Flag signal: none

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				
162		TADD P	S1 S2 D	Calendar data addition

	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			
–	–	–	–

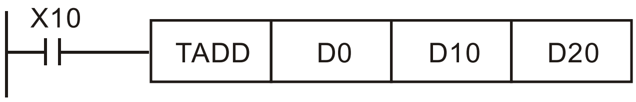
- Flag signal: M1020 Zero flag
  M1022 Carry flag
  M1068 Calendar error

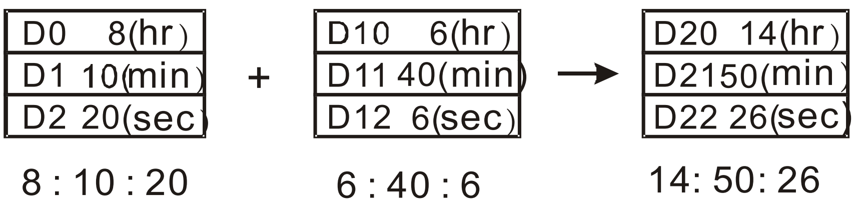
Explanation

- **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.





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

–	–	–	–

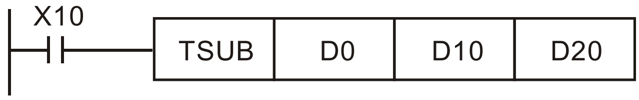
- Flag signal: M1020 Zero flag
  M1022 Carry flag
  M1068 Calendar error

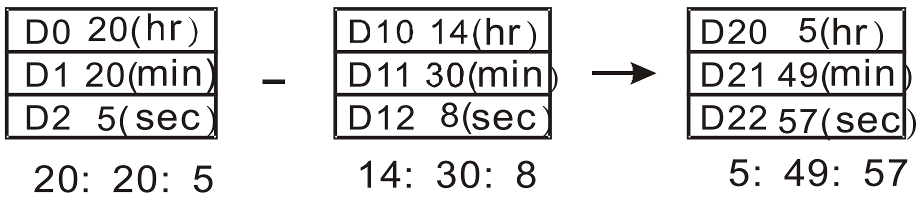
Explanation

- **S₁**: time minuend. **S₂**: time augend. **D**: time sum.
- Subtracts the calendar data in hours, minutes, and seconds designated by **S₂** from the calendar data in hours, minutes, and seconds designated by **S₁**, and the result is temporarily stored as hours, minutes, and seconds in the register designated by **D**.
- If the value of **S₁** or **S₂** 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.





API		TRD		D	Calendar data read
166			P		

	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	120	Pulse execution type

32-bit command

–	–	–	–

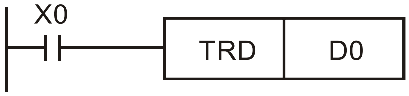
- Flag signal: none

Explanation

- **S**$_1$: time minuend. **S**$_2$: 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

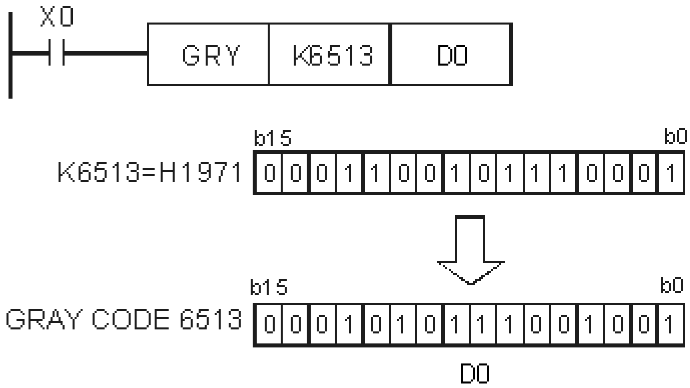
Explanation

- **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

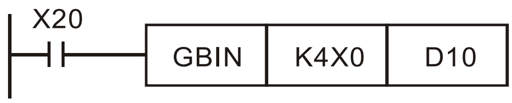
Explanation

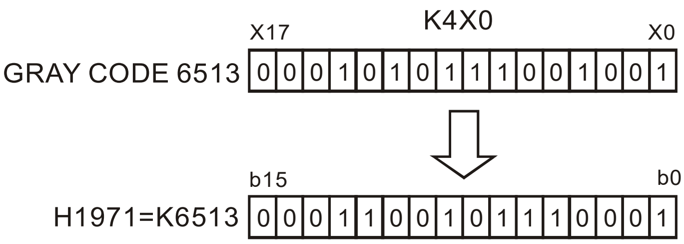
- **S**: source device used to store GRAY code. **D**: device used to store BIN value after transformation.
- The GRAY code corresponding to the value of the device designated by **S** is transformed into a BIN value, which is stored in the device designated by **D**.
- This command will transform the 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.





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

- **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 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**	$= 0$

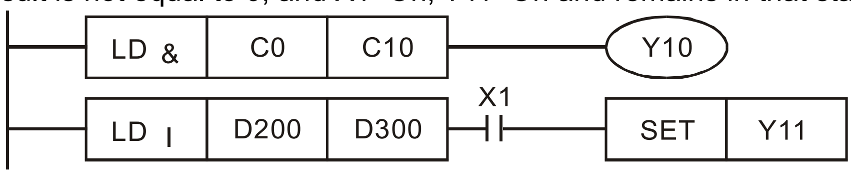
&: logical AND operation.

|: logical OR operation.

^: logical XOR operation.

Example

21. When the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y10=On.
22. 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	$=0$

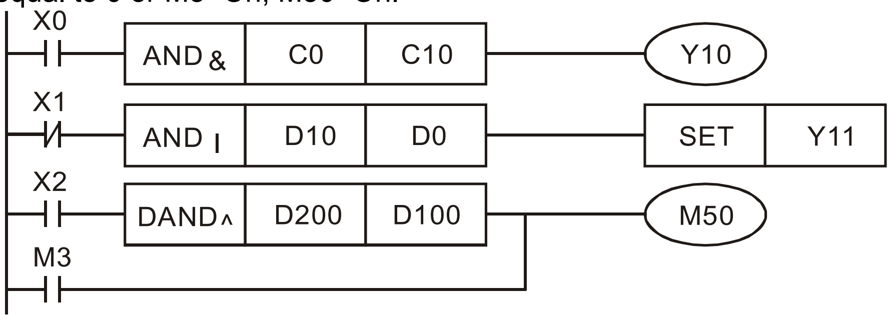
&: logical AND operation.

|: logical OR operation.

^: logical XOR operation.

Example

23. 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.
24. 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.
25. 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

- **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 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&	**D**OR&	**S₁**	&	**S₂**	≠ 0	**S₁**	&	**S₂**	= 0
222	OR|	**D**OR|	**S₁**	|	**S₂**	≠ 0	**S₁**	|	**S₂**	= 0
223	OR^	**D**OR^	**S₁**	^	**S₂**	≠ 0	**S₁**	^	**S₂**	= 0

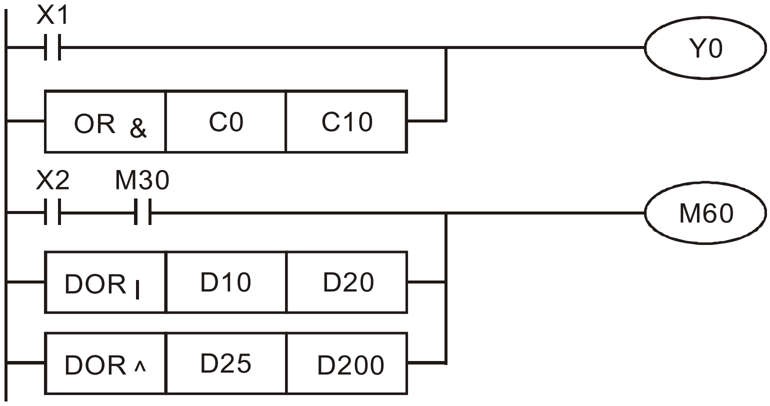
&: logical AND operation.

|: logical OR operation.

^: logical XOR operation.

Example

26. 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.
27. 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

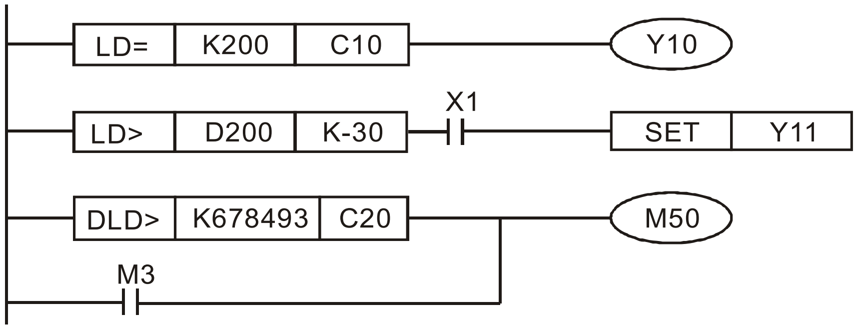
Explanation

- 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

28. When the content of C10 is equal to K200, Y10=On.
29. 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

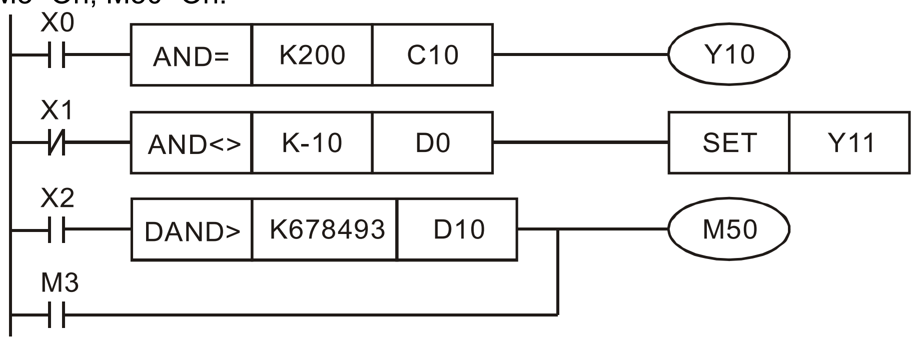
Explanation

- 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

30. When X0=On and the current value of C10 is also equal to K200, Y10=On.
31. When X1=Off and the content of register D0 is not equal to K-10, Y11=On and remains in that state.
32. When X2 =On and the content of the 32-bit register D0(D11)is less than 678,493, or M3=On, M50=On.



API					
240~246	D	OR※		(S1) (S2)	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 (5 STEP)

OR※	Continuous execution type	－	－

32-bit command (9 STEP)

DOR※	Continuous execution type	－	－

Flag signal: none

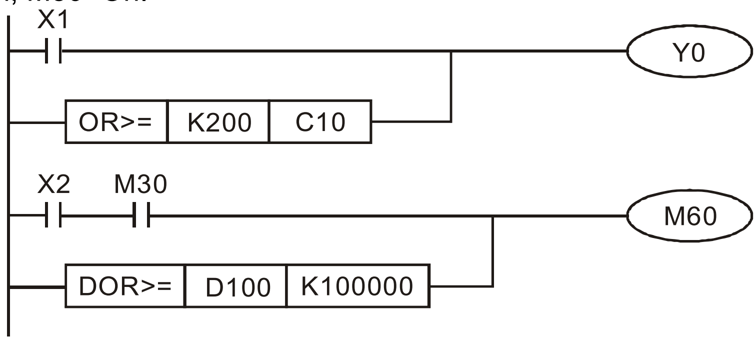
Explanation

- 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＝	**D**OR＝	$S_1 = S_2$	$S_1 \neq S_2$
241	OR＞	**D**OR＞	$S_1 > S_2$	$S_1 \leqq S_2$
242	OR＜	**D**OR＜	$S_1 < S_2$	$S_1 \geqq S_2$
244	OR＜＞	**D**OR＜＞	$S_1 \neq S_2$	$S_1 = S_2$
245	OR＜＝	**D**OR＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
246	OR＞＝	**D**OR＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

33. When X0=On and the current value of C10 is also equal to K200, Y10=On.
34. When X1=Off and the content of register D0 is not equal to K-10, Y11=On and remains in that state.
35. 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								16-bit command
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	– – – –
S1									*	*	*	32-bit command (9 STEP)
S2									*	*	*	FLD※ Continuous execution type – –

Notes on operand usage: # : & 、| 、^

Please refer to the function specifications table for each device in series for the scope of device usage

Flag signal: none

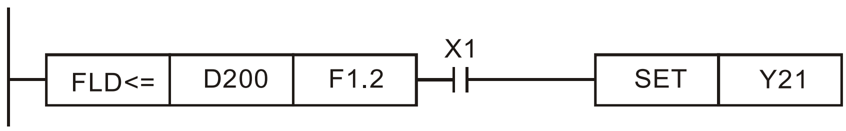
Explanation

- $\mathbf{S_1}$: data source device 1. $\mathbf{S_2}$: data source device 2.
- This command compares the content of $\mathbf{S_1}$ and $\mathbf{S_2}$. 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 $\mathbf{S_1}$, $\mathbf{S_2}$ 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=	$\mathbf{S_1} = \mathbf{S_2}$	$\mathbf{S_1} \neq \mathbf{S_2}$
276	FLD>	$\mathbf{S_1} > \mathbf{S_2}$	$\mathbf{S_1} \leqq \mathbf{S_2}$
277	FLD<	$\mathbf{S_1} < \mathbf{S_2}$	$\mathbf{S_1} \geqq \mathbf{S_2}$
278	FLD<>	$\mathbf{S_1} \neq \mathbf{S_2}$	$\mathbf{S_1} = \mathbf{S_2}$
279	FLD<=	$\mathbf{S_1} \leqq \mathbf{S_2}$	$\mathbf{S_1} > \mathbf{S_2}$
280	FLD>=	$\mathbf{S_1} \geqq \mathbf{S_2}$	$\mathbf{S_1} < \mathbf{S_2}$

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								16-bit command
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	– – – –
S1									*	*	*	32-bit command (9 STEP)
S2									*	*	*	FAND※ Continuous execution type – –

Notes on operand usage: #：&、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

Flag signal: none

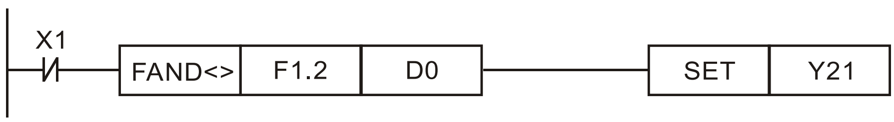
Explanation

- 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		FOR※		(S1) (S2)	Floating point number contact form compare OR*
287~292					

	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."

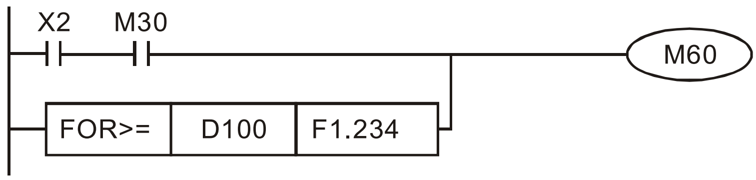
◆ The FOR* command can directly input floating point numerical values (for instance: F1.2) to the S_1, S_2 operands, or store floating-point numbers in register D for use in operations.

◆ 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

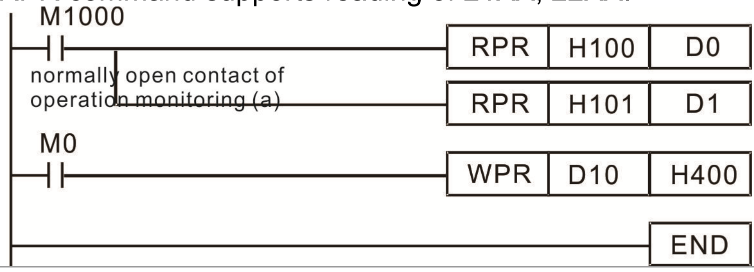
–	–	–	–

Flag signal: none

Explanation ■ S1: Data to write to specified page. S2: Parameter address of data to be written.

Example

36. When the data in the CT2000 driver's parameter H01.00 is read and written to D0, data from H01.01 will be read and written to D1.
37. When M0=On, the content of D10 will be written to the CT2000 driver parameter 04.00 (first speed of multiple speed levels).
38. When the parameter has been written successfully, M1017=On.
39. The CT2000'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.

P00-10: Control method

P00-11: Speed mode selection

P00-12: P2P position mode

P00-13: Torque mode select

P00-27: User-defined value

P01-12: Acceleration time 1
P01-13: Deceleration time 1
P01-14: Acceleration time 2
P01-15: Deceleration time 2
P01-16: Acceleration time 3
P01-17: Deceleration time 3
P01-18: Acceleration time 4
P01-19: Deceleration time 4

P02-12: Select MI Conversion Time mode:
P02-18: Select MO Conversion Time mode:

P04-50 ~ P04-69: PLC register parameter 0 - 19

P08-04: Upper limit of integral
P08-05: PID output upper limit

P10-17: Electronic gear A
P10-18: Electronic gear B

P11-34: Torque command
P11-43: P2P highest frequency
P11-44: Position control acceleration time
P11-45: Position control deceleration time

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		FPID	P	S1 S2 S3 S4	Driver PID control mode
141			P		

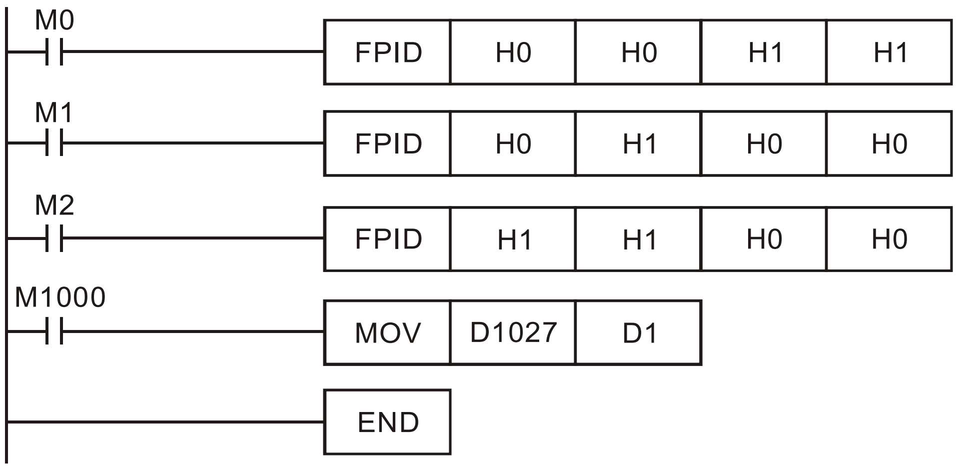
	Bit device			Word device								16-bit command (9 STEP)
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	FPID: Continuous execution type; FPIDP: Pulse execution type
S1				*	*						*	32-bit command
S2				*	*						*	— — — —
S3				*	*						*	
S4				*	*						*	
Notes on operand usage: none												Flag signal: none

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 08-00 PID reference target value input terminal selection, 08-01 proposal gain P, 08-02 integral time I, and 08-03 differential time D.

Example

40. 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.).
41. 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.
42. 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.
43. 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

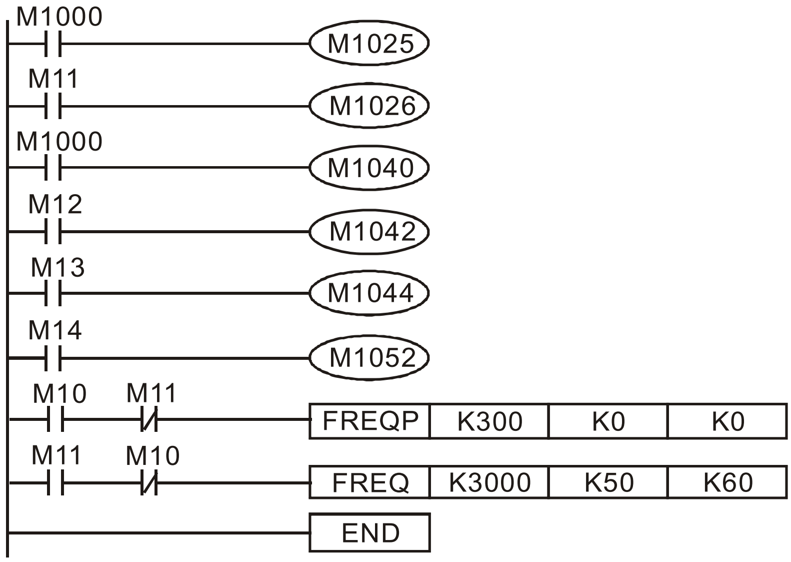
- S1: Frequency command. S2: Acceleration time. S3: Deceleration time
- S2,S3: In acceleration/deceleration time settings, the number of decimal places is determined by the definitions of Pr01-45.

Example
When 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

44. M1025: Driver RUN(On)/STOP(Off), M1026: driver operating direction FWD(Off)/REV(On). M1015: frequency reached.
45. When M10=On, sets the driver frequency command K300(3.00Hz), with an acceleration/deceleration time of 0.
    When M11=On, sets the driver frequency command K3000 (30.00Hz), with an acceleration time of 50 (0.5 sec.) and deceleration time of 60 (0.6 sec.). (When 01-45=0)
46. When M11=Off, the driver frequency command will now change to 0

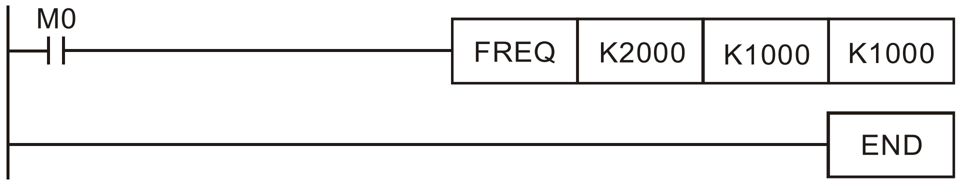


- Parameter 09-33 are defined on the basis of whether reference commands have been cleared before PLC operation
  Bit 0 : Prior to PLC scanning procedures, whether the target frequency has been cleared is 0. (This will be written to the FREQ command when the PLC is On)

Bit 1 : Prior to PLC scanning procedures, whether the target torque has been cleared is 0. (This will be written to the TORQ command when the PLC is On)

Bit 2 : Prior to PLC scanning procedures, whether speed limits in the torque mode have been cleared is 0. (This will be written to the TORQ 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 09-33 bit 0 is 0, and M0 is set as 0, the frequency command will remain at 20.00Hz.

Case 2: When the 09-33 bit 0 is 1, and M0 is set as 0, the frequency command will change to 0.00Hz

The reason for this is that when the 09-33 bit 0 is 1 prior to PLC scanning procedures, the frequency will first revert to 0.

When the 09-33 bit 0 is 0, the frequency will not revert to 0.

API 263	TORQ P	(S1) (S2)	Driver torque control mode

	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)

TORQ	Continuous execution type	TORQ P	Pulse execution type

32-bit command

–	–	–	–

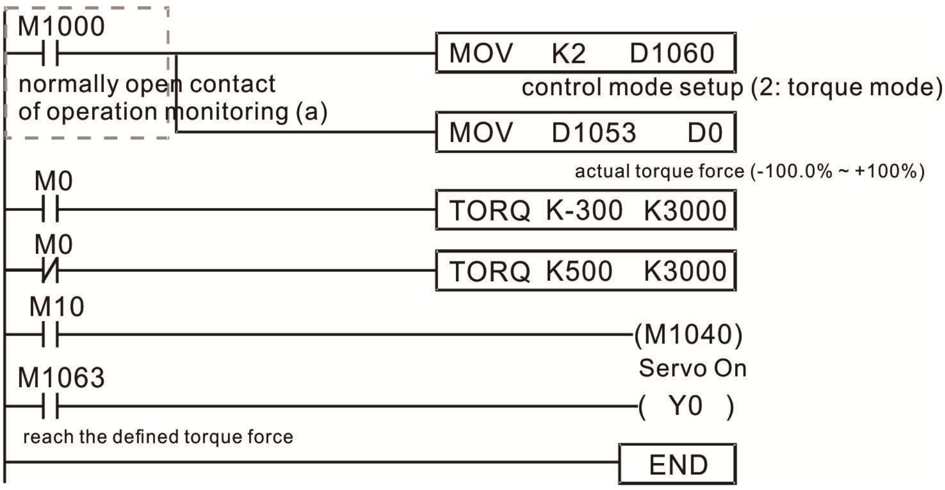
Flag signal: M1063

Explanation

- (S1): Torque command (numbered, no more than one digit). (S2): Speed limit.
- The TORQ command can control the driver torque command and speed limits; it also uses special register control actions, such as:
  M1040: Controls Servo On/Servo Off. When Servo is ON, if a TORQ command is executed, the torque will output the torque defined by the TORQ command, and the frequency restrictions will similarly be controlled by the TORQ command.

Example

47. M1040: Control Servo On/Servo Off. M1063: set torque attained. D1060 is the mode controls. D1053 is the actual torque.
48. When M0=Off, set the driver torque command K+500 (+50.0%), rotational speed restrictions is 3000 (30Hz).
49. When M0=On, sets the driver torque command K-300 (-30.0%), rotational speed restrictions is 3000 (30Hz).
50. When M10=On, driver began output torque command.
51. When set torque is attained, M1063 will go On; this flag usually jumps continuously, however.



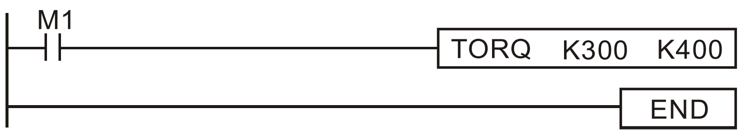
- Parameter 09-33 are defined on the basis of whether reference commands have been cleared before PLC operation

  Bit 0 : 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)

  Bit 1 : Prior to PLC scanning procedures, whether the target torque has been cleared is 0. (This will be written to the TORQ command when the PLC is On)

  Bit 2 : Prior to PLC scanning procedures, whether speed limits in the torque mode have been cleared is 0. (This will be written to the TORQ command when the PLC is On)

Example:



If we now force M1 to be 1, the torque command will be K+300 (+30%), and the speed limit will be 400 (40Hz). But when M1 is set as 0, there will be a different situation

Case 1: When bit 1 and bit 2 of 09-33 are both set as 0, and M1 is set as 0, the torque command will remain at +30%, and the speed limit will be set as 40Hz.
Case 2: When bit 1 and bit 2 of 09-33 are both 1, and M1 is set as 0, the torque command will revert 0%, and the speed limit will be set as 0Hz.

API		DPOS	P	S1	Driver point-to-point control
262					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
				*	*						*

Notes on operand usage: none

16-bit command

–	–	–	–

32-bit command (5 STEP)

DPOS	Continuous execution type	DPOSP	Pulse execution type

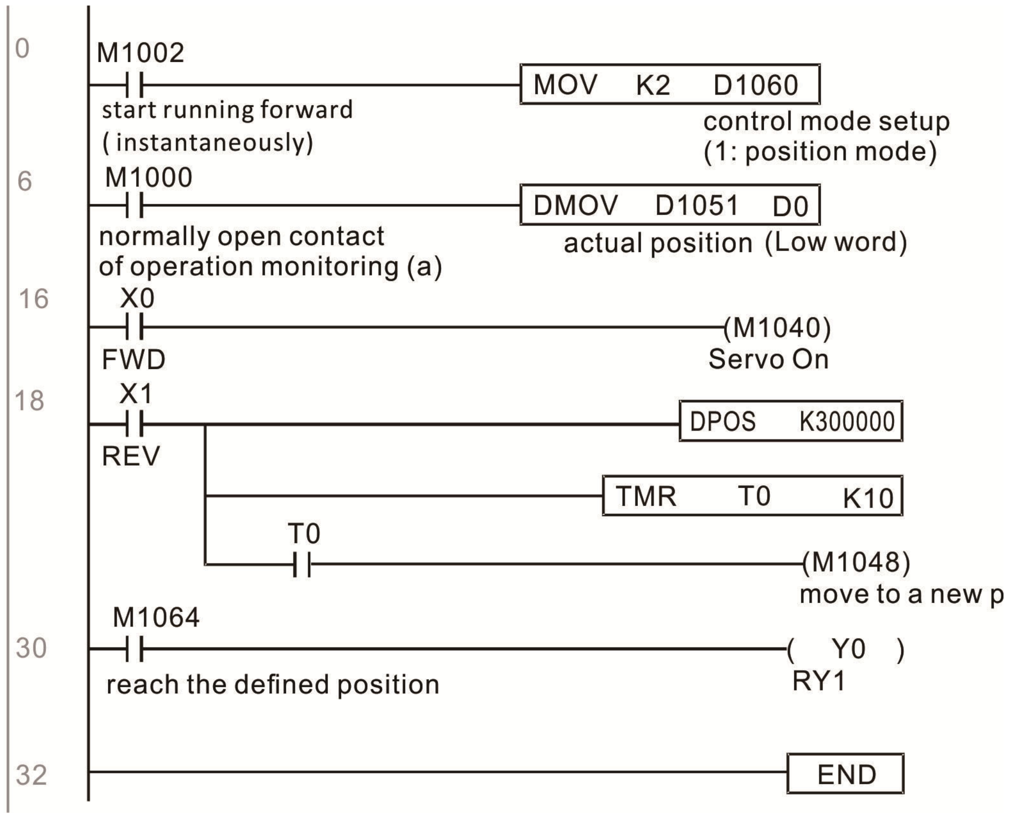
Flag signal: M1064, M1070

Explanation

- S1: Target (must have a number).
- The DPOS command can control the driver's position commands, and employs special register control actions, such as:
  M1040: Control Servo On/Servo Off. M1055 search for origin. M1048 move to new position. If the control mode is position mode (D1060 = 1), and the converter is in the Servo ON state (M1040 = 1), if the DPOS command is executed, the driver will move to a new position in conjunction with activation of M1048 once (OFF to ON).

Example

52. M1040: Control Servo On/Servo Off. M1064: set position attained. D1060 is the mode control. D1051(L) and D1052(H) are the actual position points.
53. When X0=On, M1040 will be On (Servo On).
54. When X1=On, sets DPOS position as +300000, and M1048 will change to On (move to new position) after a delay of 1 sec. Check whether the value of D1051 has changed at this time; after the set position point has been reached, M1064 will go On, and Y0 will output On.



API		Mnemonic	Operands	Function
261		CANRX P	(S1) (S2) (S3) (D)	Read CANopen slave station data

	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	CANRXP	Pulse execution type

32-bit command

–	–	–	–

Flag signal

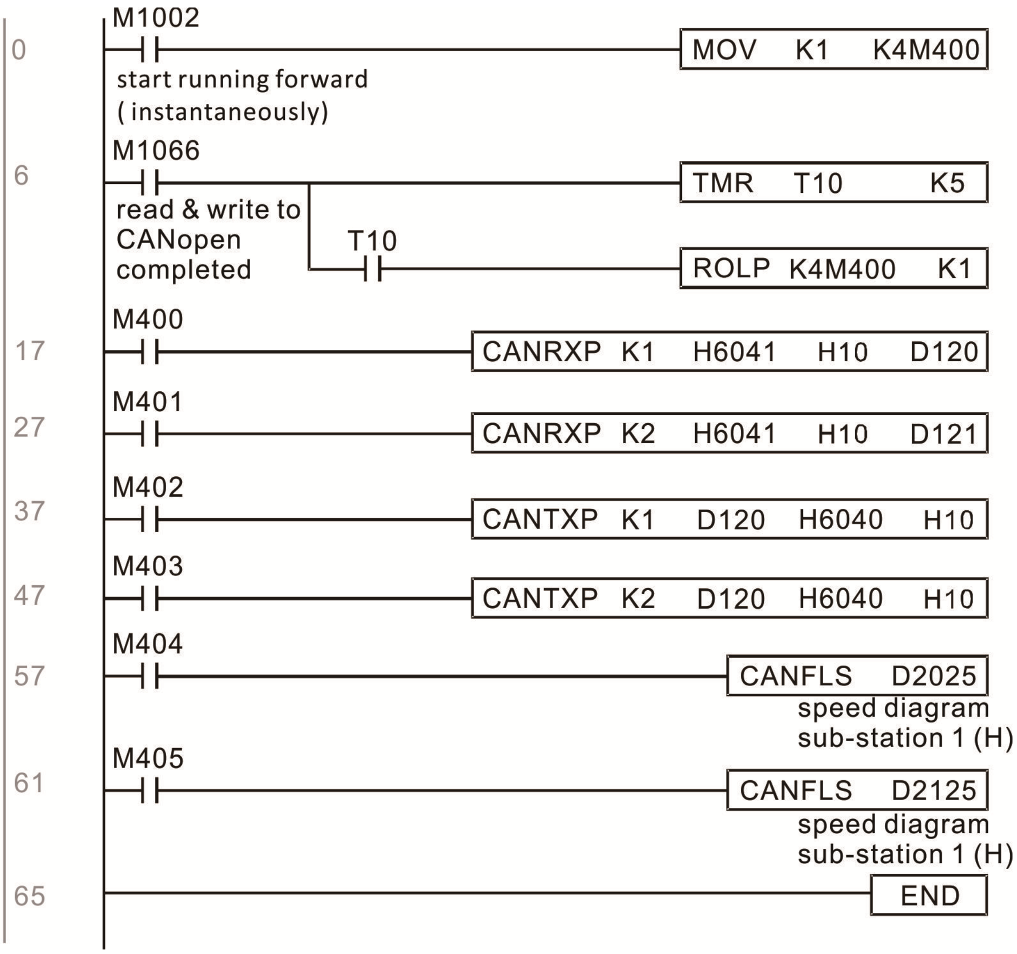
Explanation

- (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								16-bit command (3 STEP)
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	CANFLS: Continuous execution type; CANFLSP: Pulse execution type
D				*	*							32-bit command: – – – –
Notes on operand usage: none												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								16-bit command (9 STEP)
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	ICOMR: Continuous execution type; ICOMRP: Pulse execution type
S1				*	*						*	32-bit command (17 STEP)
S2				*	*						*	DICOMR: Continuous execution type; DICOMRP: Pulse execution type
S3				*	*						*	
D				*	*						*	
Notes on operand usage: none												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

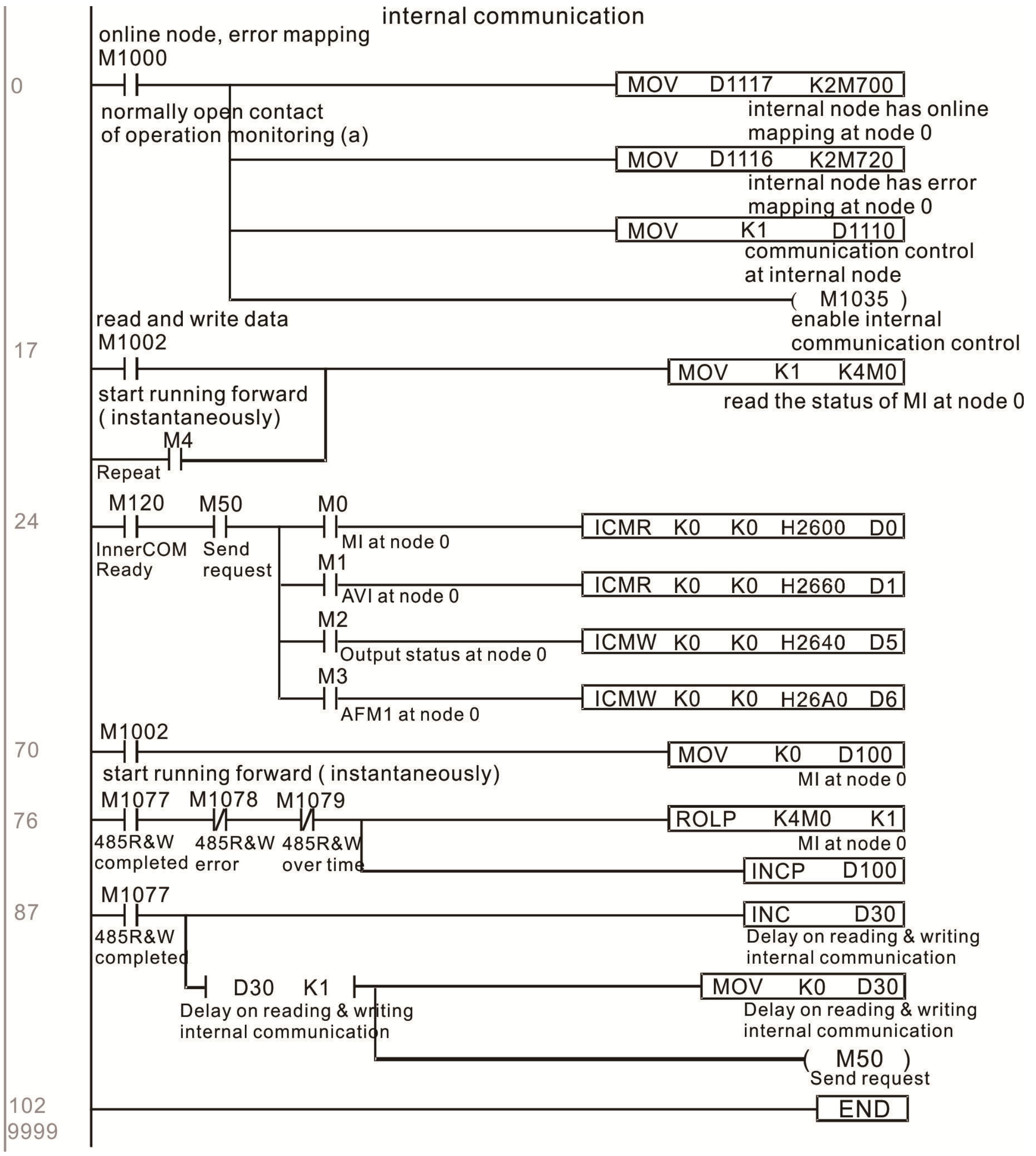
Explanation

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:



16-7 Error display and handling

Code	ID	Descript	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

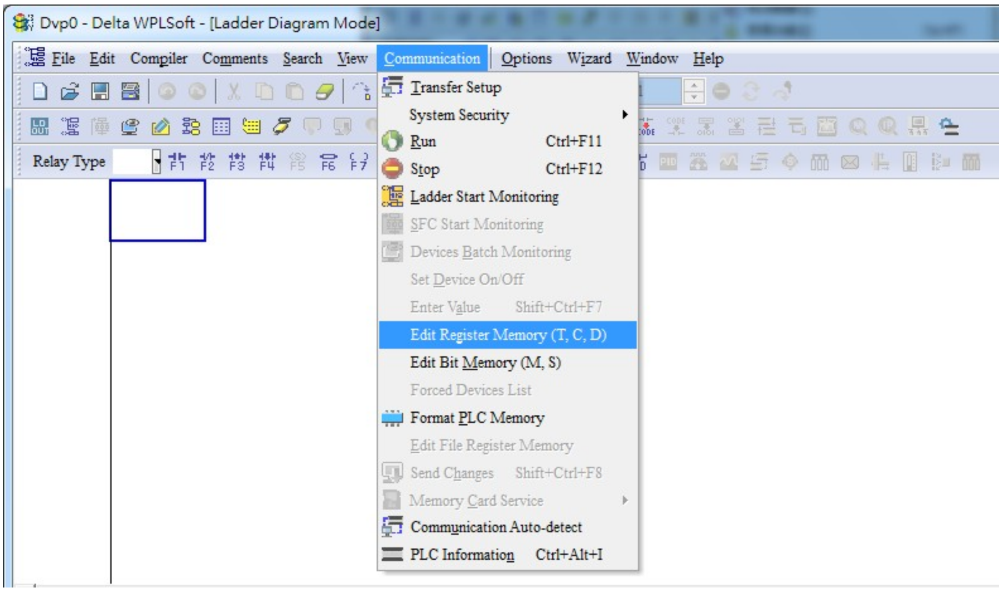
Control of a simple multi-axis application is required in certain situations. If the device supports the CANopen protocol, a CT2000 can serve as the master in implementing simple control (position, speed, homing, and torque control). The setting method comprises the following seven steps:

Step 1: Activating CANopen Master functions

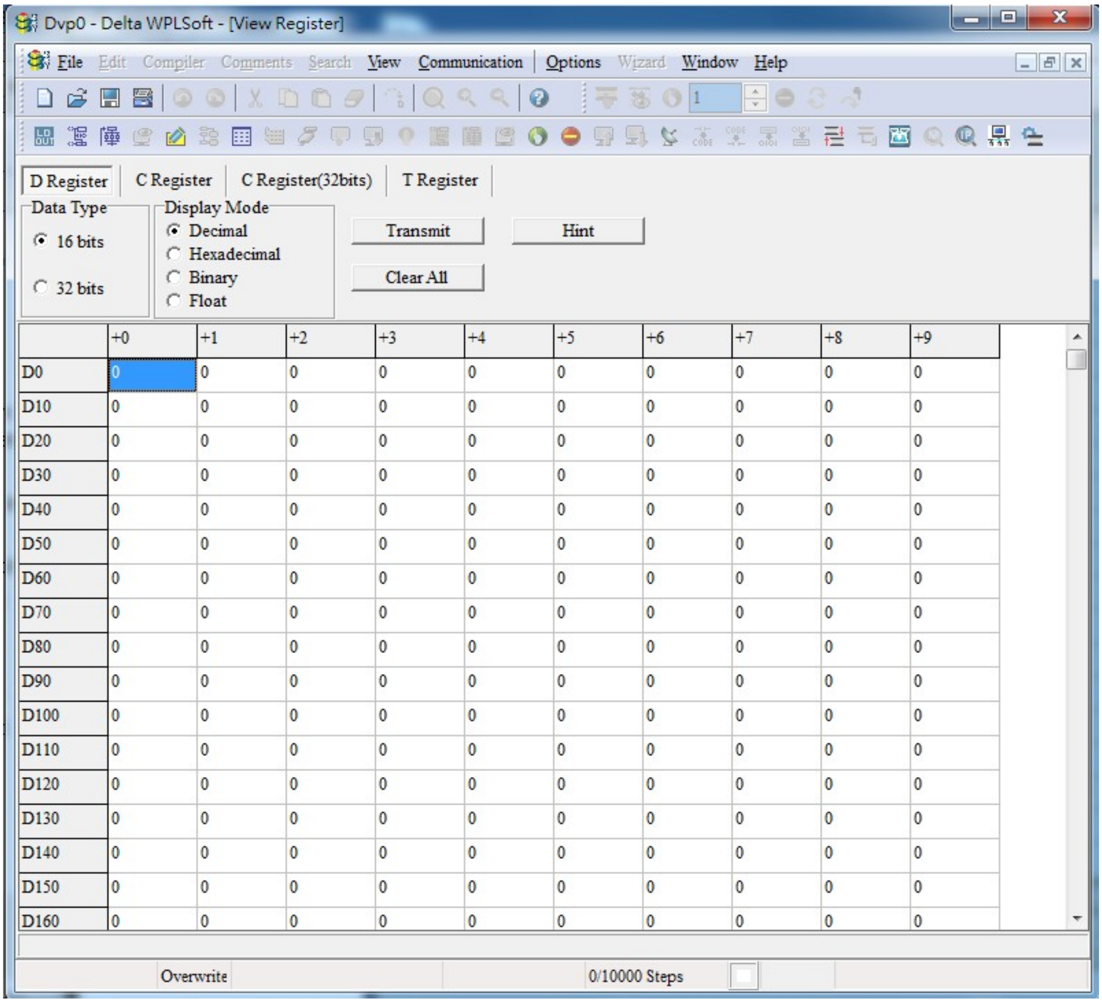
1. Parameter 09-45=1 (initiates Master functions); restart power after completing setting, the status bar on the KPC-CC01 digital keypad will display "CAN Master".
2. Parameter 00-02=6 reset PLC (please note that this action will reset the program and PLC registers to the default values)
3. Turn power off and on again.
4. Use the KPC-CC01 digital keypad to set the PLC control mode as **"PLC Stop"** (if the KPC-CE01 digital keypad is used, set as "PLC 2"; 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

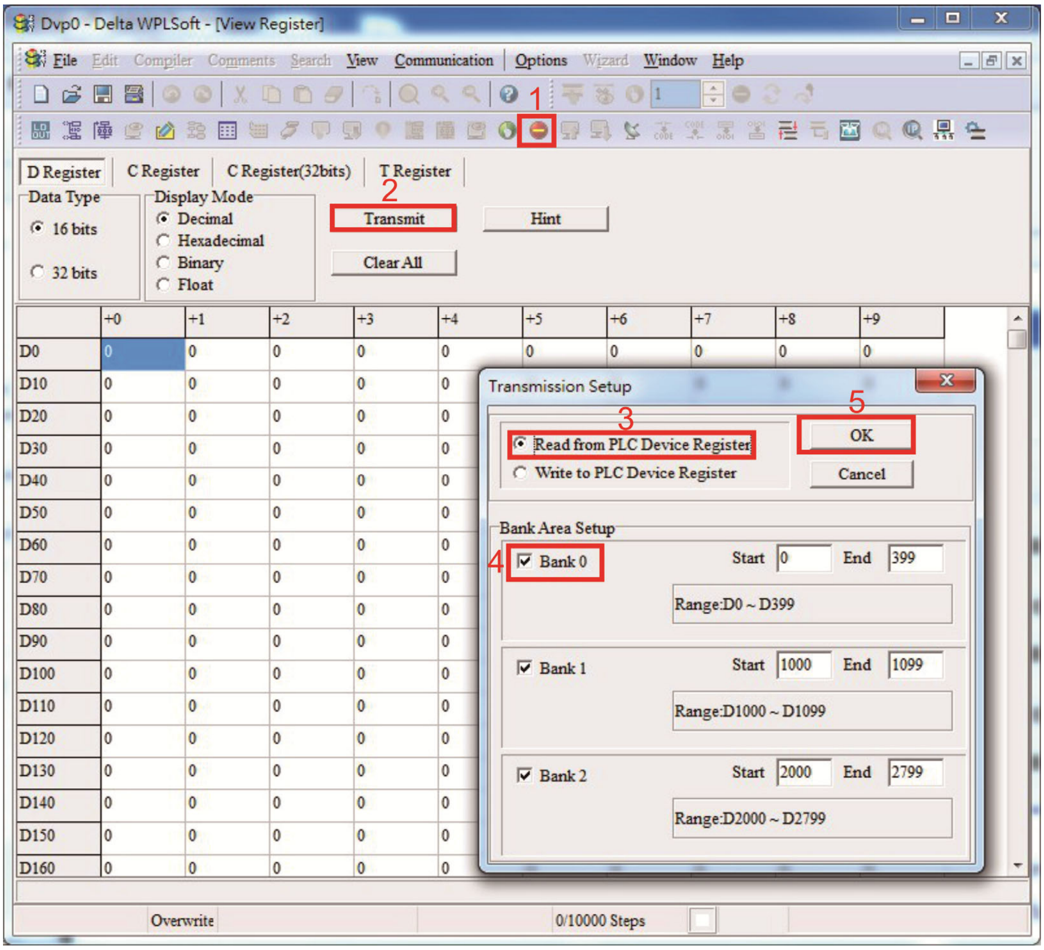
1. After connecting the 485 communications cable, use WPL Soft to set the PLC **status** as Stop (if the PLC mode has been switched to the **"PLC Stop"** mode, the PLC **status** should already be Stop)
2. Set the address and corresponding station number of the slave station to be controlled. For instance, 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 from 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	-
D1073	CANopen break channel (bit0=Machine code0 …….)	R

Special D	Description of Function	R/W
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:

$$\text{Sync time} \geq \frac{1M}{Rate} * \frac{N}{4}$$

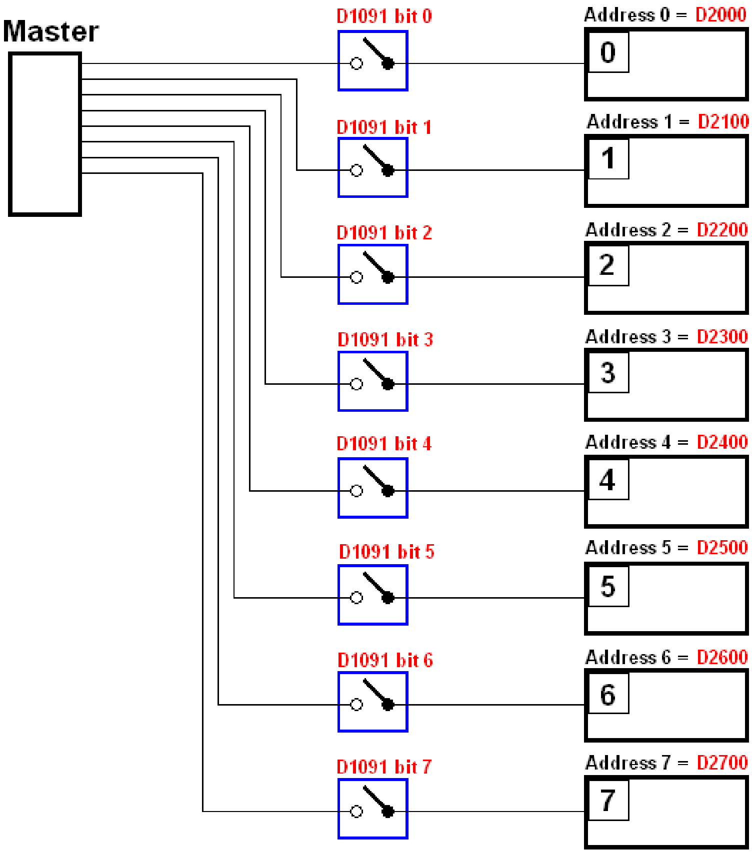
N: TXPDO + RXPDO

For instance, when communications speed is 500K, 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 (bit 0-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 CT2000 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 CT2000 cannot perform mapping of commonly-used registers; the following is an overview of the current PDO mapping situation:

TX PDO							
PDO4 (Torque)		PDO3 (Position)		PDO2 (Remote I/O)		PDO1 (Speed)	
Description	Special D	Description	Special D	Description	Special D	Description	Special D
Controller Word	D2008+100*n	Controller Word	D2008+100*n	Slave device DO	D2027+100*n	Controller Word	D2008+100*n
Target torque	D2017+100*n	Target	D2020+100*n D2021+100*n	Slave device AO1	D2031+100*n	Target speed	D2012+100*n
Control method	D2010+100*n	Control method	D2010+100*n	Slave device AO2	D2032+100*n		
				Slave device AO3	D2033+100*n		

RXPDO							
PDO4 (Torque)		PDO3 (Position)		PDO2 (Remote I/O)		PDO1 (Speed)	
Description	Special D	Description	Special D	Description	Special D	Description	Special D
Mode word	D2009+100*n	Mode word	D2009+100*n	Slave device DI	D2026+100*n	Mode word	D2009+100*n
Actual torque	D2018+100*n	Actual position	D2022+100*n D2023+100*n	Slave device AI1	D2028+100*n	Actual frequency	D2013+100*n
Actual mode	D2011+100*n	Actual mode	D2011+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:

	PDO4		PDO3		PDO2		PDO1	
Default definition	Torque		Position		Remote I/O		Speed	
bit	15	14 ~ 12	11	10 ~ 8	7	6 ~ 4	3	2 ~ 0
Definition	En	Length:	En	Length:	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 CT2000 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							
	PDO4		PDO3		PDO2		PDO1	
	Description	Special D	Description	Special D	Description	Special D	Description	Special D
1	Controller Word	D2008+100*n	Controller Word	D2008+100*n	Slave device DO	D2027+100*n	Controller Word	D2008+100*n
2	Target torque	D2017+100*n	Target	D2020+100*n D2021+100*n	Slave device AO1	D2031+100*n	Target speed	D2012+100*n
3	Control method	D2010+100*n	Control method	D2010+100*n	Slave device AO2	D2032+100*n		
4					Slave device AO3	D2033+100*n		

	PDO4		PDO3		PDO2		PDO1	
Definition	Torque		Position		Remote I/O		Speed	
bit	15	14 ~ 12	11	10 ~ 8	7	6 ~ 4	3	2 ~ 0
Definition	0	0	0	0	0	0	1	2

D2067+100*n =000Ah

Length:	TX PDO							
	PDO4		PDO3		PDO2		PDO1	
	Description	Special D	Description	Special D	Description	Special D	Description	Special D
1	Controller Word	D2009+100*n	Controller Word	D2009+100*n	Slave device DI	D2026+100*n	Controller Word	D2009+100*n
2	Actual torque	D2018+100*n	Actual position	D2022+100*n D2023+100*n	Slave device AI1	D2028+100*n	Actual frequency	D2013+100*n
3	Actual mode	D2011+100*n	Actual mode	D2011+100*n	Slave device AI2	D2029+100*n		
4					Slave device AI3	D2030+100*n		

	PDO4		PDO3		PDO2		PDO1	
Definition	Torque		Position		Remote I/O		Speed	
bit	15	14 ~ 12	11	10 ~ 8	7	6 ~ 4	3	2 ~ 0
Definition	0	0	0	0	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 CT2000 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 CT2000'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: 1	2	3	4	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:	PDO Default:				R/W
			1	2	3	4	
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	3	4	
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

Torque control

Special D	Description of Function	Default:	PDO Default:				R/W
			1	2	3	4	
D2017+100*n	Target torque of slave station number n(-100.0%~+100.0%)	0				●	RW
D2018+100*n	Actual torque of slave station number n(XX.X%)	0				▲	R
D2019+100*n	Actual current of slave station number n(XX.XA)	0					R

Position control

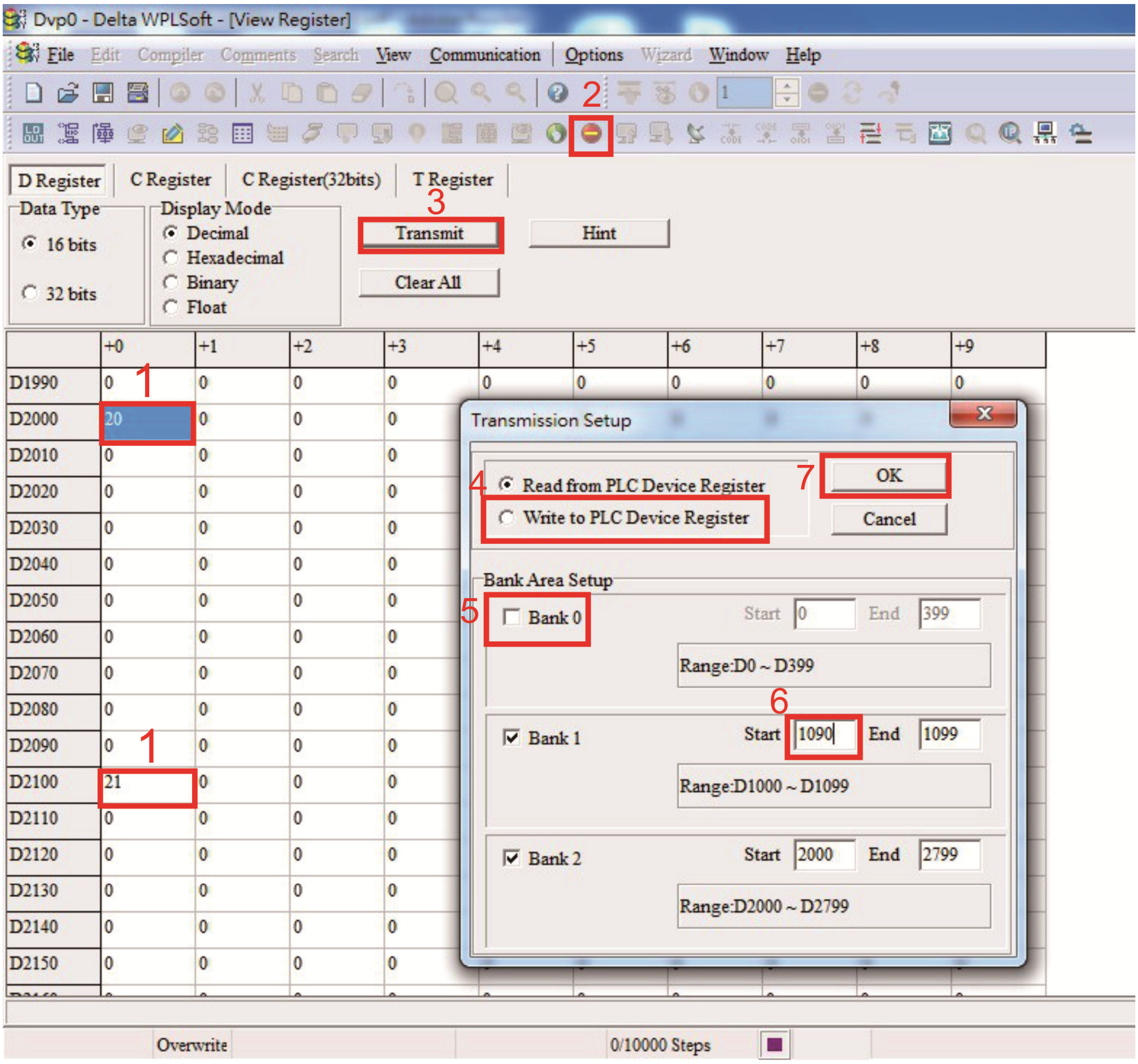
Special D	Description of Function	Default:	PDO Default:				R/W
			1	2	3	4	
D2020+100*n	Target of slave station number n (L)	0			●		RW
D2021+100*n	Target of slave station number n (H)	0					RW
D2022+100*n	Actual position of slave station number n (L)	0			▲		R
D2023+100*n	Actual position of slave station number n (H)	0					R
D2024+100*n	Speed chart of slave station number n (L)	10000					RW
D2025+100*n	Speed chart of slave station number n (H)	0					RW

Remote I/O

Special D	Description of Function	Default:	PDO Default:				R/W
			1	2	3	4	
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 (parameter 09-46, default is set as 100), make sure not to use the same number as a slave station.
- ☑ Set the CANopen communications speed (parameter 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 CT2000 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
	CT2000	E-C		
Slave station address	09-36	09-20	0	Disable CANopen hardware interface
			1~127	CANopen Communication address
Communication speed	09-37	09-21	0	1M
			1	500K
			2	250K
			3	125K
			4	100K
			5	50K

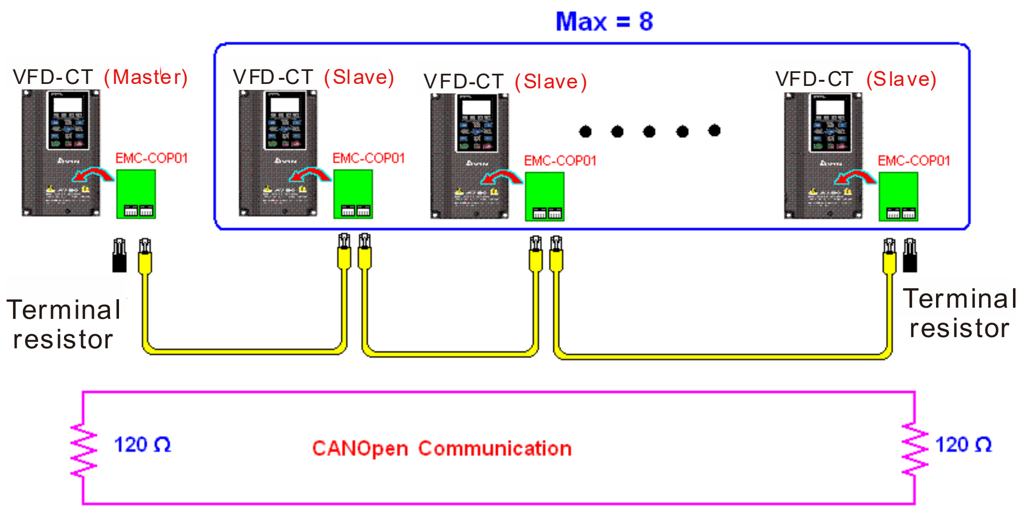
Control source	00-21	-	3	
	-	02-01	5	
Frequency source	00-20	-	6	
	-	02-00	5	
Torque source	11-33	-	3	
	-	-	-	
Position source	11-40	-	3	
	-	-	-	

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	03-00	1~127	CANopen Communication address
Communication speed	03-01 bit 8-11 XRXX	R= 0	125K
		R= 1	250K
		R= 2	500K
		R= 3	750K
		R= 4	1M
Control/command source	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

CT2000 driver one-to-two control

Step 1: Activating CANopen Master functions

- ☑ Parameter 09-45=1 (initiates Master functions); restart power after completing setting, the status bar on the KPC-CC01 digital keypad will display "CAN Master".
- ☑ Parameter 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 the KPC-CE01 digital keypad is used, set as "PLC 2"; 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 (parameter 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 (parameter 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**)

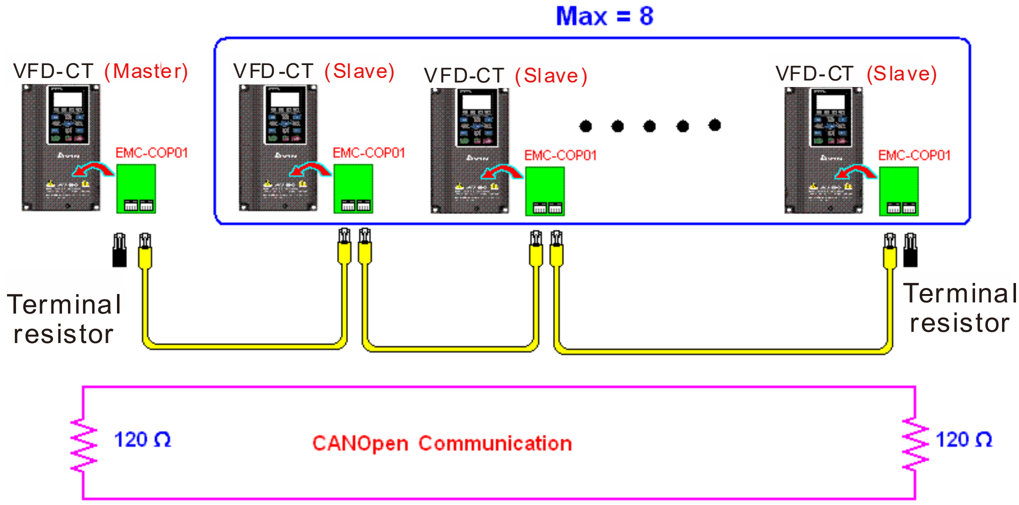
Step 5: Set the slave stations' station numbers and communications speed

Slave station no. 1: 09-37 = 0(Speed 1M) 09-36=10(Node ID 10)

Slave station no. 2: 09-37 = 0(Speed 1M) 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 mode controls (speed, torque, homing, and position)

The torque mode and position mode are based on FOC vector control and speed mode also supports FOC vector control. Control therefore cannot be performed successfully unless you study motor parameters ahead of time for the torque mode and position mode, and the speed mode based on FOC.

In addition, motors are classified as two types: IM and PM. You therefore need to study IM motor parameters. For PM motors, after completing motor parameter study, you must also complete study of motor origin angle of deviation. Please refer to parameters 12-58 Pr. 05-00 detailed explanation.

※ If a PM motor belongs to Delta's ECMA series, motor parameters can be directly input from data in the servo motor catalog, and parameter study will not be needed.

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:

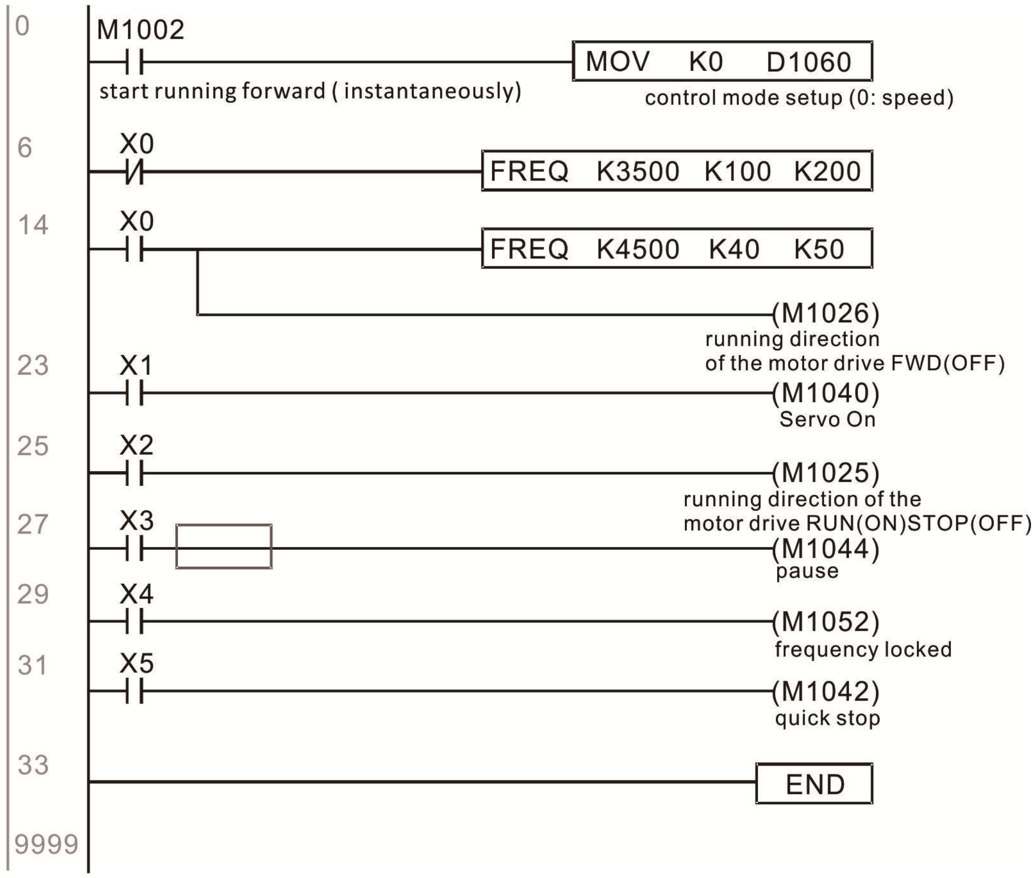
FREQ(P) S1 S2 S3

Target speed The first acceleration time setting The first deceleration time setting

Example of speed mode control:

Before performing speed control, if the FOC (magnetic field orientation) 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)



Torque control:

Register table for torque mode:

Control special M

Special M	Description of Function	Attributes
M1040	Servo On	RW

Status special M

Special M	Description of Function	Attributes
M1056	Servo On Ready	RO
M1063	Torque attained	RO

Control special D

Special D	Description of Function	Attributes
D1060	Operating mode setting (torque mode is 2)	RW

Status special D

Special D	Description of Function	Attributes
D1050	Actual operating mode (speed mode is 0)	RO
D1053	Actual torque	RO

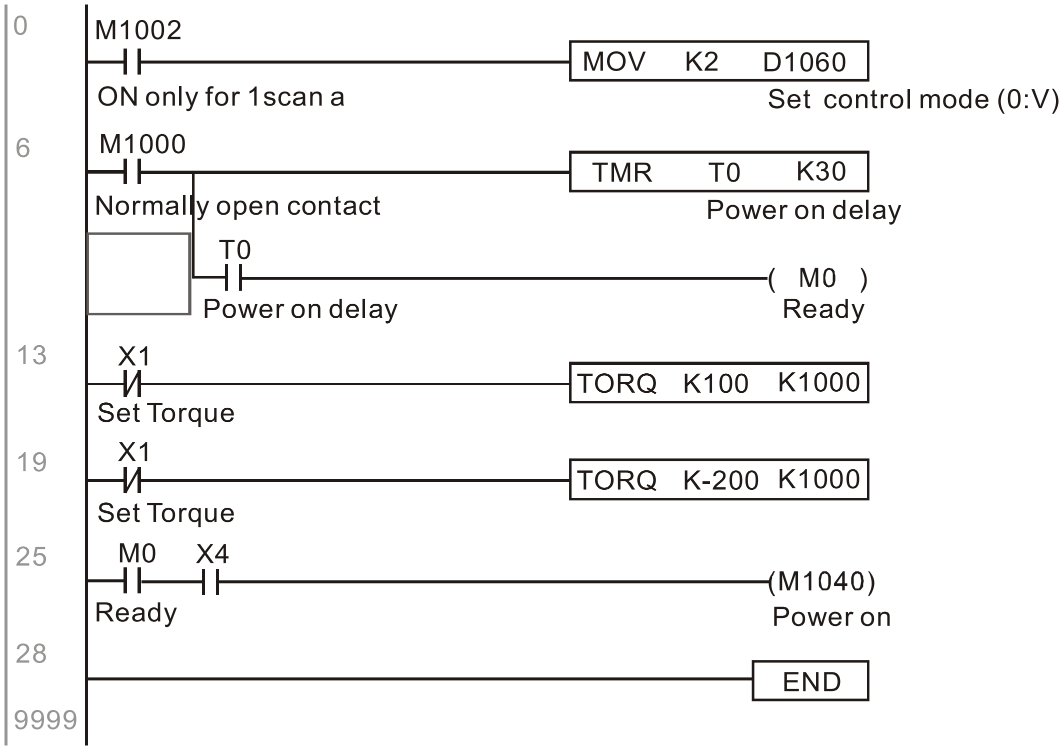
Torque mode control commands:

TORQ(P)	S1	S2
	Target torque (with numbers)	Frequency restrictions

Example of torque mode control:

The setting of electromechanical parameters involved in torque control must be completed before implementing torque control.

1. Set D1060 = 2 to change the converted to the torque mode.
2. Use the TORQ command to implement torque control and speed limits.
3. Set M1040 = 1; the driver will now be excited, and immediately jump to the target torque or speed limit. D1053 can be used to find out the current torque.


0
M1002
MOV K2 D1060
ON only for 1scan a
Set control mode (0:V)
6
M1000
TMR T0 K30
Normally open contact
Power on delay
T0
M0
Power on delay
Ready
13
X1
TORQ K100 K1000
Set Torque
19
X1
TORQ K-200 K1000
Set Torque
25
M0
X4
M1040
Ready
Power on
28
END
9999

Homing control/position control:

Register table in homing mode/position mode:

Control special M

Special M	Description of Function	Attributes
M1040	Servo On	RW
M1048	Move to new position, must use control mode as position mode (D1060 = 1) and M1040 = 1	RW
M1050	Absolute position/relative position (0: relative/1: absolute)	RW
M1055	Search for origin (home start), must use control mode as position mode (D1060 = 3) and M1040 = 1	RW

Status special M

Special M	Description of Function	Attributes
M1064	Target reached	RO
M1070	Return home complete	RO
M1071	Homing error	RO

Control special D

Special D	Description of Function	Attributes
D1060	Operating mode setting (position mode is 1, homing mode is 3)	RW

Status special D

Special D	Description of Function	Attributes
D1050	Actual operating mode (speed mode is 0)	RO
D1051	Actual position (Low word)	RO
D1052	Actual position (High word)	RO

※ D1051 and D1052 must be combined to give the actual location, and it has a serial number.

Position mode control commands:

DPOS(P) S1

Target (with numbers)

Example of homing mode/position mode control:

First complete setting of electromechanical parameters connected with position before implementing homing control or position control.

1. Set 00-40 to select the homing method and the corresponding limit sensors and origin. (Setting the MI function gives a reverse rotation limit of 44, a forward rotation limit of 45, and an origin proximity of 46. Because the CT2000 current only supports a Z-phase origin, the encoder card must a provide Z-phase.)

2. Set D1060 = 3 to change the converter to the homing mode.

3. Set M1040 = 1
   In the VF/SVC/VFPG mode, will enter the STANDBY mode (01-34 can be used to access the STANDBY mode's action options).
   In the FOC+PG mode, zero speed holding will occur

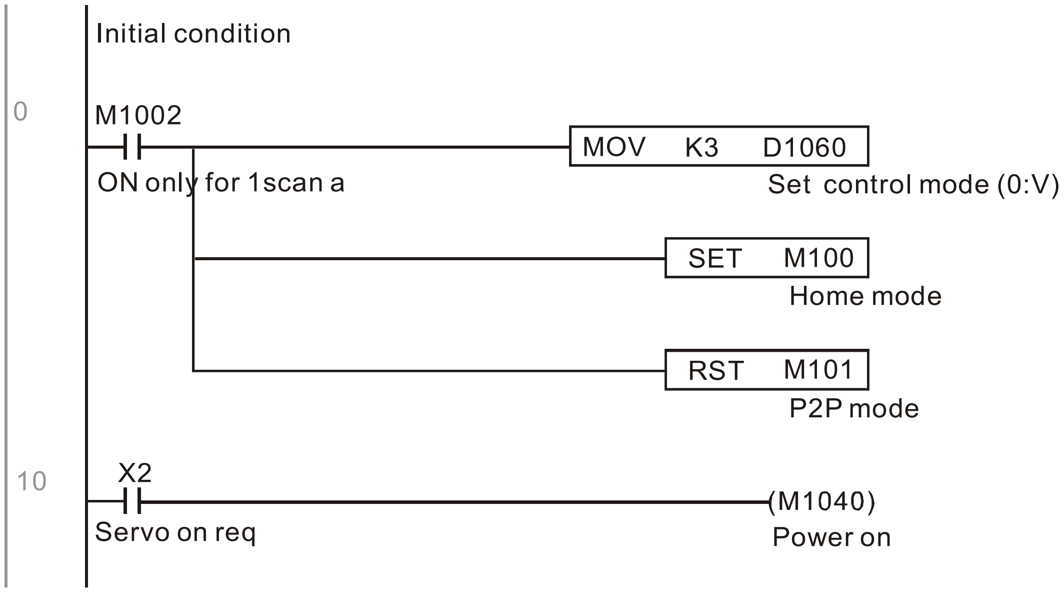
4. Set M1055 = 1, and the driver will now start to search for the origin.

5. When homing is complete, M1070 will change to ON. If you now set D1060 = 1, the control mode will switch to position mode (please note that M1040 will not change to off; this mechanical origin move).

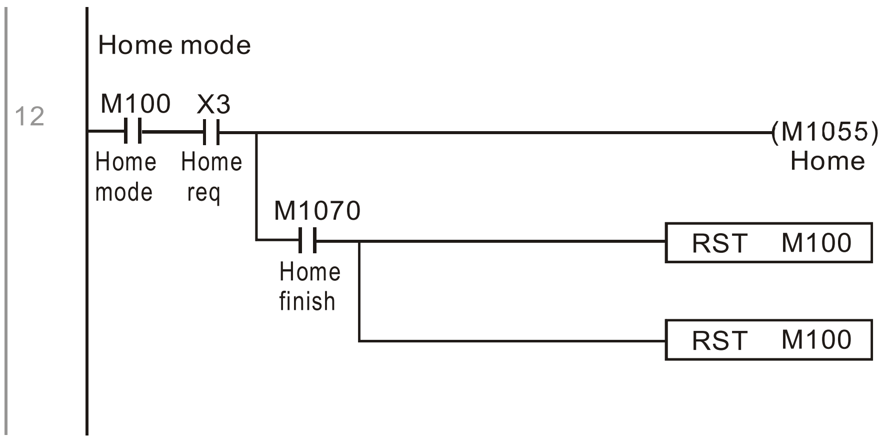
6. The DPOS command can now be used to designate the driver's target location. M1050 or parameter 00-12 can be used to set a change in absolute or relative position.

7. Implement M1048 Pulse ON once (must be more than 1 ms in duration), and the converter will begin to move toward the target (M1040 must be 1 to be effective). The current position can be obtained from D1051 and D1052.

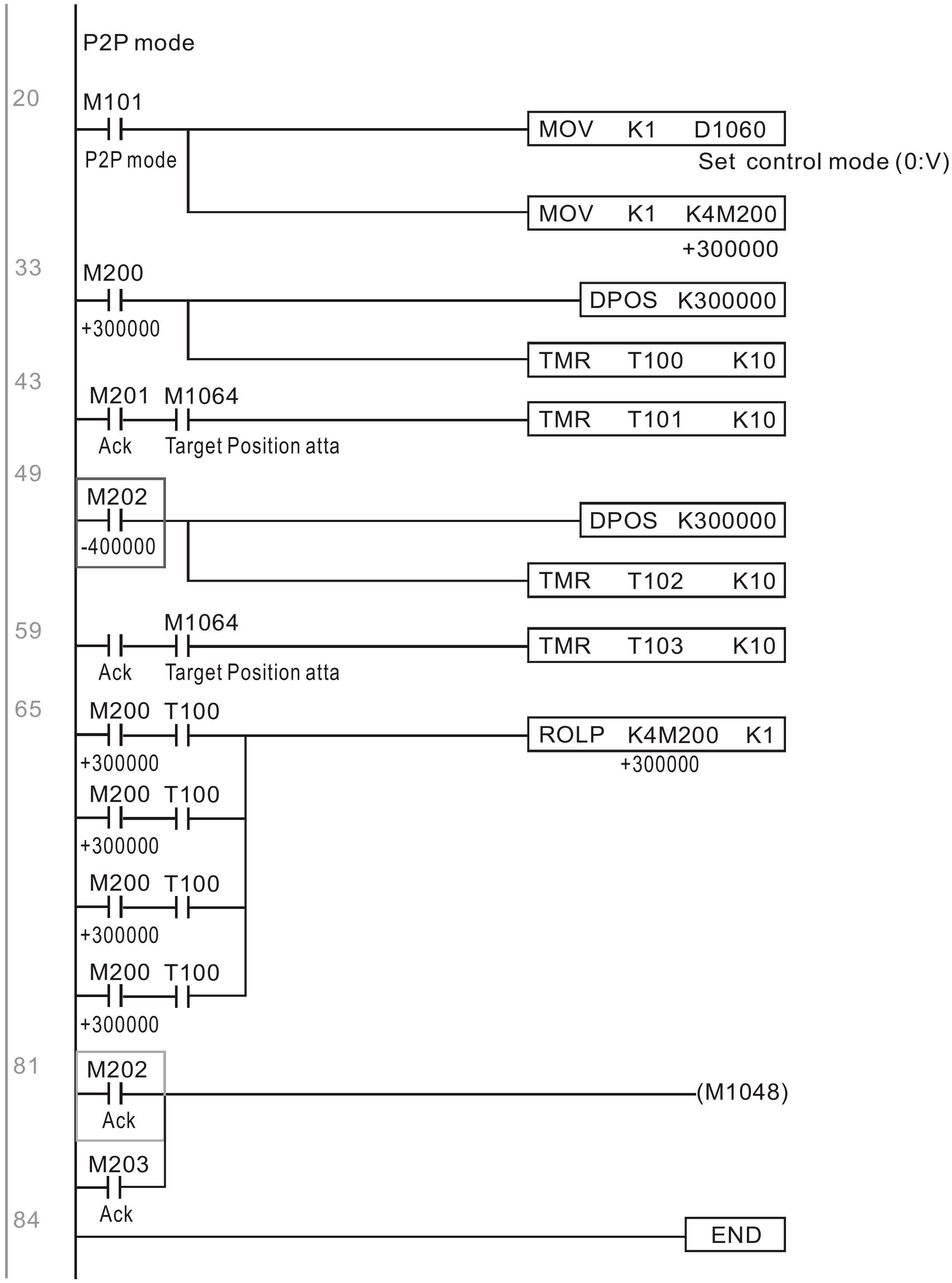
Part 1: The initialization mode is defined as the "homing" mode from the beginning (set D1060 = 3). X2 is used to implement converter excitation.



Part 2—homing: Use X3 to trigger homing action; will automatically switch to position mode after completion.



Part 3—point-to-point movement: Switch to position mode (set D1060 = 1), and move back and forth between position points. (+300000 ~ -300000)



※ If homing is not needed in an application, the first and second parts can be skipped. However, the M1040 condition from Part 1 must be included, and the writing method in Part 1 involve the use of X2 to achieve direct access. In addition, when M101 is used at the beginning of Part 3 to set the control mode, it can be rewritten as M1002, which will put the PLC immediately into the position mode when it starts running.

16-10 Internal communications main node control

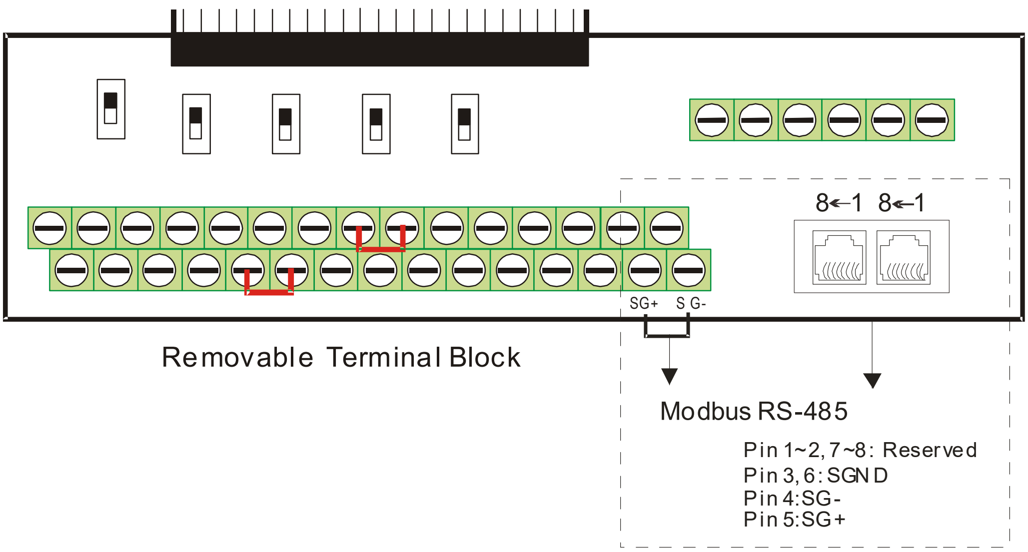
The protocol has been developed in order to facilitate the use of 485 instead of CANopen in certain application situations. The 485 protocol offers similar real-time characteristics as CANopen; this protocol can only be used on the C2000 and CT2000 devices. The maximum number of slave devices is 8.

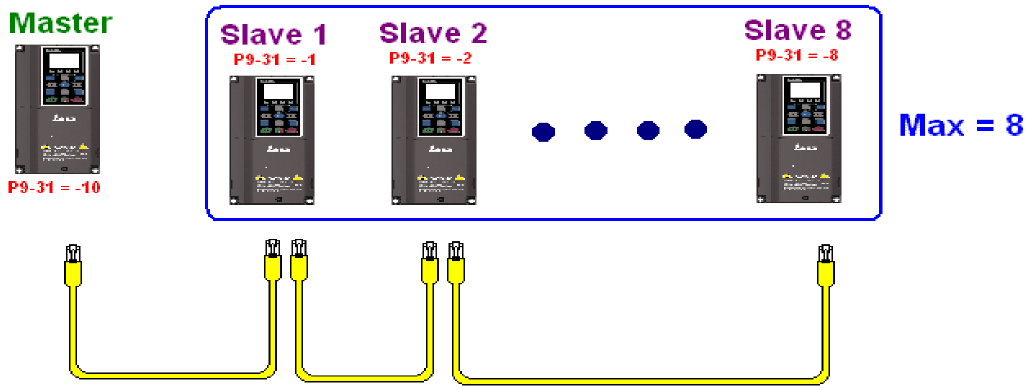
Internal communications have a master-slave structure. The initiation method is very simple:

Slave device:
Set parameter 09-31 = -1 to -8 in order to access 8 nodes, and set parameter 00-20 = 1 to define the control source as 485 and access the reference sources that must be controlled, namely speed command (00-21 = 2), torque command (11-33 = 1), and position command (11-40=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 parameter 09-31 = -10, and enable the PLC.

Hardware wiring: The master and slave stations are connected via the 485 serial port. The CT2000 provide two types of 485 serial port interfaces, see the figure below: (please refer to 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	Location mode	Torque mode	Homing mode	
D1120 + 10*N	Internal node N control command	0	4	Command functions	-	-	Homing Origin	RW
		1	4	Reverse rotation requirements	Immediate change	-	-	
		2	4	-	-	-	-	
		3	3	Temporary pause	Temporary pause	-	-	
		4	4	Frequency locking	-	-	Temporary pause	
		5	4	JOG	-	-	-	
		6	2	Quick Stop	Quick Stop	Quick Stop	Quick Stop	
		7	1	Servo ON	Servo ON	Servo ON	Servo ON	
		11~8	4	Speed interval switching	Speed interval switching	-	-	
		13~12	4	Deceleration time change	-	-	-	
		14	4	Enable Bit 13 ~ 8	Enable Bit 13 ~ 8	-	-	
		15	4	Clear error code	Clear error code	Clear error code	Clear error code	
D1121 + 10*N	Internal node N control mode			0	1	2	3	RW
D1122 + 10*N	Internal node N reference command L			Speed command (no number)	Position command (with numbers)	Torque command (with numbers)	-	RW
D1123 + 10*N	Internal node N reference command H			-		Speed limit	-	RW

※ N = 0 ~ 7

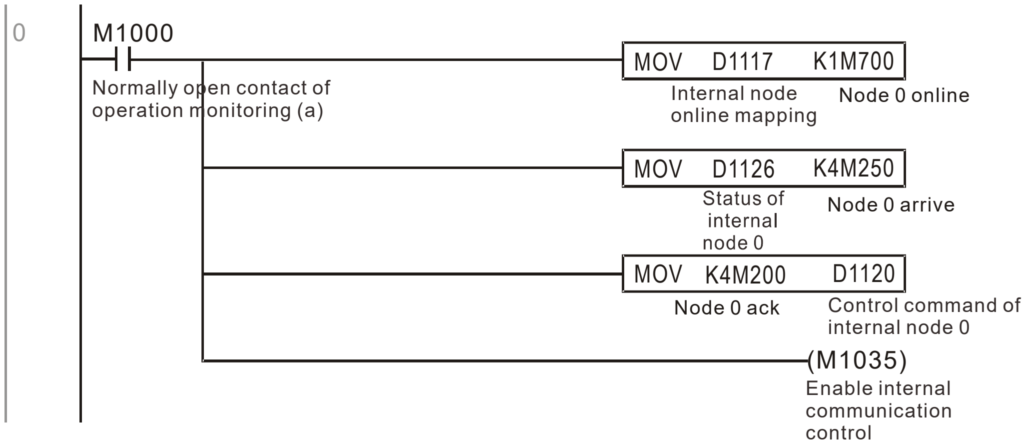
Status special D

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

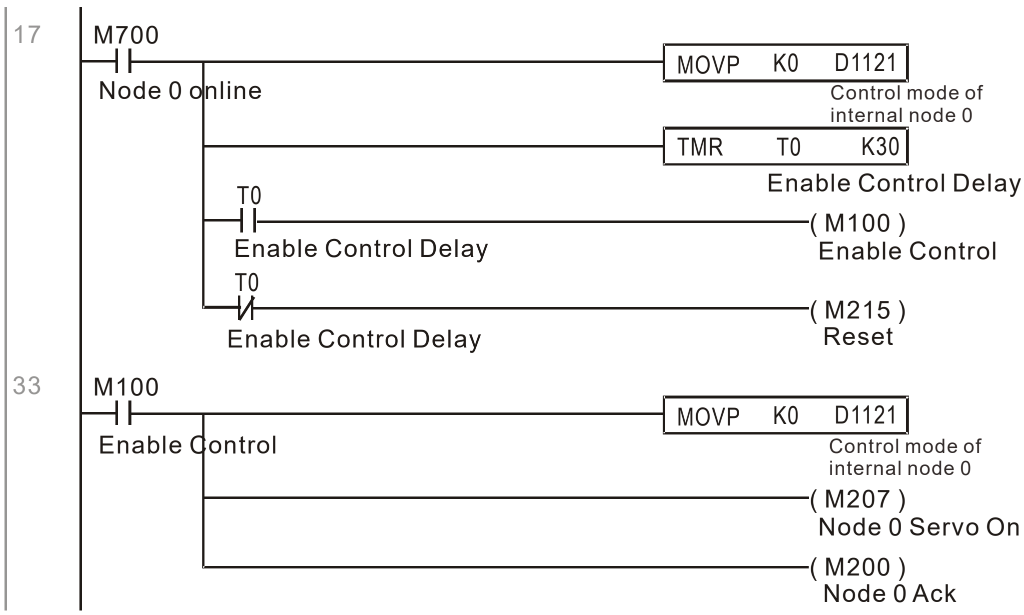
Special D	Description of Function					Attributes
	bit	Speed mode	Location mode	Torque mode	Homing mode	
D1126 + 10*N	0	Frequency command arrival	Position command attained	Torque command attained	Zero command completed	RO
	1	Clockwise Counterclockwise:	Clockwise Counterclockwise:	Clockwise Counterclockwise:	Clockwise Counterclockwise:	
	2	Warning	Warning	Warning	Warning	
	3	Error	Error	Error	Error	
	5	JOG				
	6	Quick Stop	Quick Stop	Quick Stop	Quick Stop	
	7	Servo ON	Servo ON	Servo ON	Servo ON	
D1127 + 10*N		Actual frequency	Actual position (with numbers)	Actual torque (with numbers)	-	RO
D1128 + 10*N		-		-	-	

※ N = 0 ~ 7

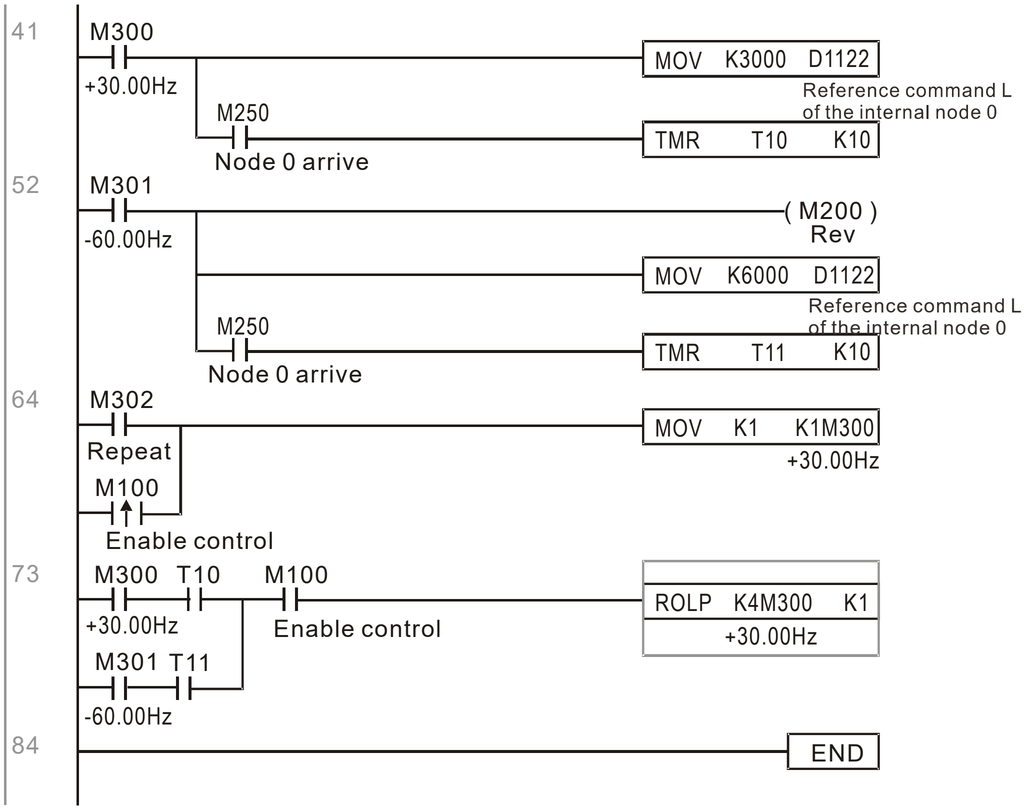
Example: Assume it is desired to control slave station 1 operation at frequencies of 30.00Hz and 60.00 Hz, status, and online node correspondences:



When it is judged that slave station 1 is online, delay 3 sec. and begin control



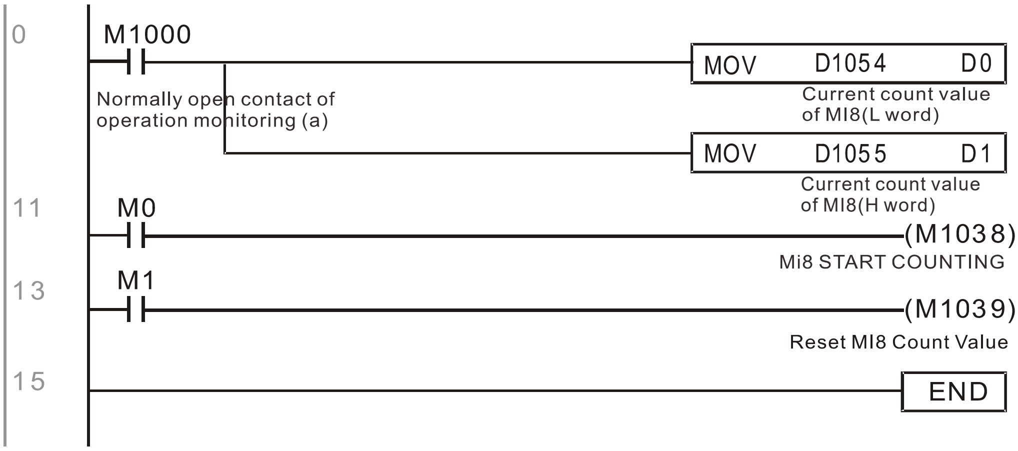
It is required slave station 1 maintain forward rotation at 30.00Hz for 1 sec., and maintain reverse rotation at 60.00 Hz for 1 sec., and repeat this cycle continuously.



16-11 Count function using MI8

16-11-1 High-speed count function

The CT2000's MI8 supports one-way pulse counting, and the maximum speed is 100K. The starting method is very simple, and only requires setting M1038 to begin counting. The 32 bit count value is stored on D1054 and D1055 in non-numerical form. M1039 can reset the count value to 0.



※ When the PLC program defines MI8 for use as a high-speed counter, and also for use in PLC procedures, it must be written to M1038 or M1039, and the original MI8 functions will be disabled.

16-11-2 Frequency calculation function

Apart from high-speed counting, the CT2000's MI8 can also convert a received pulse to frequency. The following figure shows that there is no conflict between frequency conversion and count calculations, which can be performed simultaneously.

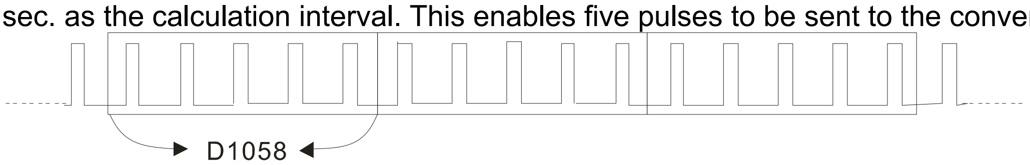
PLC speed calculation formula

D1057 Speed

D1058 Interval between calculations

D1059 Decimal places

Assuming that there are 5 input pulses each second, (see figure below) we set D1058=1000ms=1.0 sec. as the calculation interval. This enables five pulses to be sent to the converter each second.



Assuming that each 5 pulses correspond to 1Hz, we set D1057=5.

Assuming that we wish to display numbers to two decimal places, we set D1059=2, which is also 1.00Hz. The numerical value displayed at D1056 is 100. For simplicity, the D1059 conversion formula can be expressed as in the following table:

$$D1058 = \frac{\text{Pulses per second}}{D1057} \times \frac{1000}{D1057} \times 10^{D1059}$$

16-12 Modbus remote IO control applications (use MODRW)

The CT2000'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 parameter 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 parameter 09-01, the communications format is defined by parameter 09-04, and the PLC's current station number is defined by parameter 09-35. The CT2000 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:

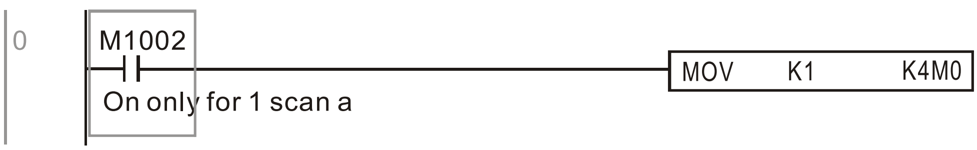
MODRW command					General meaning	Slave device is Delta's PLC meaning	Slave device is Delta's converter meaning
S1	S2	S3	S4	S5			
Node ID	Command	Address	Return: D area	Length:			
K3	H01	H500	D0	K18	Read coil (Bit)	Read 18 bits of data corresponding to slave station 3 PLC Y0 to Y21. This data is stored by bit 0 to 15 of the 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

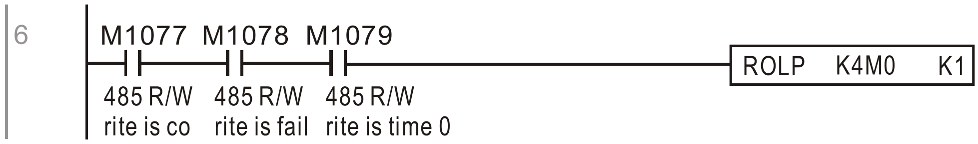
After implementing MODRW, the status will be displayed in M1077 (485 read/write complete), M1078 (485 read/write error), and M1079 (485 read/write time out). M1077 is defined so as to immediately revert to 0 after the MODRW command has been implemented. However, any of three situations—a report of no 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

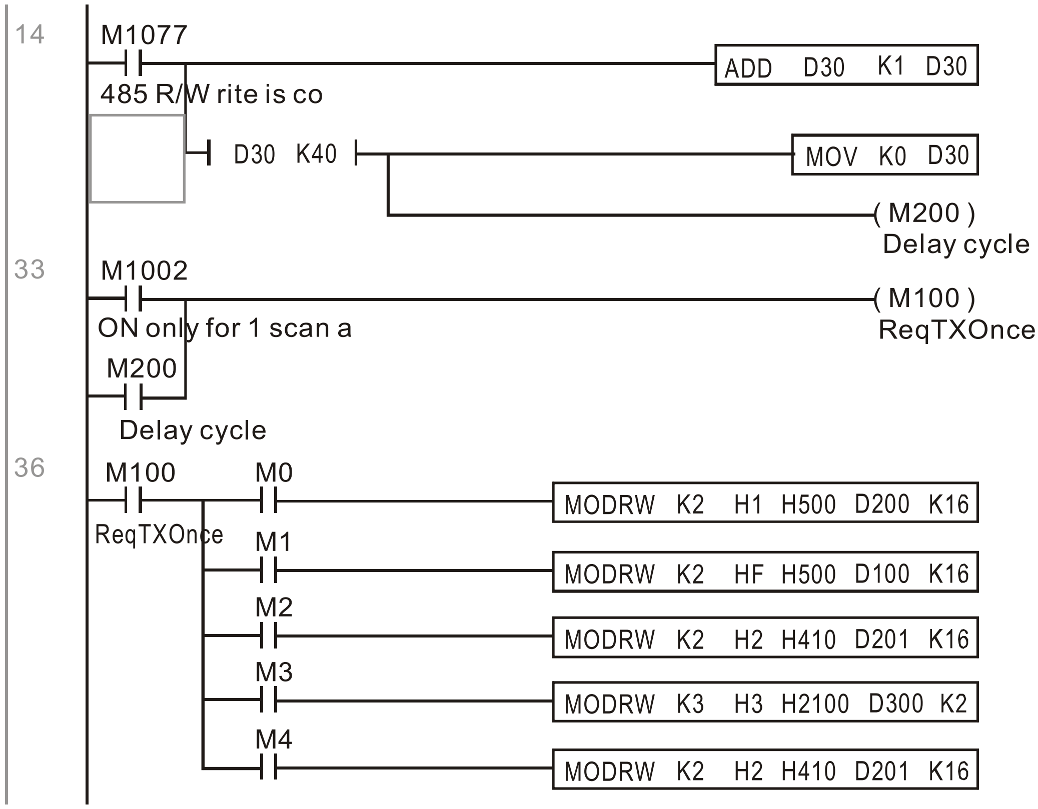
At the start, will cause the transmitted time sequence to switch to the first data unit.



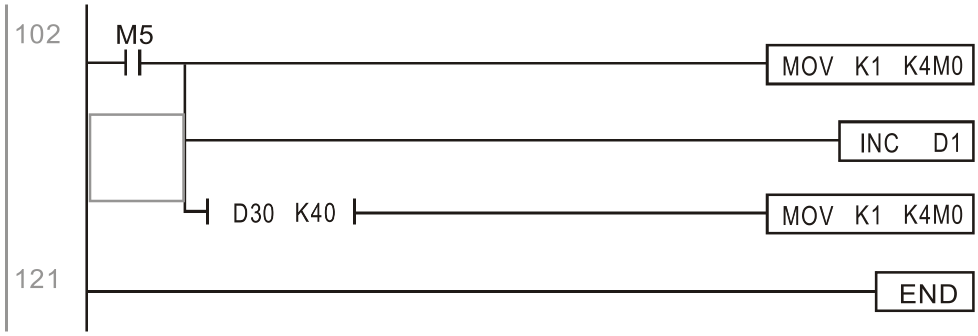
When the reported message indicates no error, it will switch to the next transmitted command



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

CT2000：The default PLC station number is set as 2 (09-35)

09-31=-12(COM1 is controlled by the PLC), 09-01=115.2(The communications speed is 115200)

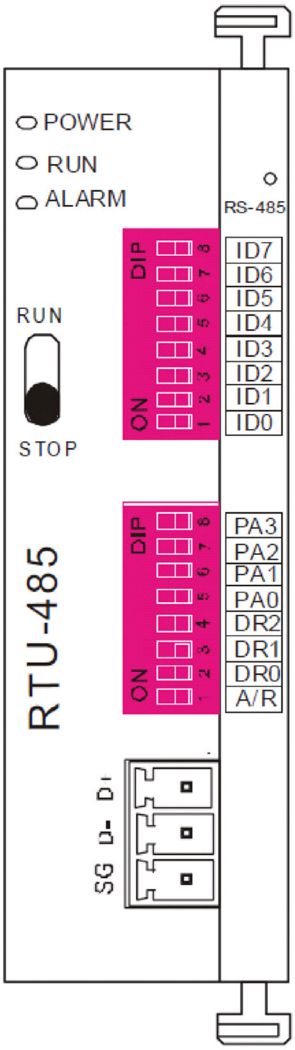
09-04=13(The format is 8,N,2, RTU)

RTU485: The station number = 8 (give example)

ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0

PA3	PA2	PA1	PA0	DR2	DR1	DR0	A/R

0	0	0	0	1	0	0	0	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

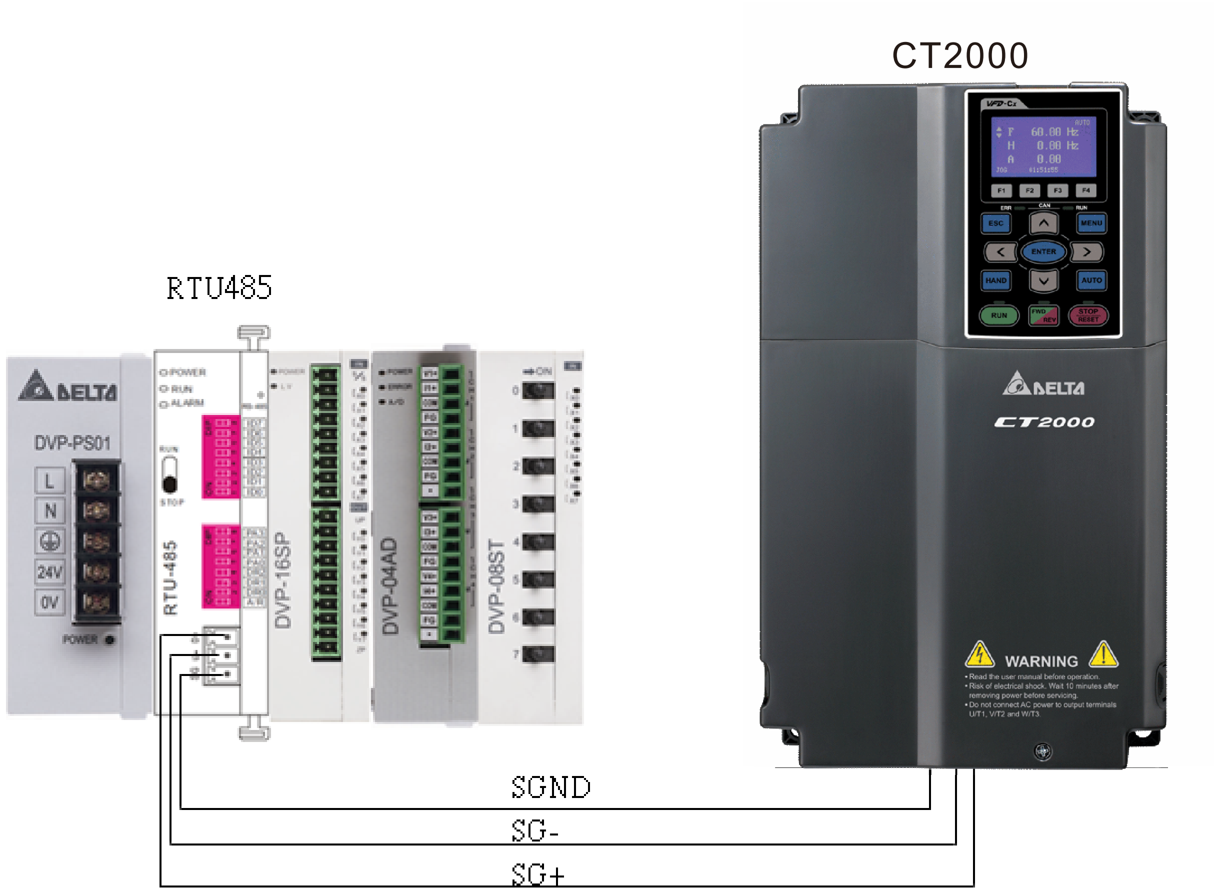
DR2	DR1	DR0	Communicaton Speed
OFF	OFF	OFF	1,200 bps
OFF	OFF	ON	2,400 bps
OFF	ON	OFF	4,800 bps
OFF	ON	ON	9,600 bps
ON	OFF	OFF	19,200 bps
ON	OFF	ON	38,400 bps
ON	ON	OFF	57,600 bps
ON	ON	ON	115,200 bps

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.

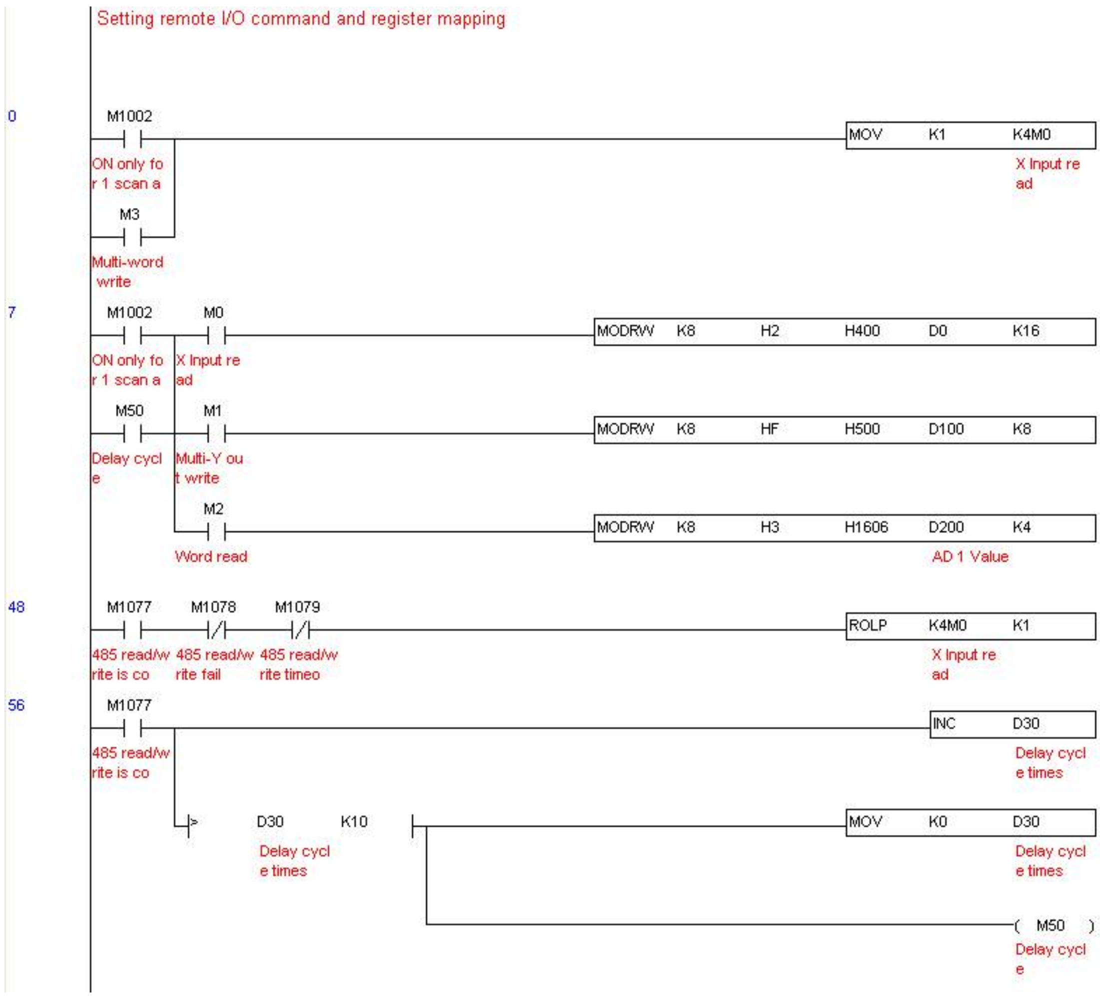
The following corresponding locations can be obtained from the RTU485's configuration definitions:

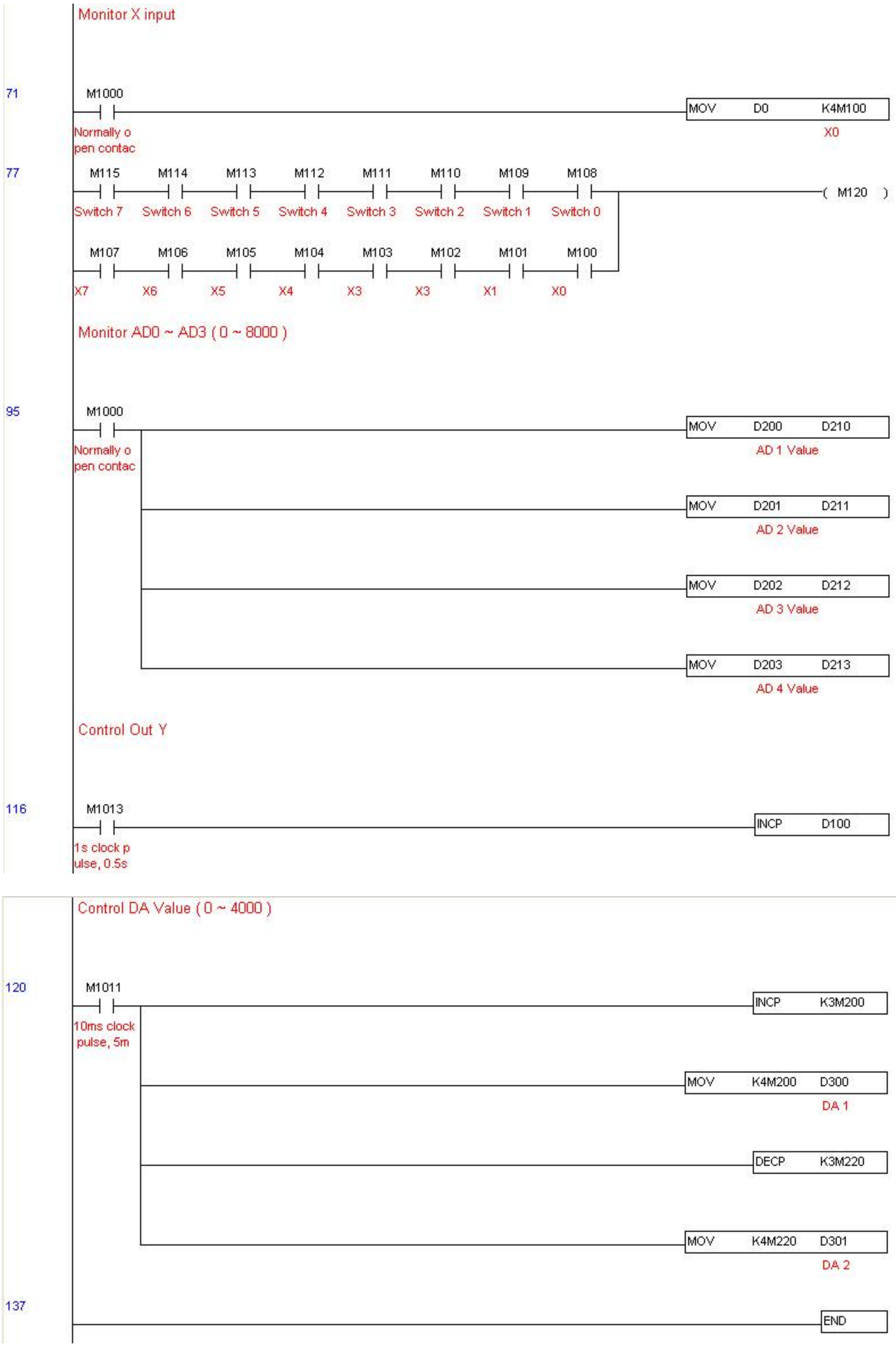
Module	Terminals	485 Address
DVP16-SP	X0 ~ X7	0400H ~ 0407H
	Y0 ~ Y7	0500H ~ 0507H
DVP-04AD	AD0 ~ AD3	1600H ~ 1603H
DVP02DA	DA0 ~ DA1	1640H ~ 1641H
DVP-08ST	Switch 0 ~ 7	0408H ~ 040FH

Step 3: Physical configuration



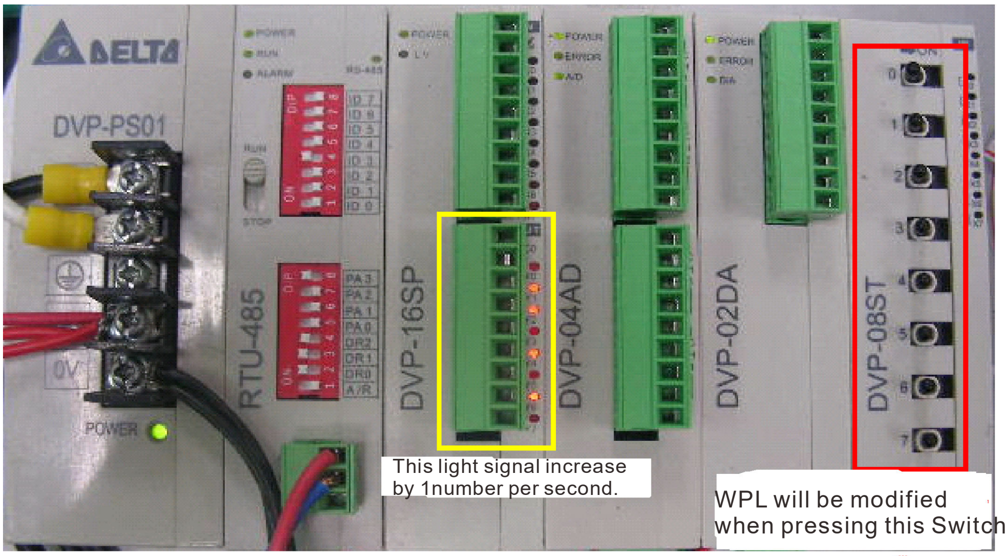
Step 4: Write to PLC program

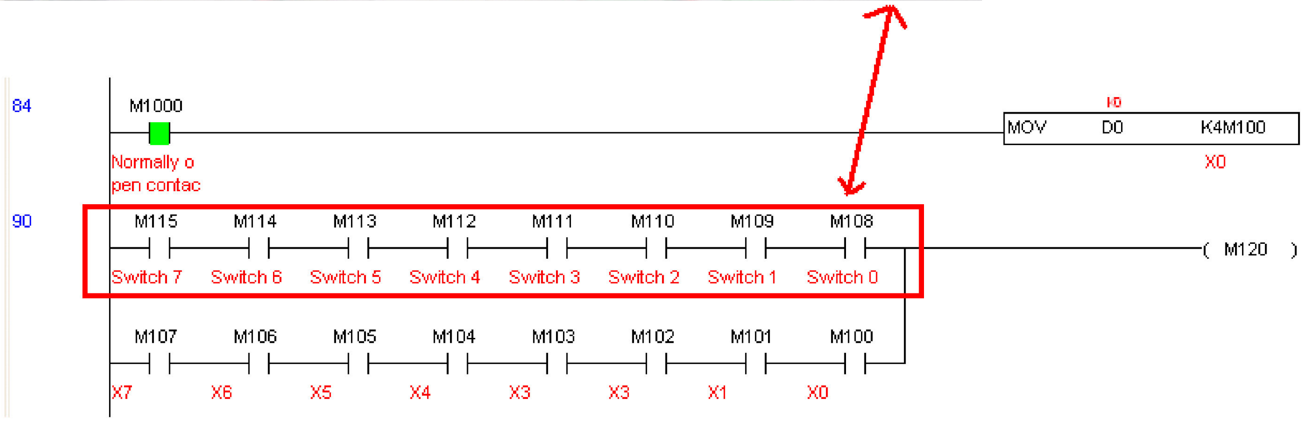



Monitor X input
71
M1000
Normally o
pen contac
MOV D0 K4M100
X0
77
M115 M114 M113 M112 M111 M110 M109 M108
Switch 7 Switch 6 Switch 5 Switch 4 Switch 3 Switch 2 Switch 1 Switch 0
M120
M107 M106 M105 M104 M103 M102 M101 M100
X7 X6 X5 X4 X3 X3 X1 X0
Monitor AD0 ~ AD3 (0 ~ 8000)
95
M1000
Normally o
pen 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

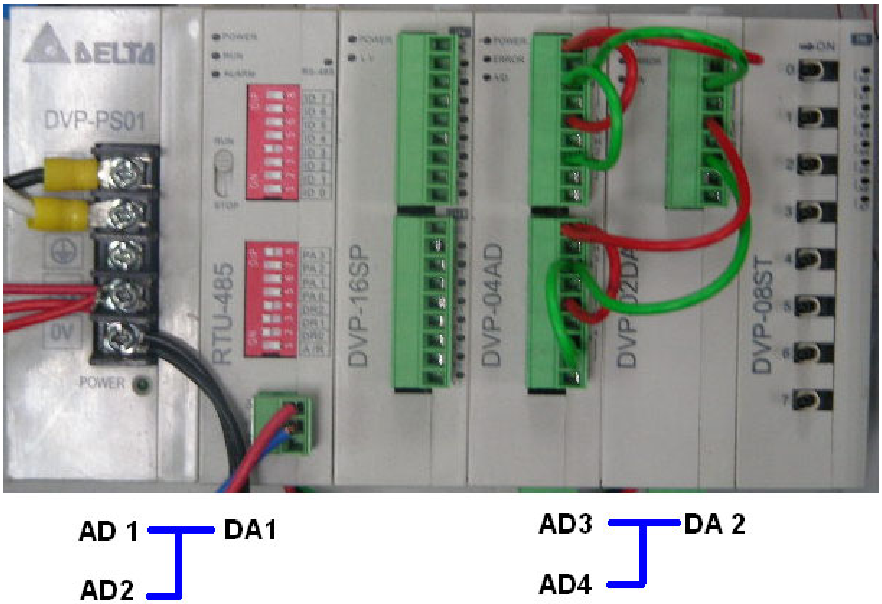
Step 5: Actual testing situation:

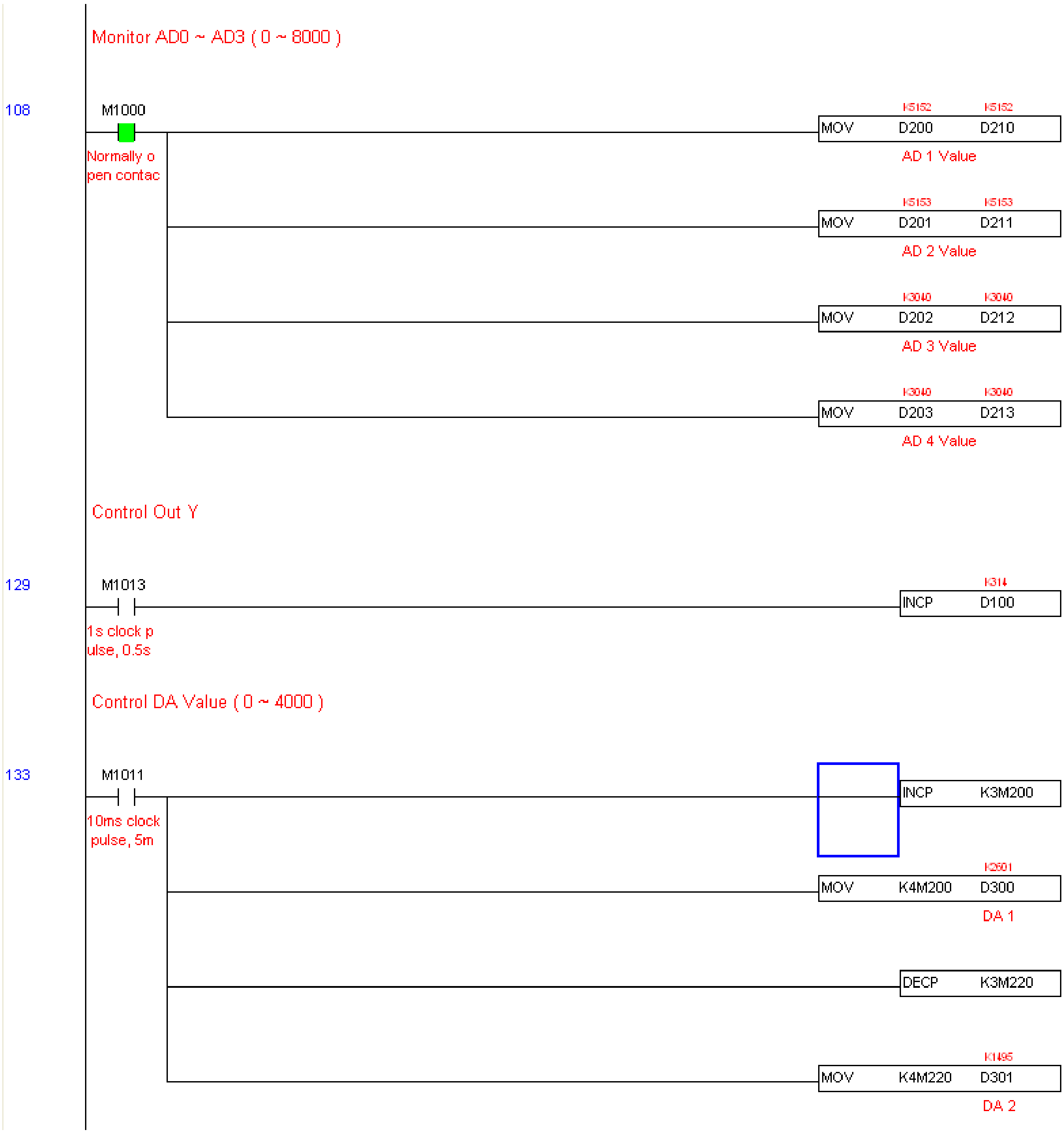
I/O testing: When the switch is activated, it can be discovered that the display corresponds to M115 - M108. Furthermore, it can be seen that one output point light is added every 1 sec. (the display uses a binary format)





AD DA testing: It can be discovered that D200 and D201 are roughly twice the D300, and continue to increase progressively. For their part, the D202 and D203 are roughly twice the D301, and continue to decrease progressively.




Monitor AD0 ~ AD3 (0 ~ 8000)
108
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
129
M1013
1s clock p
ulse, 0.5s
INCP D100
Control DA Value (0 ~ 4000)
133
M1011
10ms clock
pulse, 5m
INCP K3M200
MOV K4M200 D300
DA 1
DECP K3M220
MOV K4M220 D301
DA 2

16-13 Calendar functions

The CT2000's internal PLC includes calendar functions, but these may only be used when a keypad (KPC-CC01) is connected, and otherwise 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.

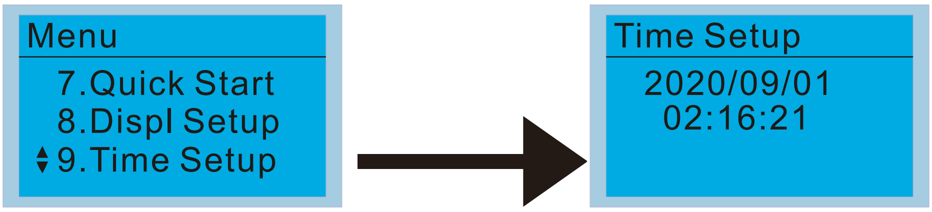
*When it is discovered that the CT2000 has no keypad 10 sec. after startup, PLrt will be triggered.

*If the keypad is suddenly pulled out while the calendar is operating normally, and is not reconnected for more than 1 minute, PLrt will be triggered.

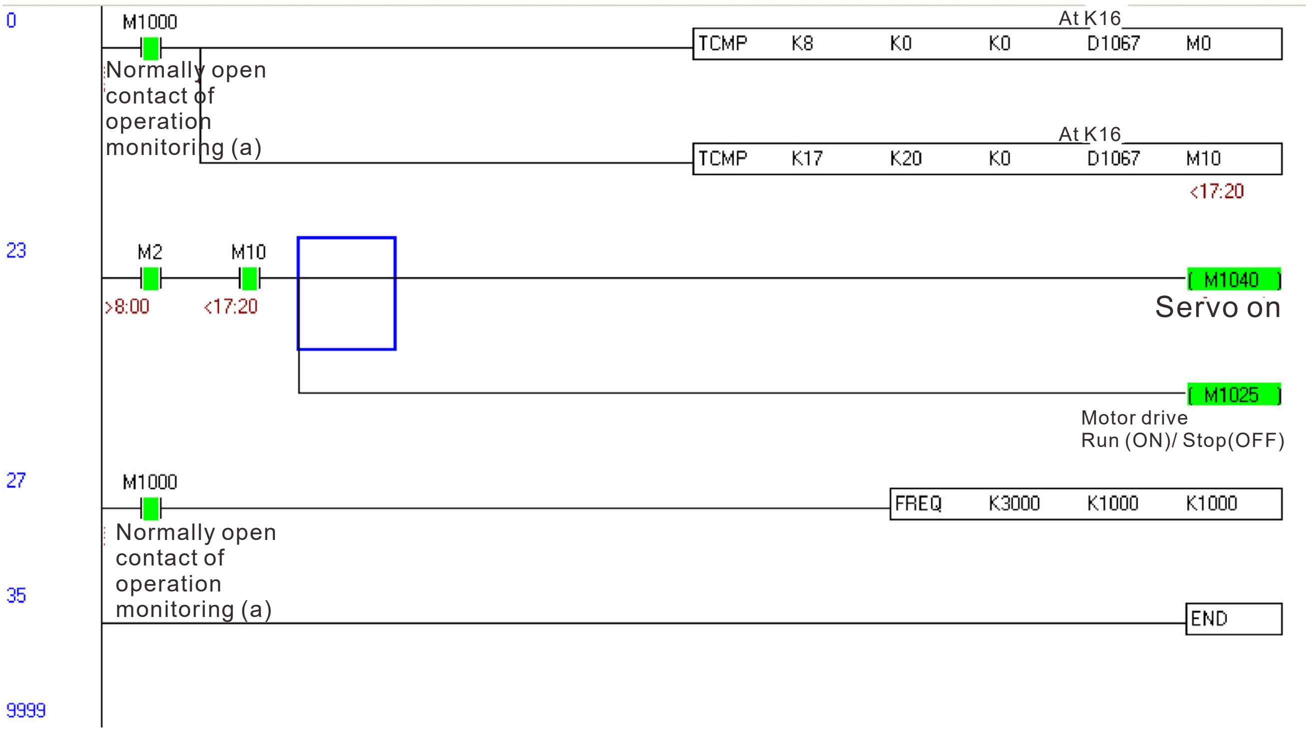
Practical applications:

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



Chapter 17 Safe Torque Off Function

17-1 The Drive Safety Function Failure Rate

Item	Definition	Standard	Performance
SFF	Safe Failure Fraction	IEC61508	Channel 1: 80.08% Channel 2: 68.91%
HFT (Type A subsystem)	Hardware Fault Tolerance	IEC61508	1
SIL	Safety Integrity Level	IEC61508	SIL 2
		IEC62061	SILCL 2
PFH	Average frequency of dangerous failure [h-1]	IEC61508	9.56×10^{-10}
PFD_{av}	Probability of Dangerous Failure on Demand	IEC61508	4.18×10^{-6}
Category	Category	ISO13849-1	Category 3
PL	Performance level	ISO13849-1	d
$MTTF_d$	Mean time to dangerous failure	ISO13849-1	High
DC	Diagnostic coverage	ISO13849-1	Low

17-2 Safety Torque Off Terminal Function Description

The Safe Torque Off function (STO) 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:

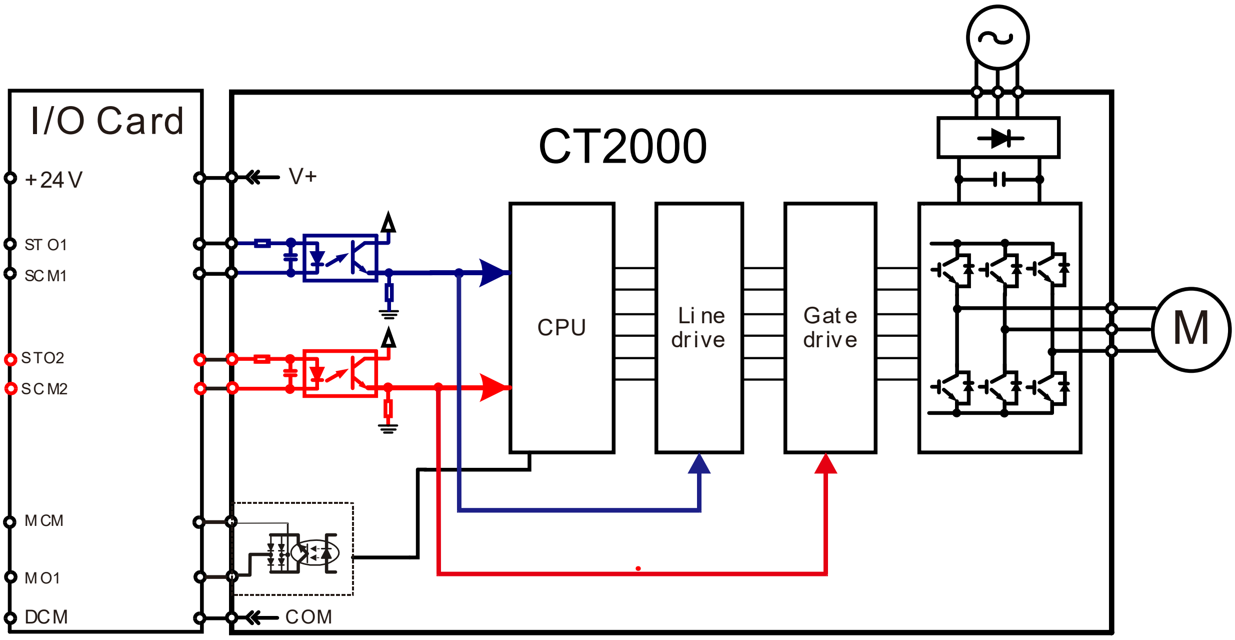
Table 1: Terminal operation description

Signal	Channel	Photo-coupler Status			
STO signal	STO1–SCM1	ON (High)	ON (High)	OFF (Low)	OFF (Low)
	STO2–SCM2	ON (High)	OFF (Low)	ON (Low)	OFF (Low)
Driver Output status		Ready	STL2 mode (Torque output off)	STL1 mode (Torque output off)	STO mode (Torque output off)

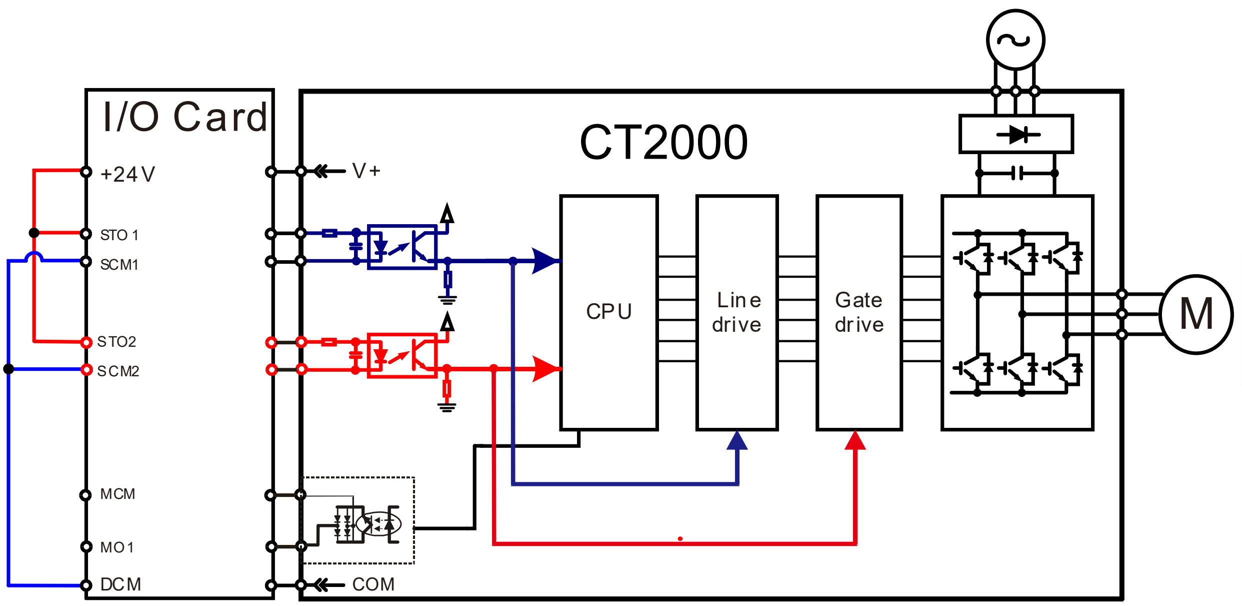
- STO means Safe Torque Off
- STL1–STL3 means Safe Torque Off hardware abnormal.
- STL3 means STO1–SCM1 and STO2–SCM2 internal circuit detected abnormal.
- STO1–SCM1 ON (High): means STO1–SCM1 has connection to a +24 V_{DC} power supply.
- STO2–SCM2 ON (High): means STO2–SCM2 has connection to a +24 V_{DC} power supply.
- STO1–SCM1 OFF (Low): means STO1–SCM1hasn’t connection to a +24 V_{DC} power supply.
- STO2–SCM2 OFF (Low): means STO2–SCM2hasn’t connection to a +24 V_{DC} power supply.

17-3 Wiring Diagram

17-3-1 Internal STO circuit as below:

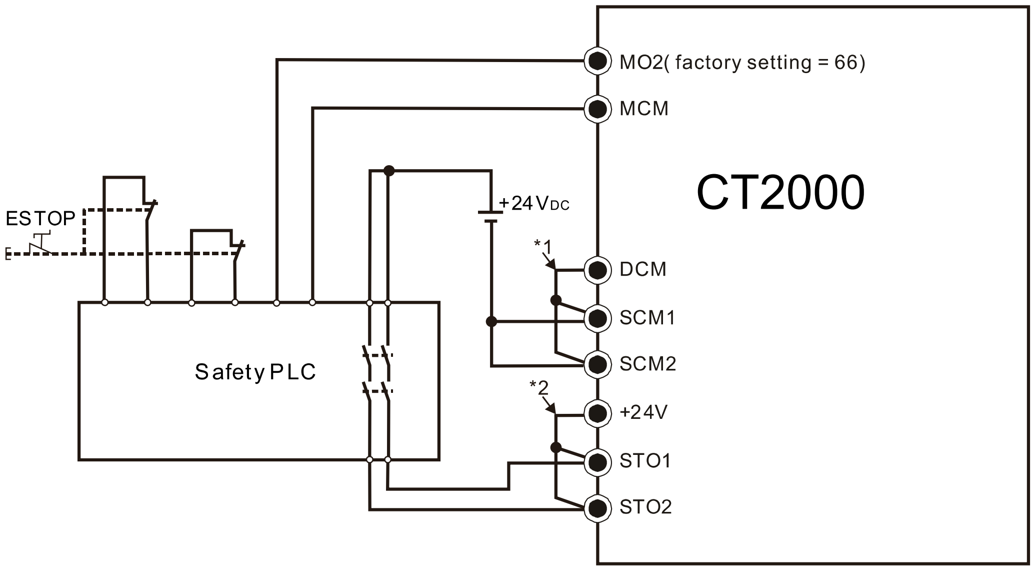


17-3-2 In the figure below, the default setting for +24V-STO1-STO2 and SCM1-SCM2-DCM is short-circuited:



17-3-3 The control loop wiring diagram:

1. Remove the short-circuit of +24V-STO1-STO2 and DCM-SCM1-SCM2.
2. The wiring as below diagram. The ESTOP switch must be at Close status in normal situation, and the drive will be able to RUN.
3. STO mode, switch ESTOP open. The drive output stops and keypad displays STO.



NOTE:

*1. Default short-circuit of DCM-SCM1-SCM2. Remove the short-circuit to use the Safety function.

*2. Default short-circuit of +24V-STO1-STO2. Remove the short-circuit to use the Safety function.

17-4 Parameters

06-44 STO Alarm Latch

Default: 0

Settings 0: STO Alarm Latch

1: STO Alarm no Latch

- Pr.06-44 = 0 STO Alarm Latch: after the reason of STO Alarm is cleared, a Reset command is needed to clear the STO Alarm.
- Pr.06-44 = 1 STO Alarm no Latch: after the reason of STO Alarm is cleared, the STO Alarm will be cleared automatically.
- 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

02-16 Multi-Function Output 3 (MO1)

Default: 66

02-17 Multi-Function Output 4 (MO2)

Default: 0

Settings 66: SO output logic A

68: SO output logic B

Settings	Functions	Descriptions
66	SO Logic A output	Safety Output Normal Open
68	SO Logic B output	Safety Output Normal Close

- CT2000 default setting Pr.02-17 (MO2) = 66 (N.O.) and multi-function output setting adds two new functions: 66 and 68.

Drive Status	Safety Output Status	
	N.O. (MO = 66)	N.C. (MO = 68)
Normal run	Open	Close
STO	Close	Open
STL1–STL3	Close	Open

00-04 Content of Multi-function Display

Default: 3

Settings 45: Hardware version

17-5 Operating Sequence Description

17-5-1 Normal operation Status

As shown in Figure 3: When the STO1–SCM1 and STO2–SCM2=ON (no STO function is needed), the drive will execute “Operating” or “Output Stop” according to RUN/STOP command.

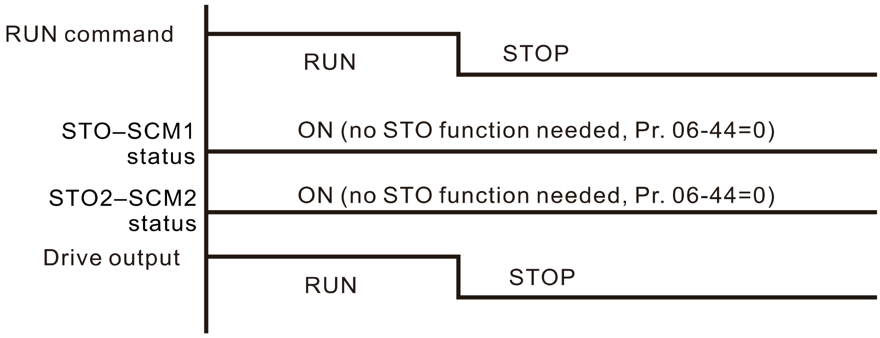


Figure 3

17-5-2 STO

17-5-2-1 STO, Pr.06-44 = 0, Pr.02-35 = 0

As shown in Figure 4: When both of STO1–SCM1 and STO2–SCM2 channel has turned off during operating, the STO function enabling and the drive will stop output regardless of Run command is ON or OFF status.

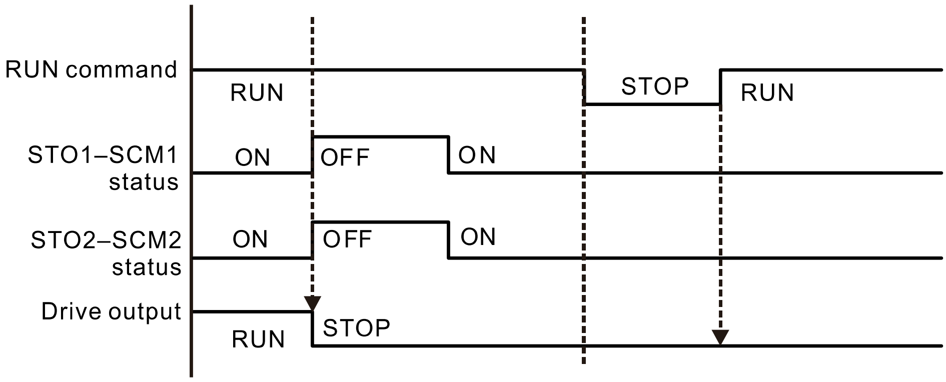


Figure 4

17-5-2-2 STO, Pr.06-44 = 0, Pr.02-35 = 1

As shown in Figure 5: As same as the figure 4. Because the Pr.02-35 = 1, after the Reset command, if the operating command still exists, then the drive will immediately execute the run command again.

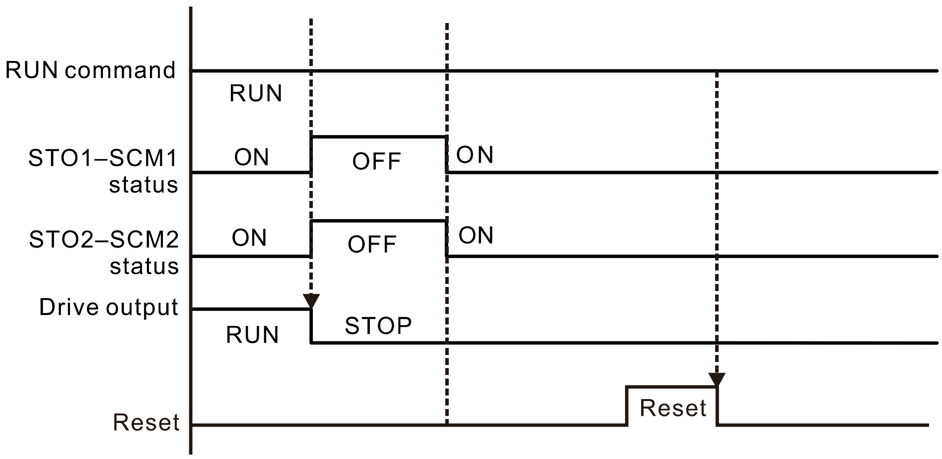


Figure 5

17-5-3 STO, Pr.06-44 = 1

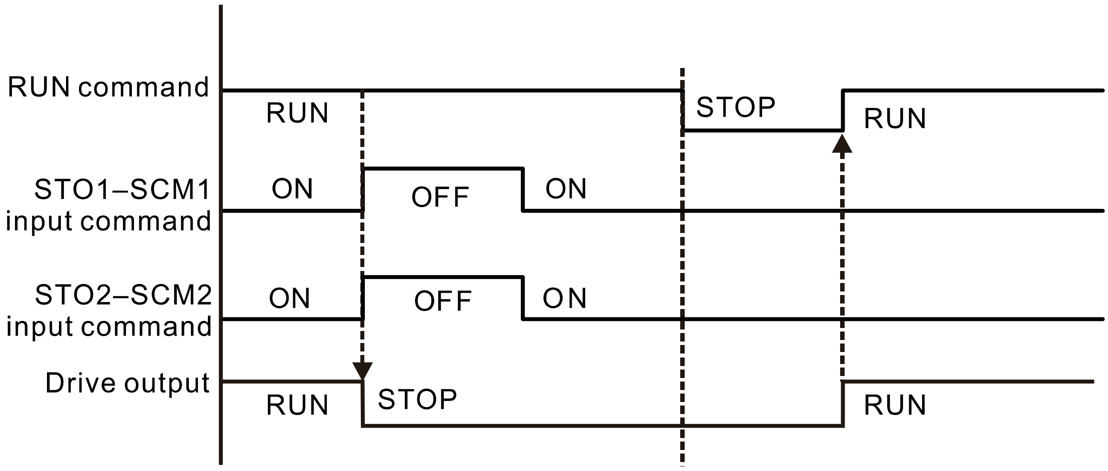


Figure 6

17-5-4 STL1

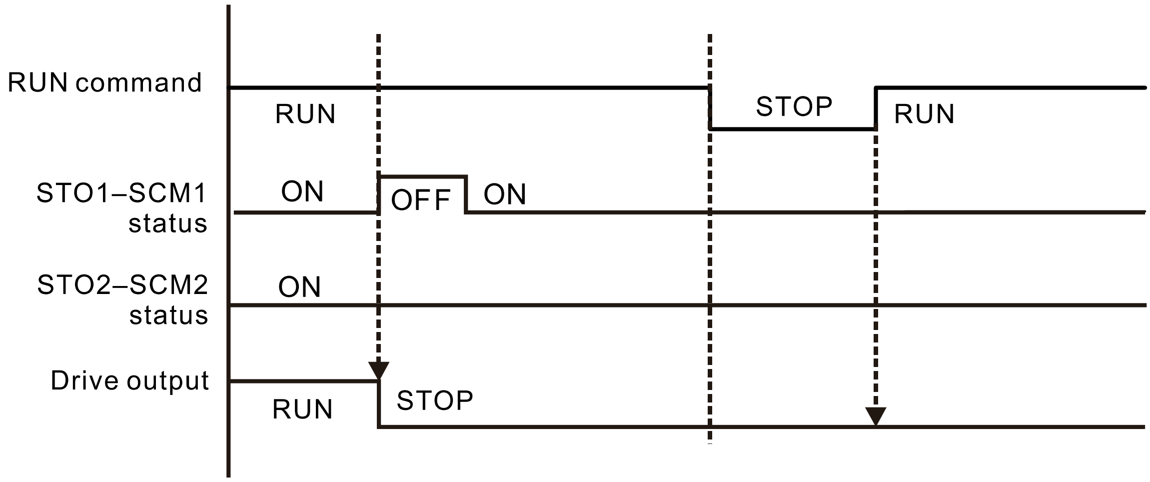


Figure 7

17-5-5 STL2

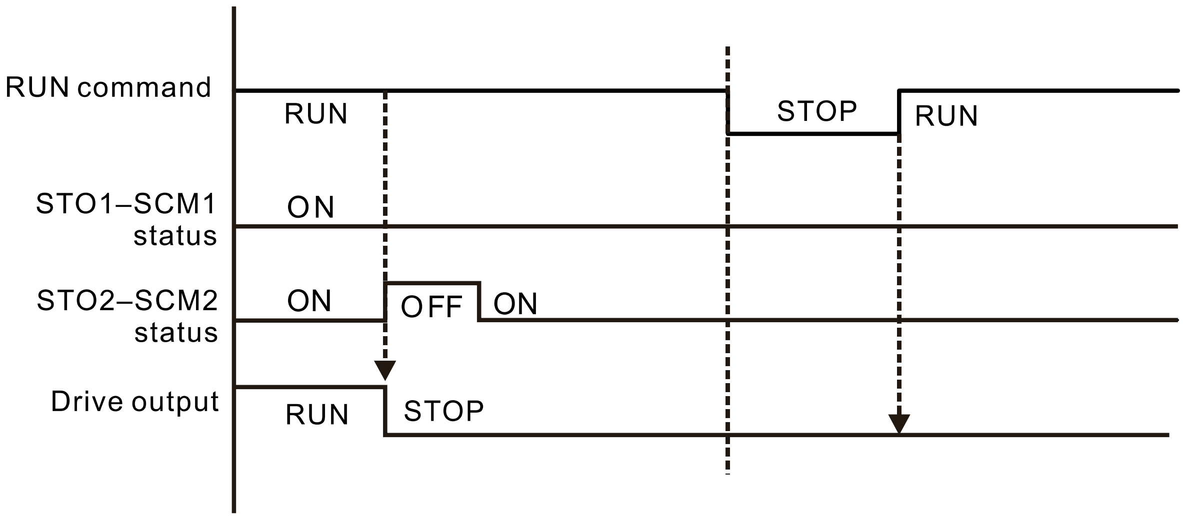


Figure 8

17-6 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

Default: 0

Settings 72: STO loss 1 (STL1)

76: Safe torque off (STO)

77: STO loss 2 (STL2)

78: STO loss 3 (STL3)

Error Code	Name	Description
76 (STO)	STO	Safe Torque Off function active
72 (STL1)	STL1 (STO1–SCM1)	STO1–SCM1 internal hardware detect error
77 (STL2)	STL2 (STO2–SCM2)	STO2–SCM2 internal hardware detect error
78 (STL3)	STL3	STO1–SCM1 and STO2–SCM2 internal hardware detect error

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Appendix A. Revision History

New Information	
Description	Related Part
Plate mounting models (CT2000-A) related information	Chapter 1, 2, 3, 5, 6, 7, 9
Efficiency curve	Chapter 9
New parameters and functions ● Parameter group 00: 00-00 ● Parameter group 02: 02-70	Chapter 11, 12
STO function	Chapter 17

Updated Information	
Description	Related Part
Information of model name, serial number	Chapter 1
Information of ring lug and wire gauge	Chapter 5
Information of brake resistors, magnetic contactor / air circuit breaker and non-fuse circuit breaker, AC / DC reactor, motor cable length, sine-wave filter, zero phase reactor, EMC filter, assembly of fans	Chapter 7
Specification table	Chapter 9
Update parameter settings and descriptions: ● Parameter group 00: 00-11、00-13、00-17 ● Parameter group 01: 01-10、01-11、01-23 ● Parameter group 02: 02-01~02-08、02-26~02-31、02-13~02-17、02-36~02-46、02-50、02-51、02-52、02-53 ● Parameter group 03: 03-07、03-08、03-09、03-20、03-23 ● Parameter group 06: 06-17~06-22、06-46、06-47、06-48、06-55 ● Parameter group 07: 07-01、07-13 ● Parameter group 08: 08-00、08-23 ● Parameter group 09: 09-04、09-75~09-92 ● Parameter group 10: 10-04、10-05、10-06、10-07、10-53 ● Parameter group 11: 11-34	Chapter 11, 12