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Delta Motor-mounted Pump Drive MPD Series User Manual

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

DELTA_IA-MDS_MPD_UM_EN_20210721

www.deltaww.com

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Limitation of Liability

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

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

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

- ☑ Disconnect AC input power before connecting any wiring to the AC motor drive.
- ☑ Even if the power has been turned off, a charge may still remain in the DC-link capacitors with hazardous voltages before the POWER LED is OFF. Do not touch the internal circuits and components.
- ☑ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Take anti-static measures 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

- ☑ The rated voltage of power system to install motor drives is 323V–528V. Ensure that the installation voltage is in the correct range when installing a motor drive.
- ☑ Refer to the table below for short circuit rating:

Model (Power)	Short circuit rating
460V	5 kA

- ☑ Only qualified persons are allowed to install, wire and maintain the AC motor drives.
- ☑ If you store the AC motor drive in a not-charged condition for more than three months, the ambient temperature should not be higher than 30°C. Storage longer than one year is not recommended and could result in the degradation of the electrolytic capacitors.
- ☑ Pay attention to the following when transporting and installing this package (including wooden crate, wood stave and carton box).
    1 If you need to sterilize or deworm the wooden crate or carton box, do not use steamed sterilization or you will damage the VFD. Use other methods to sterilize or deworm.
    2 You may use high temperatures to sterilize or deworm. Leave the packaging materials in an environment of over 56°C for 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 drive generates leakage current over AC 3.5 mA or DC 10 mA on a grounding conductor, compliance with local grounding regulations or IEC61800-5-1 standard is the minimum requirement for grounding.

NOTE

- 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.

- 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.
- The content of this manual may be revised without prior notice. Consult our distributors or download the latest version at http://www.deltaww.com/iadownload_acmotordrive.

Table of Contents

Issued Edition: 01
Firmware Version: V1.XX (Refer to Parameter 00-06 on the product to get the firmware version.)
Issued Date: 2021/07

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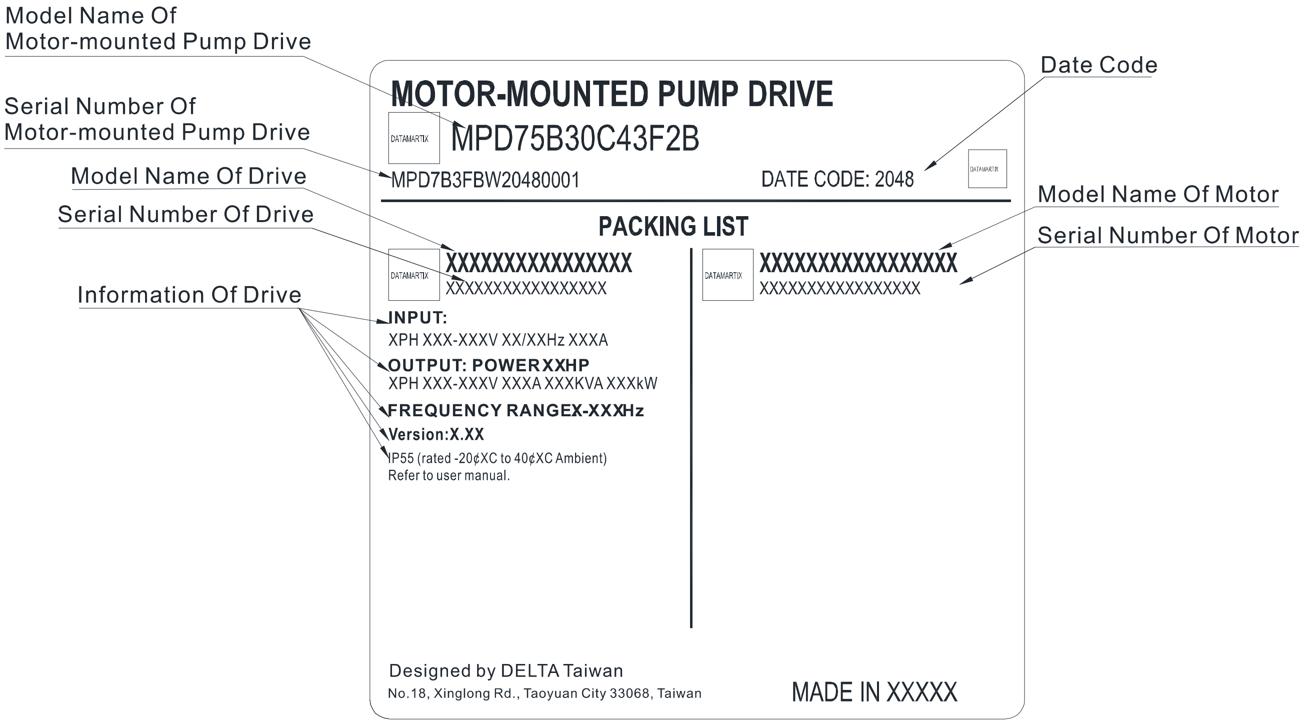
Chapter 1 Introduction

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

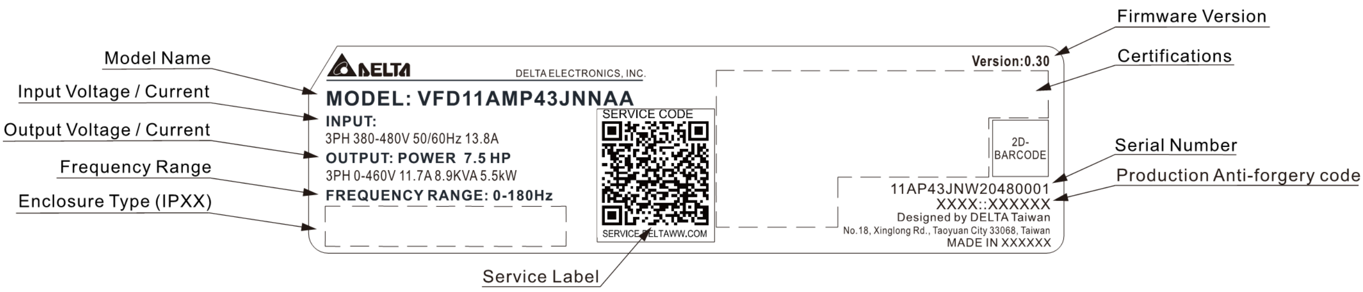
1. Inspect the unit after unpacking to ensure that it was not damaged during shipment. Make sure that the part number printed on the package matches the part number indicated on the nameplate.
2. Make sure that the mains voltage is within the range indicated on the nameplate. Install the AC motor drive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

1-1 Nameplate Information

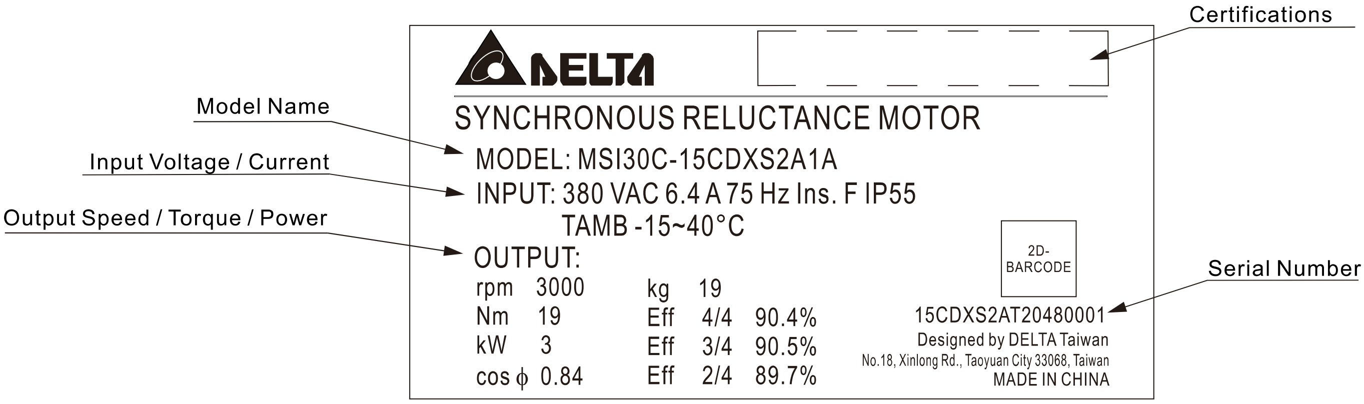
MPD = MP300 (AC motor drive) + MSI (Motor)



MP300 (AC motor drive)

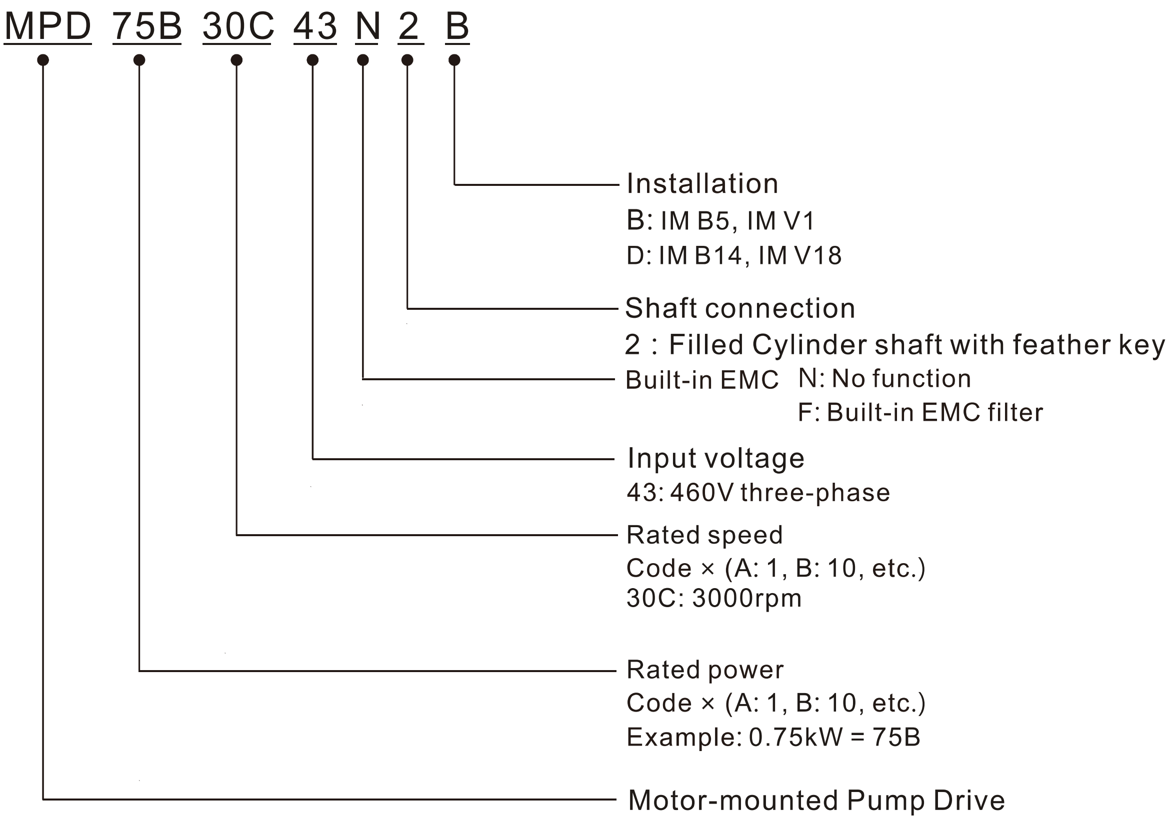


MSI (Motor)



1-2 Model Name

MPD = MP300 (AC motor drive) + MSI (Motor)



MP300 (AC motor drive)

VFD 8A5 MP 43 J F N A A

- A: Version type
- A: Model type A: Standard
- N: Safety function N: No function
- F: EMC function N: No function
  F: Built-in EMC filter
- J: Protection level J: IP55
- 43: Input voltage 43: 460V 3-phase
- MP: Series
  MP: MP300 (for Motor-mounted Pump Drive)
- 8A5: Rated output current
  Under normal duty mode (120%, 6 seconds)
  Refer to Chapter 9 Specifications in user manual for more details
- VFD: Series name (Variable Frequency Drive)

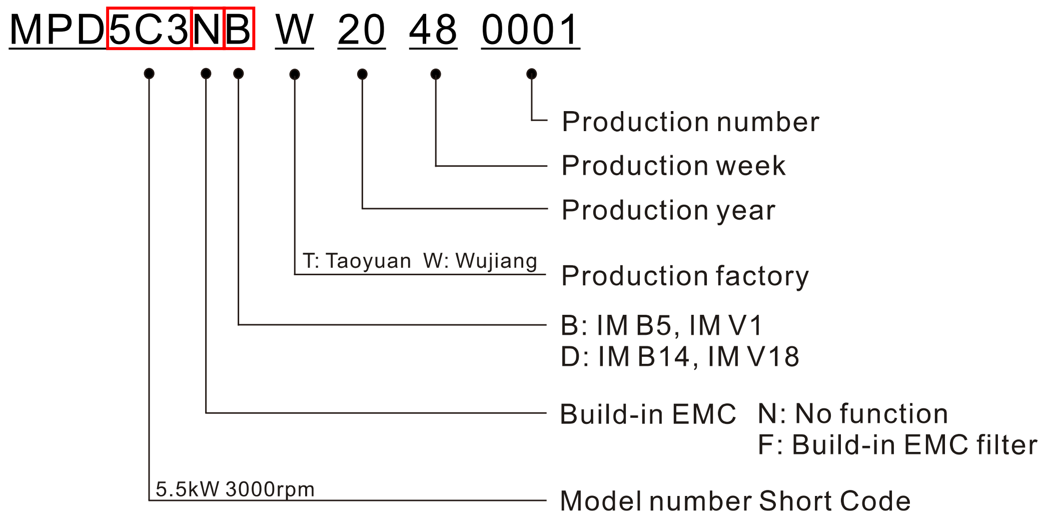
MSI (Motor)

MSI 75B 30C D X S 2 B 1 A P

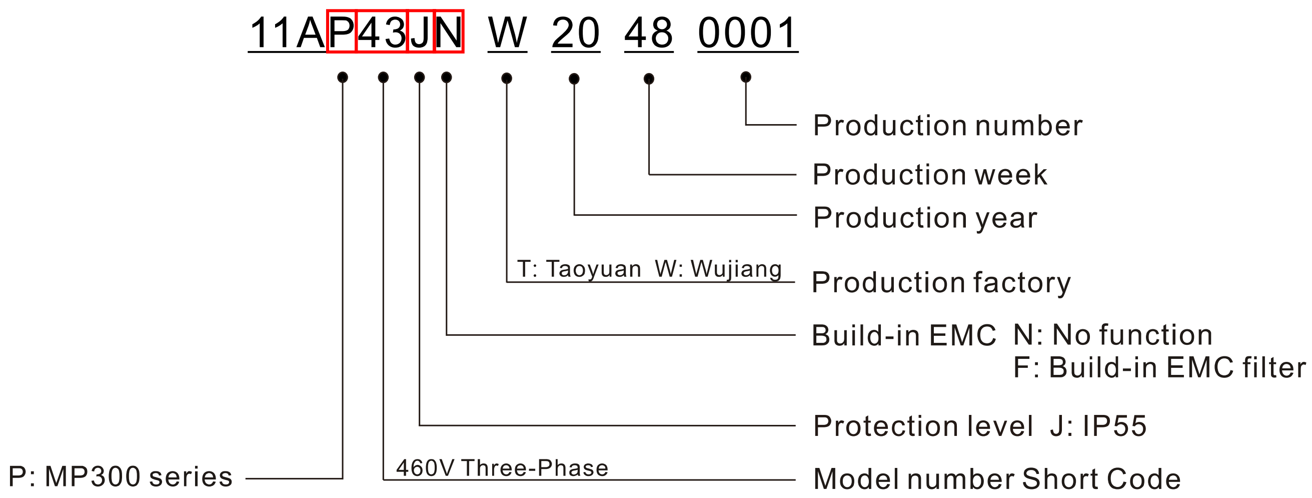
- P: Application
  P: Motor-mounted Pump Drive
- A: Material
  A: Aluminum cover
- 1: Shielded Ball Bearing
  1 : Oil seal
  F : Oil seal + Fancover (Frame B)
- B: Installation
  B: IM B5, IM V1
  D: IM B14, IM V18
- 2: 2: Filled Cylinder shaft with feather key
- S: Cooling
  S: Ic411
- X: X: Without sensor
- D: D: 380V Three-phase
- 30C: Rotor Speed
  Code × (A : 1, B : 10, etc.)
  30C = 3000rpm
- 75B: Moto Power
  Code × (A : 1, B : 10, etc.)
  Example: 0.75kW = 75B
- MSI: Motor Type

1-3 Serial Number

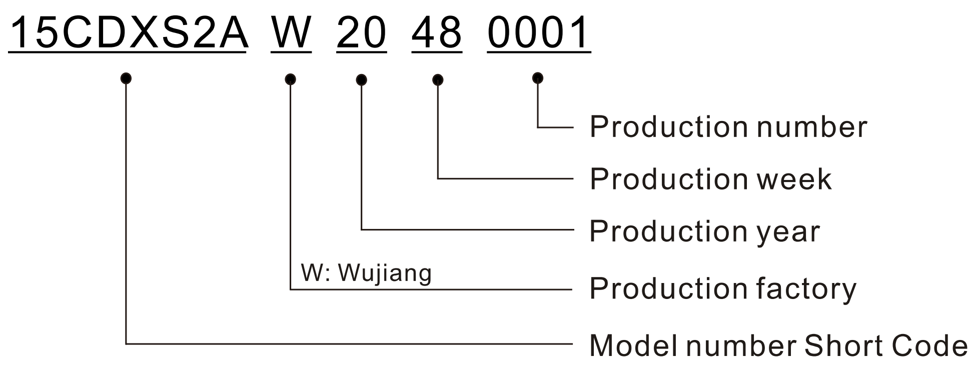
MPD = MP300 (AC motor drive) + MSI (Motor)



MP300 (AC motor drive)



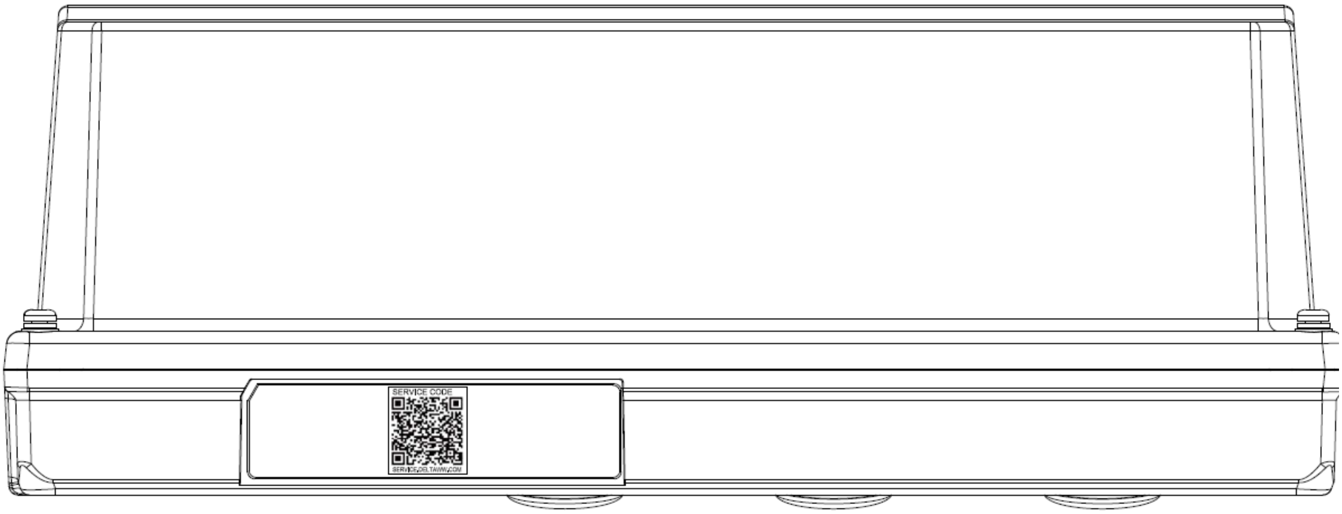
MSI (Motor)



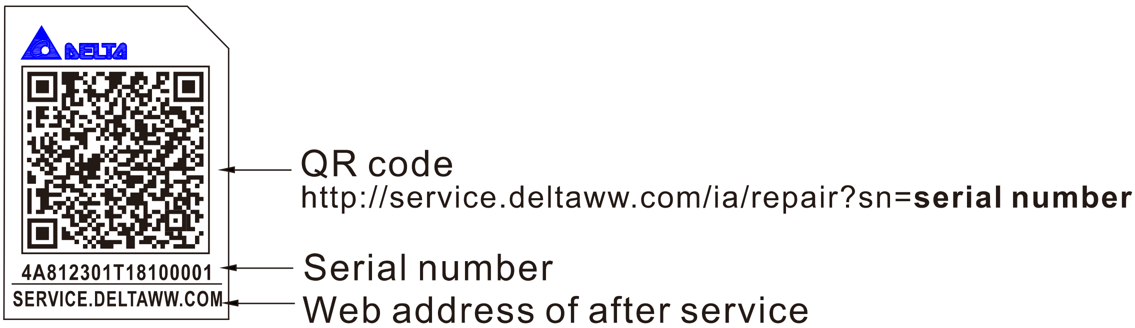
1-4 Apply After Service by Mobile Device

Location of Service Link Label

Service link label (Service Label) is pasted on the area as the drawing below shows.



Service Link Label



Scan QR Code to request service

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

Cannot find the QR Code

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

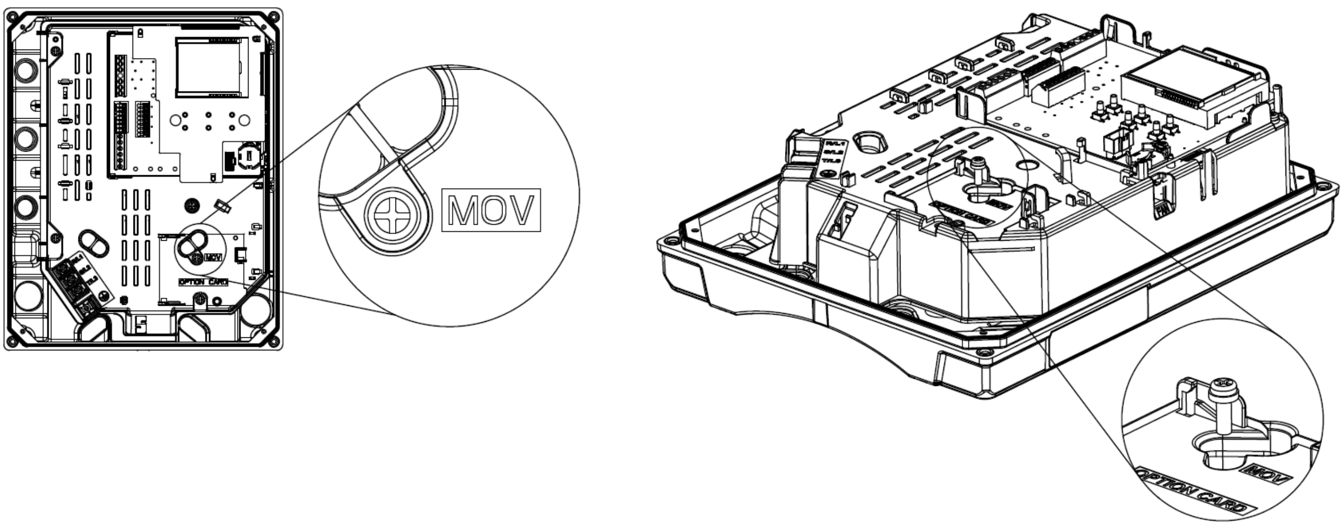
1-5 RFI Jumper

RFI Jumper:

☑ 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.

☑ 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.

Screw Torque: 6–8 kg-cm / [5.2–6.9 lb-in.] / [0.59–0.78 Nm]
As shown in the picture below, the screw works as a RFI jumper, loosen or tighten the screw to disconnect or connect the RFI jumper according to your need.



Isolating main power from ground

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

Important points regarding ground connection

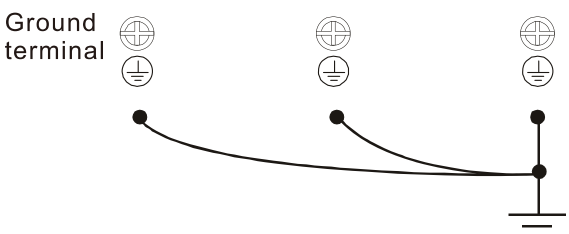
☑ To ensure the safety of personnel, proper operation, and to reduce electromagnetic radiation, you must properly ground the motor and drive during installation.

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

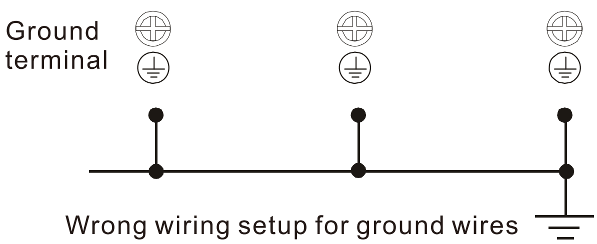
☑ You must connect the shielded cable to the motor drive's ground to meet safety regulations.

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

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



Correct wiring setup for ground wires



Wrong wiring setup for ground wires

Pay particular attention to the following points:

☑ Do not remove the RFI jumper while the power is on.
☑ Make sure the main power is OFF before removing the RFI jumper.
☑ 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.

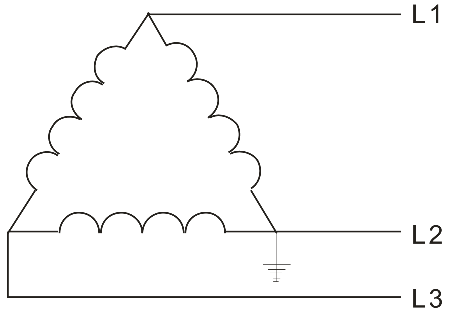
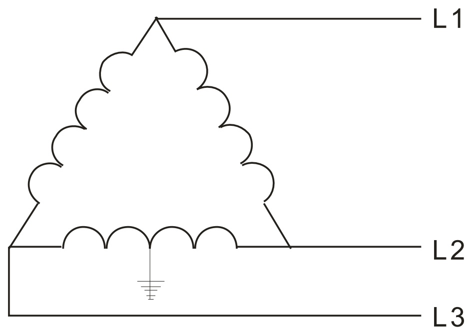
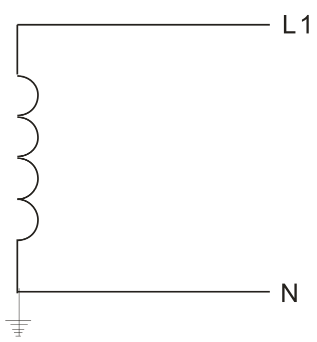
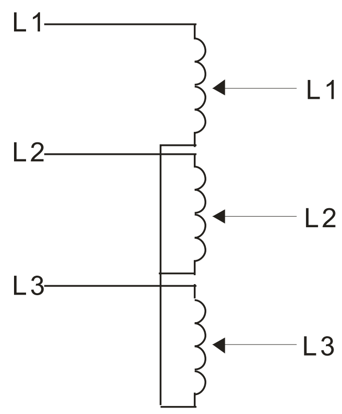
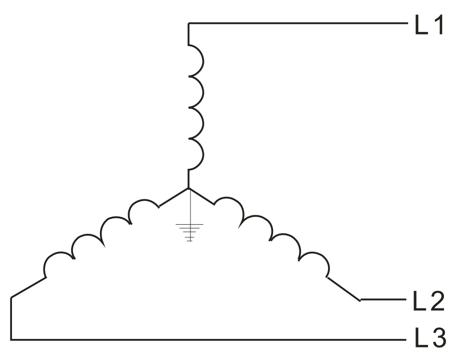
Floating Ground System (IT Systems)

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

☑ Remove the RFI jumper to disconnect the ground cable from the internal filter capacitor and surge absorber.
☑ 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.
☑ Disconnecting the ground cable from the filter prevents damage to the motor drive but compliance with EMC is no longer guaranteed.
☑ 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.

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, you must remove the RFI jumper. This is to prevent the system from grounding through the RFI and filter capacitors and damaging the drive.

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

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

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

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

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

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Chapter 2 Dimensions

2-1 The Size of The AC Motor Drive

Frame A: VFD1A6MP43JNNAA; VFD1A6MP43JFNAA; VFD3A3MP43JNNAA; VFD3A3MP43JFNAA; VFD4A7MP43JNNAA; VFD4A7MP43JFNAA; VFD6A2MP43JNNAA; VFD6A2MP43JFNAA; VFD8A5MP43JNNAA; VFD8A5MP43JFNAA; VFD11AMP43JNNAA

Frame B: VFD11AMP43JFNAA; VFD15AMP43JNNAA; VFD15AMP43JFNAA

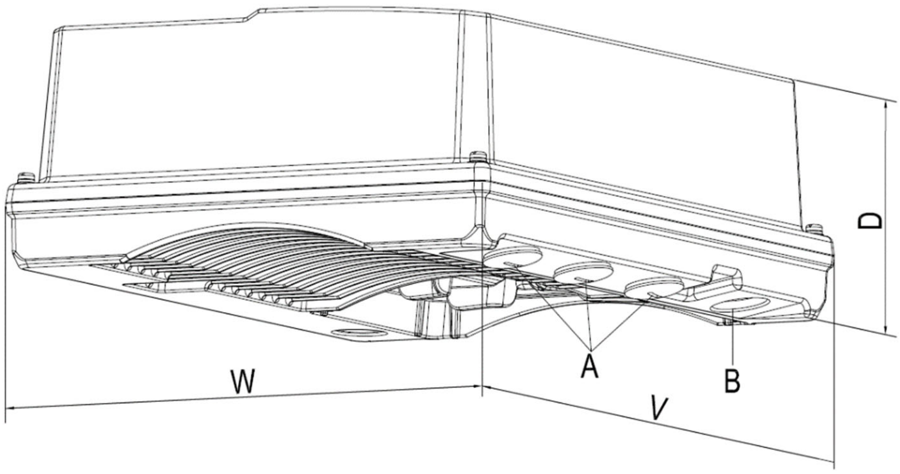


Figure 2-1

Unit: mm (inch)

<table>
<tr><th rowspan="2">Frame</th><th>Power (kW)</th><th>Length</th><th>Width</th><th>Height</th><th colspan="2">Waterproof connector</th></tr>
<tr><th>3 x 380–480V</th><th>V</th><th>W</th><th>D</th><th>A</th><th>B</th></tr>
<tr><td rowspan="6">A</td><td>0.75</td><td rowspan="6">290 (11.42)</td><td rowspan="6">237 (9.33)</td><td rowspan="8">106 (4.18)</td><td rowspan="8">M20</td><td rowspan="8">M25</td></tr>
<tr><td>1.5</td></tr>
<tr><td>2.2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td rowspan="2">5.5</td></tr>
<tr><td rowspan="2">B</td><td rowspan="2">322 (12.68)</td><td rowspan="2">277 (10.91)</td></tr>
<tr><td>7.5</td></tr>
</table>

Table 2-1

2-2 The Size Of The MPD

IM B5, IMV1 (with large flange)

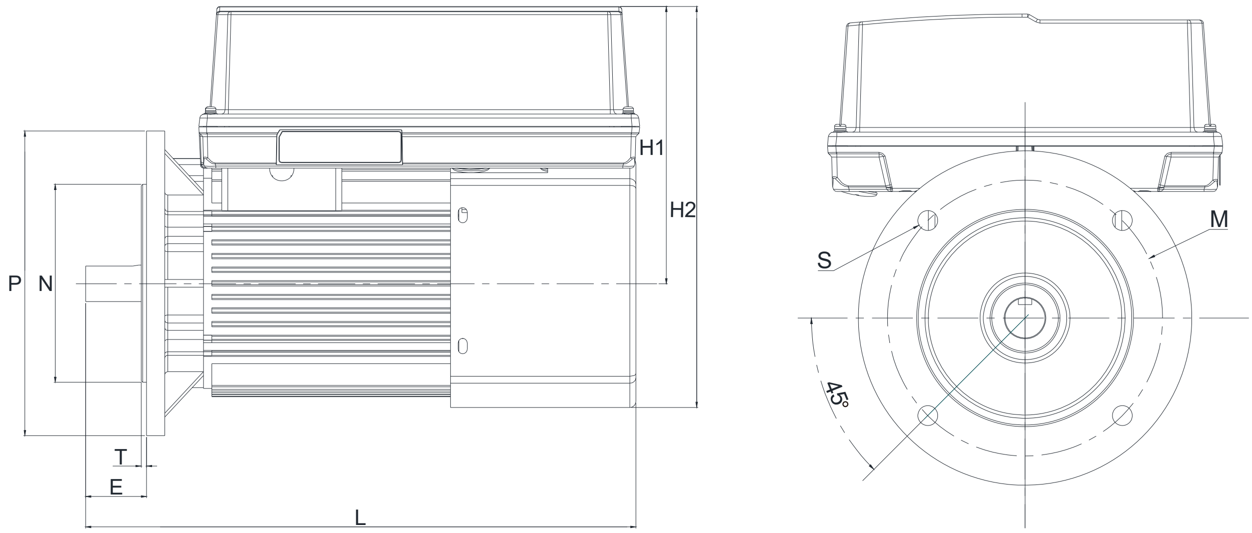


Figure 2-2

Unit: mm (inch)

<table>
<tr><th>Model name
(MPD)</th><th>Frame
(AC
motor
drive)</th><th>Frame and model name
(Motor)</th><th>P</th><th>N</th><th>T</th><th>E</th><th>L</th><th>H1</th><th>H2</th><th>S</th><th>M</th></tr>
<tr><td>MPD75B30C43N2B
MPD75B30C43F2B</td><td rowspan="3">A</td><td>80-1
MSI75B-30CDXS2B1AP</td><td rowspan="2">200
(7.88)</td><td rowspan="2">130
(5.12)</td><td rowspan="2">3.5
(0.14)</td><td>40
(1.58)</td><td>363
(14.3)</td><td rowspan="2">182.1
(7.17)</td><td rowspan="2">263.3
(10.37)</td><td rowspan="2">12
(0.48)</td><td rowspan="2">165
(6.5)</td></tr>
<tr><td>MPD15C30C43N2B
MPD15C30C43F2B
MPD22C30C43N2B
MPD22C30C43F2B</td><td>80-2
MSI15C-30CDXS2B1AP
MSI22C-30CDXS2B1AP</td><td>50
(1.97)</td><td>373
(14.69)</td></tr>
<tr><td>MPD30C30C43N2B
MPD30C30C43F2B
MPD40C30C43N2B
MPD40C30C43F2B</td><td>90
MSI30C-30CDXS2B1AP
MSI40C-30CDXS2B1AP</td><td>250
(9.85)</td><td>180
(7.09)</td><td rowspan="3">4
(0.16)</td><td>60
(2.37)</td><td>396
(15.6)</td><td>192.9
(7.6)</td><td>282.5
(11.13)</td><td rowspan="3">14.5
(0.58)</td><td>215
(8.47)</td></tr>
<tr><td>MPD55C30C43N2B</td><td>A</td><td>100-1
MSI55C-30CDXS2B1AP</td><td rowspan="2">300
(11.82)</td><td rowspan="2">230
(9.06)</td><td rowspan="2">80
(3.15)</td><td>420
(16.54)</td><td rowspan="2">202.3
(7.97)</td><td rowspan="2">299.1
(11.78)</td><td rowspan="2">265
(10.44)</td></tr>
<tr><td>MPD55C30C43F2B
MPD75C30C43N2B
MPD75C30C43F2B</td><td>B</td><td>100-2
MSI55C-30CDXS2BFAP
MSI75C-30CDXS2B1AP</td><td>451
(17.76)</td></tr>
</table>

Table 2-2

IM B14, IMV18 (with small flange)

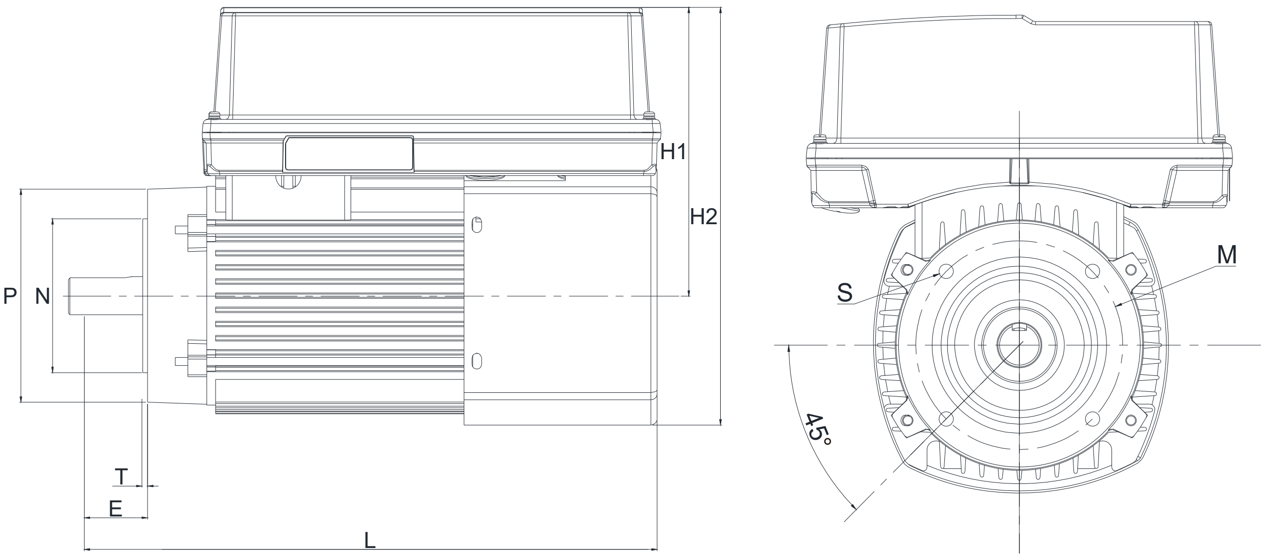


Figure 2-3

Unit: mm (inch)

<table>
<tr><th>Model name
(MPD)</th><th>Frame
(AC
motor
drive)</th><th>Frame and model name
(Motor)</th><th>P</th><th>N</th><th>T</th><th>E</th><th>L</th><th>H1</th><th>H2</th><th>S</th><th>M</th></tr>
<tr><td>MPD75B30C43N2D
MPD75B30C43F2D</td><td rowspan="3">A</td><td>80-1
MSI75B-30CDXS2D1AP</td><td>129
(5.08)</td><td>80
(3.15)</td><td rowspan="2">3.0
(0.12)</td><td>40
(1.58)</td><td>363
(14.3)</td><td rowspan="2">182.1
(7.17)</td><td rowspan="2">263.3
(10.37)</td><td>M6</td><td>100
(3.94)</td></tr>
<tr><td>MPD15C30C43N2D
MPD15C30C43F2D
MPD22C30C43N2D
MPD22C30C43F2D</td><td>80-2
MSI15C-30CDXS2D1AP
MSI22C-30CDXS2D1AP</td><td>134
(5.28)</td><td>95
(3.75)</td><td>50
(1.97)</td><td>373
(14.69)</td><td rowspan="2">M8</td><td>115
(4.53)</td></tr>
<tr><td>MPD30C30C43N2D
MPD30C30C43F2D
MPD40C30C43N2D
MPD40C30C43F2D</td><td>90
MSI30C-30CDXS2D1AP
MSI40C-30CDXS2D1AP</td><td>148
(5.83)</td><td>110
(4.34)</td><td>3.5
(0.14)</td><td>60
(2.37)</td><td>396
(15.6)</td><td>192.9
(7.6)</td><td>282.5
(11.13)</td><td>130
(5.12)</td></tr>
<tr><td>MPD55C30C43N2D</td><td>A</td><td>100-1
MSI55C-30CDXS2D1AP</td><td rowspan="2">184
(7.25)</td><td rowspan="2">130
(5.12)</td><td rowspan="2">4
(0.16)</td><td rowspan="2">80
(3.15)</td><td>420
(16.54)</td><td rowspan="2">202.3
(7.97)</td><td rowspan="2">299.1
(11.78)</td><td rowspan="2">M10</td><td rowspan="2">165
(6.5)</td></tr>
<tr><td>MPD55C30C43F2D
MPD75C30C43N2D
MPD75C30C43F2D</td><td>B</td><td>100-2
MSI55C-30CDXS2DFAP
MSI75C-30CDXS2D1AP</td><td>451
(17.76)</td></tr>
</table>

Table 2-3

2-3 The Size of The Motor Axle

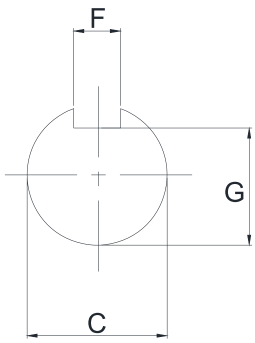


Figure 2-4

Unit: mm (inch)

<table>
<tr><th>Model name
(MPD)</th><th>Frame and model name
(Motor)</th><th>F</th><th>G</th><th>C</th></tr>
<tr><td>MPD75B30C43N2B
MPD75B30C43N2D
MPD75B30C43F2B
MPD75B30C43F2D</td><td>80-1
MSI75B-30CDXS2B1AP
MSI75B-30CDXS2D1AP</td><td>6
(0.24)</td><td>15.5
(0.62)</td><td>19
(0.75)</td></tr>
<tr><td>MPD15C30C43N2B
MPD15C30C43N2D
MPD15C30C43F2B
MPD15C30C43F2D
MPD22C30C43N2B
MPD22C30C43N2D
MPD22C30C43F2B
MPD22C30C43F2D</td><td>80-2
MSI15C-30CDXS2B1AP
MSI22C-30CDXS2B1AP
MSI15C-30CDXS2D1AP
MSI22C-30CDXS2D1AP</td><td rowspan="2">8
(0.32)</td><td>20
(0.79)</td><td>24
(0.95)</td></tr>
<tr><td>MPD30C30C43N2B
MPD30C30C43N2D
MPD30C30C43F2B
MPD30C30C43F2D
MPD40C30C43N2B
MPD40C30C43N2D
MPD40C30C43F2B
MPD40C30C43F2D</td><td>90
MSI30C-30CDXS2B1AP
MSI40C-30CDXS2B1AP
MSI30C-30CDXS2D1AP
MSI40C-30CDXS2D1AP</td><td>24
(0.95)</td><td>28
(1.11)</td></tr>
<tr><td>MPD55C30C43N2B
MPD55C30C43N2D</td><td>100-1
MSI55C-30CDXS2B1AP
MSI55C-30CDXS2D1AP</td><td rowspan="2">10
(0.4)</td><td rowspan="2">33
(1.3)</td><td rowspan="2">38
(1.5)</td></tr>
<tr><td>MPD55C30C43F2B
MPD55C30C43F2D
MPD75C30C43N2B
MPD75C30C43N2D
MPD75C30C43F2B
MPD75C30C43F2D</td><td>100-2
MSI55C-30CDXS2BFAP
MSI75C-30CDXS2B1AP
MSI55C-30CDXS2DFAP
MSI75C-30CDXS2D1AP</td></tr>
</table>

Table 2-4

2-4 The Weight of The MPD

Model name (MPD)	Model name (AC motor drive)	Power (kW)	Frame (Motor)	Model name (Motor)	Type (Flange)	Weight [kg (lb)]		
						AC motro drive	Motor	MPD
MPD75B30C43N2B	VFD1A6MP43JNNAA	0.75	80-1	MSI75B-30CDXS2B1AP	IM B5、IMV1	3.5 (7.8)	11.3 (25.0)	14.8 (32.7)
MPD75B30C43N2D				MSI75B-30CDXS2D1AP	IM B14、IMV18		9.2 (20.3)	12.7 (28.0)
MPD75B30C43F2B	VFD1A6MP43JFNAA			MSI75B-30CDXS2B1AP	IM B5、IMV1	3.7 (8.2)	11.3 (25)	15.0 (33.1)
MPD75B30C43F2D				MSI75B-30CDXS2D1AP	IM B14、IMV18		9.2 (20.3)	12.9 (28.5)
MPD15C30C43N2B	VFD3A3MP43JNNAA	1.5	80-2	MSI15C-30CDXS2B1AP	IM B5、IMV1	3.5 (7.8)	13.6 (30.0)	17.1 (37.7)
MPD15C30C43N2D				MSI15C-30CDXS2D1AP	IM B14、IMV18		12.2 (26.9)	15.7 (34.7)
MPD15C30C43F2B	VFD3A3MP43JFNAA			MSI15C-30CDXS2B1AP	IM B5、IMV1	3.7 (8.2)	13.6 (30.0)	17.3 (38.2)
MPD15C30C43F2D				MSI15C-30CDXS2D1AP	IM B14、IMV18		12.2 (26.9)	15.9 (35.1)
MPD22C30C43N2B	VFD4A7MP43JNNAA	2.2	80-2	MSI22C-30CDXS2B1AP	IM B5、IMV1	3.5 (7.8)	15.3 (33.8)	18.8 (41.5)
MPD22C30C43N2D				MSI22C-30CDXS2D1AP	IM B14、IMV18		13.9 (30.7)	17.4 (38.4)
MPD22C30C43F2B	VFD4A7MP43JFNAA			MSI22C-30CDXS2B1AP	IM B5、IMV1	3.7 (8.2)	15.3 (33.8)	19.0 (41.9)
MPD22C30C43F2D				MSI22C-30CDXS2D1AP	IM B14、IMV18		13.9 (30.7)	17.6 (38.8)
MPD30C30C43N2B	VFD6A2MP43JNNAA	3	90	MSI30C-30CDXS2B1AP	IM B5、IMV1	3.6 (8.0)	19.1 (42.1)	22.7 (50.1)
MPD30C30C43N2D				MSI30C-30CDXS2D1AP	IM B14、IMV18		16.5 (36.4)	20.1 (44.4)
MPD30C30C43F2B	VFD6A2MP43JFNAA			MSI30C-30CDXS2B1AP	IM B5、IMV1	3.8 (8.4)	19.1 (42.1)	22.9 (50.5)
MPD30C30C43F2D				MSI30C-30CDXS2D1AP	IM B14、IMV18		16.5 (36.4)	20.3 (44.8)
MPD40C30C43N2B	VFD8A5MP43JNNAA	4	90	MSI40C-30CDXS2D1AP	IM B5、IMV1	3.6 (8.0)	19.9 (43.9)	23.5 (51.8)
MPD40C30C43N2D				MSI40C-30CDXS2B1AP	IM B14、IMV18		17.3 (38.2)	20.9 (46.1)
MPD40C30C43F2B	VFD8A5MP43JFNAA			MSI40C-30CDXS2D1AP	IM B5、IMV1	3.8 (8.4)	19.9 (43.9)	23.7 (52.3)
MPD40C30C43F2D				MSI40C-30CDXS2B1AP	IM B14、IMV18		17.3 (38.2)	21.1 (46.6)
MPD55C30C43N2B	VFD11AMP43JNNAA	5.5	100-1	MSI55C-30CDXS2B1AP	IM B5、IMV1	3.7 (8.2)	27.7 (61.1)	31.4 (69.3)
MPD55C30C43N2D				MSI55C-30CDXS2D1AP	IM B14、IMV18		24.2 (53.4)	27.9 (61.5)
MPD55C30C43F2B	VFD11AMP43JFNAA		100-2	MSI55C-30CDXS2BFAP	IM B5、IMV1	4.1 (9.1)	27.7 (61.1)	31.8 (70.1)
MPD55C30C43F2D				MSI55C-30CDXS2DFAP	IM B14、IMV18		24.2 (53.4)	28.3 (62.4)
MPD75C30C43N2B	VFD15AMP43JNNAA	7.5	100-2	MSI75C-30CDXS2B1AP	IM B5、IMV1		31.3 (69.0)	35.4 (78.1)
MPD75C30C43N2D				MSI75C-30CDXS2D1AP	IM B14、IMV18		27.8 (61.3)	31.9 (70.4)
MPD75C30C43F2B	VFD15AMP43JFNAA			MSI75C-30CDXS2B1AP	IM B5、IMV1	4.2 (9.3)	31.3 (69.0)	35.5 (78.3)
MPD75C30C43F2D				MSI75C-30CDXS2D1AP	IM B14、IMV18		27.8 (61.3)	32.0 (70.6)

Table 2-5

Chapter 3 Installation

3-1 Mounting Clearance

☑ Prevent fiber particles, scraps of paper, shredded wood, sawdust, metal particles, etc. from adhering to the heat sink.

☑ Install the AC motor drive in a metal cabinet. When installing one drive below another one, use a metal separator between the AC motor drives to prevent mutual heating and to prevent the risk of fire accident.

☑ Install the AC motor drive in a Pollution Degree 2 (IEC/EN 60664-1) environment.

☑ Install the AC motor drive in an IP55 and below IP rating interior environment, do not use the AC motor drive in an environment that exceeds the IP rating.

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

Inflow Outflow Distance

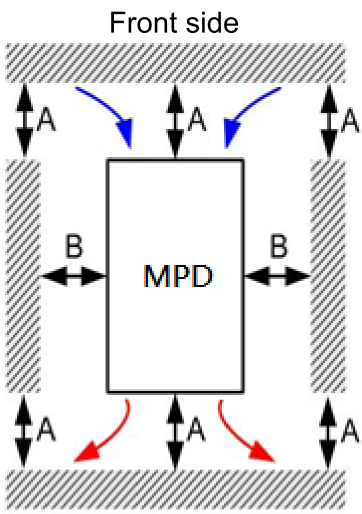


Figure 3-1

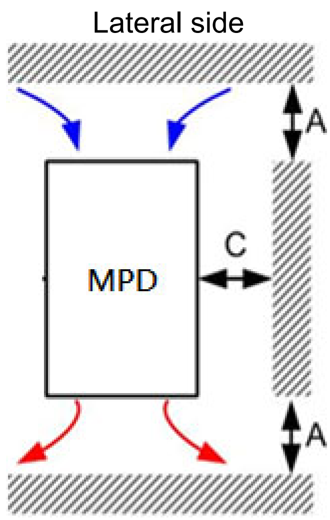


Figure 3-2

Frame	Model name	Clearance A (Unit: mm)	Clearance B (Unit: mm)	Clearance C (Unit: mm)	Maximum ambient temperature (°C)	
					Without derating	With derating
A	MPD75B30C43N2B MPD75B30C43N2D MPD75B30C43F2B MPD75B30C43F2D MPD15C30C43N2B MPD15C30C43N2D MPD15C30C43F2B MPD15C30C43F2D MPD22C30C43N2B MPD22C30C43N2D MPD22C30C43F2B MPD22C30C43F2D	120	50	50	40	50

Frame	Model name	Clearance A (Unit: mm)	Clearance B (Unit: mm)	Clearance C (Unit: mm)	Maximum ambient temperature (°C)	
					Without derating	With derating
A	MPD30C30C43N2B	135	60	60	40	50
	MPD30C30C43N2D					
	MPD30C30C43F2B					
	MPD30C30C43F2D					
	MPD40C30C43N2B					
	MPD40C30C43N2D					
	MPD40C30C43F2B					
	MPD40C30C43F2D					
	MPD55C30C43N2B	150	70	70		
	MPD55C30C43N2D					
B	MPD55C30C43F2B					
	MPD55C30C43F2D					
	MPD75C30C43N2B					
	MPD75C30C43N2D					
	MPD75C30C43F2B					
	MPD75C30C43F2D					

Table 3-1

3-2 Airflow and Power Dispassion

<table>
<tr><th rowspan="2">Frame</th><th rowspan="2">Model name</th><th colspan="2">Airflow rate</th><th>Power dispassion</th></tr>
<tr><th>(Unit: m³/hr)</th><th>(Unit: cfm)</th><th>(Unit: W)</th></tr>
<tr><td rowspan="22">A</td><td>MPD75B30C43N2B</td><td rowspan="12">31.1</td><td rowspan="12">52.8</td><td rowspan="2">155</td></tr>
<tr><td>MPD75B30C43N2D</td></tr>
<tr><td>MPD75B30C43F2B</td><td rowspan="2">156</td></tr>
<tr><td>MPD75B30C43F2D</td></tr>
<tr><td>MPD15C30C43N2B</td><td rowspan="2">269</td></tr>
<tr><td>MPD15C30C43N2D</td></tr>
<tr><td>MPD15C30C43F2B</td><td rowspan="2">271</td></tr>
<tr><td>MPD15C30C43F2D</td></tr>
<tr><td>MPD22C30C43N2B</td><td rowspan="2">341</td></tr>
<tr><td>MPD22C30C43N2D</td></tr>
<tr><td>MPD22C30C43F2B</td><td rowspan="2">343</td></tr>
<tr><td>MPD22C30C43F2D</td></tr>
<tr><td>MPD30C30C43N2B</td><td rowspan="8">46.7</td><td rowspan="8">79.2</td><td rowspan="2">416</td></tr>
<tr><td>MPD30C30C43N2D</td></tr>
<tr><td>MPD30C30C43F2B</td><td rowspan="2">419</td></tr>
<tr><td>MPD30C30C43F2D</td></tr>
<tr><td>MPD40C30C43N2B</td><td rowspan="2">512</td></tr>
<tr><td>MPD40C30C43N2D</td></tr>
<tr><td>MPD40C30C43F2B</td><td rowspan="2">515</td></tr>
<tr><td>MPD40C30C43F2D</td></tr>
<tr><td>MPD55C30C43N2B</td><td rowspan="8">66.1</td><td rowspan="8">112.2</td><td rowspan="2">633</td></tr>
<tr><td>MPD55C30C43N2D</td></tr>
<tr><td rowspan="6">B</td><td>MPD55C30C43F2B</td><td rowspan="2">637</td></tr>
<tr><td>MPD55C30C43F2D</td></tr>
<tr><td>MPD75C30C43N2B</td><td rowspan="2">775</td></tr>
<tr><td>MPD75C30C43N2D</td></tr>
<tr><td>MPD75C30C43F2B</td><td rowspan="2">780</td></tr>
<tr><td>MPD75C30C43F2D</td></tr>
</table>

Table 3-2

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. If the AC motor drive does not fully discharge, and assemble the wiring with a residual voltage may cause personal injury, sparks and a short circuit. Ensure your safety to use AC motor drive with no voltage. ☑ 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 you 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

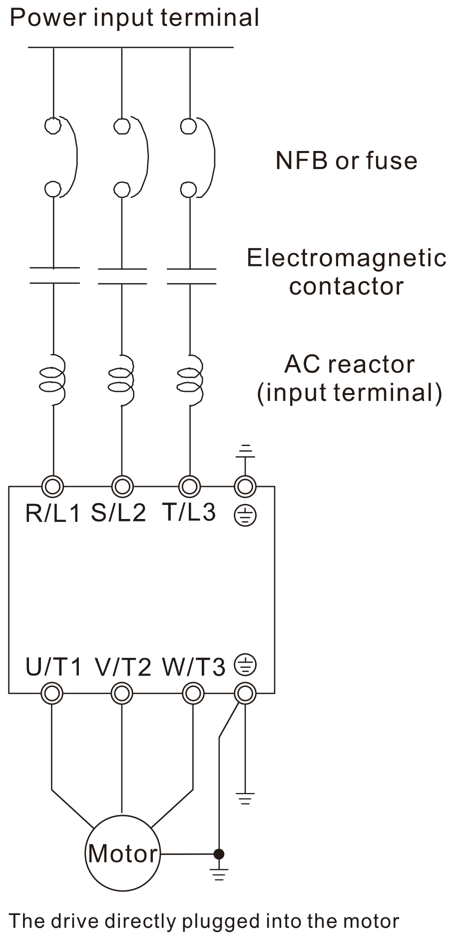


Figure 4-1

Power input terminal	Supply power according to the rated power specifications indicated in the manual. Refer to Chapter 09 Specifications for details.
NFB or fuse	There may be a large inrush current during power on. Refer to Section 7-1 NFB to select a suitable NFB or Section 7-2 Fuse Specification Chart.
Electromagnetic contactor	Switching the power ON / OFF on the primary side of the electromagnetic contactor can make the drive work / stop, but frequent switching can cause machine failure. Do not switch ON / OFF more than once an hour. Do not use the electromagnetic contactor as the power switch for the drive; doing so shortens the life of the drive.
AC reactor (input terminal)	When the main 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 7-3 AC Reactor for details.

Table 4-1

4-2 Wiring

Input: three-phase power

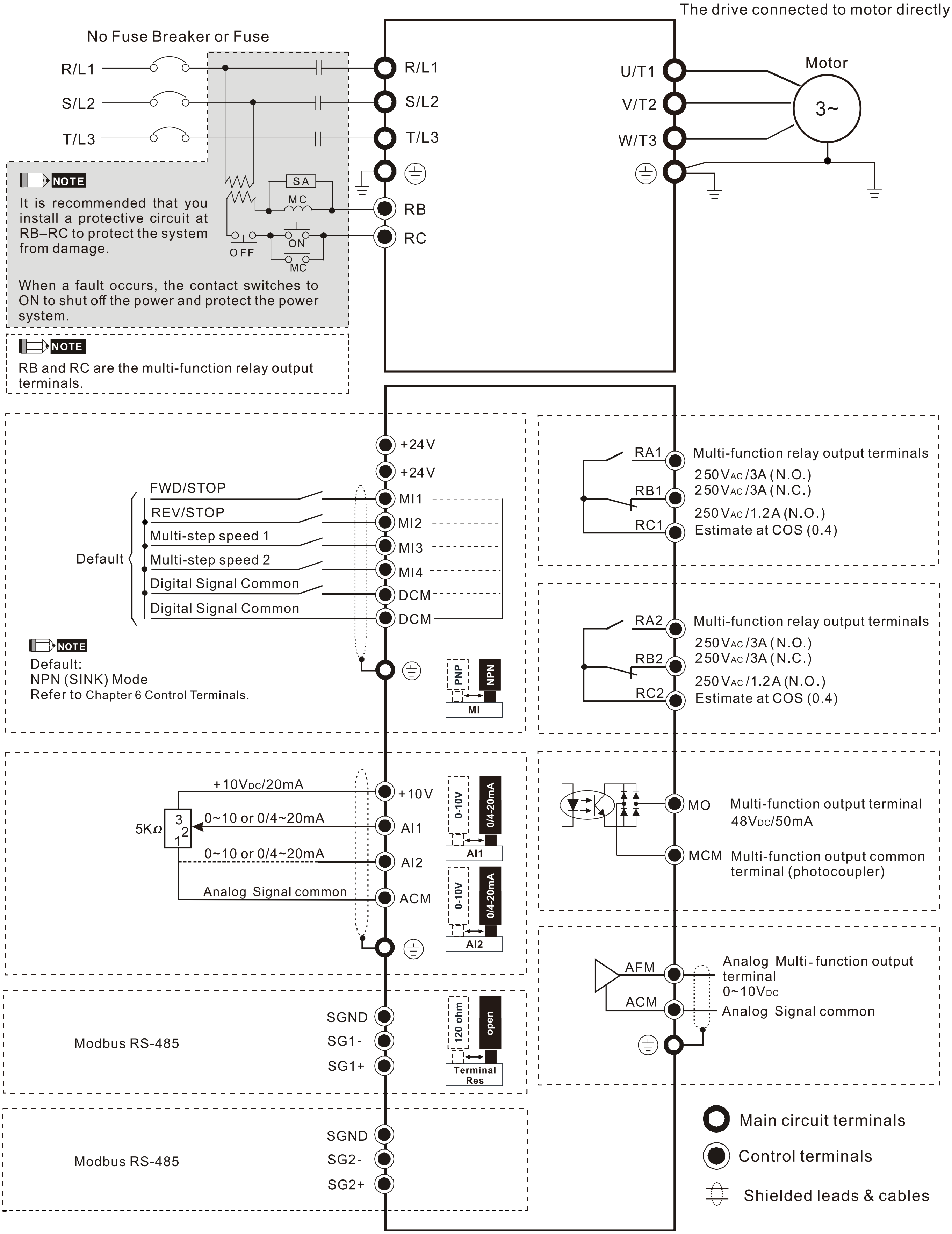


Figure 4-2

4-3 Motor and AC Motor Drive Assembly

4-3-1 Motor thermal wire selection (Skip this if thermal wire is not required)

Take the appropriate thermal wire out from the motor terminal box, there are KTY-84 and PTC130.

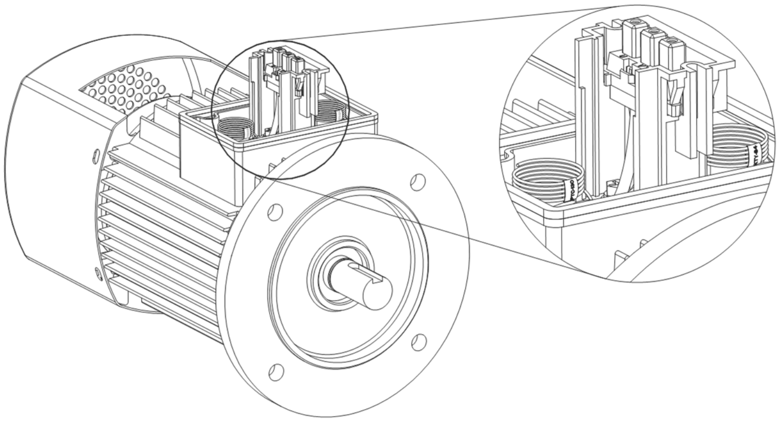
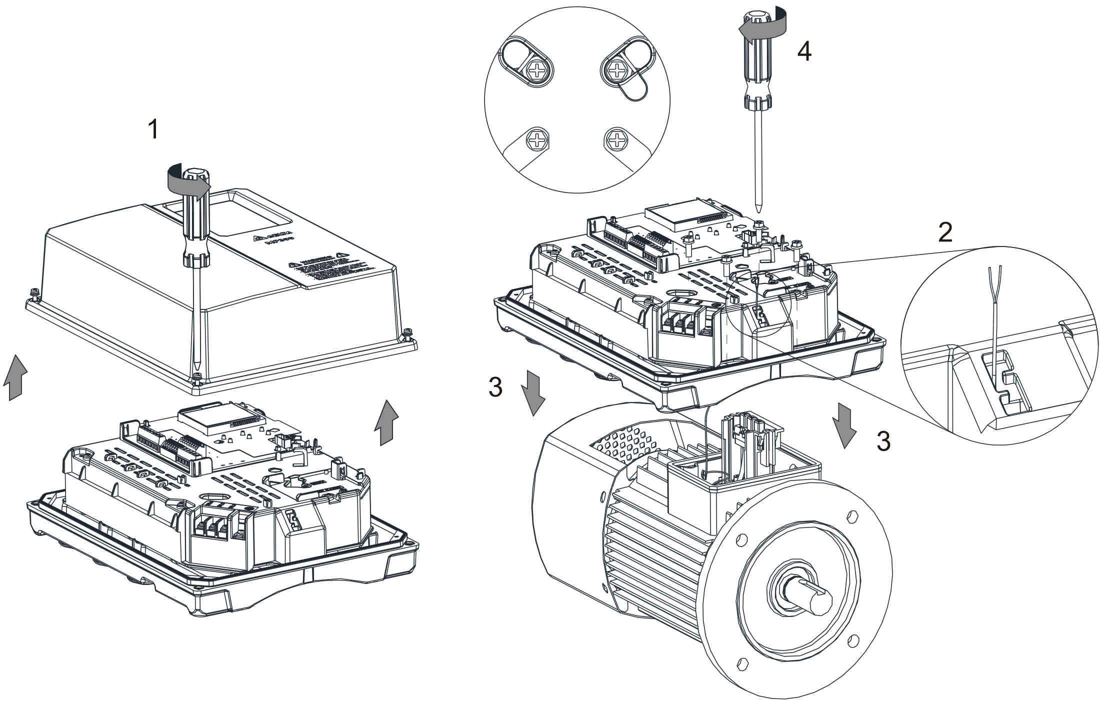


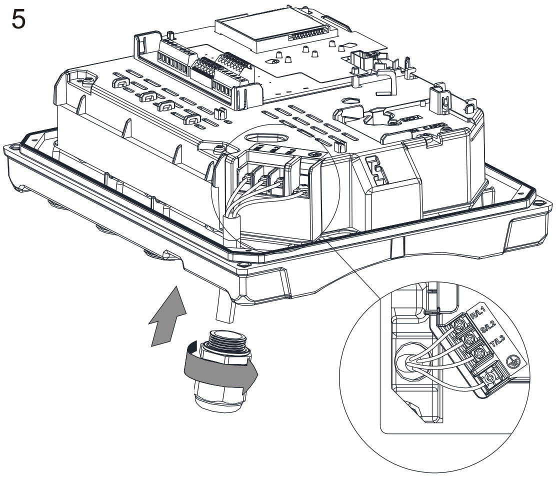
Figure 4-3

4-3-2 AC motor drive and motor assembly steps

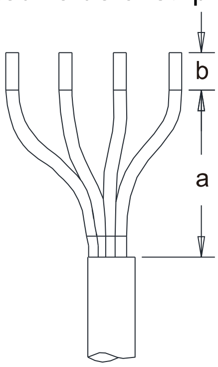
1. Use cross screwdriver to loosen the screws on the front cover of the AC motor drive, and then remove the front cover.
2. If the motor thermal wire is required, take out the appropriate thermal wire (see section 4-3-1) and pass through the hole from the inside case. Skip this step if the thermal wire is not required.
3. Assemble the AC motor drive and the motor according to the direction arrow shown in the Figure 4-4. If the thermal wire is assembled, pay attention that do not let the thermal wire exceed the waterproof ring's boundary on the motor terminal box, otherwise the thermal wire will be flatted and broken.
4. Screw up four M5 screws according to the positions shown in the Figure 4-4
   Torque: 16~20 kg-cm [13.9~17.3 Ib-in.] [1.56~1.96 Nm]
5. Screw up the waterproof connector before starting the wiring.
6. Put the front cover back, and screw up the screws according to the order from a to d (see Figure 4-4).
   Torque: 6~8 kg-cm [5.2~6.9 Ib-in.] [0.59~0.78 Nm]



5



Suggested value of striping cable



Unit: mm

Frame	R/L1, S/L2, T/L3, ⏚	
	a	b
A	60 [2.36]	8 [0.31]
B		

6

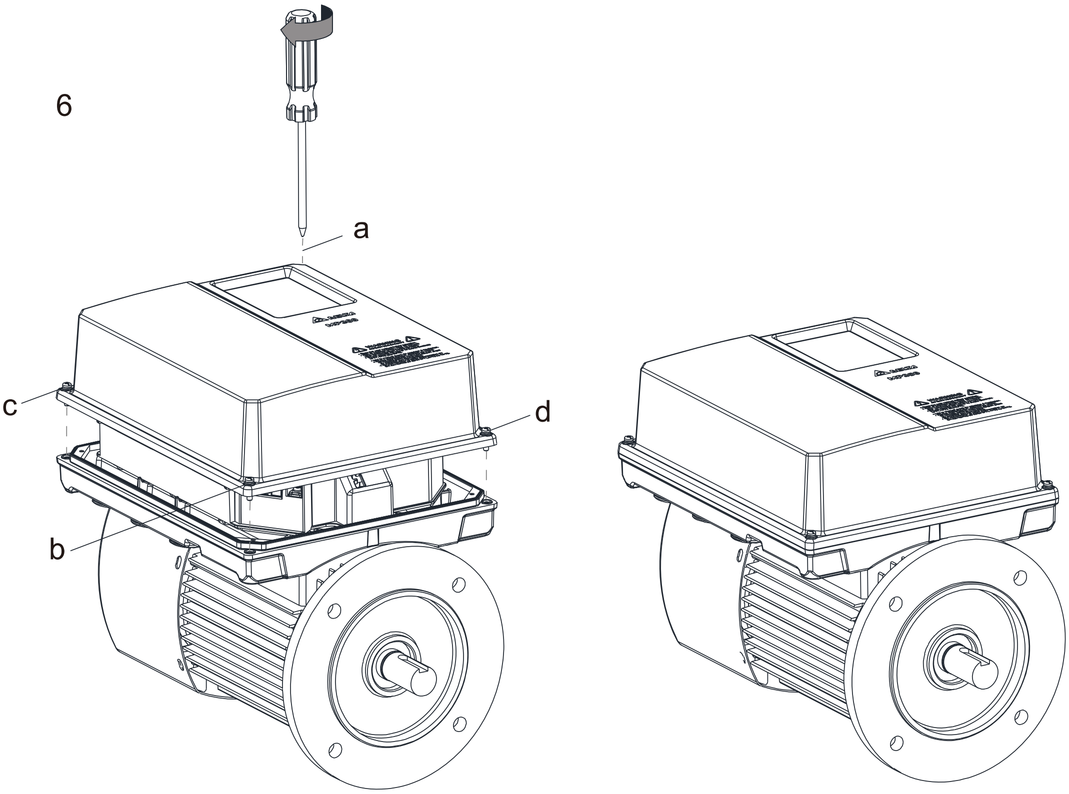


Figure 4-4

4-3-3 Thermal wire (KTY-84, PTC130) assembly

1. As explained in the section 4-3-1, take out the appropriate thermal wire from the motor terminal box, and works with the step 1 to 4 in the section 4-3-2.
2. Every thermal wire has two bare wires, no polarity and no order of priority to connect, one connects with ACM, and another one connects with AI1 or AI2.
3. Organize and fix the thermal wire by the snap lock of the case.
4. Put the surplus wire segment of the thermal wire into the hole as the direction arrow shown in the Figure 4-5.

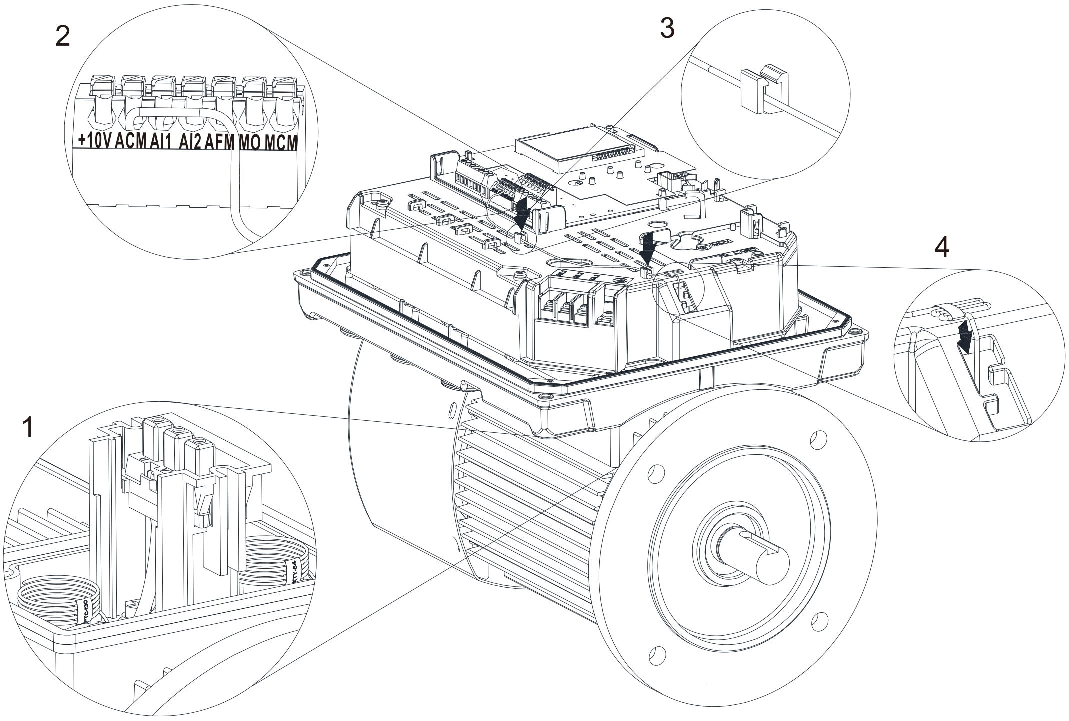


Figure 4-5

4-4 Wiring of Multi-pump Controled Communication Cable

If using multi-pump function, connect the first RS-485 communication port of each station in parallel (SG1- to SG1-; SG1+ to SG1+); if connect to upper device (HMI) is required, then connect with the second RS-485 communication port (SG2- / SG2+) of the absolute master (ID1). See the figure below.

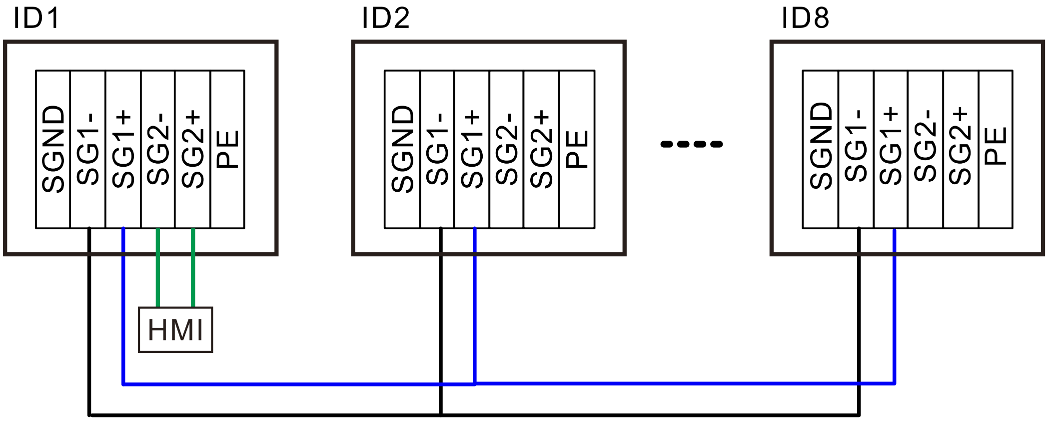


Figure 4-6

4-5 Wiring of Pressure Sensor

When set multi-master function in auto-change pump system, if feedback signal of pressure sensor uses in constant pressure control is required, and both master and spare master need pressure signal to feedback, then set one more pressure sensor to transfer feedback signal to spare master, or master and spare master use the same feedback signal.

Signal type	Source of power	Maximum numbers to connect
ACI	Internal power (+24V)	4
	External power (+30V)	6
AVI	Internal power (+24V)	8
	External power (+30V)	8

Single pump: One pressure sensor to one drive

- **ACI**

ACI mode with internal power :
Single pump

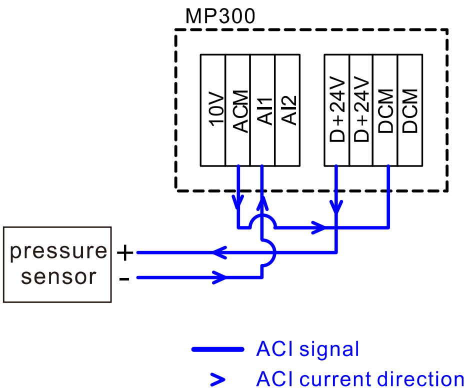


Figure 4-7

ACI mode with external power :
Single pump

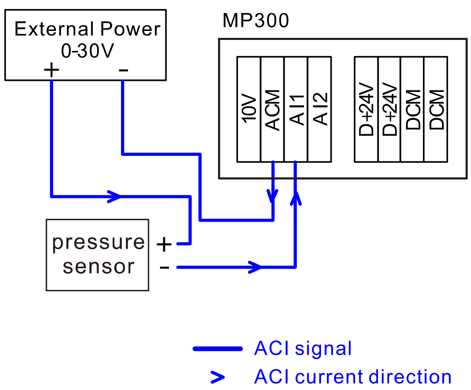


Figure 4-8

- **AVI**

AVI mode with internal power : Single pump

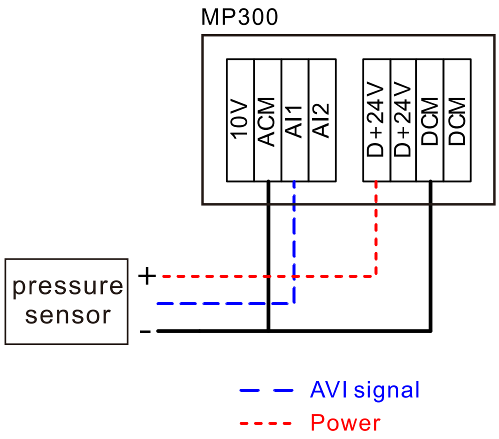


Figure 4-9

AVI mode with external power : Single pump

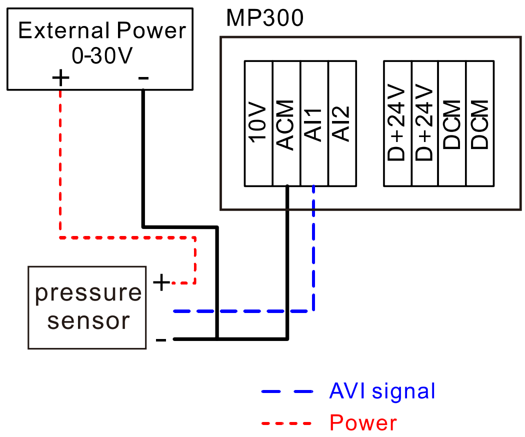


Figure 4-10

Multi pump: One pressure sensor to more than one drive

- **ACI**

ACI mode with internal power : Multi pump (Max:4)

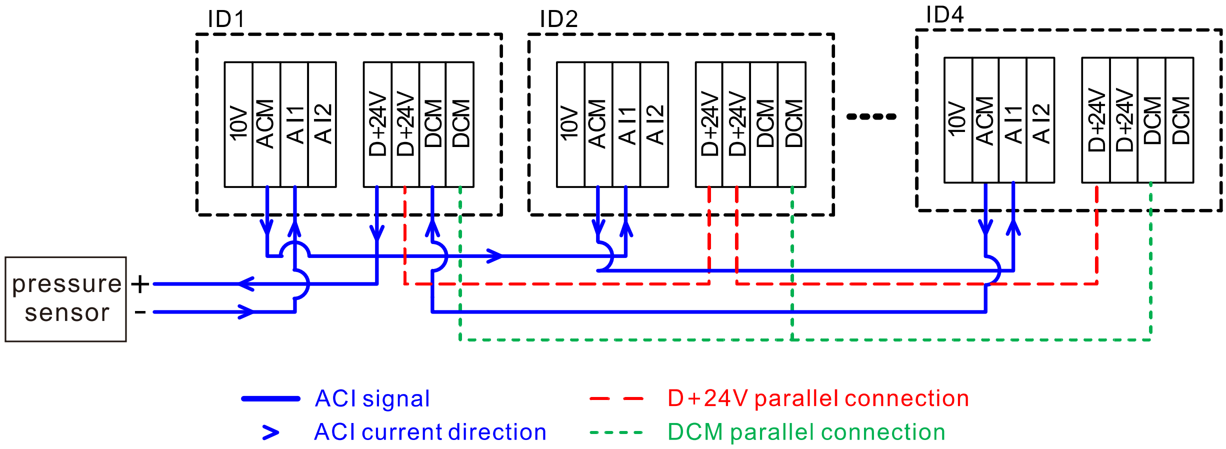


Figure 4-11

ACI mode with external power : Multi pump (Max:6)

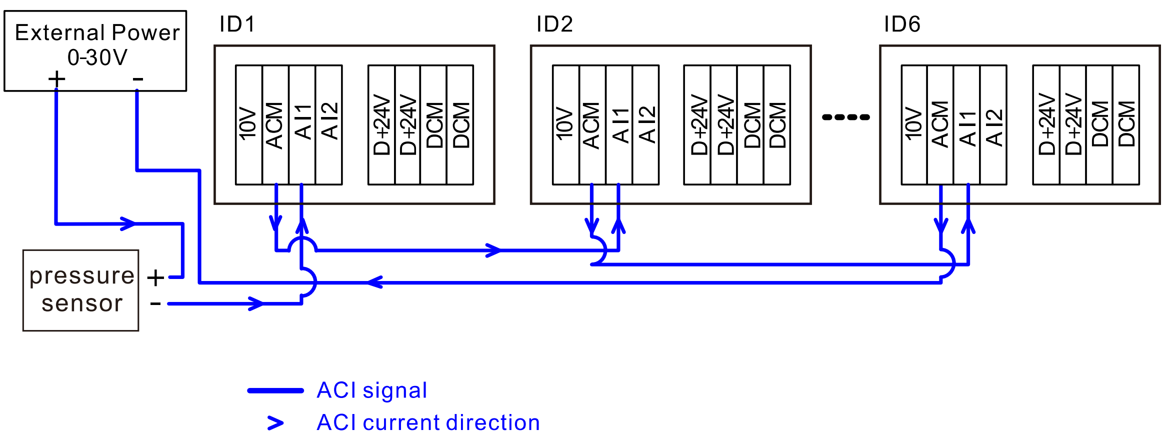


Figure 4-12

- **AVI**

AVI mode with internal power :
Multi pump

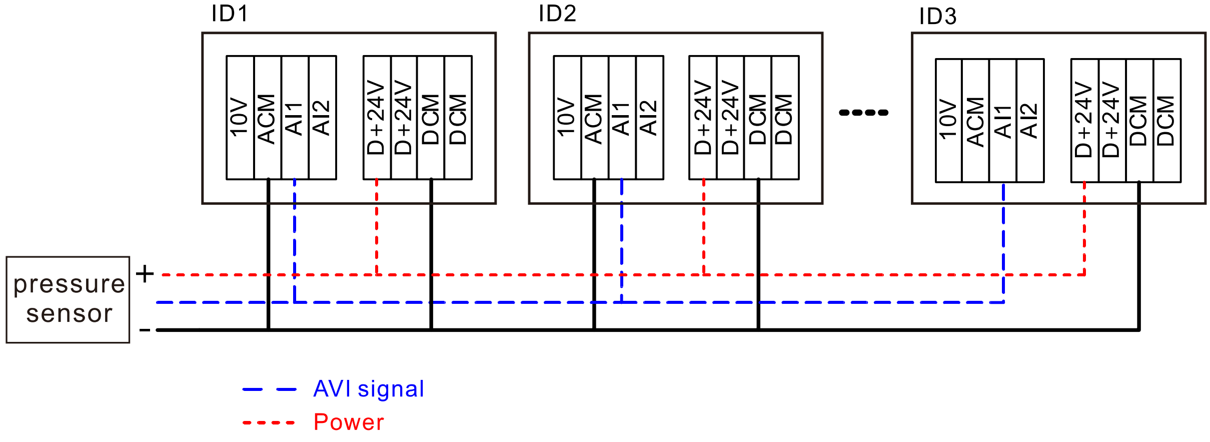


Figure 4-13

AVI mode with external power :
Multi pump

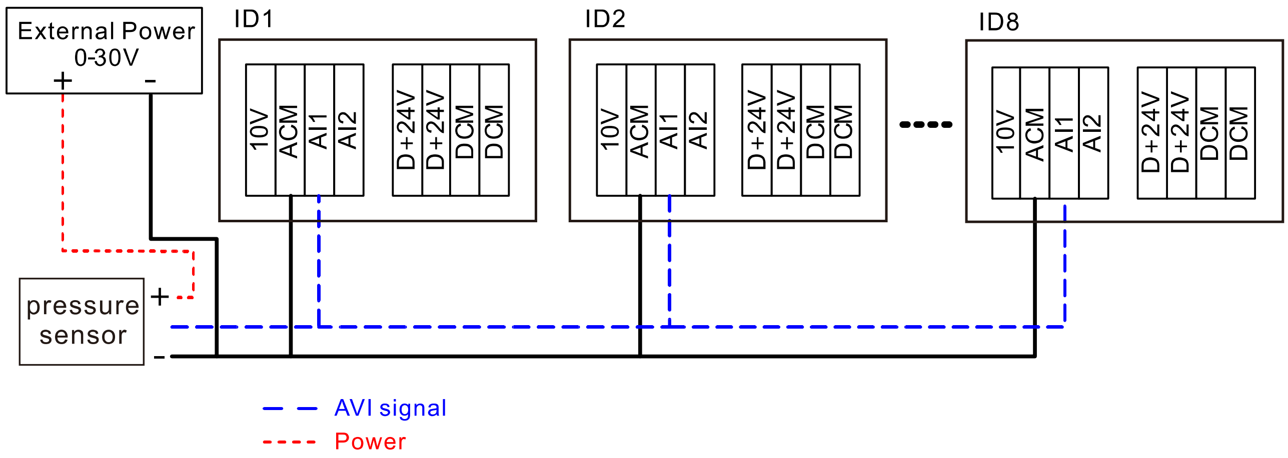


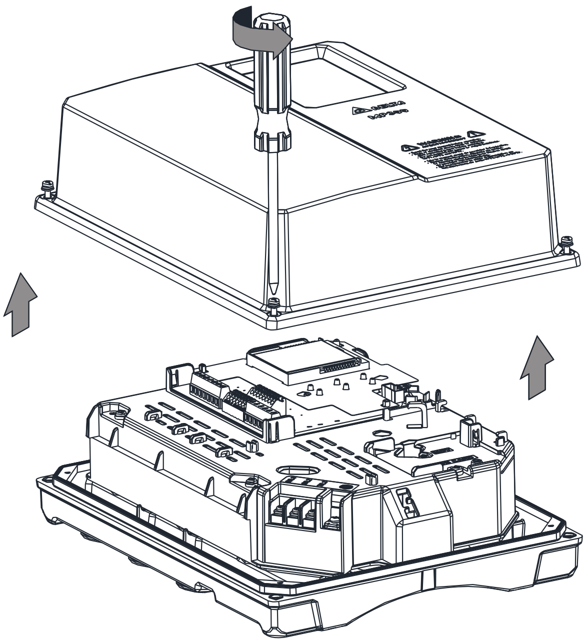
Figure 4-14

Chapter 5 Main Circuit Terminals

DANGER	☑ Tighten the screws in the main circuit terminal to prevent sparks caused by screws loosened due to vibration. ☑ Ensure proper insulation of the main circuit wiring in accordance with the relevant safety regulations.
CAUTION	Main input power terminals ☑ DO NOT connect a three-phase model to one-phase power. R/L1, S/L2 and T/L3 have no phase-sequence requirement; they can be connected in any sequence. ☑ You must install a NFB between the three-phase power input terminals and the main circuit terminals (R/L1, S/L2, T/L3). Add a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunctions when the AC motor drive protection function activates. Both ends of the MC should have an R-C surge absorber. ☑ Use voltage and current within the specifications in Chapter 09. ☑ If install an earth leakage circuit breaker (ELCB) to the AC motor drive as a protection to the electrical leakage, choose industrial type or time-delay type to avoid malfunction. ☑ Use shielded wire or conduit for the power wiring and ground the two ends of the shielding or conduit. ☑ DO NOT run and stop the AC motor drives by turning the power ON and OFF. Run and stop the AC motor drives by sending the RUN and STOP commands through the control terminals or the keypad. If you still need to run and stop the AC motor drives by turning the power ON and OFF, do so no more often than ONCE per hour. ☑ To comply with UL standards, connect the drive to a three-phase three-wire (star connection, Y connection) or three-phase four-wire (star connection, Wye connection) system type of mains power system.

Remove the front cover

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



Use cross screwdriver to loosen the screws on the front cover of the AC motor drive, and then remove the front cover.

Figure 5-1

5-1 Main Circuit Diagram

Figure 5-2

Terminals	Descriptions
R/L1, S/L2, T/L3	Mains input terminals (three-phase)
⏚	Ground connection; comply with local regulations.

5-2 Main Circuit Terminal Specifications

- Use the specified ring lug for main circuit terminal wiring. See Figure 5-3 and Figure 5-4 for ring lug specifications. For other types of wiring, use the wires that comply with the local regulations.
- After crimping the wire to the ring lug (must be UL and CSA approved R/C (YDPU2)), install heat shrink tubing rated at a minimum of 600 V_{AC} insulation over the live part. Refer to Figure 5-4.
- Main circuit terminal: R/L1, S/L2, T/L3

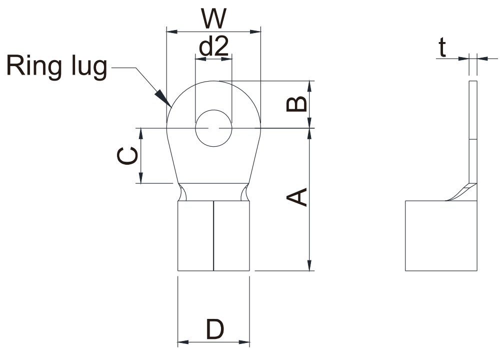


Figure 5-3

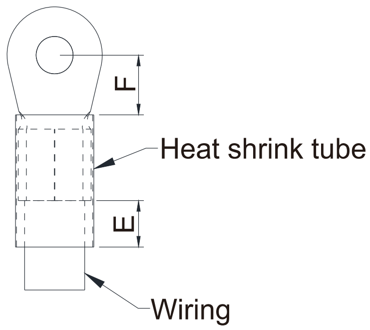


Figure 5-4

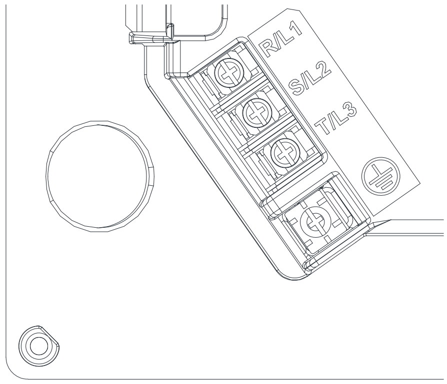
- Dimensions of Ring Lug
  The part # of the ring lugs (produced by K.S. Terminals Inc.) in the table below are for reference only. You can buy other ring lugs of your choice to match with different frame sizes.

Unit: mm

<table>
<tr><th>Frame</th><th>AWG*1</th><th>Model Name</th><th>A (MAX)</th><th>B (MAX)</th><th>C (MIN)</th><th>D (MAX)</th><th>d2 (MIN)</th><th>E (MIN)</th><th>F (MIN)</th><th>W (MAX)</th><th>t (MAX)</th></tr>
<tr><td rowspan="5">A</td><td>22</td><td>RNBS 1-4</td><td rowspan="7">12.1</td><td rowspan="7">3.6</td><td rowspan="7">6.1</td><td rowspan="7">5.6</td><td rowspan="7">4.3</td><td rowspan="7">13.00</td><td rowspan="7">4.5</td><td rowspan="7">7.2</td><td rowspan="7">1.0</td></tr>
<tr><td>18</td><td>RNBS 1-4</td></tr>
<tr><td>16</td><td>RNBS 1-4</td></tr>
<tr><td>14</td><td>RNBS 2-4</td></tr>
<tr><td>12</td><td>RNBS 5-4</td></tr>
<tr><td rowspan="2">B</td><td>12</td><td>RNBS 5-4</td></tr>
<tr><td>10</td><td>RNBS 5-4</td></tr>
</table>

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

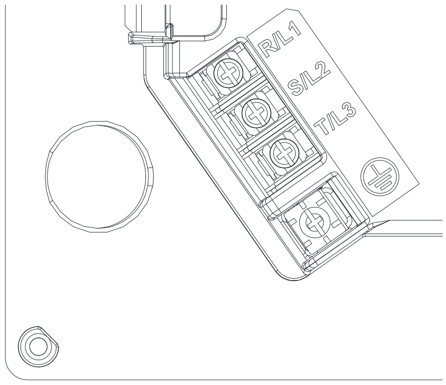
Frame A



- If you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600 V and are temperature resistant to 90°C or above.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Model	Main Circuit Terminals R/L1, S/L2, T/L3			Terminal ⏚		
	Maximum Wire Gauge	Minimum Wire Gauge	Torque (±10%)	Maximum Wire Gauge	Minimum Wire Gauge	Torque (±10%)
VFD1A6MP43JNNAA, VFD1A6MP43JFNAA	4 mm^2 [12 AWG]	0.5 mm^2 [22 AWG]	#6-32 UNC 8 Kg-cm [7.0 lb-in.] [0.78 Nm]	0.5 mm^2 [22 AWG]	0.5 mm^2 [22 AWG]	M4 8 Kg-cm [7.0 lb-in.] [0.78 Nm]
VFD3A3MP43JNNAA VFD3A3MP43JFNAA		0.75 mm^2 [18 AWG]		0.75 mm^2 [18 AWG]	0.75 mm^2 [18 AWG]	
VFD4A7MP43JNNAA, VFD4A7MP43JFNAA		1.5 mm^2 [16 AWG]		1.5 mm^2 [16 AWG]	1.5 mm^2 [16 AWG]	
VFD6A2MP43JNNAA, VFD6A2MP43JFNAA		2.5 mm^2 [14 AWG]		2.5 mm^2 [14 AWG]	2.5 mm^2 [14 AWG]	
VFD8A5MP43JNNAA, VFD8A5MP43JFNAA		2.5 mm^2 [14 AWG]		2.5 mm^2 [14 AWG]	2.5 mm^2 [14 AWG]	
VFD11AMP43JNNAA		4 mm^2 [12 AWG]		4 mm^2 [12 AWG]	4 mm^2 [12 AWG]	

Frame B



- If you install at Ta 40°C above environment, use copper wires that have a voltage rating of 600 V and are temperature resistant to 90°C or above.
- To be UL installation compliant, you must use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations. Do not reduce the wire gauge when using high-temperature resistant wires.

Model	Main Circuit Terminals R/L1, S/L2, T/L3			Terminal ⏚		
	Maximum Wire Gauge	Minimum Wire Gauge	Torque (±10%)	Maximum Wire Gauge	Minimum Wire Gauge	Torque (±10%)
VFD11AMP43JFNAA	6 mm^2 [10 AWG]	4 mm^2 [12 AWG]	#6-32 UNC 8 Kg-cm [7.0 lb-in.] [0.78 Nm]	4 mm^2 [12 AWG]	4 mm^2 [12 AWG]	M4 8 Kg-cm [7.0 lb-in.] [0.78 Nm]
VFD15AMP43JNNAA VFD15AMP43JFNAA		6 mm^2 [10 AWG]		6 mm^2 [10 AWG]	6 mm^2 [10 AWG]	

Chapter 6 Control Terminals

6-1 Control Terminals

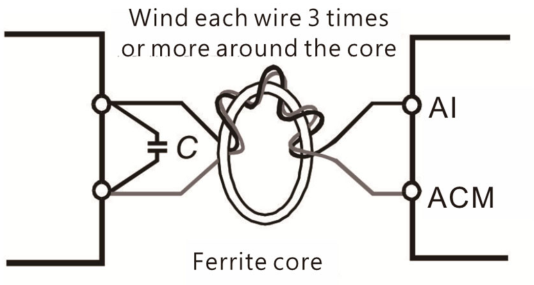
CAUTION

Analog input terminals (AI1–2, ACM)

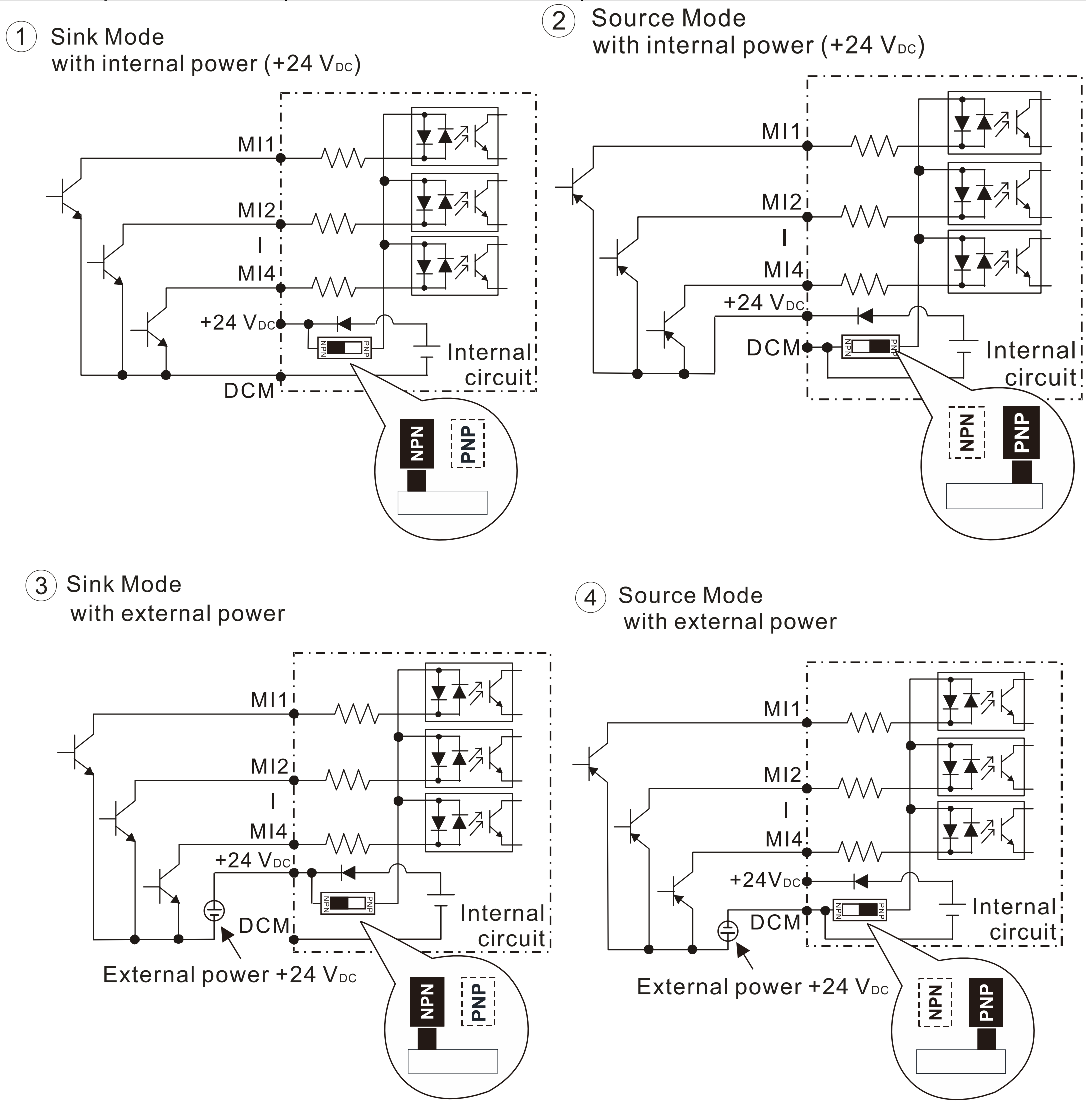
☑ Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (less than 20 m) with proper grounding. If the noise is inductive, connecting the shield to the ACM terminal can reduce interference.

☑ Use twisted-pair wire for weak analog signals.

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



Contact input terminals (MI1–MI4, DCM, +24 V)



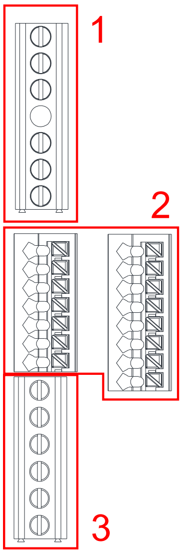
☑ When using internal power, the terminal switches to NPN is collinear with 24V, and switches to PNP is collinear with DCM.

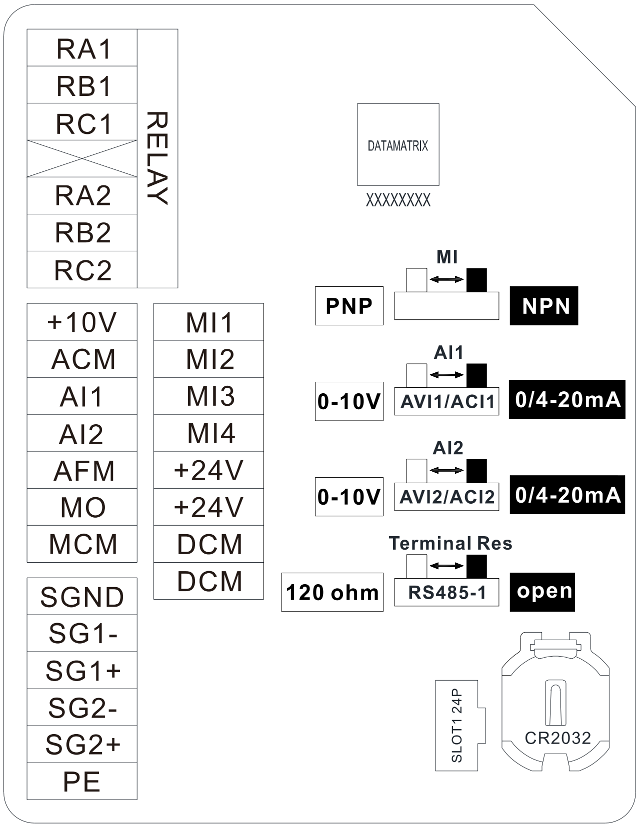
☑ It's Sink mode when the external transistor is NPN, and it's Source mode when the external transistor is PNP.

Transistor (digital) output terminals (MO, 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.





Control Terminal Distribution Diagram

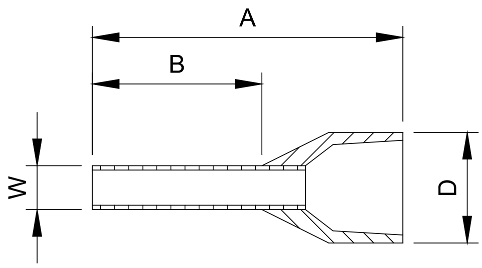
Control Terminal Location Diagram

Wiring precautions:

- The RELAY terminal uses the PCB terminal block (as shown in Area 1 in the control terminal distribution diagram):
  - Tighten the wiring with a 2.5 mm width and 0.4 mm thickness slotted screwdriver.
  - The ideal length of stripped wire at the connection side is 9–10 mm.
  - When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.
- The control terminal uses the push-in spring terminal block (as shown in Area 2 in the control terminal distribution diagram):
  - When removing wires, use the slotted screwdriver to press down the terminal, and the suggested force is 1.5 kgf.
    Slotted screwdriver: 2.5 mm width and 0.4 mm thickness
  - The ideal length of stripped wire at the connection side is 9 mm.
  - When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.
- The RS-485 terminal uses the PCB terminal block (as shown in Area 3 in the control terminal distribution diagram):
  - Tighten the wiring with a 2.5 mm width and 0.4 mm thickness slotted screwdriver.
  - The ideal length of stripped wire at the connection side is 9 mm.
  - When wiring bare wires, ensure that they are perfectly arranged to go through the wiring holes.

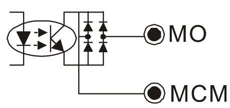
Wiring Specifications of Terminals

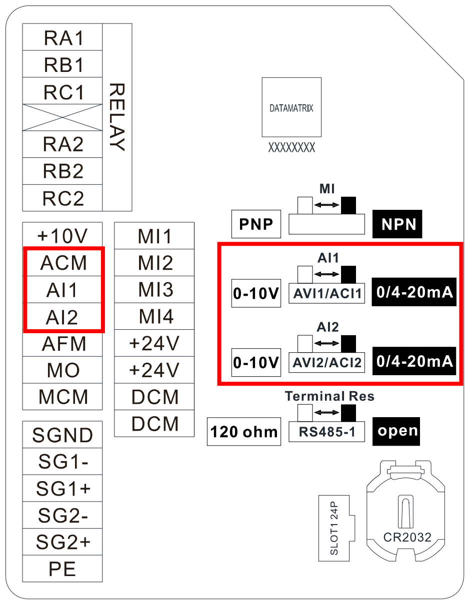
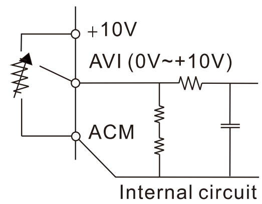
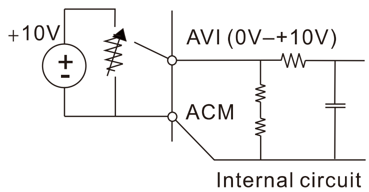
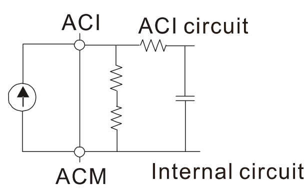
<table>
<tr><th>Name</th><th>Wiring Specifications of Control Terminals</th><th>Stripping Length (mm)</th><th>Maximum Wire Gauge</th><th>Minimum Wire Gauge</th><th>Torque (±10%)</th></tr>
<tr><td rowspan="2">RELAY Terminals</td><td>Solid</td><td rowspan="7">9</td><td rowspan="4">1.5mm^2
16AWG</td><td rowspan="4">0.2mm^2
24AWG</td><td rowspan="4">5 Kg-cm
[4.3 lb-in.]
[0.49 Nm]</td></tr>
<tr><td>Strand</td></tr>
<tr><td rowspan="2">RS-485 terminal</td><td>Solid</td></tr>
<tr><td>Strand</td></tr>
<tr><td rowspan="3">Control terminal</td><td>Solid</td><td rowspan="2">0.75mm^2
18AWG</td><td rowspan="3">0.25mm^2
24AWG</td><td rowspan="3"></td></tr>
<tr><td>Strand</td></tr>
<tr><td>Stranded with ferrules with plastic sleeve</td><td>0.5mm^2
20AWG</td></tr>
</table>

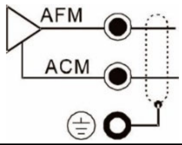
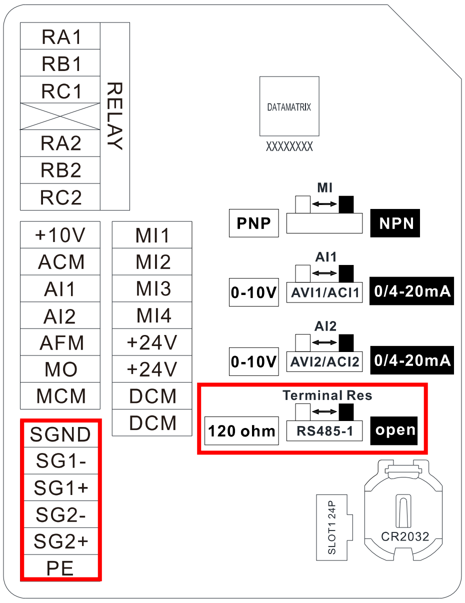


Unit: mm

Suggested models and dimensions for crimping terminals						
Wire Gauge	Manufacturer	Model Name	A (MAX)	B (MAX)	D (MAX)	W (MAX)
0.25mm^2 24AWG	PHOENIX CONTACT	AI 0,25- 8 YE	12.5	8	2.6	1.1
0.34mm^2 22AWG	PHOENIX CONTACT	AI 0,34- 8 TQ	12.5	8	3.3	1.3
0.5mm^2 20AWG	PHOENIX CONTACT	AI 0,5 - 8 WH	14	8	3.5	1.4
Suggested specifications and models for crimping tool: CRIMPFOX 10S - 1212045, Manufacturer: PHOENIX CONTACT DNT13-0101, Manufacturer: DINKLE						

Terminal Name	Terminal function	Descriptions
+24V	Digital control signal common (Source)	+24 VDC ± 10 % 100 mA
MI 1 – MI4	Multi-function Input Selection 1–4	Refer to Pr.02-01–02-04 to program the multi-function inputs Source Mode ON: activation current 3.3 mA, and breakover voltage 11 V_{DC} OFF: cut-off voltage ≤ 5 V_{DC} Sink Mode ON: activation current 3.3 mA, and breakover voltage 13 V_{DC} OFF: cut-off voltage ≥ 19 V_{DC} ■ Pr.02-00 = 0 You can set multi-function options with multi-function input terminals MI1, MI2. ■ Pr.02-00 ≠ 0 The multi-function input terminals MI1, MI2 work in accordance with the setting values for Pr.02-00.
MO	Multi-function Output 1 (photo coupler)	The AC motor drive outputs various monitoring signals, such as drive in operation, frequency reached, and overload indication through a transistor. Max. 48 V_{DC} 50 mA 
MCM	Multi-function Output Common (photo coupler)	
RA1 RA2	Multi-function output (Relay N.O. a)	Resistive Load 3 A (N.O.) / 3 A (N.C.) 250 V_{AC} 5 A (N.O.) / 3 A (N.C.) 30 V_{DC} Inductive Load (COS 0.4) 1.2 A (N.O.) / 1.2 A (N.C.) 250 V_{AC}
RB1 RB2	Multi-function output (Relay N.C. b)	

Terminal Name	Terminal function	Descriptions
RC1 RC2	Multi-function output common (Relay)	2.0 A (N.O.) / 1.2 A (N.C.) 30 V_{DC} To output different kinds of monitoring signals such as motor drive in operation, frequency reached, and overload indication.
+10V	Potentiometer power supply	Power supply for analog frequency setting: +10.5 ± 0.5 V_{DC} / 20 mA
AI1 AI2	Analog input	The default of AI1 terminal is 0–20 mA current mode. Change to voltage mode by switching J3 of AI1 to 0–10V side, and set Pr.03-28. The default of AI2 terminal is 0–20 mA current mode. Change to voltage mode by switching J3B of AI2 to 0–10V side, and set Pr.03-29.  Voltage mode (AVI) Analog voltage frequency command Impedance: 20 kΩ Range: 0 – +10 V = corresponding to maximum operation frequency (Pr.01-00) Mode switching by setting Pr.03-00, 03-01, 03-28, 03-29 AVI resolution=12 bits   Current mode (ACI) ACI analog current frequency command Impedance: 250 kΩ Range: 0–20 mA / 4–20 mA = corresponding to maximum operation frequency (Pr.01-00) Mode switching by setting Pr.03-00, 03-01, 03-28, 03-29 ACI resolution = 12 bits 

Terminal Name	Terminal function	Descriptions
AFM	Multi-function analog voltage output	Range: 0–10 V corresponds to the maximum operating range of the control target Maximum output current: 2 mA, Maximum load: 5 kΩ 
ACM	Analog signal common	Analog signal common terminal
PE	Ground function	For grounding the shielding of communication cable. The inside of terminal does not connect to system grounding, so connect system grounding cable and shielded cable to PE terminal.
SG1- SG1+ SGND	RS-485 communication port (The port to communicate with multi-pump control)	SG1+, SG1-: This is for multi-pump control. The loop includes terminal reistor, and switch it by using J5. When it switches to 120 ohm, in the middle of SG1+ and SG1- is in equivalent parallel with 120 ohm resistance. When the cable of multi-pump control is too long, Its reflection wave causes signals to distort. At this moment, J5 of the first and the last drives switch to 120 ohm can decrease the influence. Remember that J5 should be at open side for the drives except the first one and the last one. SG2+, SG2-: To communication with upper device. SGND: Signal ground of SG1+, SG1-, SG2+, SG2-
SG2- SG2+ SGND	RS-485 communication port (The port to communicate with upper device)	 Note: Refer to Chapter 12 DESCRIPTIONS OF PARAMETER SETTINGS parameter group 09 Communication Parameters for details.

* Analog control signal wiring specification: 0.82 mm^2 [18 AWG] with shielded stranded wire.

Chapter 7 Optional Accessories

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

7-1 Magnetic Contactor / Air Circuit Breaker and Non-fuse Circuit Breaker

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

It is recommended the ambient 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.

<table>
<tr><th>Frame</th><th>Models</th><th>Voltage / Three-phase</th><th>Output current [A]</th><th>Input current [A]</th><th>Selection of MC / ACB [A]</th></tr>
<tr><td rowspan="6">A</td><td>VFD1A6MP43JNNAA
VFD1A6MP43JFNAA</td><td rowspan="8">460V
three-phase</td><td>1.6</td><td>1.9</td><td>7</td></tr>
<tr><td>VFD3A3MP43JNNAA
VFD3A3MP43JFNAA</td><td>3.3</td><td>3.8</td><td>7</td></tr>
<tr><td>VFD4A7MP43JNNAA
VFD4A7MP43JFNAA</td><td>4.7</td><td>5.4</td><td>9</td></tr>
<tr><td>VFD6A2MP43JNNAA
VFD6A2MP43JFNAA</td><td>6.2</td><td>7.2</td><td>12</td></tr>
<tr><td>VFD8A5MP43JNNAA
VFD8A5MP43JFNAA</td><td>8.5</td><td>9.9</td><td>18</td></tr>
<tr><td>VFD11AMP43JNNAA</td><td rowspan="2">11.7</td><td rowspan="2">13.8</td><td rowspan="2">32</td></tr>
<tr><td rowspan="2">B</td><td>VFD11AMP43JFNAA</td></tr>
<tr><td>VFD15AMP43JNNAA
VFD15AMP43JFNAA</td><td>15.6</td><td>18.5</td><td>40</td></tr>
</table>

Table 7-1

Non-fuse Circuit Breaker

☑ Comply with the UL standard: Per UL 61800, paragraph 6.3.7DV.2.2.1

☑ The rated current of the non-fuse circuit breaker should be 1.6–2.6 times the drive's rated input current. The recommended current values are shown in the table below.

☑ Compare the time characteristics of the non-fuse circuit breaker with those of the drive's overheated protection to ensure that there is no tripping.

<table>
<tr><th>Frame</th><th>Model</th><th>Voltage / Three-phase</th><th>Input / output current (the maximum)</th><th>Suggested current [A]</th></tr>
<tr><td rowspan="6">A</td><td>VFD1A6MP43JNNAA
VFD1A6MP43JFNAA</td><td rowspan="8">460V
three-phase</td><td>1.9 / 1.6</td><td>5</td></tr>
<tr><td>VFD3A3MP43JNNAA
VFD3A3MP43JFNAA</td><td>3.8 / 3.3</td><td>10</td></tr>
<tr><td>VFD4A7MP43JNNAA
VFD4A7MP43JFNAA</td><td>5.4 / 4.7</td><td>15</td></tr>
<tr><td>VFD6A2MP43JNNAA
VFD6A2MP43JFNAA</td><td>7.2 / 6.2</td><td>20</td></tr>
<tr><td>VFD8A5MP43JNNAA
VFD8A5MP43JFNAA</td><td>9.9 / 8.5</td><td>25</td></tr>
<tr><td>VFD11AMP43JNNAA</td><td rowspan="2">13.8 / 11.7</td><td rowspan="2">32</td></tr>
<tr><td rowspan="2">B</td><td>VFD11AMP43JFNAA</td></tr>
<tr><td>VFD15AMP43JNNAA
VFD15AMP43JFNAA</td><td>18.5 / 15.6</td><td>40</td></tr>
</table>

Table 7-2

7-2 Fuse Specification Chart

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

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

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

Model	Voltage / Three-phase	Input / output current (the maximum)	Branch circuit fuses output [A]
VFD1A6MP43JNNAA	460V three-phase	1.9 / 1.6	6.4
VFD1A6MP43JFNAA			Class T JJS-10 600 V_{AC}
VFD3A3MP43JNNAA		3.8 / 3.3	13.2
VFD3A3MP43JFNAA			Class T JJS-15 600 V_{AC}
VFD4A7MP43JNNAA		5.4 / 4.7	18.8
VFD4A7MP43JFNAA			Class T JJS-20 600 V_{AC}
VFD6A2MP43JNNAA		7.2 / 6.2	24.8
VFD6A2MP43JFNAA			Class T JJS-25 600 V_{AC}
VFD8A5MP43JNNAA		9.9 / 8.5	34
VFD8A5MP43JFNAA			Class T JJS-35 600 V_{AC}
VFD11AMP43JNNAA		13.8 / 11.7	46.8
VFD11AMP43JFNAA			Class T JJS-45 600 V_{AC}
VFD15AMP43JNNAA		18.5 / 15.6	46.8
VFD15AMP43JFNAA			Class T JJS-45 600 V_{AC}

Table 7-3

7-3 AC Reactor

AC Input Reactor

Install an AC reactor at 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 mains 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 at the input side of the AC motor drive protects it by suppressing surges.

Installation

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

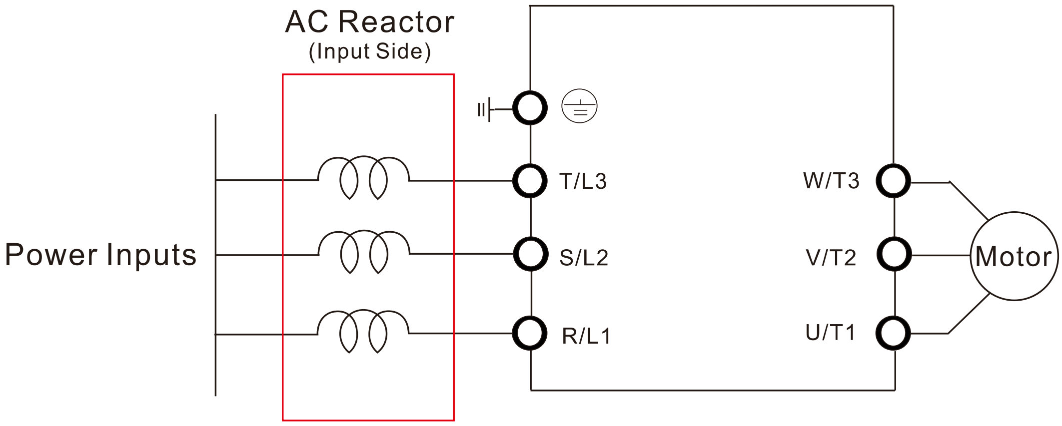


Figure 7-1 AC input reactor installation diagram

The size and the specification of the AC input reactor:

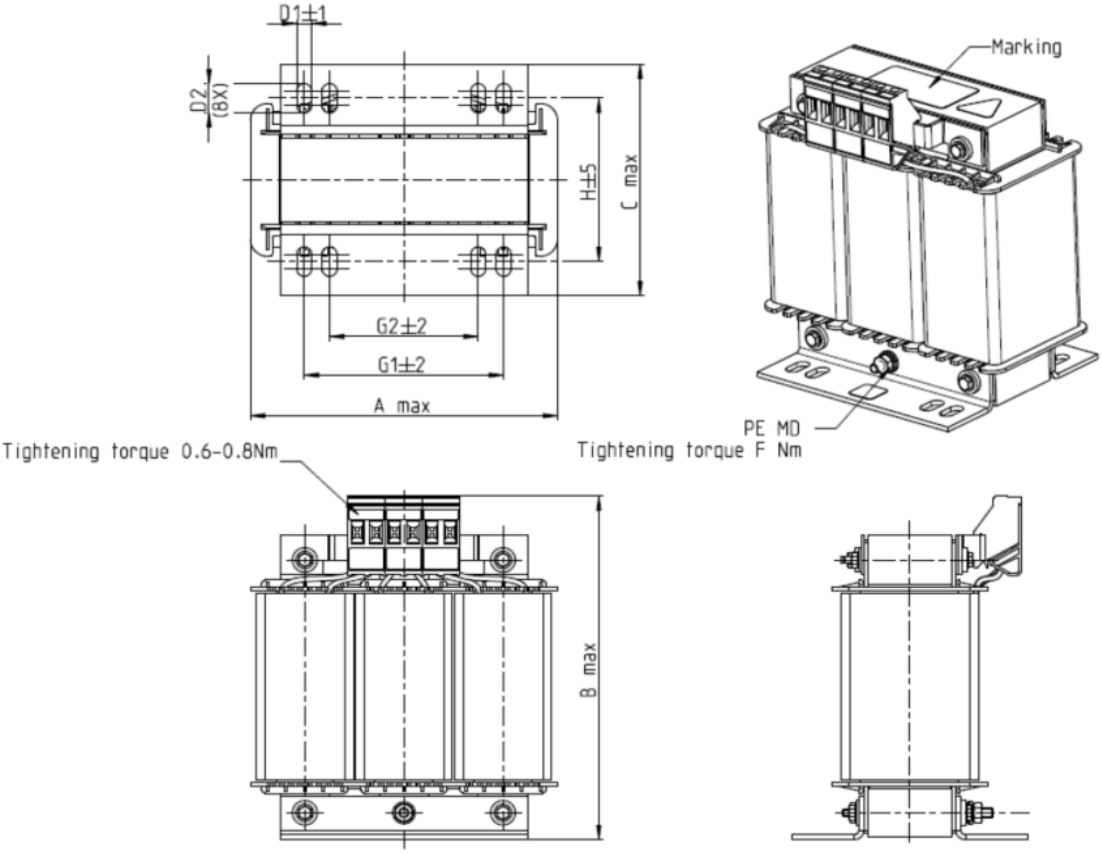


Figure 7-2

Unit: mm

Delta's part no.	A	B	C	D1*D2	E	G1	G2	PE D
DR005A0254	100	115	65	6*9	45	60	40	M4
DR008A0159	100	115	65	6*9	45	60	40	M4
DR011A0115	130	135	95	6*12	60	80.5	60	M4
DR017AP746	130	135	100	6*12	65	80.5	60	M4

Table 7-4

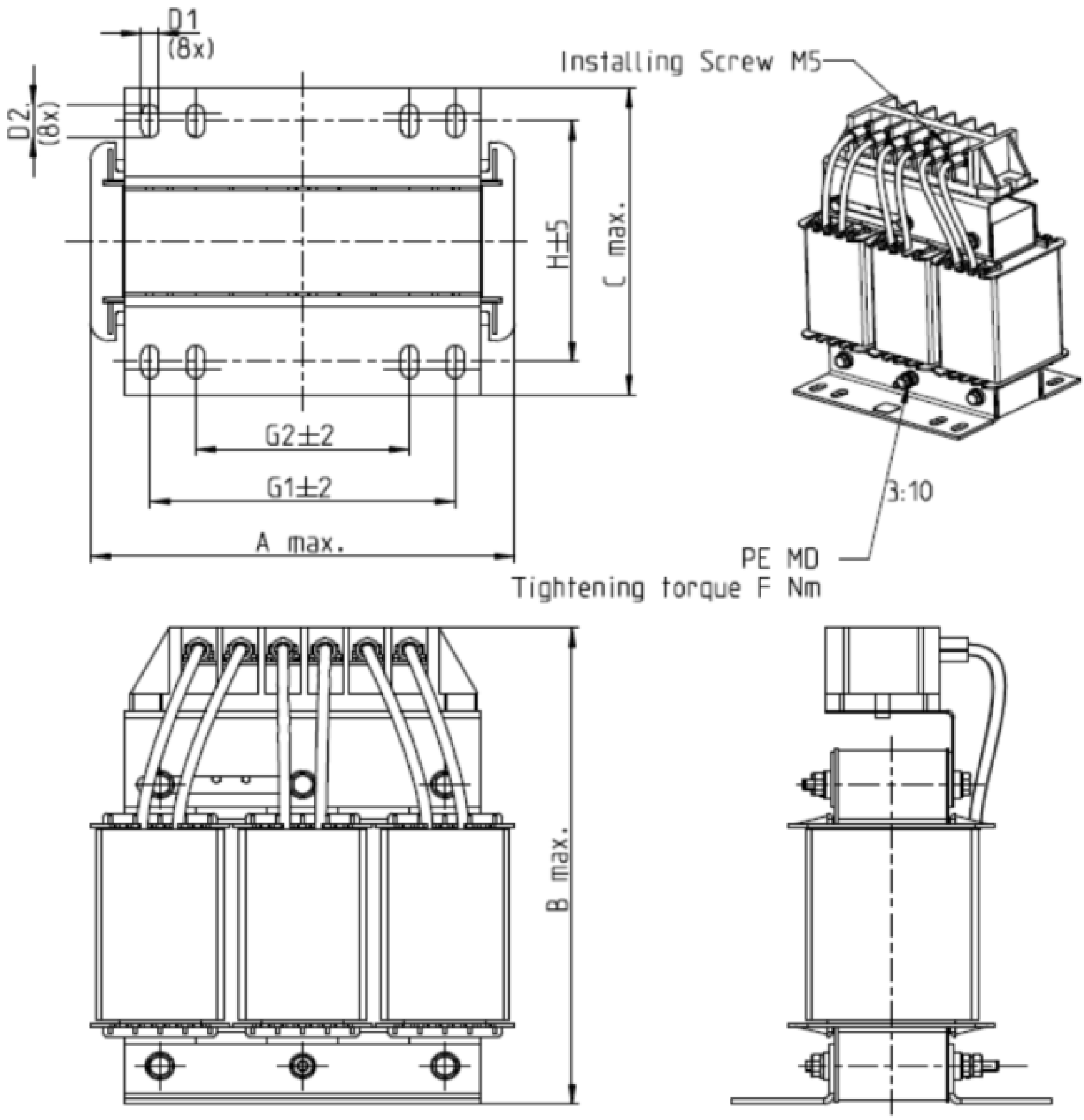


Figure 7-3

Unit: mm

Delta's part no.	A	B	C	D1*D2	H	G1	G2	PE D
DR025AP507	130	195	100	6*12	65	80.5	60	M4

Table 7-5

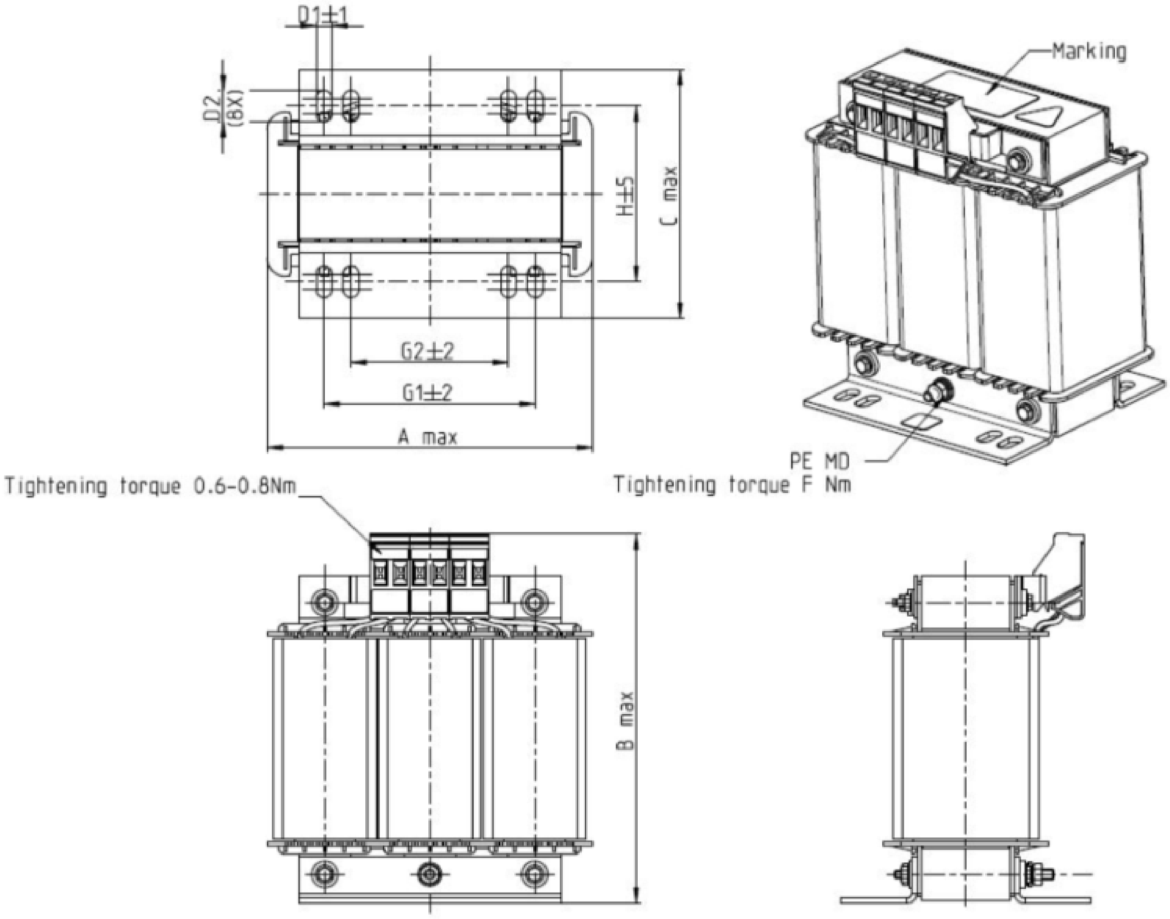


Figure 7-4

Unit: mm

Delta’s part no.	A	B	C	D1*D2	H	G1	G2	PE D
DR003A0810	100	125	65	6*9	43	60	40	M4
DR004A0607	100	125	65	6*9	43	60	40	M4
DR006A0405	130	15	95	6*12	60	80.5	60	M4
DR009A0270	160	160	105	6*12	75	107	75	M4
DR010A0231	160	160	115	6*12	90	107	75	M4
DR012A0202	160	160	115	6*12	90	107	75	M4
DR018A0117	160	160	115	6*12	90	107	75	M4

Table 7-6

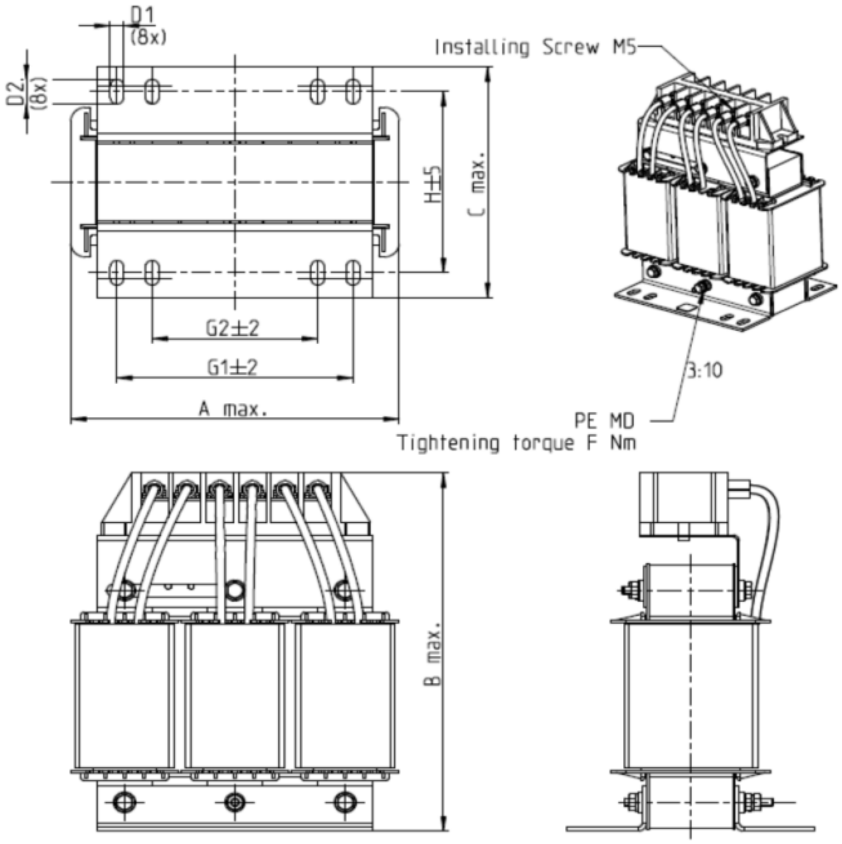


Figure 7-5

Unit: mm

Delta's part no.	A	B	C	D1*D2	H	G1	G2	PE D
DR024AP881	160	175	115	6*12	90	107	75	M4

Table 7-7

The specification of the AC input reactor

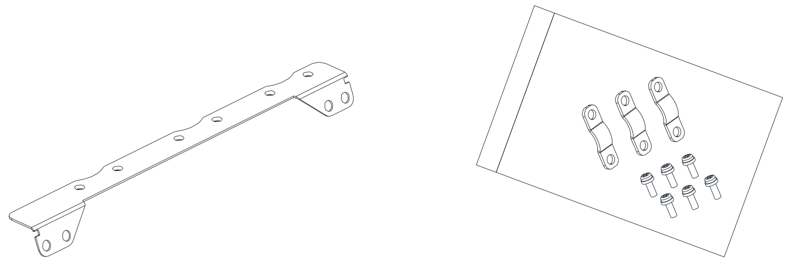
460V, 50-60 Hz / three-phase

Model	Rated current [Arms]	Saturation Current [Arms]	Recommended selection	
			AC input reactor [mH]	Delta's part no.
VFD1A6MP43JNNAA VFD1A6MP43JFNAA	1.6	2.4	8.102	DR003A0810
VFD3A3MP43JNNAA VFD3A3MP43JFNAA	3.3	4.95	6.077	DR004A0607
VFD4A7MP43JNNAA VFD4A7MP43JFNAA	4.7	7.05	4.05	DR006A0405
VFD6A2MP43JNNAA VFD6A2MP43JFNAA	6.2	9.3	2.7	DR009A0270
VFD8A5MP43JNNAA VFD8A5MP43JFNAA	8.5	12.75	2.7	DR009A0270
VFD11AMP43JNNAA VFD11AMP43JFNAA	11.7	17.55	2.315	DR010A0231
VFD15AMP43JNNAA VFD15AMP43JFNAA	15.6	23.4	1.174	DR018A0117

Table 7-8

7-4 EMC Shield Plate

EMC Shield Plate (for use with shielded cable)

Frame	Model of EMC shield plate	Reference figure
A, B	MKMP-EPB	 Figure 7-6

The appearance and the size

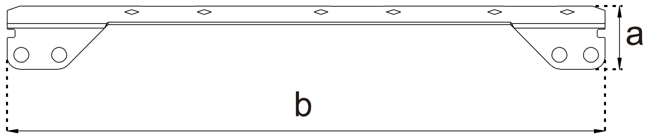


Figure 7-7

The size of EMC shield plate mm [inch]	
a	b
19.8 [0.78]	189.5 [7.46]

Installation (This example uses frame A model)

1. As shown in the right figure, fix the shield plate on the AC motor drive.

Torque value:

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

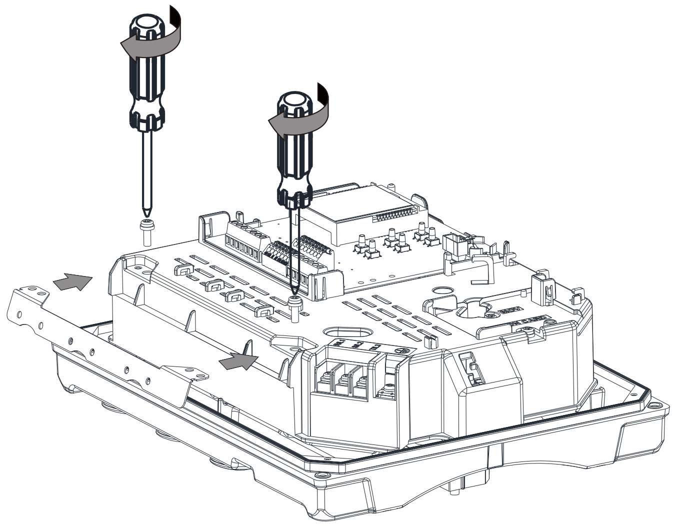


Figure 7-8

2. Select a suitable metal omega clip according to the wire gauge used, and then fix the metal omega clip on the shield plate.

Torque value:

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

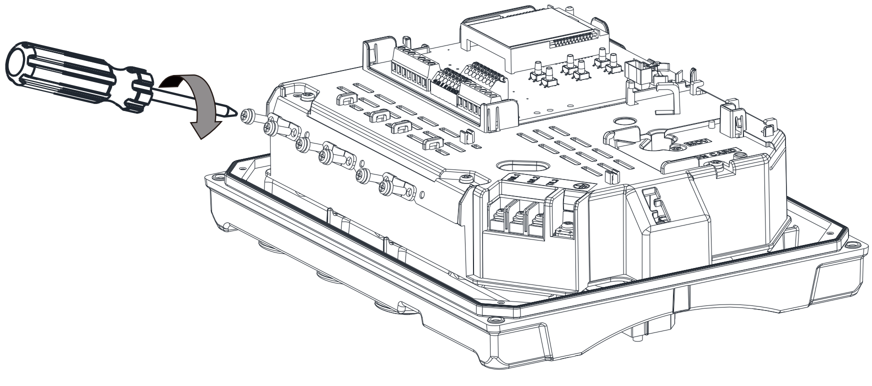


Figure 7-9

7-5 Waterproof Connector

Waterproof connector (for wiring)

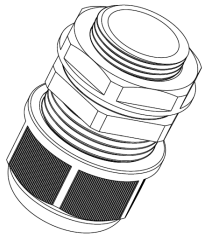
<table>
<tr><th>Frame</th><th>Models</th><th>Reference figure</th></tr>
<tr><td>A, B</td><td>MKMP-CG20
MKMP-CG25</td><td>
Figure 7-10</td></tr>
</table>

Table 7-9

The appearance and the size

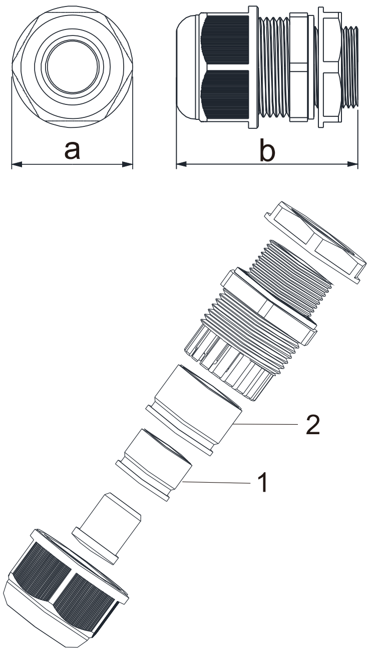
<table>
<tr><td rowspan="4">
Figure 7-11</td><td rowspan="2">Models</td><td colspan="2">The suitable wire gauge
mm [inch]</td><td colspan="2">The size of the waterproof connector
mm [inch]</td></tr>
<tr><td>1</td><td>2</td><td>a</td><td>b</td></tr>
<tr><td>MKMP-CG20</td><td>5.5 [0.22]
–
9.0 [0.35]</td><td>9.0 [0.35]
–
14.4 [0.57]</td><td>30.5
[1.20]</td><td>49.3
[1.94]</td></tr>
<tr><td>MKMP-CG25</td><td>10.5 [0.41]
–
14.1 [0.56]</td><td>14.1 [0.56]
–
18.8 [0.74]</td><td>37.0
[1.46]</td><td>55.0
[2.17]</td></tr>
</table>

Table 7-10

Suggested torque value to install

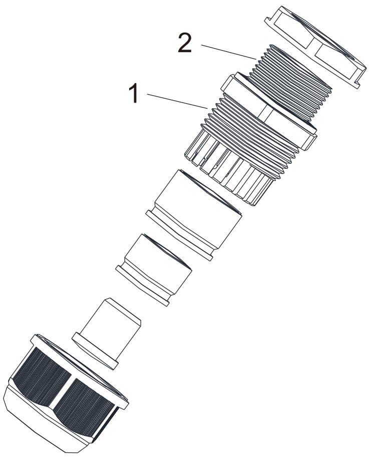
<table>
<tr><td rowspan="6">
Figure 7-12</td><td rowspan="2">Models</td><td colspan="2">1</td><td>2</td></tr>
<tr><td>The suitable wire gauge
mm [inch]</td><td>The suggested torque value
kg-cm [lb-in.] [Nm]</td><td>The suggested torque value
kg-cm [lb-in.] [Nm]</td></tr>
<tr><td rowspan="2">MKMP-CG20</td><td>5.5 [0.22]
–
9 [0.35]</td><td>20–30 kg-cm
[17.3–26.0 lb-in.]
[1.97–2.95 Nm]</td><td rowspan="2">20–25 kg-cm
[17.3–21.7 lb-in.]
[1.97–2.46 Nm]</td></tr>
<tr><td>9 [0.35]
–
14.4 [0.57]</td><td>25–30 kg-cm
[21.7–26.0 lb-in.]
[2.46–2.95 Nm]</td></tr>
<tr><td rowspan="2">MKMP-CG25</td><td>10.5 [0.41]
–
14.1 [0.56]</td><td>30–35 kg-cm
[26.0–30.3 lb-in.]
[2.95–3.44 Nm]</td><td rowspan="2">28–35 kg-cm
[24.3–30.3 lb-in.]
[2.75–3.44 Nm]</td></tr>
<tr><td>14.1 [0.56]
–
18.8 [0.74]</td><td>25–45 kg-cm
[21.7–39.0 lb-in.]
[2.46–4.42Nm]</td></tr>
</table>

Table 7-11

Installation (This example uses Frame A model)

<table>
<tr><td>

1. As the figure shown below, remove the waterproof connector nuts and the vent plugs.

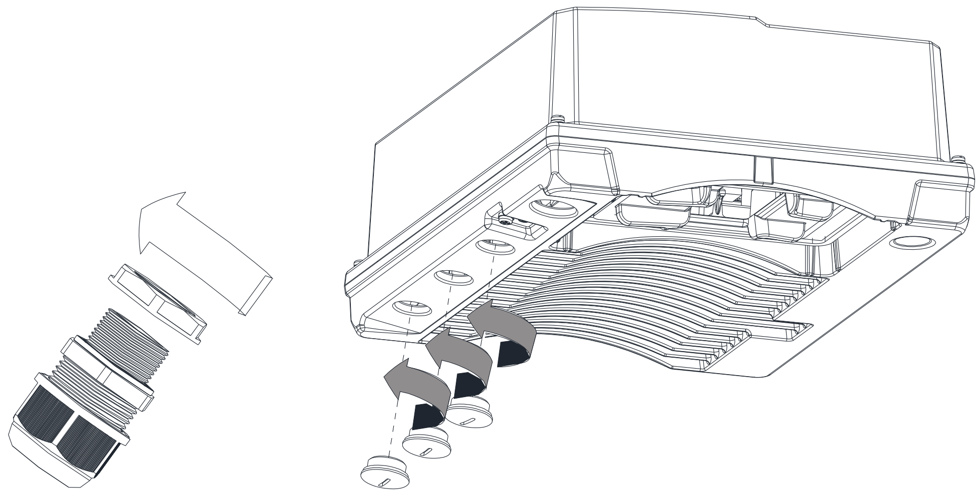


Figure 7-13

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

2. Choose the waterproof connector which is suitable to the heat sink screw thread according to the outgoing cable position. And screw the waterproof connector to the AC motor drive according to the suggested torque value.
Note: Refer to Chapter 2 Dimensions for more details about the specification of the heat sink screw thread.

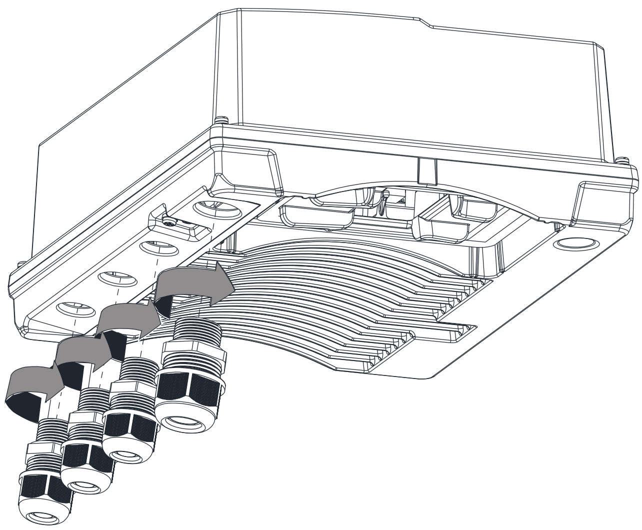


Figure 7-14

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

7-6 USB / RS-485 Communication Interface IFD6500

☑ Please thoroughly read this instruction sheet before installing 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 on Delta's download center.

Introduction
IFD6500 is a convenient RS485-to-USB converter, which does not require external power supply and complex setting process. It supports the transmission speed from 75 to 115 Kbps and auto switching direction of data transmission. In addition, it adopts RJ-45 in RS485 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 industrial automation products to your PC.
Applicable models: all Delta's industrial automation products.

Product application and the appearance

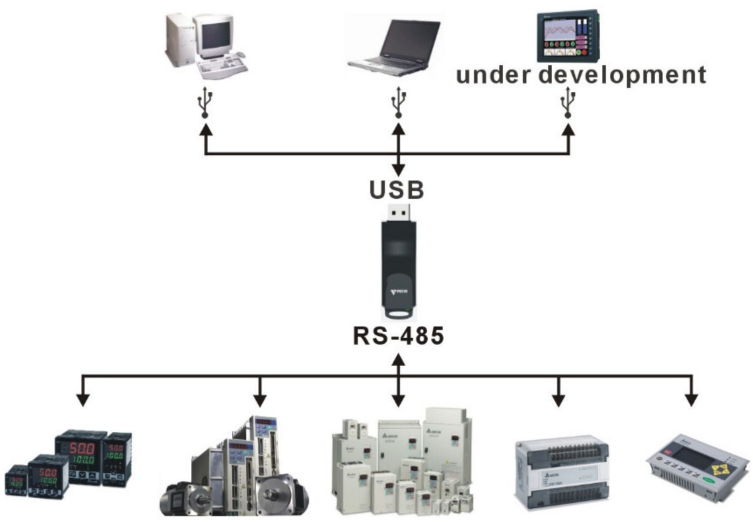


Figure 7-15

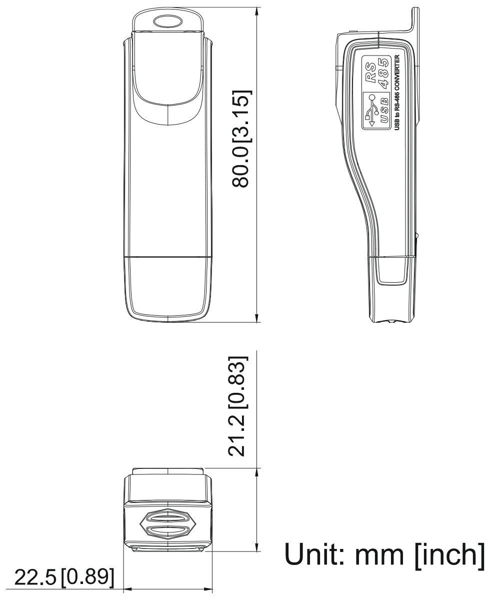
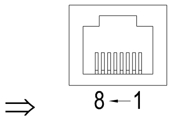


Figure 7-16

Specifications

Power supply	No external power is needed
Power consumption	0.4 W
Isolated voltage	2,500 V_{DC}
Transmission speed	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	In compliance with USB V2.0 specification
The maximum cable length	RS-485 communication port: 100 m
Supports RS-485 half-duplex transmission	

RJ45



PIN	Descriptions	PIN	Descriptions
1	Reserved	5	SG+
2	Reserved	6	Reserved
3	Reserved	7	Reserved
4	SG-	8	Reserved

The accessory pack includes one cable, one side is RJ11 which connects with IFD6500, another side is two bare wires which are SG1+ (red) and SG1- (green) that can connect to two sets of communication ports on the control board of MP300 drive.

- If you select the first set of RS-485 communication port, then lock the red bare wire to SG1+, and lock the green bare wire to SG1-.
- If you select the second set of RS-485 communication port, then lock the red bare wire to SG2+, and lock the green bare wire to SG2-.

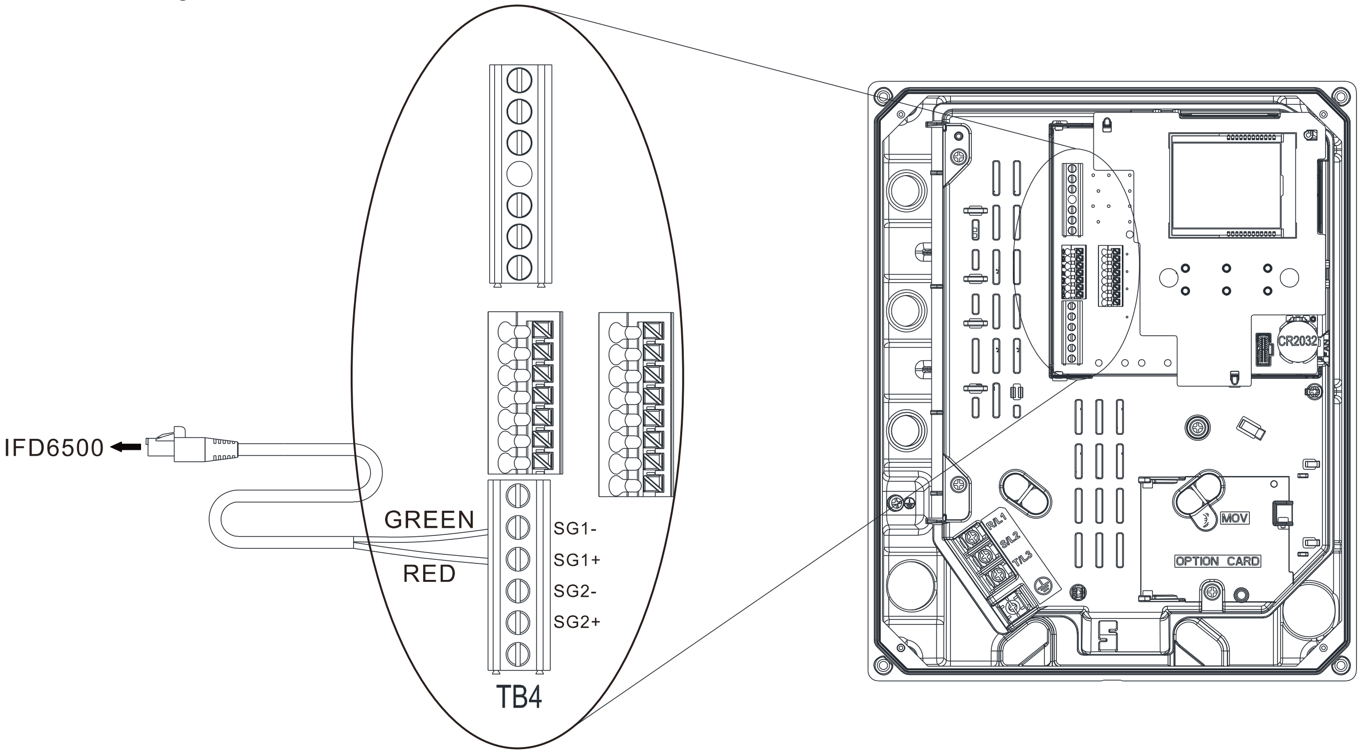
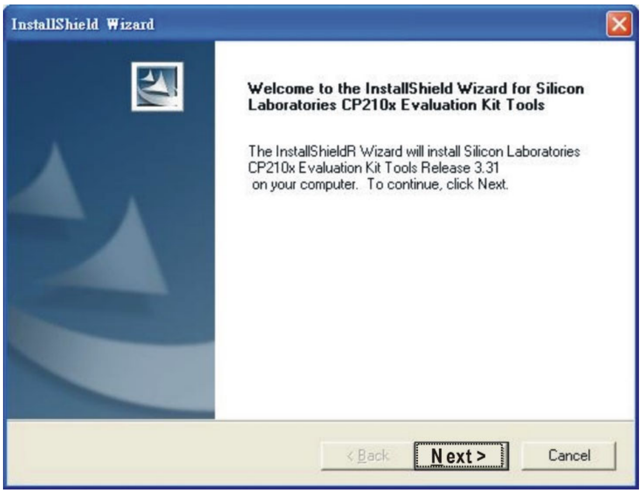


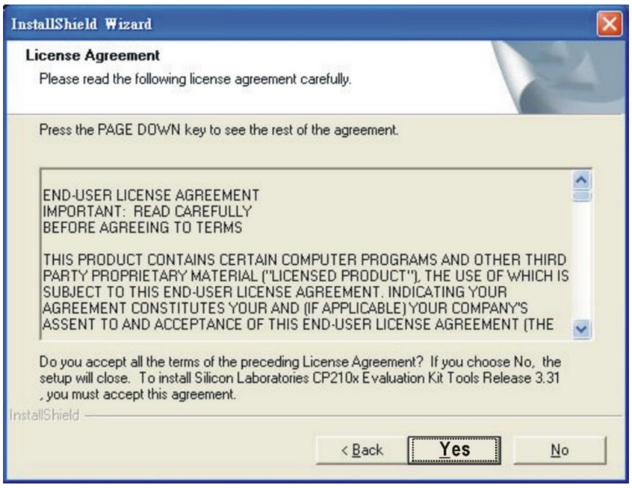
Figure 7-17

Preparations before the driver installation
Extract the driver file (IFD6500_Drivers.exe) by the following steps.
Note: Do not connect IFD6500 to PC before extracting the driver file.

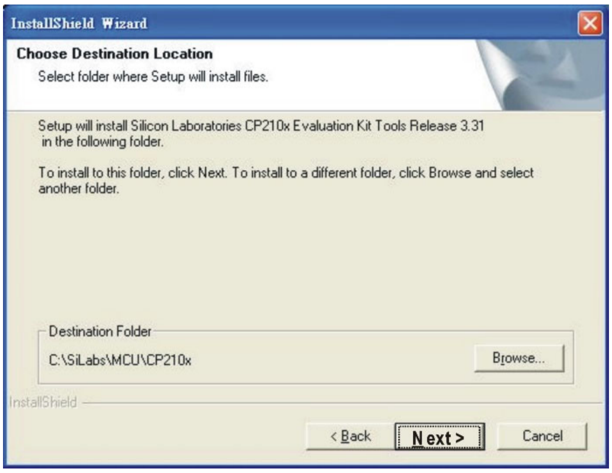
STEP 1



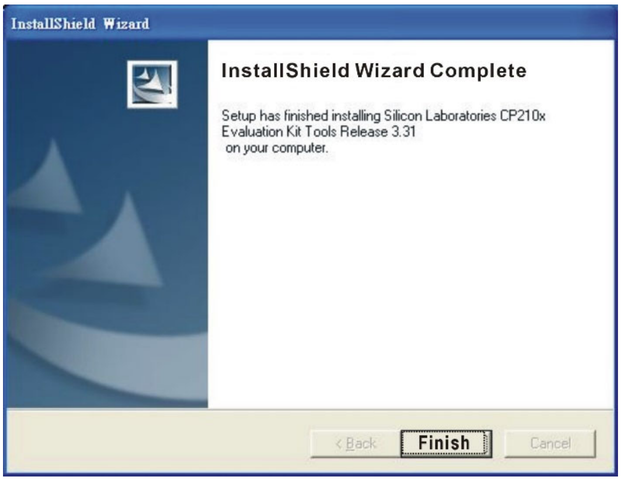
STEP 2



STEP 3



STEP 4



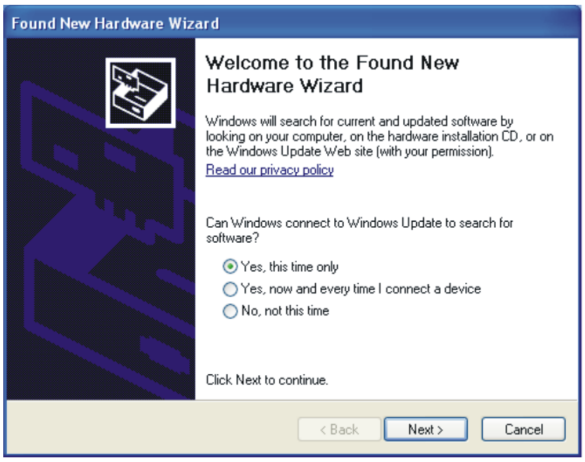
STEP 5

IFD6500 driver file is stored in a folder marked SiLabs under drive C.   (c:\ SiLabs)

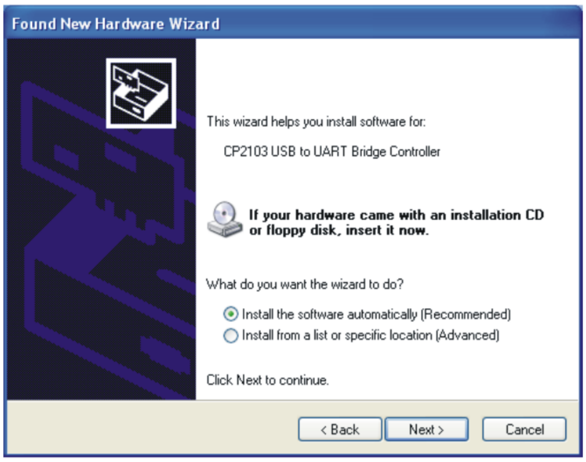
Driver installation

After connecting IFD6500 to PC, install the driver by the following steps.

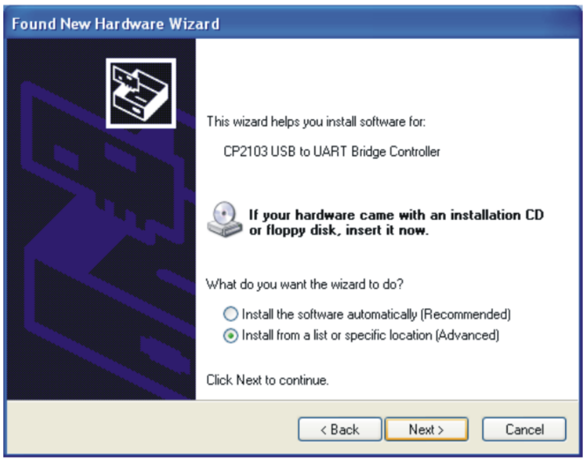
STEP 1

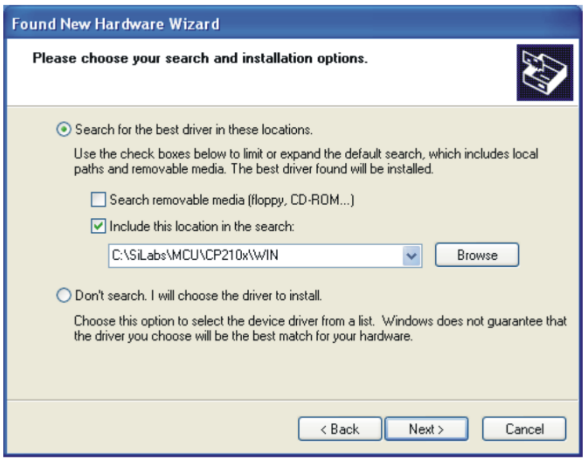


STEP 2



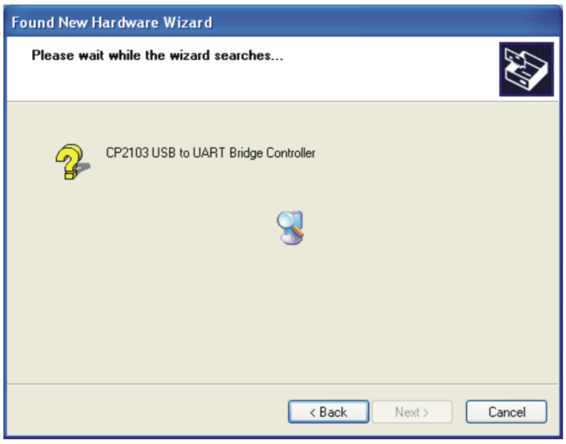
OR



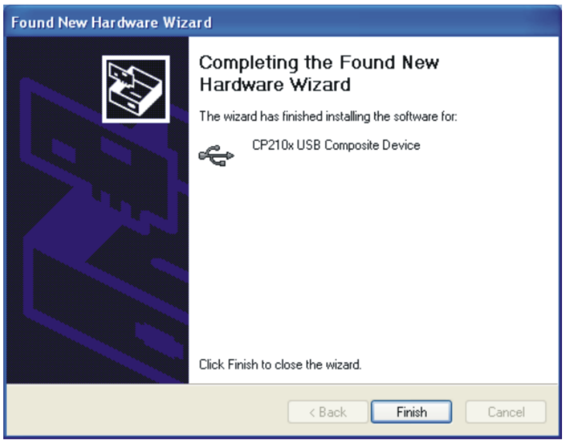


Browse and select directory, or enter C:\SiLabs\MCU\CP210x\WIN

STEP 3



STEP 4



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

LED display

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

7-7 Perpetual Calendar And Battery

☑ The perpetual calendar function has to install the battery CR2032 (this battery is common specification). Follow the figure shown below to install the battery.
☑ When the battery voltage is insufficient, the panel shows LBAt (Low battery voltage) to remind user to change the battery.
☑ This product doesn't ship with any battery and we don't sell any battery. Please purchase the battery for this product by yourself.

Install and remove

1. Install: Press the battery into the battery slot, and confirm the battery is securely latched. The installation is finished.
2. Remove: When change the battery, use a slotted screwdriver to press the latch to release the battery.

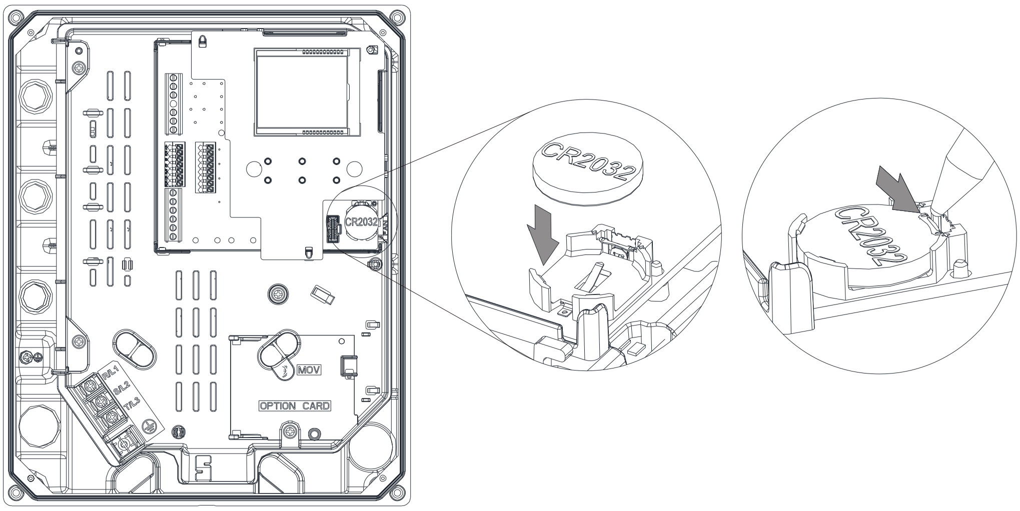


Figure 7-18

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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.

8-1 Option Card Installation

Mounting Position of Option Cards

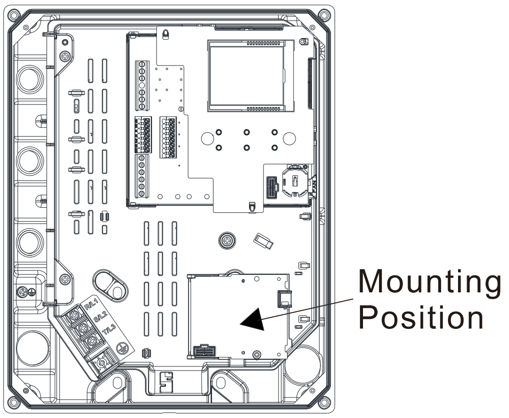


Figure 8-1

MP300 control board connector

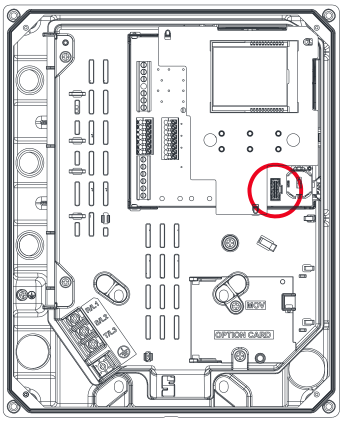


Figure 8-2

Option card connector

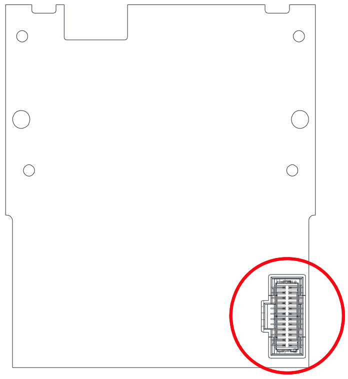


Figure 8-3

Option Card Installation

1. Turn off the power of the motor drive, use cross screwdriver to loosen four screws of the front cover and then remove it, as shown in Figure 8-4.
2. Check the MOV position if there is a screw tightened. If yes, then make sure the screw is tightened well, the recommended torque is 6-8 kg-cm [5.2-6.9 lb-in] [0.59-0.78 Nm]. As shown in Figure 8-5.
3. Engage the lower end of the option card with the guiding slot, as shown in Figure 8-6.
4. Press the upper end of the option card to engage the clips, as shown in Figure 8-7.
5. Use cross screwdriver tighten one M3 screw, the recommended torque is 4-6 kg-cm [3.5-5.2 lb-in] [0.39-0.59 Nm], as shown in Figure 8-8.
6. Connect the cable and fix it in the slotted hole, as shown in Figure 8-9.

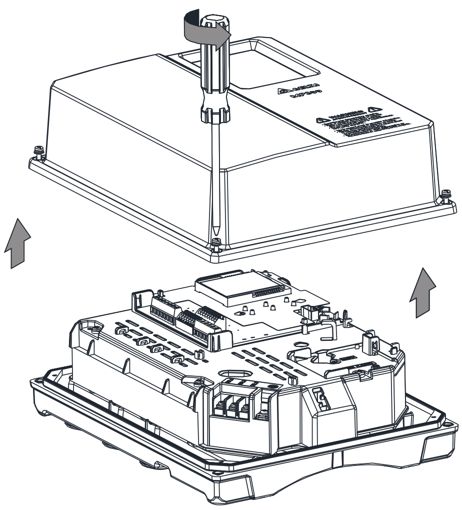


Figure 8-4

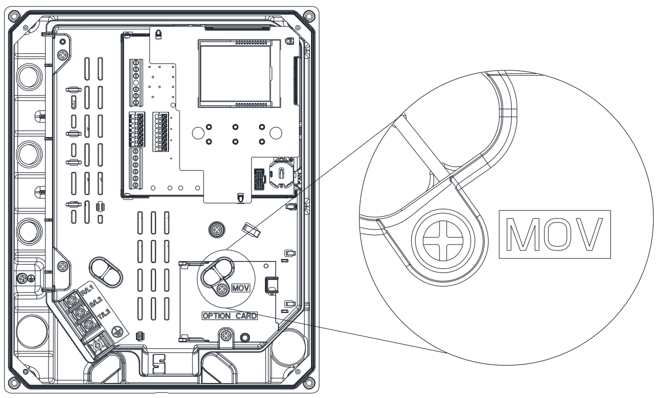


Figure 8-5

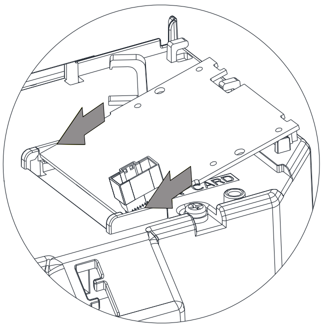


Figure 8-6

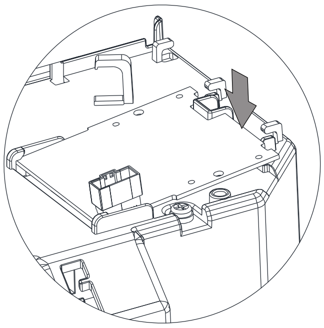


Figure 8-7

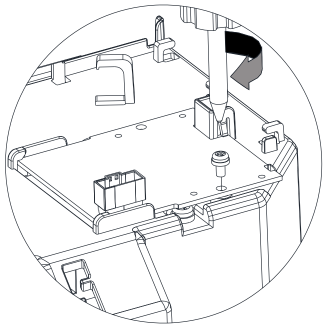


Figure 8-8

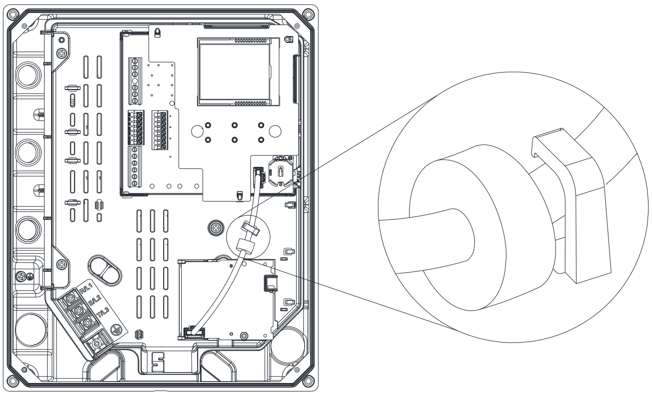
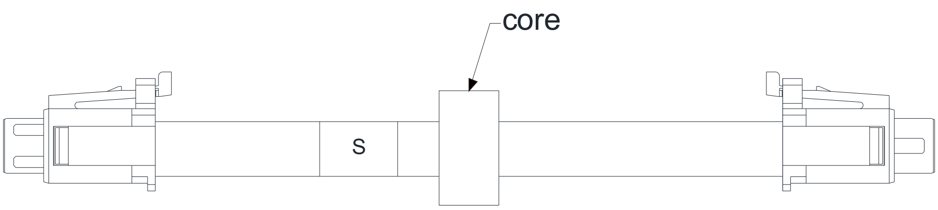


Figure 8-9

Option card cable

To correctly use the option cards, you must purchase the option cards along with the connection cables CBM-CL01A.

Communication cards	CMM-DN02, CMM-EIP02, CMM-PD02, CMMP-BT01
Cable	CBM-CL01A  Figure 8-10

Grounded installation

- You must ground the option cards as listed below when wiring. The ground terminal is included in the option card package, as shown in Figure 8-11.
    1. CMM-PD02
    2. CMM-DN02
    3. CMM-EIP02
    4. CMMP-BT01

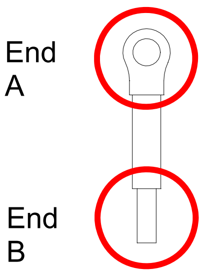


Figure 8-11

- Installation Method

The B end of the grounding wire connects to the ground terminal block of the option card, as the No.6 shows in Figure 8-12 (see Chapter 8 for the ground terminal block position of other option cards). The A end of the grounding wire connects to the drive's PE, as the circles shown in Figure 8-13.

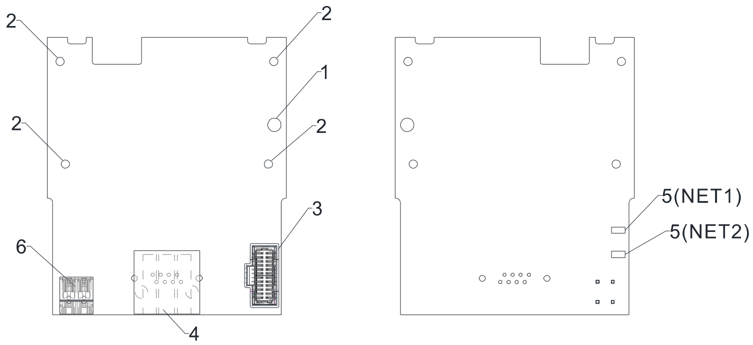


Figure 8-12

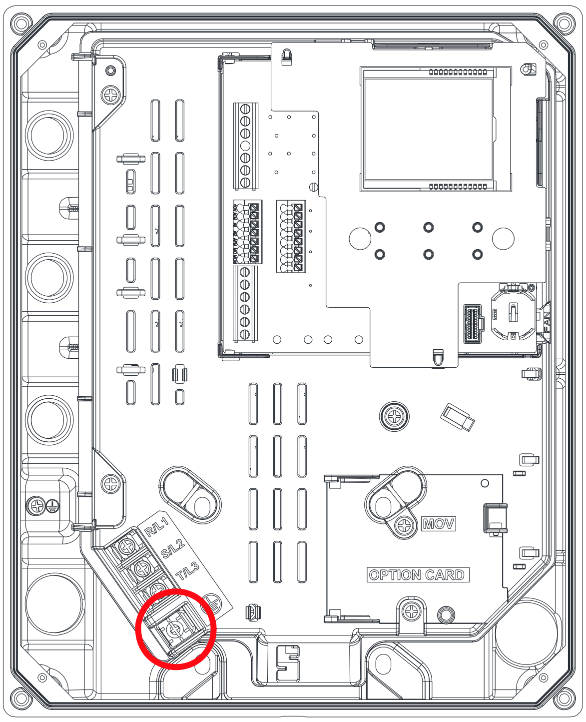
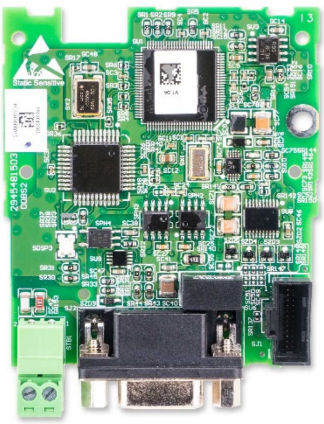


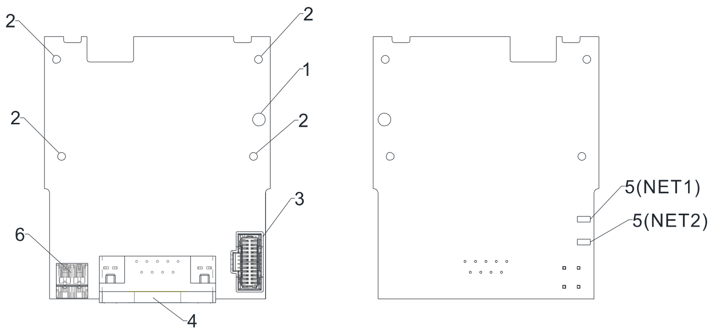
Figure 8-13

Frame	Screw	Torque (±10%)
A, B	M4	8 kg-cm [7.0lb-in] [0.78Nm]

8-2 CMM-PD02

■ Product Profile





Wire gauge: 0.25–0.5 mm^2 [24–20 AWG]
Stripping length: 7–8 mm
Screw torque: 2 kg-cm / [1.7 Ib-in.] / [0.2 Nm]

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication port
5. Indicator NET1, NET2
6. Ground terminal block

■ 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 maximum of 12 Mbps.

■ 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	CMM-PD02
GSD document	DELTA08DB.GSD
Product 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 (bits per second)

Electrical Specification

Power supply voltage	15 V_{DC} (supplied by the AC motor drive)
Insulation voltage	500 V_{DC}
Power consumption	1 W
Weight	28 g

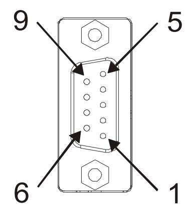
Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operation / storage	Operation: -10–50°C (temperature), 90% (humidity) Storage: -25–70°C (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc) / IEC 61131-2 & IEC 68-2-27 (TEST Ea)

■ 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



■ LED Indicator & Troubleshooting

There are two LED indicators on the CMM-PD02: 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 (NET2)

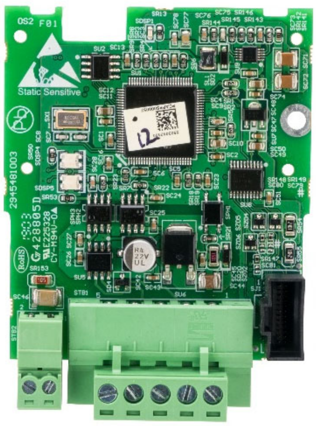
LED status	Indication	Corrective Action
Green light is ON	Power supply in normal status.	No action is required.
OFF	No power	Check if the connection between the CMM-PD02 and the AC motor drive is normal.

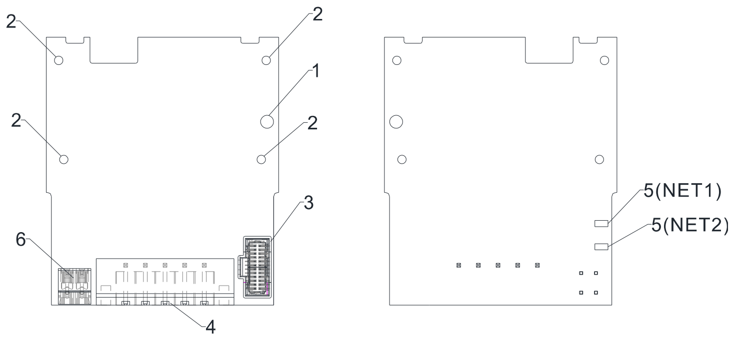
NET LED (NET1)

LED status	Indication	Corrective Action
Green light is ON	Normal status	No action is required.
Red light is ON	The CMM-PD02 is not connected to PROFIBUS DP bus.	Connect the CMM-PD02 to the PROFIBUS DP bus.
Red light flashes	Invalid PROFIBUS communication address	Set the PROFIBUS address of the CMM-PD02 between 1–125 (decimal).
Orange light flashes	The CMM-PD02 fails to communicate with the AC motor drive.	Switch off the power and check whether the CMM-PD02 is correctly installed and normally connected to the AC motor drive.

8-3 CMM-DN02

■ Product Profile





1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication port
5. Indicator NET1, NET2
6. Ground terminal block

Wire gauge: 0.25–0.5 mm^2 [24–20 AWG]

Stripping length: 7–8 mm

Screw torque: 2 kg-cm / [1.7 Ib-in.] / [0.2 Nm]

■ Features

1. Based on the high-speed communication interface of Delta's HSSP protocol, the AC motor drive can be controlled in real-time.
2. Supports Group 2 only connection and polling I/O data exchange.
3. For I/O mapping, supports a maximum of 32 words input and 32 words 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 baud rate mode.
6. Node address and baud rate can be set in the AC motor drive.
7. Power is supplied from the AC motor drive.

■ Specifications

DeviceNet Connector

Interface	5-PIN open pluggable connector. PIN interval: 5.08 mm
Transmission method	CAN
Transmission cable	Shielded twisted-pair cable (with 2 power cables)
Transmission speed	125 kbps, 250 kbps, 500 kbps and extendable baud rate mode

AC motor drive connection port

Interface	24 PIN communication terminal
Transmission method	SPI communication
Terminal function	1. Communication module communicates with the AC motor drive through this port. 2. The AC motor drive supplies power to communication module through this port.
Communication protocol	Delta HSSP protocol

Electrical Specification

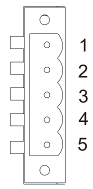
Power supply voltage	15 V_{DC} (supplied by the AC motor drive)
Insulation voltage	500 V_{DC}
Communication cable power consumption	0.85 W
Power consumption	1 W
Weight	23 g

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operation / storage	Operation: -10–50°C (temperature), 90% (humidity) Storage: -25–70°C (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

DeviceNet Connector

PIN	Signal	Color	Definition
1	V+	Red	$24\ V_{DC}$
2	H	White	Signal+
3	S	-	Ground
4	L	Blue	Signal-
5	V-	Black	0V



■ LED Indicator & Troubleshooting

There are two LED indicators on the CMM-DN02:
NS LED and MS LED. NS LED and MS LED are dual-color LEDs, displaying the connection status and error messages of the communication module.

NS LED (NET2)

LED status	Indication	Corrective Action
OFF	No power supply or the CMM-DN02 does not pass the MAC ID test.	1. Check the power to the CMM-DN02 and see if the connection is normal. 2. Make sure there is at least one node on the bus. Check if the baud rate of the CMM-DN02 is the same as that of the other nodes.
Green light flashes	The CMM-DN02 is on-line but does not connect to the master.	1. Configure the CMM-DN02 to the scan list of the master. 2. Re-download the configured data to the master.
Green light is ON	The CMM-DN02 is on-line and normally connects to the master.	No action is required.
Red light flashes	The CMM-DN02 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 is ON	1. Broken communication 2. MAC ID test failure 3. No network power supply. CMM-DN02 is off-line.	1. Make sure all MAC IDs on the network are unique. 2. Check if the network installation is normal. 3. Check if the baud rate of the CMM-DN02 is the same as that of the other nodes. 4. Check if the node address of the CMM-DN02 is illegal. 5. Check if the network power supply is normal.

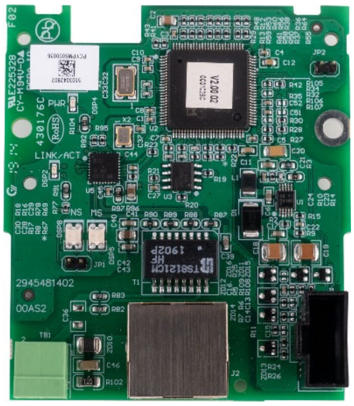
MS LED (NET1)

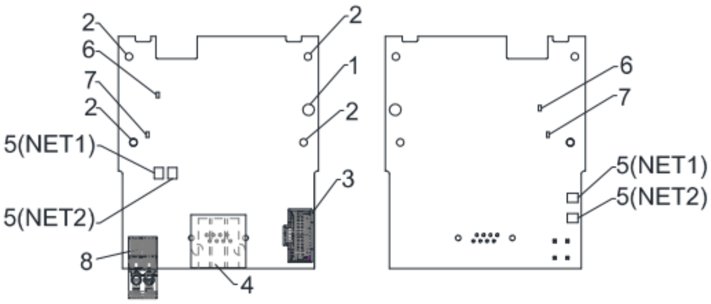
LED status	Indication	Corrective Action
OFF	No power supply or device is off-line	Check the power supply of the CMM-DN02 and see if the connection is normal.
Green light flashes	Waiting for I/O data	Switch the master PLC to RUN status.
Green light is ON	I/O data is normal	No action is required.
Red light flashes	Mapping error	Reset the CMM-DN02. Re-power the AC motor drive.

LED status	Indication	Corrective Action
Red light is ON	Hardware error	See the fault codes displayed on the keypad and find the causes. Return the unit to the factory for repair if necessary.
Orange light flashes	The CMM-DN02 is connecting with the AC motor drive.	If the flashing lasts for a long period of time, turn off the power to check if the CMM-DN02 and the AC motor drive install correctly and are normally connected to each other.

8-4 CMM-EIP02

■ Product Profile





Wire gauge: 0.25–0.5 mm^2 [24–20 AWG]
Stripping length: 7–8 mm
Screw torque: 2 kg-cm / [1.7 Ib-in.] / [0.2 Nm]

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Communication port
5. Indicator NET1 (NS), NET2 (MS)
6. POWER
7. LINK
8. Ground terminal block

■ Features

1. Supports Modbus TCP and EtherNet/IP protocol
2. 32 / 32 words parameter reading / writing correspondence
3. User-defined corresponding parameters
4. MDI / MDI-X auto-detect
5. E-mail alarm
6. IP filter simple firewall function

■ 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 100 M
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

Power supply voltage	15 V_{DC}
Insulation voltage	500 V_{DC}
Power consumption	0.8 W
Weight	25 g

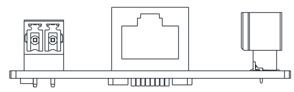
Environment

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: -10–50°C (temperature), 90% (humidity) Storage: -25–70°C (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

- Installation

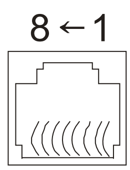
Connecting the CMM-EIP02 to the Network

1. Turn off the power of the drive.
2. Open the front cover of the drive.
3. Connect the CAT-5e network cable to the RJ45 port of the CMM-EIP02 (as shown in the right figure).



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



- MP300 Communication Parameter Settings when Connecting to Ethernet

When you connect the MP300 to Ethernet, set up the communication parameters based on the table below. The Ethernet master reads and writes the frequency command words and operation command words after you set the communication parameters.

MP300 Parameters	Function	Current Setting Value	Description
00-20	Master frequency command source	8	The frequency command is controlled by the communication card.
00-21	Operation command source	5	The operation command is controlled by the 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
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 192.168.1.1.1
09-85	Default gateway 2	168	Default gateway 192.168.1.1.1
09-86	Default gateway 3	1	Default gateway 192.168.1.1.1
09-87	Default gateway 4	1	Default gateway 192.168.1.1.1

LED Indicator & Troubleshooting

LED indicators

Indicator	Status	Indication	Corrective Action
NET1 (NS)	The red and green lights	Self-test of network status	No action is required.
	Green light is ON	Already established a connection with CIP	No action is required.
	Green light flashes	Never establish connection with CIP after powering ON	No action is required.
	Red light is ON	Duplicate IP	Check if the IP setting is wrong
	Red light flashes	Communication time out / disconnected / IP changed	Check if the communication setting is wrong
	Light is OFF	Network is not connected	Check if the network cable is connected.
NET2 (MS)	The red and green lights flash alternately.	Self-test of product status	No action is required.
	Green light is ON	The parameter setting finished	No action is required.
	Green light flashes	No parameter setting	Follow manual instructions to set parameters
	Red light is ON	Occur an error cannot be restored	Hardware malfunction, contact with the dealer
	Red light flashes	Occur an error can be restored	Check if any parameter setting is wrong
	Light is OFF	No power supply	Check the power supply.
POWER	ON	Power supply in normal status	No action is required.
	Light is OFF	No power supply	Check the power supply.
LINK	ON	Sending / receiving network packet	No action is required.
	Light is OFF	Network is not connected	Check if the network cable is connected.

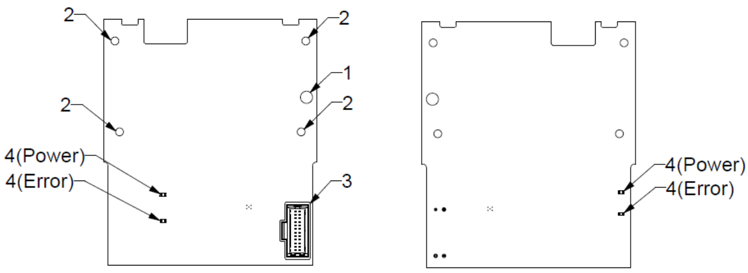
Troubleshooting

Abnormality	Cause	Corrective Actions
POWER LED OFF	The AC motor drive is not powered.	Check the power of the AC motor drive, and see if the power supply is normal.
	The CMM-EIP02 is not connected to the AC motor drive.	Ensure that the CMM-EIP02 is connected to the AC motor drive.
LINK LED OFF	The CMM-EIP02 is not connected to network.	Ensure that the network cable is correctly connected to network.
	Poor contact to the RJ45 connector	Ensure that the RJ45 connector is connected to the Ethernet port.
Cannot find communication card	The CMM-EIP02 is not connected to the network.	Ensure that the CMM-EIP02 is correctly connected to the network.
	The PC and the CMM-EIP02 are in different networks and blocked by network firewall.	Search by IP or set up relevant settings using the AC motor drive keypad.
Cannot open CMM-EIP02 setup page	The CMM-EIP02 is not connected to the network.	Ensure that the CMM-EIP02 is correctly connected to the network.
	Incorrect communication setting in DCISoft	Ensure that the communication setting in DCISoft is set to Ethernet.

Abnormality	Cause	Corrective Actions
	The PC and the CMM-EIP02 are in different networks and blocked by network firewall.	Set up with the AC motor drive keypad.
Can open CMM-EIP02 setup page, but cannot use web monitor	Incorrect network setting in the CMM-EIP02	Check if the network setting for the CMM-EIP02 is correct. For the Intranet setting in your company, please consult your IT staff. For the Internet setting at home, please refer to the network setting instructions provided by your ISP.
Cannot send e-mails	Incorrect network setting in the CMM-EIP02	Check if the network setting for the CMM-EIP02 is correct.
	Incorrect mail server setting	Confirm the IP address for the SMTP-Server.

8-5 CMMP-BT01

■ Product Profile



Wire gauge: 0.25–0.5 mm^2 [24–20 AWG]
Stripping length: 7–8 mm
Screw torque: 2 kg-cm / [1.7 Ib-in.] / [0.2 Nm]

1. Screw fixing hole
2. Positioning hole
3. AC motor drive connection port
4. Indicator POWER, ERROR

■ Features

1. Supports to communicate with handhold devices via bluetooth signal.
2. Communication and power supply are fully isolated, and have strong noise immunity

■ Specifications

Specifications of the wireless

Interface	Bluetooth
Transmission speed	1 Mbps / 2 Mbps
Communication protocol	GATT
Frequency	2.402–2.480GHz
Communication range	50m (under the circumstances of no barriers and no interruptions)

Electrical specification

Power supply voltage	15 V_{DC}
Insulation voltage	500 V_{DC}
Power consumption	0.8 W
Weight	25 g

Environment

Noise immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operation / storage	Operation: -10–50°C (temperature), 90% (humidity) Storage: -25–70°C (temperature), 95% (humidity)
Shock / vibration resistance	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc) / IEC 61131-2 & IEC 60068-2-27 (TEST Ea)

■ LED Indicator & Troubleshooting

There are two LED indicators on the CMMP-BT01: POWER LED and ERROR LED.
POWER LED displays the status of the working power. ERROR LED displays the connection status of the communication whether it's abnormal.

POWER LED

LED status	Indication	Corrective Action
Green light is ON	Power supply in normal status.	No action is required.
OFF	No power	Check if the connection between the CMMP-BT01 and the AC motor drive is normal.
Green light flashes	APP connects with the bluetooth card	No action is required.

ERROR LED

LED status	Indication	Corrective Action
OFF	Normal status	No action is required.
Red light is ON	The bluetooth card and MP300 have abnormal communication	1. Re-power ON. 2. Remove and insert the bluetooth card again. 3. Check the wiring. 4. Contact with Delta.
Red light flashes	This model or the firmware version does not support the bluetooth card.	1. Make sure the series and the firmware version are as below: ● MH300 series: V1.03 and later ● MS300 series: V1.08 and later ● MS300-HS series: V5.04 and later ● MP300 series: V1.0 and later 2. Contact with Delta.

8-6 Delta Standard Fieldbus Cables

Delta Standard Fieldbus Cables	Models	Descriptions	Length
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
PROFIBUS Cable	UC-PF01Z-01A	PROFIBUS DP cable	305 m

Chapter 9 Specifications

9-1 460V Models

460V_three-phase

Frame		A			
MPD models: MPD_ _ _ 30C43□2B MPD_ _ _ 30C43□2D		75B		15C	
		N	F	N	F
Applicable Motor Output (kW)		0.75		1.5	
Applicable Motor Output (HP)		1		2	
Applicable AC Motor Drive Models		VFD1A6MP43JNNAA	VFD1A6MP43JFNAA	VFD3A3MP43JNNAA	VFD3A3MP43JFNAA
Applicable Motor Models		MSI75B-30CDXS2B1AP MSI75B-30CDXS2D1AP		MSI15C-30CDXS2B1AP MSI15C-30CDXS2D1AP	
Output	Motor Rated Current (A)	1.5		3.1	
	Rated Output Torque (N.m)	2.3		4.7	
	Rated Output Speed (rpm)	3000			
	Carrier Frequency of AC Motor Drive (kHz)	2–15			
Input	Rated Input Current (A)	1.9		3.8	
	Rated Voltage / Frequency	Three-phase 380–480 VAC (-15–10%), 50/60 Hz			
	Mains Input Voltage Range (V_{AC})	323–528			
	Mains Frequency Range (Hz)	47–63			
Cooling Method		Fan cooling			
EMC Filter		---	Built-in	---	Built-in
CE / RE Class		C1 / C2			
IP Rating		IP55			
PDS Efficiency Class *2		IES2			

Frame		A			
MPD models: MPD_ _ _ 30C43□2B MPD_ _ _ 30C43□2D		22C		30C	
		N	F	N	F
Applicable Motor Output (kW)		2.2		3	
Applicable Motor Output (HP)		3		4	
Applicable AC Motor Drive Models		VFD4A7MP43JNNAA	VFD4A7MP43JFNAA	VFD6A2MP43JNNAA	VFD6A2MP43JFNAA
Applicable Motor Models		MSI22C-30CDXS2B1AP MSI22C-30CDXS2D1AP		MSI30C-30CDXS2B1AP MSI30C-30CDXS2D1AP	
Output	Motor Rated Current (A)	4.4		5.8	
	Rated Output Torque (N.m)	7		9.5	
	Rated Output Speed (rpm)	3000			
	Carrier Frequency of AC Motor Drive (kHz)	2–15			
Input	Rated Input Current (A)	5.4		7.2	
	Rated Voltage / Frequency	Three-phase 380–480 VAC (-15–10%), 50/60 Hz			
	Mains Input Voltage Range (V_{AC})	323–528			
	Mains Frequency Range (Hz)	47–63			
Cooling Method		Fan cooling			
EMC Filter		---	Built-in	---	Built-in
CE / RE Class		C1 / C2			
IP Rating		IP55			
PDS Efficiency Class *2		IES2			

Frame		A			B
MPD models: MPD_ _ _ 30C43□2B MPD_ _ _ 30C43□2D		40C		55C	
		N	F	N	F
Applicable Motor Output (kW)		4.0		5.5	
Applicable Motor Output (HP)		5.5		7.5	
Applicable AC Motor Drive Models		VFD8A5MP43JNNAA	VFD8A5MP43JFNAA	VFD11AMP43JNNAA	VFD11AMP43JFNAA
Applicable Motor Models		MSI40C-30CDXS2B1AP MSI40C-30CDXS2D1AP		MSI55C-30CDXS2B1AP MSI55C-30CDXS2D1AP	MSI55C-30CDXS2BFAP MSI55C-30CDXS2DFAP
Output	Motor Rated Current (A)	8		11	
	Rated Output Torque (N.m)	12.7		17.5	
	Rated Output Speed (rpm)	3000			
	Carrier Frequency of AC Motor Drive (kHz)	2–15			
Input	Rated Input Current (A)	9.9		13.8	
	Rated Voltage / Frequency	Three-phase 380–480 VAC (-15–10%), 50/60 Hz			
	Mains Input Voltage Range (V_{AC})	323–528			
	Mains Frequency Range (Hz)	47–63			
Cooling Method		Fan cooling			
EMC Filter		---	Built-in	---	Built-in
CE / RE Class		C1 / C2			
IP Rating		IP55			
PDS Efficiency Class *2		IES2			

Frame		B	
MPD models: MPD_ _ _ 30C43□2B MPD_ _ _ 30C43□2D		75C	
		N	F
Applicable Motor Output (kW)		7.5	
Applicable Motor Output (HP)		10	
Applicable AC Motor Drive Models		VFD15AMP43JNNAA	VFD15AMP43JFNAA
Applicable Motor Models		MSI75C-30CDXS2B1AP MSI75C-30CDXS2D1AP	
Output	Motor Rated Current (A)	14.7	
	Rated Output Torque (N.m)	23.8	
	Rated Output Speed (rpm)	3000	
	Carrier Frequency of AC Motor Drive (kHz) *1	2–15	
Input	Rated Input Current (A)	18.5	
	Rated Voltage / Frequency	Three-phase 380–480 VAC (-15–10%), 50/60 Hz	
	Mains Input Voltage Range (V_{AC})	323–528	
	Mains Frequency Range (Hz)	47–63	
Cooling Method		Fan cooling	
EMC Filter		---	Built-in
CE / RE Class		C1 / C2	
IP Rating		IP55	
PDS Efficiency Class *2		IES2	

Table 9-1

Note

*1: The AC motor drive have to derating when the carrier frequency is higher than the default. Refer to Chapter 9-4 for derating curve.

*2: Power drive system (PDS) that IEC 61800-9-2 defines.

9-2 General Specifications

Control Characteristics of AC Motor Drive	Applicable Motor	MSI motor
	Output frequency (Hz)	0.00–180 Hz
	Starting Torque *1	100% / (motor rated frequency/20)
	Speed Control Range *1	1 : 20
	Overload Capacity	120% of rated current can endure for 1 minute during every 5 minutes; 150% of rated current can endure for 3 seconds during every 30 seconds
	Frequency Setting Signal	0– +10V / 4 (0)–20 mA
	Main Functions	PID constant pressure control, multi-pump control, multi-master function, scheduled function, sleep function, DC preheating, flow estimation function, clean function
	Application Macro	Built-in user-defined application parameter groups.
Characteristic of motor	Rotation Direction	It's clockwise as viewed on the shaft end of the motor.
	Motor Duty Cycles	Continuous duty (S1)
	Motor Temperature Protection	KTY84-130 / PTC-130
	Insulation Classes	Class F
	Temperature Rise Classes	Class B
Protection Characteristics	Protection	Over-current, Over-voltage, Over-heating of AC motor drive, Over-heating of motor, Phase loss, Speed loss
	Pump Protection	Dry pump, High / Low water pressure, Pipe explosion, Cavitaion
Certifications		CE、RoHS

Table 9-2

[Note 1] Control accuracy may vary depending on the environment, application conditions. For more information, contact Delta or your local distributors.

9-3 Environment for Operation, Storage and Transportation

DO NOT expose the AC motor drive and the motor to a poor environment, such as one with direct sunlight, corrosive / inflammable gases, humidity, grease or excessive vibration. The salt in the air must be less than 0.01 mg/cm^2 every year.			
Environment	Installation Location	IEC 60364-1/ IEC 60664-1 Pollution degree 2, Indoor use only.	
	Surrounding Temperature	Operation	-20–40 ºC -20–50 ºC with derating
		Storage	-40–85 ºC
		Transportation	-20–70 ºC
		Non-condensing, non-freezing	
	Rated Humidity	Operation	Maximum 90 %
		Storage / Transportation	Maximum 95 %
		No water condensation	
	Air Pressure	Operation	86–106 kPa
		Storage / Transportation	70–106 kPa
	Altitude	<1000 m (For altitudes > 1000 m, derate to use it.)	
Package Drop	Storage	ISTA procedure 1A (according to weight) IEC 60068-2-31	
	Transportation		
Vibration	Operation / Non operation	4.5mm (0-P), from 2–10 Hz 1.8 G–2.0 G, from 10–55 Hz 2.0 G, from 55–512 Hz； In accordance with IEC 60068-2-6	
Impact	Operation	15 G, 11 ms, in accordance with IEC / EN 60068-2-27	
	Non-operation	30 G	

Table 9-3

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

9-4-1 Derating Curve for Ambient Temperature and Altitude

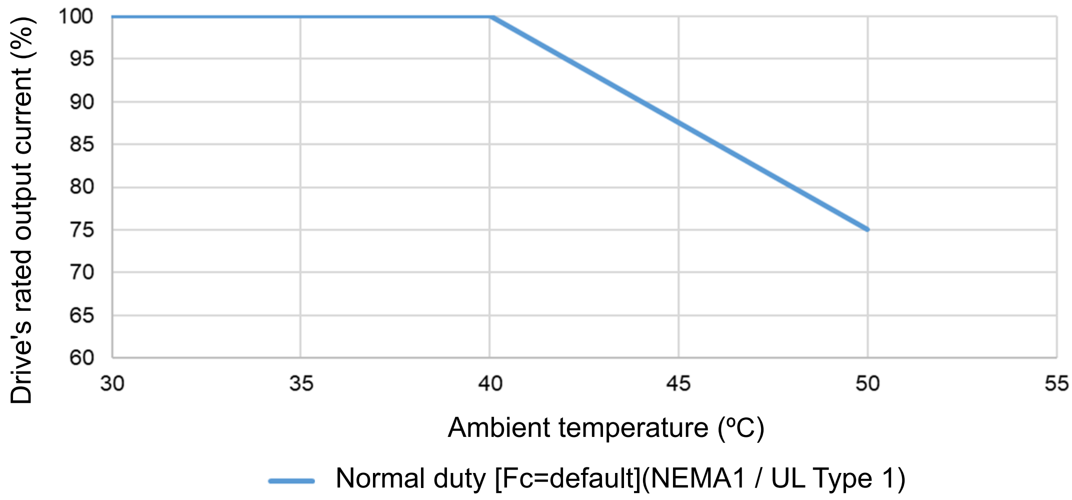
<table>
<tr><th colspan="2">Ambient temperature</th></tr>
<tr><td>Protection Level</td><td>NEMA1 / UL Type 1</td></tr>
<tr><td>Operating Environment</td><td>If the AC motor drive operates at the rated current, the ambient temperature needs to be between -20–40ºC.
If the temperature is above 40ºC, decrease 2.5% of the rated current for every 1ºC increase in temperature. The maximum allowable temperature is 50ºC.</td></tr>
<tr><td>Derating Curve</td><td>

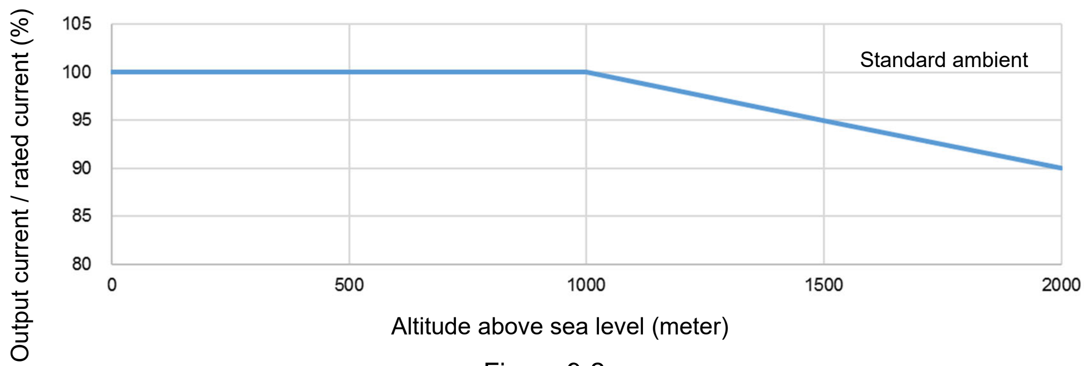
Figure 9-1</td></tr>
<tr><th colspan="2">Altitude</th></tr>
<tr><td>Protection Level</td><td>High Altitude</td></tr>
<tr><td>Operating Environment</td><td>If the AC motor drive is installed at an altitude of 0–1000 m, follow normal operation restrictions.
For altitudes of 1000–2000 m, decrease the drive's rated current by 1% or lower the temperature by 0.5ºC for every 100 m increase in altitude. The maximum altitude for corner grounded is 2000 m. If installing at an altitude higher than 2000 m is required, contact Delta for more information.</td></tr>
<tr><td>Derating Curve</td><td>

Figure 9-2</td></tr>
</table>

Table 9-4

The rated output current derating

In normal duty, carrier frequencies are defaults

Fc (kHz) \ Ambient temperature (Ta) / 100% Load	30°C	40°C	50°C
Default (%)	100	100	75

Different altitudes above sea level:

Altitude above sea level (meter)	0	1000	1500	2000
Output current / rated current (%)	100	100	95	90

Table 9-5

9-4-2 Derating Curve for Carrier Frequency

- Phase modulation mode (Pr.11-41 = 0)

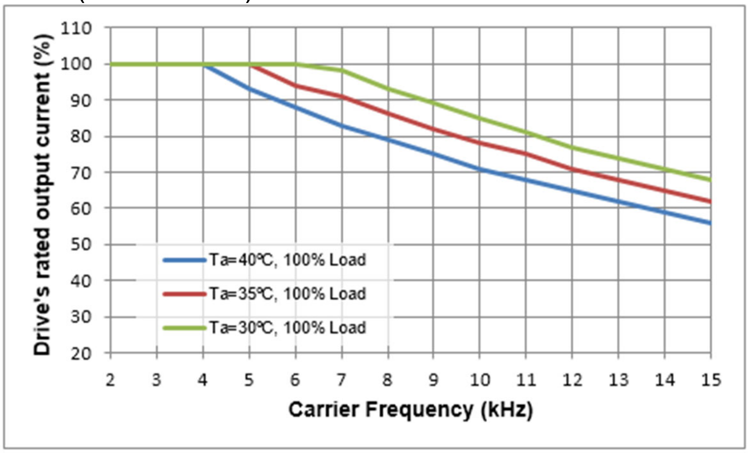


Figure 9-3

The rated output current of DPWM in different carrier frequencies

Fc (kHz) / Ambient temperature (Ta) 100% Load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
40°C	100	100	100	93	88	83	79	75	71	68	65	62	59	56
35°C	100	100	100	100	94	91	86	82	78	75	71	68	65	62
30°C	100	100	100	100	100	98	93	89	85	81	77	74	71	68

Table 9-6

- Space vector modulation mode (Pr.11-41 = 2)

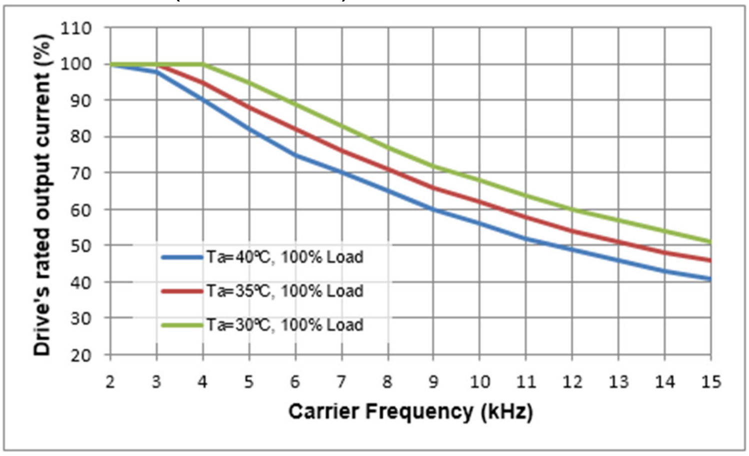


Figure 9-4

The rated output current of SVPWM in different carrier frequencies (unit: %)

Fc (kHz) / Ambient temperature (Ta) 100% Load	2	3	4	5	6	7	8	9	10	11	12	13	14	15
40°C	100	98	90	82	75	70	65	60	56	52	49	46	43	41
35°C	100	100	95	88	82	76	71	66	62	58	54	51	48	46
30°C	100	100	100	95	89	83	77	72	68	64	60	57	54	51

Table 9-7

9-5 Specifications of Motor

Summary of properties (0.75~7.5kW-3000rpm)

Models	Rated power (kW)	Frame (mm)	Rated speed (rpm)	Rated current (A)	Rated torque (Nm)	Maximum torque (Nm)
MSI75B-30CDXS2_1AP	0.75	80-1	3000	1.5	2.3	3.5
MSI15C-30CDXS2_1AP	1.5	80-2		3.1	4.7	7.1
MSI22C-30CDXS2_1AP	2.2	80-2		4.4	7	10.5
MSI30C-30CDXS2_1AP	3	90		5.8	9.5	14.3
MSI40C-30CDXS2_1AP	4	90		8	12.7	19.1
MSI55C-30CDXS2_1AP	5.5	100-1		11	17.5	26.3
MSI55C-30CDXS2_FAP	5.5	100-2		11	17.5	26.3
MSI75C-30CDXS2_1AP	7.5	100-2		14.7	23.8	35.7

Models	Maximum rotor speed (rpm)	Moment of inertia ($kg\text{-}m^2$)	Power factor (%)	Full load efficiency (%)	3/4 load efficiency (%)	2/4 load efficiency (%)
MSI75B-30CDXS2_1AP	3600	$1.16*10^{-3}$	0.85	86.3	84.6	83.5
MSI15C-30CDXS2_1AP		$1.56*10^{-3}$	0.85	88.9	88.0	85.4
MSI22C-30CDXS2_1AP		$1.76*10^{-3}$	0.85	90.2	91.4	89.6
MSI30C-30CDXS2_1AP		$3.03*10^{-3}$	0.85	91.1	92.2	90.6
MSI40C-30CDXS2_1AP		$3.36*10^{-3}$	0.86	91.8	92.7	91.2
MSI55C-30CDXS2_1AP		$5.83*10^{-3}$	0.87	92.6	93.2	92.0
MSI55C-30CDXS2_FAP		$5.83*10^{-3}$	0.87	92.6	93.2	92.0
MSI75C-30CDXS2_1AP		$7.53*10^{-3}$	0.87	93.3	93.9	93.2

Table 9-8

Specification of Bearing

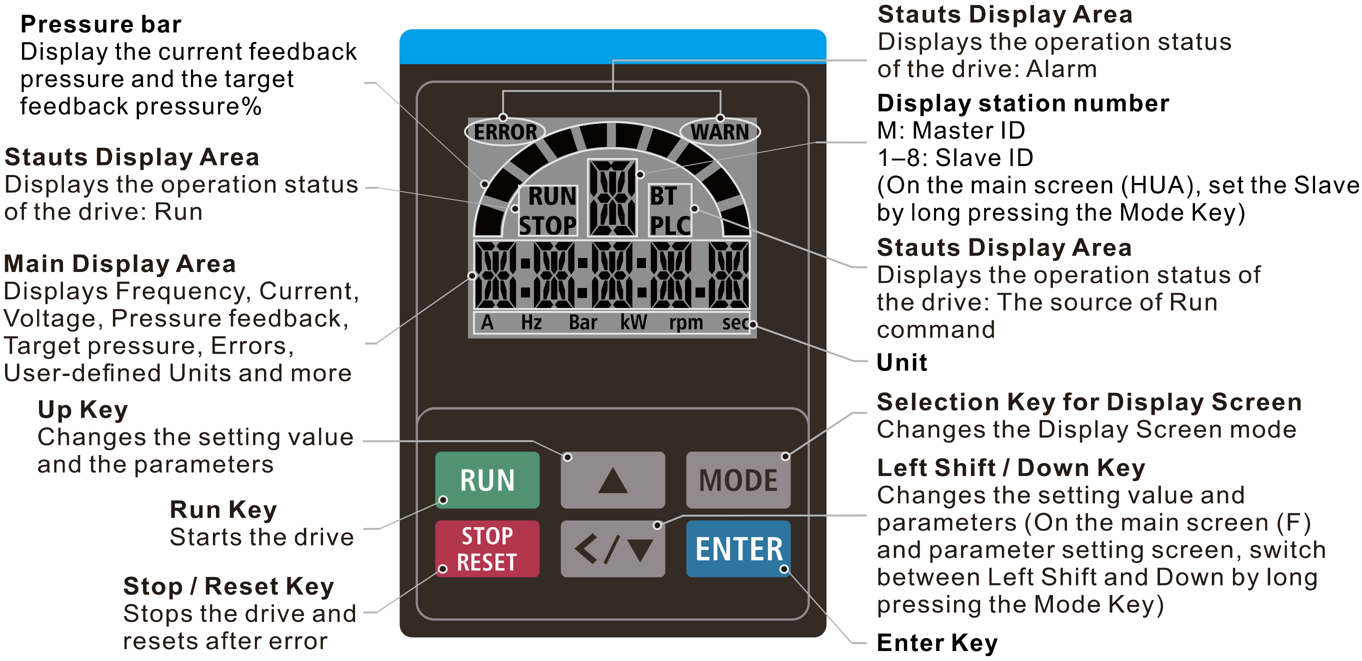
Models	Front bearing	Rear bearing
MSI75B-30CDXS2_1AP	6305 ZZ/C3	6204 ZZ/C3
MSI15C-30CDXS2_1AP		
MSI22C-30CDXS2_1AP		
MSI30C-30CDXS2_1AP	6306 ZZ/C3	6205 ZZ/C3
MSI40C-30CDXS2_1AP		
MSI55C-30CDXS2_1AP	6308 ZZ/C3	6206 ZZ/C3
MSI55C-30CDXS2_FAP		
MSI75C-30CDXS2_1AP		

Table 9-9

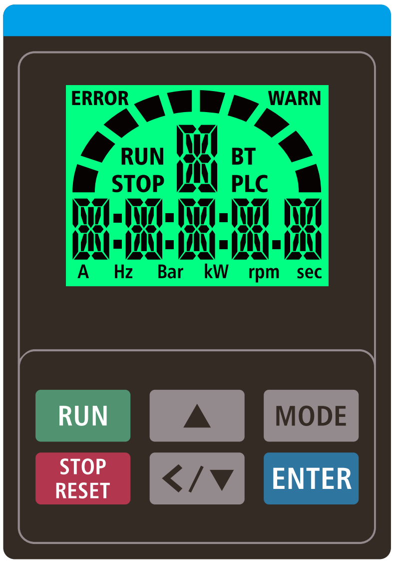
Note: The positions mark as “_” mean the installation ways: B (IM B5 / IM V1), D (IM B14 / IM V18)

Chapter 10 Digital Keypad

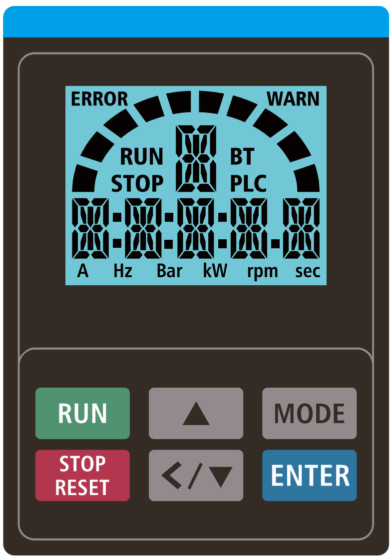
10-1 Appearance of Keypad Panel



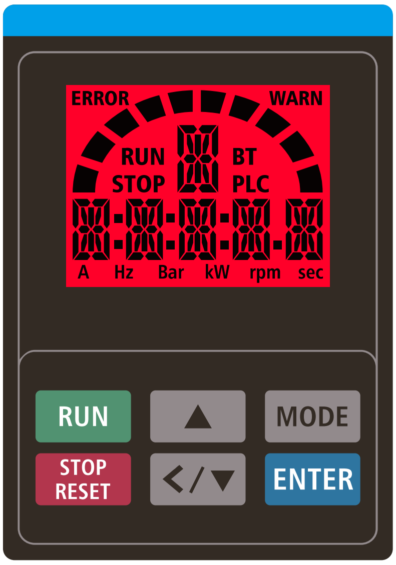
10-2 The Backlight of the Keypad Panel



Green light: Standby

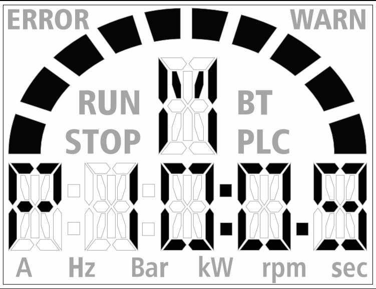
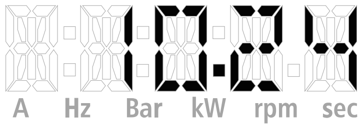
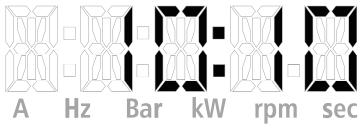
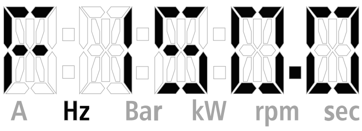
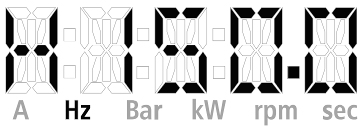
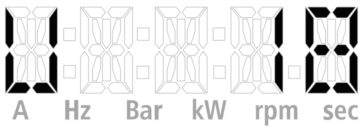
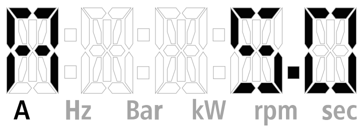
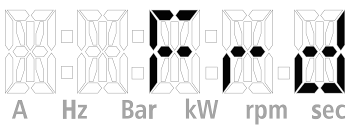
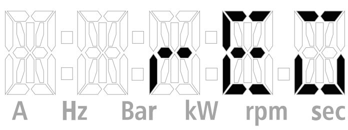
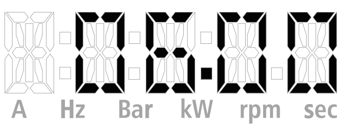
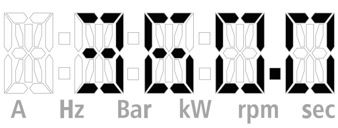


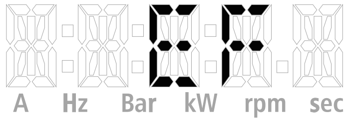
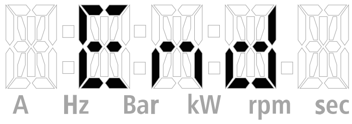
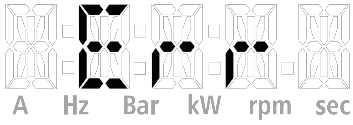
Blue light: Run



Red light: Alarm

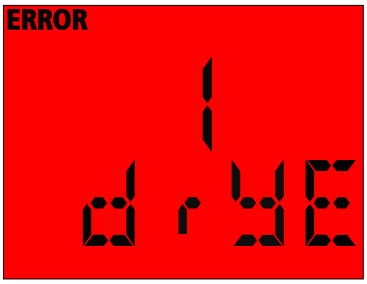
10-3 Descriptions of Keypad Functions

Display	Descriptions
	Displays the target pressure and the feedback pressure, and the pressure bar changes along with the percentage.
	Displays station address. Master ID: M; Slave ID: 1–8
	Displays the date.
	Displays the time.
	Displays the present frequency setting for the drive.
	Displays the actual output frequency to the motor.
	Displays the user-defined output of a physical quantity. This example uses Pr.00-04 = 30 (user-defined output).
	Displays the load current.
	Forward command
	Reverse command
	Displays a parameter item.
	Displays a parameter value.

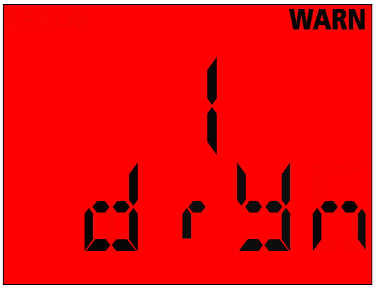
Display	Descriptions
	Displays an external fault.
	Displays “End” for approximately one second if the data has been accepted and automatically stored in the register.
	Displays if the setting data is not accepted or data value exceeds the allowed range.

10-4 Information Displayed on the Panel

1. Operation status: RUN / STOP
   The RUN LED and the STOP LED light up according to the operation status of AC motor drive.
   - The RUN LED lights up: It's in operation.
   - The STOP LED lights up: It's not in operation.
2. Source of the RUN command: PLC / BT
   The BT LED and the PLC LED light up according to the operation source of AC motor drive.
   - BT LED: The BT LED lights up when the the AC motor drive and the bluetooth card are connected and they can communicate normally; the BT LED flashes when using mobile app to link with the bluetooth card.
   - PLC LED: The PLC LED lights up when using PLC as RUN command. Sets the corresponding display according to the descriptions below.
     PLC0: Not using PLC, the PLC LED does not light up.
     PLC1: Switch ON PLC and it can operate, the PLC LED flashes.
     PLC2: Switch ON PLC and it cannot operate, the PLC LED lights up.
3. Alarm: ERROR / WARN
   When there is any fault or warning of AC motor drive, the ERROR / WARN LED lights up, and displays the fault code in main display area, the backlight becomes red at the same time.

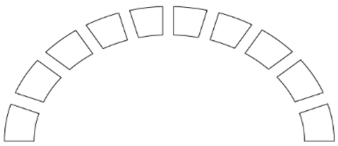


Fault-ERROR LED lights up

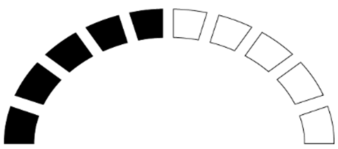


Warn-WARN LED lights up

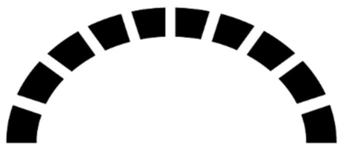
4. Pressure bar:
   Displays the target pressure divided by the feedback pressure as a percentage, one square is 10%, increases from left to right, and rounds it to the nearest whole number. Refer to the schematic diagrams below.



0%



50%



100%

Example 1:
The target pressure can be divided with no remainder, the pressure bar displays the calculation directly.

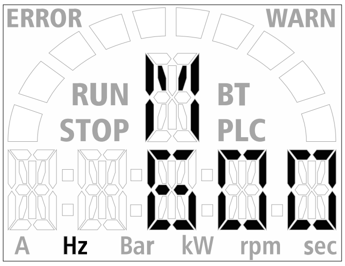
- The target pressure is 10 bar, the present pressure is 5:
  10 ÷ 10 = 1, 5 ÷ 1 = 5 (squares)

Example 2:
The target pressure cannot be divided with no remainder, the pressure bar displays the calculation which rounds to the nearest whole number.

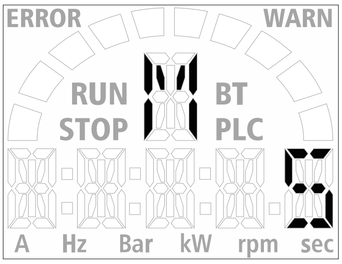
- The target pressure is 15 bar, the present pressure is 8:
  15 ÷ 10 = 1.5, 8 ÷ 1.5 = 5.3 (squares), rounds it down to 5 (squares)
- The target pressure is 13 bar, the present pressure is 6:
  13 ÷ 10 = 1.3, 6 ÷ 1.3 = 4.6 (squares), rounds it up to 5 (squares)

5. Unit:
When select parameters, if the units can be displayed on keypad includes the unit of the parameter (such as A, Hz, Bar, kW, rpm, sec), then the LED of this unit lights up. If the unit of the parameter isn't included in the units mentioned above, then the unit does not display.

Example 1:
Selects Pr.01-00 (Motor 1 maximum operation frequency), the setting range is 0.00–180.00 Hz.
Hz is the unit can be displayed on keypad, the display is as below:

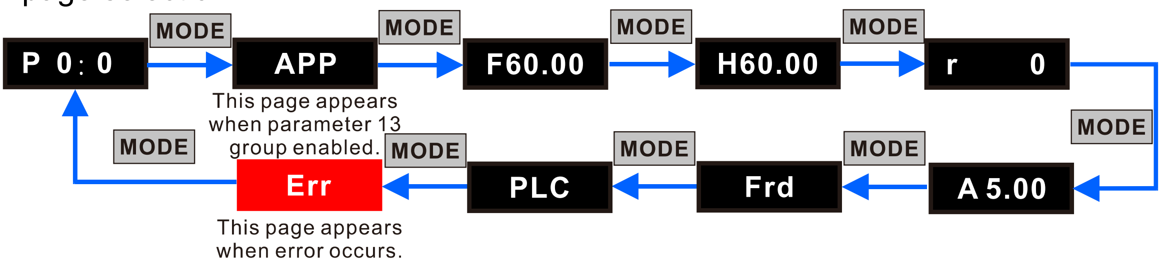


Example 2:
Selects Pr.03-00 (AI1 analog input selection), the setting value is 5, the display is as below:



10-5 Keypad Operation Process

1. Main page selection



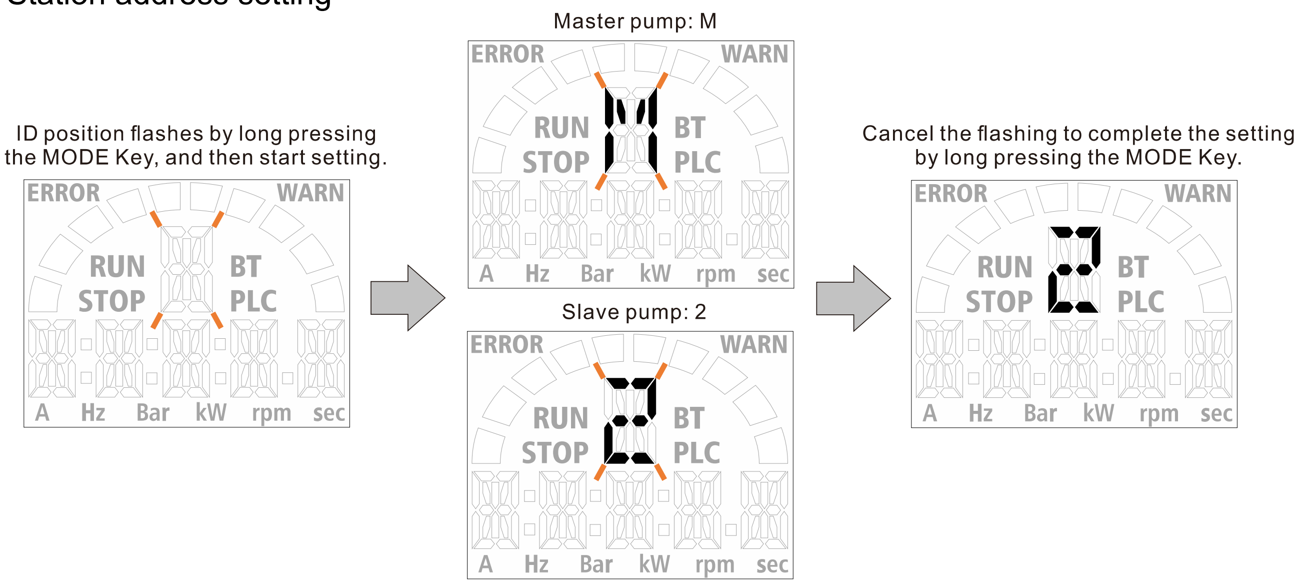
- Parameter setting

Note: In the parameter setting mode, you can press MODE to return to the previous layer.

- Data adjustment

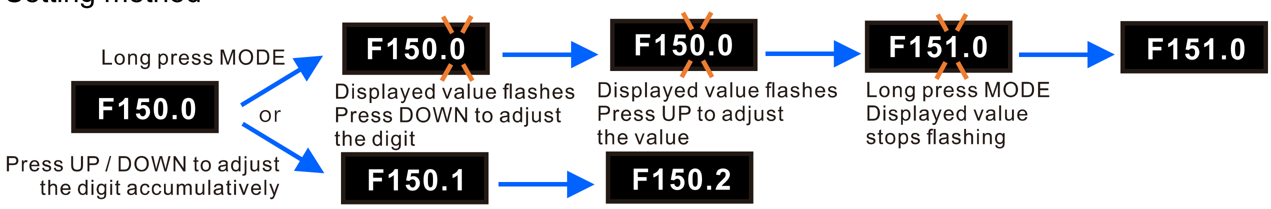
- Rotation direction setting

- Station address setting

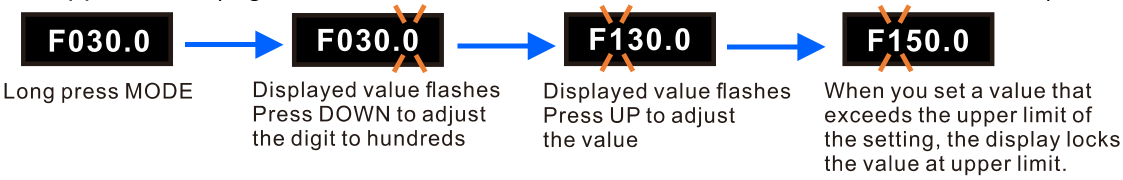


2. F Page (Frequency command setting page)

- Setting method

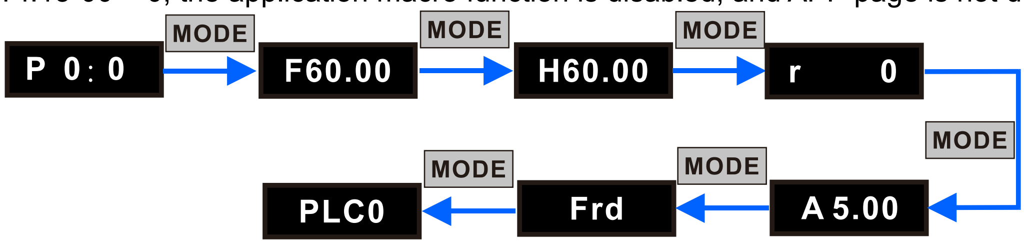


- Normal mode
  When the frequency exceeds the maximum operation frequency, the displayed value is locked at the upper value (e.g. Sets the Pr.01-00 = 150.00 Hz, the value is locked at 150.0).

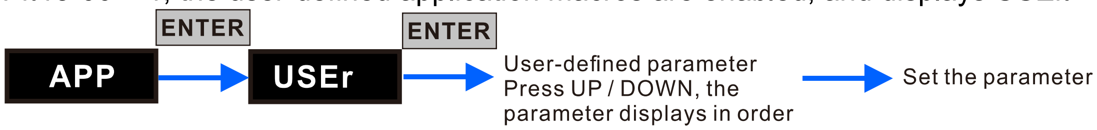


3. Application Macro Selection Page

- Users can set common parameters quickly in this page. Use Pr.13-01–13-50 to define the common parameters. Set Pr.13-00 = 1, select APP page and enter User-defined page to set values for parameters.
- Once enabled, the Application Marco Selection page displays “APP”. If Pr.13-00 = 0, the APP page does not display.
- The explanations to the setting of Pr.13-00 is as below:
  Pr.13-00 = 0, the application macro function is disabled, and APP page is not displayed.



Pr.13-00 = 1, the user-defined application macros are enabled, and displays USEr.



If Pr.13-00 = 1 and you do not set any parameters for Pr.13-01–Pr.13-50, you cannot enter the sub-layer of the USEr page.

Follow the process below to set the user-defined application macro parameters (Pr.13-00=1).

Set Pr.13-00=1 to enable the user-defined application selection. → Set Pr.13-01–Pr.13-50 user-defined parameters orderly. → After finishing setting, press MODE to display the APP page, and then press ENTER to display the USEr page. Press ENTER again to display the user-defined parameters.

↓

To remove a user-defined parameter, return to Pr.13-01–Pr.13-50 and set the parameters as 0.00 from the last defined parameter in sequence. ← To change a user-defined parameter, return to Pr.13-01–Pr.13-50 to modify the setting value. ← Use Up and Down keys to select the user-defined parameters, and press ENTER to check and set the setting.

(1) Go to Parameter Group 13 to set the application macro functions. The application macro function is enabled when Pr.13-00 ≠ 0.
(2) Set Pr.13-00 = 1 to enable the user-defined applications.
(3) Use Pr.13-01–Pr.13-50 to set the user-defined parameters orderly according to your requirement. The default setting 0-00 means there is no user-defined parameter. Press ENTER to set the corresponding parameters for Pr.13-01– Pr.13-50.
(4) The setting method of user-defined parameters is the same as that for non-user-defined parameters. You can use Up and Down keys or left shift key to speed up the settings.
Note: You must set Pr.13-01, Pr.13-02, Pr.13-03, ...orderly, otherwise the display shows “Err”.
(5) If you want to change parameters which have been set before, you have to go back to Pr.13-01–13-50.

(6) If you want to remove unused parameters which have been set before, you have to remove the parameters from the last one.
For example, if there are five user-defined parameters (Pr.13-01, 13-02…13-05), to remove Pr.13-02, you must remove Pr.13-05 first, then Pr.13-04, then Pr.13-03, and then Pr.13-02.

(7) After finishing the setting, return to the APP page, and then press ENTER. The display shows “USEr”. After you press ENTER again, the parameter you just set appears.

4. Parameter setting

(1) Unsigned parameters
(Parameter setting range ≥ 0; e.g. Pr.01-00)

A. Without using the left shift key: Use Up and Left/Down key to select and adjust the parameters. Then, press ENTER to start the parameter settings.

B. Using the left shift key: Long press MODE for two seconds until the last digit of the parameter value starts to blink. Increase the value by pressing the Up key. The value goes back to 0 after 9.

C. Press left / down key to shift the blinking cursor one digit to the left, and increase the value by pressing the Up key.

D. After you finish setting the parameter, the left shift key function is not disabled automatically until you disable it manually by pressing MODE for two seconds.

E. The upper limit for Pr.01-00 is 180.00. If you set a value greater than 180.00, “Err” appears after you press ENTER, and then the keypad shows the upper limit (180.0) for a second to remind you of the incorrect setting. The setting value remains as the original set value (default is 150.00, which means the setting value is not changed), and the cursor returns to the last digit.

(2) Minus-signed parameter setting status 1
(The parameter value is one decimal place or no decimal point, the range can be < 0; e.g. Pr.03-03)

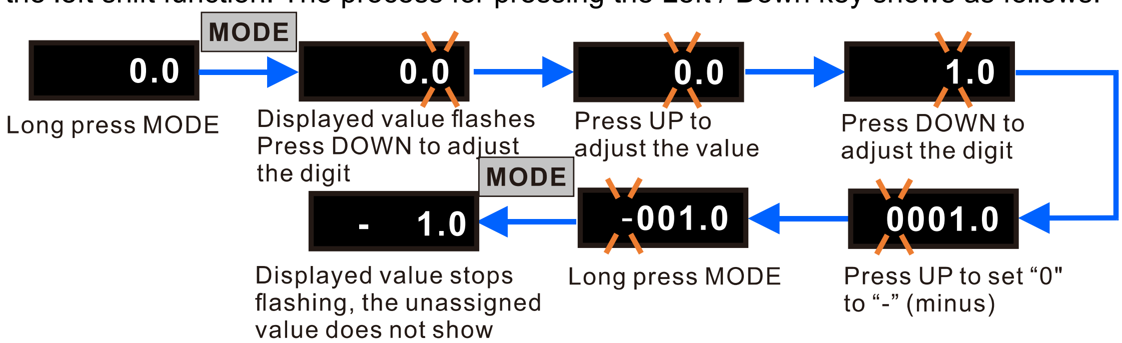
A. Without using the left shift key: Use Up and Left/Down key to select and adjust the parameters. Then, press ENTER to start the parameter settings.

B. Using the left shift key: Long press MODE for two seconds until the last digit of the parameter value starts to blink. Increase the value by pressing the Up key. The value goes back to 0 after 9.

C. Press the left / down key to shift the blinking cursor one digit to the left, and increase the value by pressing the Up key. When you shift to the first digit and press the Up key, the digit “0” changes to “-” (minus).

D. After you finish setting the parameter, the left shift key function is not disabled automatically until you disable it manually by pressing MODE for two seconds.

E. For parameter values with three digits and one decimal place (Pr.03-03, -100–100.00%), the display only shows three digits.
Example: The default of Pr.03-03 is 0.0. Long pressing MODE for two seconds enables the left shift function. The process for pressing the Left / Down key shows as follows:



(3) If the displayed value is over four digits and has directing character, displays a superscript point on keypad to remind the value is five digits.
Example:
Set Pr.00-04 = 31, Pr.00-05 = 100, and the present output frequency = 150.00 Hz, the display should show 15000 (= 150 x 100), but because of digit limitation, it shows K15˙00.

10-6 Reference Table for the 16-segment Digital Keypad LED Display

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

Chapter 11 Summary of Parameter Settings

00 Drive Parameters

01 Basic Parameters

02 Digital Input / Output Parameters

03 Analog Input / Output Parameters

04 Multi-Step Speed Parameters

05 Motor Parameters

06 Protection Parameters (1)

07 Special Parameters

08 High-function PID Parameters

09 Communication Parameters

10 Speed Feedback Control Parameters

11 Advanced Parameters

12 Function Parameters

13 Macro / User-defined Macro

14 Protection Parameters (2)

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

Note:
1. ≁: You can set this parameter during operation.
2. Refer to chapter 12 for the details of parameters.

00 Drive Parameters

	Pr.	Parameter Name	Settings	Default
	00-00	AC motor drive identity code	404: 460 V, 3 Phase, 1 HP 405: 460 V, 3 Phase, 2 HP 406: 460 V, 3 Phase, 3 HP 482: 460V, 3 Phase, 4 HP 483: 460 V, 3 Phase, 5.5 HP 408: 460 V, 3 Phase, 7.5 HP 409: 460 V, 3 Phase, 10 HP	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 8: Keypad does not respond 10: Reset all parameters to defaults (base frequency is 150 Hz) 12: Reset all parameters to defaults with base frequency at 150 Hz (keep the user-defined parameter values Pr.13-01–Pr.13-50)	0
≁	00-03	Start-up display	0: F (frequency command) 1: H (output frequency) 2: U (user-defined) see Pr.00-04 3: A (output current) 4: P (display the setting value and the feedback of PID control)	4
≁	00-04	Content of multi-function display (User-Defined)	0: Display output current from the drive to the motor (A) (Unit: Amp) 1: Display counter value (c) (Unit: CNT) 2: Display the drive's actual output frequency (H.) (Unit: Hz) 3: Display the drive's DC bus voltage (v) (Unit: V_{DC}) 4: Display the drive's output voltage (E) (Unit: V_{AC}) 5: Display the drive's output power angle (n) (Unit: deg) 6: Display the drive's output power (P) (Unit: kW) 7: Display the motor speed (r) (Unit: rpm) 10: Display PID feedback (b) (Unit: %) 11: Display AI1 analog input terminal signal (1.) (Unit: %) 12: Display AI2 analog input terminal signal (2.) (Unit: %) 14: Display the drive's IGBT temperature (i.) (Unit: ºC) 15: Display the drive's internal temperature (c.) (Unit: ºC) 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.) 25: Overload count (0.00–100.00%) (o.) (Unit: %) 26: Ground Fault GFF (G.) (Unit: %) 27: DC bus voltage ripple (r.) (Unit: V_{DC})	7

Pr.	Parameter Name	Settings	Default
		28: Display PLC register D1043 data (C) 30: Display the output of User-defined (U) 31: Display Pr.00-05 user gain (K) 36: Present operating carrier frequency of the drive (J.) (Unit: Hz) 38: AC motor drive status (6.) 41: kWh display (J) (Unit: kWh) 42: PID target value (h.) (Unit: %) 43: PID compensation (o.) (Unit: %) 44: PID output frequency (b.) (Unit: Hz) 49: Display the motor's temperature (M) (PTC-130, PT100, KTY84-130) 51: PMSVC torque offset (T.) 60: Display the setting value and the feedback of PID control (P) 65: Accumulated Motor Operation Time (days) (r.) 112: Estimated flow rate (F) (Unit: m^3/hr) 113: Display the inlet pressure (I) (Unit: according to Pr.00-38 setting) 114: Display the outlet pressure (O) (Unit: according to Pr.00-25 setting) 115: Cavitation detection index (V)	
00-05	Coefficient gain in actual output frequency	0.00–160.00	1.00
00-06	Firmware version	Read only	Read only
00-07	Parameter protection password Input	0–65535 0–4 (the number of password attempts)	0
00-08	Parameter protection password setting	0–65535 0: No password protection or password is entered correctly (Pr.00-07) 1: Password has been set	0
00-17	Carrier frequency	2–15 kHz	4/4
00-19	PLC command mask	bit 0: Control command is forced by PLC control bit 1: Frequency command is forced by PLC control	Read only
00-20	Master frequency command source (AUTO, REMOTE)	0: Digital keypad 1: RS-485 communication input (COM1) 2: External analog input (refer to Pr.03-00) 3: External UP / DOWN terminal (multi-function input terminals) 8: Communication card (does not include CANopen card) Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56.	0
00-21	Operation command source (AUTO, REMOTE)	0: Digital keypad 1: External terminals 2: RS-485 communication input (COM1) 5: Communication card (does not include CANopen card) Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56.	0
00-22	Stop method	0: Ramp to stop 1: Coast to stop	0
00-23	Motor direction control	0: Enable forward / reverse 1: Disable reverse 2: Disable forward	0
00-24	Digital operator (keypad) frequency command memory	Read only	Read only
00-25	User-defined characteristics 1	bit 0–3: user-defined decimal places 0000h-0000b: no decimal place	353

Pr.	Parameter Name	Settings	Default
		0001h-0001b: one decimal place 0002h-0010b: two decimal places 0003h-0011b: three decimal places bit 4–15: user-defined unit 000xh: Hz 001xh: rpm 002xh: % 003xh: kg/cm^2 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	
00-26	Maximum sser-defined value 1	0: No Function 0–65535 (when Pr.00-25 is set to no decimal place) 0.0–6553.5 (when Pr.00-25 is set to one decimal place) 0.00–655.35 (when Pr.00-25 is set to two decimal places) 0.000–65.535 (when Pr.00-25 is set to three decimal places)	0

Pr.	Parameter Name	Settings	Default
00-27	User-defined value 1	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 operating status. 3: When switching between local and remote, the drive runs with LOCAL settings for frequency and operating 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 operating status.	0
00-30	Master frequency command source (HAND, LOCAL)	0: Digital keypad 1: RS-485 communication input 2: External analog input (Refer to Pr.03-00) 3: External UP / DOWN terminal (multi-function input terminals) 8: Communication card (does not include CANopen card) Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56.	0
00-31	Operation command source (HAND, LOCAL)	0: Digital keypad 1: External terminals 2: RS-485 communication input 5: Communication card (does not include CANopen card) Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56.	0
00-32	Digital keypad STOP function	0: STOP key disabled 1: STOP key enabled	0
00-33	RPWM mode	0: Disable 1: RPWM mode 1 2: RPWM mode 2 3: RPWM mode 3	0
00-34	RPWM carrier frequency variation	0.0–4.0 kHz	0.0
00-38	User-defined characteristics 2	bit 0–3: user-defined decimal places 0000h-0000b: no decimal place 0001h-0001b: one decimal place 0002h-0010b: two decimal places 0003h-0011b: three decimal places bit 4–15: user-defined unit 003xh: kg/cm^2 015xh: mbar 016xh: bar 017xh: Pa 018xh: kPa 019xh: mWG 01Axh: inWG 01Bxh: ftWG 01Cxh: psi 01Dxh: atm	353

Pr.	Parameter Name	Settings	Default
00-39	Maximum user-defined value 2	0: No Function 0–65535 (when Pr.00-25 is set to no decimal place) 0.0–6553.5 (when Pr.00-25 is set to one decimal place) 0.00–655.35 (when Pr.00-25 is set to two decimal places) 0.000–65.535 (when Pr.00-25 is set to three decimal places)	0
00-47	Motor direction setting	0: Motor does not change running direction 1: Motor changes running direction	0.100
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	Settings	Default
	01-00	Motor 1 maximum operation frequency	0.00–180.00 Hz	150.00
	01-01	Motor 1 rated / base frequency	0.00–180.00 Hz	150.00
	01-02	Motor 1 rated / base voltage	0.0~510.0 V	380.0
	01-09	Start-up frequency	0.0–180.0 Hz	0.50
✎	01-10	Output frequency upper limit	Pr.01-11–180.00 Hz	180.00
✎	01-11	Output frequency lower limit	0.00–Pr.01-10 Hz	0.00
✎	01-12	Acceleration time 1	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-13	Deceleration time 1	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-14	Acceleration time 2	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-15	Deceleration time 2	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-16	Acceleration time 3	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-17	Deceleration time 3	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-18	Acceleration time 4	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-19	Deceleration time 4	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-20	JOG acceleration time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-21	JOG deceleration time	Pr.01-45 = 0: 0.00–600.00 sec. Pr.01-45 = 1: 0.0–6000.0 sec.	10.00 10.0
✎	01-22	JOG frequency	0.00–180.00 Hz	6.00
✎	01-23	First / fourth acceleration and deceleration frequency	0.00–180.00 Hz	0.00
✎	01-24	S-curve acceleration begin time 1	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
✎	01-25	S-curve acceleration arrival time 2	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
✎	01-26	S-curve deceleration begin time 1	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
✎	01-27	S-curve deceleration arrival time 2	Pr.01-45 = 0: 0.00–25.00 sec. Pr.01-45 = 1: 0.0–250.0 sec.	0.20 0.2
	01-28	Skip frequency 1 (upper limit)	0.00–180.00 Hz	0.00
	01-29	Skip frequency 1 (lower limit)	0.00–180.00 Hz	0.00

	Pr.	Parameter Name	Settings	Default
	01-30	Skip frequency 2 (upper limit)	0.00–180.00 Hz	0.00
	01-31	Skip frequency 2 (lower limit)	0.00–180.00 Hz	0.00
	01-32	Skip Frequency 3 (upper limit)	0.00–180.00 Hz	0.00
	01-33	Skip Frequency 3 (lower limit)	0.00–180.00 Hz	0.00
✓	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.01-12–01-21)	0
	01-45	Time unit for acceleration and deceleration and S-curve	0: Unit 0.01 sec. 1: Unit 0.1 sec.	0

02 Digital Input / Output Parameters

Pr.	Parameter Name	Settings	Default
02-00	Two-wire / three-wire operation control	0: No function 1: Two-wire mode 1, power on for operation control (M1: FWD / STOP, M2: REV / STOP) 2: Two-wire mode 2, power on for operation control (M1: RUN / STOP, M2: REV / FWD) 3: Three-wire, power on for operation control (M1: RUN, M2: REV / FWD, M3: STOP) 4: Two-wire mode 1, Quick Start (M1: FWD / STOP, M2: REV / STOP) 5: Two-wire mode 2, Quick Start (M1: RUN / STOP, M2: REV / FWD) 6: Three-wire, Quick Start (M1: RUN, M2: REV / FWD, M3: STOP) **IMPORTANT** 1. In the Quick Start function, the output remains ready for operation. The drive responds to the Start command immediately. 2. When using Quick Start function, the output terminals UVW are with driving voltages in order to output and respond immediately if a Start command is given. Do NOT touch the terminals or modify the motor wiring to prevent electric shocks.	1
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 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 13: Cancel the setting of auto-acceleration / auto-deceleration time 15: Rotating speed command from AI1 16: Rotating speed command from AI2 18: Force to stop (Pr.07-20) 19: Digital up command 20: Digital down command 21: PID function disabled 22: Clear the counter 23: Input the counter value (MI4) 24: FWD JOG command 25: REV JOG command 38: Disable writing EEPROM function 41: HAND switch 42: AUTO switch 51: Selection for PLC mode bit 0 52: Selection for PLC mode bit 1 56：Local / Remote selection	0
02-02	Multi-function input command 2 (MI2)		0
02-03	Multi-function input command 3 (MI3)		1
02-04	Multi-function input command 4 (MI4)		2

	Pr.	Parameter Name	Settings	Default
			58: Enable fire mode (with RUN command) 59: Enable fire mode (without RUN command) 69: Enable preheating function 97: Multi-pump manual / auto switch 100: Enable clean function	
〆	02-09	UP / DOWN key mode	0: UP / DOWN by the acceleration / deceleration time 1: UP / DOWN constant speed (Pr.02-10) 2: Pulse signal (Pr.02-10) 3: External terminals UP / DOWN key mode	0
〆	02-10	Constant speed, acceleration / deceleration speed of the UP / DOWN key	0.001–1.000 Hz / ms	0.001
〆	02-11	Multi-function input response Time	0.000–30.000 sec.	0.005
〆	02-12	Multi-function input mode selection	0000h–FFFFh (0: N.O.; 1: N.C.)	0000
〆	02-13	Multi-function output 1 (RY1)	0: No Function	11
〆	02-14	Multi-function output 2 (RY2)	1: Indication during RUN	0
〆	02-16	Multi-function output 3 (MO)	2: Operation speed reached	0
			3: Desired frequency reached 1 (Pr.02-22) 4: Desired frequency reached 2 (Pr.02-24) 7: Over-torque 1 (Pr.06-06–06-08) 9: Drive is ready 10: Low voltage warning (Lv) (Pr.06-00) 11: Malfunction indication 13: Overheat warning (Pr.06-15) 15: Abnormal PID feedback 17: Count value reached, does not return to 0 (Pr.02-20) 18: Count value reached, return 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 source 25: Forward command 26: Reverse command 29: Output when frequency ≥ Pr.02-34 30: Output when frequency < Pr.02-34 35: Error output selection 1 (Pr.06-23) 36: Error output selection 2 (Pr.06-24) 37: Error output selection 3 (Pr.06-25) 38: Error output selection 4 (Pr.06-26) 40: Speed reached (including STOP) 44: Low current output (use with Pr.06-71–Pr.06-73) 51: Analog output control for RS-485 interface 52: Output control for communication cards 53: Fire mode indication 67: Analog input level reached 69: Indication of preheating operation 75: Forward RUN status 76: Reverse RUN status 81: Indication of multi-pump system error (only Master)	
〆	02-18	Multi-function output direction	0000h–FFFFh (0: N.O.; 1: N.C.)	0000
〆	02-19	Terminal counting value reached (returns to 0)	0–65500	0
〆	02-20	Preliminary counting value reached (does not return to 0)	0–65500	0
〆	02-22	Desired frequency reached 1	0.00–180.00 Hz	150.00

	Pr.	Parameter Name	Settings	Default
⌿	02-23	The width of the desired frequency reached 1	0.00–180.00 Hz	2.00
⌿	02-24	Desired frequency reached 2	0.00–180.00 Hz	150.00
⌿	02-25	The width of the desired frequency reached 2	0.00–180.00 Hz	2.00
	02-34	Output frequency setting for multi-function output terminal	0.00–180.00 Hz	0
⌿	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
	02-50	Display the status of multi-function input terminal	Monitor the status of the multi-function input terminal	Read only
	02-51	Display the status of multi-function output terminal	Monitor the status of the multi-function output terminal	Read only
	02-52	Display the external multi-function input terminals used by PLC	0–65535	0
	02-53	Display the external multi-function output terminals used by PLC	0–65535	0
	02-54	Display the frequency command executed by external terminal	Read only	Read only
⌿	02-72	Preheating DC current level	0–100%	0
⌿	02-73	Preheating DC current duty cycle	0–100%	0

03 Analog Input / Output Parameters

	Pr.	Parameter Name	Settings	Default
ϟ	03-00	AI1 analog input selection	0: No function 1: Frequency command 4: PID target value 5: PID feedback signal 6: Thermistor input value (PTC-130 / KTY-84-130) 11: PT100 thermistor input value 13: PID compensation value 21: Pressure inputs (outlet side) 22: Pressure inputs (inlet side) 23: Flow inputs	5
ϟ	03-01	AI2 analog input selection		0
ϟ	03-03	AI1 analog input bias	-100.0–100.0%	0
ϟ	03-04	AI2 analog input bias	-100.0–100.0%	0
ϟ	03-07	AI1 positive / negative bias mode	0: No bias 4: Bias serves as the center	0
ϟ	03-08	AI2 positive / negative bias mode		
ϟ	03-11	AI1 analog input gain	-500.0–500.0%	100.0
ϟ	03-12	AI2 analog input gain	-500.0–500.0%	100.0
ϟ	03-15	AI1 analog input filter time	0.00–20.00 sec.	0.01
ϟ	03-16	AI2 analog input filter time	0.00–20.00 sec.	0.01
ϟ	03-19	Signal loss selection for AI1 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
ϟ	03-20	Multi-function output (AFM)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 9: AI1 analog input 10: AI2 analog input 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage output	0
ϟ	03-21	AFM analog output gain	0–500.0%	100.0
ϟ	03-22	AFM analog output in REV direction	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	0
ϟ	03-27	AFM output bias	-100.00–100.00%	0.00
ϟ	03-28	AI1 terminal input selection	0: 0–10 V 1: 0–20 mA 2: 4–20 mA	2
	03-29	AI2 serminal input selection	0: 0–10 V 1: 0–20 mA 2: 4–20 mA	2
ϟ	03-30	PLC analog output terminal Status	bit 0: Reserved bit 1: AFM	0
ϟ	03-32	AFM DC output setting level	0.00–100.00%	0.00
ϟ	03-35	AFM output filter time	0.00–20.00 sec.	0.01
ϟ	03-44	Multi-function output (MO) by AI level source	0: AI1 1: AI2	0
ϟ	03-45	AI1 upper level 1	-100.00–100.00%	50
ϟ	03-46	AI1 lower level 2	-100.00–100.00%	10
ϟ	03-47	AI2 upper level 1	-100.00–100.00%	50
ϟ	03-48	AI2 lower level 2	-100.00–100.00%	10
ϟ	03-50	Analog input curve selection	0: Normal curve 1: Three-point curve of AI1 2: Three-point curve of AI2	0

Pr.	Parameter Name	Settings	Default
03-51	AI1 lowest point	Pr.03-28 = 0.00–10.00 V Pr.03-28 =1, 0.00–20.00 mA Pr.03-28 =2, 4.00–20.00 mA	4.00
03-52	AI1 proportional lowest point	0.00–100.00%	0.00
03-53	AI1 mid-point	Pr.03-28 = 0.00–10.00 V Pr.03-28 =1, 0.00–20.00 mA Pr.03-28 =2, 4.00–20.00 mA	12.00
03-54	AI1 proportional mid-point	0.00–100.00%	50.00
03-55	AI1 highest point	Pr.03-28 = 0.00–10.00 V Pr.03-28 =1, 0.00–20.00 mA Pr.03-28 =2, 4.00–20.00 mA	20.00
03-56	AI1 proportional highest point	0.00–100.00%	100.00
03-57	AI2 lowest point	Pr.03-29 = 0.00–10.00 V Pr.03-29 =1, 0.00–20.00 mA Pr.03-29 =2, 4.00–20.00 mA	4.00
03-58	AI2 proportional lowest point	0.00–100.00%	0.00
03-59	AI2 mid-point	Pr.03-29 = 0.00–10.00 V Pr.03-29 =1, 0.00–20.00 mA Pr.03-29 =2, 4.00–20.00 mA	12.00
03-60	AI2 proportional mid-point	0.00–100.00%	50.00
03-61	AI2 highest point	Pr.03-29 = 0.00–10.00 V Pr.03-29 =1, 0.00–20.00 mA Pr.03-29 =2, 4.00–20.00 mA	20.00
03-62	AI2 proportional highest point	0.00–100.00%	100.00
03-69	Analog input 4–20 mA signal loss selection of AI2	0: Disabled 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display ACE	0

04 Multi-Step Speed Parameters

Pr.04-50 to Pr.04-99 listed below are the settings when built-in PLC function is ON. If the built-in PLC function is not loaded into the drive, Pr.04-50 to Pr.04-99 are PLC buffer 0 to PLC buffer 50, and the setting range is 0–65535, the default is 0. But if the built-in PLC function is loaded into the drive, see the explanation below:

Pr.	Parameter Name	Settings	Default
04-00	1st step speed frequency	0.00–180.00 Hz	0.00
04-01	2nd step speed frequency	0.00–180.00 Hz	0.00
04-02	3rd step speed frequency	0.00–180.00 Hz	0.00
04-03	4th step speed frequency	0.00–180.00 Hz	0.00
04-04	5th step speed frequency	0.00–180.00 Hz	0.00
04-05	6th step speed frequency	0.00–180.00 Hz	0.00
04-06	7th step speed frequency	0.00–180.00 Hz	0.00
04-07	8th step speed frequency	0.00–180.00 Hz	0.00
04-08	9th step speed frequency	0.00–180.00 Hz	0.00
04-09	10th step speed frequency	0.00–180.00 Hz	0.00
04-10	11th step speed frequency	0.00–180.00 Hz	0.00
04-11	12th step speed frequency	0.00–180.00 Hz	0.00
04-12	13th step speed frequency	0.00–180.00 Hz	0.00
04-13	14th step speed frequency	0.00–180.00 Hz	0.00
04-14	15th step speed frequency	0.00–180.00 Hz	0.00
04-50	PLC buffer 0	0–65535	0
04-51	PLC buffer1	0–65535	0
04-52	PLC buffer 2	0–65535	0
04-53	PLC buffer 3	0–65535	0
04-54	PLC buffer 4	0–65535	0
04-55	PLC buffer 5	0–65535	0
04-56	PLC buffer 6	0–65535	0
04-57	Pump system configuration setting	bit 0–3 00x0h: Digital keypad 00x1h: RS-485 communication 00x8h: Communication card (does not include CANopen card) bit 4–7 000xh: Digital keypad 001xh: RS-485 communication 002xh: External terminals (MI1) 005xh: Communication card (does not include CANopen card)	0
04-58	Weekdays, weekend, specific day schedule	bit 0: 1 (weekdays) bit 1: 1 (weekend) bit 2: 1 (specific day)	0
04-59	Weekend setting	0: Saturday, Sunday 1: Sunday	0
04-60	Weekdays start time 1	00:00–23:59	00:00
04-61	Weekdays target pressure 1	0–system pressure value	0
04-62	Weekdays start time 2	00:00–23:59	00:00
04-63	Weekdays target pressure 2	0–system pressure value	0
04-64	Weekdays start time 3	00:00–23:59	00:00
04-65	Weekdays target pressure 3	0–system pressure value	0
04-66	Weekdays start time 4	00:00–23:59	00:00
04-67	Weekdays target pressure 4	0–system pressure value	0
04-68	Weekdays start time 5	00:00–23:59	00:00
04-69	Weekdays target pressure 5	0–system pressure value	0
04-70	Weekend start time 1	00:00–23:59	00:00
04-71	Weekend target pressure 1	0–system pressure value	0
04-72	Weekend start time 2	00:00–23:59	00:00
04-73	Weekend target pressure 2	0–system pressure value	0
04-74	Weekend start time 3	00:00–23:59	00:00
04-75	Weekend target pressure 3	0–system pressure value	0

	Pr.	Parameter Name	Settings	Default
✎	04-76	Weekend start time 4	00:00–23:59	00:00
✎	04-77	Weekend target pressure 4	0–system pressure value	0
✎	04-78	Weekend start time 5	00:00–23:59	00:00
✎	04-79	Weekend target pressure 5	0–system pressure value	0
✎	04-80	Specific day start date 1	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-81	Specific day end date 1	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-82	Specific day start date 2	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-83	Specific day end date 2	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-84	Specific day start date 3	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-85	Specific day end date 3	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-86	Specific day start date 4	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-87	Specific day end date 4	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-88	Specific day start date 5	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-89	Specific day end date 5	MM.DD (MM = month, 01–12; DD = date, 01–31)	00.00
✎	04-90	Specific day start time 1	00:00–23:59	00:00
✎	04-91	Specific day target pressure 1	0–system pressure value	0
✎	04-92	Specific day start time 2	00:00–23:59	00:00
✎	04-93	Specific day target pressure 2	0–system pressure value	0
✎	04-94	Specific day start time 3	00:00–23:59	00:00
✎	04-95	Specific day target pressure 3	0–system pressure value	0
✎	04-96	Specific day start time 4	00:00–23:59	00:00
✎	04-97	Specific day target pressure 4	0–system pressure value	0
✎	04-98	Specific day start time 5	00:00–23:59	00:00
✎	04-99	Specific day target pressure 5	0–system pressure value	0

05 Motor Parameters

Pr.	Parameter Name	Settings	Default
05-00	Motor parameter auto-tuning	0: No Function 5: Rolling auto-tuning for motor 13: High frequency stall test for motor	0
05-26	Motor accumulated watt in every millisecond (W-msec.)	Read only	0.0
05-27	Motor accumulated watt in every second (W-sec.)	Read only	0.0
05-28	Motor accumulated watt in every hour (W-hour)	Read only	0.0
05-29	Motor accumulated kilowatt in every kilowatt-hour (kW-Hour)	Read only	0.0
05-30	Motor accumulated megawatt in every megawatt-hour (MW-Hour)	Read only	0.0
05-31	Accumulated motor operation time (minutes)	0–1439	0
05-32	Accumulated motor operation time (days)	0–65535	0
05-34	Motor gull-load current	0–120% of the drive's rated current	#.#
05-35	Motor rated power	0.00–655.35 kW	#.#
05-36	Motor rated speed	0–65535 rpm	2000
05-37	Number of poles for a motor	0–65535	10
05-39	Stator resistance for a motor	0.000–65.535 Ω	0.000
05-40	Motor Ld	0.00–655.35 mH	0.00
05-41	Motor Lq	0.00–655.35 mH	0.00
05-43	Ke parameter of a motor	0.0~6553.5 V/krpm	0

06 Protection Parameters (1)

Pr.	Parameter Name	Settings	Default
06-00	Low voltage level	300.0–440.0 V_{DC}	360.0
06-01	Over-voltage stall prevention	0: No function 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 stall prevention	0
06-03	Over-current stall prevention during Acceleration	Normal duty: 0–150% (100% corresponds to the rated current of the drive)	120
06-04	Over-current stall prevention during operation	Normal duty: 0–150% (100% corresponds to the rated current of the drive)	120
06-05	Acceleration / deceleration time selection for stall prevention at constant speed	0: By current acceleration / deceleration time 1: By the 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 (motor 1)	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0
06-07	Over-torque detection level (motor 1)	10–250% (100% corresponds to the rated current of the drive)	120
06-08	Over-torque detection time (motor 1)	0.0–60.0 sec.	0.1
06-13	Electronic thermal relay selection 1 (motor 1)	1: Standard motor (motor with fan on the shaft) 2: Disabled	2
06-14	Electronic thermal relay action time 1 (motor 1)	30.0–600.0 sec.	60.0
06-15	Temperature level overheat (OH) warning	0.0–110.0ºC	105.0
06-16	Stall prevention limit level (weak magnetic field current stall prevention level)	0–100% (refer to Pr.06-03)	100
06-17	Fault record 1	0: No fault record	0
06-18	Fault record 2	1: Over-current during acceleration (ocA)	0
06-19	Fault record 3	2: Over-current during deceleration (ocd)	0
06-20	Fault record 4	3: Over-current during steady operation (ocn)	0
06-21	Fault record 5	4: Ground fault (GFF)	0
06-22	Fault record 6	6: Over-current at stop (ocS)	0
	Fault record 7 (Pr.14-70)	7: Over-voltage during acceleration (ovA)	
	Fault record 8 (Pr.14-71)	8: Over-voltage during deceleration (ovd)	
	Fault record 9 (Pr.14-72)	9: Over-voltage during constant speed (ovn)	
	Fault record 10 (Pr.14-73)	10: Over-voltage at stop (ovS)	
		11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage at constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (orP) 16: IGBT overheating (oH1) 17: Heatsink overheating (oH2) 18: IGBT temperature detection failure (tH1o) 19: Capacitor hardware error (tH2o) 21: Over load (oL) 22: Electronics thermal relay 1 protection (EoL1) 24: Motor overheating PTC-130 / KTY-84-130 / PT100 (oH3) 26: Over torque 1 (ot1) 28: Under current (uC)	

	Pr.	Parameter Name	Settings	Default
			31: EEPROM read error (cF2) 33: U-phase error (cd1) 34: V-phase error (cd2) 35: W-phase error (cd3) 36: cc hardware error (Hd0) 37: oc hardware error (Hd1) 40: Auto-tuning error (AUE) 41: PID loss ACI (AFE) 48: ACI loss (ACE) 49: External fault (EF) 51: External base block (bb) 52: Password is locked (Pcod) 54: Illegal command (CE1) 55: Illegal data address (CE2) 56: Illegal data value (CE3) 57: Data is written to read-only address (CE4) 58: Modbus transmission time-out (CE10) 79: U-phase over-current before run (Aoc) 80: V-phase over-current before run (boc) 81: W-phase over-current before run (coc) 82: U-phase output phase loss (oPL1) 83: Output phase loss V phase (oPL2) 84: Output phase loss W phase (oPL3) 87: Low frequency overload protection (oL3) 89: Rotor position detection error (roPd) 90: Force to stop (FStp) 98: Fire mode output (Fire) 140: oc hardware error (Hd6) 141: GFF occurs before run (b4GFF) 142: Auto-tune error 1 (AuE1) (DC test stage) 143: Auto-tune error 2 (AuE2) (high frequency stall stage) 144: Auto-tune error 3 (AuE3) (rotation test stage) 221: High water pressure (HPS) 222: Low water pressure (LPSE) 223: Dry pump (dryE) 224: Water leaking (pipe explosion) (LEKE) 225: Clogged pipe (JAME) 226: RTC error (rtF) 227: Dry pump curve auto-measuring (dAUE)	
✔	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
✔	06-29	PTC-130 / KTY84-130 / PT100 action	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0
✔	06-30	PTC-130 / KTY84-130 level	0.0–100.0%	50.0
	06-31	Frequency command at malfunction	0.00–180.00 Hz	Read only
	06-32	Output frequency at malfunction	0.00–180.00 Hz	Read only
	06-33	Output voltage at malfunction	0.0–6553.5 V	Read only
	06-34	DC bus voltage at malfunction	0.0–6553.5 V	Read only
	06-35	Output current at malfunction	0.00–655.35 Amps	Read only
	06-36	IGBT temperature at malfunction	0.0–6553.5ºC	Read only
	06-38	Motor speed at malfunction	0–65535 rpm	Read only

Pr.	Parameter Name	Settings	Default
06-40	Status of the multi-function input terminal at malfunction	0000h–FFFFh	Read only
06-41	Status of the multi-function output terminal at malfunction	0000h–FFFFh	Read only
06-42	Drive status at malfunction	0000h–FFFFh	Read only
06-45	Output phase loss detection action (OPHL)	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	3
06-46	Detection time for output phase loss	0.000–65.535 sec.	0.500
06-47	Current detection level for output phase loss	0.00–100.00%	1.00
06-48	DC brake time for output phase loss	0.000–65.535 sec.	0.000
06-49	LvX auto-reset	0: Disabled 1: Enabled	0
06-53	Input phase loss detection action (OrP)	0: Fault and ramp to stop 1: Fault and coast to stop	0
06-55	Derating protection	0: Constant rated current and limit carrier frequency by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier frequency 2: Constant rated current (same as setting 0), but close current limit	0
06-56	PT100 voltage level 1	0.000–10.000 V	5.000
06-57	PT100 voltage level 2	0.000–10.000 V	7.000
06-58	PT100 level 1 frequency protection	0.00–180.00 Hz	0.00
06-59	PT100 activation level 1 protection frequency delay time	0–6000 sec.	60
06-60	Software detection GFF current level	0.0–6553.5%	60.0
06-61	Software detection GFF filter time	0.00–655.35 sec.	0.10
06-63	Operation time of fault record 1 (day)	0–65535 days	Read only
06-64	Operation time of fault record 1 (minute)	0–1439 minutes	Read only
06-65	Operation time of fault record 2 (day)	0–65535 days	Read only
06-66	Operation time of fault record 2 (minute)	0–1439 minutes	Read only
06-67	Operation time of fault record 3 (day)	0–65535 days	Read only
06-68	Operation time of fault record 3 (minute)	0–1439 minutes	Read only
06-69	Operation time of fault record 4 (day)	0–65535 days	Read only
06-70	Operation time of fault record 4 (minute)	0–1439 minutes	Read only
06-71	Low current setting level	0.0–100.0%	0.0
06-72	Low current detection time	0.00–360.00 sec.	0.00
06-73	Low current action	0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the 2nd deceleration time 3: Warn and continue operation	0
06-80	Fire mode	0: Disabled 1: Forward operation (counterclockwise) 2: Reverse operation (clockwise)	0

Pr.	Parameter Name	Settings	Default
06-81	Operating frequency in fire mode	0.00–180.00 Hz	150.00
06-86	PTC type	0: PTC-130 1: KTY84-130	0
06-88	Operation times in fire mode	0–65535 times	Read only
06-90	Operation time of fault record 5 (day)	0–65535 days	Read only
06-91	Operation time of fault record 5 (minute)	0–1439 minutes	Read only
06-92	Operation time of fault record 6 (day)	0–65535 days	Read only
06-93	Operation time of fault record 6 (minute)	0–1439 minutes	Read only

07 Special Parameters

Pr.	Parameter Name	Settings	Default
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
07-05	Voltage increasing gain	1–200%	100
07-06	Restart after momentary power loss	0: Stop operation 1: Speed tracking by the speed before the power loss	0
07-07	Allowed power loss duration	0.0–20.0 sec.	2.0
07-08	Base block time	0.1–5.0 sec.	0.5
07-09	Current limit of speed tracking	20–200%	100
07-10	Restart after fault action	0: Stop operation 1: Speed tracking by current speed	0
07-11	Number of times of restart after fault	0–10	0
07-12	Speed tracking during start-up	0: No function 1: Speed tracking by current speed	0
07-20	Emergency stop (EF) & force to stop selection	0: Coast to stop 1: By the first deceleration time 2: By the second deceleration time 3: By the third deceleration time 4: By the fourth deceleration time 5: System deceleration 6: Automatic deceleration	0
07-23	Automatic voltage regulation (AVR) function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0
07-24	Torque command filter time	0.001–10.000 sec.	0.050
07-26	Torque compensation gain	0–5000	1
07-33	Auto-restart interval of fault	0.0–6000.0	60.0
07-38	Voltage feed forward gain	0.50–2.00	1.00

08 High-function PID Parameters

	Pr.	Parameter Name	Settings	Default
✎	08-00	Terminal selection of PID feedback	0: No function 1: Negative PID feedback: by analog input (Pr.03-00)	0
✎	08-01	Proportional gain (P)	0.0–500.0 (when Pr.08-23 set bit1 = 0) 0.00–5000.0 (when Pr.08-23 set bit1 = 1)	1.00
✎	08-02	Integral time (I)	0.00–100.00 sec.	1.00
✎	08-03	Differential time (D)	0.00–1.00 sec.	0.00
✎	08-04	Upper limit of integral control	0.0–100.0%	100.0
✎	08-05	PID output command limit (positive limit)	0.0–100.0%	100.0
✎	08-08	Feedback signal detection time	0.0–3600.0 sec.	0.0
✎	08-09	Treatment of feedback signal	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency	0
	08-20	PID mode selection	0: Serial connection 1: Parallel connection	0
✎	08-23	PID control flag	bit 1 = 1, two decimal places for PID Kp bit 1 = 0, one decimal place for PID Kp	2

09 Communication Parameters

	Pr.	Parameter Name	Settings	Default
✓	09-00	Communication address	1–254	1
✓	09-01	COM1 transmission speed	4.8–115.2 Kbps	115.2
✓	09-02	Treatment of COM1 transmission fault	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	3
✓	09-03	COM1 time-out detection	0.0–100.0 sec.	0.0
✓	09-04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O 2 (RTU)	12
✓	09-05	COM2 transmission speed	4.8–115.2 Kbps	9.6
✓	09-06	Treatment of COM2 transmission fault	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	3
✓	09-07	COM2 time-out detection	0.0–100.0 sec.	0.0
✓	09-08	COM2 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O 2 (RTU)	1
✓	09-09	Communication response delay time	0.0–200.0 ms	2.0
	09-10	Communication main frequency	0.00–180.00 Hz	150.00
✓	09-11	Block transfer 1	0–65535	0
✓	09-12	Block transfer 2	0–65535	0
✓	09-13	Block transfer 3	0–65535	0
✓	09-14	Block transfer 4	0–65535	0
✓	09-15	Block transfer 5	0–65535	0
✓	09-16	Block transfer 6	0–65535	0
✓	09-17	Block transfer 7	0–65535	0
✓	09-18	Block transfer 8	0–65535	0
✓	09-19	Block transfer 9	0–65535	0
✓	09-20	Block transfer 10	0–65535	0
✓	09-21	Block transfer 11	0–65535	0

Pr.	Parameter Name	Settings	Default
09-22	Block transfer 12	0–65535	0
09-23	Block transfer 13	0–65535	0
09-24	Block transfer 14	0–65535	0
09-25	Block transfer 15	0–65535	0
09-26	Block transfer 16	0–65535	0
09-30	Communication decoding method	0: Decoding method 1 1: Decoding method 2	0
09-31	COM1 internal communication protocol	0: Modbus 485 -12: Modbus master (for PLC) -21: ID1 (pump master) -22: ID2 (pump slave) -23: ID3 (pump slave) -24: ID4 (pump slave) -25: ID5 (pump slave) -26: ID6 (pump slave) -27: ID7 (pump slave) -28: ID8 (pump slave)	0
09-33	PLC command force to 0	bit 0: Every time before PLC scan, set the PLC target frequency = 0 bit 1: Every time before PLC scan, set the PLC target torque = 0 bit 2: Every time before PLC scan, set the speed limit of torque mode = 0	0
09-34	PLC program ID	0–65535	0
09-35	PLC Address	1–254	100
09-60	Communication card identification	0: No communication card 1: DeviceNet Slave 2: Profibus-DP Slave 5: EtherNet/IP Slave 13: Bluetooth	Read only
09-61	Firmware version of communication card	0–655.35 (read only)	Read only
09-62	Product code	0–655.35 (read only)	Read only
09-63	Fault code	0–655.35 (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 1: Non-standard DeviceNet	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)	0–255	0
09-77	Communication card IP address 2 (for EtherNet)	0–255	0

	Pr.	Parameter Name	Settings	Default
✔	09-78	Communication card IP address 3 (for EtherNet)	0–255	0
✔	09-79	Communication card IP address 4 (for EtherNet)	0–255	0
✔	09-80	Communication card address mask 1 (for EtherNet)	0–255	0
✔	09-81	Communication card address mask 2 (for EtherNet)	0–255	0
✔	09-82	Communication card address mask 3 (for EtherNet)	0–255	0
✔	09-83	Communication card address mask 4 (for EtherNet)	0–255	0
✔	09-84	Communication card gateway address 1 (for EtherNet)	0–255	0
✔	09-85	Communication card gateway address 2 (for EtherNet)	0–255	0
✔	09-86	Communication card gateway address 3 (for EtherNet)	0–255	0
✔	09-87	Communication card gateway address 4 (for EtherNet)	0–255	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: No function 1: Reset to defaults	0
✔	09-91	Additional setting for the communication card (for EtherNet)	bit 0: Enable IP filter bit 1: Enable internet parameters bit 2: Enable login password	0
	09-92	Communication card status (for EtherNet)	bit 0: Enable password	Read only

10 Speed Feedback Control Parameters

Pr.	Parameter Name	Settings	Default
10-31	MSI motor control current compensation command	0–150% rated current of the motor	40
10-32	Speed estimator bandwidth	0.00–600.00 Hz	5.00
10-34	Speed estimator low-pass filter gain	0.00–655.35	1.00
10-39	MSI motor control current compensation frequency point	0.00–180.00 Hz	15.00
10-42	Initial angle detection pulse value	0.0–3.0	1.0
10-49	Zero voltage time during start-up	00.000–60.000 sec.	00.000
10-51	Injection frequency	0–1200 Hz	500
10-52	Injection magnitude	0.0~200.0 V	30.0
10-53	Angle detection method	0: No function 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	0

11 Advanced Parameters

	Pr.	Parameter Name	Settings	Default
	11-00	System control	bit 3: Dead time compensation closed bit 7: Save or do not save the frequency	0
	11-41	PWM mode selection	0: Two-phase modulation mode 2: Space vector modulation mode	0
〃	11-42	System control flag	0000–FFFFh	0000

12 Function Parameters

	Pr.	Parameter Name	Settings	Default
✓	12-00	Set point deviation level	0–50%	0
✓	12-01	Detection time of set point deviation level	1–9999 sec.	10
✓	12-02	Offset level of low water consumption	0–50%	10
✓	12-03	Offset level of high water consumption	0: No function 0–100%	0
✓	12-04	High water consumption delay time	0: No function 0.1–10.0 sec.	0.5
✓	12-08	Frequency to start switching pumps	Pr.12-10–FMAX	FMAX
✓	12-09	Time detected when pump reaches the starting frequency	0.0–3600.0 sec.	1.0
✓	12-12	Pump's frequency at time-out (disconnection)	0.00–FMAX	0.00
	12-13	Treatment of pump fault	bit 0: When the operating pump is failed, whether switch to the substitute pump or not 0: Stop all pumps' action 1: Switch to an alternate pump bit 1: During the operation, stop or standby after resetting from error 0: Standby after resetting 1: Stop after resetting bit 2: Before the operation, whether the system can run or not if the pump has an error 0: The system can not activate the operation 1: The system selects another pump to operate	1
	12-14	Selection of pump start-up sequence	0: According to the serial numbers of the pumps 1: According to the operating time	1
	12-18	Cavitation detection method	bit 0–3 00x0h: not using cavitation 00x1h: use AI1 to detect flow 00x2h: use flow estimation Q-H method bit 4–7 000xh: no warning when cavitation 001xh: warning when cavitation, but continue operating	0
	12-19	Cavitation detection tolerance	0–655.00	1
	12-20	Flow estimation method	0: Not using 1: Q-H method 2: P-Q method	1
	12-21	Accumulated flow-units digit	0–999.9 m^3 (read only)	Read only
	12-22	Accumulated flow-thousands digit	0–65535 km^3 (read only)	Read only
	12-23	Reset accumulated flow	0: Not reset 1: When powering the AC motor drive on, reset volume flow 2: Reset volume flow immediately	0
✓	12-24	Diameter of the pump inlet	5.0–6500.0 mm	0.0
✓	12-25	Diameter of the pump outlet	5.0–6500.0 mm	0.0
✓	12-26	The rated rotation speed of pump	0–65535 rpm	3000
✓	12-27	Fluid density	0.0–6550.0 kg/m^3	995.7
✓	12-28	Fluid temperature during operation	0.00–600.00°C	30.00
✓	12-29	Height difference of inlet / outlet pump pressure sensor	-30.00–30.00 m	0
✓	12-30	Pump curve head 1	0.00–655.00 m	0

Pr.	Parameter Name	Settings	Default
12-31	Pump curve head 2	0.00–655.00 m	0
12-32	Pump curve head 3	0.00–655.00 m	0
12-33	Pump curve head 4	0.00–655.00 m	0
12-34	Pump curve head 5	0.00–655.00 m	0
12-35	Pump curve flow 1	0.00–655.00 m^3/hr	0
12-36	Pump curve flow 2	0.00–655.00 m^3/hr	0
12-37	Pump curve flow 3	0.00–655.00 m^3/hr	0
12-38	Pump curve flow 4	0.00–655.00 m^3/hr	0
12-39	Pump curve flow 5	0.00–655.00 m^3/hr	0
12-40	Pump curve power 1	0.00–655.35 kW	0
12-41	Pump curve power 2	0.00–655.35 kW	0
12-42	Pump curve power 3	0.00–655.35 kW	0
12-43	Pump curve power 4	0.00–655.35 kW	0
12-44	Pump curve power 5	0.00–655.35 kW	0
12-45	Pump curve NPSHr 1	0.00–655.00 m	0
12-46	Pump curve NPSHr 2	0.00–655.00 m	0
12-47	Pump curve NPSHr 3	0.00–655.00 m	0
12-48	Pump curve NPSHr 4	0.00–655.00 m	0
12-49	Pump curve NPSHr 5	0.00–655.00 m	0
12-50	Cycle time selection	0: No function 1: Absolute time 2: Fixed time	2
12-51	Multi-pump's absolute time circulation period	00:00–23:59	00:00
12-52	Multi-pump's fixed time circulation period	0.0–3000.0 hours	5.0
12-53	Clean function	0: Disabled 1: Enabled (trigger the clean function when DI works) 2: Enabled (trigger the clean function when current exceeds stall current and the operation is restricted) 3: Enabled (trigger the clean function when the counting time is up)	0
12-54	Jam current setting value	0– the smallest one of Pr.06-03 and Pr.06-04	120
12-55	Jam current delay time	0.0–300.0 sec.	60.0
12-56	Auto clean day	0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	0
12-57	Cleaning time	00:00–23:59	00:00
12-58	Cleaning cycle times	1–30	5
12-59	Clean forward frequency	0.00–50.00 Hz	40.00
12-60	Clean forward time	0.0–300.0 sec.	2.0
12-61	Clean reverse frequency	0.00–50.00 Hz	40.00
12-62	Clean reverse time	0.0–300.0 sec.	2.0
12-63	Cleaning acceleration time	1.0–300.0 sec.	1.0
12-64	Cleaning deceleration time	1.0–300.0 sec.	1.0
12-65	Auto-tuning load curve	0: Disabled 1: Enabled	0
12-66	50% power consumption point	0–65535 kW	0
12-67	100% power consumption point	0–65535 kW	0
12-68	Dry pump function	0: Disabled 1: Enabled	0
12-69	Dry pump check time	0–300.0 sec.	15.0
12-70	Dry pump restart delay time	0–1000 min.	30
12-71	Number of restart times limitation of dry pump	0–20	5
12-72	Treatment of dry pump fault	1: Fault and coast to stop 2: Fault and ramp to stop	1

Pr.	Parameter Name	Settings	Default
12-73	Heavy water leakage abnormal pressure detection	0: No function 1–50%	15
12-74	Heavy water leakage abnormal detection time	0.1–300.0 sec.	15.0
12-75	Heavy water leakage load setting	0–100%	20.00
12-76	Treatment of heavy water leakage	0: Warn and continue operation 1: Fault and coast to stop 2: Fault and ramp to stop	0
12-77	Sleep boost pressure setting	0–50%	0
12-78	Sleep boost pressure delay time	0.0–600.0 sec.	10.0
12-79	Level of high pressure alarm	0: No Function 0–50%	25
12-80	High pressure time delay	0.1–300.0 sec.	5.0
12-81	Treatment of high pressure	1: Fault and coast to stop 2: Fault and ramp to stop	1
12-82	Level of low pressure alarm	0: No Function 0–50%	25
12-83	Low pressure time delay	0.1–300.0 sec.	5.0
12-84	Treatment of low pressure	0: Warn and continue operation 1: Fault and coast to stop 2: Fault and ramp to stop	1
12-88	Dry pump detection tolerance	0–50%	10
12-93	Year setting	2020–2099	2000
12-94	Date setting	1.01–12.31	1.01
12-95	Time setting	00:00–23:59	00:00
12-96	Week setting	0–6 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	0

13 Macro / User-defined Macro

Pr.	Parameter Name	Settings	Default
13-00	Macro selection	00: Disabled 01: User-defined	00
13-01 – 13-50	Application parameter (user-defined)		

14 Protection Parameters (2)

Pr.	Parameter Name	Settings	Default
14-50	Output frequency at malfunction 2	0.00–180.00 Hz	Read only
14-51	DC bus voltage at malfunction 2	0.0–6553.5 V	Read only
14-52	Output current at malfunction 2	0.00–655.35 Amps	Read only
14-53	IGBT temperature at malfunction 2	-3276.7–3276.7ºC	Read only
14-54	Output frequency at malfunction 3	0.00–180.00 Hz	Read only
14-55	DC bus voltage at malfunction 3	0.0–6553.5 V	Read only
14-56	Output current at malfunction 3	0.00–655.35 Amps	Read only
14-57	IGBT temperature at malfunction 3	-3276.7–3276.7ºC	Read only
14-58	Output frequency at malfunction 4	0.00–180.00 Hz	Read only
14-59	DC bus voltage at malfunction 4	0.0–6553.5 V	Read only
14-60	Output current at malfunction 4	0.00–655.35 Amps	Read only
14-61	IGBT temperature at malfunction 4	-3276.7–3276.7ºC	Read only
14-62	Output frequency at malfunction 5	0.00–180.00 Hz	Read only
14-63	DC bus voltage at malfunction 5	0.0–6553.5 V	Read only
14-64	Output current at malfunction 5	0.00–655.35 Amps	Read only
14-65	IGBT temperature at malfunction 5	-3276.7–3276.7ºC	Read only
14-66	Output frequency at malfunction 6	0.00–180.00 Hz	Read only
14-67	DC bus voltage at malfunction 6	0.0–6553.5 V	Read only
14-68	Output current at malfunction 6	0.00–655.35 Amps	Read only
14-69	IGBT temperature at malfunction 6	-3276.7–3276.7ºC	Read only
14-70	Fault record 7	Refer to fault record Pr.06-17–06-22	0
14-71	Fault record 8	Refer to fault record Pr.06-17–06-22	0
14-72	Fault record 9	Refer to fault record Pr.06-17–06-22	0
14-73	Fault record 10	Refer to fault record Pr.06-17–06-22	0

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 Read only

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

460V models - Three-phase							
Frame	A					A / B	B
Power (kW)	0.75	1.5	2.2	3	4	5.5	7.5
Power (HP)	1	2	3	4	5.5	7.5	10
Identity Code	404	405	406	482	483	408	409
Rated Current	1.6	3.3	4.7	6.2	8.5	11.7	15.6

📖 For the 5.5 kW / 7.5 HP models
Frame A: VFD11AMP43JNNAA, model without filter
Frame B: VFD11AMP43JFNAA, model with filter

00-02 Parameter Reset

Default: 0

Settings
0: No Function
1: Write protection for parameters
5: Return kWh displays to 0
6: Reset PLC
8: Keypad does not respond
10: Reset all parameters to defaults (base frequency is 150 Hz)
12: Reset all parameters to defaults with base frequency at 150 Hz (keep the user-defined parameter values Pr.13-01–Pr.13-50)

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

📖 5: You can return the kWh displayed value to 0 even during drive operation.For example, you can set Pr.05-26–Pr.05-30 to 0.

📖 6: Clear the internal PLC program (includes the related settings of PLC internal CANopen master).

📖 10: Reset all parameters to defaults. If you have set a password (Pr.00-08), unlock the password (Pr.00-07) to clear the password you have set before you reset all parameters.

📖 For the setting of 10, you must reboot the motor drive after you finish the setting.

✓ 00-03 Start-up Display

Default: 4

Settings
0: F (frequency command)
1: H (output frequency)
2: U (user-defined) see Pr.00-04
3: A (output current)
4: P (display the setting value and the feedback of PID control)

📖 Determines the start-up display page after power is applied to the drive. The user-defined contents display according to the Pr.00-04 settings.

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

Default: 7

Settings
0: Display output current (A) (Unit: Amp)
1: Display counter value (c) (Unit: CNT)
2: Display the drive's actual output frequency (H.) (Unit: Hz)
3: Display the drive's DC bus voltage (v) (Unit: V_{DC})
4: Display the drive's output voltage (E) (Unit: V_{AC})

5: Display the drive's output power angle (n) (Unit: deg)
6: Display the drive's output power (P) (Unit: kW)
7: Display the motor speed (r) (Unit: rpm)
10: Display PID feedback (b) (Unit: %)
11: Display AI1 analog input terminal signal (1.) (Unit: %)
12: Display AI2 analog input terminal signal (2.) (Unit: %)
14: Display the drive's IGBT temperature (i.) (Unit: ℃)
15: Display the drive's internal temperature (c.) (Unit: ℃)
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.)
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)
30: Display the output of User-defined (U)
31: Display Pr.00-05 user gain (K)
36: Present operating carrier frequency of the drive (J.) (Unit: Hz)
38: Display the drive status (6.) (See Explanation 5)
41: kWh display (J) (Unit: kWh)
42: PID target value (h.) (Unit: %)
43: PID compensation (C.) (Unit: %)
44: PID output frequency (b.) (Unit: Hz)
49: Display the motor's temperature (M) (PTC-130, PT100, KTY84-130)
51: PMSVC torque offset (T.)
60: Display the setting value and the feedback of PID control (P)
65: Accumulated motor operation record (day) (r.) (Refer to Pr.05-32)
112: Estimated flow rate (F) (Unit: m^3/hr)
113: Display the inlet pressure (I) (Unit: according to Pr.00-38 setting)
114: Display the outlet pressure (O) (Unit: according to Pr.00-25 setting)
115: Cavitation detection index (V) (See Pr.12-18 for more details)

Explanation 1

- Setting value 11, 12: display the percentage corresponds to AI1, AI2, and 0–10 V / 0–20 mA / 4–20 mA correspond to 0.00–100.00%.
- It can also display negative values when setting analog input bias (Pr.03-03–03-10). Assume that AI1 input voltage is 0 V, Pr.03-03 is 10.0%, Pr.03-07 is 4 (Bias serves as the center).

Explanation 2

If MI1 and MI4 are ON, the following table shows the status of the terminals.
Normally opened contact (N.O.): (0: OFF, 1: ON)

Terminal	MI4	MI3	MI2	MI1
Status	1	0	0	1

- The value is 0000 0000 0000 1001 in binary system. And converts to 0009H in hexadecimal system. When Pr.00-04 is set to 16 or 19, the u page on the keypad displays 0009h.
- The setting 16 is the ON / OFF status of digital input according to Pr.02-12 setting and the setting 19 is the corresponding CPU pin ON / OFF status of the digital input.
- When MI1 / MI2 default setting is two-wire / three-wire operation control (Pr.02-00 ≠ 0), and MI3 is set to three-wire, it is 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 3

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

Terminal	MO	RY2	RY1
Status	0	0	1

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

Explanation 4

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

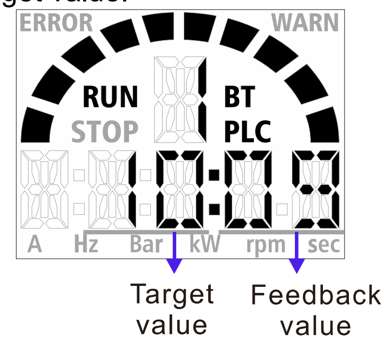
Explanation 5

- Setting value 38:

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

Explanation 6

- Setting value 60:
  Read from left to right , the second and the third digit display the maximum target value, and it's limited by Pr.00-26 setting; the forth and the fifth digit display pressure feedback value. Users can use the UP / DOWN button on the keypad to adjust the maximum target value.
  Example: In water pump system, the maximum target value is 4 bar, and the maximum range can be detected by the pressure sensor is 10 bar. Set Pr.00-25 = 353 to define the unit as bar and in one decimal place; set Pr.00-26 = 10.0 to define the maximum pressure to be 10 bar. And then use keypad to adjust the the second and the third digit from 10 to 4, finish the setting of the target value.



Explanation 7

- Setting value 113, 114: Set pressure unit in Pr.00-38 and Pr.00-25, otherwise the display shows 0.
- The pressure unit: 003xh: kg/cm^2, 015xh: mbar, 016xh: bar, 017xh: Pa, 018xh: kPa, 0x19xh: mWG, 0x1Axh: inWG, 0x1Bxh: ftWG, 01Cxh: psi

✎ 00-05 Coefficient Gain in Actual Output Frequency

Default: 1.00

Settings 0.00–160.00

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

00-06 Firmware Version

Default: Read only

Settings Read only

✎ 00-07 Parameter Protection Password Input

Default: 0

Settings 0–65535
Display 0–4 (the number of password attempts)

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

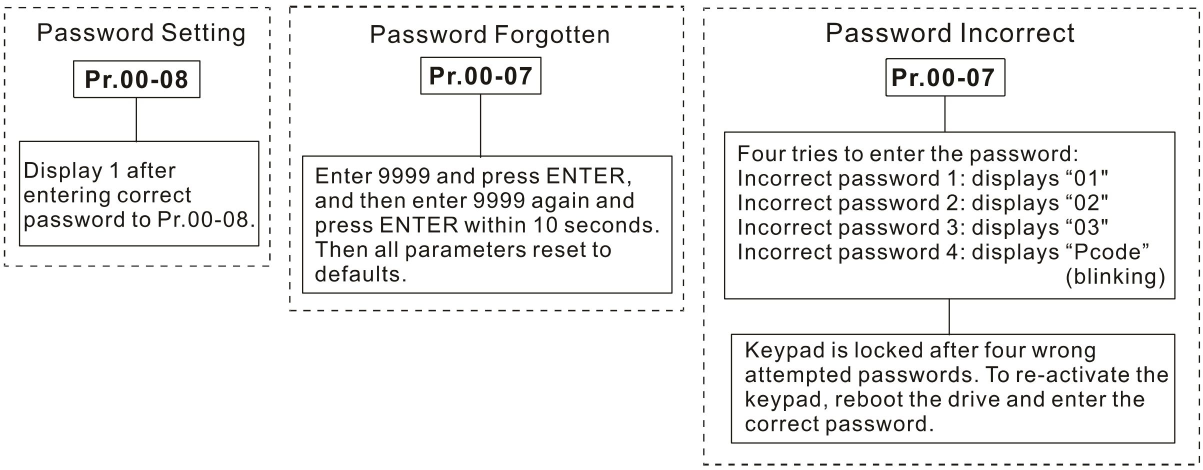
- If you forget the password, clear the password setting by entering 9999 and pressing the ENTER key, then enter 9999 again and press ENTER within 10 seconds. After decoding, all the settings return to default.
- When setting is under password protection, all the parameters read 0, except Pr.00-08.

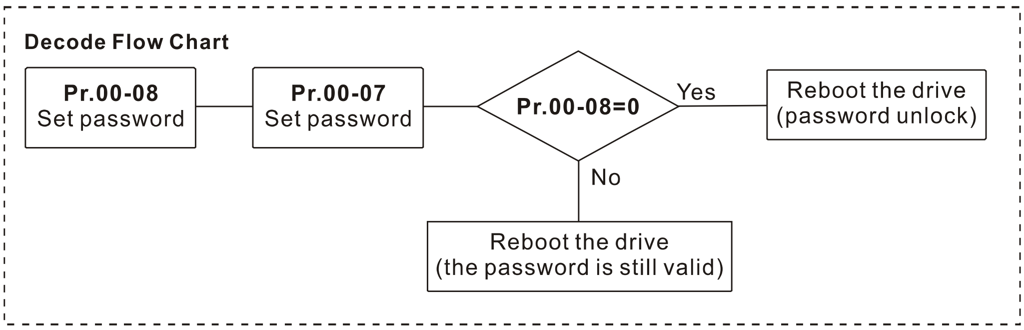
00-08 Parameter Protection Password Setting

Default: 0

Settings 0–65535
Display 0: No password protection or password is entered correctly (Pr.00-07)
1: Password has been set

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





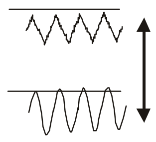
00-17 Carrier frequency

Default: 4 / 4

Settings 2–15 kHz

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

Models	Model	Settings	Normal Duty Default	Heavy Duty Default
460V	1–30 HP [0.75–22kW]	02–15 kHz	4 kHz	4 kHz

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

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

00-19 PLC Command Mask

Default: Read only

Settings bit 0: Control command is forced by PLC control
bit 1: Frequency command is forced by PLC control

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

00-20 Master frequency command source (AUTO, REMOTE)

Default: 0

Settings 0: Digital keypad
1: RS-485 communication input (COM1)
2: External analog input (refer to Pr.03-00)
3: External UP / DOWN terminal (multi-function input terminals)
8: Communication card (does not include CANopen card)

Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56.

- Determines the master frequency source in the "AUTO, REMOTE "mode. The default is AUTO mode.
- You can switch the AUTO, REMOTE mode with the multi-function input terminal (MI) to set the master frequency source.
- It returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.
- If the built-in PLC function is ON, refer to Pr.04-57 details for the settings of Pr.00-20 and Pr.00-21.

00-21 Operation command source (AUTO, REMOTE)

Default: 0

Settings 0: Digital keypad
1: External terminals
2: RS-485 communication input (COM1)
5: Communication card (does not include CANopen card)

Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 42 and 56.

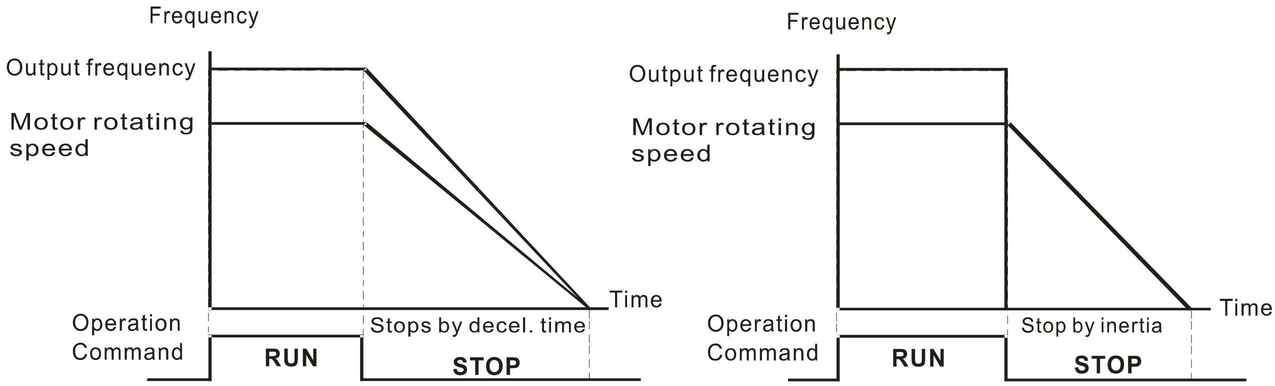
- Determines the operation frequency source in the "AUTO, REMOTE" mode.
- In the HOA mode, if the multi-function input terminal (MI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid.
- If the built-in PLC function is ON, refer to Pr.04-57 details for the settings of Pr.00-20 and Pr.00-21.

00-22 Stop method

Default: 0

Settings 0: Ramp to stop
1: Coast to stop

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



Ramp to Stop and Coast to Stop

1. Ramp to stop: According to the set deceleration time, the AC motor drive decelerates to 0 Hz or the minimum output frequency (Pr.01-07), and then stop.
2. Coast to stop: According to the load inertia, the AC motor drive stops output immediately, and the motor coasts to stop.
   - 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.

00-23 Motor Direction Control

Default: 0

Settings 0: Enable forward / reverse
1: Disable reverse
2: Disable forward

This parameter can prevent the equipment to be broken from a malfunction caused by the forward and reverse rotation of the motor. To limit the motor to run in the forward or reverse direction when only one running direction is allowed for the motor load.

Refer to Pr.00-47 for the definition of motor running direction, and refer to Chapter 5 for schematic diagram of motor running direction.

00-24 Digital Operator (Keypad) Frequency Command Memory

Default: Read only

Settings Read only

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

00-25 User-Defined Characteristics 1

Default: 353

Settings bit 0–3: user-defined decimal places
0000h-0000b: no decimal place
0001h-0001b: one decimal place
0002h-0010b: two decimal places
0003h-0011b: three decimal places
bit 4–15: user-defined unit
000xh: Hz
001xh: rpm
002xh: %
003xh: kg/cm^2
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

- User-defined characteristic 1 is applicable to the setting of AI1 and the system; user-defined characteristic 2 is applicable to be inlet pressure only when Pr.03-01=22.
- The default is in one decimal place (xxx1h), and the unit is bar (016xh). 0161h in hexadecimal system equals 353 in decimal system, so set Pr.00-25 to 353 via the keypad will be succeed.
- When Pr.03-00=21 (the outlet pressure), the unit of Pr.00-25 should be the pressure unit, otherwise the function cannot work correctly.
- When Pr.03-00=23 (the input flow), the unit of Pr.00-25 should be the flow unit, otherwise the function cannot work correctly.
- bit 0–3: The displayed units for the control frequency F page and user-defined (Pr.00-04 = 10, PID feedback), and the displayed number of decimal places for Pr.00-26 (support up to three decimal places).
- bit 4–15: The displayed units for the control frequency F page, user-defined (Pr.00-04 = 10, PID feedback) and Pr.00-26.

0 0 0 0 h

→ user-defined decimal places
0: no decimal place
1: one decimal place
2: two decimal places
3: three decimal places

→ user-defined unit
0: Hz
1: rpm
2: %
3: kg

- You must convert the setting value to decimal system when using the keypad to set parameters.
  Example: Assume that the user-defined unit is inWG and user-defined decimal place is the third decimal point.
  According to the information above, the corresponding unit to inWG is 01Axh (x is the set decimal point), and the corresponding unit to the third decimal place is 0003h, then inWG and the third decimal point displayed in hexadecimal is 01A3h, that is 419 in decimal system. Thus, set Pr.00-25 = 419 to complete the setting.
- The unit conversion table of pressure
  Refer to the table below to set the corresponding decimal value according to the unit and the decimal point.
  For example, if it's two decimal points and the unit is bar, then set Pr.00-25 = 354.

	003xh: kg/cm^2	015xh: mbar	016xh: bar
0000h no decimal place	Hex: 0030h Decimal: 48	Hex: 0150h Decimal: 336	Hex: 0160h Decimal: 352
0001h one decimal place	Hex: 0031h Decimal: 49	Hex: 0151h Decimal: 337	Hex: 0161h Decimal: 353
0002h two decimal places	Hex: 0032h Decimal: 50	Hex: 0152h Decimal: 338	Hex: 0162h Decimal: 354
0003h three decimal places	Hex: 0033h Decimal: 51	Hex: 0153h Decimal: 339	Hex: 0163h Decimal: 355

00-26 Maximum User-Defined Value 1

Default: 0

Settings 0: No Function
0–65535 (when Pr.00-25 is set to no decimal place)
0.0–6553.5 (when Pr.00-25 is set to one decimal place)
0.00–655.35 (when Pr.00-25 is set to two decimal places)
0.000–65.535 (when Pr.00-25 is set to three decimal places)

- When Pr.00-26 is NOT 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).
  Example: When the frequency set in Pr.01-00 = 150.00 Hz, the maximum user-defined value for Pr.00-26 is 100.0. This also means that Pr.00-25 is set at 33 (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 display(F) on the keypad shows correctly according to Pr.00-25 settings.

00-38 User-Defined Characteristics 2

Default: 353

Settings bit 0–3: user-defined decimal places
0000h-0000b: no decimal place
0001h-0001b: one decimal place
0002h-0010b: two decimal places
0003h-0011b: three decimal places
bit 4–15: user-defined unit
003xh: kg/cm^2
015xh: mbar
016xh: bar
017xh: Pa
018xh: kPa
019xh: mWG
01Axh: inWG
01Bxh: ftWG
01Cxh: psi
01Dxh: atm

- User-defined characteristic 1 is applicable to the setting of AI1 and the system; user-defined characteristic 2 is applicable to be inlet pressure only when Pr.03-01=22.
- When Pr.03-01=22 (the inlet pressure), the unit of Pr.00-38 should be the pressure unit, otherwise the function cannot work correctly.
- The default is in one decimal place (xxx1h), and the unit is bar (016xh). 0161h in hexadecimal

system equals 353 in decimal system, so set Pr.00-38 to 353 via the keypad will be succeed.

- You must convert the setting value to decimal system when using the keypad to set parameters.
- The unit conversion table of pressure
  Refer to the table below to set the corresponding decimal value according to the unit and the decimal point.
  For example, if it's two decimal points and the unit is bar, then set Pr.00-25 = 354.

	003xh: kg/cm^2	015xh: mbar	016xh: bar
0xx0h no decimal place	Hex: 0030h Decimal: 48	Hex: 0150h Decimal: 336	Hex: 0160h Decimal: 352
0xx1h one decimal place	Hex: 0031h Decimal: 49	Hex: 0151h Decimal: 337	Hex: 0161h Decimal: 353
0xx2h two decimal places	Hex: 0032h Decimal: 50	Hex: 0152h Decimal: 338	Hex: 0162h Decimal: 354
0xx3h three decimal places	Hex: 0033h Decimal: 51	Hex: 0153h Decimal: 339	Hex: 0163h Decimal: 355

00-39 Maximum User-Defined Value 2

Default: 0

Settings 0: No Function
0–65535 (when Pr.00-25 is set to no decimal place)
0.0–6553.5 (when Pr.00-25 is set to one decimal place)
0.00–655.35 (when Pr.00-25 is set to two decimal places)
0.000–65.535 (when Pr.00-25 is set to three decimal places)

- Pr.00-39 displays the user-defined value when Pr.00-38 is not 0.
- Note: Set Pr.00-38 before using Pr.00-39. After you finish setting, when Pr.00-38 is not 0, the displayed unit on the keypad shows correctly according to Pr.00-38 settings [Pr.00-04=113, display the inlet pressure (I)].

00-27 User-Defined Value 1

Default: Read only

Settings Read only

- Pr.00-27 displays the user-defined value when Pr.00-26 is not 0.

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 operating status.
3: When switching between local and remote, the drive runs with local settings for frequency and operating 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 operating status.

- The default for Pr.00-29 is 0, that is, the standard HOA (Hand-Off-Auto) function. Set the AUTO and HAND frequency and operation source with Pr.00-20, 00-21 and Pr.00-30, 00-31. The external terminal function (MI) = 56 for LOC / REM mode selection is disabled when Pr.00-29=0.
- If Pr.00-29 is not set to 0, set the REMOTE and LOCAL frequency and operation source with Pr.00-20, 00-21 and Pr.00-30, 00-31.
  Set the multi-function input terminal (MI) = 56 to set the LOC / REM selection.
- If Pr.00-29 is not set to 0, the AUTO / HAND keys are disabled. In this case, the external terminal (MI) setting = 56 (local / remote selection) has the highest command priority.

00-30 Master frequency command source (HAND, LOCAL)

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 (multi-function input terminals)
8: Communication card (does not include CANopen card)

Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56.

- Determines the master frequency source in the "HAND, LOCAL" mode.
- You can switch the HAND, LOCAL mode with the multi-function input terminal (MI) to set the master frequency source.
- It returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.

00-31 Operation command source (HAND, LOCAL)

Default: 0

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

Note: HOA (Hand-Off-Auto) function is valid only when you use with MO function setting 41 and 56.

- Determines the operation frequency source in the "HAND, LOCAL" mode.
- In the HOA mode, if the multi-function input terminal (MI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid.

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 this parameter.

00-33 RPWM Mode Selection

Default: 0

Settings 0: Disable
1: RPWM mode 1
2: RPWM mode 2
3: RPWM mode 3

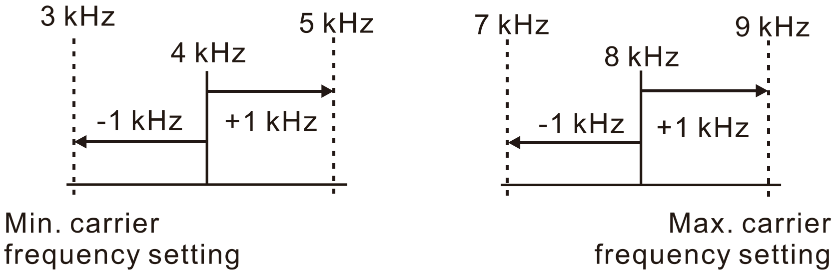
- When activate RPWM function, the carrier wave of the drive is randomly distributed according to the carrier frequency (Pr.00-17) which is at the center
- The RPWM function is applicable to all control modes.
- After activating RPWM function, decrease the shrill noise which focuses on a specific high frequency, and change the sound frequency of the motor (usually change the sound from shill to a little deep and low).
- The AC motor drive supports three kinds of RPWM modes for different applications. Each mode has its own frequency distribution, the corresponding electromagnetic noise distribution and the pitch are also different. Generally, the load bearing capacity: RPWM mode 2 > RPWM mode 1 > RPWM mode 3; the capacity of decreasing the high frequency sound: RPWM mode 3 > RPWM mode 1 > RPWM mode 2.

00-34 RPWM Range

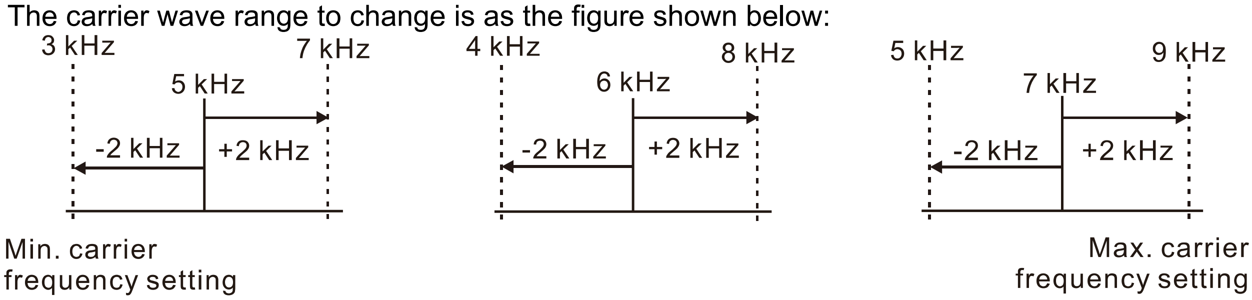
Default: 0.0 kHz

Settings 0.0–4.0 kHz

- When activate RPWM function, the lowest carrier wave can be set in Pr.00-17 is 4 kHz, and the highest is 8 kHz.
- Pr.00-34 is valid only when RPWM function is activating (Pr.00-33 ≠ 0).
  Example: When the carrier wave (Pr.00-17) is 4 kHz, activate RPWM function (Pr.00-33 = 1, 2, or 3), and the RPWM range (Pr.00-34) is 2.0 kHz, the output carrier wave is based on 4 kHz, the random frequency range is +/-1 kHz, thus the carrier wave changes randomly within 3 kHz to 5 kHz.
- When Pr.00-17 = 4 or 8 kHz, the maximum setting value of Pr.00-34 can be 2.0 kHz (+/-1 kHz). The carrier wave range to change is as the figure shown below:



- When Pr.00-17 = 5, 6, or 7 kHz, the maximum setting value of Pr.00-34 can be 4.0 kHz (+/-2 kHz). The carrier wave range to change is as the figure shown below:



00-47 Motor Running Direction Setting

Default: 0

Settings 0: Motor does not change running direction
1: Motor changes running direction

- This parameter can be used to change the running direction from forward to reverse or from reverse to forward, and the light don't change.
- This parameter influences the definition of running direction such as Pr.00-23, Pr.06-80, pay attention on this.
- Refer to Chapter 5 for schematic diagram of motor running direction.

00-48 Display Filter Time (Current)

Default: 0.100

Settings 0.001–65.535 sec.

- Minimizes the current fluctuation displayed by the digital keypad.

00-49 Display Filter Time (Keypad)

Default: 0.100

Settings 0.001–65.535 sec.

- Minimizes the value fluctuation displayed by the digital keypad.

00-50 Software Version (Date)

Default: Read only

Settings Read only

- Displays the current drive software version by date.

01 Basic Parameters

✓You can set this parameter during operation.

01-00 Motor 1 Maximum Operation Frequency

Default:150.00

Settings 0.00–180.00 Hz

- Determines the AC motor drive's maximum operation frequency. All the AC motor drive frequency command sources (analog inputs 0–10 V, 4–20 mA, 0–20 mA) are scaled to correspond to the output frequency range.

01-01 Motor 1 Rated / Base Frequency

Default:150.00

Settings 0.00–180.00 Hz

- Set this parameter according to the motor's rated frequency on the motor nameplate. The motor for MPD is 150.00 Hz.

01-02 Motor 1 Rated / Base Voltage

Default:380.0

Settings 0.0–510.0 V

- Set this parameter according to the rated voltage on the motor nameplate. The motor for MPD is 380.0 V
- 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.

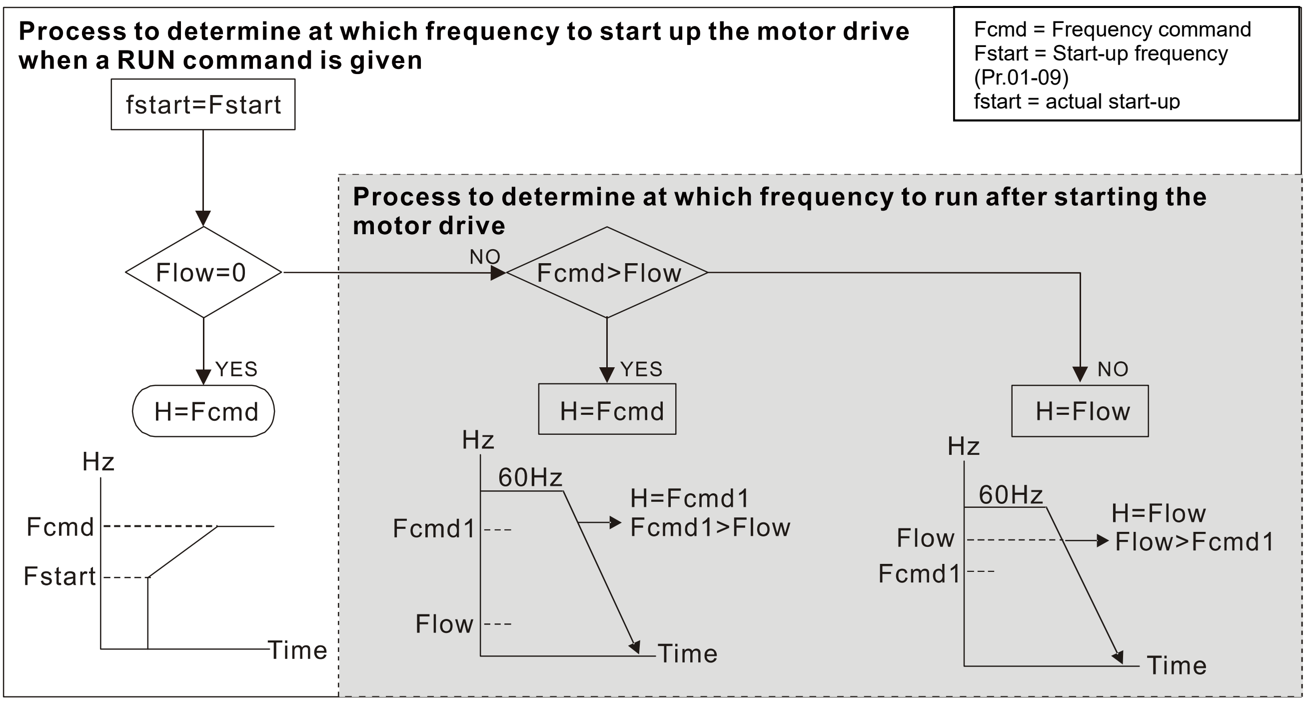
01-09 Start-up Frequency

Default:0.50

Settings 0.0–180.00 Hz

- At the moment of the startup, the drive's frequency output starts from the start-up frequency until reaching the F command.
- After starting up, if frequency command (Fcmd) > output frequency lower limit (Flow, Pr.01-11), the drive outputs according to the frequency command (Fcmd); if frequency command (Fcmd) < output frequency lower limit (Flow, Pr.01-11), the drive outputs according to the output frequency lower limit (Flow, Pr.01-11).

  Refer to the figure shown below:



✓ 01-10 Output Frequency Upper Limit

Default:180.00

Settings Pr.01-11~180.00 Hz

✓ 01-11 Output Frequency Lower Limit

Default:0.00

Settings 0.0~Pr.01-10 Hz

- Use the upper and lower limit output frequency settings to limit the actual output frequency. 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. Set the upper limit frequency > the lower limit frequency (Pr.01-10 setting value must be > Pr.01-11 setting value).
- The upper output frequency limits the drive's maximum output frequency. If the frequency setting for the frequency command is higher than Pr.01-10, the drive runs with the Pr.01-10 setting.
- If the PID feedback control is enabled for the drive, the drive's output frequency may exceed the frequency command but is still limited by this setting.
- Related parameters: Pr.01-00 Maximum Operation Frequency, Pr.01-11 Output Frequency Lower Limit.
- The lower output frequency limits the drive's minimum output frequency. If the frequency setting for the frequency command is lower than Pr.01-11, the drive runs with the Pr.01-11 setting.
- Use the output 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 speed.
- If the output frequency upper limit setting is 50 Hz and the frequency setting is 150 Hz, the maximum output frequency is 50 Hz.
- If the frequency output upper limit is 150 Hz and the frequency setting is also 150 Hz, only the Frequency command is limited at 150 Hz. The actual output frequency may be higher than 150 Hz if used for slip compensation.

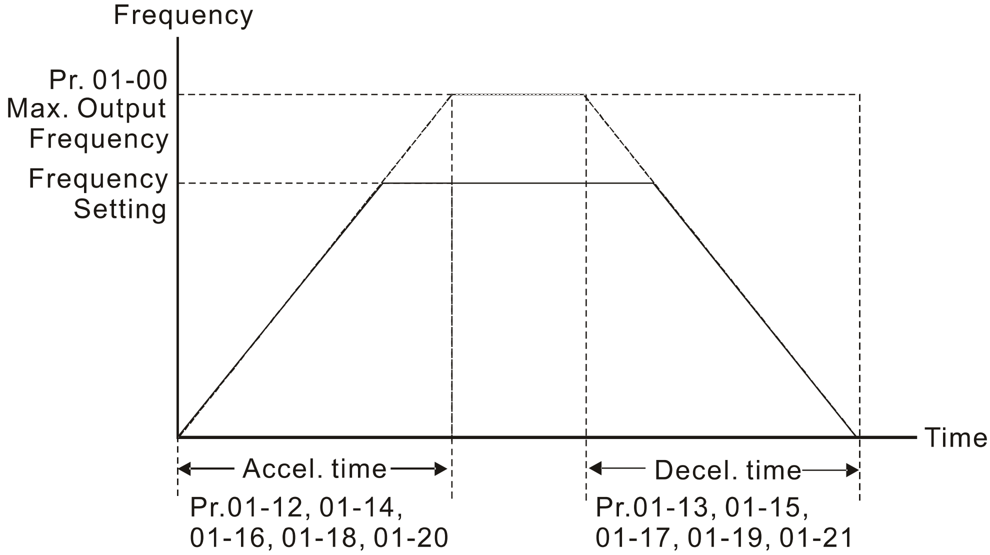
✓ 01-12 Acceleration Time 1
✓ 01-13 Deceleration Time 1
✓ 01-14 Acceleration Time 2
✓ 01-15 Deceleration Time 2
✓ 01-16 Acceleration Time 3
✓ 01-17 Deceleration Time 3
✓ 01-18 Acceleration Time 4
✓ 01-19 Deceleration Time 4
✓ 01-20 JOG Acceleration Time
✓ 01-21 JOG Deceleration Time

Default: 10.00 /10.0

Settings Pr.01-45 = 0: 0.00–6000.0 sec.
Pr.01-45 = 1: 0.0–6000.0 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 terminal 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 set 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 set the acceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's acceleration.

- Note that set 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.
- 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 0.00–180.00 Hz

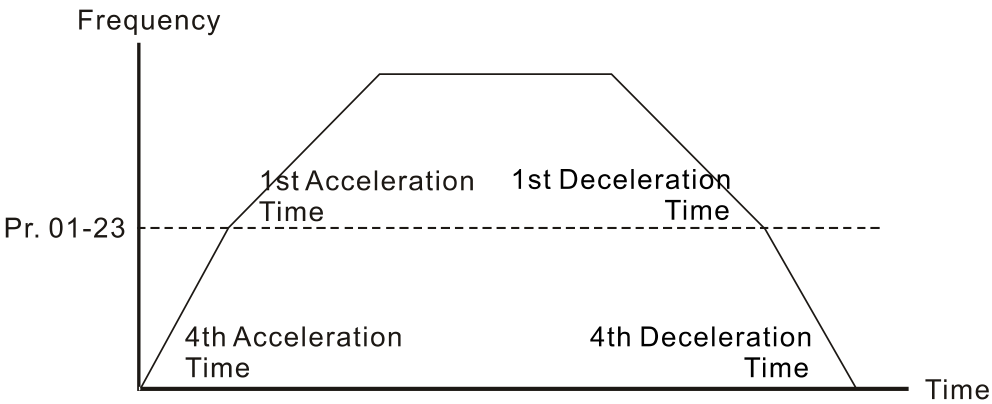
- You can use the external terminal JOG to set the JOG function. When the JOG command is ON, the AC motor drive accelerates from 0 Hz to the JOG frequency (Pr.01-22). When the JOG command is OFF, the AC motor drive decelerates from the JOG frequency to stop. The JOG acceleration and deceleration time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

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

Default:0.00

Settings 0.00–180.00 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.
- When using this function, set the S-curve acceleration time to 0 if the fourth acceleration time is short.



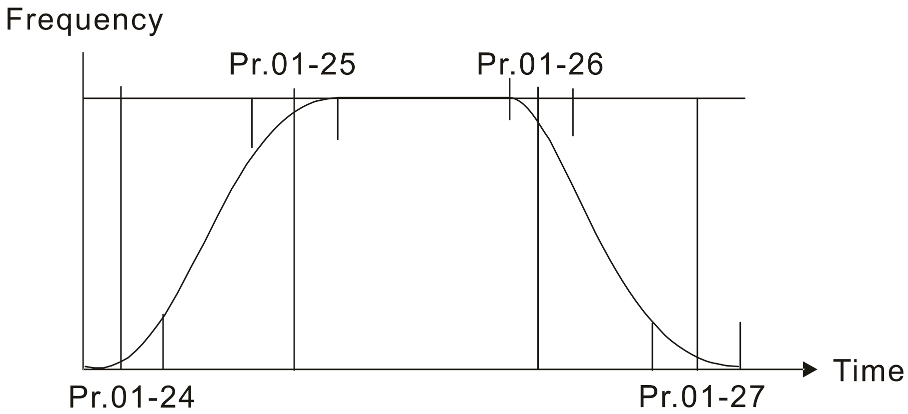
1st/4th Acceleration/Deceleration Frequency Switching

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, 01-14, 01-16, 01-18 ≥ Pr.01-24 and Pr.01-25, the actual acceleration time = Pr.01-12, 01-14, 01-16, 01-18 + (Pr.01-24 + Pr.01-25) / 2.
- When Pr.01-13, 01-15, 01-17, 01-19 ≥ Pr.01-26 and Pr.01-27, the actual deceleration time = Pr.01-13, 01-15, 01-17, 01-19 + (Pr.01-26 + Pr.01-27) / 2.

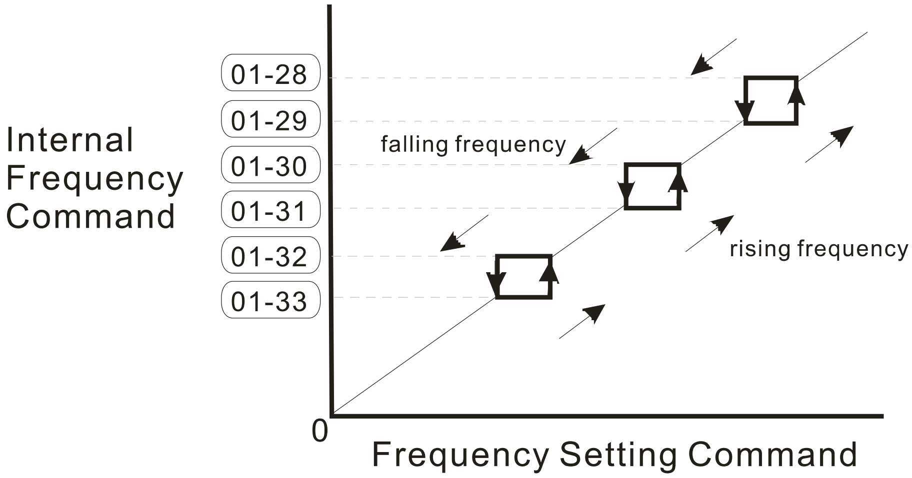


01-28	Skip Frequency 1 (Upper Limit)
01-29	Skip Frequency 1 (Lower Limit)
01-30	Skip Frequency 2 (Upper Limit)
01-31	Skip Frequency 2 (Lower Limit)
01-32	Skip Frequency 3 (Upper Limit)
01-33	Skip Frequency 3 (Lower Limit)

Default:0.00

Settings 0.00–180.00 Hz

- Sets 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.

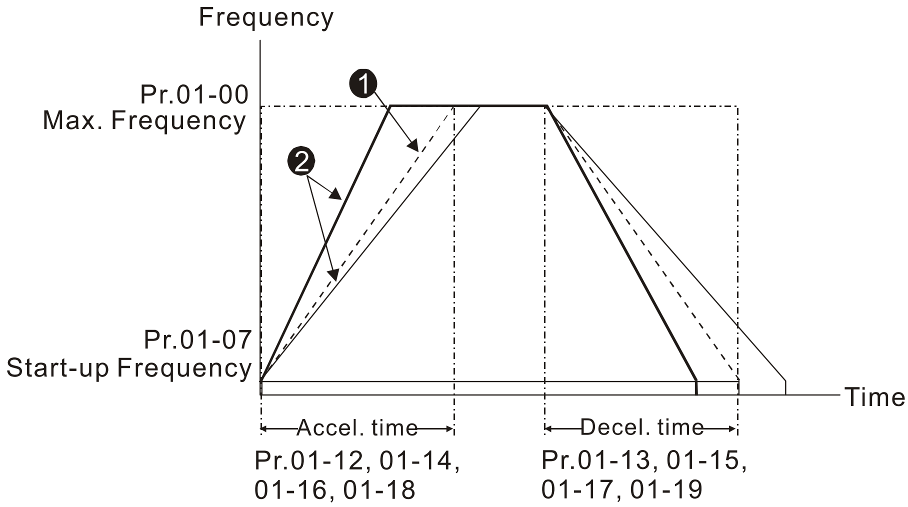


01-44 Auto-acceleration and Auto-deceleration Setting

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.01-12–01-21)

- 0 (linear acceleration and 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 the 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 and Deceleration and S-Curve

Default:0

Settings	0: Unit 0.01 sec.
	1: Unit 0.1 sec.

02 Digital Input / Output Parameters

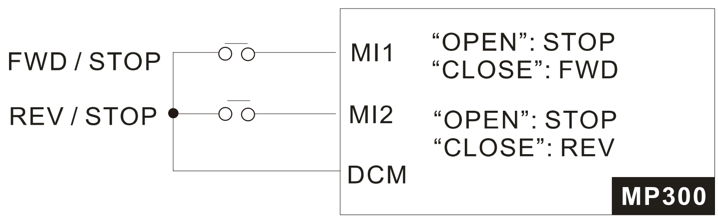
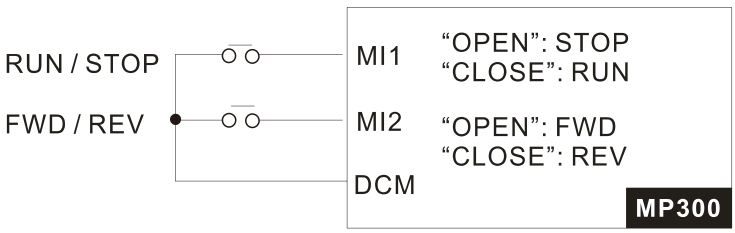
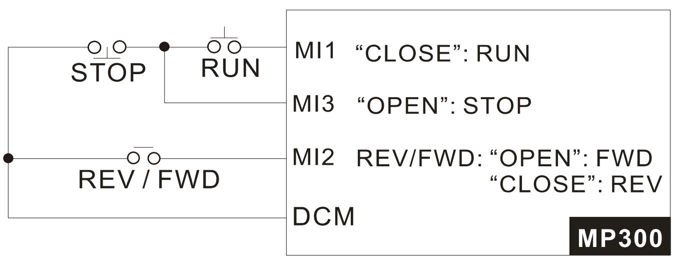
✓You can set this parameter during operation.

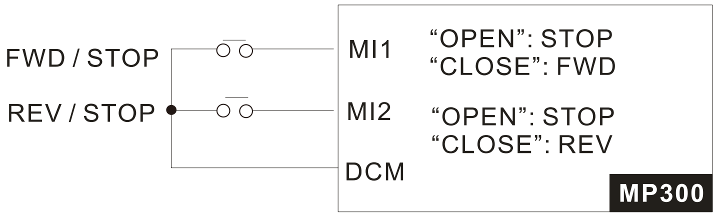
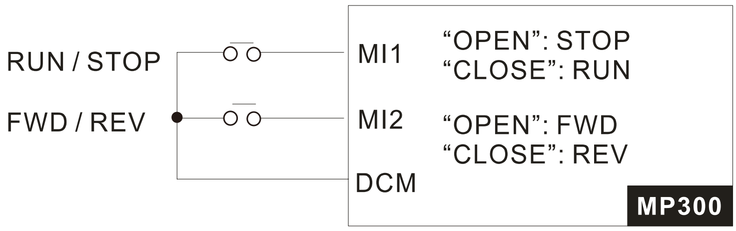
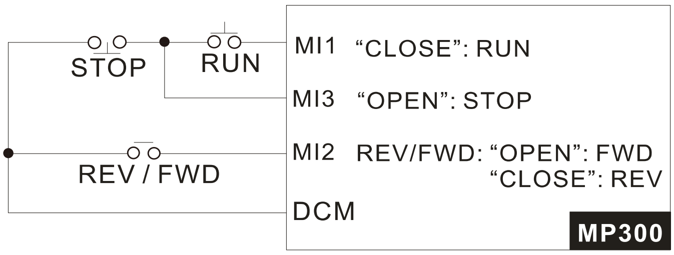
02-00 Two-wire / Three-wire Operation Control

Default:1

Settings
0: No function
1: Two-wire mode 1, power ON for operation control
(M1: FWD / STOP, M2: REV / STOP)
2: Two-wire mode 2, power ON for operation control
(M1: RUN / STOP, M2: REV / FWD)
3: Three-wire, power ON for operation control
(M1: RUN, M2: REV / FWD, M3: STOP)
4: Two-wire mode 1, Quick Start
(M1: FWD / STOP, M2: REV / STOP)
5: Two-wire mode 2, Quick Start
(M1: RUN / STOP, M2: REV / FWD)
6: Three-wire, Quick Start
(M1: RUN, M2: REV / FWD, M3: STOP)

- After enabling built-in PLC function, Pr.02-00 has no function. MI1 has no function when Pr.04-57 is not 002xh; MI1 is fixed to the mode that open is stop and close is run when Pr.04-57 is 002xh. Users can set MI2, MI3 according to Pr.02-02 and Pr.02-03.
- In the Quick Start function, the output remains ready for operation. The drive responds to the Start command immediately.
- When using Quick Start function, the output terminals UVW are with driving voltages in order to output and respond immediately if a Start command is given. Do NOT touch the terminals or modify the motor wiring to prevent electric shocks.
- This parameter sets the configuration of the external drive operation control and the Quick Start function. There are six different control modes listed in the following table.

<table>
<tr><th>Pr.02-00</th><th>External Terminal Control Circuits</th></tr>
<tr><td>Setting value: 1
Two-wire operation control
FWD / STOP
REV / STOP</td><td>
</td></tr>
<tr><td>Setting value: 2
Two-wire operation control
RUN / STOP
REV / FWD</td><td>
</td></tr>
<tr><td>Setting value: 3
Three-wire operation control</td><td>
</td></tr>
</table>

Pr.02-00	External Terminal Control Circuits
Setting value: 4 Two-wire operation control Quick Start	
Setting value: 5 Two-wire operation control Quick Start	
Setting value: 6 Three-wire operation control Quick Start	

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

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

Default:0

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

Default:1

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

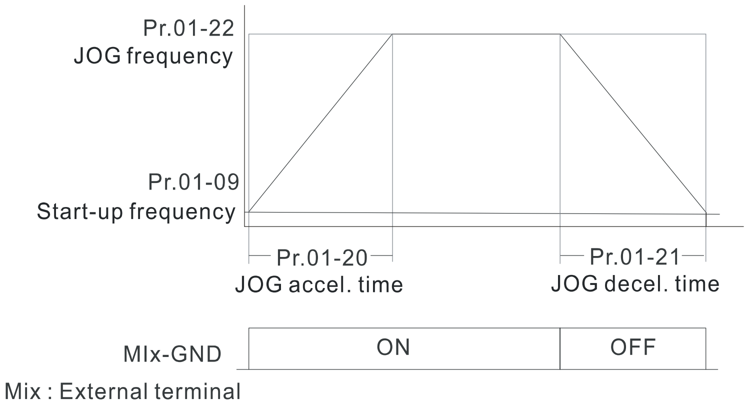
Default:2

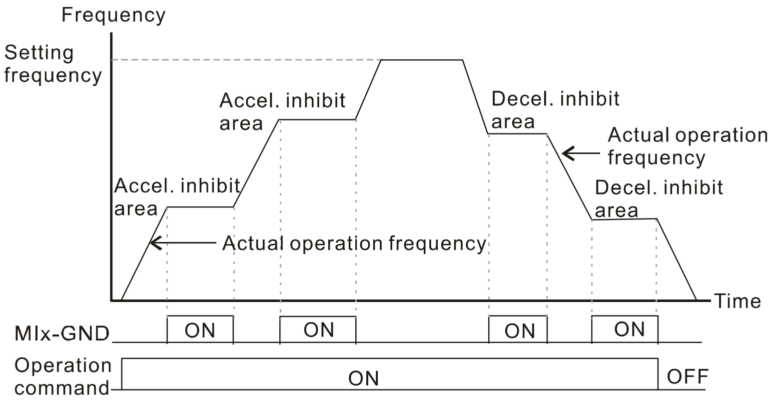
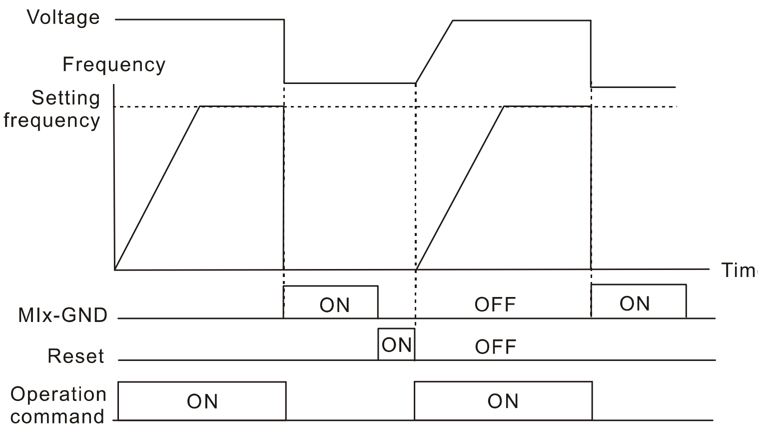
Settings
0: No function
1: Multi-step speed command 1 / multi-step position command 1
2: Multi-step speed command 2 / multi-step position command 2
3: Multi-step speed command 3 / multi-step position command 3
4: Multi-step speed command 4 / multi-step position command 4
5: Reset
6: JOG command
7: Acceleration / 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
13: Cancel the setting of auto-acceleration / auto-deceleration time
15: Rotating speed command from AI1
16: Rotating speed command from AI2
18: Force to stop (Pr.07-20)
19: Digital up command
20: Digital down command
21: PID function disabled
22: Clear the counter
23: Input the counter value (MI4)
24: FWD JOG command
25: REV JOG command
38: Disable writing EEPROM function

41: HAND switch
42: AUTO switch
51: Selection for PLC mode bit 0
52: Selection for PLC mode bit 1
56: Local / Remote selection
58: Enable fire mode (with RUN command)
59: Enable fire mode (without RUN command)
69: Enable preheating function
97: Multi-pump manual / auto switch
100: Enable clean function

- Use this parameter to set the function of multi-function terminals.
- When Pr.02-00 = 0, you can set multi-function options with multi-function input terminals MI1, MI2.
- When Pr.02-00 ≠ 0, the multi-function input terminals MI1, MI2 work in accordance with the setting values for Pr.02-00.
  Example: If Pr.02-00 = 1: multi-function input terminal MI1 = FWD / STOP, MI2 = REV / STOP.
  If Pr.02-00 = 2: multi-function input terminal MI1 = RUN / STOP, MI2 = FWD / REV.
- If Pr.02-00 is set to three-wire operation control, terminal MI3 is for the STOP contact. The function set previously for this terminal is automatically invalid.
- When the built-in PLC function is enabled, MI is not regulated by Pr.02-00, and users can set MI2, MI3 according to Pr.02-02 and Pr.02-03. And when Pr.04-67 bit0 = 1, MI1 is fixed in the mode that open is stop and close is run.

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

ID*	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	
3	Multi-step speed command 3 / multi-step position command 3	
4	Multi-step speed command 4 / multi-step position command 4	
5	Reset	Use this terminal to reset the drive after clearing a drive fault.
6	JOG command	This function is valid when the source of the operation command is the external terminal. 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. Note *: This function is valid when Pr.00-32 is set to 1. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to Pr.01-20–01-22 for details. 

<table>
<tr><th>ID*</th><th>Functions</th><th>Descriptions</th></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>
<tr><td>8</td><td>1st and 2nd acceleration / deceleration time selection</td><td rowspan="2">You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selections.
<table><tr><th></th><th>MIx = 8</th><th>MIx = 9</th></tr><tr><td>1st acceleration / deceleration time</td><td>0</td><td>0</td></tr><tr><td>2nd acceleration / deceleration time</td><td>1</td><td>0</td></tr><tr><td>3rd acceleration / deceleration time</td><td>0</td><td>1</td></tr><tr><td>4th acceleration / deceleration time</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>9</td><td>3rd and 4th acceleration / deceleration time selection</td></tr>
<tr><td>10</td><td>EF inputs
(EF: External Fault)</td><td>For external fault input. The drive decelerates according to the Pr.07-20 setting, and the keypad shows "EF" (it shows the fault record when an external fault occurs). The drive keeps running until the fault is cleared (terminal status restored) after RESET.

</td></tr>
<tr><td>11</td><td>B.B. inputs from external
(B.B.: Base Block)</td><td>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.</td></tr>
<tr><td>13</td><td>Cancel the setting of auto-acceleration / auto-deceleration time</td><td>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.</td></tr>
<tr><td>15</td><td>Rotating speed command from AI1</td><td>ON: force the source of the drive's frequency to be AI1.
(If the rotating speed commands are set to AI1 and AI2 at the same time, the priority is AI1 > AI2.)</td></tr>
</table>

<table>
<tr><th>ID*</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>16</td><td>Rotating speed command from AI2</td><td>ON: force the source of the drive's frequency to be AI2.
(If the rotating speed commands are set to AI1 and AI2 at the same time, the priority is AI1 > AI2.)</td></tr>
<tr><td>18</td><td>Force to stop</td><td>ON: the drive ramps to a stop according to the Pr.07-20 setting.</td></tr>
<tr><td>19</td><td>Digital 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.
The Frequency command returns to zero when the drive stops and the displayed frequency is 0.00 Hz. If you select Pr.11-00, bit 7 = 1, the frequency is not saved.</td></tr>
<tr><td>20</td><td>Digital 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 (MI4)</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 the 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 the 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>38</td><td>Disable writing EEPROM function (parameter memory is disabled)</td><td>ON: writing to EEPROM is disabled. (Changed parameters are not saved after powering off.)</td></tr>
<tr><td>41</td><td>HAND switch</td><td rowspan="2">☑ 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.
☑ Use the optional keypad KPC-CC01 to switch between HAND and AUTO. The drive stops first, and then switches to HAND or AUTO status.
☑ The optional digital keypad KPC-CC01 displays the current status of the drive (HAND / OFF / AUTO).
<table>
<tr><th></th><th>bit 1</th><th>bit 0</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>51</td><td>Selection for PLC mode (bit 0)</td><td rowspan="2"><table>
<tr><th>PLC status</th><th>bit 1</th><th>bit 0</th></tr>
<tr><td>Disable PLC function (PLC 0)</td><td>0</td><td>0</td></tr>
<tr><td>Trigger PLC to operate (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>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.
<table>
<tr><th></th><th>bit 0</th></tr>
<tr><td>REM</td><td>0</td></tr>
<tr><td>LOC</td><td>1</td></tr>
</table></td></tr>
</table>

ID*	Functions	Descriptions
58	Enable fire mode (with RUN command)	When fire occurs, enable this terminal to make the drive enter the fire mode to force the drive to run. If the drive is in stop status, enable this terminal to make the drive enter the fire mode to force the drive to run according to Pr.06-80 settings. (Refer to Pr.06-80, 06-81, 06-88 for details)
59	Enable fire mode (without RUN command)	When fire occurs, enable this terminal to make the drive enter the fire mode. If the drive is in stop status, enable this terminal to make the drive enter the fire mode, but the drive does not run. If the drive is in running status, enable this terminal to run the drive according to Pr.06-80 settings. (Refer to Pr.06-80, 06-81, 06-88 for details)
69	Enable preheating function	When you set MI = 69, MI determines the preheating function whether is enabled or disabled.
97	Multi-pump manual / auto switch	When you set MI = 97, you can use manual mode to select whether it's controlled by multi-pump system.
100	Enable clean function	When you set MI = 100, you can enable clean function. Refer to Pr.12-53–12-64 for the clean function setting.

02-09 UP / DOWN key mode

Default:0

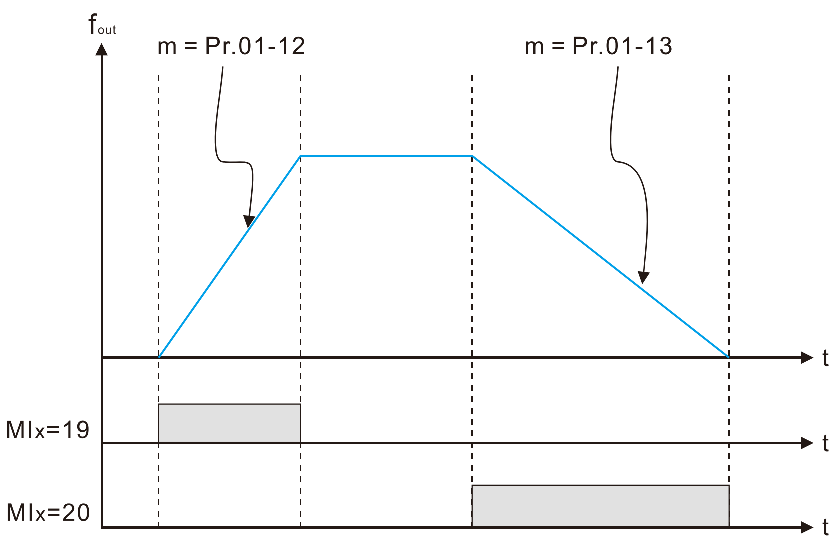
Settings 0: UP / DOWN by the acceleration / deceleration time
1: UP / DOWN constant speed (Pr.02-10)
2: Pulse signal (Pr.02-10)
3: External terminals UP / DOWN key mode

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

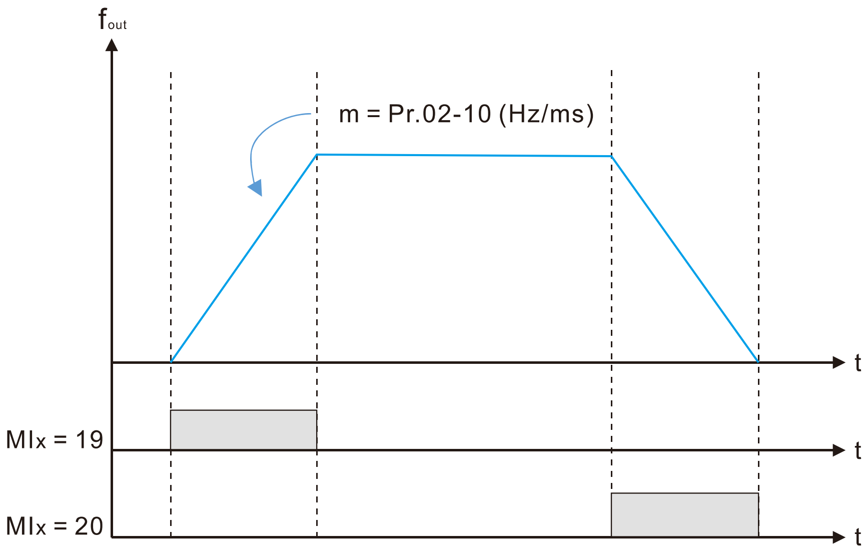
Default:0.001

Settings 0.001–1.000 Hz / ms

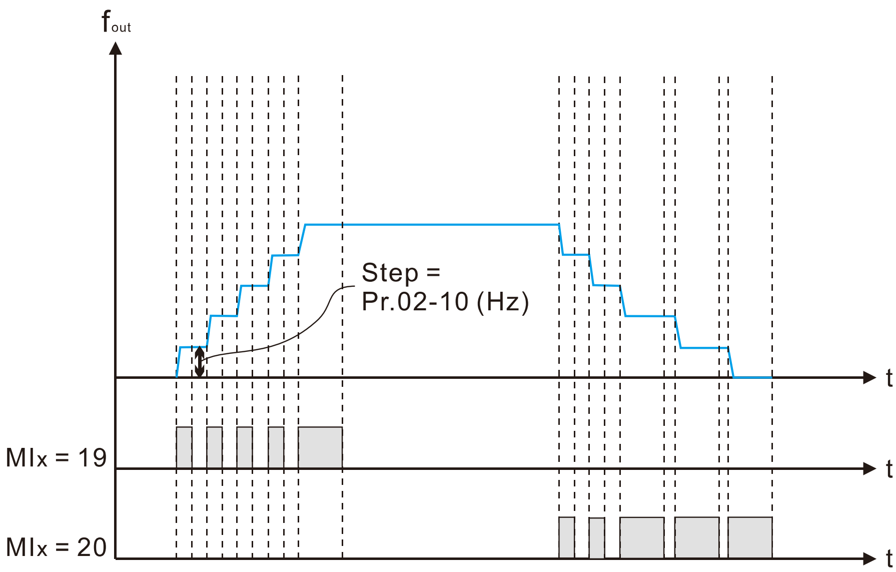
- Use when the multi-function input terminals are set to 19, 20 (Digital UP / DOWN command). The frequency increases or decreases according to Pr.02-09 and Pr.02-10.
- When Pr.11-00 bit 7 = 1, the frequency is not saved. The Frequency command returns to zero when the drive stops, and the displayed frequency 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).



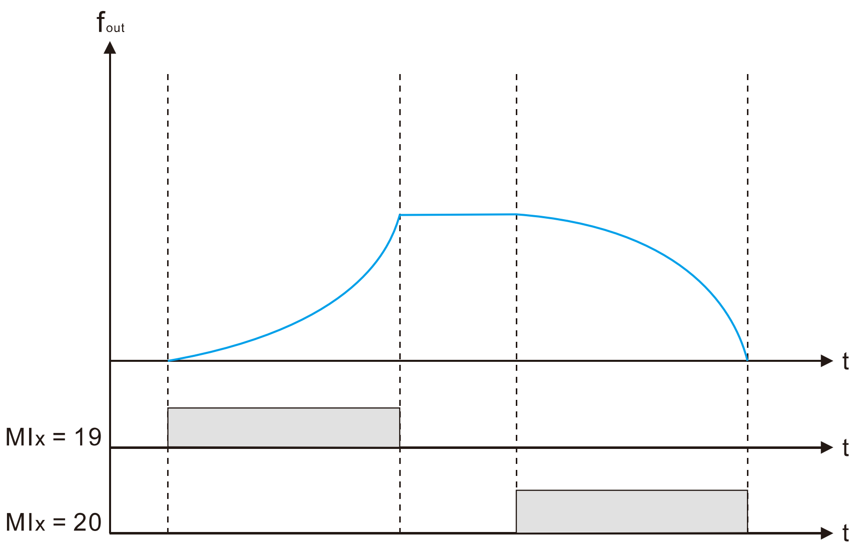
📖 When Pr.02-09 is set to 1: The increasing or decreasing Frequency command (F) operates according to the setting of Pr.02-10 (0.01–1.000 Hz/ms).



📖 When Pr.02-09 is set to 2: The increasing or decreasing Frequency command (F) operates according to the setting of Pr.02-10.



📖 When Pr.02-09 is set to 3: The increasing or decreasing Frequency command (F) operates according to the exponential curve .



02-11 Multi-function Input Response Time

Default: 0.005

Settings 0.000–30.000 sec.

- Use this parameter to set the response time of the digital input terminals MI1–MI7.
- To prevent interference from causing malfunction in the input of the digital terminals, executes operation after delaying the time set in this parameter when the terminal is triggered.

02-12 Multi-function Input Mode Selection

Default:0000

Settings 0000h–FFFFh

- The parameter setting is in hexadecimal.
- (0: N.O.; 1: N.C.)
- This parameter sets the status of the multi-function input signal (0: normally open ; 1: normally closed) and it is not affected by the status of SINK / SOURCE.
- bit 0–bit 3 correspond to MI1–MI4.
- The default for bit 0 (MI1) is FWD terminal, and the default for bit 1 (MI2) is REV terminal. You cannot use this parameter to change the input mode when Pr.02-00 ≠ 0.
- You can change the terminal ON / OFF status through communications.
  For example: MI3 is set to 1 (multi-step speed command 1) and MI4 is set to 2 (multi-step speed command 2).
  Then the forward + second step speed command = $1001_2 = 9_{10}$.
  As long as Pr.02-12 = 9 is set through communications, there is no need to wire any multi- function terminal to run forward with the second step speed.

bit 3	bit 2	bit 1	bit 0
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 (RY1)

Default:11

02-14 Multi-function Output 2 (RY2)

Default:0

02-16 Multi-function Output 3 (MO)

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)
7: Over-torque 1 (Pr.06-06–06-08)
9: Drive is ready
10: Low voltage warning (Lv) (Pr.06-00)
11: Malfunction indication
13: Overheat warning (Pr.06-15)
15: Abnormal PID feedback
17: Count value reached, does not return to 0 (Pr.02-20)
18: Count value reached, return 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 source
25: Forward command
26: Reverse command
29: Output when frequency ≥ Pr.02-34
30: Output when frequency < Pr.02-34

35: Error output selection 1 (Pr.06-23)
36: Error output selection 2 (Pr.06-24)
37: Error output selection 3 (Pr.06-25)
38: Error output selection 4 (Pr.06-26)
40: Speed reached (including STOP)
44: Low current output (use with Pr.06-71–Pr.06-73)
51: Analog output control for RS-485 interface
52: Output control for communication cards
53: Fire mode indication
67: Analog input level reached
69: Indication of preheating operation
75: Forward RUN status
76: Reverse RUN status
81: Indication of multi-pump system error (only Master)

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

Summary of Function Settings (Take the normally open contact (N.O.) for example, closed: contacts are conducted)

ID*	Functions	Descriptions
0	No function	Output terminal with no function
1	Indication during RUN	Activates when the drive is not in STOP.
2	Operation speed reached	Activates when output frequency of drive reaches to the setting frequency.
3	Desired frequency reached 1 (Pr.02-22)	Activates when the desired frequency (Pr.02-22) is reached.
4	Desired frequency reached 2 (Pr.02-24)	Activates when the desired frequency (Pr.02-24) is reached.
7	Over torque 1	Activates when the drive detects over-torque. Pr.06-07 sets the over-torque detection level, and Pr.06-08 sets the over-torque detection time. (Refer to Pr.06-06–06-08)
9	Drive is ready	Activates when the drive is ON with no error detected.
10	Low voltage warning (Lv)	Activates when an extremely low voltage at DC side is detected. Activates when the DC bus voltage is too low. (refer to Pr.06-00 Low Voltage Level)
11	Malfunction indication	Activates when fault occurs (except Lv stop).
13	Overheat warning	Activates when IGBT or heat sink overheats to prevent the drive from shutting down due to overheating. (Refer to Pr.06-15)
15	Abnormal PID feedback	Activates when the PID feedback signal error is detected.
17	Count value reached (Pr.02-20)	When the drive executes external counter, this contact activates if the count value is equal to the setting value for Pr.02-20. This contact deactivates when the setting value of Pr.02-20 > the setting value of Pr.02-19.
18	Count value reached (Pr.02-19)	When the drive executes the external counter, this contact activates if the count value is equal to the setting value for Pr.02-19.
19	External interrupt B.B. Input (Base Block)	Activates when external interrupt (B.B.) occurs in the drive and stops outputting .
20	Warning output	Activates when a warning is detected.
21	Over-voltage	Activates when over-voltage is detected.
22	Over-current stall prevention	Activates when the over-current stall prevention is detected.
23	Over-voltage stall prevention	Activates when over-voltage stall prevention is detected.
24	Operation source	Activates when the source of operation command is not controlled by the digital keypad (Pr.00-21 ≠ 0).
25	Forward command	Activates when the operation direction is forward.
26	Reverse command	Activates when the operation direction is reverse.

<table>
<tr><th>ID*</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>29</td><td>Outputs when frequency ≥ Pr.02-34</td><td>Activates when frequency is ≥ Pr.02-34 (actual output H ≥ Pr.02-34).</td></tr>
<tr><td>30</td><td>Outputs when frequency < Pr.02-34</td><td>Activates when frequency is < Pr.02-34 (actual output H < Pr.02-34).</td></tr>
<tr><td>35</td><td>Error output selection 1 (Pr.06-23)</td><td>Activates when Pr.06-23 is ON.</td></tr>
<tr><td>36</td><td>Error output selection 2 (Pr.06-23)</td><td>Activates when Pr.06-24 is ON.</td></tr>
<tr><td>37</td><td>Error output selection 3 (Pr.06-23)</td><td>Activates when Pr.06-25 is ON.</td></tr>
<tr><td>38</td><td>Error output selection 4 (Pr.06-23)</td><td>Activates when Pr.06-26 is ON.</td></tr>
<tr><td>40</td><td>Speed reached (including Stop)</td><td>Activates when the drive's output frequency reaches the setting frequency or stopped.</td></tr>
<tr><td>44</td><td>Low current output</td><td>Use this function with Pr.06-71–Pr.06-73.</td></tr>
<tr><td>51</td><td>Analog output control for RS-485 interface</td><td>For RS-485 communication control output.</td></tr>
<tr><td>52</td><td>Output control for communication cards</td><td>Control the output through the communication cards (CMMP-BT01, CMM-PD02, CMM-DN02, CMM-EIP02)
<table>
<tr><th>Physical terminal</th><th>Related Parameters</th><th>Attribute</th><th>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>MO</td><td>Pr.02-16 = 52</td><td>RW</td><td>The bit3 of 2640H</td></tr>
</table></td></tr>
<tr><td>53</td><td>Fire mode indication</td><td>Activates when MI setting 58 or 59 is enabled.</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 (AI1, AI2) 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 outputting.</td></tr>
<tr><td>69</td><td>Indication of preheating operation</td><td>Activates when enabling the function.</td></tr>
<tr><td>75</td><td>Forward RUN status</td><td>When the drive runs FWD, the output terminal for forward running is closed; when the drive stops, the output terminal for forward running is open.</td></tr>
<tr><td>76</td><td>Reverse RUN status</td><td>When the drive runs REV, the output terminal for reverse running is closed; when the drive stops, the output terminal for reverse running is open.</td></tr>
<tr><td>81</td><td>Indication of multi-pump system error (only Master)</td><td>When all AC motor drives in multi-pump system are failed, the contact is closed.</td></tr>
</table>

02-18 Multi-function Output Direction

Default:0000

Settings 0000h–FFFFh

- The parameter setting is in hexadecimal.
- 0: N.O.; 1: N.C.

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

bit3	bit2	bit1	bit0
MO	Reserved	Reserved	RY

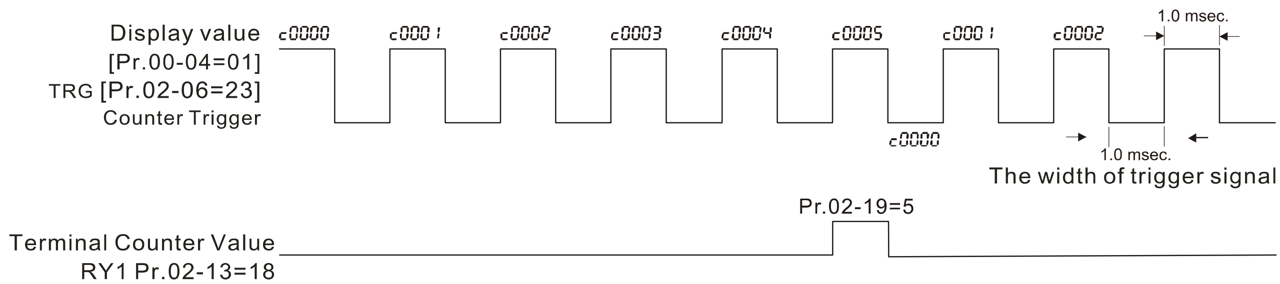
02-19 Terminal Counting Value Reached (returns to 0)

Default:0

Settings 0–65500

- The counting function is enabled when Pr.02-19≠0.
- You can set the input point for the counter using the multi-function terminal MI4 as a trigger terminal (set Pr.02-04 to 23). When counting is completed, the specified multi-function output terminal is activated (Pr.02-13 or Pr.02-16 is set to 18).

The timing diagram below shows that when counting to 5, RY1 activates and displays 0.



The timing diagram of
the external counting terminals and the counting value reached

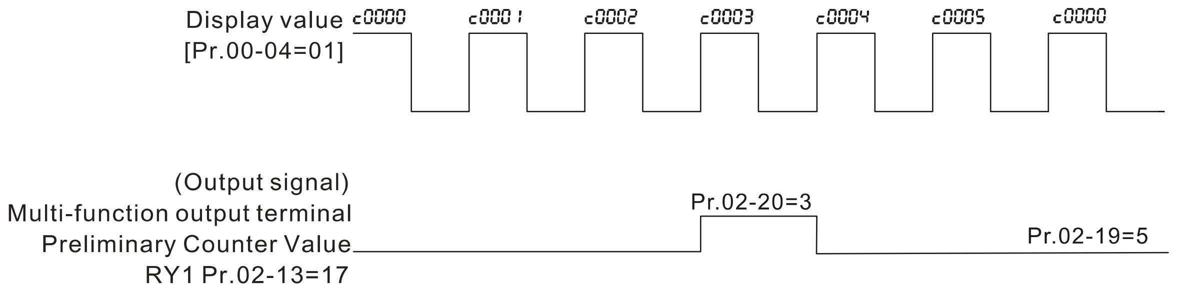
02-20 Preliminary Counting Value Reached (does not return to 0)

Default:0

Settings 0–65500

- Use this parameter with Pr.02-19.
- When the count value counts from 1 to reach this value, the corresponding multi-function output terminal is activated (Pr.02-13 and Pr.02-16 are set to 17) and keeps counting to the last count value.
- You can use this parameter as the end of counting to make the drive run from the low speed to stop.

The timing diagram is RY1 activates when the count value is three, and the display returns to zero when counts to five:



The timing diagram of
the external counting terminals and the counting value reached

02-22 Desired Frequency Reached 1

Default:150.00

Settings 0.00–180.00 Hz

02-24 Desired Frequency Reached 2

Default:150.00

Settings 0.00–180.00 Hz

02-23 The Width of the Desired Frequency Reached 1

Default:2.00

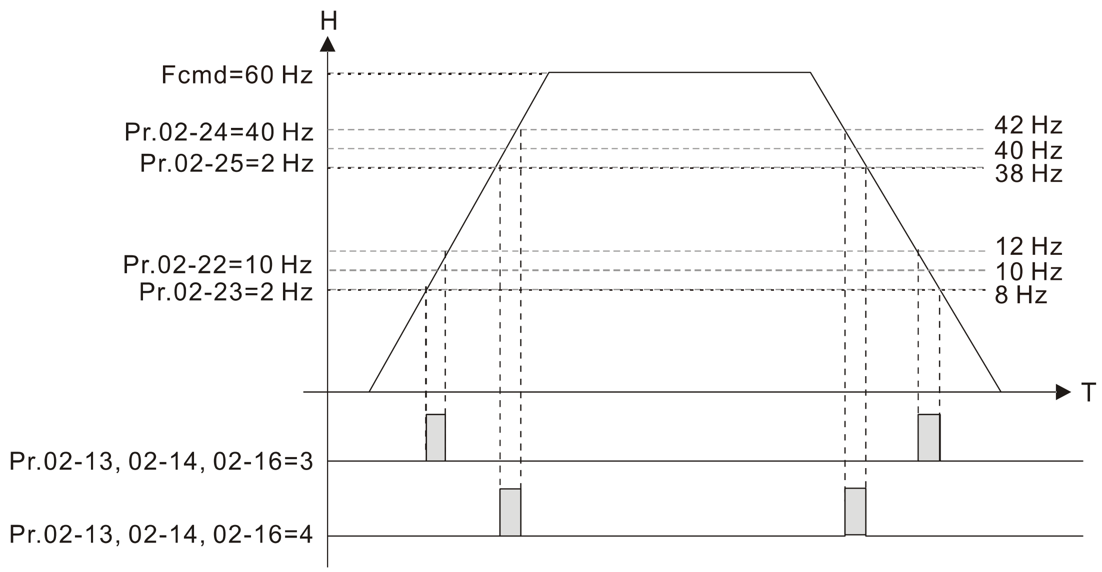
Settings 0.00–180.00 Hz

02-25 The Width of the Desired Frequency Reached 2

Default:2.00

Settings 0.00–180.00 Hz

- Once the output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3 or 4 (Pr.02-13, Pr.02-14, and Pr.02-16), this multi-function output terminal is “closed”.



02-34 Output Frequency Setting for Multi-function Output Terminal

Default:0.00

Settings 0.00–180.00Hz

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.

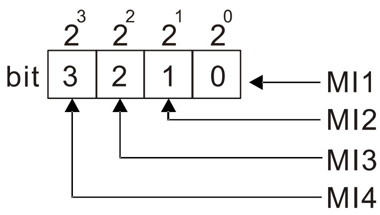
Setting value 1:

- Situation 1-1: After powering ON the drive, if the external terminal for RUN stays ON and Pr.00-21 = 1 which operation source is from external terminals, then the drive runs. This is the setting of the operation with power ON.
- Situation 1-2: As mentioned above, if the built-in PLC function is enabled, then you have to set Pr.04-57 bit0 = 1.
- Situation 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.

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

Default: Read only

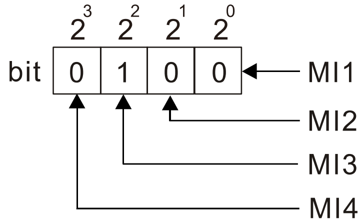
Settings Monitor the status of the Multi-function Input Terminal



0=OFF
1=ON

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

Example:
When Pr.02-50 is 0004h (hex), that is, the value is 4 (decimal), and displays 0100 (binary). It means that MI3 is ON.



0=OFF
1=ON

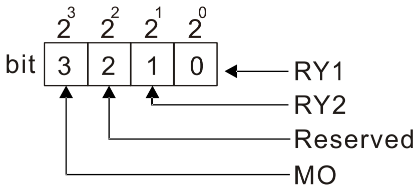
Setting
$= \text{bit3} \times 2^3 + \text{bit2} \times 2^2 + \text{bit1} \times 2^1 + \text{bit0} \times 2^0$
$= 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$
$= 0 + 4 + 0 + 0$
$= 4$

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

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

Default: Read only

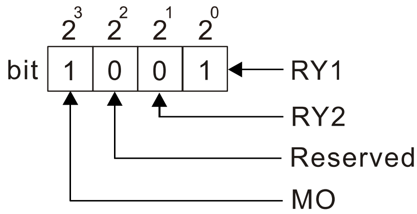
Settings Monitor the status of the Multi-function Output Terminal



0=OFF
1=ON

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

Example:
When Pr.02-51 is 0009h (hex), that is, the value is 9 (decimal), and displays 1001 (binary). It means that RY1 and MO are ON.



0=OFF
1=ON

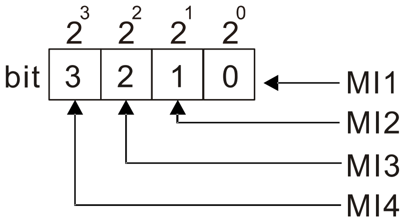
Setting
$= \text{bit } 3 \times 2^3 + \text{bit } 0 \times 2^0$
$= 1 \times 2^3 + 1 \times 2^0$
$= 8 + 1$
$= 9$

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

02-52 Display the External Multi-function Input Terminals Used by PLC

Default: 0

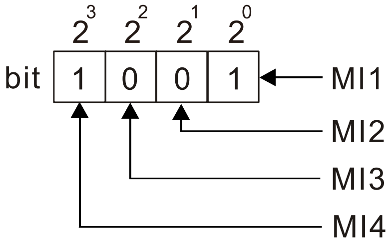
Settings 0–65535



0=OFF
1=ON

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

📖 Example:
When Pr.02-52 Is 0009h (hex), that is, the value is 9 (decimal), and displays 1001 (binary). It means that MI1 and MI4 are used by PLC.



0=OFF
1=ON

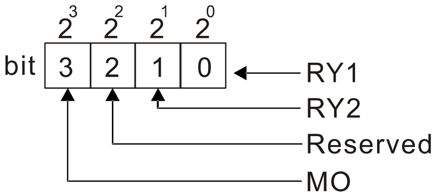
Setting
$= bit3 \times 2^3 + bit0 \times 2^0$
$= 1 \times 2^3 + 1 \times 2^0$
$= 8 + 1$
$= 9$

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

02-53 Display the External Multi-function Output Terminals Used by PLC

Default: 0

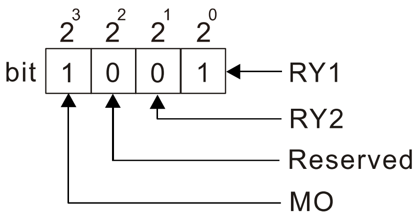
Settings 0–65535



0=OFF
1=ON

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

📖 Example:
When Pr.02-53 is 0009h (hex), that is, the value is 9 (decimal), and displays 1001 (binary). It means that RY1 and MO are used by PLC.



0=OFF
1=ON

Setting
$= bit\ 3 \times 2^3 + bit\ 0 \times 2^0$
$= 1 \times 2^3 + 1 \times 2^0$
$= 8 + 1$
$= 9$

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

02-54 Display the Frequency Command Executed by External Terminal

Default: Read only

Settings 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.

⌁ 02-72 Preheating DC current level

Default:0

Settings 0–100%

📖 This parameter controls the level of the preheating DC current input to the motor. The percentage of the preheating DC current equals to the percentage of motor rated current (Pr.00-01). Therefore, when you set this parameter, increase the level slowly to reach the desired preheating temperature.

📖 Pr.02-72 is defined as direct current, so the actual output current is Pr.02-72 x $\sqrt{2}$.

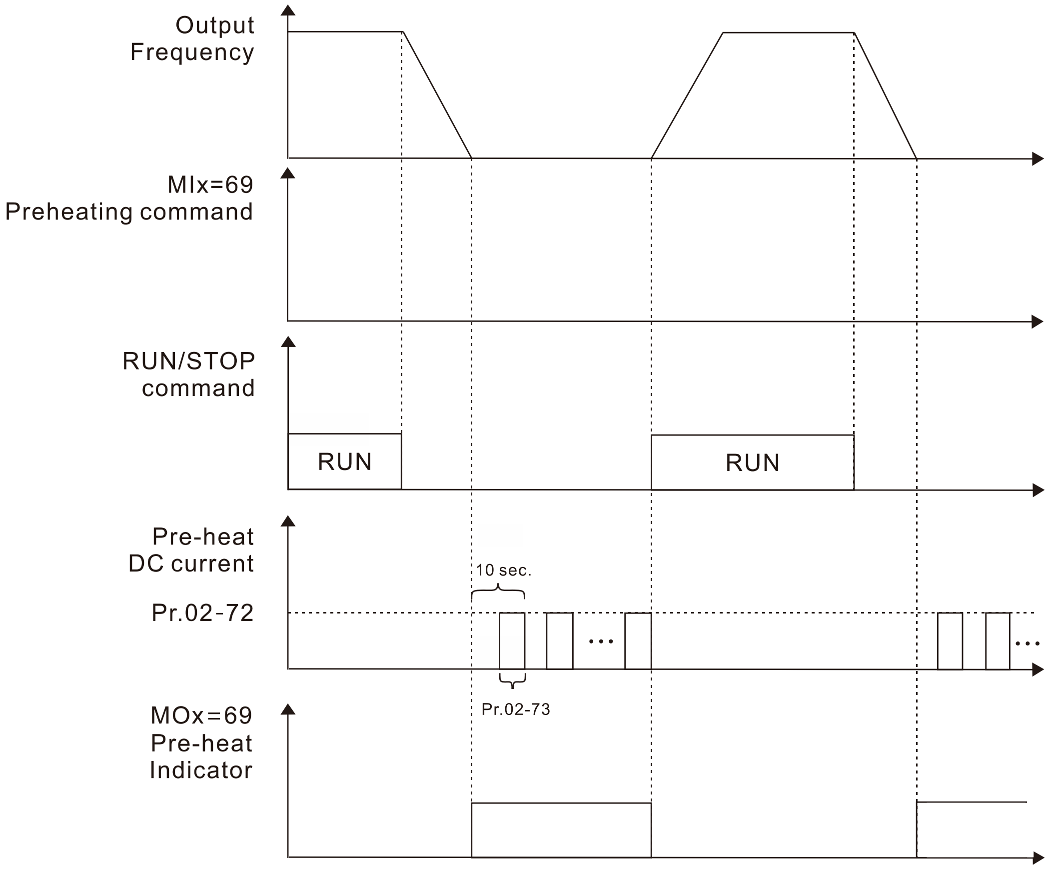
📖 Related parameters: Pr.02-73 Preheating DC Current Duty Cycle, Pr.02-13 and Pr.02-16 Multi-function Output Relay 69: Indication of Preheating Function, Pr.02-01–02-05 Multi-function Input Terminal 69: Auto-activate preheating function.

⚡ 02-73 Preheating DC Current Duty Cycle

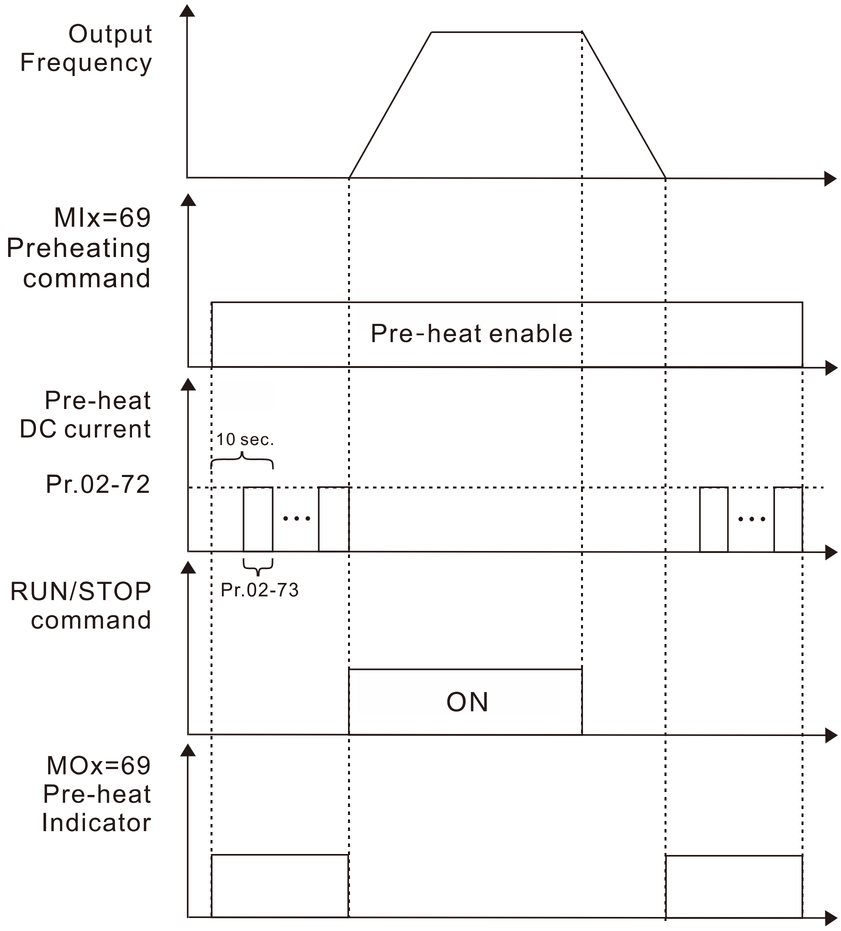
Default:0

Settings 0–100%

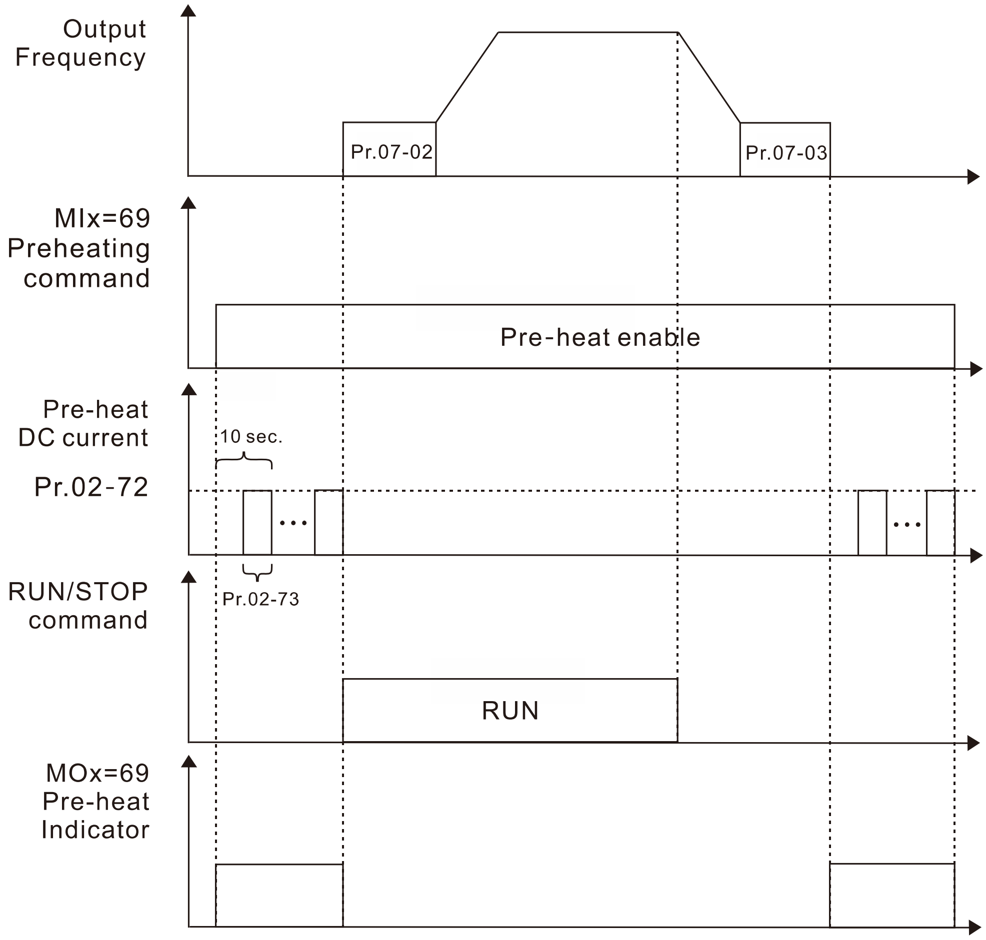
- This parameter is to set up the duty cycle of the preheating DC current input to the motor. 0–100% corresponds to 0–10 sec. If the setting is 0%, there is no output current from the motor drive; if the setting is 100%, there is continuous output DC current. For example, when the setting of this parameter is 50%, the cycle time is the time spent to input current to motor for 5 seconds and stop inputting for 5 seconds. When MI #69 is enabled, this parameter operates periodically with MI#69 until the motor drive starts to run the motor or until MI#69 is disabled.
- Preheating function works only when the setting value for Pr.02-72 and Pr.02-73 are not 0.
- If user doesn't set MI=69 (enable preheating function), this function activates when the first operation stops, or immediately activates after rebooting.
- When MI=69 (enable preheating function) is enabled, MI=69 controls the start and stop of preheating function.
- The figure below shows the timing relationship when MI=69 enable preheating function is disabled and when preheating DC current is enabled and cycle time is 50%. When the motor drive is stopped, the preheating function starts to output DC current continuously.



📖 The figure below shows the timing relationship when MI=69 enable preheating function is enabled and when preheating DC current is enabled and cycle time is 50%.



📖 The figure below shows the timing relationship between preheating function and enabling DC brake.



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03 Analog Input / Output Parameters

✎You can set this parameter during operation.

✎ **03-00** AI1 Analog Input Selection

Default:5

✎ **03-01** AI2 Analog Input Selection

Default:0

Settings
0: No function
1: Frequency command
4: PID target value
5: PID feedback signal
6: Thermistor input value (PTC-130 / KTY-84-130)
11: PT100 thermistor input value
13: PID compensation value
21: Pressure inputs (outlet side)
22: Pressure inputs (inlet side)
23: Flow inputs

- When you use analog input as the PID reference target input, you must set Pr.00-20 to 2 (external analog input).
  Pr.03-00 = 1: To be frequency command when PID uses frequency as target value.
  Pr.03-00 = 5: To be PID feedback signal when PID uses the pressure feedback signal as reference value, and Pr.08-00 = 1 (negative PID feedback) at the same time.
- When using the frequency command, the corresponding value for 0–10 V / 4–20 mA is 0–maximum operation frequency (Pr.01-00).
- Pr.00-25 should set as the unit of pressure when Pr.03-00 = 21 (outlet pressure), and Pr.00-38 should set as the unit of pressure when Pr.03-01 = 22 (inlet pressure), otherwise flow estimation module cannot work correctly.
- Pr.00-25 should set as the unit of flow when Pr.03-00 = 23 (flow inputs), otherwise cavitation detection module cannot work correctly.
- When using water pump related functions, connect AI1 to outlet pressure, connect AI2 to inlet pressure. The settings are as below:

Selections of control	Pr.03-00: AI1 (outlet pressure)	Pr.03-01: AI2 (inlet pressure)
Pressure feedback control	5: PID feedback signal	
Q-H method (Pr.12-20 = 1)	21: Pressure inputs (outlet side)	22: Pressure inputs (inlet side)
Q-H method (Pr.12-20 = 1) + Pressure feedback control	5: PID feedback signal	22: Pressure inputs (inlet side)
Cavitation detection (Pr.12-18 = 2)	23: Flow inputs	22: Pressure inputs (inlet side)
Cavitation detection (Pr.12-18 = 1) + Q-H method (Pr.12-20 = 1) + Pressure feedback control	5: PID feedback signal (If use with pressure feedback control at the same time, the flow meter cannot be used directly, but can estimate by Q-H method.	22: Pressure inputs (inlet side)

✎ **03-03** AI1 Analog Input Bias

Default:0

Settings -100.0–100.0%

- Sets the corresponding AI1 voltage for the external analog input 0.
- Refer to Pr.03-11 for details.

03-04 AI2 Analog Input Bias

Default:0

Settings -100.0–100.0%

- Sets the corresponding AI2 voltage for the external analog input 0.
- Refer to Pr.03-12 for details.

03-07 AI1 Positive / Negative Bias Mode
03-08 AI2 Positive / Negative Bias Mode

Default:0

Settings 0: No bias

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 1V to set the drive's operation frequency.

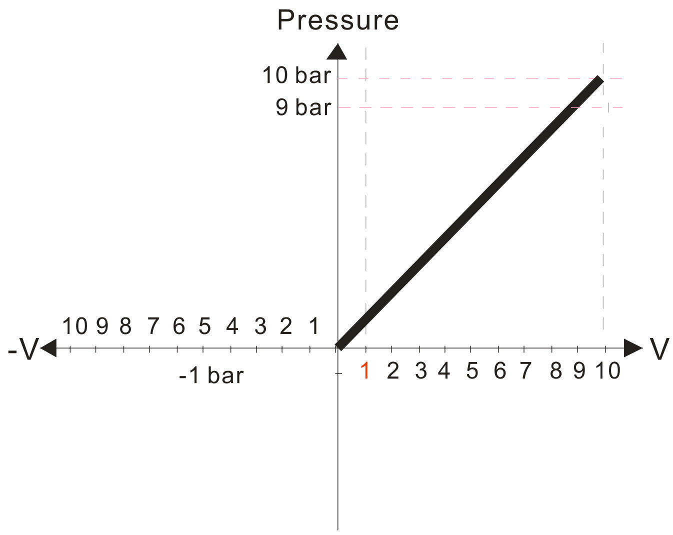
03-11 AI1 Analog Input Gain
03-12 AI2 Analog Input Gain

Default:100.0

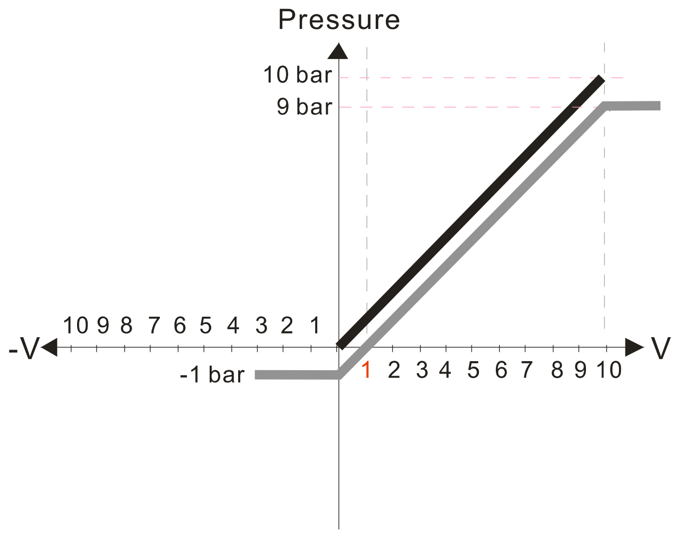
Settings -500.0–500.0%

- Pr.03-03–03-12 are used when the Frequency command source is the analog voltage or current signal.
- Use this function when user's pressure sensor have to detect negative value
  For example: if AI1 needs to use a pressure sensor 0–10 V of voltage type, and the detection range is -1.0–9.0 bar that the total is10 bar, then follow the steps below:
  1. Setting: 0.0–10.0 bar, Pr.00-25 = 353, Pr.00-26 = 10.0
  2. Set the bias: 10%, to make the corresponding point of 0.0 bar change from 0V to 1V, the detection range of pressure sensor changes to -1.0–9.0 bar, and Pr.03-03 = 10%
  3. Set the bias mode: Bias serves as the center, Pr.03-07 = 4
  4. If you want the pressure sensor to respond more quickly, then set the gain to be 200%, Pr.03-11 = 200%

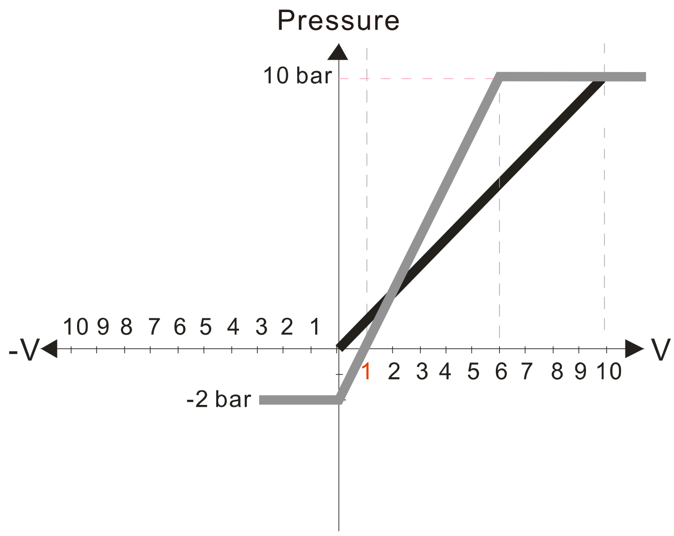
  Refer to the graphic expression below:
  1. Step1: Pr.00-25 = 353, Pr.00-26 = 10.0



2. Step2: Pr.03-03 = 10%
   Step3: Pr.03-07 = 4



3. Step4: Pr.03-11 = 200%



03-15 AI1 Analog Input Filter Time
03-16 AI2 Analog Input Filter Time

Default:0.01

Settings 0.00–20.00 sec.

- Analog signals inputed by the control terminals AI1 and AI2 mostly have noise. Noise affects the stability to 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.

03-19 Signal Loss Selection For AI1 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

- Determines the treatment when the 4–20 mA signal is lost (AI1 (Pr.03-28 = 2)).
- When the setting is 1 or 2, the keypad displays the warning code “ANL”. It keeps blinking until the AI2 signal is recovered.
- When the drive stops, the condition that causes the warning does not exist , so the warning automatically disappears.

03-69 Signal Loss Selection For AI2 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

- Determines the treatment when the 4–20 mA signal is lost (AI2 (Pr.03-29 = 2)).
- When the setting is 1 or 2, the keypad displays the warning code "ANL". It keeps blinking until the AI2 signal is recovered.
- When the drive stops, the condition that causes the warning does not exist , so the warning automatically disappears.

03-20 Multi-function Output (AFM)

Default:0

Settings 0–23

Summary of Function Settings

ID*	Functions	Descriptions
0	Output frequency (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
1	Frequency command (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
2	Motor speed (Hz)	Maximum frequency Pr.01-00 is processed as 100%.
3	Output current (rms)	(2.5 X drive rated current) is processed as 100%.
4	Output voltage	(2 X motor rated voltage) is processed as 100%.
5	DC bus voltage	450 V (900 V) = 100%
6	Power factor	-1.000–1.000 = 100%
7	Power	(2 X drive rated power) is processed as 100%.
9	AI1 Analog input	0–10 V = 0–100%
10	AI2 Analog input	0–10 V = 0–100%
21	RS-485 analog output	For InnerCOM analog output
22	Communication card analog output	For communication analog output of CMMP-BT01, CMM-PD02, CMM-DN02, CMM-EIP02 Terminal: AFM, Address: 26A0H
23	Constant voltage output	Pr.03-32 controls the voltage output level. 0–100% of Pr.03-32 corresponds to 0–10 V for AFM.

03-21 AFM Analog Output Gain

Default:100.0

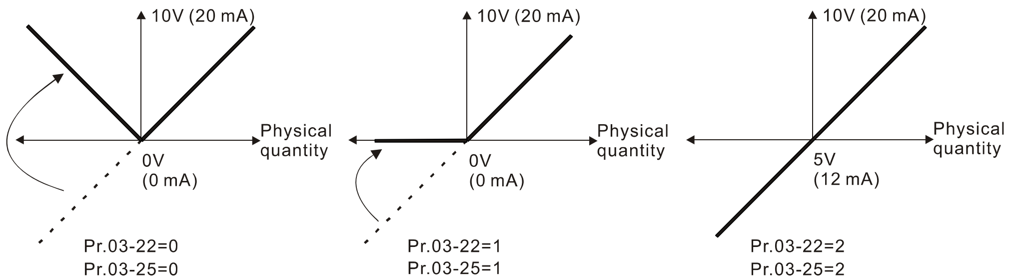
Settings 0–500.0%

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

03-22 AFM Analog Output in REV Direction

Default:0

Settings 0: Absolute value 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 AFM Output Bias

Default:0.00

Settings -100.00–100.00%

- Example 1: AFM 0–10 V is set to the output frequency, the output equation is 10V × (output frequency / Pr.01-00) x Pr.03-21 + 10V x Pr.03-27
- This parameter sets the corresponding voltage of the analog output 0.

03-28 AI1 Terminal Input Selection

Default:2

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

- Use DIP switch to change voltage mode and current mode, refer to Chapter 06 for AI1 terminal instruction.

03-29 AI2 Terminal Input Selection

Default:2

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

- Use DIP switch to change voltage mode and current mode, refer to Chapter 06 for AI2 terminal instruction.

03-30 PLC Analog Output Terminal Status

Default:0

Settings bit 0: Reserved
bit 1: AFM

- Displays the external multi-function output terminals used by PLC.
- Use DIP switch to change voltage mode and current mode, refer to Chapter 06 for AI1 terminal instruction.

0=OFF
1=ON

Weights	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}	
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	← AFM

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.03-30 displays 0001h (hex), it means that AFM is used by PLC.

0=Not used by PLC
1=Used by PLC

Weights	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}	
bit	0	0	0	0	0	0	0	1	← AFM

Display value = bit $0x2^0$
= $1x2^0$
= 1

03-32 AFM DC Output Setting Level

Default:0.00

Settings 0.00–100.00%

03-35 AFM Output Filter Time

Default:0.01

Settings 0.00–20.00 sec.

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

Default:0

Settings 0: AI1
1: AI2

03-45 AI1 Upper Level 1

Default:50

Settings -100–100%

03-46 AI1 Lower Level 2

Default:10

Settings -100–100%

03-47 AI2 Upper Level 1

Default:50

Settings -100–100%

03-48 AI2 Lower Level 2

Default:10

Settings -100–100%

- MOx = 67: analog input level reached, to choose AI level source in Pr.03-44.
- If Pr.03-44 = 0, the MO activates when the AI input level is higher than the Pr.03-45; the MO stops when the AI input is lower than the Pr.03-46.
- If Pr.03-44 = 1, the MO activates when the AI input level is higher than the Pr.03-47: the MO stops when the AI input is lower than the Pr.03-48.
- When setting levels, Pr.03-45 > Pr.03-46, Pr.03-47 > Pr.03-48

03-50 Analog Input Curve Selection

Default:0

Settings 0: Normal curve
1: Three-point curve of AI1
2: Three-point curve of AI2

03-51 AI1 Lowest Point

Default:4.00

Settings Pr.03-28 = 0, 0.00–10.00 V
Pr.03-28 = 1, 0.00–20.00 mA
Pr.03-28 = 2, 4.00–20.00 mA

03-52 AI1 Proportional Lowest Point

Default:0.00

Settings 0.00–100.00%

03-53 AI1 Mid-point

Default:12.00

Settings Pr.03-28 = 0, 0.00–10.00 V
Pr.03-28 = 1, 0.00–20.00 mA
Pr.03-28 = 2, 4.00–20.00 mA

03-54 AI1 Proportional Mid-point

Default:50.00

Settings 0.00–100.00%

03-55 AI1 Highest Point

Default:20.00

Settings Pr.03-28 = 0, 0.00–10.00 V
Pr.03-28 = 1, 0.00–20.00 mA
Pr.03-28 = 2, 4.00–20.00 mA

03-56 AI1 Proportional Highest Point

Default:100.00

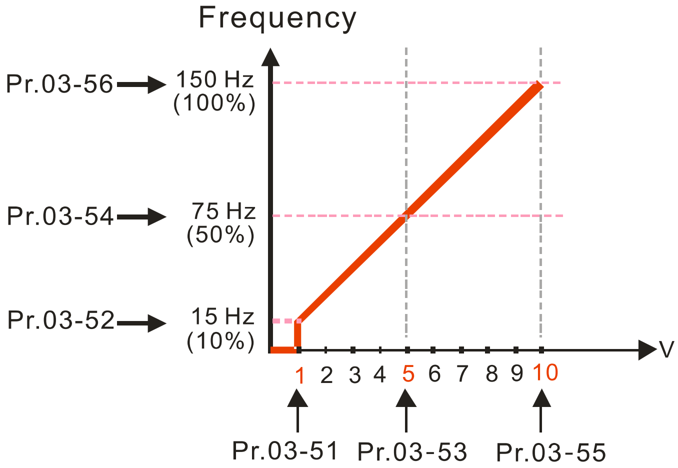
Settings 0.00–100.00%

- When Pr.03-28 = 0, the AI1 setting is 0–10 V and the unit is voltage (V). When Pr.03-28 ≠ 0, the

AI1 setting is 0–20 mA or 4–20 mA and the unit is current (mA).

- When you set the analog input AI1 to the frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).
- Setting range: 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. There is a linear calculation between two points.
- The output percentage becomes 0% when the AI1 input value is lower than the lowest point setting.
  Example:
  Pr.03-51 = 1V, Pr.03-52 = 10% The output is 0 % when AI1 input is lower than 1V. If the AI1 input swings between 1 V and 1.1 V, the drive's output frequency oscillates between 0% and 10%.

Pr.03-51 = 1 V; Pr.03-52 = 10%
Pr.03-53 = 5 V; Pr.03-54 = 50%
Pr.03-55 = 10 V; Pr.03-56 = 100%



03-57 AI2 Lowest Point

Default:4.00

Settings Pr.03-29 = 0, 0.00–10.00 V
Pr.03-29 = 1, 0.00–20.00 mA
Pr.03-29 = 2, 4.00–20.00 mA

03-58 AI2 Proportional Lowest Point

Default:0.00

Settings 0.00–100.00%

03-59 AI2 Mid-point

Default:12.000

Settings Pr.03-29 = 0, 0.00–10.00 V
Pr.03-29 = 1, 0.00–20.00 mA
Pr.03-29 = 2, 4.00–20.00 mA

03-60 AI2 Proportional Mid-point

Default:50.00

Settings 0.00–100.00%

03-61 AI2 Highest Point

Default:20.00

Settings Pr.03-29 = 0, 0.00–10.00 V
Pr.03-29 = 1, 0.00–20.00 mA
Pr.03-29 = 2, 4.00–20.00 mA

03-62 AI2 Proportional Highest Point

Default:100.00

Settings 0.00–100.00%

- When Pr.03-29 ≠ 0, the AI2 is 0–20 mA or 4–20 mA and the unit is current (mA).
- When you set the analog input AI2 to the frequency command, 100% corresponds to Fmax (Pr.01-00 Maximum Operation Frequency).

- Setting range: 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 AI2 input value is lower than the lowest point setting.
  Example:
  Pr.03-57 = 2 mA, Pr.03-58 = 10% The output is 0 % when AI2 input is lower than 2 mA.
  If the ACI input swings between 2 mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

04 Multi-Step Speed Parameters

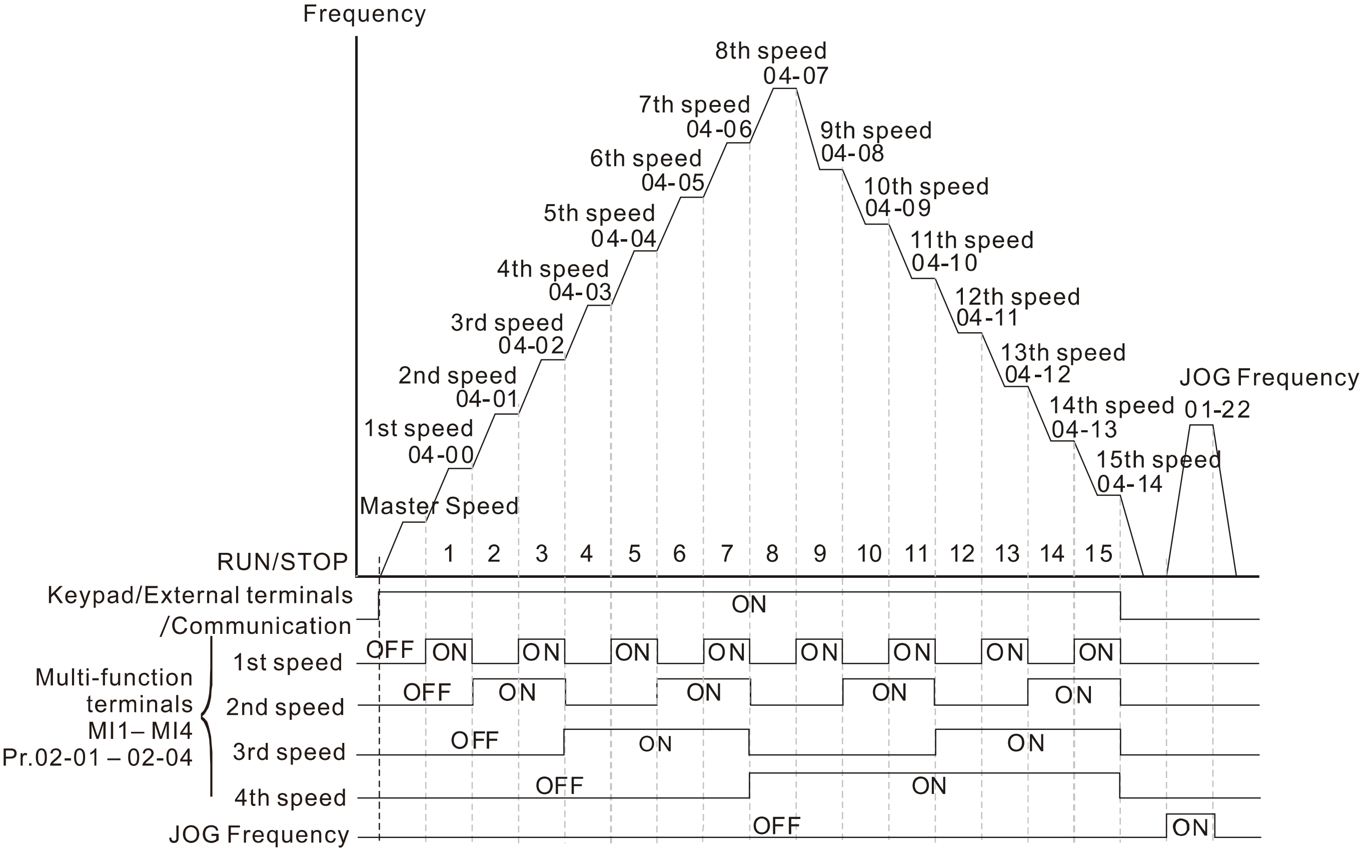
⌿You can set this parameter during operation.

⌿	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 0.00–180.00 Hz

- Use the multi-step speed command 1–4 / multi-step position command 1–4 of the multi-function input terminals (refer to the setting 1–4 of Pr.02-01–02-04 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 (frequency) between 0.00–180.00 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.02-04: sets the multi-function input terminals (multi-step speed command 1–4).
- Related parameters:
  - Pr.01-22 JOG frequency setting
  - Pr.02-01 multi-function input command 1 (MI1)
  - Pr.02-02 multi-function input command 2 (MI2)
  - Pr.02-03 multi-function input command 3 (MI3)
  - Pr.02-04 multi-function input command 4 (MI4)



Multi-speed via External Terminals

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

Default: 0

Settings 0–65535

- If the built-in PLC function is not loaded in, then PLC buffer 0–19 (Pr.04-50–04-69) and PLC application parameters (Pr.04-70–04-99) can be flexibly used for PLC function, its setting range is 0–65535, and the default is 0.
- If the built-in PLC function is loaded in, Pr.04-50–04-99 become the settings for the built-in PLC function which is enabled. See the following pages for the explanations.
- After enabling the built-in PLC function, PLC buffer 0–6 are disabled.
- Refer to chapter 15 PLC Function Applications for the way to enable the built-in PLC function.

04-57 Pump System Configuration Setting

Default: 0

Settings	Source of frequency bit 0–3	00x0h: Digital keypad 00x1h: RS-485 communication (COM2) 00x8h: Communication card (does not include CANopen card)
	Source of operation bit 4–7	000xh: Digital keypad 001xh: RS-485 communication (COM2) 002xh: External terminals (MI1) 005xh: Communication card (does not include CANopen card)
	bit 8	Set to be backup master.
	bit 9	Display a PL00 warning when the backup master becomes the master.

- This parameter is to set the multi-pump configuration of the built-in PLC function. Refer to chapter 15 PLC Function Applications for the way to enable the built-in PLC function.
- Do the settings according to the different system statuses, refer to the table below.
  Because the backup master continues the pressure command from the master, it's invalid to set the source of frequency.

Pr.04-57	Suitable system
bit 0–3, source of frequency	The master (station address is 1)
bit 4–7, source of operation	The master (station address is 1), the backup master
bit 8, set to be the backup master	Backup master
bit 9, display a PL00 warning when the backup master becomes the master.	Backup master

- Example: When a multi-pump system is established, the AC motor drives connect with each other by Modbus communication, thus Pr.00-20, Pr.00-21 have to be RS-485 (COM1). The default of Pr.04-57 for the master of the multi-pump system is by using digital keypad, users press RUN, STOP button to control system, and press UP / DOWN to set target pressure. If the master has to connect with HMI, then set Pr.04-57 to be RS-485 (COM2), and connect with HMI and the COM2 of the master, now HMI can control the operation and frequency command of the master. Take notice of this, you can not control the system by pressing RUN and STOP when using HMI.
- When switching frequency command, the system takes the present source of frequency as a reference of target pressure. For example, if the frequency command is from the communication card, the system operates with 10 bar according to the target pressure of the communication card; but when the frequency command is from Modbus, the system operates with 4 bar according to the target pressure of Modbus.
- Switch the operation or stop by using MI1 when bit 4–7 set to be 002xh, refer to Pr.02-00 for more details.

Source of operation / Source of frequency	000xh: Digital keypad	001xh: RS-485 communication	002xh: External terminal (MI1)	005xh: Communication card (does not include CANopen card)
00x0h: Digital keypad	Hex: 0000h Decimal: 0	Hex: 0010h Decimal: 16	Hex: 0020h Decimal: 32	Hex: 0050h Decimal: 80
00x1h: RS-485 communication	Hex: 0001h Decimal: 1	Hex: 011h Decimal: 17	Hex: 021h Decimal: 33	Hex: 051h Decimal: 81
00x8h: Communication card (does not include CANopen card)	Hex: 0008h Decimal: 8	Hex: 0018h Decimal: 24	Hex: 0028h Decimal: 40	Hex: 0058h Decimal: 88

- bit 8: Set to be backup master. If you want the station address to be backup master, then set bit 8 to be 1, and key in 256. If you want a warning is displayed on the digital keypad when the backup master switches, then set bit 9 to be 768 to display PL00 warning.

PLC1

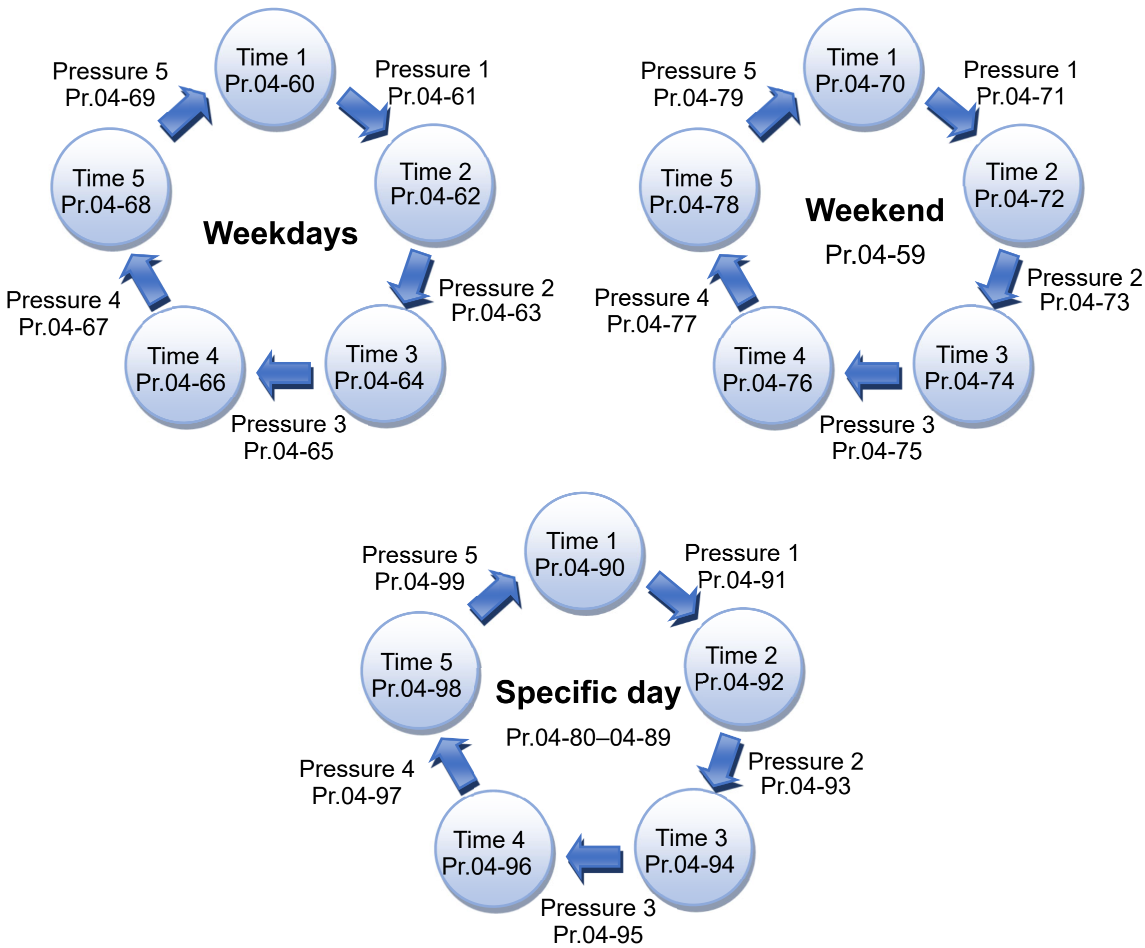
04-58 Weekdays, weekend, specific day schedule

Default: 0

Settings bit 0: 1 (weekdays)
bit 1: 1 (weekend)
bit 2: 1 (specific day)

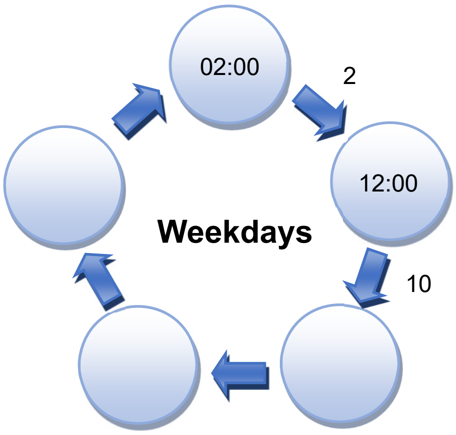
- This function is built-in scheduled function of PLC. Refer to chapter 15 PLC Function Applications for the way to enable the built-in PLC function.
- Before using the scheduled function, adjust time in Pr.12-93–12-96 and install a battery. If not doing so, the AC motor drive displays warnings to adjust the RTC (rCAL) and has low battery voltage (LBAt).
- Refer to section 7-7 RTC Function And Battery
- To meet water requirements at different time, use this scheduled function to arrange the target pressure in the specific time interval for saving energy. The schedule can be divided into three phases: weekdays, weekend, specific day. Set them individually and:
  1. The priority is specific day > weekend > weekdays.
  2. The next time interval has to be larger than the previous one, otherwise the following time intervals are invalid, and the pump only operates during the valid time interval.
  3. These parameters can not been set randomly, if there is any blank in the middle, then the settings after the blank are invalid.
  4. This can be less than five time intervals.
  5. In case of crossing day, follow the operating pressure setting in the last valid time interval of the previous day.

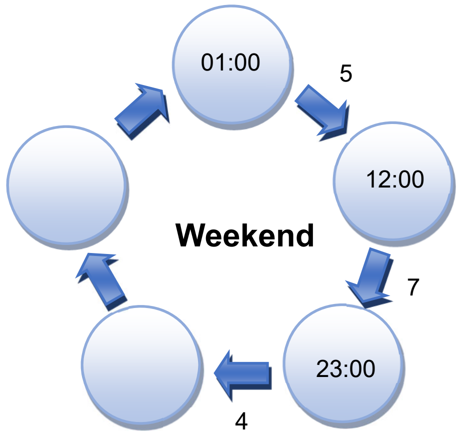
  The schematic diagrams

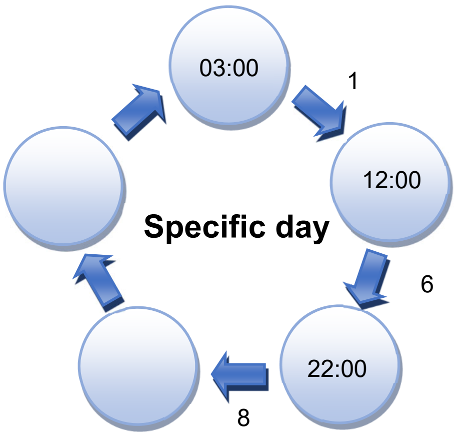


Example:

Settings	Weekdays					Weekend		Weekdays	Specific day					Weekend
									2/1	2/2	2/3	2/4	2/5	
Time	Mon.	Tue.	Wed.	Thur.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Thur.	Fri.	Sat.	Sun.
00:00	4	10	10	10	10	10	4	4	10	8	8	8	8	8
01:00	4	10	10	10	10	5	5	4	10	8	8	8	8	5
02:00	2	2	2	2	2	5	5	2	10	8	8	8	8	5
03:00	2	2	2	2	2	5	5	2	1	1	1	1	1	5
04:00	2	2	2	2	2	5	5	2	1	1	1	1	1	5
21:00	10	10	10	10	10	7	7	10	6	6	6	6	6	7
22:00	10	10	10	10	10	7	7	10	8	8	8	8	8	7
23:00	10	10	10	10	10	4	4	10	8	8	8	8	8	4
00:00	10	10	10	10	10	4	4	10	8	8	8	8	8	4







04-59 Weekend Setting

Default: 0

Settings 0: Saturday, Sunday
1: Sunday

📖 Define the days of weekend according to requirements. Set 0 means the weekdays are from Monday to Friday; set 1 means the weekdays are from Monday to Saturday.

04-60 Weekdays Start Time 1

Default: 00:00

Settings 00:00~23:59

04-61 Weekdays Target Pressure 1

Default: 0

Settings 0–system pressure value

04-62 Weekdays Start Time 2

Default: 00:00

Settings 00:00–23:59

04-63 Weekdays Target Pressure 2

Default: 0

Settings 0–system pressure value

04-64 Weekdays Start Time 3

Default: 00:00

Settings 00:00–23:59

04-65 Weekdays Target Pressure 3

Default: 0

Settings 0–system pressure value

04-66 Weekdays Start Time 4

Default: 00:00

Settings 00:00–23:59

04-67 Weekdays Target Pressure 4

Default: 0

Settings 0–system pressure value

04-68 Weekdays Start Time 5

Default: 00:00

Settings 00:00–23:59

04-69 Weekdays Target Pressure 5

Default: 0

Settings 0–system pressure value

04-70 Weekend Start Time 1

Default: 00:00

Settings 00:00–23:59

04-71 Weekend Target Pressure 1

Default: 0

Settings 0–system pressure value

04-72 Weekend Start Time 2

Default: 00:00

Settings 00:00–23:59

04-73 Weekend Target Pressure 2

Default: 0

Settings 0–system pressure value

04-74 Weekend Start Time 3

Default: 00:00

Settings 00:00–23:59

04-75 Weekend Target Pressure 3

Default: 0

Settings 0–system pressure value

04-76 Weekend Start Time 4

Default: 00:00

Settings 00:00–23:59

04-77 Weekend Target Pressure 4

Default: 0

Settings 0–system pressure value

04-78 Weekend Start Time 5

Default: 00:00

Settings 00:00–23:59

04-79 Weekend Target Pressure 5

Default: 0

Settings 0–system pressure value

04-80 Specific Day Start Date 1

04-81 Specific Day End Date 1

✓ **04-82**	Specific Day Start Date 2
✓ **04-83**	Specific Day End Date 2
✓ **04-84**	Specific Day Start Date 3
✓ **04-85**	Specific Day End Date 3
✓ **04-86**	Specific Day Start Date 4
✓ **04-87**	Specific Day End Date 4
✓ **04-88**	Specific Day Start Date 5
✓ **04-89**	Specific Day End Date 5

Default: 00.00

Settings MM.DD (MM = month, 01–12; DD = date, 01–31)

- All the specific days operate the same scheduled time and pressure. That means when time is the specific days which set in Pr.04-80–04-89, the schedule executes according to Pr.04-90–04-99 settings.
- Set the date to be 00.00 means the parameter is invalid.
- The setting of the specific days start from the start date and end on the end date.
  Example: If the setting starts from 1/2 and ends on 1/3, then both 1/2 and 1/3 are the specific days for operation.
- If the end date is smaller than the start date, then this operation continues to a new year.
  Example: If the setting starts from 12/30 and ends on 1/2, then 12/30, 12/31, 1/1, 1/2 are the specific days for operation.
- The maximum of the system pressure value is Pr.00-26.

✓ **04-90** Specific Day Start Time 1

Default: 00:00

Settings 00:00–23:59

✓ **04-91** Specific Day Target Pressure 1

Default: 0

Settings 0–system pressure value

✓ **04-92** Specific Day Start Time 2

Default: 00:00

Settings 00:00–23:59

✓ **04-93** Specific Day Target Pressure 2

Default: 0

Settings 0–system pressure value

✓ **04-94** Specific Day Start Time 3

Default: 00:00

Settings 00:00–23:59

✓ **04-95** Specific Day Target Pressure 3

Default: 0

Settings 0–system pressure value

✓ **04-96** Specific Day Start Time 4

Default: 00:00

Settings 00:00–23:59

✓ **04-97** Specific Day Target Pressure 4

Default: 0

Settings 0–system pressure value

✓ **04-98** Specific Day Start Time 5

Default: 00:00

Settings 00:00–23:59

✓ **04-99** Specific Day Target Pressure 5

Default: 0

Settings 0–system pressure value

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05 Motor Parameters

✓You can set this parameter during operation.

05-00 Motor Parameter Auto-tuning

Default: 0

Settings 0: No function
5: Rolling auto-tuning for motor
13: High frequency stall test for motor

✓ **05-26** Motor Accumulated Watt In Every Millisecond (W-msec.)

05-27 Motor Accumulated Watt In Every Second (W-sec.)

✓ **05-28** Motor Accumulated Watt In Every Hour (W-hour)

05-29 Motor Accumulated Kilowatt In Every Kilowatt-hour (kW-Hour)

05-30 Motor Accumulated Megawatt In Every Megawatt-hour (MW-Hour)

Default: 0.0

Settings Read only

- Pr.05-26–05-30 records the amount of power the motors consume. The accumulation begins when the drive is activated and the record is saved when the drive stops or turns OFF. The amount of consumed watts continues to accumulate when the drive is activated again. To clear the accumulation, set Pr.00-02 to 5 to return the accumulation record to 0.
- The accumulated total kilowatts of the motor per hour = Pr.05-30 x 1000000 + Pr.05-28 x 1000 + Pr.05-28 Wh
  Example:
  When Pr.05-30 = 76 MWh, Pr.05-29 = 150 kWh, Pr.05-28 = 400 Wh (or 0.4 kWh), the motor accumulated watt In every hour = 76 x 1000000 + 150 x 1000 + 400 = 76150400 Wh = 76150.4 kWh

05-31 Accumulated Motor Operation Time (Minutes)

Default: 0

Settings 0–1439

05-32 Accumulated Motor Operation 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 to 00. An operation time shorter than 60 seconds is not recorded.

05-34 Motor Full-load Current

Default: #.#

Settings 0–120% of the drive's rated current

05-35 Motor Rated Power

Default: #.#

Settings 0.00–655.35 kW

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

05-36 Motor Rated Speed

Default: 3000

Settings 0–65535 rpm

05-37 Number Of Poles For A Motor

Default: Differs from models (6 / 8)

Settings 0–65535

05-39 Stator Resistance For A Motor

Default: 0.000

Settings 0.000–65.535 Ω

05-40 Motor Ld

Default: 0.00

Settings 0.00–655.35 mH

05-41 Motor Lq

Default: 0.00

Settings 0.00–655.35 mH

05-43 Ke Parameter Of A Motor

Default: 0

Settings 0.0–6553.5 V/krpm

- Pr.05-34–05-43 which are related with the MSI motor that corresponds with MPD enter automatically.

06 Protection Parameters (1)

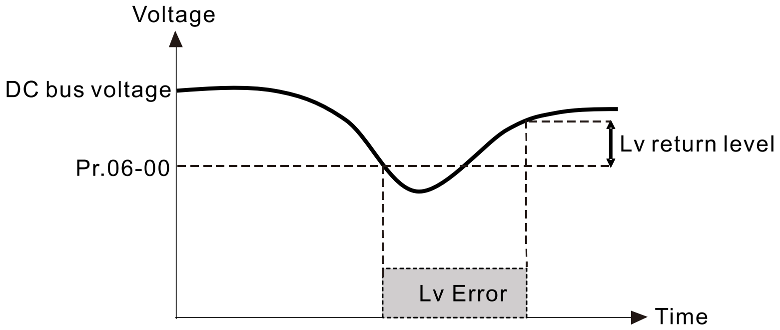
✐ You can set this parameter during operation.

✐ 06-00 Low Voltage Level

Default: 360.0

Settings 300.0–440.0 V_{DC}

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



✐ 06-01 Over-voltage Stall Prevention

Default: 760.0

Settings 0: No function

0.0–900.0 V_{DC}

- Setting Pr.06-01 to 0.0 disables the over-voltage stall prevention function.
- Setting Pr.06-01 to a value > 0 enables the over-voltage stall prevention. This setting refers to the power supply system and loading. If the setting is too low, then over-voltage stall prevention is easily activated, which may increase deceleration time.
- If the value exceeds OV level (see the table below), then OV stall function is disabled.

Voltage	OV Stall	OV	Setting range
460V models	760 V_{DC}	820 V_{DC}	0–900 V_{DC}

- Related parameters:
  - Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4
  - Pr.02-13 multi-function output terminal 1 (RY1) MOx = 23: over-voltage stall prevention
  - Pr.02-14 multi-function output terminal 2 (RY2) MOx = 23: over-voltage stall prevention
  - Pr.02-16 multi-function output terminal 3 (MO) MOx = 23: over-voltage stall prevention
  - Pr.06-02 Selection for Over-voltage Stall Prevention.

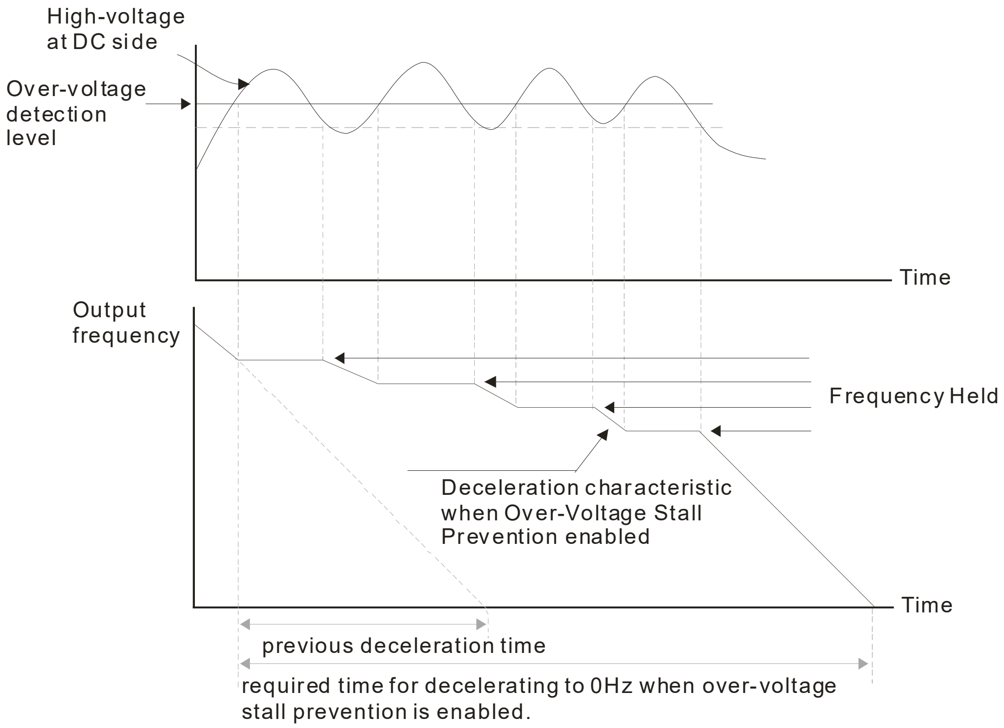
✐ 06-02 Selection for Over-voltage Stall Prevention

Default:0

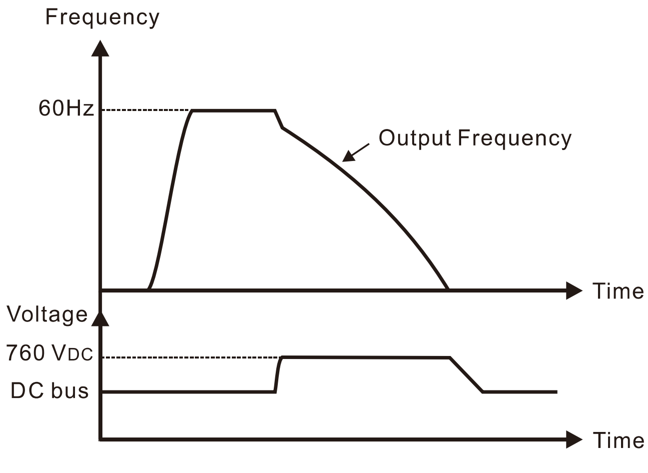
Settings 0: Traditional over-voltage stall prevention
1: Smart over-voltage stall prevention

- Use this function when you are unsure about the load inertia. When stopping under normal load, the over-voltage does not occur during deceleration and meet the deceleration time setting. Sometimes it may not stop due to over-voltage during decelerating to STOP when the load regenerative inertia increases. In this case, the AC motor drive extends the deceleration time automatically until the drive stops.
- When you set Pr.06-02 to 0, during deceleration the motor exceeds the synchronous speed due to load inertia. In this case, the motor becomes an electrical generator. The DC BUS voltage may exceed its maximum allowable value due to motor regeneration in some situations, such as

loading inertia being too high or deceleration time being set too short. When you enable traditional over-voltage stall prevention and the DC BUS voltage detected is too high, the drive stops decelerating (output frequency remains unchanged) until the DC BUS voltage drops below the setting value.



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



460V Models

📖 When you enable the over-voltage stall prevention, the drive's deceleration time is longer than the setting. If you encounter any problem with deceleration time, refer to the following guides for troubleshooting.

- Increase the deceleration time to a suitable value.

📖 Related parameters:

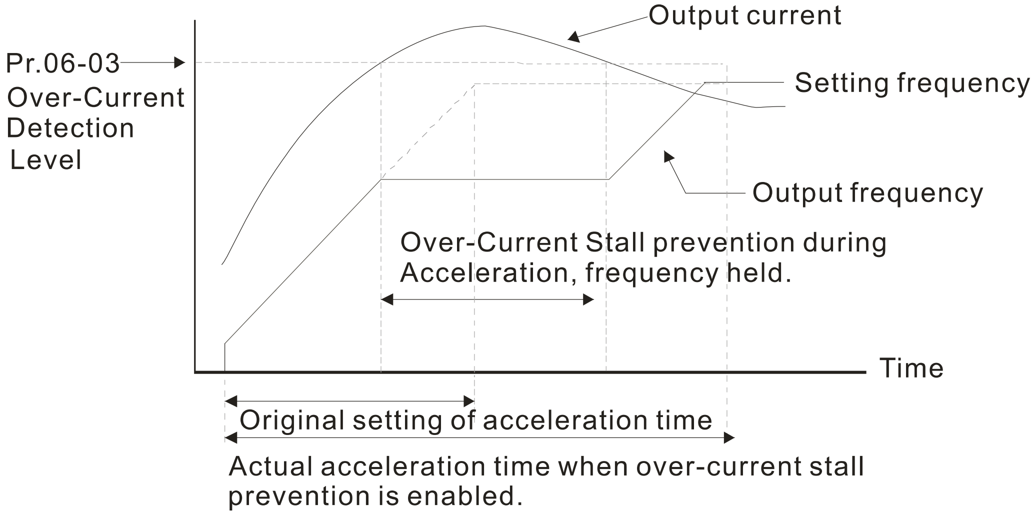
- Pr.01-13, Pr.01-15, Pr.01-17, Pr.01-19 Deceleration Time 1–4
- Pr.02-13 multi-function output terminal 1 (RY1) MOx = 23: over-voltage stall prevention
- Pr.02-14 multi-function output terminal 2 (RY2) MOx = 23: over-voltage stall prevention
- Pr.02-16 multi-function output terminal 3 (MO) MOx = 23: over-voltage stall prevention
- Pr.06-01 Over-voltage Stall Prevention

⚡ **06-03** Over-current Stall Prevention during Acceleration

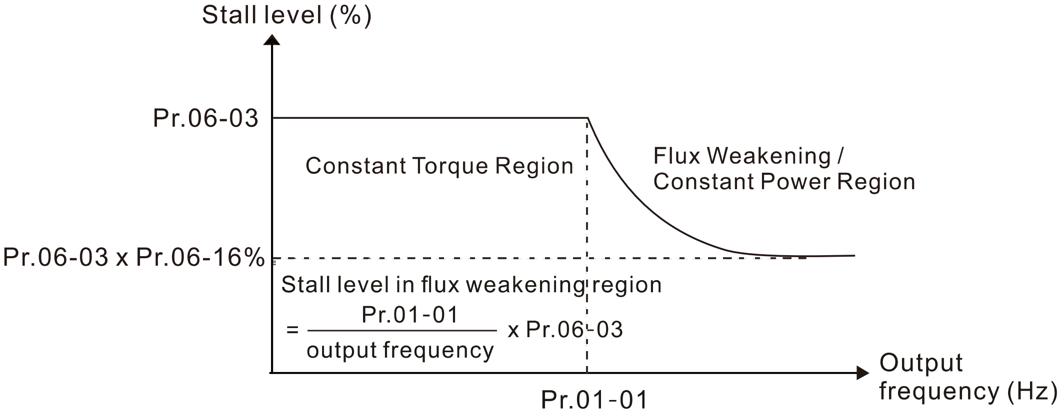
Default: 120

Settings Normal Load: 0–150% (100% corresponds to the rated current of the drive)

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



- Refer to Pr.06-16 for more details of stall level in flux weakening region. The protection curve is as follows:



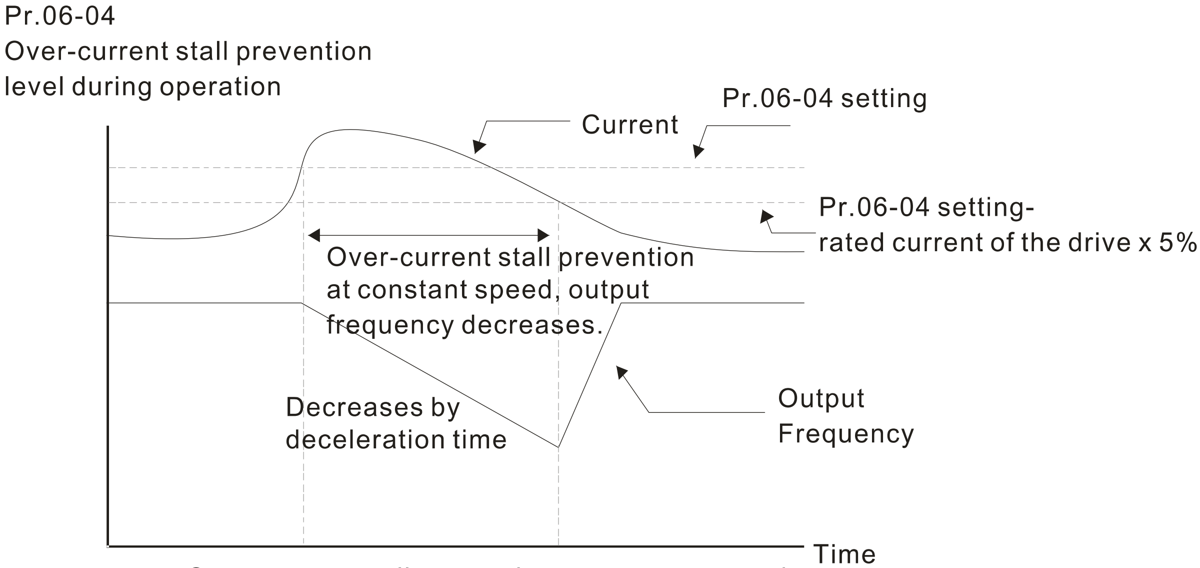
- When you enable the over-current stall prevention, the drive's acceleration time is longer than the setting.
- When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the Pr.06-03 setting value.
- When you encounter any problem with the acceleration time, refer to the following guides for troubleshooting.
  1. Increase the deceleration time to a suitable value.
  2. Set Pr.01-44 Auto-Acceleration and Auto-Deceleration Setting to 1, 3 or 4. (auto-acceleration)
- Related parameters:
  - Pr.01-12, 01-14, 01-16, 01-18 Acceleration Time 1–4),
  - Pr.01-44Auto-Acceleration and Auto-Deceleration Setting,
  - Pr.02-13 multi-function output terminal 1 (RY1) MOx = 23: over-voltage stall prevention
  - Pr.02-14 multi-function output terminal 2 (RY2) MOx = 23: over-voltage stall prevention
  - Pr.02-16 multi-function output terminal 3 (MO) MOx = 23: over-voltage stall prevention

06-04 Over-current Stall Prevention during Operation

Default:120

Settings Normal duty: 0–150% (100% corresponds to the rated current of the drive)

- This is a protection for the drive to decrease output frequency automatically when the motor over-loads abruptly during constant motor operation.
- If the output current exceeds the setting value for Pr.06-04 when the drive is operating, the drive decreases output frequency (according to Pr.06-05) to prevent the motor from stalling. The lower limit for the over-current stall prevention is determined by the maximum value among 0.5 Hz, Pr.01-07 and Pr.01-11.
- If the output current is lower than the setting value for Pr.06-04, the drive accelerates (according to Pr.06-05) again to the setting frequency.



Over-current stall prevention at constant speed

06-05 Accel. / Decel. Time Selection for Stall Prevention at Constant Speed

Default: 0

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

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

06-06 Over-torque Detection Selection (Motor 1)

Default: 0

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

06-07 Over-torque Detection Level (Motor 1)

Default: 120

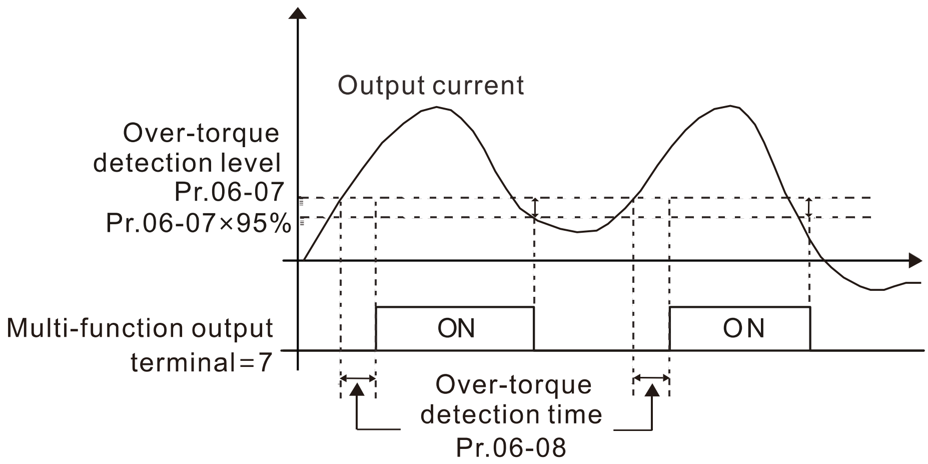
Settings 10–250% (100% corresponds to the rated current of the drive)

06-08 Over-torque Detection Time (Motor 1)

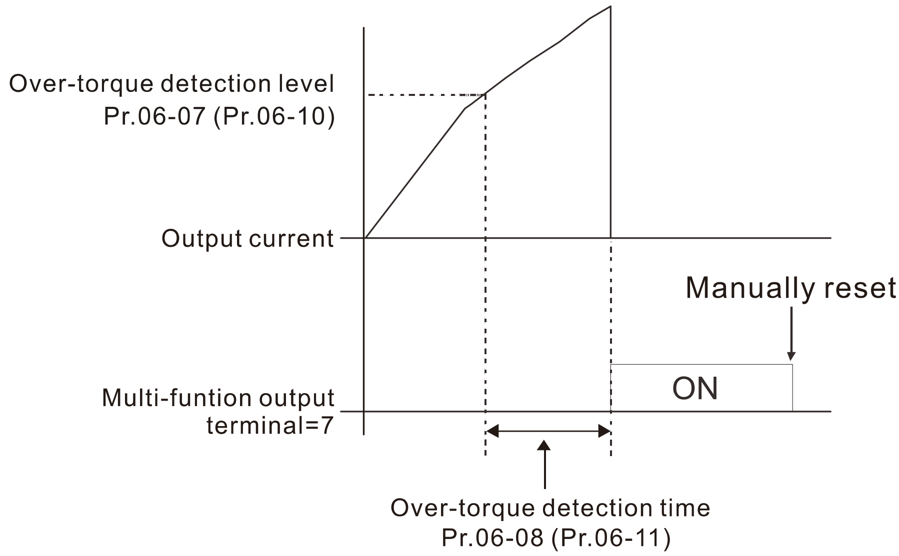
Default: 0.1

Settings 0.0–60.0 sec.

- When the output current exceeds the over-torque detection level (Pr.06-07) and also exceeds the over-torque detection time (Pr.06-08), the over-torque detection follows the setting of Pr.06-06 and Pr.06-09.
- When you set Pr.06-06 to 1 or 3, an ot1 warning displays while the drive keeps running. The warning remains on until the output current is smaller than 5% of the over-torque detection level.



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



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

Default: 2

Settings 1: Standard motor (motor with fan on the shaft)
2: Disable

📖 Prevents self-cooled motor from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.

📖 Setting the parameter to 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.

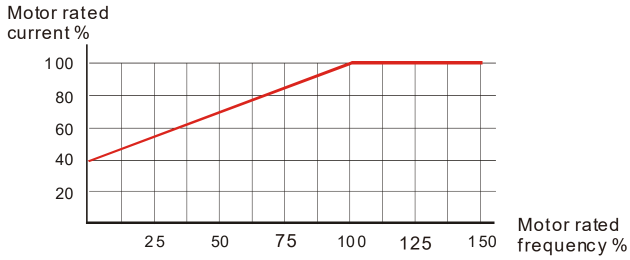
06-14 Electronic Thermal Relay Action Time 1 (Motor 1)

Default: 60.0

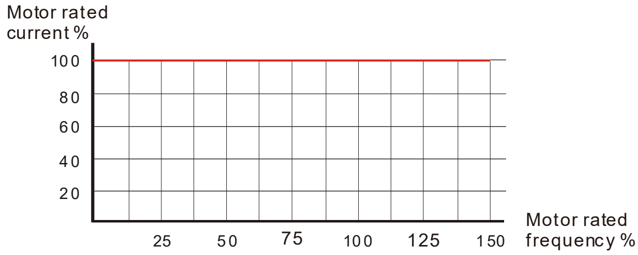
Settings 30.0–600.0 sec.

📖 Set the parameter to 150% of motor rated current and use with the setting of Pr.06-14 to prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL1", and the motor free runs to stop.

📖 Use this parameter to set the action time of the electronic thermal relay. It works based on the I2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent the motor from overheating.



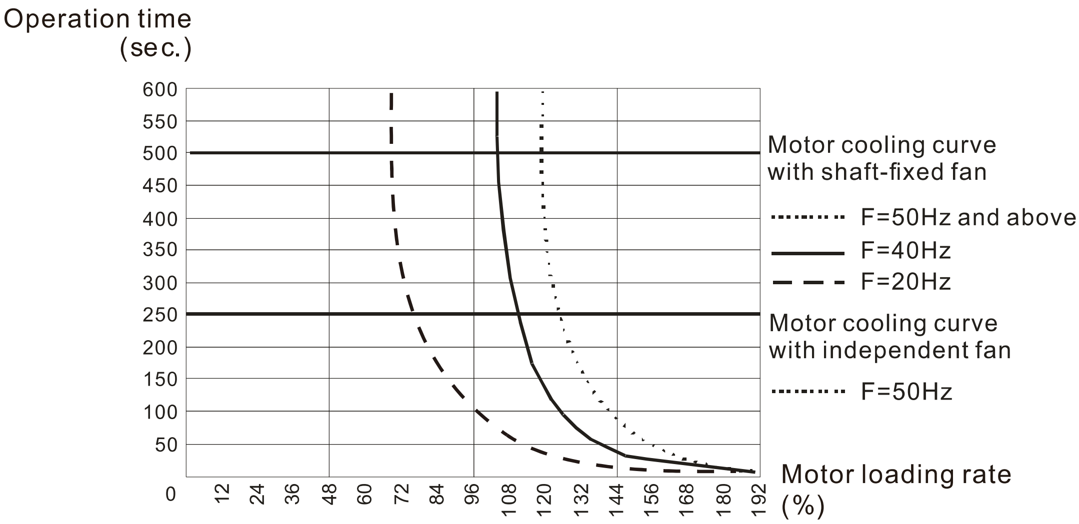
Motor cooling curve with shaft-fixed fan



Motor cooling curve with independent fan

📖 The action of the electronic thermal relay depends on the settings for Pr.06-13.

1. Pr.06-13 sets to 1 (using standard motor):
   When the output current of the drive is higher than 150% of the motor rated current (refer to the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds Pr.06-14.
   The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following chart:



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

Default: 105.0

Settings 0.0–110.0 ºC

📖 The trigger level of oH1, oH2 are shown as below,

Level	oH1: IGBT overheating	oH2: Heatsink overheating
Trigger the alarm level	Pr.06-15	-
Auto-reset alarm level	Pr.06-15 - 5ºC	-
Trigger the fault level	115ºC	95ºC
Manual reset fault level	115 ºC - 10 ºC = 105ºC	95ºC - 10ºC = 85ºC

06-16 Stall prevention limit level (weak magnetic field current stall prevention level)

Default: 100

Settings 0–100% (Refer to Pr.06-03)

📖 Sets the over-current stall prevention level when operation frequency is larger than Pr.01-01.
Example: When Pr.06-03 = 150%, Pr.06-04 = 100% and Pr.06-16 = 80%.
The over-current stall prevention level during acceleration:
Pr.06-03 * Pr.06-16 = 150 x 80% = 120%.

📖 Pr.06-16 is invalid when the over-current stall prevention activates according to Pr.06-04 at constant speed.

06-17 Fault Record 1
06-18 Fault Record 2
06-19 Fault Record 3

06-20	Fault Record 4
06-21	Fault Record 5
06-22	Fault Record 6

Default:0

Display

0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during constant speed (ocn)
4: Ground fault (GFF)
6: Over-current at stop (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage during constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
17: Heatsink overheating (oH2)
18: IGBT temperature detection failure (tH1o)
19: Capacitor hardware error (tH2o)
21: Over load (oL)
22: Electronics thermal relay 1 protection (EoL1)
24: Motor overheating PTC-130 / KTY-84-130 / PT100 (oH3)
26: Over torque 1 (ot1)
28: Under current (uC)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc hardware error (Hd0)
37: oc hardware error (Hd1)
40: Auto-tuning error (AUE)
41: PID loss ACI (AFE)
48: ACI loss (ACE)
49: External fault (EF)
51: External base block (bb)
52: Password is locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)
58: Modbus transmission time-out (CE10)
79: U-phase over-current before run (Aoc)
80: V-phase over-current before run (boc)
81: W-phase over-current before run (coc)
82: U-phase output phase loss (oPL1)
83: Output phase loss V phase (oPL2)
84: Output phase loss W phase (oPL3)
87: Low frequency overload protection (oL3)
89: Rotor position detection error (roPd)
90: Force to stop (FStp)
98: Fire mode output (Fire)
140: oc hardware error (Hd6)
141: GFF occurs before run (b4GFF)
142: Auto-tune error 1 (AuE1) (DC test stage)

143: Auto-tune error 2 (AuE2) (high frequency stall stage)
144: Auto-tune error 3 (AuE3) (rotation test stage)
221: High water pressure (HPS)
222: Low water pressure (LPSE)
223: Dry pump (dryE)
224: Water leaking (pipe explosion) (LEKE)
225: Clogged pipe (JAME)
226: RTC error (rtF)
227: Dry pump curve auto-measuring (dAUE)

- When the fault occurs and forces stopping, the fault is recorded in this parameter.
- During stop with low voltage Lv (LvS warning), there is no error record. During operation with mid-low voltage Lv (LvA, Lvd, Lvn error), there is a record.

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

Default: 0

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

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

Fault Code	bit0	bit1	bit2	bit3	bit4	bit5	bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
0: No fault record							
1: Over-current during acceleration (ocA)	●						
2: Over-current during deceleration (ocd)	●						
3: Over-current during constant speed (ocn)	●						
4: Ground fault (GFF)	●						
6: Over-current at stop (ocS)	●						
7: Over-voltage during acceleration (ovA)		●					
8: Over-voltage during deceleration (ovd)		●					
9: Over-voltage during constant speed (ovn)		●					
10: Over-voltage at stop (ovS)		●					
11: Low-voltage during acceleration (LvA)		●					
12: Low-voltage during deceleration (Lvd)		●					
13: Low-voltage during constant speed (Lvn)		●					
14: Low-voltage at stop (LvS)		●					
15: Phase loss protection (orP)		●					
16: IGBT overheating (oH1)			●				
17: Heatsink overheating (oH2)			●				
18: IGBT temperature detection failure (tH1o)			●				
19: Capacitor hardware error (tH2o)			●				
21: Over load (oL)			●				
22: Electronics thermal relay 1 protection (EoL1)			●				
24: Motor overheating PTC-130 / KTY-84-130 / PT100 (oH3)			●				
26: Over torque 1 (ot1)			●				
28: Under current (uC)			●				
31: EEPROM read error (cF2)	●						
33: U-phase error (cd1)				●			
34: V-phase error (cd2)				●			
35: W-phase error (cd3)				●			
36: cc hardware error (Hd0)				●			

Fault Code	bit0	bit1	bit2	bit3	bit4	bit5	bit6
	current	Volt.	OL	SYS	FBK	EXI	CE
37: oc hardware error (Hd1)				●			
40: Auto-tuning error (AUE)				●			
17: Heatsink overheating (oH2)				●			
41: PID loss ACI (AFE)					●		
48: ACI loss (ACE)					●		
49: External fault (EF)						●	
51: External base block (bb)						●	
52: Password is locked (Pcod)				●			
54: Illegal command (CE1)							●
55: Illegal data address (CE2)							●
56: Illegal data value (CE3)							●
57: Data is written to read-only address (CE4)							●
58: Modbus transmission time-out (CE10)							●
79: U-phase over-current before run (Aoc)	●						
80: V-phase over-current before run (boc)	●						
81: W-phase over-current before run (coc)	●						
82: U-phase output phase loss (oPL1)	●						
83: Output phase loss V phase (oPL2)	●						
84: Output phase loss W phase (oPL3)	●						
87: Low frequency overload protection (oL3)			●				
89: Rotor position detection error (roPd)					●		
90: Force to stop (FStp)				●			
98: Fire mode output (Fire)				●			
140: oc hardware error (Hd6)				●			
141: GFF occurs before run (b4GFF)				●			
142: Auto-tune error 1 (AuE1) (DC test stage)				●			
143: Auto-tune error 2 (AuE2) (high frequency stall stage)				●			
144: Auto-tune error 3 (AuE3) (rotation test stage)				●			
221: High water pressure (HPS)				●			
222: Low water pressure (LPSE)				●			
223: Dry pump (dryE)				●			
224: Water leaking (pipe explosion) (LEKE)				●			
225: Clogged pipe (JAME)				●			
226: RTC error (rtF)				●			
227: Dry pump curve auto-measuring (dAUE)				●			

06-29 PTC-130 / KTY84-130 / PT100 action

Default: 0

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

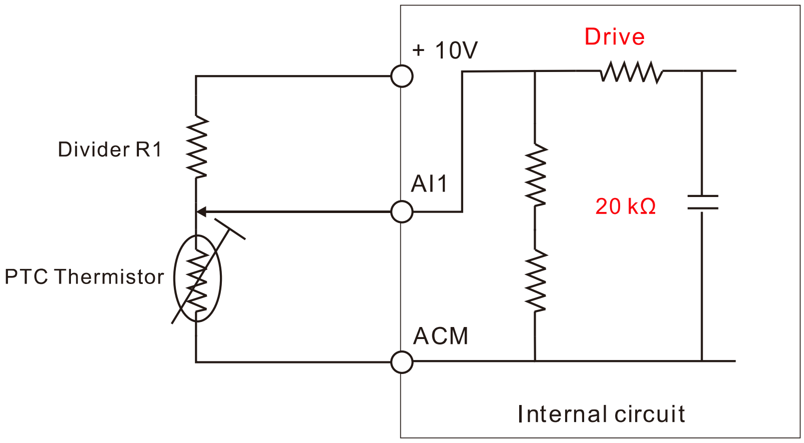
- MSI motor has two kinds of built-in PTC-130 and KTY84-130 thermistors.
- Refer to section 4-3 for the installation of motor and drive.
- Sets the operation mode of a drive after you set Pr.06-29 to define PTC-130 / KTY84-130 detection.
- Running a motor at low frequency for a long time reduces the cooling function of the motor fan. To prevent the motor from damage due to overheating, use a Positive Temperature Coefficient thermistor on the motor, and connect the thermistor output signal to the drive's analog input terminals.

06-30 PTC-130 / KTY84-130 Level

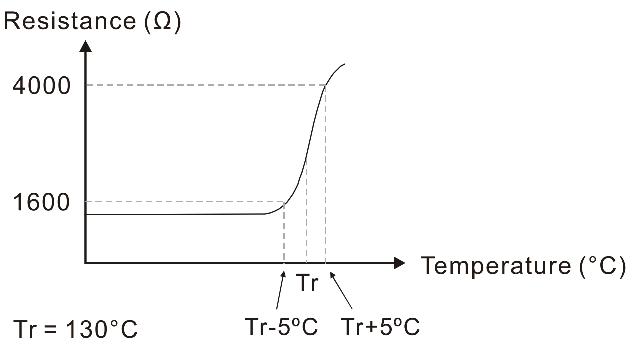
Default: 50.0

Settings 0.0–100.0%

- MSI motor has two kinds of built-in PTC-130 and KTY84-130 thermistors.
- Sets AI1 / AI2 analog input function Pr.03-00 to 6 [Positive temperature coefficient (PTC-130 / KTY84-130) thermistor input value].
- Use this to set the PTC-130 / KTY84-130) level; the corresponding value for 100% is the analog input maximum value.
- When using the AI1 terminal,
  1. you must set Pr.03-28 to 1 and switch AI1 voltage to 0–10 V. At this time, the AVI input impedance is 20 KΩ.
  2. When the temperature reaches to the set protection level, the motor acts according to the settings for Pr.06-29 and displays warning "oH3" (if Pr.06-29 = 1–3). When the temperature is lower than the set protection level, you can press RESET key to clear the fault.
  3. The PTC uses the AVI-input and is connected via resistor-divider as shown below:
     (1) The voltage between +10V to ACM: lies within10V–11V.
     (2) The impedance for AI1 is around 20 KΩ. Recommended value for resistor-divider 1K–10KΩ.
     (3) Please contact your motor dealer for the curve of temperature and resistance value for PTC.
     Protection level (Pr.06-30) = V+10 *(RPTC//20K)/[R1+(RPTC//20K)]
     - V+10: voltage between +10V-ACM
     - RPTC: motor PTC overheat protection level;
     - 20KΩ: is AVI input impedance;
     - R1: PTC-130 resistor-divider (recommended value: 1–10kΩ); KTY84-130 resistor-divider connects to 2 kΩ



Take the standard PTC-130 thermistor as example: if protection level is 4000 Ω, the voltage between +10V-ACM is 10.5V and resistor-divider R1 is 4.4 kΩ.



Refer to following calculation for Pr.06-30 setting:
40000//20000 = (40000 x 20000) ÷ (1330 + 20000) = 3333.33 Ω
10.5 x 3333.33 ÷ (4400 + 3333.33) = 4.52 (V) ≒ 4.5 (V)
Pr.06-30 should be set to 4.5 ÷ 10V x 100% = 45%

06-31 Frequency Command for Malfunction

Default: Read only

Settings 0.00–180.00 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 0.00–180.00 Hz

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

06-33 Output Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

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

06-34 DC bus Voltage at Malfunction

Default: Read only

Settings 0.0–6553.5 V

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

06-35 Output Current at Malfunction

Default: Read only

Settings 0.00–655.35 Amp

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

06-36 IGBT Temperature at Malfunction

Default: Read only

Settings 0.0–6553.5ºC

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

06-38 Motor Speed at Malfunction

Default: Read only

Settings 0.0–65535 rpm

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

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

Default: Read only

Settings 0000h–FFFFh

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

Default: Read only

Settings 0000h–FFFFh

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

06-42 Drive Status at Malfunction

Default: Read only

Settings 0000h–FFFFh

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

06-45 Output Phase Loss Detection Action (OPHL)

Default: 3

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

- Pr.06-45 = 0: When phase loss protection is triggered, the keypad displays OPL1 (U-phase output phase loss), OL2 (U-phase output phase loss), OPL3 (W-phase output phase loss).
- Pr.06-45 = 1, 2: When phase loss protection is triggered, the keypad displays OPHL.

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

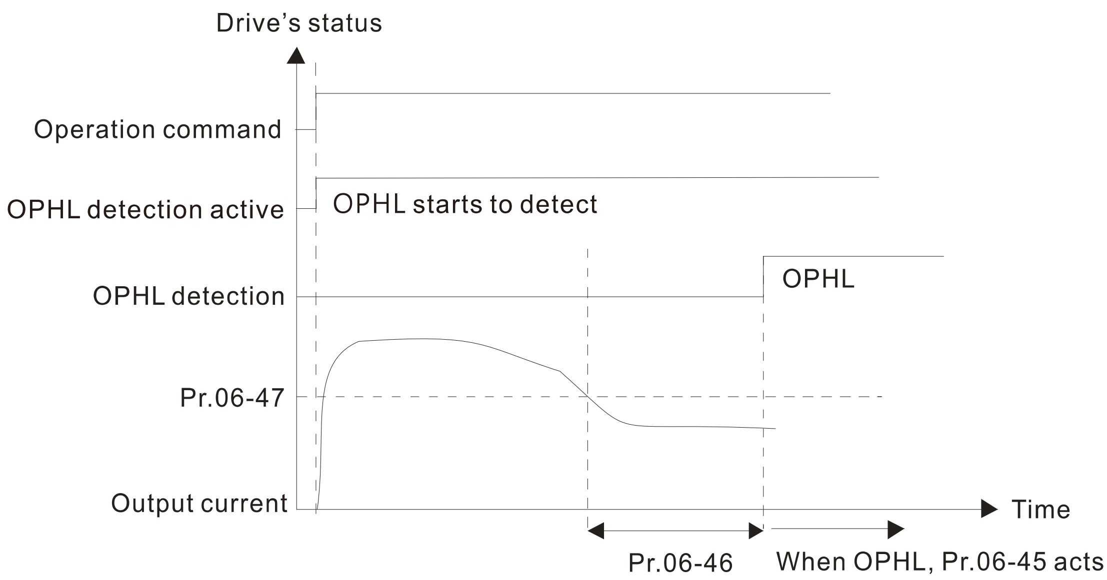
Settings 0.00–100.00%

06-48 DC Brake Time for Output Phase Loss

Default: 0.000

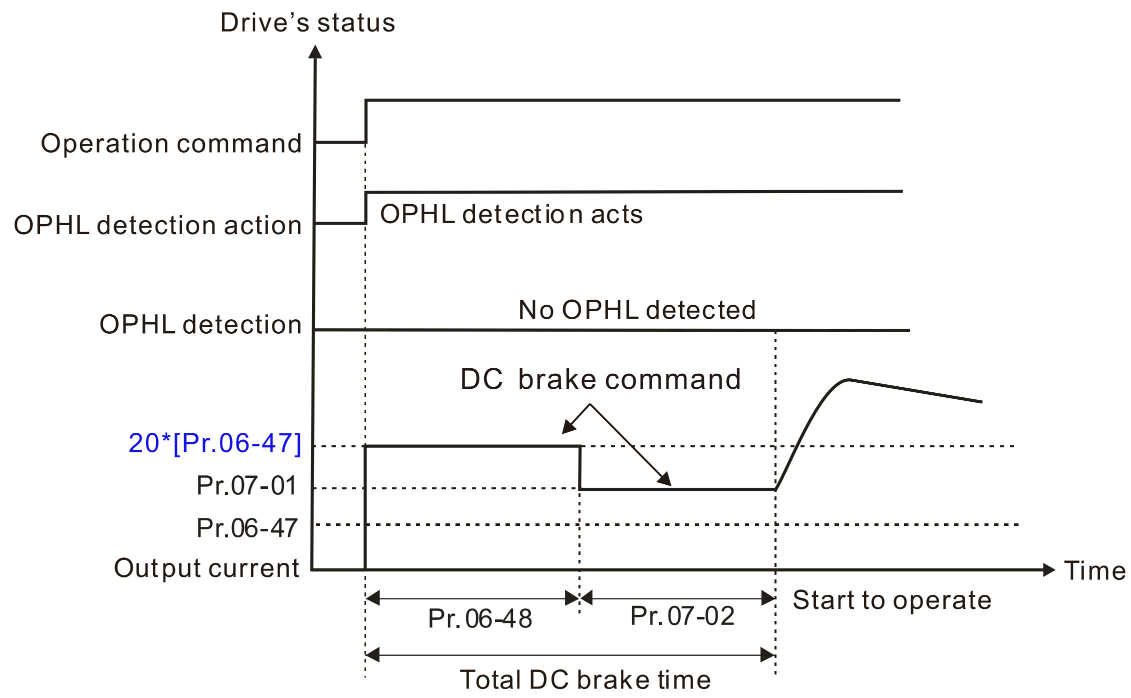
Settings 0.000–65.535 sec.

- The base of Pr.06-47 is rated current (Pr.00-01).
- Setting Pr.06-48 to 0 disables the OPHL detection function.
- Example:
  If the rated current = 10A, Pr.06-47 = 1%, Pr.06-48 =3 seconds, then triggers phase loss protection when the output current is lower 10A x 1% =1A and continues for 3 seconds.
- 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.

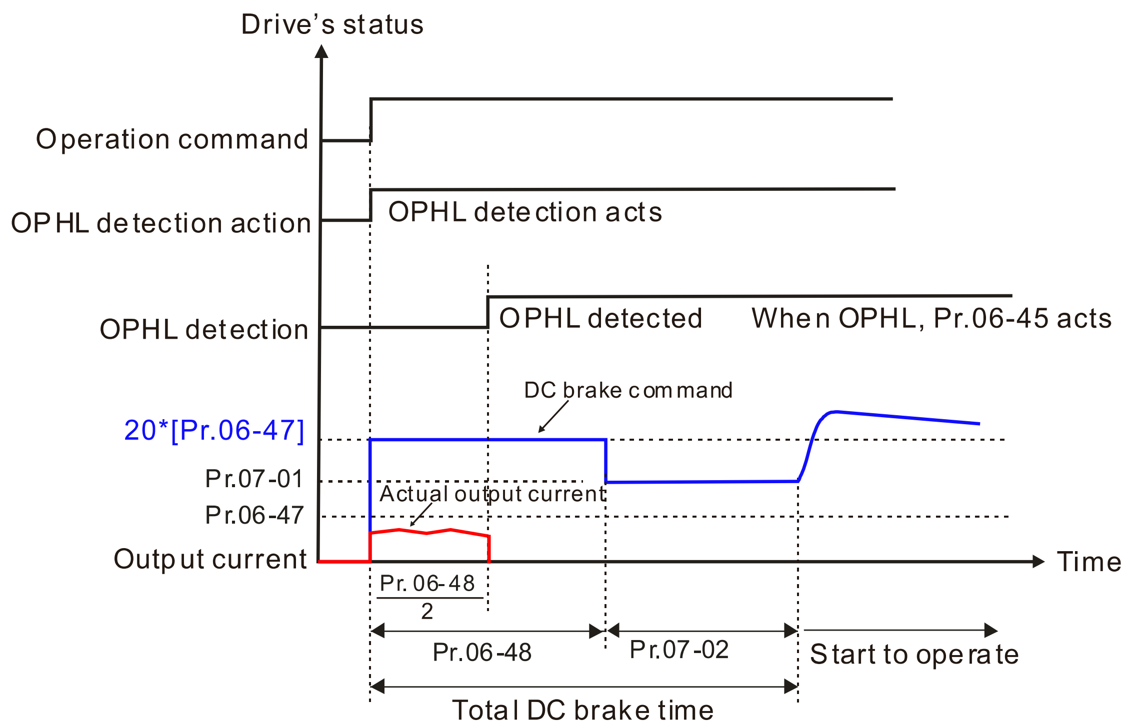


📖 Status 2: The drive is in STOP; Pr.06-48 ≠ 0; Pr.07-02 ≠ 0
When the drive starts, it executes Pr.06-48 first, and then executes Pr.07-02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the Pr.06-47 setting value in Pr.06-48 setting time; the other is the Pr.07-01 setting value in Pr.07-02 setting time.

Status 2-1: Pr.06-48 ≠ 0, Pr.07-02 ≠ 0 (No OPHL detected before the operation)

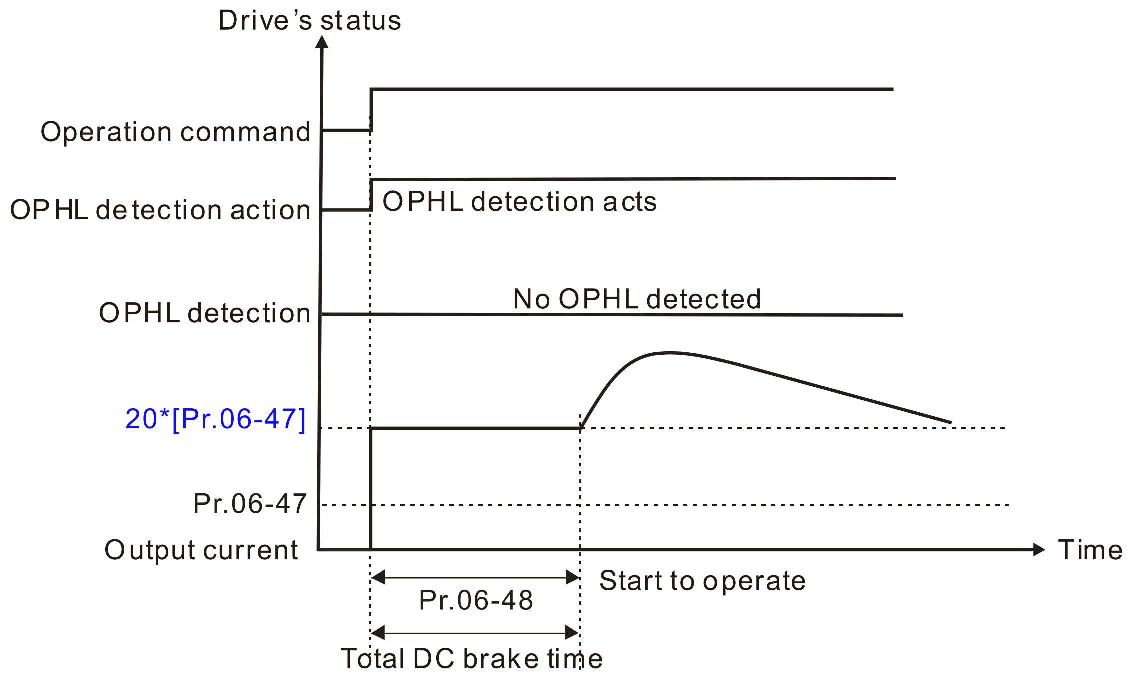


Status 2-2: Pr.06-48 ≠ 0, Pr.07-02 ≠ 0 (OPHL detected before the operation)
In this period, if an OPHL happens within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.



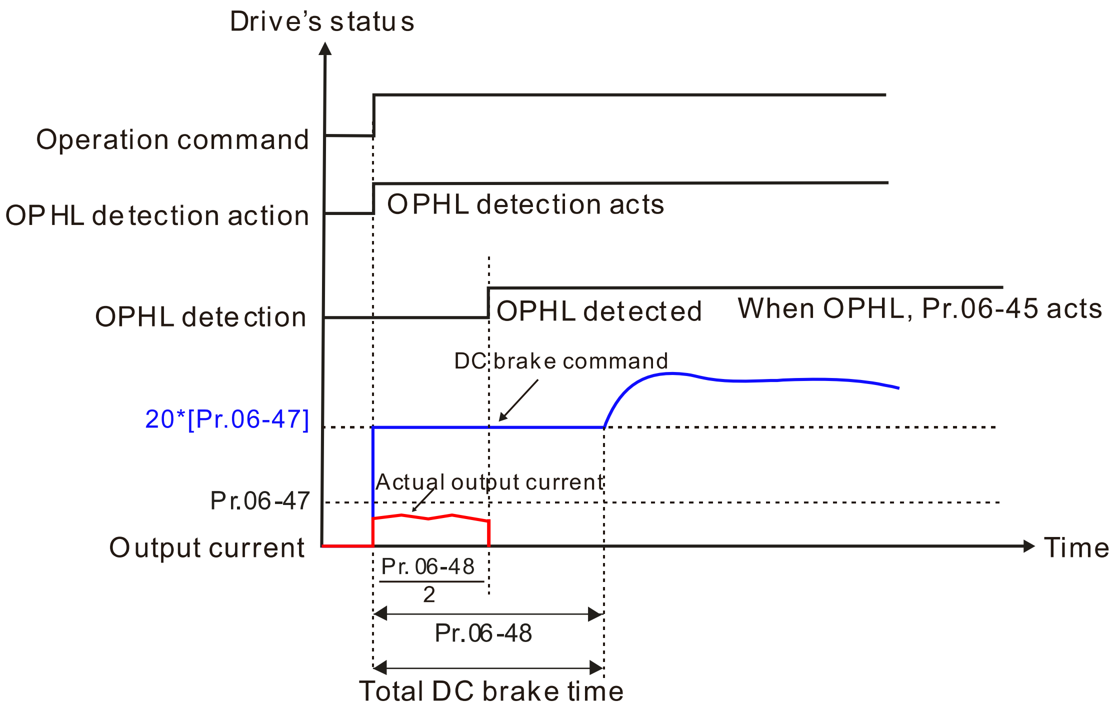
📖 Status 3: The drive is in STOP; Pr.06-48 ≠ 0; Pr.07-02 = 0
When the drive starts, it executes Pr.06-48 as the DC brake. The DC brake current level is 20 times the Pr.06-47 setting value.

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



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

In this period, if an OPHL happens within the time for Pr.06-48, the drive executes the Pr.06-45 setting after the drive starts counting for half the time of Pr.06-48.



06-49 LvX Auto-reset

Default: 0

Settings 0: Disable
1: Enable

06-53 Detected Input Phase Loss Action (OrP)

Default: 0

Settings 0: Warn and ramp to stop
1: Warn and coast to stop

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

06-55 Derating Protection

Default: 0

Settings 0: Constant rated current and limit carrier wave by load current and temperature
1: Constant carrier frequency and limit load current by setting carrier wave
2: Constant rated current (same as setting 0), but close current limit

- Refer to section 9-4-2 for the carrier frequency of derating.
- Setting 0:

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

Take VFD8A5MP43JNNAA for example:

Ambient temperature 40°C, 100% duty, and independent installation. When the carrier frequency is set to 8 kHz, it corresponds to 85% of the rated output current. When the output current is higher than this value, it automatically decreases the carrier wave according to the ambient temperature, output current and overload time. At this time, the overload capacity of the drive is still 150% of the rated current.

- Setting 1:

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

Take VFD8A5MP43JNNAA for example:

when the carrier frequency is to be maintained at 8 kHz, the rated current decreases to 85%. The OL protection executes when the current is 120% x 85% = 102% for one minute; therefore, it must operate by the curve to keep the carrier frequency.

- Setting 2:

The protection method and action are the same as setting it to 0, but this disables the current limit when output current is the derating ratio ×120% (default value).

The advantage is that this can provide a higher starting output current when the carrier frequency setting is higher than the default. The disadvantage is that the carrier waves derate easily when it overloads.

- Example:

When Pr.06-55 = 0 or 1, over-current stall prevention level = ratio x Pr.06-03.

When Pr.06-55 = 2, the over-current stall prevention level = Pr.06-03.

- Use with the settings for Pr.00-16 and Pr.00-17.
- The ambient temperature also affects the derating; refer to section 9-4-1 for ambient temperature derating curve.

Example:

Take VFD8A5MP43JNNAA for example:

Ambient temperature 40ºC, and independent installation. When the carrier frequency is set to 8 kHz, it corresponds to 85% of the rated output current. The ambient temperature 50ºC corresponds to 75% x 75% 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: Pr.06-57 > Pr.06-56.

06-58 PT100 Level 1 Frequency Protection

Default: 0.00

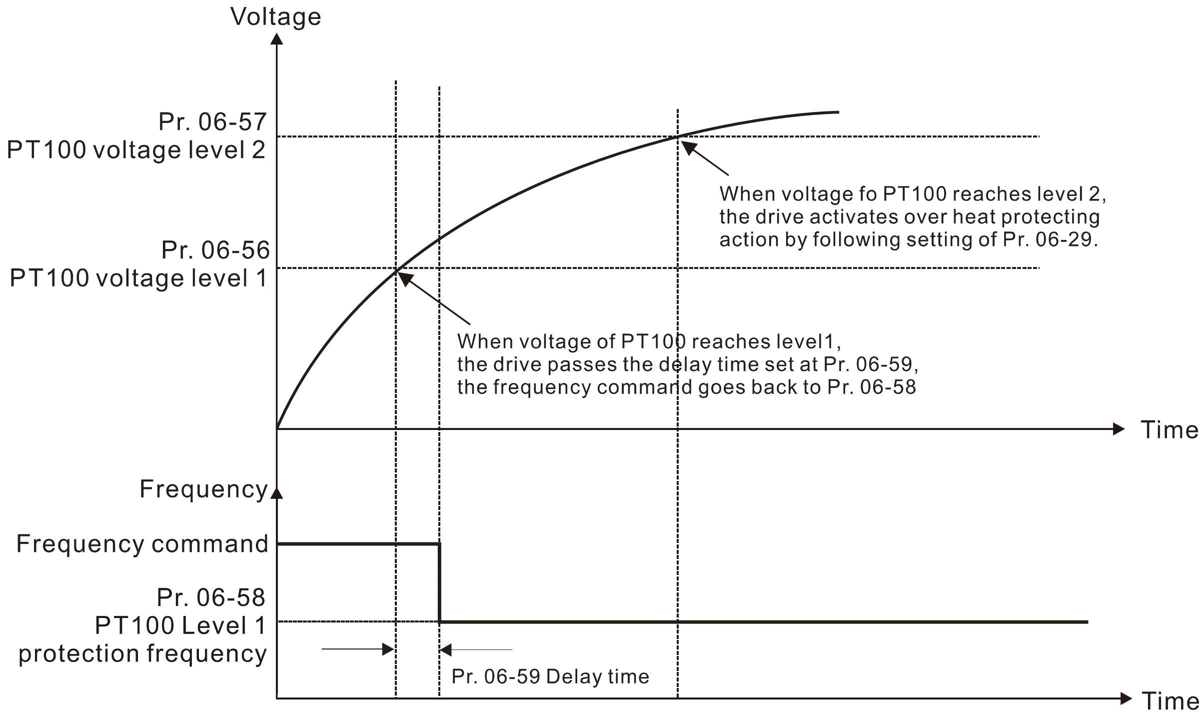
Settings 0.00–180.00 Hz

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 (AI1 voltage 0–10 V) and select PT100 mode.
  2. When selecting Pr.03-00 = 11 and Pr.03-28 = 0, you must switch AI1 to 0–10 V.
  3. The AFM outputs constant voltage or current, then Pr.03-20 = 23.
  4. Use Pr.03-32 to adjust the constant voltage or constant current of the AFM output; the setting range is 0–100.00%.
  5. There are two types of action levels for PT100. The diagram below shows the PT100 protecting action.



- When Pr.06-58 = 0.00 Hz, PT100 function is disabled.

  Example:

  When using PT100, if the motor temperature is higher than 135°C (275°F), the drive starts to count the delay time for auto-deceleration (Pr.06-59). The drive decreases the motor frequency to the setting for Pr.06-58 when it reaches the delay time count value. The drive operates at the frequency set for Pr.06-58 until the motor temperature is lower than 135°C (275°F). If the motor temperature is higher than 150°C (302°F), the drive automatically decelerates to STOP and displays the warning “OH3”.

  Set up process:
  1. Wiring:
     Connect external terminal AFM to “+”; Connect external terminal ACM to “-“
     Connect AFM and AVI to “short-circuit”
  2. Pr.03-00 = 11, Pr.03-20 = 23, Pr.03-32 = 45% (9 mA)

3. Refer to the RTD temperature and resistance comparison table
   Temperature = 135°C, resistance = 151.71 Ω, input current: 9 mA, voltage: about 1.37 V_{DC}
   Temperature = 150°C, resistance = 157.33 Ω, input current: 9 mA, voltage: about 1.42 V_{DC}
4. When the RTD temperature > 135°C, the drive decelerates to the specified operation frequency automatically. Then, Pr.06-56 = 1.37 and Pr.06-58 = 10 Hz. When Pr.06-58 = 0, it disables the specified operation frequency.
5. When RTD temperature > 150°C, the drive outputs a fault, decelerates to STOP, and displays the warning "OH3". Then, Pr.06-57 = 1.42 and Pr.06-29 = 1 (warn and ramp to stop).

06-60 Software Detection GFF Current Level

Default: 60.0

Settings 0.0–6553.5%

06-61 Software Detection GFF Filter Time

Default: 0.10

Settings 0.00–655.35 sec.

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

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

Default: Read only

Settings 0–65535 days

06-64 Operation Time of Fault Record 1 (Min.)
06-66 Operation Time of Fault Record 2 (Min.)
06-68 Operation Time of Fault Record 3 (Min.)
06-70 Operation Time of Fault Record 4 (Min.)
06-91 Operation Time of Fault Record 5 (Min.)
06-93 Operation Time of Fault Record 6 (Min.)

Default: Read only

Settings 0–1439 min.

If there is any malfunction when the drive operates, Pr.06-17–06-22 records the malfunctions, and Pr.06-63–06-70 records the operation time for four sequential malfunctions. Check if there is any problem with the drive according to the interval of the recorded fault.
Example:
The first error: ocA occurs after motor drive operates for 1000 minutes.
The second error: ocd occurs after another 1000 minutes.
The third error: ocn occurs after another 1000 minutes.
The fourth error: ocA occurs after another 1000 minutes.
The fifth error: ocd occurs after another 1000 minutes.
The sixth error: ocn occurs after another 1000 minutes.
Then Pr.06-17–06-22 and Pr.06-63–06-70 are recorded as follows:

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

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

06-71 Low Current Setting Level

Default: 0.0

Settings 0.0–100.0%

06-72 Low Current Detection Time

Default: 0.00

Settings 0.00–360.00 秒

06-73 Low Current Action

Default: 0

Settings 0: No function

1: Warn and coast to stop

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

3: Warn and continue operation

- The drive operates according to the setting for Pr.06-73 when the output current is lower than the setting for Pr.06-71 and when the time of the low current exceeds the detection time for Pr.06-72. Use this parameter with the external multi-function output terminal 44 (for low current output).
- The low current detection function does not execute when drive is in sleep or standby status.

06-80 Fire Mode

Default: 0

Settings 0: Disable

1: Forward operation (counter clockwise)

2: Reverse operation (clockwise)

- Use this parameter with multi-function input terminal setting 58 or 59, and multi-function output terminal setting 53.
- 0: Fire detection is invalid.
- 1: The motor operates in a counterclockwise direction (U, V, W).
- 2: The motor operates in a clockwise direction (U, W, V).

06-81 Operating Frequency in Fire Mode

Default: 150.00

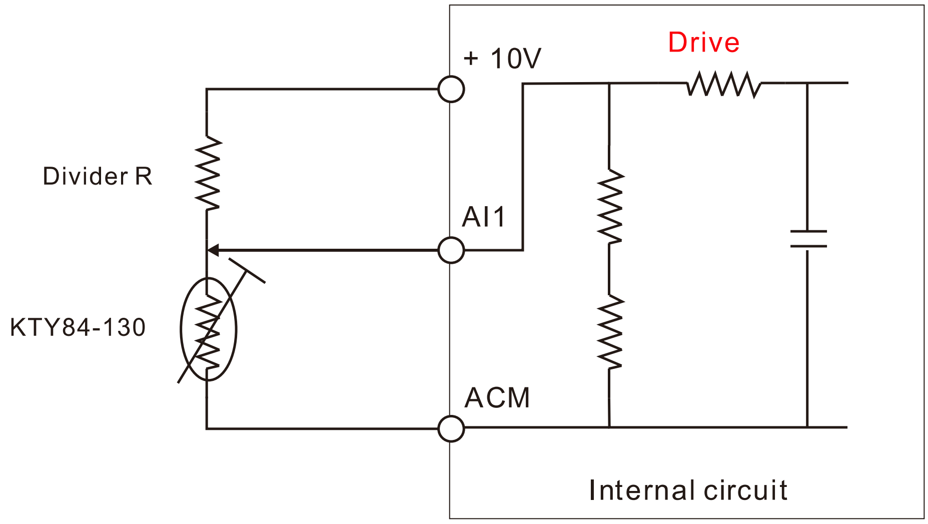
Settings 0.00–180.00 Hz

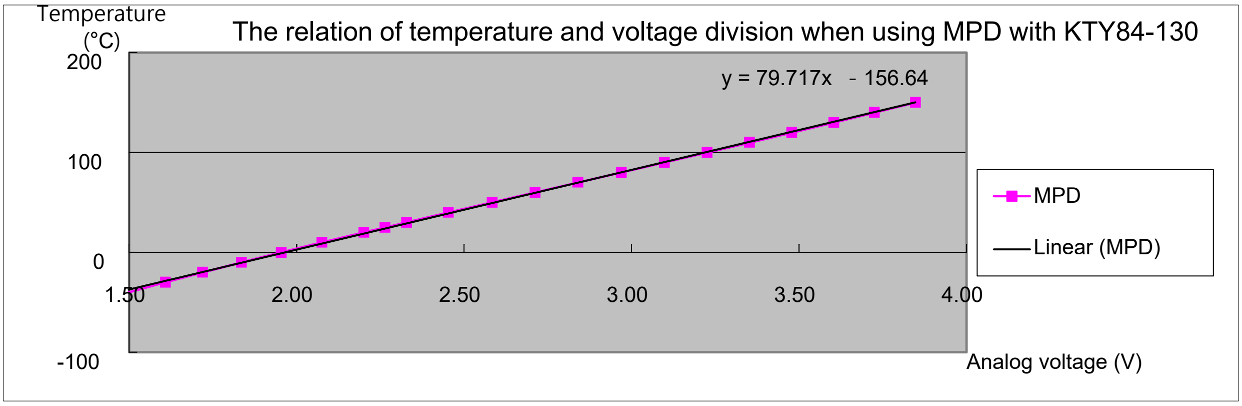
06-86 PTC Type

Default: 0

Settings 0: PTC-130
1: KTY84-130

- When using KTY84-130, users have to select the fixed resistor-divider 2 kΩ (the power cannot smaller than 1/4W) ± 0.1%
- The thermistor and the corresponding resistor-divider are shown as below:





- The drive occurs oH3 fault when the value is over the setting level. When the temperature is lower than the trigger level -5°C, oH3 fault can be cleared.
- If the drive does not connect to KTY84-130 or KTY84-130 is broken and the temperature is not within -40~150°C, then the temperature can only display the upper limit or lower limit, and does not display any information about the fault. The drive still displays oH3 fault, then check if KTY84-130 is installed correctly.
- If a warning occurs during the temperature detection of KTY84-130, acts according to the setting of Pr.06-29.

06-88 Operation times in fire mode

Default: Read only

Settings 0–65535 times

- After triggering fire mode by setting Mix =58, 59, the drive outputs frequency according to Pr.06-81 setting. Pr.06-88 accumulates every time the drive operates.
- if fire mode runs less than 4 minutes, MIx cancels the trigger of fire mode, and returns to the normal state; if fire mode runs over 4 minutes, MIx cancels the trigger of fire mode, and returns to the normal state after running at least 2.5 hours.
- The keypad displays Fire when the fire mode is triggered.

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07 Special Parameters

⌿You can set this parameter during operation.

⌿ 07-01 DC Brake Current Level

Default: 0

Settings 0–100%

📖 Sets the level of the DC brake current output to the motor at start-up and stop. When setting the DC brake current, the rated current is 100%. It is recommended that you start with a low DC brake current level and then increase until you reach the proper holding torque. However, the DC brake current cannot exceed the motor's rated current to prevent the motor from burnout. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.

⌿ 07-02 DC Brake Time At Start-up

Default: 0.0

Settings 0.0–60.0 sec.

📖 The motor may continue rotating 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. Set this parameter to 0.0 to disable the DC brake at start-up.

⌿ 07-03 DC Brake Time At STOP

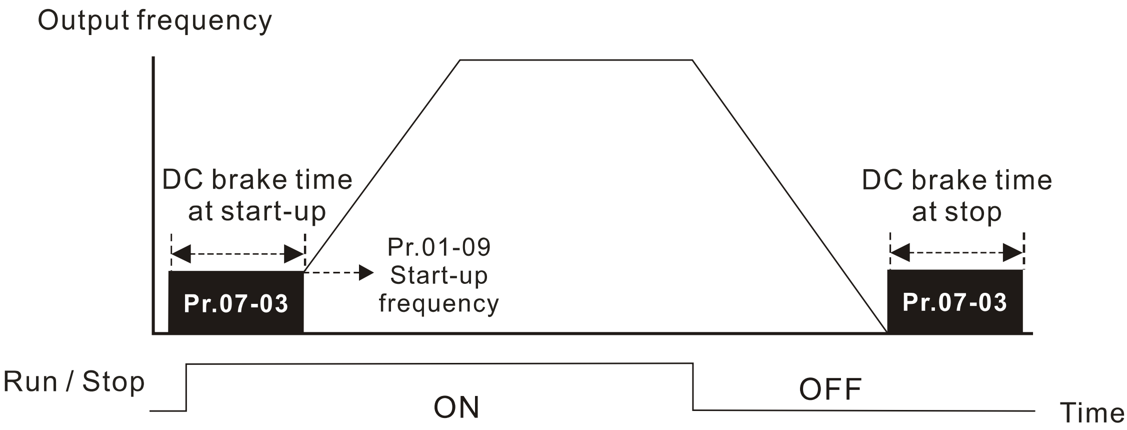
Default: 0.0

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 motor 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.



DC Brake Output Timing Diagram

⌿ 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

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

- The power system connected to the drive may power off momentarily for many reasons. This function allows the drive to keep outputting voltages after the drive is re-powered and does not cause the drive to stop.
- 1: Frequency tracking begins before momentary power loss and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is a lot of inertia with little resistance on the motor load. For example, in equipment with a large inertia flywheel, there is NO need to wait until the flywheel stops completely after a restart to execute the operation command; therefore, it saves time.

07-07 Allowed Power Loss Duration

Default: 2.0

Settings 0.0–20.0 sec.

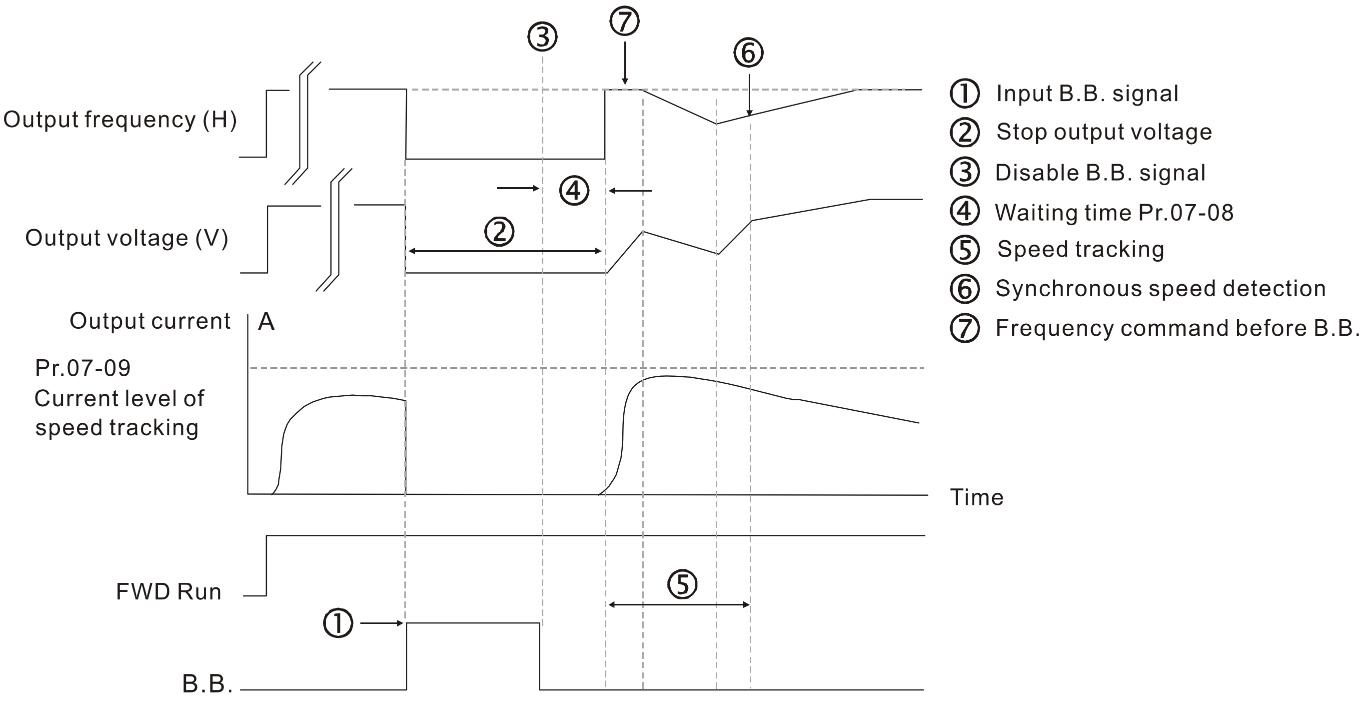
- Determines the maximum time of allowable power loss. If the duration of a power loss exceeds this parameter setting, the AC motor drive stops output after the power recovers.
- Pr.07-06 is valid when the AC motor drive displays "Lv" during the maximum allowable power loss time. If the AC motor drive powers off due to overload which even does not exceed the allowed power loss duration, Pr.07-06 is invalid after the power recovers

07-08 Base Block Time

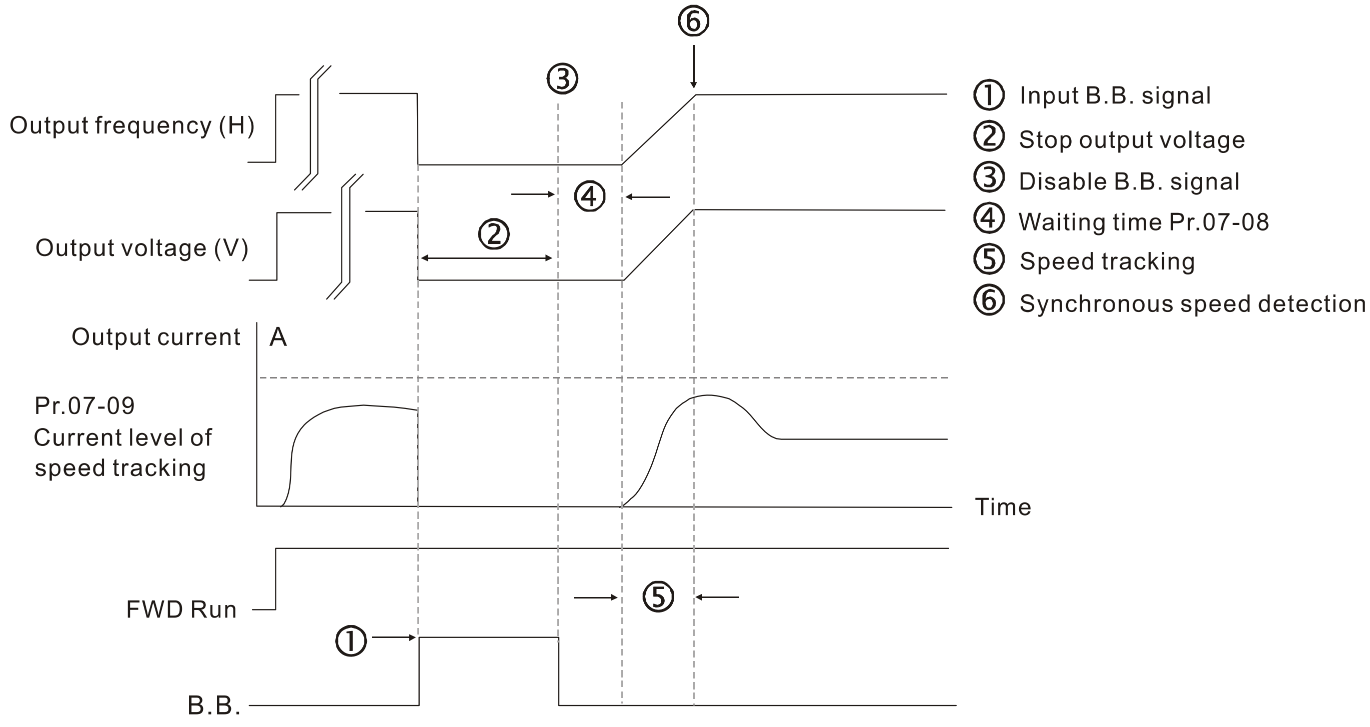
Default: 0.5

Settings 0.1–5.0 sec.

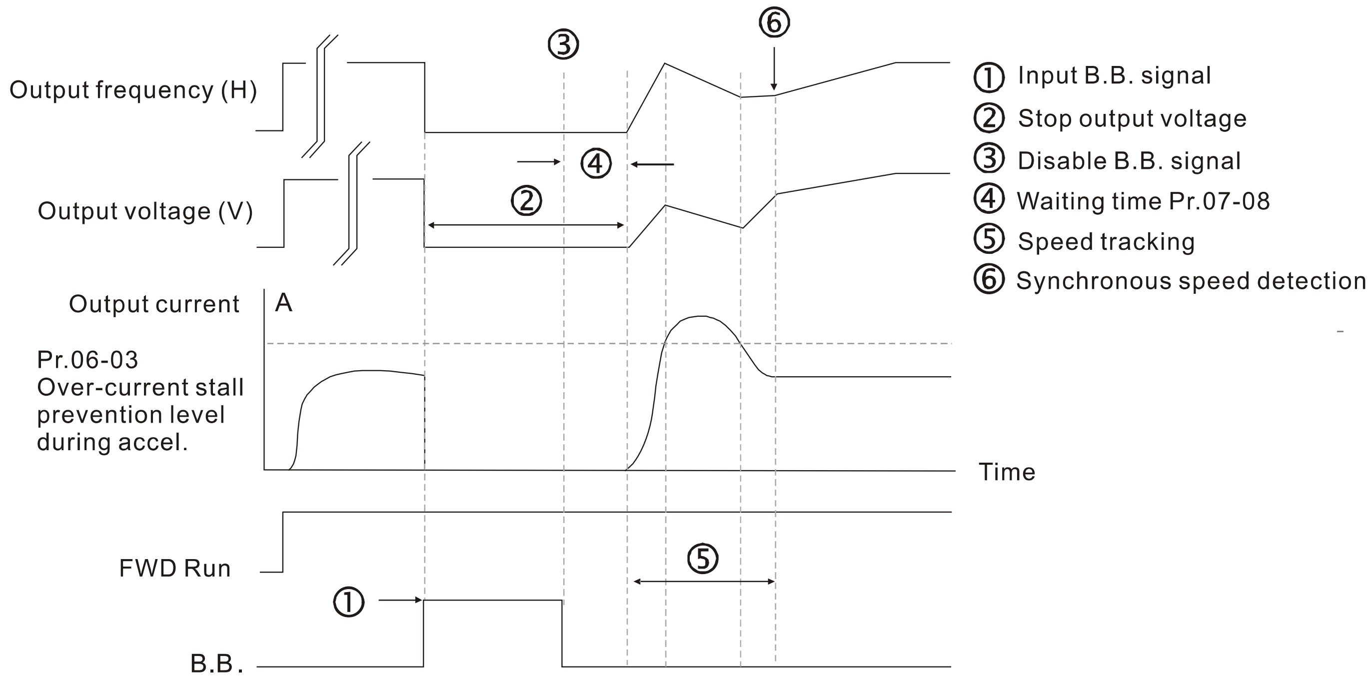
- When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by Pr.07-08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual voltage at the output side to decrease to 0 V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



B.B. Speed tracking: from last output frequency



B.B. Speed tracking: from minimum output frequency



Over-current stall prevention

07-09 Current Limit of Speed Tracking

Default: 100

Settings 20–200%

- The AC motor drive executes speed tracking only 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, 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

- 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, occ. To restart after oc, ov, 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 (allowed fault: oc, ov, 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 does not reset or restart 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: No function
1: Speed tracking by current speed

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

07-20 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.

07-23 Automatic Voltage Regulation (AVR) Function

Default: 0

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

- The rated voltage of a 220V motor is usually 200 VAC, 60 Hz / 50 Hz, and the input voltage of the AC motor drive may vary from 180–264 VAC, 50 Hz / 60 Hz. Therefore, when the AC motor drive is used without the AVR function, the output voltage is the same as the input voltage. When the motor runs at the voltage exceeding 12–20% of the rated voltage, it causes higher temperatures, damaged insulation, and unstable torque output, which result in losses due to shorter motor lifetime.
- The AVR function automatically regulates the output voltage of the AC motor drive to the motor’s rated voltage when the input voltage exceeds the motor’s rated voltage. For example, if the V/F curve is set at 200 VAC, 50 Hz and the input voltage is at 200–264 VAC, then the drive automatically reduces the output voltage to the motor to a maximum of 200 VAC, 50 Hz. If the input voltage is at 180–200 VAC, the output voltage to motor is in direct proportion to the input voltage.
- 0: When the AVR function is enabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage does NOT change when the DC bus voltage changes.

- 1: When the AVR function is disabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage changes with the DC bus voltage, and may cause insufficient current, over-current or oscillation.
- 2: The drive disables the AVR function only during deceleration to stop, and at this time, you can accelerate the braking to achieve the same result.
- When the motor ramps to stop, disable the AVR function to shorten the deceleration time. Then, use with the auto-acceleration and auto-deceleration functions to make the motor's deceleration more stable and quicker.

07-24 Torque Command Filter Time

Default: 0.050

Settings 0.001–10.000 sec.

- 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.

07-26 Torque Compensation Gain

Default: 1

Settings 0–5000

- When the compensation gain is set too high, 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. 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.

07-33 Auto-restart Interval Of Fault

Default: 60.0

Settings 0.0–6000.0

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

07-38 Voltage Feed Forward Gain

Default: 1.00

Settings 0.50–2.00

- Adjusts the voltage feedback forward gain under MSI control, and to meet the demand of rapid feedback application.
- Pr.07-38 = 1.00 means forward feedback = Ke × motor rotor speed

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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

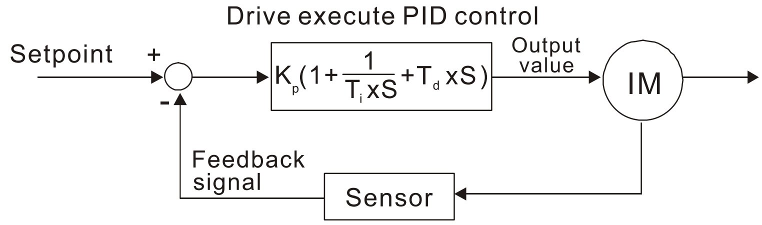
Settings 0: No function

1: Negative PID feedback: by analog input (Pr.03-00)

📖 Negative feedback: Error = Target value (set point) – Feedback. Use negative feedback when the detection value increases if the output frequency increases.

1. 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.

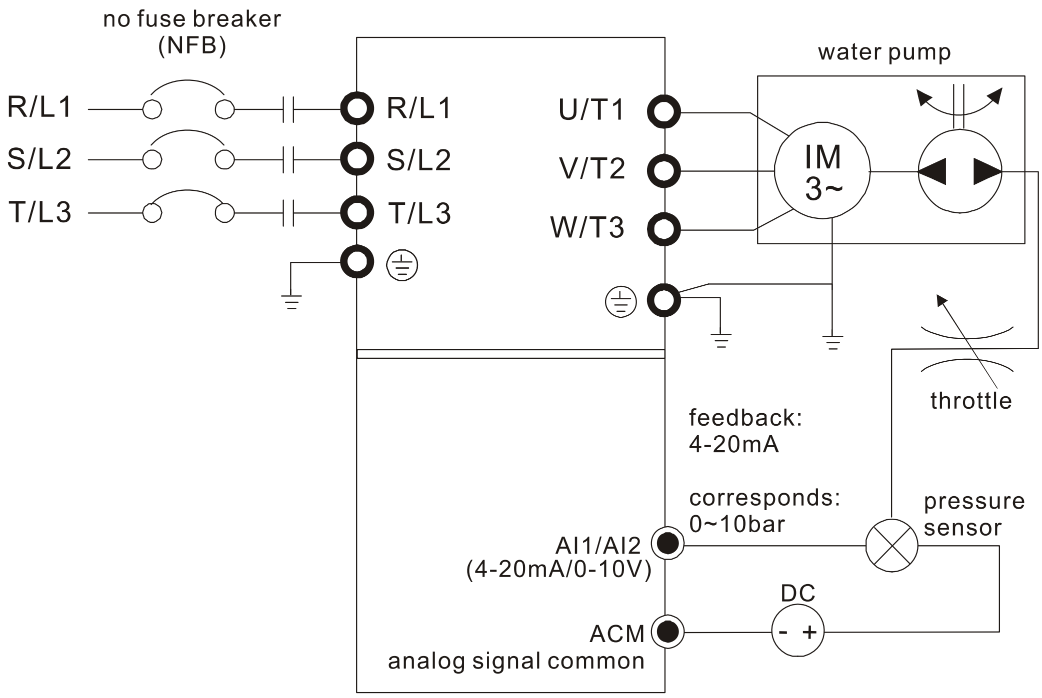
2. PID control loop:



K_P Proportional Gain (P), T_i Integral Time (I), T_d Differential Time (D), S Calculation

3. Concept of PID control:
   (1) Proportional gain (P):
   The output is proportional to input. With only a proportional gain control, there is always a steady-state error.
   (2) 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 the 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.
   (3) 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 0, the differential control should be 0. Use proportional gain (P) and differential control (D) to improve the system state during PID adjustment.

4. 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.00-03 = 4 (displays PID target value and analog feedback signal value)
- 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.00-25 = 353, set user-defined AI signal unit to be one decimal place.
- Pr.00-26 = 10, set user-defined AI signal maximum is 10.0 bar.
- Pr.08-00 = 1 (negative PID feedback from analog input)
- AI1 analog input Pr.03-00 = 5, PID feedback signal.
- Set Pr.03-28 as 2 to be current type sensor 4–20 mA, and make sure DIP switch is on current type side.
- Set Pr.08-01-08-03 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.08-00–08-21 for PID parameter settings.

✔ 08-01 Proportional Gain (P)

Default: 1.00

Settings 0.0–500.0 (when Pr.08-23 setting bit 1=0)
0.00–500.00 (when Pr.08-23 setting bit 1=1)

- 1.0: Kp gain is 100%; if the setting is 0.5, Kp gain is 50%.
- Sets the proportional gain to determine the deviation response speed. The higher the proportional gain, the faster the response speed, and causes oscillation. The lower the proportional gain, the slower the response speed. Eliminates the system deviation; usually used to decrease the deviation and get faster response speed. 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.

- 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 the 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 differential output is 0 when there is no change. Note that you cannot use the differential control independently. You must use it with the other two controllers for the PD controller or PID controller.
- Sets the D controller gain to determine the 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%

- Defines 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) x (Pr.08-04%).
- An excessive integral value causes a slow response due to sudden load changes and may cause motor stall or machine damage. If so, decrease it to a proper value.

08-05 PID Output Command Limit (Positive Limit)

Default: 100.0

Settings 0.0–100.0%

- Defines 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%.

08-20 PID Mode Selection

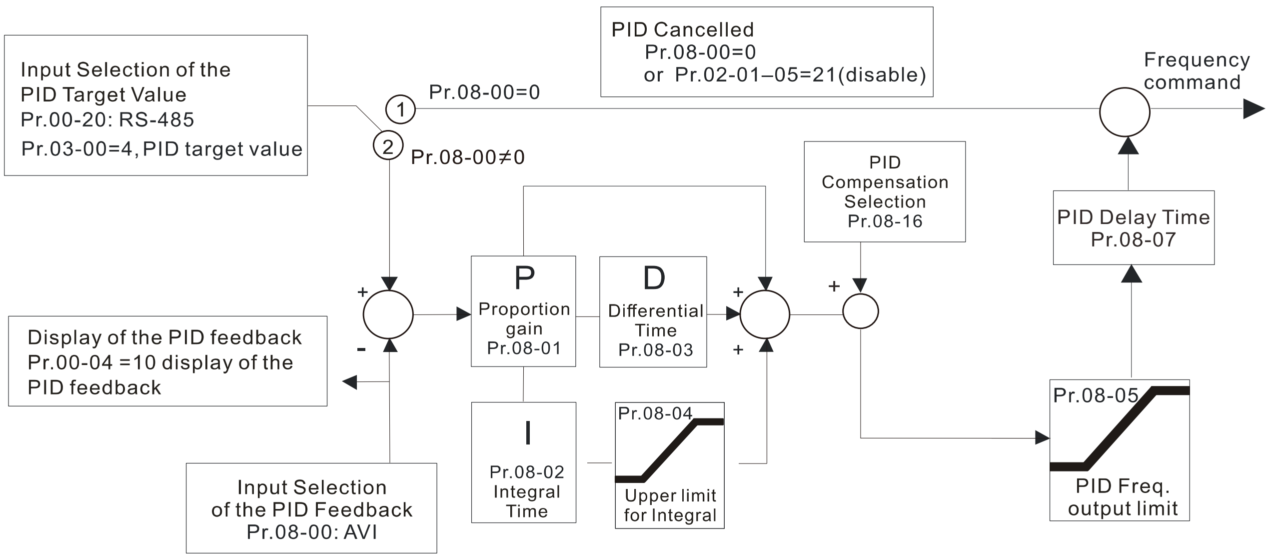
Default: 0

Settings 0: Serial connection
1: Parallel connection

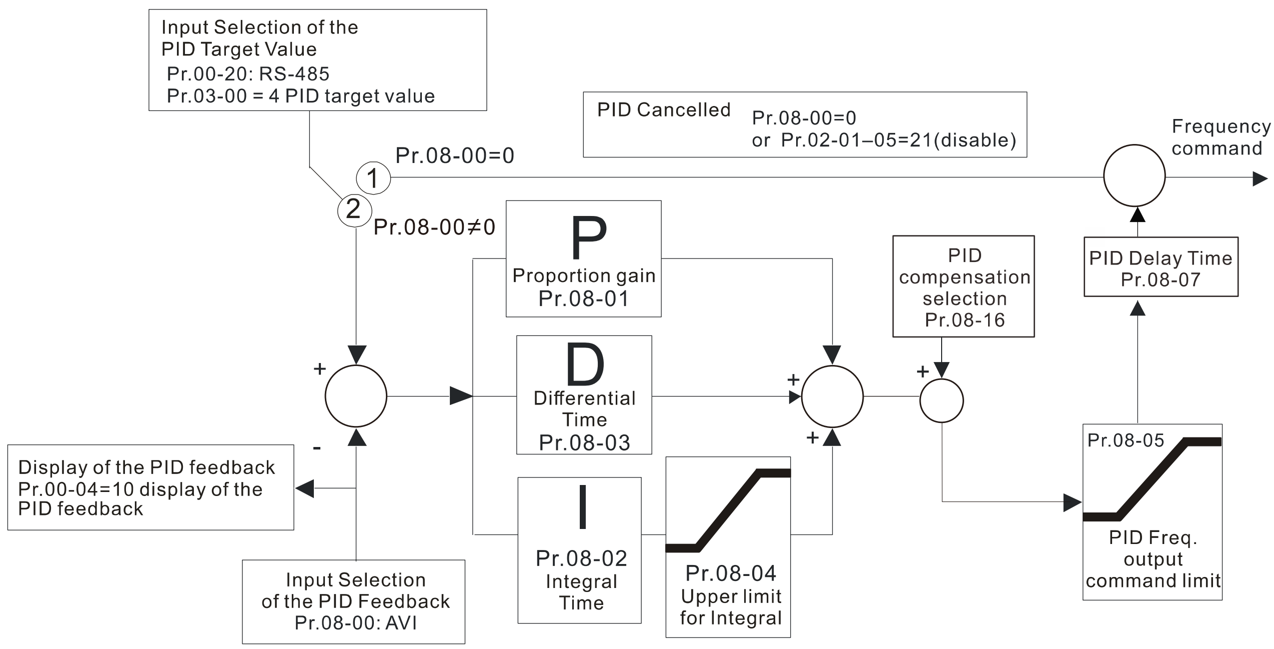
- 0: Use conventional PID control structure.
  1: The proportional gain, integral gain and differential gain are independent. You can customize the P, I and D value to fit your application.
- This parameter determines the primary low pass filter time when in PID control. Setting a large time constant 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 of 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, use 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 response when there is rapid variation. You can use the P action by itself to control the loading system with the integral components.

- PD Control:
  When deviation occurs, the system immediately generates an operation load that is greater than the load generated only by the D action to restrain the deviation increment. If the deviation is small, the effectiveness of the P action decreases as well. The control objects include applications with integral component loads, which are controlled by the P action only. Sometimes, if the integral component is functioning, the whole system may 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 accuracy, 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 4–20 mA (Pr.03-28 = 2).
- 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 Treatment Of Feedback Signal

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 4–20 mA (Pr.03-28 = 2).
- Sets the treatments when the PID feedback signal is abnormal.

⌁ 08-23 PID Control Flag

Default: 2

Settings bit 1 = 1, two decimal places for PID Kp
bit 1 = 0, one decimal place for PID Kp

- When the bit1 setting changes, the Kp gain does not change.
  For example: Kp = 6. When Pr.08-23 bit1 = 0, Kp = 6.0; when Pr.08-23 bit1 = 1, Kp = 6.00.

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09 Communication Parameters

Using communication interface, it's recommended that uses Delta's IFD6530 or IFD6500 as communication adapter, and uses terminal SG+, SG- to connect the drive and PC.

⌿ You can set this parameter during operation.

⌿ 09-00 Communication Address

Default: 1

Settings 1–254

- If RS-485 serial communication controls the AC motor drive, you must set the communication address for this drive in this parameter. Each AC motor drive's communication address must be different.
- When multi-master function of PLC is enabled, every drive has to set the parameter for distinguishing station address.

⌿ 09-01 COM1 Transmission Speed

Default:115.2

Settings 4.8–115.2 Kbps

- Sets the transmission speed of the computer and the drive.
- Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, or 115.2 Kbps; if the setting value is not to be one of the transmission speed mentioned above, then the drive uses 9.6 Kbps.

⌿ 09-02 Treatment of COM1 transmission fault

Default:3

Settings
0: Warn and continue operation
1: Display error and ramp to stop
2: Display error and coast to stop
3: No warning, no error displayed and continue operation

- Sets the response for Modbus communication errors in with the host. Set the detection time in Pr.09-03.
- When a transmission error occurs (for example, the error code CE10 is displayed), the error remains even if the transmission status returns to normal, and does not clear automatically. In this case, set a reset command (Reset) to clear the error.

⌿ 09-03 COM1 Time-out Detection

Default: 0.0

Settings 0.0–100.0 sec.

- Sets the communication time-out.
- It's recommended that sets the value to be 10.0 seconds under multi-master mode (enables built-in PLC function).

⌿ 09-04 COM1 Communication Protocol

Default: 14

Settings
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)

- COM1 is for multi-pump control of MPD.
- COM2 is for writing in PLC, connecting to upper device.

09-05 COM2 transmission speed

Default: 9.6

Settings 4.8–115.2 Kbps

- Sets the transmission speed of the computer and the drive.
- Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, or 115.2 Kbps; if the setting value is not to be one of the transmission speed mentioned above, then the drive uses 9.6 Kbps.

09-06 Treatment of COM2 transmission fault

Default: 3

Settings 0: Warn and continue operation
1: Display error and ramp to stop
2: Display error and coast to stop
3: No warning, no error displayed and continue operation

- Sets the response for Modbus communication errors in with the host. Set the detection time in Pr.09-03.
- When a transmission error occurs (for example, the error code CE10 is displayed), the error remains even if the transmission status returns to normal, and does not clear automatically. In this case, set a reset command (Reset) to clear the error.

09-07 COM2 time-out detection

Default: 0.0

Settings 0.0–100.0 sec.

- Sets the communication time-out.

09-08 COM2 communication protocol

Default: 1

Settings 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)

- Control by PC (Computer Link)
  When using the RS-485 serial communication interface, you must specify each drive's communication address in Pr.09-00. The computer then implements control using the drives' individual addresses.
- Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

1. Code Description

The communication protocol is in hexadecimal, ASCII: "0" … "9", "A" … "F", every hexadecimal value represents an ASCII code. The following table shows some examples.

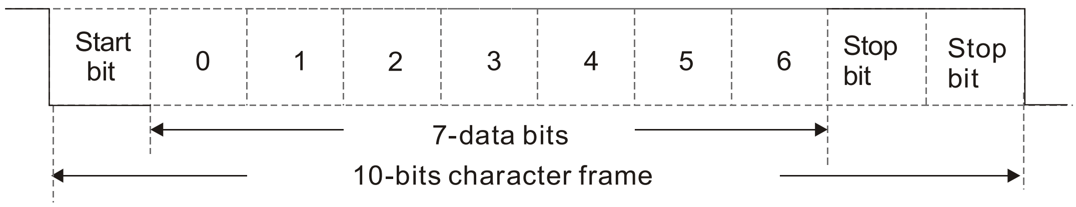
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

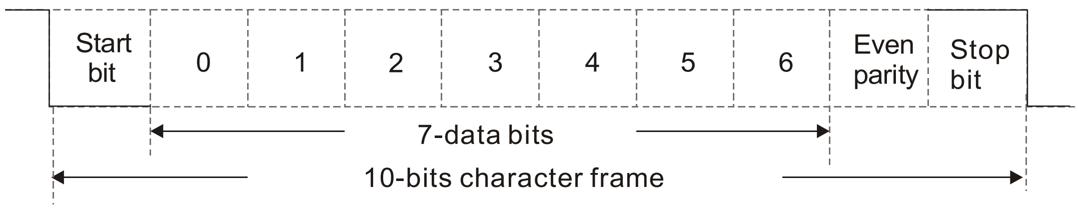
2. Data Format

10-bit character frame (For ASCII):

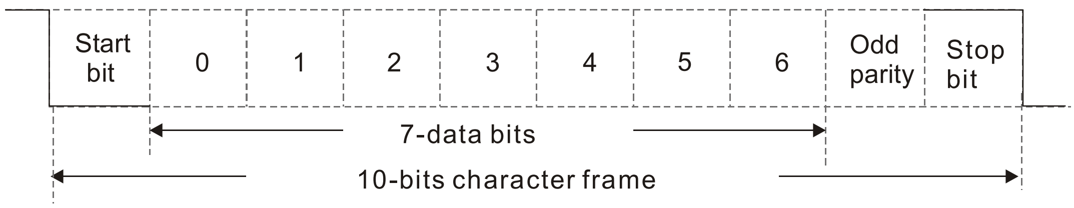
(7, N, 2)



(7, E, 1)

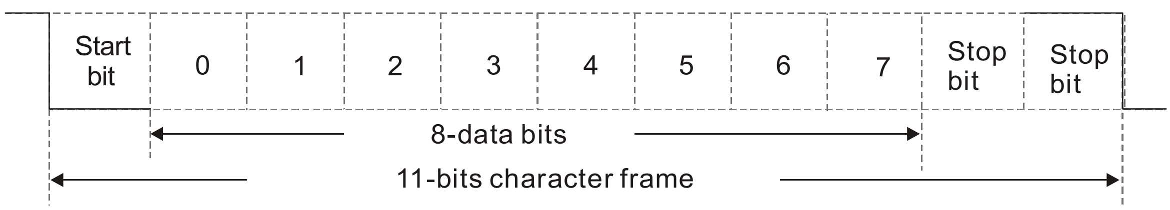


(7, O, 1)

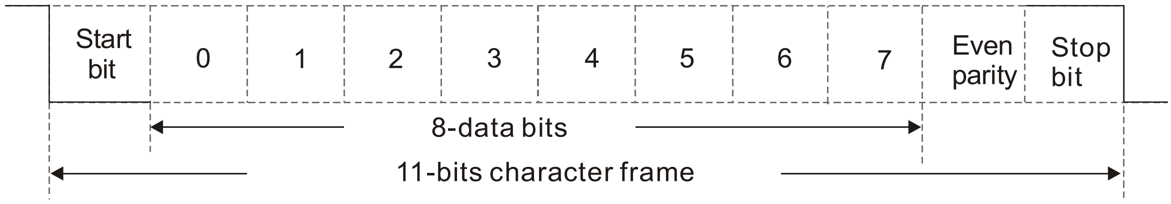


11-bit character frame (For RTU):

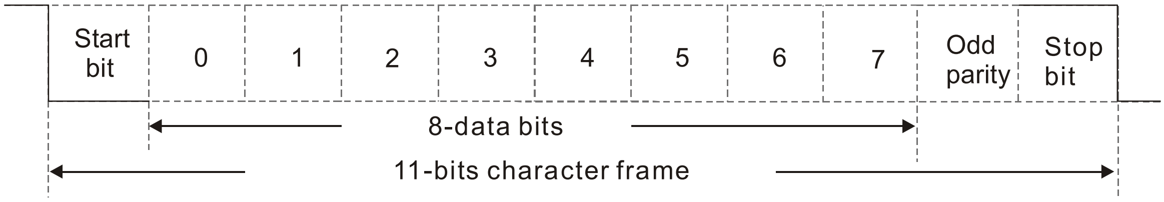
(8, N, 2)



(8, E, 1)



(8, O, 1)



3. Communication Protocol

Communication Data Frame

ASCII mode:

STX	Start character = ' : ' (3AH)
Address Hi	Communication address:
Address Lo	one 8-bit address consists of 2 ASCII codes
Function Hi	Command code:
Function Lo	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 CHK Hi	LRC checksum:
LRC CHK Lo	one 8-bit checksum consists of 2 ASCII codes
END Hi	End characters:
END Lo	END Hi = CR (0DH), END Lo = LF (0AH)

RTU mode:

START	Defined by a silent interval of more than 10 ms
Address	Communication address: 8-bit address
Function	Command code: 8-bit command
DATA (n-1)	Contents of data:
…….	N × 8-bit data, n ≤16
DATA 0	
CRC CHK Low	CRC checksum:
CRC CHK High	one 16-bit checksum consists of 2 8-bit characters
END	Defined by a silent interval of more than 10 ms

Communication Address (Address)

00H: broadcast to all AC motor drives
01H: AC motor drive of address 01
0FH: AC motor drive of address 15
10H: AC motor drive of address 16
:
FEH: AC motor drive of address 254

Function code (Function) and DATA (Data characters)
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 world)	00H
	02H
CRC CHK Low	6FH
CRC CHK 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 CHK Low	FEH
CRC CHK High	5CH

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’

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

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 CHK Low	86H
CRC CHK High	22H

Response Message

Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC CHK Low	86H
CRC CHK High	22H

10H: write multiple registers (write multiple data to registers). The system can write up to 20 sets of data simultaneously.

Example: Set the multi-step speed of an AC motor drive (address is 01H):

Pr.04-00 = 50.00 (1388H), Pr.04-01 = 40.00 (0FA0H)

ASCII Mode:

Command Message

STX	':'
ADR 1	'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 (bytes)	04
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	‘9’
CRC Check High	‘A’

Response Message

ADR	01H
CMD 1	10H
Target register	05H
	00H
Number of register (count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

Checksum

ASCII mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2’s-complement negation of the sum.

Example:

01H + 03H + 21H + 02H + 00H + 02H = 29H, the 2’s-complement negation of 29H is **D7**H.

RTU mode:

CRC (Cyclical Redundancy Check) is calculated by the following steps:

Step 1: Load a 16-bit register (called CRC register) with FFFFH.

Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

Step 3: Examine the LSB of CRC register.

Step 4: If the LSB of CRC register is 0, shift the CRC register one bit to the right, fill MSB with zero, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right, fill MSB with zero, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

Step 5: Repeat step 3 and 4 until you perform eight shifts. This processes a complete 8-bit byte.

Step 6: Repeat step 2 through 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, that is, the lower order byte is transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

Unsigned int crc_chk(unsigned char* data, unsigned char length)

```
{
    int j;
    unsigned int reg_crc=0Xffff;
    while(length--){
        reg_crc ^= *data++;
        for(j=0;j<8;j++){
            if(reg_crc & 0x01){   /* LSB(b0)=1 */
                reg_crc=(reg_crc>>1) ^ 0Xa001;
            }else{
                reg_crc=reg_crc >>1;
            }
        }
    }
    return reg_crc;                    // return register CRC
}
```

4. Address list

Content	Register	Function	
AC motor drive parameters	GGnnH	GG is the parameter group, nn is the parameter number; for example, the address of Pr.04-10 is 040AH.	
Command write only	2000H	bit 1–0	00B: No function
			01B: Stop
			10B: Run
			11B: JOG + RUN
		bit 3–2	Reserved
		bit 5–4	00B: No function
			01B: FWD
			10B: REV
			11B: Change direction
		bit 7–6	00B: 1st acceleration / deceleration
			01B: 2nd acceleration / deceleration
			10B: 3rd acceleration / deceleration
			11B: 4th acceleration / deceleration
		bit 11–8	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
			1100B: 12th Step speed frequency
			1101B: 13th Step speed frequency
			1110B: 14th Step speed frequency
			1111B: 15th Step speed frequency

Content	Register	Function	
		bit 12	1: Enable bit 06–11 function
		bit 14–13	00B: No function
			01B: Operated by digital keypad
			10B: Operated by Pr.00-21 setting
			11B: Change operation source
		bit 15	Reserved
	2001H	Frequency command (XXX.XX Hz)	
	2002H	bit 0	1: EF (external fault) on
		bit 1	1: Reset
		bit 2	1: B.B. ON
		bit 4–3	Reserved
		bit 5	1: Trigger fire mode 0: Does not trigger fire mode Note: Clear bit 5 = 1, issues STOP command to clear by communication
		bit 15–6	Reserved
Status monitor read only	2100H	High byte: Warn code Low Byte: Error code	
	2101H	bit 1–0	AC motor drive operation status 00B: Drive stops 01B: Drive decelerating 10B: Drive standby 11B: Drive operating
		bit 2	1: JOG command
		bit 4–3	Operation direction 00B: FWD run 01B: From REV run to FWD run 10B: REV run 11B: From FWD run to REV run
		bit 8	1: Master frequency controlled by communication interface
		bit 9	1: Master frequency controlled by analog signal
		bit 10	1: Operation command controlled by communication interface
		bit 11	1: Parameter locked
		bit 12	1: Enable to copy parameters from keypad
		bit 15–13	Reserved
	2102H	Frequency command (XXX.XX Hz)	
	2103H	Output frequency (XXX.XX Hz)	
	2104H	Output current (XX.XX A). When current is higher than 655.35, it shifts the decimal as (XXX.X A). The decimal can refer to High byte of 211F.	
	2105H	DC bus voltage (XXX.X V)	
	2106H	Output voltage (XXX.X V)	
	2107H	Current step number of multi-step speed operation	
	2108H	Reserved	
	2109H	Counter value	
	210AH	Power factor angle (XXX.X)	
	210BH	Output torque (XXX.X %)	
	210CH	Motor speed (XXXXX rpm)	
	210DH	Reserved	
	210EH	Reserved	
	210FH	Prompt Power output (X.XXX kW)	
	2116H	Multi-function display (Pr.00-04)	
	211BH	Maximum Operation Frequency (Pr.01-00) or Maximum User-defined Value (Pr.00-26)	

Content	Register	Function
		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	High byte: decimal of current value (display)
	2157H	Display the position of multi-point positioning
	2200H	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	Display counter value (c)
	2202H	Actual output frequency (XXXXX Hz)
	2203H	DC bus voltage (XXX.X V)
	2204H	Output voltage (XXX.X V)
	2205H	Power angle (XXX.X)
	2206H	Display actual motor speed kW of U, V, W (XXXXX kW)
	2207H	Display motor speed in rpm estimated by the drive (XXXXX rpm)
	2208H	Display positive / negative output torque in %, estimated by the drive (+0.0: positive torque, -0.0: negative torque) (XXX.X%)
	2209H	Reserved
	220AH	PID feedback value after enabling PID function (XXX.XX%)
	220BH	Display signal of AI1 analog input terminal, 0–10 V / 0–20 mA / 4–20 mA correspond to 0.00–100.00% (see NOTE 1 in Pr.00-04)
	220CH	Display signal of AI2 analog input terminal, 0–10 V / 0–20 mA / 4–20 mA correspond to 0.00–100.00% (see NOTE 1 in Pr.00-04)
	220DH	Reserved
	220EH	IGBT temperature of drive power module (XXX.X °C)
	220FH	Reserved
	2210H	The status of digital input (ON / OFF), refer to Pr.02-12 (see NOTE 3 in Pr.00-04)
	2211H	The status of digital output (ON / OFF), refer to Pr.02-18 (see NOTE 4 in Pr.00-04)
	2212H	The multi-step speed that is executing (S)
	2213H	The corresponding CPU pin status of digital input (d.) (see NOTE 3 in Pr.00-04)
	2214H	The corresponding CPU pin status of digital output (O.) (see NOTE 4 in Pr.00-04)
	2215H	Reserved
	2216H	Frequency of pulse input (XXX.XX Hz)
	2217H	Reserved
	2218H	Reserved
	2219H	Display times of counter overload (XXX.XX%)
	221AH	GFF (XXX.XX%)
	221BH	DC BUS voltage ripples (XXX.X V)
	221DH	Number of poles of a permanent magnet motor
	221EH	User page displays the value in physical measure
	221FH	Output value of Pr.00-05 (XXX.XX Hz)
	2220H	Reserved
	2221H	Reserved
	2222H	Reserved
	2223H	Control mode of the drive. 0: speed mode 1: torque mode
	2224H	Carrier frequency of the drive (XX kHz)
	2225H	Reserved

Content	Register	Function
	2226H	Drive status bit 1–0 00b: No direction 01b: Forward 10b: Reverse bit 3–2 01b: Drive ready 10b: Error bit 4 0b: Motor drive did not output 1b: Motor drive did output bit 5 0b: No alarm 1b: Alarm
	2227H	Drive's estimated output torque (positive or negative direction) (XXXX Nt-m)
	2228H	Reserved
	2229H	Accumulate KWH display (XXXX.X)
	222AH	Reserved
	222BH	Reserved
	222CH	Reserved
	222DH	Reserved
	222EH	PID reference (XXX.XX%)
	222FH	PID offset (XXX.XX%)
	2230H	PID output frequency (XXX.XX Hz)
	2231H	Reserved
	2232H	Display auxiliary frequency
	2233H	Display master frequency
	2234H	Display frequency after addition and subtraction of auxiliary and master frequencies.

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 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 CHK	'7'
	'7'
END	CR
	LF

RTU mode:

Address	01H
Function	86H
Exception code	02H
CRC CHK Low	C3H
CRC CHK High	A1H

The explanation of error codes

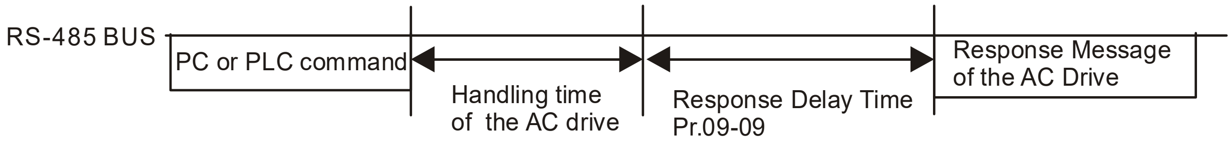
Error code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Failure to execute this function code

09-09 Communication Response Delay Time

Default: 2.0

Settings 0.0–200.0 ms

📖 Sets the response delay time after the AC motor drive receives a communication command as shown in the following.



09-10 Communication Main Frequency

Default: 60.00

Settings 0.00–180.00 Hz

📖 When you set Pr.00-20 to 1 (RS-485 serial communication), the AC motor drive saves the last Frequency command into Pr.09-10 when there is abnormal power off or momentary power loss. After the drive reboots when power is restored, it checks the frequency in Pr.09-10 if no new Frequency command is input. When a Frequency command of 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: 0

Settings 0–65535

📖 There is a group of block transfer parameters available in the AC motor drive (Pr.09-11–Pr.09-26). Using communication code 03H, you can store the parameters (Pr.09-11–Pr.09-26) that you want to read.

09-30 Communication Decoding Method

Default: 0

Settings 0: Decoding method 1
1: Decoding method 2

📖 The EtherCAT communication card only supports Decoding Method 2 (60xx).

		Decoding Method 1	Decoding Method 2
Source of Operation Control	Digital Keypad	Digital keypad controls the drive action regardless of decoding method 1 or 2.	
	External Terminal	External terminal controls the drive action regardless of decoding method 1 or 2.	
	RS-485	Refer to address: 2000h–20FFh	Refer to address: 6000h–60FFh

09-31 COM1 internal communication protocol

Default: 0

Settings 0: Modbus 485
-12: Modbus master (for PLC)
-21: ID1 (Pump Master)
-22: ID2 (Pump Slave)
-23: ID3 (Pump Slave)
-24: ID4 (Pump Slave)
-25: ID5 (Pump Slave)
-26: ID6 (Pump Slave)
-27: ID7 (Pump Slave)
-28:ID8 (Pump Slave)

09-33 PLC command force to 0

Default: 0

Settings bit0: Every time before PLC scan, set the PLC target frequency = 0
bit1: Every time before PLC scan, set the PLC target torque = 0
bit2: Every time before PLC scan, set the speed limit of torque mode = 0

Defines whether the Frequency command or the Speed command must be cleared to zero or not before the PLC starts the next scan.

09-34 PLC program ID

Default: 0

Settings 0–65535

09-35 PLC Address

Default: 100

Settings 1–254

09-60 Communication card identification

Default: Read only

Settings 0: No communication card
1: DeviceNet Slave
2: Profibus-DP Slave
5: EtherNet/IP Slave
13: Bluetooth

09-61 Firmware version of communication card

Default: Read only

Settings 0–65535

09-62 Product code

Default: Read only

Settings 0–65535

09-63 Fault code

Default: Read only

Settings 0–65535

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
1: Non-standard DeviceNet

- 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 0–255

- Use Pr.09-76–09-79 with a communication card.

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 0–255

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 0–255

✔ **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: No function
1: Reset to default

✔ **09-91**	Additional setting for the communication card (for EtherNet)

Default: 0

Settings bit 0: Enable IP filter
bit 1: Enable internet parameters
bit 2: Enable login password

- bit0: Sets this bit as 1 to enable IP filter function; sets this bit as 0 to disable IP filter function.
- bit1: Sets this bit as 1, this function updates the parameter settings from internet side (Pr.09-75–09-87) to communication card. After communication card finishes the update, sets this bit as 0 to disable it.
- bit2: Sets this bit as 1, this function updates the login password (Pr.09-88–09-89) to communication card. After communication card finishes the update, sets this bit as 0 to be disable.

09-92	Communication card status (for EtherNet)

Default: Read only

Settings bit 0: Enable password

- bit0: This bit is set as 1 to be enable if communication card sets a password (Pr.09-91, bit2 =1). After clearing the password of communication card, sets this bit as 0 to be disable.

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10 Speed Feedback Control Parameters

✎You can set this parameter during operation.

✎ 10-31 MSI Motor Control Current Compensation Command

Default:40

Settings 0–150% rated current of the motor

- Sets the current command for the drive in low speed area.
  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 Speed Estimator Bandwidth

Default:5.00

Settings 0.00–600.00 Hz

- Sets the speed estimator bandwidth. Adjust the parameter to influence the stability and the accuracy of the motor speed.
- If there is low frequency vibration (the waveform is similar to a 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 Speed Estimator Low-pass Filter Gain

Default:1.00

Settings 0.00–655.35

- Influences the response speed of the speed estimator.
- If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the gain.
- If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the gain.

✎ 10-39 MSI Motor Control Current Compensation Frequency Point

Default:15.00

Settings 0.00–180.00

- If the compensation point is too high, the drive easily runs in the frequency area of current compensation for a long time, which generates a larger current and cannot save energy.

✎ 10-42 Initial Angle Detection Pulse Value

Default:1.0

Settings 0.0–3.0

- It's valid when Pr.10-53 = 3.
- Activates by using pulse injection method. The parameter influences the value of the pulse during the angle detection. The larger the pulse, the higher the accuracy of rotor's position. A larger pulse might cause oc.
- Increases the parameter when the running direction and the command are opposite during start-up. If oc occurs at start-up, then decrease the parameter.

✎ 10-49 Zero Voltage Time During Start-up

Default:00.000

Settings 00.000–60.000 sec.

- This parameter is valid 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 of the drive output to the motor to 0 V. The Pr.10-49 setting time is the length of time for three-phase output at 0 V.
- It is possible that even when you apply this parameter, the motor cannot go in to the static state because of inertia or some external force. If the motor does not go into a complete static state in 0.2 seconds, increase this setting value appropriately.
- If Pr.10-49 is set too high, the start-up time is longer. If it is too low, then the braking performance is weak.

10-51 Injection Frequency

Default:500

Settings 0–1200 Hz

- It's valid when Pr.10-53 = 2.
- This parameter is a high frequency injection command in MSI control, and usually you do not need to adjust it.
  But 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 x 10, then increase the frequency of the carrier frequency.

10-52 Injection Magnitude

Default:30.0

Settings 0.0–200.0 V

- It's valid when Pr.10-53 = 2.
- The parameter is the magnitude command for the high frequency injection signal when detecting MSI angle at start-up.
- 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 accurate.

10-53 Angle Detection Method

Default:0

Settings 0: No function
1: Force attracting the rotor to zero degrees
2: High frequency injection
3: Pulse injection

- Use this parameter to adjust initial angle detection when the motor runs abnormally or has large current at startup.

11 Advanced Parameters

⁄You can set this parameter during operation.

11-00 System Control

Default: 0

Settings bit 3: Dead time compensation closed
bit 7: Save or do not save the frequency

- bit 3 = 0: Enable dead time compensation
- bit 3 = 1: Disable dead time compensation
- bit 7 = 0: Save the frequency before power is OFF. When power is ON again, the saved frequency is displayed.
- bit 7 = 1: Do not save the frequency before power is OFF. When power is ON again, 0.00 Hz is the displayed frequency.

11-41 PWM Mode Selection

Default: 0

Settings 0: Two-phase modulation mode
2: Space vector modulation mode

- Two-phase modulation mode: effectively reduces the drive power component losses and provides better performance in long wiring applications.
- Space vector modulation mode: effectively reduces the power loss and electromagnetic noise of the motor.

⁄ 11-42 System Control Flag

Default: 0000

Settings 0000–FFFFh

bit No.	Functions	Descriptions
0	Reserved	
1	FWD / REV action control	0: FWD / REV cannot be controlled by Pr.02-12 bit 0 & 1. 1: FWD / REV can be controlled by Pr.02-12 bit 0 & 1.
2–15	Reserved	

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12 Function Parameters

✍You can set this parameter during operation.

✍ 12-00 Set Point Deviation Level

Default: 0

Settings 0–50%

- The base of the parameter is the set point of PID control setting (the set point displays on the keypad when Pr.00-03 = 4)

✍ 12-01 Detection Time Of Set Point Deviation Level

Default: 10

Settings 1–9999 sec.

- If the deviation keeps within the range of Pr.12-00 and exceeds the time set in Pr.12-01, the AC motor drive decelerates to stop to be constant pressure status (this deceleration time is the setting for Pr.01-15). The system is in standby status when the deviation is within the range of PID set point (Pr.12-00) during deceleration. In the standby status, when the system pressure is lower than high / low water consumption conditions, the AC motor drive will start operating to pressurize the system.
- Refer to Pr.12-02–12-04 for the settings of high and low water consumption conditions.

✍ 12-02 Offset Level Of Low Water Consumption

Default:10

Settings 0–50%

- The base of the parameter is the set point of PID control setting.
- When the system is in standby status, if the pressure exceeds the deviation of low water consumption setting, the AC motor drive starts pressurizing.

✍ 12-03 Offset Level of High water Consumption

Default: 0

Settings 0: Disabled

0–100%

- The base of the parameter is the set point of PID control setting.

✍ 12-04 High Water Consumption Delay Time

Default: 0.5

Settings 0: Disabled

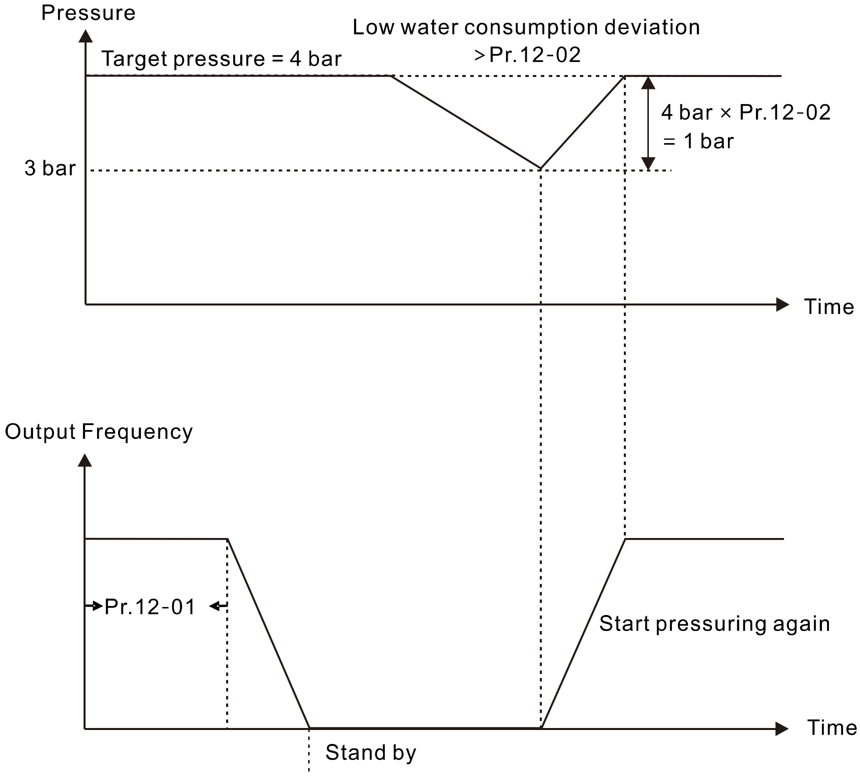
0.1–10.0 sec.

- When the system is in standby status, if the pressure change exceeds the deviation within the time set in Pr.12-03 and 12-04, the AC motor drive starts pressurizing.

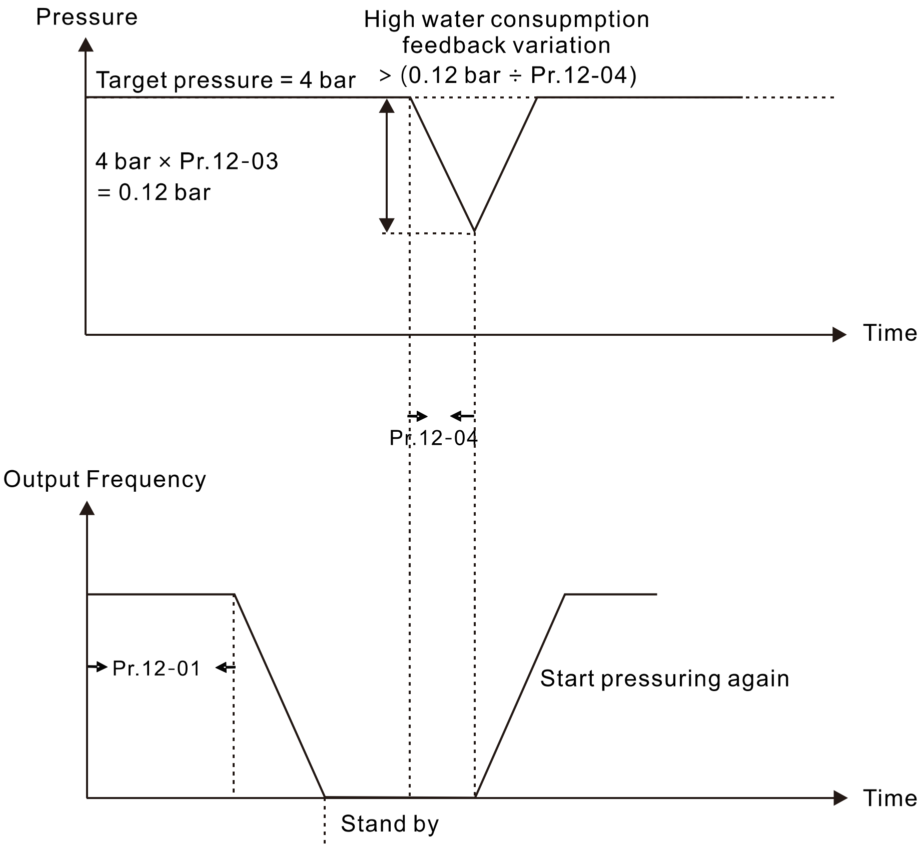
  Example:

  If the set point of constant pressure control of a pump is 4 bar, Pr.12-00 is set to 5%, Pr.12-01 is set to 15 seconds, Pr.12-02 is set to 25%, Pr.12-03 is set to 3% and Pr.12-04 is set to 0.5 seconds, then the deviation is 0.2 bar (4 bar x 5% = 0.2 bar). It means when the feedback value is higher than 3.8 bar for a time exceeding 15 seconds, the AC motor drive decelerates to stop, this deceleration time acts according to Pr.01-15.

Status 1: Low water consumption restart detection
When the AC motor drive is in constant pressure status, it does not operate until the feedback change value is ≥ 1 bar than set point deviation (4 bar x 25% = 1 bar), which means the AC motor drive starts operating when the feedback value is less than 3 bar.



Status 2: High water consumption restart detection
When the AC motor drive is in constant pressure status, it does not operate until the feedback change value exceeds 0.12 bar within 0.5 seconds, which means the AC motor drive starts operating when the feedback value is less than 3.88 bar within 0.5 seconds.



12-08 Frequency To Start Switching Pumps

Default: Max. operation frequency

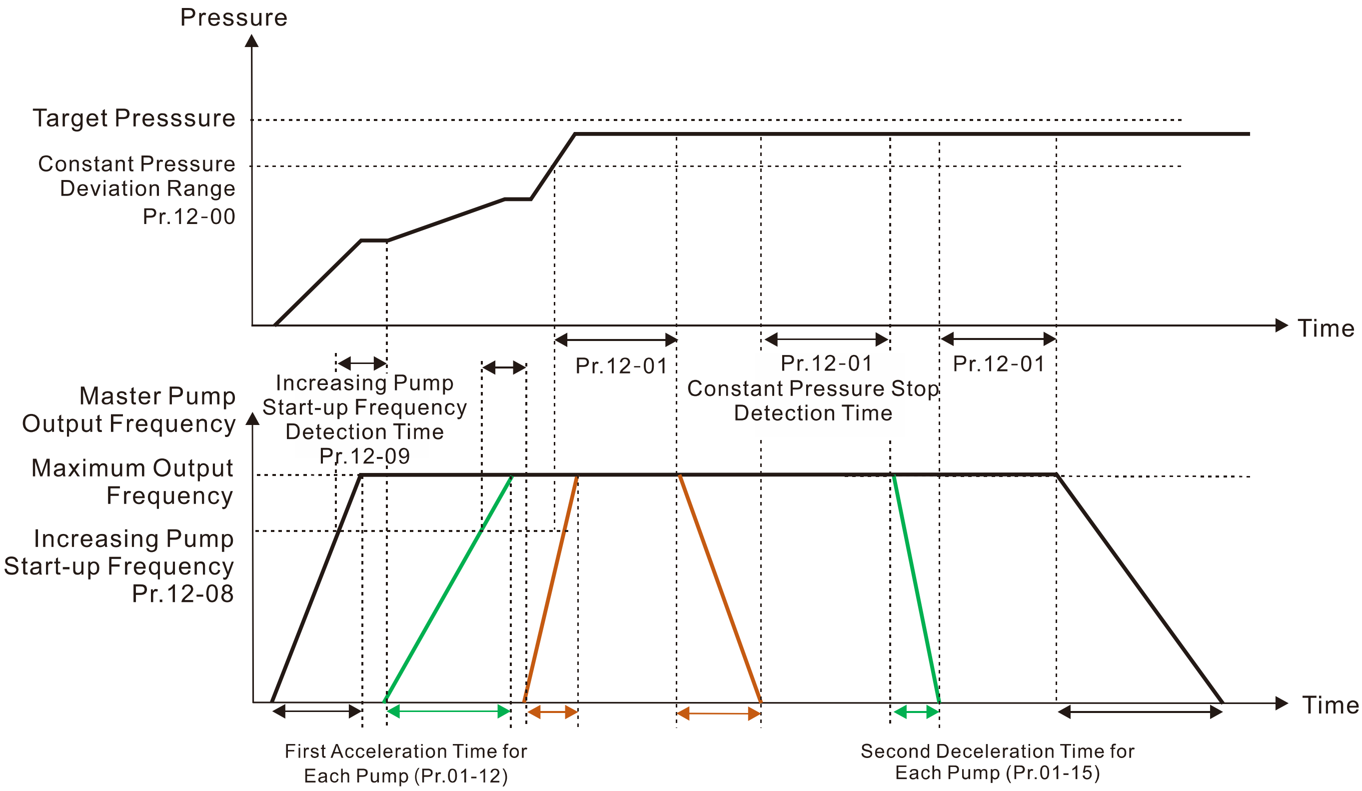
Settings Pr.12-10–the maximum operation frequency

12-09 Time Detected When Pump Reaches The Starting Frequency

Default: 1.0

Settings 0.0–3600.0 sec.

- This parameter is valid for master pump.
- Refer to Pr.01-00 for maximum operation frequency
- Pump adding mechanism of multi-pump: When master pump operation frequency ≥ Pr.12-08 and the time exceeds the setting in Pr.12-09, activate the next pump; if the water is still insufficient, activate the third, forth pump according to the same conditions.
- Pump reducing mechanism of multi-pump: The AC motor drive confirms the stable operation according to Pr.12-00 and Pr.12-01, and reduce pumps according to the deceleration time (Pr.01-15).



12-12 Pump's Frequency At Time-Out (Disconnection)

Default: 0.00

Settings 0.00–FMAX (01-00)

- This parameter is valid for salve pump.
- Refer to Pr.09-02 (COM1 transmission fault handling) and Pr.09-03 (COM1 time-out detection) for the communication failure conditions and fault handling.
- If a disconnection occurs in the multi-pump circumstances, the frequency command of slave pump is Pr.12-12; the slave pump is in standalone mode after STOP commend is given. Set the RUN command and operation frequency by the slave pump parameters.
- The master pump has the function to re-detect if a slave pump is time-out.

12-13 Treatment of Pump Fault

Default: 1

Settings bit 0: When the operating pump is failed, whether it switches to an alternative pump or not
0: Stop all pumps' action
1: Switch to an alternative pump
bit 1: During the operation, stop or standby after resetting from error
0: Standby after resetting
1: Stop after resetting
bit 2: Before the operation, whether the system can run or not if the pump has an error
0: The system can not activate the operation
1: The system selects another pump to operate

- This parameter is valid for master pump.
- If enable built-in PLC function, the value of the parameter is fixed to 5 (default).
- This parameter only works under auto mode. If the pump switches to manual mode by setting MIx = 97 (multi-pump manual / auto switch) or press STOP button on the keypad to be not controlled by multi-pump, then the parameter setting does not effect the pump.
- When a pump is failed in the multi-pump system, the master pump deals with system behavior of during and before the operation and the operation of the failed pump according to this parameter setting.
- bit 0: When the operating pump is failed, whether it switches to an alternative pump or not
  - bit 0 = 0: Stop all pumps
  - bit 0 = 1: Stop the failed pump, and select another pump to operate according to the principle of activation.
- bit 1: During the operation, stop or standby after resetting from error
  - bit 1 = 0, Standby: After resetting the failed pump, this pump can accept master pump's command to operate.
  - bit 1 = 1, Stop: After resetting the failed pump, this pump can not accept master pump's command until restart the system.
- bit 2: Before the operation, whether the system can run or not if the pump has an error
  - bit 2 = 0: Any pump of the system is failed, the master pump can not accept RUN command.
  - bit2 = 1: Any pump of the system is failed, the master pump can accept RUN command, and select another pump to operate according to the principle of activation.

12-14 Selection Of Pump Start-Up Sequence

Default: 1

Settings 0: According to the serial numbers of the pumps
1: According to the operating time

- 0: According to the serial numbers of the pumps (1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 1).
- 1: According to the shortest operating time

12-18 Cavitation Detection Method

Default: 0

Settings bit 0–3 00x0h: not using cavitation
00x1h: use AI1 to detect flow
00x2h: use flow estimation Q-H method
bit 4–7 000xh: no warning when cavitation
001xh: warning when cavitation, but continue operating

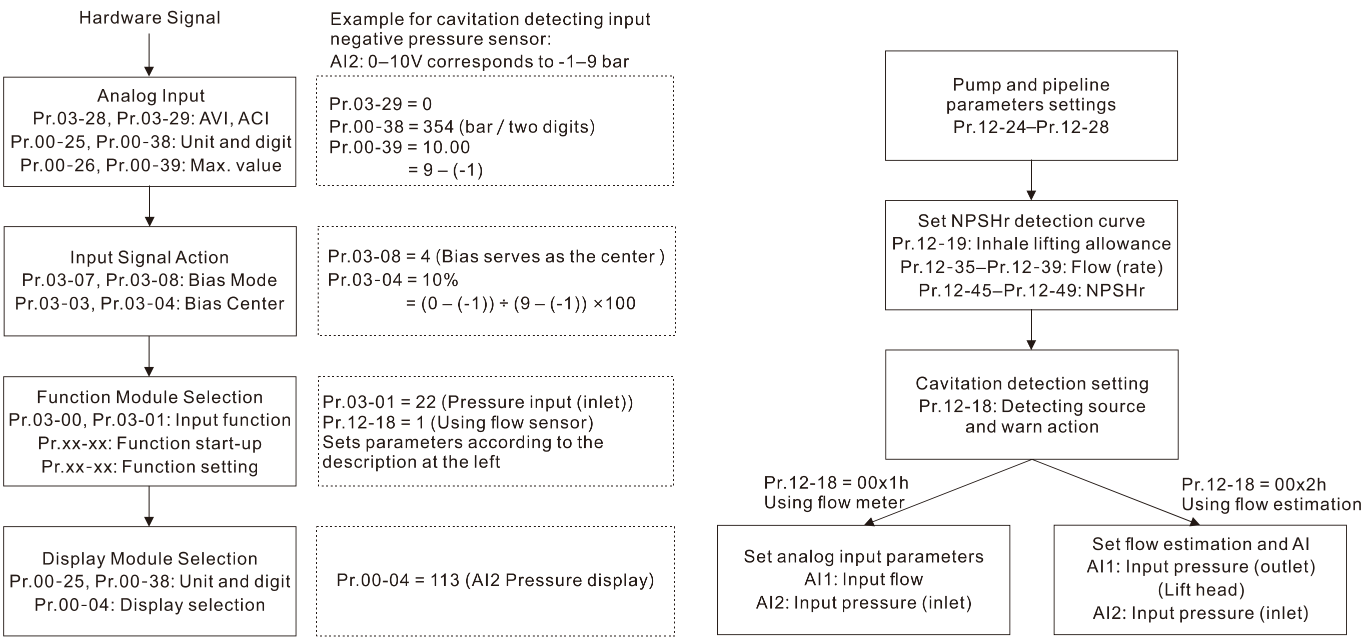
- Use this parameter to define the required flow whether is detected by flow meter or flow estimation Q-H method, refer to Pr.03-00 for more details.
- The AC motor drive displays Cavi warning when a cavitation is detected. To warn users that there is probably a cavitation occurred in the pipe, check and repair it early before it is malfunctioned.
- Refer to the table below, set the corresponding decimal value according to ON / OFF of cavitation and cavitation warning setting.
  Example: If you want the required flow detected by flow estimation Q-H method, and receive a waring when a cavitation occurred but the pump continues operating, then set Pr.12-18 = 18

Settings	000xh: no warning when cavitation	001xh: warning when cavitation, but continue operating
00x0h: not using cavitation	Hex: 0000h Decimal: 0	Hex: 0010h Decimal: 16
00x1h: use AI1 to detect flow	Hex: 0001h Decimal: 1	Hex: 011h Decimal: 17
00x2h: use flow estimation Q-H method	Hex: 0002h Decimal: 2	Hex: 0012h Decimal: 18

📖 Read the information below by using Pr.00-04 and communication address:

Indication of cavitation status	User-defined (Pr.00-04)	Communication Address
0: Disable cavitation module: possible reasons are incorrect analog module setting (refer to the setting procedure below), low rotation speed. 1: Start detecting cavitation 2: Discover cavitation (the keypad displays cavitation warning if you select warning at this moment)	Pr.00-04 = 115	2273H

📖 The setting procedure and related parameters of cavitation detection:



12-19 Cavitation Detection Tolerance

Default: 1.00

Settings 0.00–655.00

📖 The larger the setting value is, the easier a cavitation warning occurs. This means that increase NPSHr value (Pr.12-45–12-49) can protect it in advance before a cavitation occurs.

12-20 Flow Estimation Method

Default: 1

Settings 0: Not using
1: Q-H method
2: P-Q method

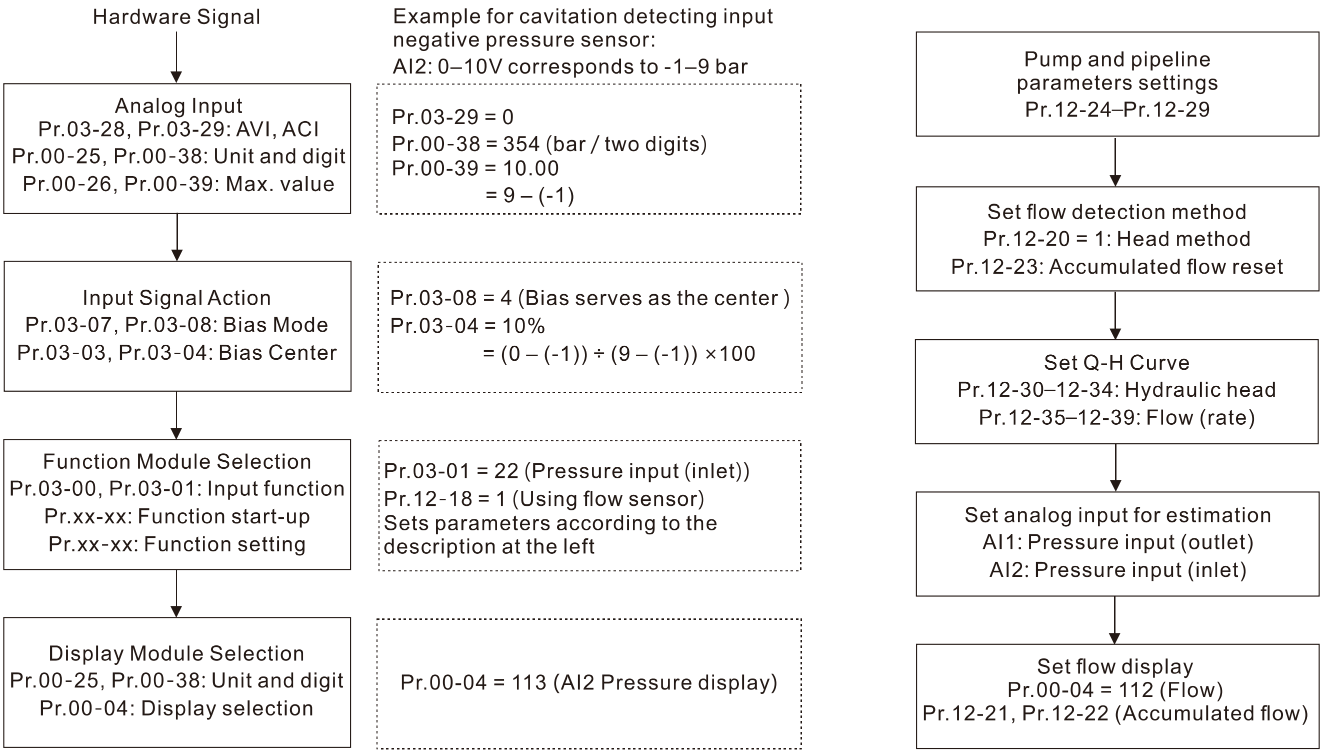
📖 Use these two flow estimation methods mentioned below can assist users to estimate the system flow without a flow meter.
1. Q-H method: Install two pressure sensors, one is at the inlet side and another one is at the outlet side, and set Pr.12-24–12-39.
2. P-Q method: Set Pr.12-24–12-26, Pr.12-35–12-44.

📖 When using Q-H method, it's recommended that do not install any pressure reducing devices (e.g. non-return valve) between the pressure sensors and the pumps, because this will affect the estimation accuracy. If there is any pressure reducing devices between the pumps and the pressure sensors, the deviation could be over 5% but differs from pressure reducing devices. The deviation caused by the pressure reducing devices can be adjusted by head point related parameters.

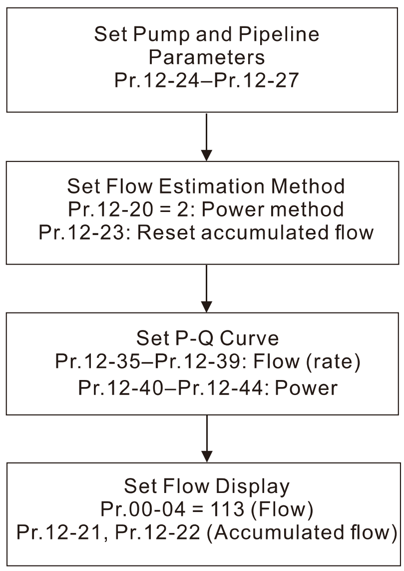
📖 Read the information below by using Pr.00-04 and communication address:

	User-defined (Pr.00-04)	Communication Address
Estimated flow rate	Pr.00-04 = 112	2270H
Inlet pressure	Pr.00-04 = 113	2271H
Outlet pressure	Pr.00-04 = 114	2272H

📖 The setting procedure and related parameters of flow estimation-Q-H method:



📖 The setting procedure and related parameters of flow estimation-P-Q method:



12-21 Accumulated Flow-Units Digit

Default: Read only

Settings 0–999.9 m^3 (read only)

12-22 Accumulated Flow-Thousands Digit

Default: Read only

Settings 0–65535 km^3 (read only)

- To execute flow estimation, you have to enable the flow estimation function and follow the instruction in Pr.12-20, the estimated accumulated flow displays in Pr.12-21 and Pr.12-22.
- Refer to Pr.12-23 for details if the accumulated flow have to being reset.

12-23 Reset Accumulated Flow

Default: 0

Settings 0: Not reset
1: When powering the AC motor drive on, reset volume flow
2: Reset volume flow immediately

- Refer to Pr.12-21, 12-22 for the volume flow.
- 0: not reset, this means every time when activating the pump, the volume flow (Pr.12-21, Pr.12-22) is accumulated from the last time, and it stops accumulating while reaching the limit.

✎ 12-24 Diameter Of The Pump Inlet

Default: 0.0

Settings 5.0–6500.0 mm

12-25 Diameter Of The Pump Outlet

Default: 0.0

Settings 5.0–6500.0 mm

- The pipe diameter at the pressure sensor.
- If it does not install a pressure sensor, enter the pipe diameter of the pump inlet / outlet.

✎ 12-26 The Rated Rotation Speed Of Pump

Default: 3000

Settings 0–65535 rpm

✎ 12-27 Fluid Density

Default: 995.7

Settings 0.0–6550.0 kg/m^3

- The density under the operation temperature for the fluid in pipe.

✎ 12-28 Fluid Temperature During Operation

Default: 30.00

Settings 00.00–600.00°C

✎ 12-29 Height Difference Of Inlet / Outlet Pump Pressure Sensor

Default: 0.00

Settings -30.00–30.00 m

- The height difference is between the outlet and the inlet.

✎ 12-30 Pump Curve Head 1
✎ 12-31 Pump Curve Head 2
✎ 12-32 Pump Curve Head 3
✎ 12-33 Pump Curve Head 4
✎ 12-34 Pump Curve Head 5

Default: 0.00

Settings 0.00–655.00 m

12-35	Pump Curve Flow 1
12-36	Pump Curve Flow 2
12-37	Pump Curve Flow 3
12-38	Pump Curve Flow 4
12-39	Pump Curve Flow 5

Default: 0.00

Settings 0.00–655.00 m^3/hr

12-40	Pump Curve Power 1
12-41	Pump Curve Power 2
12-42	Pump Curve Power 3
12-43	Pump Curve Power 4
12-44	Pump Curve Power 5

Default: 0.00

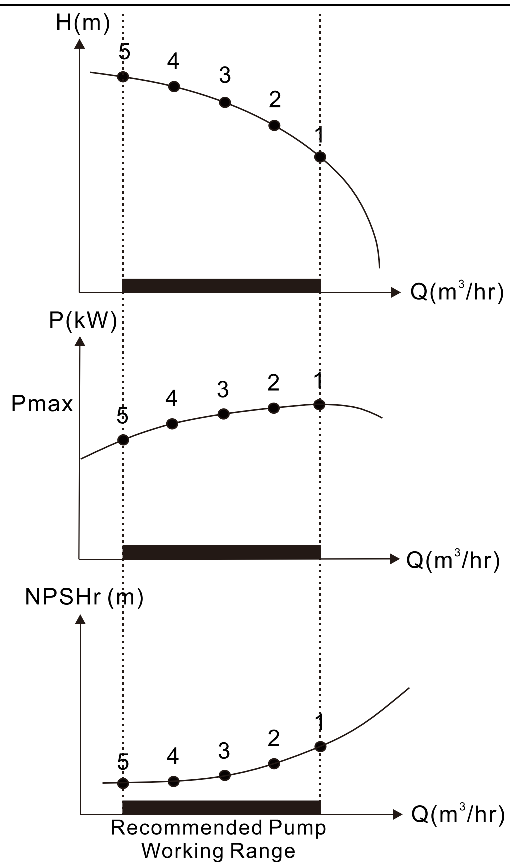
Settings 0.00–655.00 kW

12-45	Pump Curve NPSHr 1
12-46	Pump Curve NPSHr 2
12-47	Pump Curve NPSHr 3
12-48	Pump Curve NPSHr 4
12-49	Pump Curve NPSHr 5

Default: 0.00

Settings 0.00–655.00 m

- Refer to the chosen pump characteristic curve, select five points and ensure it includes the suggested working range of pump. See the table below for more about the functions and the related pump characteristic curves.
- Note: Pr.12-34 > Pr.12-33 > Pr.12-32 > Pr.12-31 > Pr.12-30, and set these parameters that starts from Pr.12-34 to Pr.12-30.

Functions	Pump characteristic curve	Flow (Pr.12-35–12-39)
Flow estimation Q-H method	Head (H) Pr.12-30–12-34	
Flow estimation P-Q method	Power (P) Pr.12-40–12-44	
Cavitation detection	NPSHr Pr.12-45–12-49	

12-50 Cycle Time Selection

Default: 2

Settings 0: Disabled

1: Absolute time

2: Fixed time

12-51 Multi-pump's Absolute Time Circulation Period

Default: 00:00

Settings 00:00–23:59

✓ 12-52 Multi-pump's Fixed Time Circulation Period

Default: 5.0

Settings 0.0–3000.0 hours

- This parameter is valid for master pump.
- Set cycle time in Pr.12-50, master pump and slave pump switches when the absolute time is equal to Pr.12-51 or the operation time of master pump is larger than Pr.12-52.
- If Pr.12-50 = 1, adjust RTC in Pr.12-93–12-96 before setting this parameter.

12-53 Clean Function

Default: 0

Settings 0: Disabled

1: Enabled (trigger the clean function when DI works)

2: Enabled (trigger the clean function when current exceeds stall current and the operation is restricted)

3: Enabled (trigger the clean function when the counting time is up)

- If Pr.00-23 = 1 or 2 (only single direction is allowed), the clean function can not work.
- The clean function makes the pump runs in forward and reverse direction. Some pumps run in single direction that the function does not support. Take notice of this, otherwise the pump breaks down.
- Three types of clean function:
  - Pr.12-53 = 1, 3: DI (set Mix = 100 synchronously) and scheduled trigger (set Pr.12-56, 12-57 synchronously) is for daily maintenance.
  - Pr.12-53 = 2: the clean function triggered by high stall current (set Pr.12-54, 12-55 synchronously) is for protection.
- The clean procedures are according to the setting of Pr.12-58–12-64.
- When Pr.12-53 = 3, adjust RTC in Pr.12-93–12-96 before setting this parameter.
- During the clean process, the AC motor drive displays CLE means the clean function is running. Return to the original control mode after finishing the clean. After finishing the clean process which is triggered by stall current, if there is still stall current, the display shows a JAME fault and coasts to stop.

12-54 Jam Current Setting Value

Default: 120

Settings 0– the smallest one of Pr.06-03 and Pr.06-04

12-55 Jam Current Delay Time

Default: 60.0

Settings 0.0–300.0 sec.

- Trigger the clean function when the output current is larger than Pr.12-54 and continues for the time set in Pr.12-55. The AC motor drive displays CLE means the clean function is running. After finishing the clean process, if there is still stall current, the display shows a JAME fault and coasts to stop.

12-56 Auto Clean Day

Default: 0

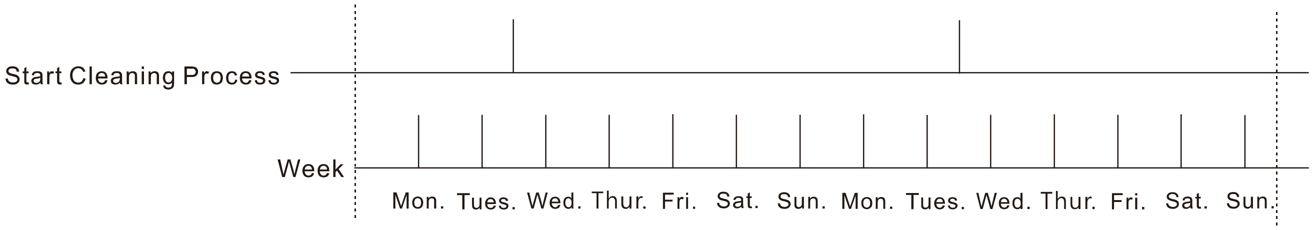
Settings
0: Sunday
1: Monday
2: Tuesday
3: Wednesday
4: Thursday
5: Friday
6: Saturday

12-57 Cleaning Time

Default: 00:00

Settings 00:00–23:59

- Scheduled clean function is triggered by Pr.12-56 and Pr.12-57.
- Example: Pr.12-56 = 2, Pr.12-57 = 12:00



12-58 Cleaning Cycle Times

Default: 5

Settings 1–30

12-59 Clean Forward Frequency

Default: 40.00

Settings 0.00–50.00 Hz

12-60 Clean Forward Time

Default: 2.0

Settings 0.0–300.0 sec.

12-61 Clean Reverse Frequency

Default: 40.00

Settings 0.00–50.00 Hz

12-62 Clean Reverse Time

Default: 2.0

Settings 0.0–300.0 sec.

12-63 Cleaning Acceleration Time

Default: 1.0

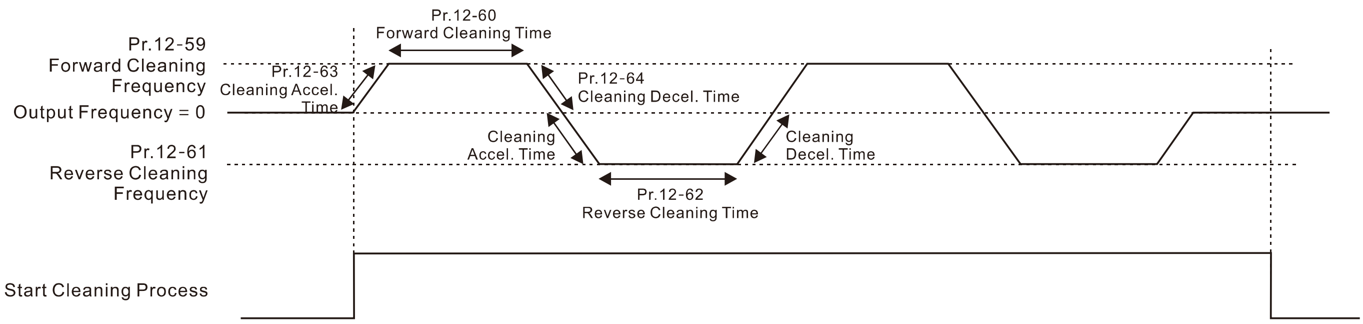
Settings 1.0–300.0 sec.

12-64 Cleaning Deceleration Time

Default: 1.0

Settings 1.0–300.0 sec.

- The clean procedures below are according to the setting of Pr.12-58–12-64.
- If the AC motor drive is running or in acceleration / deceleration state while triggering the clean function, the clean function starts after it returns to 0 Hz.

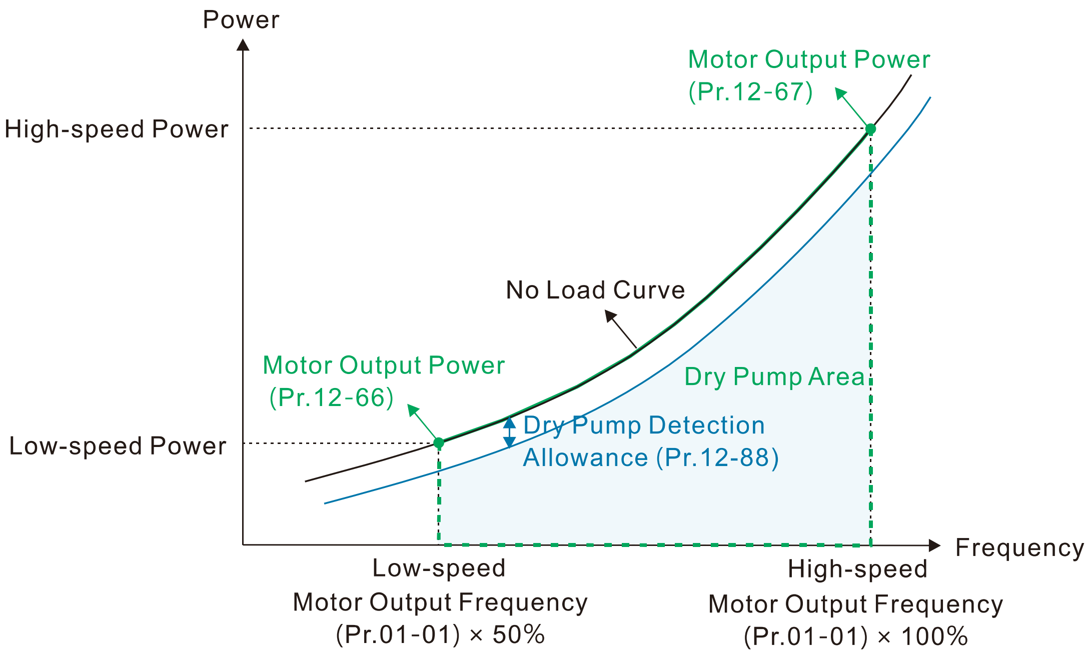


12-65 Auto-tuning Load Curve

Default: 0

Settings 0: Disabled
1: Enabled

- Set a state without water at the beginning, enable load auto-tuning curve (Pr.12-65 = 1) and press RUN button, and then the AC motor drive displays tUn to run to 50% and 100% of the rated frequency (Pr.01-01). Their output powers are recorded (see Pr.00-04 = 6 for output power) and enter into Pr.12-66, Pr.12-67.
- If there is a fault of the curve by auto-detection, the AC motor drive displays a dAUE warning to re-detect.
- The range below the load curve is the area that dry pump occurs.



12-66 50% Power Consumption Point

Default: 0

Settings 0–65535 kW

12-67 100% Power Consumption Point

Default: 0

Settings 0–65535 kW

- When Pr.12-65 = 1 enables load auto-tuning curve, the auto-tuning is according to the settings of Pr.12-66 and Pr.12-67.

12-68 Dry Pump Function

Default: 0

Settings 0: Disabled
1: Enabled

- To learn load auto-tuning curve before enabling dry pump function.

12-69 Dry Pump Check Time

Default: 15.0

Settings 0–300.0 sec.

📖 When the load is lower than the load curve and continues for the time set in Pr.12-69, a dryn warning occurs and handles this situation according to Pr.12-72.

12-70 Dry Pump Restart Delay Time

Default: 30

Settings 0–1000 min.

12-71 Number Of Restart Times Limitation Of Dry Pump

Default: 5

Settings 0–20

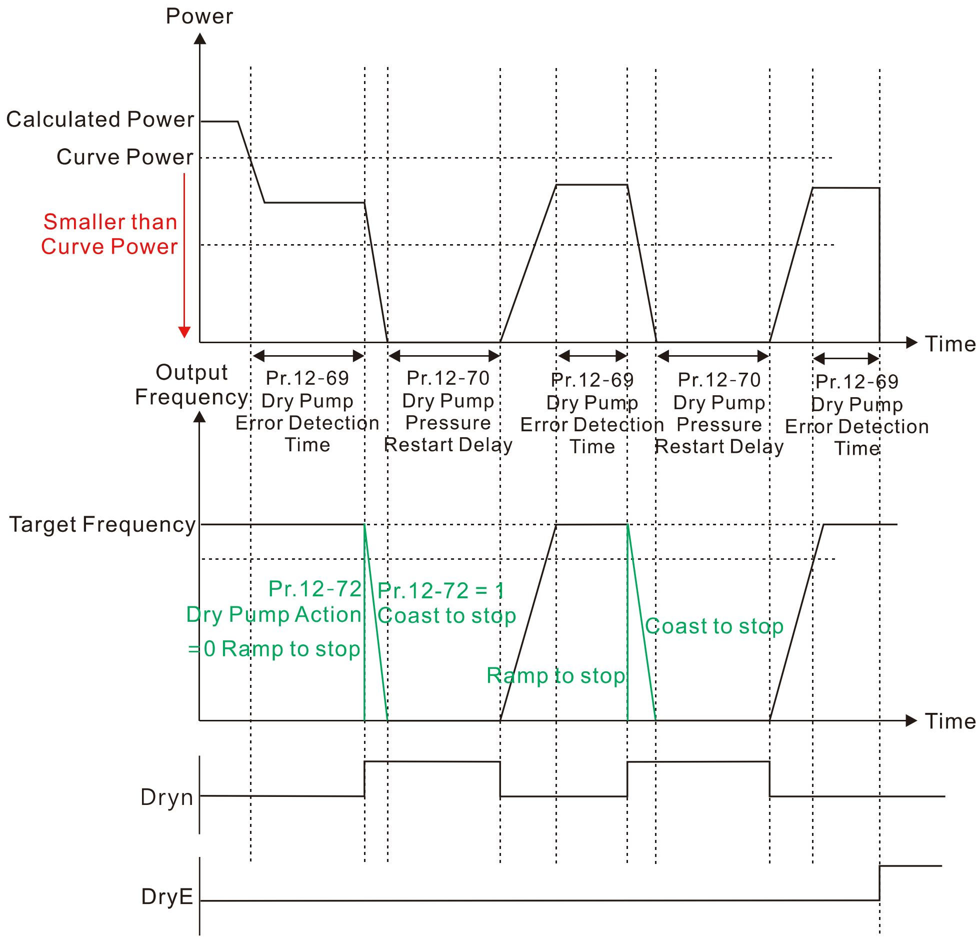
12-72 Treatment Of Dry Pump Fault

Default: 1

Settings 1: Fault and coast to stop
2: Fault and ramp to stop

📖 To check again if it's still in condition to trigger dry pump after passing the time set in Pr.12-70. If it's cleared, eliminate dryn warning to return to the original state; if it's not cleared, the dryn warning continues and waits for the next detection.

📖 If the restart times are over the setting of Pr.12-71, then a dryE fault occurs.



12-88 Dry Pump Detection Tolerance

Default: 10

Settings 0–50%

📖 This parameter determines the response speed of detecting dry pump, the larger the setting value is, the harder a dryn warning occurs; the smaller the setting value is, the easier a dryn warning occurs.

📖 Easy to trigger dry pump warning if water consumption is too low. Adjust this parameter to prevent from misinformation of dry pump.

12-73 Heavy Water Leakage Abnormal Pressure Detection

Default: 15

Settings 0: Disabled
0–50%

- The base of the parameter is the set point of PID control setting
- This parameter is to set the gap between the pressure level of water leakage and the set point of PID control setting.

12-74 Heavy Water Leakage Abnormal Detection Time

Default: 15.0

Settings 0.1–300.0 sec.

12-75 Heavy Water Leakage Load Setting

Default: 20

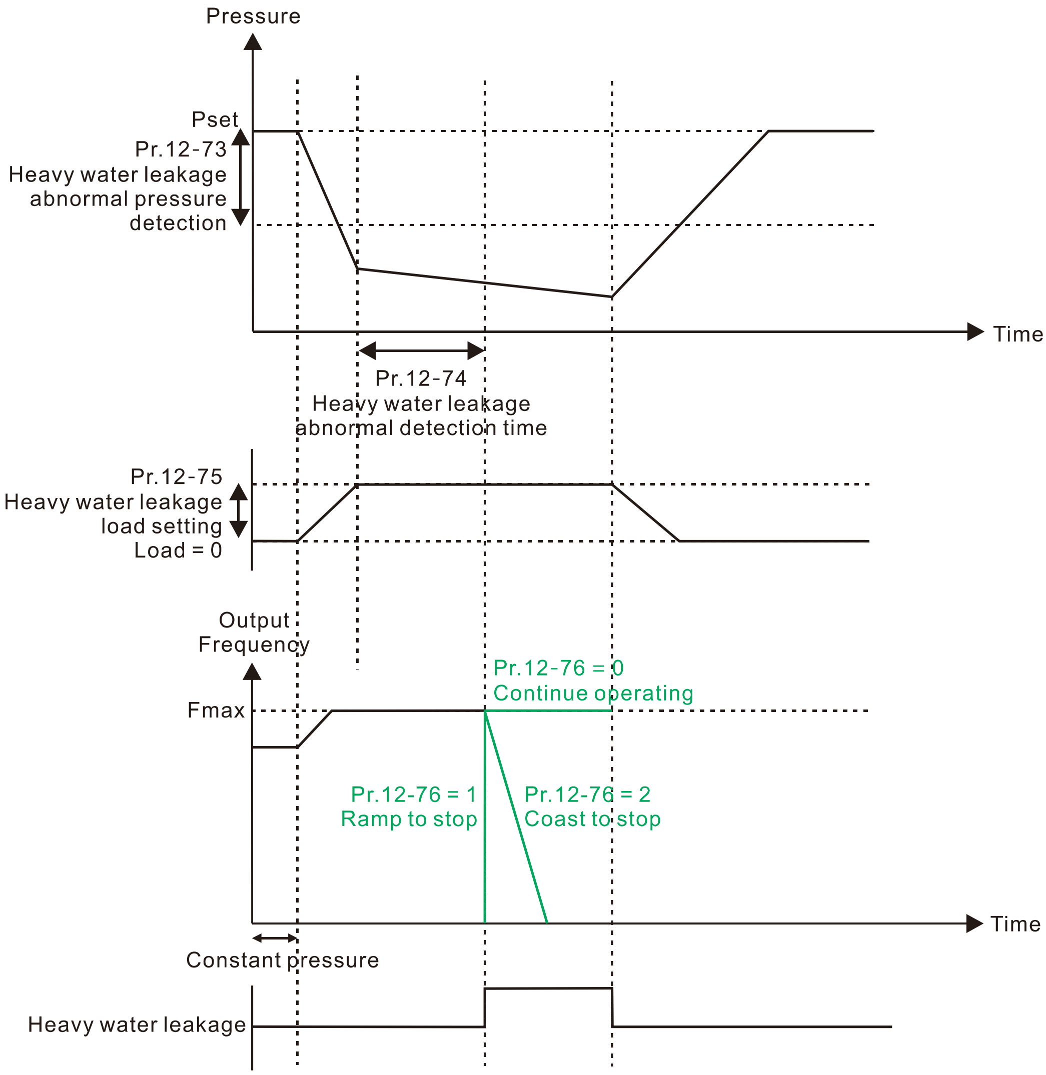
Settings 0–100%

12-76 Treatment Of Heavy Water Leakage

Default: 0

Settings 0: Warn and continue operation
1: Fault and coast to stop
2: Fault and ramp to stop

- If the feedback pressure is not higher than Pr.12-73 after passing the time set in Pr.12-74, and the output load is higher than Pr.12-75, then trigger heavy water leakage event. At the moment, the pump handles this situation according to Pr.12-76, and the AC motor drive displays a LEKn warning or a LEKE fault.



12-77 Sleep Boost Pressure Setting

Default: 0

Settings 0–50%

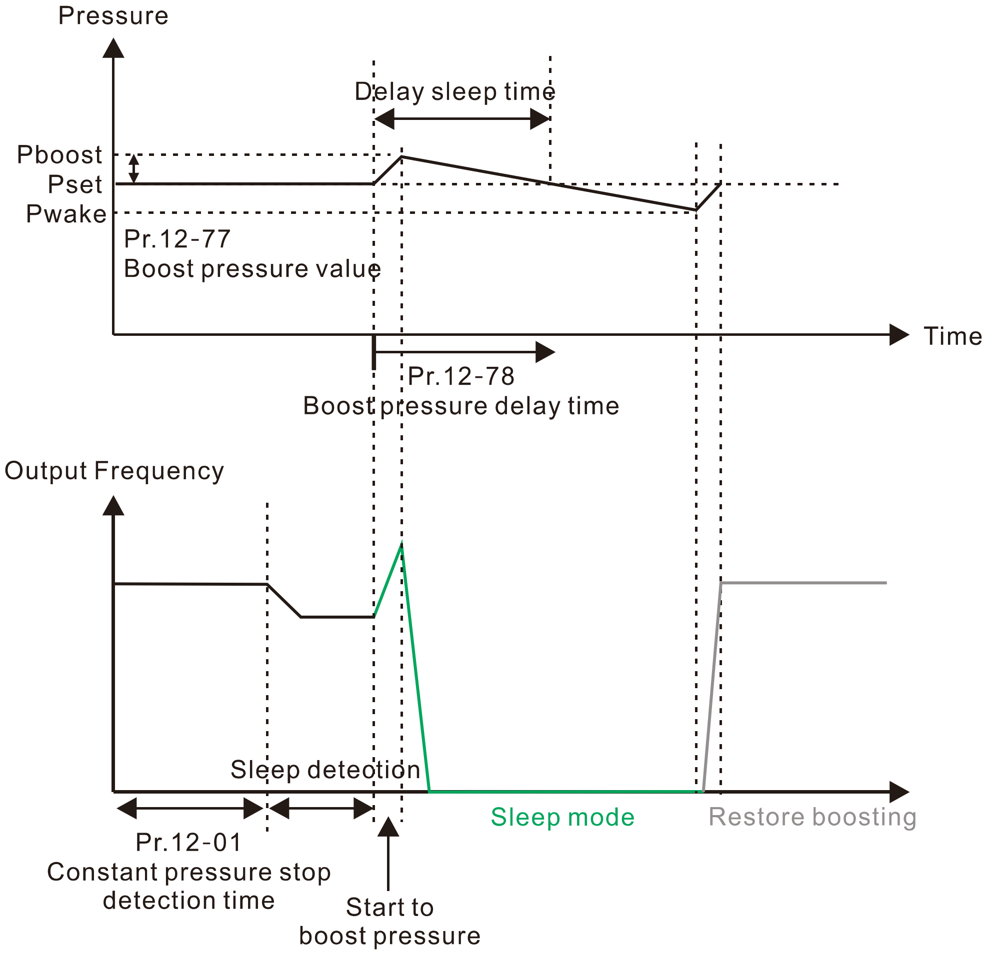
- The base of the parameter is the set point of PID control setting.
- When it's going to be constant pressure mode, you can increase the pressure (Pr.12-77) to reach the set point pressure (%) for increasing sleep time.

12-78 Sleep Boost Pressure Delay Time

Default: 10.0

Settings 0.0–600.0 sec.

- If the pump has still not reached the sleep boost pressure after passing the time set in Pr.12-78, then it returns to the normal control state.



12-79 Level Of High Pressure Alarm

Default: 25

Settings 0: Disabled
0–50%

- The base of the parameter is the set point of PID control setting.

12-80 High Pressure Time Delay

Default: 5.0

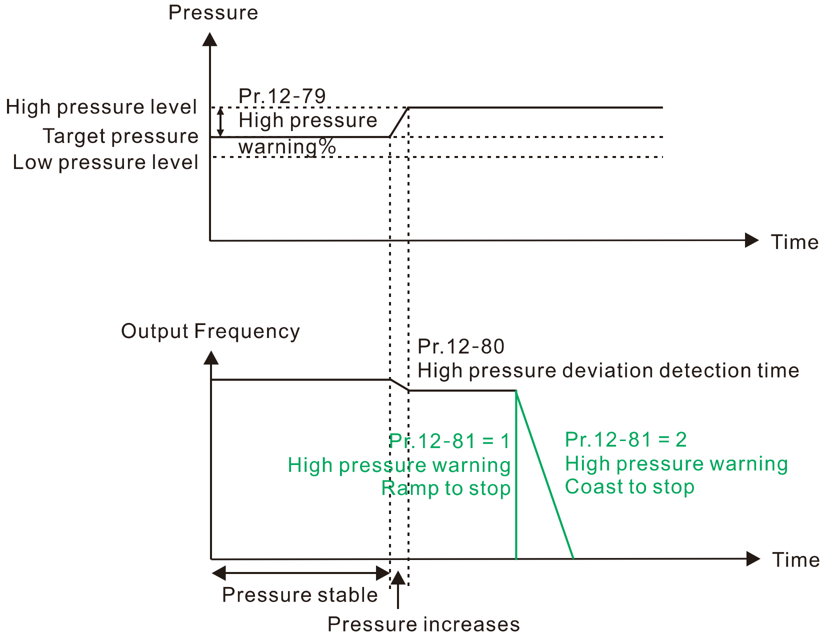
Settings 0.1–300.0 sec.

12-81 Treatment Of High Pressure

Default: 1

Settings 1: Fault and coast to stop
2: Fault and ramp to stop

- If the feedback pressure is higher than Pr.12-79 after passing the time set in Pr.12-80, then a HPS fault occurs according to Pr.12-81.



12-82 Level Of Low Pressure Alarm

Default: 25

Settings 0: Disabled

0–50%

📖 The base of the parameter is the set point of PID control setting.

12-83 Low Pressure Time Delay

Default: 5.0

Settings 0.1–300.0 sec.

12-84 Treatment Of Low Pressure

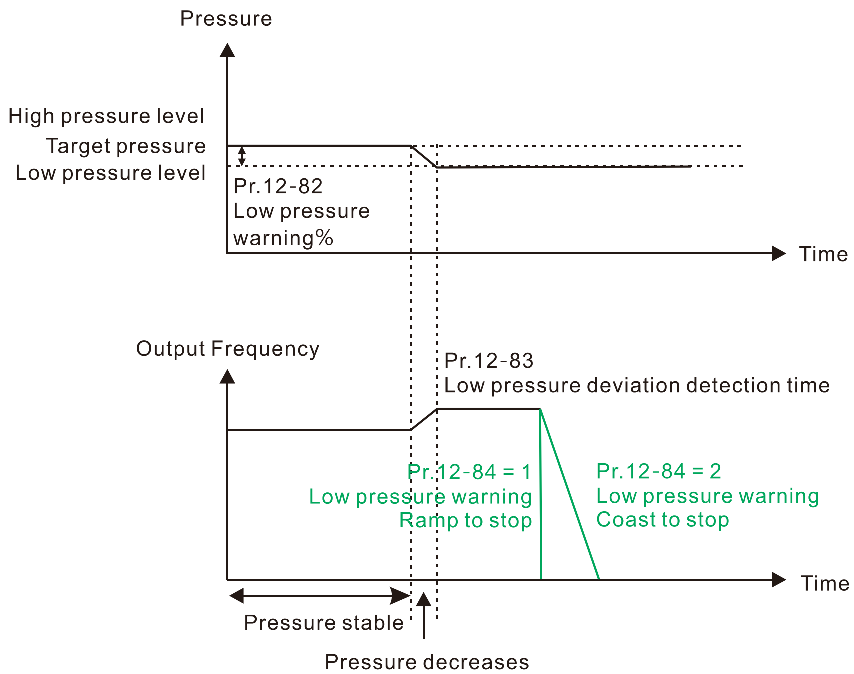
Default: 1

Settings 0: Warn and continue operation

1: Fault and coast to stop

2: Fault and ramp to stop

📖 If the feedback pressure is higher than Pr.12-82 after passing the time set in Pr.12-83, then a LPS waring or a LoPE fault occurs according to Pr.12-84.



12-93 Year Setting

Default: 2000

Settings 2020–2099

12-94 Date Setting

Default: 1.01

Settings 1.01–12.31

12-95 Time Setting

Default: 00:00

Settings 00:00–23:59

12-96 Week Setting

Default: 0

Settings 0–6

0: Sunday
1: Monday
2: Tuesday
3: Wednesday
4: Thursday
5: Friday
6: Saturday

- Install a battery before using RTC function, refer to section 7-7 for more details about the installation.
- Set Pr.12-93–12-96 first to ensure time accuracy for using RTC related functions, such as Pr.12-50 =1 (cycle time selection), Pr.12-53 = 3 (clean function), and Pr.04-58 (weekdays, weekend, specific day schedule).

13 Macro / User-defined Macro

13-00 Macro Selection

Default:00

Settings 00: Disabled
01: User-defined

📖 Note: After you select the macro, some of the default values adjust automatically according to the application selection.

13-01 – 13-50 Application Parameters (User-defined)

📖 Refer to Chapter 10 for the setting methods of the user-defined parameters.

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14 Protection Parameters (2)

✓You can set this parameter during operation.

14-50	Output Frequency at Malfunction 2
14-54	Output Frequency at Malfunction 3
14-58	Output Frequency at Malfunction 4
14-62	Output Frequency at Malfunction 5
14-66	Output Frequency at Malfunction 6

Default: Read only

Settings 0.00–180.00 Hz

📖 When an error occurs, you can check the output frequency for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-51	DC bus Voltage at Malfunction 2
14-55	DC bus Voltage at Malfunction 3
14-59	DC bus Voltage at Malfunction 4
14-63	DC bus Voltage at Malfunction 5
14-67	DC bus Voltage at Malfunction 6

Default: Read only

Display 0.0–6553.5 V

📖 When an error occurs, you can check the DC bus voltage for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-52	Output Current at Malfunction 2
14-56	Output Current at Malfunction 3
14-60	Output Current at Malfunction 4
14-64	Output Current at Malfunction 5
14-68	Output Current at Malfunction 6

Default: Read only

Display 0.00–655.35 Amps

📖 When an error occurs, you can check the output current for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-53	IGBT Temperature at Malfunction 2
14-57	IGBT Temperature at Malfunction 3
14-61	IGBT Temperature at Malfunction 4
14-65	IGBT Temperature at Malfunction 5
14-69	IGBT Temperature at Malfunction 6

Default: Read only

Display -3276.7–3276.7 °C

📖 When an error occurs, you can check the IGBT temperature for the malfunction. If the error happens again, this parameter overwrites the previous record.

14-70	Fault Record 7
14-71	Fault Record 8
14-72	Fault Record 9
14-73	Fault Record 10

Default: 0

Display
0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)

6: Over-current at stop (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage 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 at constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
17: Heatsink overheating (oH2)
18: IGBT temperature detection failure (tH1o)
19: Capacitor hardware error (tH2o)
21: Over load (oL)
22: Electronics thermal relay 1 protection (EoL1)
24: Motor overheating PTC-130 / KTY-84-130 / PT100 (oH3)
26: Over torque 1 (ot1)
28: Under current (uC)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc hardware error (Hd0)
37: oc hardware error (Hd1)
40: Auto-tuning error (AUE)
41: PID loss ACI (AFE)
48: ACI loss (ACE)
49: External fault (EF)
51: External base block (bb)
52: Password is locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)
58: Modbus transmission time-out (CE10)
79: U-phase over-current before run (Aoc)
80: V-phase over-current before run (boc)
81: W-phase over-current before run (coc)
82: U-phase output phase loss (oPL1)
83: V-phase output phase loss (oPL2)
84: W-phase output phase loss (oPL3)
87: Low frequency overload protection (oL3)
89: Rotor position detection error (roPd)
90: Force to stop (FStp)
98: Fire mode output (Fire)
140: oc hardware error (Hd6)
141: GFF occurs before run (b4GFF)
142: Auto-tune error 1 (AuE1) (DC test stage)
143: Auto-tune error 2 (AuE2) (high frequency stall stage)
144: Auto-tune error 3 (AuE3) (rotation test stage)
221: High water pressure (HPS)
222: Low water pressure (LPSE)
223: Dry pump (dryE)
224: Water leaking (pipe explosion) (LEKE)
225: Clogged pipe (JAME)
226: RTC error (rtF)
227: Dry pump curve auto-measuring (dAUE)

📖 The system records the fault codes to Pr.06-17–06-22, Pr.14-70–14-73 as long as the fault is forced to 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.

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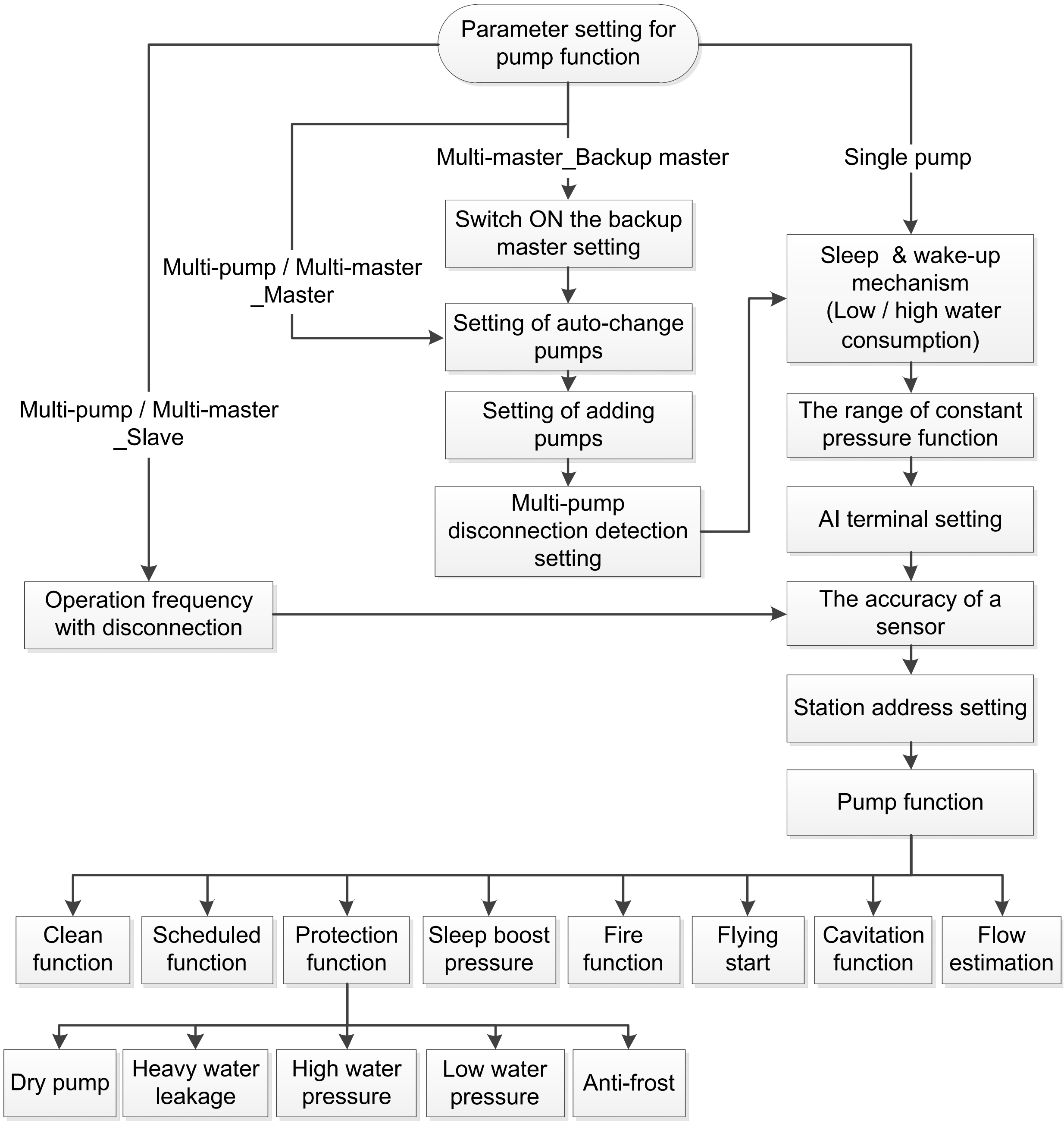
12-2 Adjustment and Applications

For different water pump systems (single pump, multi-pump, multi-master), users can follow the procedures below to set up the related parameters. Refer to section 12-1 for more details about parameter settings.

- Single pump, multi-pump: sets by parameters in the drive.
- Multi-master: sets by the built-in PLC function that goes with the parameters in the drive.



Note: All the AC motor drives should enable PLC1 for using multi-master function.

Single-pump parameters

☑ The default pressure sensor sets as 4–20 mA, the unit is bar.
☑ Before using pressure sensor, sets Pr.08-00 = 1, and sets the maximum value of pressure sensor in Pr.00-26.
☑ The mark “ * ” represents the parameters must be set and confirmed.

- The station address of master pump

Parameter	Parameter Name	Default
09-00*	Communication address	1
09-31*	COM1 internal communication protocol	0

Single-pump / multi-pump: Pr.09-31 = -21
Multi-master: Pr.09-31 = -12 (PLC auto-setting), Pr.09-00 = 1

- AI terminal setting

Parameter	Parameter Name	Default
03-00	AI1 analog input selection	5
03-28*	AI1 terminal input selection	2
08-00*	Terminal selection of PID feedback	0

- Precision of sensor

Parameter	Parameter Name	Default
00-25*	User-defined characteristics 1	353
00-26*	Maximum user-defined value 1	0

- Set point level

Parameter	Parameter Name	Default
12-00*	Set point deviation level	0
12-01	Detection time of set point deviation level	10

- Wake-up function (low / high water consumption)

Parameter	Parameter Name	Default
12-02	Offset level of low water consumption	10
12-03	Offset level of high water consumption	0
12-04	High water consumption delay time	0.5

Master of multi-pump / backup master parameters

☑ The default pressure sensor AI1 sets as 4–20 mA, the unit is bar.

☑ Before using pressure sensor, sets Pr.08-00 = 1, and sets the maximum value of pressure sensor in Pr.00-26.

☑ The mark “ * ” represents the parameters must be set and confirmed.

☑ After enabling the water pump function, the default enables auto-change function (starts up from the pump has the shortest operation time, and alternates every 5 hours), pump-adding function.

- The station address of master pump

Parameter	Parameter Name	Default
09-00*	Communication address	1
09-31*	COM1 internal communication protocol	0

Single-pump / multi-pump: Pr.09-31 = -21
Multi-master: Pr.09-31 = -12 (PLC auto-setting), Pr.09-00 = 1

- AI terminal setting

Parameter	Parameter Name	Default
03-00	AI1 analog input selection	5
03-28*	AI1 terminal input selection	2
08-00*	Terminal selection of PID feedback	0

- Precision of sensor

Parameter	Parameter Name	Default
00-25*	User-defined characteristics 1	353
00-26*	Maximum user-defined value 1	0

- Set point level

Parameter	Parameter Name	Default
12-00*	Set point deviation level	0
12-01	Detection time of set point deviation level	10

- Wake-up function (low / high water consumption)

Parameter	Parameter Name	Default
12-02	Offset level of low water consumption	10
12-03	Offset level of high water consumption	0
12-04	High water consumption delay time	0.5

- Auto-change pump setting

Parameter	Parameter Name	Default
12-14	Selection of pump start-up sequence	1
12-50	Cycle time selection	2
12-51	Multi-pump’s absolute time circulation period	00:00
12-52	Multi-pump’s fixed time circulation period	5.0

- Adding pump setting

Parameter	Parameter Name	Default
12-14	Selection of pump start-up sequence	1
12-08	Frequency to start switching pumps	FMAX
12-09	Time detected when pump reaches the starting frequency	1.0

Pump reducing mechanism executes according to Pr.12-00, Pr.12-01.

- Multi-pump COM1 time-out detection

Parameter	Parameter Name	Default
09-02	Treatment of COM1 transmission fault	3
09-03	COM1 time-out detection	0.0

- Treatment of pump disconnection

Parameter	Parameter Name	Default
12-13	Treatment of pump fault	1

Multi-master: Pr.12-13 fixes to 1.

- Multi-pump system configuration setting

Parameter	Parameter Name	Default
04-57	Pump system configuration setting	0

This parameter is to set the multi-pump configuration of the built-in PLC function. Refer to user manual for more details.
Backup master: Pr.04-57 bit8 = 1

Slave of multi-pump parameters

- Enable constant pressure function

Parameter	Parameter Name	Default
12-00*	Set point deviation level	0
12-01	Detection time of set point deviation level	10

Same setting as the master pump.

- Station address of slave pump

Parameter	Parameter Name	Default
09-00*	Communication address	1
09-31*	COM1 internal communication protocol	0

Multi-pump: Pr.09-31 = -22– -28
Multi-master: Pr.09-31 = 0 (PLC auto-setting), Pr.09-00 should set station address to be 2–8

- Precision of pressure sensor

Parameter	Parameter Name	Default
00-25*	User-defined characteristics 1	353
00-26*	Maximum user-defined value 1	0

- Operation frequency of disconnected pump

Parameter	Parameter Name	Default
12-12	Pump's frequency at time-out (disconnection)	0.00

Water pump function parameters

☑ The default enables heavy water leakage related function.

- Dry pump

Parameter	Parameter Name	Default
12-65	Auto-tuning load curve	0
12-66	50% power consumption point	0
12-67	100% power consumption point	0
12-68	Dry pump function	0
12-69	Dry pump check time	15.0
12-70	Dry pump restart delay time	30
12-71	Number of restart times limitation of dry pump	5
12-72	Treatment of dry pump fault	1

- Flying start

Parameter	Parameter Name	Default
07-06	Restart after momentary power loss	0
07-07	Allowed power loss duration	2.0
07-08	Base block time	0.5
07-09	Current limit of speed tracking	100
07-10	Restart after fault action	0
07-11	Number of times of restart after fault	0
07-12	Speed tracking during start-up	0
06-88	Operation times in fire mode	Read only

- High water pressure alarm

Parameter	Parameter Name	Default
12-79	Level of high pressure alarm (%)	25
12-80	High pressure time delay	5.0
12-81	Treatment of high pressure	1

When Pr.12-79 = 0, disables high water pressure alarm.

- Low water pressure alarm

Parameter	Parameter Name	Default
12-82	Level of low pressure alarm (%)	25
12-83	Low pressure time delay	5.0
12-84	Treatment of low pressure	0

When Pr.12-82 = 0, disables low water pressure alarm

- Clean function

Parameter	Parameter Name	Default
12-53	Clean function	0
12-54	Jam current setting value	120
12-55	Jam current delay time	60.0
12-56	Auto clean day	0
12-57	Cleaning time	00:00
12-58	Cleaning cycle times	5
12-59	Clean forward frequency	40.00
12-60	Clean forward time	2.0
12-61	Clean reverse frequency	40.00
12-62	Clean reverse time	2.0
12-63	Cleaning acceleration time	1.0
12-64	Cleaning deceleration time	1.0
02-01–02-04	Multi-function input command (MI1–MI4)	0

📖 Pr.02-01–02-04: sets 100 to enable clean function by external trigger
📖 If you need to use the timer clean trigger, sets the RTC (Pr.12-93–12-96) and install battery (section 7-7).
📖 Refer to Pr.12-53 for more details.

- Fire mode

Parameter	Parameter Name	Default
06-80	Fire mode	0
06-81	Operating frequency in fire mode (Hz)	150.00

- Anti-frost function

Parameter	Parameter Name	Default
02-72	Preheating DC current level	0
02-73	Preheating DC current duty cycle	0
02-01–02-04	Multi-function input command (MI1–MI4)	0
02-13, 02-14, 02-16	Multi-function output	0

Pr.02-01–02-04: sets as 69 to enable preheating function
Pr.02-13, 02-14, 02-16: sets 69 to enable the indication of multi-pump system error

- Sleep boost pressure function

Parameter	Parameter Name	Default
12-77	Sleep boost pressure setting	0
12-78	Sleep boost pressure delay time	10.0

- Heavy water leakage

Parameter	Parameter Name	Default
12-73	Heavy water leakage abnormal pressure detection	15
12-74	Heavy water leakage abnormal detection time	15.0
12-75	Heavy water leakage load setting	20.0
12-76	Treatment of heavy water leakage	0

When Pr.12-73 = 0, disables heavy water leakage alarm.

- Scheduled function (enables the built-in PLC function before using this function)

Parameter	Parameter Name	Default
04-58	Weekdays, weekend, specific day schedule	0
04-59	Weekend setting	0
04-60	Weekdays start time 1	0

Parameter	Parameter Name	Default
04-61	Weekdays target pressure 1	00:00
04-62	Weekdays start time 2	0
04-63	Weekdays target pressure 2	00:00
04-64	Weekdays start time 3	0
04-65	Weekdays target pressure 3	00:00
04-66	Weekdays start time 4	0
04-67	Weekdays target pressure 4	00:00
04-68	Weekdays start time 5	0
04-69	Weekdays target pressure 5	00:00
04-70	Weekend start time 1	0
04-71	Weekend target pressure 1	00:00
04-72	Weekend start time 2	0
04-73	Weekend target pressure 2	00:00
04-74	Weekend start time 3	0
04-75	Weekend target pressure 3	00:00
04-76	Weekend start time 4	0
04-77	Weekend target pressure 4	00:00
04-78	Weekend start time 5	0
04-79	Weekend target pressure 5	00:00
04-80	Specific day start date 1	00.00
04-81	Specific day end date 1	00.00
04-82	Specific day start date 2	00.00
04-83	Specific day end date 2	00.00
04-84	Specific day start date 3	00.00
04-85	Specific day end date 3	00.00
04-86	Specific day start date 4	00.00
04-87	Specific day end date 4	00.00
04-88	Specific day start date 5	00.00
04-89	Specific day end date 5	00.00
04-90	Specific day start time 1	00:00
04-91	Specific day target pressure 1	0
04-92	Specific day start time 2	00:00
04-93	Specific day target pressure 2	0
04-94	Specific day start time 3	00:00
04-95	Specific day target pressure 3	0
04-96	Specific day start time 4	00:00
04-97	Specific day target pressure 4	0
04-98	Specific day start time 5	00:00
04-99	Specific day target pressure 5	0

📖 Before using scheduled function, sets the RTC (Pr.12-93–12-96) and install battery (section 7-7).

📖 Refer to Pr.04-58 for more details.

- Flow estimation- P-Q method

Parameter	Parameter Name	Default
12-20	Flow estimation method	1
12-21	Accumulated flow-units digit (m^3)	Read only
12-22	Accumulated flow-thousands digit (km^3)	Read only
12-23	Reset accumulated flow	0
12-24	Diameter of the pump inlet (mm)	0.0
12-25	Diameter of the pump outlet (mm)	0.0
12-26	The rated rotation speed of pump	3000
12-35	Pump curve flow 1	0
12-36	Pump curve flow 2	0
12-37	Pump curve flow 3	0
12-38	Pump curve flow 4	0
12-39	Pump curve flow 5	0

Parameter	Parameter Name	Default
12-40	Pump curve power 1	0
12-41	Pump curve power 2	0
12-42	Pump curve power 3	0
12-43	Pump curve power 4	0
12-44	Pump curve power 5	0

📖 Refer to Pr.12-20 for more details.

- Flow estimation- Q-H method

Parameter	Parameter Name	Default
12-20	Flow estimation method	1
12-21	Accumulated flow-units digit (m^3)	Read only
12-22	Accumulated flow-thousands digit (km^3)	Read only
12-23	Reset accumulated flow	0
12-24	Diameter of the pump inlet (mm)	0.0
12-25	Diameter of the pump outlet (mm)	0.0
12-26	The rated rotation speed of pump	3000
12-27	Fluid density	995.7
12-28	Fluid temperature during operation (ºC)	30.00
12-29	Height difference of inlet / outlet pump pressure sensor	0
12-30	Pump curve head 1	0
12-31	Pump curve head 2	0
12-32	Pump curve head 3	0
12-33	Pump curve head 4	0
12-34	Pump curve head 5	0
12-35	Pump curve flow 1	0
12-36	Pump curve flow 2	0
12-37	Pump curve flow 3	0
12-38	Pump curve flow 4	0
12-39	Pump curve flow 5	0

📖 Before using this method, user has to set outlet / inlet pressure sensor related parameters.
📖 Refer to Pr.12-20 for more details.

- Cavitation detection

Parameter	Parameter Name	Default
12-18	Cavitation detection method	0
12-19	Cavitation detection tolerance	0
12-24	Diameter of the pump inlet (mm)	0.0
12-25	Diameter of the pump outlet (mm)	0.0
12-26	The rated rotation speed of pump	3000
12-27	Fluid density	995.7
12-28	Fluid temperature during operation (ºC)	30.00
12-35	Pump curve flow 1	0
12-36	Pump curve flow 2	0
12-37	Pump curve flow 3	0
12-38	Pump curve flow 4	0
12-39	Pump curve flow 5	0
12-45	Pump curve NPSHr 1	0
12-46	Pump curve NPSHr 2	0
12-47	Pump curve NPSHr 3	0
12-48	Pump curve NPSHr 4	0
12-49	Pump curve NPSHr 5	0

📖 Refer to Pr.12-20 for more details.

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Chapter 13 Warning Codes

Summary of Warning Codes

ID No.	Warning Name	ID No.	Warning Name
0	No record	72	ExCom test mode (ECtt)
1	Communication error 1 (CE1)	73	ExCom BUS off (ECbF)
2	Communication error 2 (CE2)	74	ExCom no power (ECnP)
3	Communication error 3 (CE3)	75	ExCom factory defect (ECFF)
4	Communication error 4 (CE4)	76	ExCom inner error (ECiF)
5	Communication error 10 (CE10)	78	ExCom Parameter data error (ECPP)
9	IGBT overheating warning (oH1)	79	ExCom configuration data error (ECPi)
11	PID feedback error (PID)	80	Ethernet link fail (ECEF)
12	ACI analog signal loss (AnL)	81	Communication time-out (ECto)
13	Under current (uC)	82	Checksum error (ECCS)
20	Over-torque 1 (ot1)	83	Return defect (ECrF)
22	Motor overheating (oH3) PTC / PT100	84	Modbus TCP over (Eco0)
25	Auto tuning (tUn)	85	EtherNet/IP over (ECo1)
28	Output phase loss (OPHL)	86	IP fail (ECiP)
50	PLC opposite defect (PLod)	87	Mail fail (EC3F)
51	PLC save memory error (PLSv)	88	ExCom busy (ECbY)
52	Data defect (PLdA)	89	ExCom card break (ECCb)
53	Function defect (PLFn)	91	Copy PLC: Read mode error (CPL0)
54	PLC buffer overflow (PLor)	92	Copy PLC: Write mode (CPL1)
55	Function defect (PLFF)	98	Fire mode output (Fire)
56	Checksum error (PLSn)	99	PLC warning (PL00)
57	No end command (PLEd)	101	InrCOM time-out (ictn)
58	PLC MCR error (PLCr)	134	Battery low voltage (LBAt)
59	PLC download fail (PLdF)	135	Perpetual calendar adjustment (rCAL)
60	PLC scan time fail (PLSF)	222	Low water pressure (LPSn)
70	ExCom ID fail (ECid)	223	Dry pump (dryn)
71	ExCom power loss (ECLv)	224	Heavy water leakage (LEKn)

ID No.	Display	Warning Name	Description
1	CE1	Communication error 1 (CE1)	RS-485 Modbus illegal function code
Action and Reset			
Action condition	When the function code is not 03, 06, 10 and 63.		
Action time	Immediately		
Warning treatment parameter	N/A		
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct function code.		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-01, Pr.09-04 are the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Warning Name	Description
2	CE2	Communication error 2 (CE2)	RS-485 Modbus illegal data address (00–254 H)
Action and Reset			
Action condition	When the input data address is incorrect.		
Action time	Immediately		
Warning treatment parameter	N/A		
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct data address.		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-01, Pr.09-04 are the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Warning Name	Description
3	CE3	Communication error 3 (CE3)	RS-485 Modbus illegal data value
Action and Reset			
Action condition	When the length of communication data is too long.		
Action time	Immediately		
Warning treatment parameter	N/A		
Reset method	“Warning” occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct communication data value.		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-01, Pr.09-04 are is the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Warning Name	Description
4	CE4	Communication error 4 (CE4)	RS-485 Modbus data is written to read-only address.
Action and Reset			
Action condition	When the data is written to read-only address.		
Action time	Immediately		
Warning treatment parameter	N/A		
Reset method	“Warning” occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct written address of communication data.		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-01, Pr.09-04 are the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Warning Name	Description
5	CE10	Communication error 10 (CE10)	RS-485 Modbus transmission time-out
Action and Reset			
Action condition	When the communication time exceeds the detection time for Pr.09-33 communication time-out.		
Action time	Settings for Pr.09-03		
Warning treatment parameter	N/A		
Reset method	"Warning" occurs when Pr.09-02=0 and the motor drive keeps running. The drive resets automatically when receiving the next communication packet.		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The upper unit does not transmit the communication command within Pr.09-03 setting time.	Check if the upper unit transmits the communication command within the setting time for Pr.09-03.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Warning Name	Description
9	oH1	IGBT over-heating warning (oH1)	The AC motor drive detects over-heating of IGBT, and over the protection level of oH1 warning. (When Pr.06-15 is higher than the IGBT over-heating level, the drive shows oH1 error without displaying oH1 warning.)
Action and Reset			
Action condition	Pr.06-15		
Action time	"oH1" warning occurs when IGBT temperature is higher than Pr.06-15 setting value.		
Warning treatment parameter	N/A		
Reset method	Auto-reset		
Reset condition	The drive auto-resets when IGBT temperature is lower than oH1 warning level minus (–) 5°C.		
Record	N/A		
Cause	Corrective Actions		
Check if the ambient temperature or temperature inside the cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.		
Check if there is any obstruction on the heat sink or if the fan is running.	Remove the obstruction or replace the cooling fan.		
Insufficient ventilation space	Increase ventilation space of the drive.		
Check if the drive matches the corresponded loading.	1. Decrease the loading. 2. Decrease the carrier. 3. Replace with a drive with larger capacity.		
The drive has run 100% or more than 100% of the rated output for a long time.	Replace with a drive with larger capacity.		

ID No.	Display	Warning Name	Description
11		PID feedback error (PID)	PID feedback loss (warning for analog feedback signal; works only when PID enables)

Action and Reset		
Action condition	When the analog input is lower than 4 mA (only detects analog input 4–20 mA).	
Action time	Pr.08-08	
Warning treatment parameter	Pr.08-09 0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: Warn and operate at last frequency	
Reset method	Auto	“Warning” occurs when Pr.08-09=0 or 3. The “Warning” automatically clears when the feedback signal is larger than 4 mA.
	Manual	“Error” occurs when Pr.08-09=1 or 2. You must reset manually.
Reset condition	Immediately reset	
Record	Records when Pr.08-09=1 or 2 (“Error”). Does not record when Pr.08-09=0 or 3 (“Warning”).	

Cause	Corrective Actions
Loose or broken PID feedback wiring	Tighten the terminals again. Replace with a new cable.
Feedback device malfunction	Replace with a new feedback device.
Hardware error	If the PID error still occurs after checking all the wiring, send the drive back to the factory for repair.

ID No.	Display	Warning Name	Description
12		ACI analog signal loss (AnL)	Analog input current loss (including all analog 4–20 mA signals)

Action and Reset		
Action condition	When the analog input is lower than 4 mA (only detects analog input 4–20 mA)	
Action time	Immediately act	
Warning treatment parameter	Pr.03-19 0: Disable 1: Continue operation at the last frequency (warning, the keypad displays ”ANL”) 2: Decelerate to 0 Hz (warning, the keypad displays ”ANL”) 3: Stop immediately and display “ACE”	
Reset method	Auto	“Warning” occurs when Pr.03-19=1 or 2. The “Warning automatically clears when the analog input signal is larger than 4 mA.
	Manual	“Error” occurs when Pr.03-19=3. You must reset manually.
Reset condition	Immediately reset	
Record	Does not record when Pr.03-19=1 or 2 (“Warning”).	

Cause	Corrective Actions
Loose or broken ACI wiring	Tighten the terminals again. Replace with a new cable.
External device error	Replace with a new device.
Hardware error	If the AnL error still occurs after checking all the wiring, send the drive back to the factory for repair.

ID No.	Display	Warning Name	Description
13		Under current (uC)	Low current

Action and Reset		
Action condition	Pr.06-71	
Action time	Pr.06-72	
Warning treatment parameter	Pr.06-73 0: No function 1: Warn and coast to stop 2: Warn and ramp to stop by 2nd deceleration time 3: Warn and continue operation	
Reset method	Auto	"Warning" occurs when Pr.06-73=3. The "Warning" automatically clears when the output current is > (Pr.06-71+0.1 A).
	Manual	"Error" occurs when Pr.06-73=1 and 2. You must reset manually.
Reset condition	Immediately reset	
Record	Does not record when Pr.06-73=3 and uC displays "Warning".	

Cause	Corrective Actions
Broken motor cable	Exclude the connection issue of the motor and its load.
Improper setting for the low current protection	Set the proper settings for Pr.06-71, Pr.06-72 and Pr.06-73.
Low load	Check the loading status. Make sure the loading matches the motor capacity.

ID No.	Display	Warning Name	Description
20		Over-torque 1 (ot1)	Over-torque 1 warning

Action and Reset	
Action condition	Pr.06-07
Action time	Pr.06-08
Warning treatment parameter	Pr.06-06=1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
Reset method	When input current < (Pr.06-07 – 5%), the ot1 warning automatically clears.
Reset condition	When input current < (Pr.06-07 – 5%), the ot1 warning automatically clears.
Record	N/A

Cause	Corrective Actions
Incorrect parameter setting	Configure the settings for Pr.06-07 and 06-08 again.
Mechanical error (e.g. mechanical lock due to over-torque)	Remove the causes of malfunction.
The load is too large.	Decrease the loading. Replace with a motor with larger capacity.
Accel./ Decel. time and working cycle is too short.	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time).
V/F voltage is too high.	Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
The motor capacity is too small.	Replace with a motor with larger capacity.
Over-load during low-speed operation.	Decrease the loading during low-speed operation. Increase the motor capacity.
The torque compensation is too large.	Readjust the torque compensation value (Pr.07-26 torque compensation gain) till the output current decreases and the motor does not stall.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for Pr.07-09 speed tracking.

ID No.	Display	Warning Name	Description
22	oH3	Motor over-heating (oH3)	The AC motor drive detects the temperature inside the motor is too high. Situation 1: Motor over-heating warning for PTC / KTY-84 Situation 2: Motor over-heating warning for PT100

Action and Reset	
Action condition	● PTC / KTY-84: Pr.03-00=6, the input level > Pr.06-30 (default=50%). ● PT100: Pr.03-00=11, the input level > Pr.06-57 (default=7V)
Action time	Immediately act
Warning treatment parameter	Error treatment: Pr.06-29 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning ● Using PTC / KTY-84 When Pr.06-29=0 and when the temperature is ≤ Pr.06-30 level, the oH3 warning is automatically cleared. When Pr.06-29=0 ("Warning"), it automatically resets. ● Using PT100 When Pr.06-29=0 and when the temperature is < Pr.06-56 level, the oH3 warning is automatically cleared. If the temperature is between the value of Pr.06-56 and Pr.06-57, the operation follows Pr.06-58 setting.
Reset method	● Using PTC / KTY-84 When Pr.06-29=0, oH3 displays "Warning". When the temperature is ≤ Pr.06-30 level, the oH3 warning is automatically cleared. ● Using PT100 When Pr.06-29=0, oH3 displays "Warning". When the temperature is < Pr.06-56 level, the oH3 warning is automatically cleared.
Reset condition	● Using PTC / KTY-84 When the temperature is ≤ Pr.06-30 level, the oH3 warning is automatically cleared. ● Using PT100 When the temperature is ≤ Pr.06-56 level, the oH3 warning is automatically cleared.
Record	N/A

Cause	Corrective Actions
Motor locked.	Clear the motor lock status.
The load is too large.	Decrease the loading. Replace with a motor with larger capacity.
Ambient temperature is too high.	Change the installed place if there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operates at low-speed too long.	Decrease low-speed operation time. Change to the dedicated motor for the drive. Increase the motor capacity.
Accel./ Decel. time and working cycle is too short.	Increase the setting values for Pr.01-12–01-19 (accel./ decel. time).
V/F voltage is too high.	Adjust the settings for Pr.01-01–01-02 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
Check if the motor rated current matches the motor nameplate.	Configure the correct rated current value of the motor again.
Check if the PTC is properly set and wired.	Situation 1: Check the connection between PTC / KTY-84 and the heat protection. Situation 2: Check the connection between PT100 and the heat protection.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics are too high.	Use remedies to reduce harmonics.

ID No.	Display	Warning Name	Description
25		Auto-tuning (tUn)	Parameter auto-tuning is processing. When running auto-tuning, the keypad displays “tUn”.

Action and Reset	
Action condition	When running Pr.05-00 motor parameter auto-tuning, the keypad displays “tUn”.
Action time	N/A
Warning treatment parameter	N/A
Reset method	When auto-tuning is finished and no error occurs, the warning automatically clears.
Reset condition	When auto-tuning is finished and no error occurs.
Record	N/A
Cause	**Corrective Actions**
The motor parameter is running auto-tuning.	When the auto-tuning is finished, the warning automatically clears.

ID No.	Display	Warning Name	Description
28		Output phase loss (OPHL)	Output phase loss

Action and Reset	
Action condition	Pr.06-47
Action time	N/A
Warning treatment parameter	Pr.06-45 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning
Reset method	If Pr.06-45 is set to 0, the OPHL warning automatically clears after the drive stops.
Reset condition	N/A
Record	N/A
Cause	**Corrective Actions**
Unbalanced three-phase impedance of the motor	Replace the motor.
Check if the wiring is incorrect.	Check the cable. Replace the cable.
Check if the motor is a single-phase motor.	Choose a three-phase motor.
Check if the current sensor is broken.	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, send the drive back to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPHL error still shows on the display, send the drive back to the factory for repair.
Check if the drive capacity is larger than the motor capacity.	Choose the drive that matches the motor capacity.

ID No.	Display	Warning Name	Description
50		PLC opposite defect (PLod)	PLC download error warning
Action and Reset			
Action condition		During PLC downloading, the program source code detects incorrect address (e.g. the address exceeds the range), then the PLod warning shows.	
Action time		Immediately displays when the fault is detected	
Warning setting parameter		N/A	
Reset method		Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.	
Reset condition		N/A	
Record		N/A	
Cause		Corrective Actions	
Incorrect component number is found when downloading the PLC program		Use the correct component number.	

ID No.	Display	Warning Name	Description
51		PLC save memory error (PLSv)	Data error during PLC operation
Action and Reset			
Action condition		The program detects incorrect written address (e.g. the address has exceeded the range) during PLC operation, then the PLSv warning shows.	
Action time		Immediately displays when the fault is detected	
Warning setting parameter		N/A	
Reset method		Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.	
Reset condition		N/A	
Record		N/A	
Cause		Corrective Actions	
An incorrect written address is detected during PLC operation		Make sure the write-in address is correct and re-download the program.	

ID No.	Display	Warning Name	Description
52	PLdA	Data defect (PLdA)	Data error during PLC operation

Action and Reset	
Action condition	T. The program detects incorrect write-in address when decoding the program source code and downloading the PLC program (e.g. the address has exceeded the range), then PLdA warning acts.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
During PLC operation, the external Modbus has written/read incorrect data to internal PLC program	Check if the upper unit transmits the correct command

ID No.	Display	Warning Name	Description
53	PLFn	Function defect (PLFn)	PLC download function code error

Action and Reset	
Action condition	The program detects incorrect command (unsupported command) during PLC downloading, then PLFn warning acts.
Action time	Immediately displays when the fault is detected
Warning setting parameter	N/A
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Unsupported command has used while downloading the program	Check if the firmware of the drive is the old version. If yes, contact Delta.

ID No.	Display	Warning Name	Description
54	PLor	PLC buffer overflow (PLor)	PLC register overflow
Action and Reset			
Action condition	When PLC runs the last command and the command exceeds the maximum capacity of the program, the PLor warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	N/A		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The program detects source code error during PLC operation	1. Disable PLC 2. Delete PLC program (Pr.00-02 = 6) 3. Enable PLC 4. Re-download PLC program		

ID No.	Display	Warning Name	Description
55	PLFF	Function defect (PLFF)	Function code error during PLC operation
Action and Reset			
Action condition	The program detects incorrect command (unsupported command) during PLC operation, then PLFF warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The PLC runs an incorrect command during operation	When starting the PLC function and there is no program in the PLC, the PLFF warning shows. This is a normal warning, please download the program.		

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>56</td><td></td><td>Checksum error
(PLSn)</td><td>PLC checksum error</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">PLC checksum error is detected after power on, then PLSn warning shows</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">NA</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">The program detects checksum error during PLC operation</td><td colspan="2">1. Disable PLC
2. Remove PLC program (Pr.00-02 = 6)
3. Enable PLC
4. Re-download PLC program</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Warning Name</th><th>Description</th></tr>
<tr><td>57</td><td></td><td>No end command
(PLEd)</td><td>PLC end command is missing</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action condition</td><td colspan="2">The “End” command is missing until the last command is executed, the PLEd warning shows</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately displays when the fault is detected</td></tr>
<tr><td colspan="2">Warning setting parameter</td><td colspan="2">NA</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">N/A</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">There is no “END” command during PLC operation</td><td colspan="2">1. Disable PLC
2. Remove PLC program (Pr.00-02 = 6)
3. Enable PLC
4. Re-download PLC program</td></tr>
</table>

ID No.	Display	Warning Name	Description
58	PLCr	PLC MCR error (PLCr)	PLC MCR command error
Action and Reset			
Action condition	The MC command is detected during PLC operation, but there is no corresponded MCR command, then the PLCr warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The MC command is continuously used for more than 9 times	The MC command cannot be used continuously for 9 times. Check and reset the program, then re-download the program.		

ID No.	Display	Warning Name	Description
59	PLdF	PLC download fail (PLdF)	PLC download fail
Action and Reset			
Action condition	PLC download fail due to momentary power loss during the downloading, when power is ON again, PLdF warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
PLC download is forced to stop, so the program write-in is incomplete	Check if there is any error in the program and re-download the PLC program		

ID No.	Display	Warning Name	Description
60		PLC scan time fail (PLSF)	PLC scan time exceeds the maximum allowable time
Action and Reset			
Action condition	When the PLC scan time exceeds the maximum allowable time (400 ms), PLSF warning shows.		
Action time	Immediately displays when the fault is detected		
Warning setting parameter	NA		
Reset method	Check if the program is correct and re-download the program. If the fault does not exist, the warning automatically clears.		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The PLC scan time exceeds the maximum allowable time (400ms)	Check if the source code is correct and re-download the program		

ID No.	Display	Warning Name	Description
70		ExCom ID fail (ECid)	Duplicate MAC ID error Node address setting error
Action and Reset			
Action condition	Duplicate setting of MAC ID Node address setting error		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Correct the setting and cycle the power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The setting address exceeds the range (0–63)	Check the address setting of the communication card (Pr.09-70)		
The speed setting exceeds the range	Standard: 0–2, non-standard: 0–7		
The address is duplicated with other nodes on the BUS	Reset the address		

ID No.	Display	Warning Name	Description
71		ExCom power loss (ECLv)	Low voltage of communication card

Action and Reset	
Action condition	The 5V power that drive provides to communication card is to low
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Re-power
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
The 5V power that drive provides to communication card is to low	1. Switch the communication card to other drives and observe if there is ECLv warning shown. If yes, replace with a new communication card; if not, replace the drive. 2. Use another communication card to test if the ECLv warning has shown as well. If not, replace the card; if yes, replace the drive.
The card is loose	Make sure the communication card is well inserted.

ID No.	Display	Warning Name	Description
72		ExCom test mode (ECtt)	Communication card is in the test mode

Action and Reset	
Action condition	Communication card is in the test mode
Action time	Immediately acts
Warning setting parameter	N/A
Reset method	Cycle the power and enter the normal mode
Reset condition	N/A
Record	N/A

Cause	Corrective Actions
Communication command error	Cycle the power

ID No.	Display	Warning Name	Description
73		ExCom Bus off (ECbF)	The communication card detects too much errors in the BUS, then enters the bus-off status and stop communicating
Action and Reset			
Action condition	When the drive detects bus-off (for DeviceNet)		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Cycle the power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Poor connection of the cable	Re-connect the cable		
Bad quality of the cable	Replace the cable		

ID No.	Display	Warning Name	Description
74		ExCom no power (ECnP)	There is no power supply on the DeviceNet
Action and Reset			
Action condition	There is no power supply on the DeviceNet		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Re-power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
The drive detects that DeviceNet has no power	Check if the cable and power is normal. If yes, return to the factory for repair.		

ID No.	Display	Warning Name	Description
75		ExCom factory defect (ECFF)	Factory default setting error
Action and Reset			
Action condition	Factory default setting error		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Cycle the power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Factory default setting error	Use DCISoft to reset to the default value.		

ID No.	Display	Warning Name	Description
76		ExCom inner error (ECiF)	Serious internal error
Action and Reset			
Action condition	Internal memory saving error		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Cycle the power		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Noise interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference. Cycle the power.		
The memory is broken	Reset to the default value and check if the error still exists. If yes, replace the communication card.		

ID No.	Display	Warning Name	Description
78		ExCom Parameter data error (ECPP)	Profibus parameter data error
Action and Reset			
Action condition	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The GSD file is incorrect	Get the correct GSD file from the software		

ID No.	Display	Warning Name	Description
79		ExCom configuration data error (ECPi)	Profibus configuration data error
Action and Reset			
Action condition	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	N/A		
Cause	Corrective Actions		
The GSD file is incorrect	Get the correct GSD file from the software		

ID No.	Display	Warning Name	Description
80	ECEF	Ethernet link fail (ECEF)	Ethernet cable is not connected
Action and Reset			
Action condition	Hardware detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Ethernet cable is loose	Re-connect the cable		
Bad quality of Ethernet cable	Replace the cable		

ID No.	Display	Warning Name	Description
81	ECto	Communication time-out (ECto)	Communication time-out for communication card and the upper unit
Action and Reset			
Action condition	N/A		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	N/A		
Reset condition	CMC-EC01: auto resets when the communication with the upper unit is back to normal		
Record	N/A		
Cause	Corrective Actions		
Communication card is not connected with the upper unit	Check if the connection of the communication cable is correct		
Communication error of the upper unit	Check if the communication of the upper unit is normal		

ID No.	Display	Warning Name	Description
82	ECCS	Checksum error (ECCS)	Checksum error for communication card and the drive

Action and Reset	
Action condition	Software detection
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A

Cause	Corrective Actions
Noise interference	Verify wiring of the control circuit, and wiring/grounding of the main circuit to prevent interference.

ID No.	Display	Warning Name	Description
83	ECrF	Return defect (ECrF)	Communication card returns to the default setting

Action and Reset	
Action condition	Communication card returns to the default setting
Action time	N/A
Warning setting parameter	N/A
Reset method	Manual reset
Reset condition	Immediately resets
Record	N/A

Cause	Corrective Actions
Communication card is returning to default setting	No actions.

ID No.	Display	Warning Name	Description
84		Modbus TCP over (Eco0)	Modbus TCP exceeds maximum communication value
Action and Reset			
Action condition	Hardware detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
The Master communication value is more than the allowable quantity of the communication card	Reduce Master communication value		
The upper unit is online without communicating, and does not break off the Modbus TCP link, causes occupy connection	Revise program of upper unit, the communication should be break off when it is not used for a long time		
A new Modbus TCP connection is built every time when the upper unit is connected to the communication card, which caused occupy connection	Revise program of upper unit: use the same Modbus TCP connection when connected to the same communication card		

ID No.	Display	Warning Name	Description
85		EtherNet/IP over (ECo1)	Ethernet/IP exceeds maximum communication value
Action and Reset			
Action condition	Hardware detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
The Master communication value is more than the allowable quantity of the communication card	Reduce Master communication value		
The upper unit is online without communicating, and does not break off the Modbus TCP link, causes occupy connection	Revise program of upper unit, the communication should be break off when it is not used for a long time		
A new Modbus TCP connection is built every time when the upper unit is connected to the communication card, which caused occupy connection	Revise program of upper unit: use the same Modbus TCP connection when connected to the same communication card		

ID No.	Display	Warning Name	Description
86		IP fail (ECiP)	IP setting error
Action and Reset			
Action condition	Software detection		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediate reset		
Record	N/A		
Cause	Corrective Actions		
IP conflict	Reset IP		
DHCP IP configuration error	MIS check if DHCP Server works normally		

ID No.	Display	Warning Name	Description
87		Mail fail (EC3F)	Mail warning: Alarm mail will be sent when the communication card establishes alarm conditions
Action and Reset			
Action condition	Communication card establishes alarm conditions		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
Communication card establishes alarm conditions	No actions		

ID No.	Display	Warning Name	Description
88		ExCom busy (ECbY)	Communication card busy: too much packets are received
Action and Reset			
Action condition	Software detection		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	N/A		
Record	N/A		
Cause	Corrective Actions		
Communication packets are too much for the communication card to process	Reduce communication packets		

ID No.	Display	Warning Name	Description
89		ExCom card break (ECCb)	Communication card break off warning
Action and Reset			
Action condition	Communication card break off		
Action time	N/A		
Warning setting parameter	N/A		
Reset method	Auto resets after communication card is re-installed		
Reset condition	Immediately resets		
Record	N/A		
Cause	Corrective Actions		
Communication card break off	Re-install communication card		

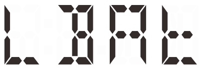
ID No.	Display	Warning Name	Description
91		Copy PLC: Read mode error (CPL0)	Copy PLC Read mode error
Action and Reset			
Action condition		When copy PLC read mode with incorrect process	
Action time		Immediately acts	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Directly resets	
Record		N/A	
Cause		Corrective Actions	
When copy PLC read mode and the process is incorrect		Cycle the power and copy PLC read mode again	

ID No.	Display	Warning Name	Description
92		Copy PLC: Write mode (CPL1)	Copy PLC write mode error
Action and Reset			
Action condition		Copy PLC write mode with incorrect process	
Action time		Immediately acts	
Warning setting parameter		N/A	
Reset method		Manual reset	
Reset condition		Directly resets	
Record		N/A	
Cause		Corrective Actions	
When copy PLC write mode and the process is incorrect		Cycle the power and copy PLC read mode again	

ID No.	Display	Warning Name	Description
98		Fire mode output (Fire)	Displayed when fire more is triggered
Action and Reset			
Action condition	MIx = 58 is triggered and run, or MIx = 59 is triggered		
Action time	Immediately acts		
Warning setting parameter	Refer to Pr.06-81, Pr.06-88 to set the operating frequency and the operation times in firemode		
Reset method	Manual reset		
Reset condition	Reset after the error is clear for 5 seconds		
Record	Yes		
Cause	Corrective Actions		
MIx = 58 is triggered and run, or MIx = 59 is triggered	If it is triggered in four minutes, then cancel MI setting. If it is triggered over four minutes, then re-power ON.		

ID No.	Display	Warning Name	Description
99		PLC warning (PL00)	Backup master switches to be the master This warning is especially for the built-in PLC function of MPD
Action and Reset			
Action condition	Pr.04-57 bit9=1 and when the backup master changes to be the master		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Auto-reset		
Reset condition	Pr.04-57 bit9 1, or change to be the slave		
Record	N/A		
Timing of detection	Load in and enable the built-in PLC function of MPD		
Cause	Corrective Actions		
The backup master becomes the master when the original master is malfunctioned, disconnected, has power failure	Check if the master has any abnormalities.		

ID No.	Display	Warning Name	Description
101		InrCOM time-out (ictn)	Internal communication time-out
Action and Reset			
Action condition	When Pr.09-31= (-1) – (-10) (no -9) and the internal communication between Master and Slave is abnormal, the ictn warning shows.		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Auto-reset		
Reset condition	The warning automatically clears when the communication is back to normal condition		
Record	N/A		
Cause	Corrective Actions		
Malfunction caused by interference	Verify wiring/grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication conditions with the upper unit	Check if the setting for Pr.09-02 is the same as the setting for upper unit		
Communication cable break off or not connected well	Check the cable status or replace the cable		

ID No.	Display	Warning Name	Description
134		Low battery voltage (LBAt)	Remind user to change the battery of perpetual calendar
Action and Reset			
Action condition	N/A		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	N/A		
Reset condition	Need to change the battery		
Record	N/A		
Cause	Corrective Actions		
The battery is dying	Change the battery		

ID No.	Display	Warning Name	Description
135		Perpetual calendar adjustment (rCAL)	Remind user to adjust the perpetual calendar
Action and Reset			
Action condition	Time has not been adjusted.		
Action time	Immediately acts		
Warning setting parameter	N/A		
Reset method	Manual reset		
Reset condition	Need to adjust the perpetual calendar		
Record	N/A		
Cause	Corrective Actions		
Time has not been adjusted yet	Adjust time by Pr.12-93–Pr.12-96		

ID No.	Display	Warning Name	Description
222		Low water pressure (LPSn)	The water pressure is lower than the setting
Action and Reset			
Action condition	The feedback pressure is lower than the difference of Pr.12-82 and the target pressure, and the condition continues as the time value set in Pr.12-83.		
Action time	Pr.12-83		
Warning setting parameter	Pr.12-84 0: Warn and continue operation		
Reset method	Auto-reset when the triggered condition is clear.		
Reset condition	Directly resets		
Record	N/A		
Cause	Corrective Actions		
No water pressure	Check if water leakage occurs in pipe, or no water inputs		
Pressure sensor is broken	Change the pressure sensor.		

ID No.	Display	Warning Name	Description
223		Dry pump (dryn)	Dry pump condition is detected.
Action and Reset			
Action condition	The power corresponds to the target frequency is under the dry pump curve.		
Action time	Pr.12-69		
Warning setting parameter	Pr.12-72 1: Fault and coast to stop 2: Fault and ramp to stop		
Reset method	Auto-reset when the triggered condition is clear.		
Reset condition	Auto-reset		
Record	N/A		
Cause	Corrective Actions		
The inlet of the water pump is broken	Check if the pipe is broken, or no water input.		

ID No.	Display	Warning Name	Description
224		Heavy water leakage (LEKn)	Triggered when heavy water leakage is detected
Action and Reset			
Action condition	When the feedback is lower than P_{low} and the load current is larger than Pr.12-75		
Action time	Pr.12-74		
Warning setting parameter	Pr.12-76 0: Warn and continue operation		
Reset method	Auto-reset when the triggered condition is clear.		
Reset condition	When the feedback is lower than P_{low} and the load current is larger than Pr.12-75		
Record	N/A		
Cause	Corrective Actions		
The outlet of the water pump is broken	Check if the pipe is broken.		

Chapter 14 Fault Codes

Summary of Fault Codes

ID No.	Fault Name	ID No.	Fault Name
0	No fault record	41	PID loss ACI (AFE)
1	Over-current during acceleration (ocA)	48	ACI loss (ACE)
2	Over-current during deceleration (ocd)	49	External fault (EF)
3	Over-current during steady operation (ocn)	51	External base block (bb)
4	Ground fault (GFF)	52	Password is locked (Pcod)
6	Over-current at stop (ocS)	54	Illegal command (CE1)
7	Over-voltage during acceleration (ovA)	55	Illegal data address (CE2)
8	Over-voltage during deceleration (ovd)	56	Illegal data value (CE3)
9	Over-voltage at constant speed (ovn)	57	Data is written to read-only address (CE4)
10	Over-voltage at stop (ovS)	58	Modbus transmission time-out (CE10)
11	Low-voltage during acceleration (LvA)	79	U-phase over-current before run (Aoc)
12	Low-voltage during deceleration (Lvd)	80	V-phase over-current before run (boc)
13	Low-voltage at constant speed (Lvn)	81	W-phase over-current before run (coc)
14	Low-voltage at stop (LvS)	82	Output phase loss U phase (OPHL)
15	Phase loss protection (OrP)	83	Output phase loss V phase (OPHL)
16	IGBT overheating (oH1)	84	Output phase loss W phase (OPHL)
17	Internal key parts overheating (oH2)	87	Overload protection at low frequency (oL3)
18	IGBT temperature detection failure (tH1o)	89	Rotor position detection error (RoPd)
19	Capacitor hardware error (tH2o)	90	Force to stop (FStp)
21	Over load (oL)	140	oc hardware error (Hd6)
22	Electronic thermal relay 1 protection (EoL1)	141	GFF occurs before run (b4GFF)
24	Motor overheating (oH3) PTC / PT100	142	Auto-tune error 1 (AUE1)
26	Over torque 1 (ot1)	143	Auto-tune error 2 (AUE2)
28	Under current (uC)	144	Auto-tune error 3 (AUE3)
31	EEPROM read error (cF2)	221	High water pressure (HPS)
33	U-phase error (cd1)	222	Low water pressure (LPSE)
34	V-phase error (cd2)	223	Dry pump (dryE)
35	W-phase error (cd3)	224	Water leaking (pipe explosion) (LEKE)
36	cc hardware failure (Hd0)	225	Clogged pipe (JAME)
37	oc hardware error (Hd1)	226	RTC error (rtF)
40	Auto-tuning error (AUE)	227	Dry pump curve auto-measuring (dAUE)

ID No.	Display	Fault Name	Description
1	ocA	Over-current during acceleration (ocA)	Output current exceeds 2.5 times of the rated current during acceleration. When ocA occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocA error.

Action and Reset	
Action level	250% of the rated current (software)
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Acceleration time is too short.	1. Increase the acceleration time 2. Increase the acceleration time of S-curve 3. Set auto-acceleration and auto-deceleration parameter (Pr.01-44) 4. Set over-current stall prevention function (Pr.06-03) 5. Replace the drive with a larger capacity model
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
The load is too large.	Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model.
Impulsive change of the load	Reduce the load or increase the capacity of the AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor's nameplate should ≤ the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The motor starts when in free run.	Enable the speed tracking during start-up of Pr.07-12.
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.
Incorrect combination of control mode and used motor	Check the settings for Pr.00-11 control mode: 1. For IM motor, Pr.00-11=0, 2, Pr.05-33=0 2. For PM motor, Pr.00-11=2, Pr.05-33=1, 2
The length of motor cable is too long.	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocA occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.

ID No.	Display	Fault Name	Description
2	ocd	Over-current during deceleration (ocd)	Output current exceeds 2.5 times of the rated current during deceleration. When ocd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocd error.

Action and Reset	
Action level	250% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes
Cause	**Corrective Actions**
Deceleration time is too short.	1. Increase the deceleration time 2. Increase the deceleration time of S-curve 3. Set auto-acceleration and auto-deceleration parameter (Pr.01-44) 4. Set over-current stall prevention function (Pr.06-03) 5. Replace the drive with a larger capacity model
Check if the mechanical brake of the motor activates too early	Check the action timing of the mechanical brake
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
The load is too large.	Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model.
Impulsive change of the load	Reduce the load or increase the capacity of the AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the motor capacity (the rated current on the motor's nameplate should the rated current of the drive)
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long.	Increase the AC motor drive's capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocd occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.

ID No.	Display	Fault Name	Description
3		Over-current during steady operation (ocn)	Output current exceeds 2.5 times of the rated current during constant speed. When ocn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocn error.

Action and Reset	
Action level	250% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible shaft lock, burnout or aging insulation of the motor	Troubleshoot the motor shaft lock. Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Impulsive change of the load	Reduce the load or increase the capacity of the AC motor drive.
Use special motor or motor with larger capacity than the drive	Check the rated current of the drive).
Use ON/OFF controller of an electromagnetic contactor at the output (U/V/W) of the drive	Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
V/F curve setting error	Adjust V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
The length of motor cable is too long.	Increase the AC motor drive’s capacity. Install AC reactor(s) on the output side (U/V/W).
Hardware failure	The ocn occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.

ID No.	Display	Fault Name	Description
4	GFF	Ground fault (GFF)	When (one of) the output terminal(s) is grounded, short circuit current is larger than Pr.06-60 setting value, and the detection time is longer than Pr.06-61 time setting, GFF occurs. NOTE: the short circuit protection is provided for AC motor drive protection, not to protect you.

Action and Reset	
Action level	Pr.06-60 (Default = 60%)
Action time	Pr.06-61 (Default = 0.10 sec.)
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Motor burnout or aging insulation occurred.	Check the motor insulation value with megger. Replace the motor if the insulation is poor.
Short circuit due to broken cable	Troubleshoot the short circuit. Replace the cable.
Larger stray capacitance in the cable and terminal	If the motor cable length exceeds 100 m, decrease the setting value for carrier frequency. Take remedies to reduce stray capacitance.
Malfunction caused by interference	Verify the grounding and wiring of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective sufficient anti-interference performance.
Hardware failure	Cycle the power after checking the status of motor, cable and cable length. If GFF still exists, return to the factory for repair.

ID No.	Display	Fault Name	Description
6	ocS	Over-current at stop (ocS)	Over-current or hardware failure in current detection at stop. Cycle the power after ocS occurs. If the hardware failure occurs, the display shows cd1, cd2 or cd3.

Action and Reset	
Action level	240% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure	Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>7</td><td></td><td>Over-voltage during acceleration
(ovA)</td><td>DC bus over-voltage during acceleration. When ovA occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovA error.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">230V series: 410 V_{DC}
460V series: 820 V_{DC}</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act when DC bus voltage is higher than the level.</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset only when DC bus voltage is lower than 90% of the over-voltage level.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Acceleration is too slow (e.g. when elevator is going down)</td><td colspan="2">Decrease the acceleration time.
Use brake unit or DC bus.
Replace the drive with a larger capacity model.</td></tr>
<tr><td colspan="2">The setting for stall prevention level is smaller than no-load current.</td><td colspan="2">The setting for stall prevention level should be larger than no-load current.</td></tr>
<tr><td colspan="2">Power voltage is too high.</td><td colspan="2">Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.</td></tr>
<tr><td colspan="2">ON/OFF switch action of phase-in capacitor in the same power system</td><td colspan="2">If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.</td></tr>
<tr><td colspan="2">Regenerative voltage of motor inertia</td><td colspan="2">Use over-voltage stall prevention function (Pr.06-01)
Use auto-acceleration and auto-deceleration setting (Pr.01-44)
Use a brake unit or DC bus</td></tr>
<tr><td colspan="2">Acceleration time is too short.</td><td colspan="2">Check if the over-voltage warning occurs after acceleration stops.
When the warning occurs, do the following:
1. Increase the acceleration time
2. Set Pr.06-01 over-voltage stall prevention
3. Increase the setting value for Pr.01-25 S-curve acceleration arrival time 2</td></tr>
<tr><td colspan="2">Motor ground fault</td><td colspan="2">The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals.
Troubleshoot the ground fault.</td></tr>
<tr><td colspan="2">Incorrect wiring of brake resistor or brake unit</td><td colspan="2">Check the wiring of brake resistor or brake unit.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
</table>

ID No.	Display	Fault Name	Description
8		Over-voltage during deceleration (ovd)	DC bus over-voltage during deceleration. When ovd occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovd error.

Action and Reset	
Action level	230V series: 410 V_{DC} 460V series: 820 V_{DC}
Action time	Immediately act when DC bus voltage is higher than the level.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset only when DC bus voltage is lower than 90% of the over-voltage level.
Record	Yes

Cause	Corrective Actions
Deceleration time is too short, causing too large regenerative energy of the load.	1. Increase the setting value for Pr.01-13, Pr.01-15, Pr.01-17 and Pr.01-19 (deceleration time). 2. Connect brake resistor, brake unit or DC bus to the drive. 3. Reduce the brake frequency. 4. Replace the drive with a larger capacity model. 5. Use S-curve acceleration/deceleration. 6. Use over-voltage stall prevention (Pr.06-01). 7. Use auto-acceleration and auto-deceleration (Pr.01-44). Adjust braking level (Pr.07-01 or the bolt position of the brake unit).
The setting for stall prevention level is smaller than no-load current.	The setting for stall prevention level should be larger than no-load current.
Power voltage is too high.	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Incorrect wiring of brake resistor or brake unit	Check the wiring of brake resistor or brake unit.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Display	Fault Name	Description
9		Over-voltage at constant speed (ovn)	DC bus over-voltage at constant speed. When ovn occurs, the drive closes the gate of the output, motor runs freely, and the display shows an ovn error.

Action and Reset	
Action level	230V series: 410 V_{DC} 460V series: 820 V_{DC}
Action time	Immediately act when DC bus voltage is higher than the level.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset only when DC bus voltage is lower than 90% of the over-voltage level.
Record	Yes

Cause	Corrective Actions
Impulsive change of the load	1. Connect brake resistor, brake unit or DC bus to the drive. 2. Reduce the load. 3. Replace the drive with a larger capacity model. 4. Adjust braking level (Pr.07-01 or the bolt position of the brake unit).
The setting for stall prevention level is smaller than no-load current.	The setting for stall prevention level should be larger than no-load current.
Regenerative voltage of motor inertia	Use over-voltage stall prevention function (Pr.06-01) Use a brake unit or DC bus
Power voltage is too high.	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.
Incorrect wiring of brake resistor or brake unit	Check the wiring of brake resistor or brake unit.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.

ID No.	Display	Fault Name	Description
10		Over-voltage at stop (ovS)	Over-voltage at stop

Action and Reset	
Action level	230V series: 410 V_{DC} 460V series: 820 V_{DC}
Action time	Immediately act when DC bus voltage is higher than the level.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset only when DC bus voltage is lower than 90% of the over-voltage level.
Record	Yes

Cause	Corrective Actions
Power voltage is too high.	Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes.
ON/OFF switch action of phase-in capacitor in the same power system	If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor.
Incorrect wiring of brake resistor or brake unit	Check the wiring of brake resistor or brake unit.
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.
Hardware failure in voltage detection	Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.
Motor ground fault	The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box and its internal terminals. Troubleshoot the ground fault.

ID No.	Display	Fault Name	Description
11		Low-voltage during acceleration (LvA)	DC bus voltage is lower than Pr.06-00 setting value during acceleration.
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediately act when DC bus voltage is lower than Pr.06-00.		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30 V (230V series) / + 60 V (460V series).		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Power voltage changes	Adjust voltage to the power range of the drive.		
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.		
The load is too large.	Reduce the load. Increase the drive capacity. Increase the acceleration time.		
DC bus	Install DC reactor(s).		
Check if there is short circuit plate or any DC reactor installed between terminal +1 and +2.	Connect short circuit plate or DC reactor between terminal +1 and +2. If the error still exists, return to the factory for repair.		

ID No.	Display	Fault Name	Description
12		Low-voltage during deceleration (Lvd)	DC bus voltage is lower than Pr.06-00 setting value during deceleration.
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediate activate when DC bus voltage is lower than Pr.06-00.		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30 V (230V series) / 60 V (460V series).		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Power voltage changes	Adjust voltage to the power range of the drive.		
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.		
Sudden load	Reduce the load. Increase the drive capacity.		
DC bus	Install DC reactor(s).		

ID No.	Display	Fault Name	Description
13		Low-voltage at constant speed (Lvn)	DC bus voltage is lower than Pr.06-00 setting value at constant speed.
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediately act when DC bus voltage is lower than Pr.06-00.		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset when DC bus voltage is higher than Pr.06-00 + 30 V (230V series) / + 60 V (460V series).		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Power voltage changes	Adjust voltage to the power range of the drive.		
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.		
Sudden load	Reduce the load. Increase the drive capacity.		
DC bus	Install DC reactor(s).		

ID No.	Display	Fault Name	Description
14		Low-voltage at stop (LvS)	1. DC bus voltage is lower than Pr.06-00 setting value at stop. 2. Hardware failure in voltage detection.
Action and Reset			
Action level	Pr.06-00 (Default = depending on the model)		
Action time	Immediately act when DC bus voltage is lower than Pr.06-00.		
Fault treatment parameter	N/A		
Reset method	Manual / Auto 230V series: Lv level + 30 V_{DC} + 500 ms 460V series: Lv level + 60 V_{DC} + 500 ms		
Reset condition	500 ms		
Record	Yes		
Cause	Corrective Actions		
Power-off	Improve power supply condition.		
Incorrect drive models	Check if the power specification matches the drive.		
Power voltage changes	Adjust voltage to the power range of the drive. Cycle the power after checking the power. If LvS error still exists, return to the factory for repair.		
Start up the motor with large capacity.	Check the power system. Increase the capacity of power equipment.		
DC bus	Install DC reactor(s).		

ID No.	Display	Fault Name	Description
15		Phase loss protection (OrP)	Phase loss of power input

Action and Reset	
Action level	DC bus is lower than Pr.07-00, and DC bus ripple is too high.
Action time	N/A
Fault treatment parameter	Pr.06-53
Reset method	Manual reset
Reset condition	Immediately reset when DC bus is higher than Pr.07-00.
Record	Yes

Cause	Corrective Actions
Phase loss of input power	Correctly install the wiring of the main circuit power.
Single phase power input to three-phase models	Choose the model whose power matches the voltage.
Power voltage changes	If the main circuit power works normally, verify the main circuit. Cycle the power after checking the power. If OrP error still exists, return to the factory for repair.
Loose wiring terminal of input power	Tighten the terminal screws according to the torque described in the user manual.
The input cable of three-phase power is cut off.	Wire correctly. Replace the cut-off cable.
Unbalanced three-phase of input power	Check the power three-phase status.
Use Delta, V-V system	Install reactors or use drives with higher power.

ID No.	Display	Fault Name	Description
16		IGBT overheating (oH1)	IGBT temperature exceeds the protection level. (Refer to Pr.06-15)

Action and Reset	
Action level	The fault level of oH1 is 115 C
Action time	IGBT temperature exceeds the protection level for more than 100 ms, oH1 error occurs.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset only when IGBT temperature is lower than oH1 error level minus (-) 10°C.
Record	Yes

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the control cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check the ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running.	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponding load.	1. Reduce the load. 2. Reduce the carrier. 3. Replace the drive with a larger capacity model.
The drive has run 100% or more than 100% of the rated output for a long time.	Replace the drive with a larger capacity model

ID No.	Display	Fault Name	Description
17		Over-heat key components (oH2)	The drive has detected the key components are over heat

Action and Reset	
Action level	The fault level of oH2 is 95 C
Action time	The oH2 fault occurs when the temperature sensor of key components detects the temperature is higher than the protection level for 100ms.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	The drive auto-resets when the temperature sensor of key components detects the temperature is lower than oH2 error level minus (–) 10 C
Record	Yes

Cause	Corrective Actions
Check if the ambient temperature or temperature inside the control cabinet is too high, or if there is obstruction in the ventilation hole of the control cabinet.	1. Check ambient temperature. 2. Regularly inspect the ventilation hole of the control cabinet. 3. Change the installed place if there are heating objects, such as braking resistors, in the surroundings. 4. Install/ add cooling fan or air conditioner to lower the temperature inside the cabinet.
Check if there is any obstruction on the heat sink or if the fan is running.	Remove the obstruction or replace the cooling fan.
Insufficient ventilation space	Increase ventilation space of the drive.
Check if the drive matches the corresponding load	1. Reduce the load 2. Reduce the carrier 3. Replace the drive with a larger capacity model.
The drive has run 100% or more than 100% of the rated output for a long time	Replace the drive with a larger capacity model.
Unstable power	Install reactor(s)
Load changes frequently	Reduce load changes

ID No.	Display	Fault Name	Description
18		IGBT temperature detection failure (tH1o)	IGBT hardware failure in temperature detection

Action and Reset	
Action level	NTC broken or wiring failure
Action time	When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH1o protection activates.
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Hardware failure	Wait for 10 minutes, and then cycle the power. Check if tH1o protection still exists. If yes, return to the factory for repair.

ID No.	Display	Fault Name	Description
19		Capacitor hardware fault (tH2o)	Hardware failure in capacitor temperature detection
Action and Reset			
Action level		NTC broken or wiring failure	
Action time		When the IGBT temperature is higher than the protection level, and detection time exceeds 100ms, the tH2o protection occurs.	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset immediately	
Record		Yes	
Cause		Corrective Actions	
Hardware failure		Wait for 10 minutes, and then cycle the power. Check if tH2o protection still occurs. If yes, return to the factory for repair.	

ID No.	Display	Fault Name	Description
21		Overload (oL)	The AC motor drive detects excessive drive output current. Overload capacity: Normal duty: Sustains for one minute when the drive outputs 120% of the drive's rated output current. Sustains for three seconds when the drive outputs 150% of the drive's rated output current. Heavy duty: Sustains for one minute when the drive outputs 150% of the drive's rated output current. Sustains for three seconds when the drive outputs 200% of the drive's rated output current.
Action and Reset			
Action level		Based on overload curve and derating curve (Pr.06-55)	
Action time		When the load is higher than the protection level and exceeds allowable time, the oL protection activates.	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset in 5 sec. after the fault is cleared.	
Record		Yes	
Cause		Corrective Actions	
The load is too large.		Reduce the load.	
Accel./Decel. time and the working cycle are too short.		Increase the setting values for Pr.01-12–01-19 (accel. / decel. time).	
V/F voltage is too high.		Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.	
The capacity of the drive is too small.		Replace the drive with a larger capacity model.	
Overload during low-speed operation.		Reduce the load during low-speed operation. Increase the drive capacity. Decrease the carrier frequency of Pr.00-17.	
Torque compensation is too large.		Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the output current reduces and the motor does not stall.	
Check if the setting for stall prevention is correct.		Set the stall prevention to the proper value.	
Output phase loss		Check the status of three-phase motor. Check if the cable is broken or the screws are loose.	
Improper parameter settings for the speed tracking function (including restart after momentary power loss and restart after fault)		Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.	

ID No.	Display	Fault Name	Description
22		Electronic thermal relay 1 protection (EoL1)	Electronic thermal relay 1 protection. The drive coasts to stop once it activates.
Action and Reset			
Action level		Start counting when output current > 150% of motor 1 rated current.	
Action time		Pr.06-14 (if the output current is larger than 105% of motor 1 rated current again within 60 sec., the counting time reduces and is less than Pr.06-14.)	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Reset in 5 sec. after the fault is cleared.	
Record		Yes	
Cause		Corrective Actions	
The load is too large.		Reduce the load.	
Accel./Decel. time and the working cycle are too short.		Increase the setting values for Pr.01-12–01-19 (accel. / decel. time)	
V/F voltage is too high.		Adjust the settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.	
Overload during low-speed operation. When using a general motor, even it operates below rated current, an overload may still occur during low-speed operation.		Decrease low-speed operation time. Replace the drive with a dedicated to VFD model. Increase the motor capacity.	
When using VFD dedicated motors, Pr.06-13=0 (electronic thermal relay selection motor 1 = 0 inverter motor)		Pr.06-13=1 electronic thermal relay selection motor 1 = standard motor (motor with fan on the shaft).	
Incorrect value of electronic thermal relay		Reset to the correct motor rated current.	
The maximum motor frequency is set too low.		Reset to the correct motor rated frequency.	
One drive to multiple motors		Set Pr.06-13=2 electronic thermal relay selection motor 1 = disable, and install thermal relay on each motor.	
Check if the setting for stall prevention is correct.		Set the stall prevention to the proper value.	
Torque compensation is too large.		Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.	
Motor fan error		Check the status of the fan, or replace the fan.	
Unbalanced three-phase impedance of the motor		Replace the motor.	

ID No.	Display	Fault Name	Description
24		Motor overheating (oH3)	The AC motor drive detects the temperature inside the motor is too high. Situation 1: Motor over-heating warning for PTC / KTY-84 Situation 2: Motor over-heating warning for PT100 When using motor with PTC / KTY-84, and enable the function (Pr.03-00–03-02 = 6 PTC / KTY-84) The input of PTC / KTY-84 > Pr.06-30, then treats with the Pr.06-29 setting. When using motor with PT100, and enable the function (Pr.03-00–03-02 = 11 PT100) The input of PT100 > Pr.06-57 (default=7V) , then treats with the Pr.06-29 setting.

Action and Reset		
Action level	PTC / KTY-84: Pr.03-00=6, the input level > Pr.06-30 (default=50%). PT100: Pr.03-00=11, the input level > Pr.06-57 (default=7V)	
Action time	Immediately act	
Fault treatment parameter	Pr.06-29 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	
Reset method	Auto	Using PTC / KTY-84 When Pr.06-29=0, oH3 displays “Warning”. When the temperature -30 level, the oH3 warning is automatically cleared. Using PT100 When Pr.06-29=0, oH3 displays “Warning”. When the temperature is < Pr.06-56 level, the oH3 warning is automatically cleared.
	Manual	When Pr.06-29=1 or 2, oH3 displays “Fault”. This should reset manually.
Reset condition	Immediately reset	
Record	When Pr.06-29=1 or 2, oH3 is a fault, and the fault is recorded.	

Cause	Corrective Actions
Motor shaft lock	Remove the shaft lock.
The load is too large.	Reduce the load. Increase the motor capacity.
Ambient temperature is too high.	Change the installed place If there are heating devices in the surroundings. Install/ add cooling fan or air conditioner to lower the ambient temperature.
Motor cooling system error	Check the cooling system to make it work normally.
Motor fan error	Replace the fan.
Operate at low-speed too long.	Decrease low-speed operation time. Replace the motor with a dedicated to VFD model. Increase the motor capacity.
Accel./Decel. time and working cycle are too short.	Increase the setting values for Pr.01-12–01-19 (accel./decel. time).
V/F voltage is too high.	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.
Check if the motor rated current matches that on the motor nameplate.	Reset to the correct motor rated current.
Check if the temperature sensor is properly set and wired	Situation 1: Check the connection between PTC / KTY-84 and the heat protection. Situation 2: Check the connection between PT100 and the heat protection.
Check if the setting for stall prevention is correct.	Set the stall prevention to the proper value.
Unbalanced three-phase impedance of the motor	Replace the motor.
Harmonics are too high.	Use remedies to reduce harmonics.

ID No.	Display	Fault Name	Description
26		Over-torque 1 (ot1)	When output current exceeds the over-torque detection level (Pr.06-07) and exceeds over-torque detection time (Pr.06-08), and when Pr.06-06 or Pr.06-09 is set to 2 or 4, the ot1 error displays.

Action and Reset		
Action level	Pr.06-07	
Action time	Pr.06-08	
Fault treatment parameter	Pr.06-06 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
Reset method	Auto	When Pr.06-06=1 or 3, ot1 is a “Warning”. The warning is automatically cleared when the output current < (Pr.06-07 – 5%).
	Manual	When Pr.06-06=2 or 4, ot1 is a “Fault”. You must reset manually.
Reset condition	Immediately reset	
Record	When Pr.06-06=2 or 4, ot1 is a “Fault”, and the fault is recorded.	

Cause	Corrective Actions
Incorrect parameter setting	Reset Pr.06-07 and 06-08.
Mechanical error (e.g. over-torque, mechanical lock)	Remove the causes of malfunction.
The load is too large.	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time and working cycle are too short.	Increase the setting values for Pr.01-12–01-19 (accel./decel. time).
V/F voltage is too high.	Adjust settings for Pr.01-01–01-08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of Pr.01-43.
The motor capacity is too small.	Replace the motor with a larger capacity model.
Overload during low-speed operation.	Decrease low-speed operation time. Increase the motor capacity.
Torque compensation is too large.	Adjust the torque compensation (refer to Pr.07-26 torque compensation gain) until the current reduces and the motor does no stall.
Improper parameter settings for speed tracking function (including restart after momentary power loss and restart after fault)	Correct the parameter settings for speed tracking. 1. Start the speed tracking function. 2. Adjust the maximum current for Pr.07-09 speed tracking.

<table>
<tr><th>ID No.</th><th>Display</th><th colspan="2">Fault Name</th><th>Description</th></tr>
<tr><td>28</td><td></td><td colspan="2">Under current
(uC)</td><td>Low current detection</td></tr>
<tr><th colspan="5">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="3">Pr.06-71</td></tr>
<tr><td colspan="2">Action time</td><td colspan="3">Pr.06-72</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="3">Pr.06-73
0: No function
1: warn and coast to stop
2: warn and ramp to stop by the 2nd deceleration time
3: warn and continue operation</td></tr>
<tr><td colspan="2" rowspan="2">Reset method</td><td>Auto</td><td colspan="2">When Pr.06-73=3, uC is a “Warning”. The warning is automatically cleared when the output current > (Pr.06-71 + 0.1 A).</td></tr>
<tr><td>Manual</td><td colspan="2">When Pr.06-73=1 or 2, uC is a “Fault”. You must reset manually.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="3">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="3">When Pr.06-73=1 or 2, uC is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="3">Corrective Actions</th></tr>
<tr><td colspan="2">Motor cable disconnection</td><td colspan="3">Troubleshoot the connection between the motor and the load.</td></tr>
<tr><td colspan="2">Improper setting of low-current protection</td><td colspan="3">Reset Pr.06-71, Pr.06-72 and Pr.06-73 to proper settings.</td></tr>
<tr><td colspan="2">The load is too low.</td><td colspan="3">Check the load status.
Check if the motor capacity matches the load.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>31</td><td></td><td>EEPROM read error
(cF2)</td><td>Internal EEPROM cannot be read.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Firmware internal detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">cF2 acts immediately when the drive detects the fault.</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Internal EEPROM cannot be read.</td><td colspan="2">Press RESET key. If cF2 error still displays on the keypad, return to the factory for repair.
Reset the parameter to the default setting. If cF2 error still displays on the keypad, return to the factory for repair.
Cycle the power. If cF2 error still exists, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
33		U-phase error (cd1)	U-phase current detection error when power is ON.
Action and Reset			
Action level	Hardware detection		
Action time	cd1 acts immediately when the drive detects the fault.		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.		

ID No.	Display	Fault Name	Description
34		V-phase error (cd2)	V-phase current detection error when power is ON.
Action and Reset			
Action level	Hardware detection		
Action time	cd2 acts immediately when the drive detects the fault.		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.		

ID No.	Display	Fault Name	Description
35	cd3	W-phase error (cd3)	W-phase current detection error when power is ON.
Action and Reset			
Action level	Hardware detection		
Action time	cd3 acts immediately when the drive detects the fault.		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.		

ID No.	Display	Fault Name	Description
36	Hd0	cc Hardware failure (Hd0)	cc (current clamp) hardware protection error when power is ON.
Action and Reset			
Action level	Hardware detection		
Action time	Hd0 acts immediately when the drive detects the fault.		
Fault treatment parameter	N/A		
Reset method	Power-off		
Reset condition	N/A		
Record	Yes		
Cause	Corrective Actions		
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.		

ID No.	Display	Fault Name	Description
37		Oc Hardware failure (Hd1)	oc hardware protection error when power is ON.

Action and Reset	
Action level	Hardware detection
Action time	Hd1 acts immediately when the drive detects the fault.
Fault treatment parameter	N/A
Reset method	Power-off
Reset condition	N/A
Record	Yes

Cause	Corrective Actions
Hardware failure	Cycle the power. If the fault code still displays on the keypad, return to the factory for repair.

ID No.	Display	Fault Name	Description
40		Auto-tuning error (AUE)	Motor auto-tuning error

Action and Reset	
Action level	Hardware detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Press STOP key during auto-tuning.	Re-execute auto-tuning.
Incorrect motor capacity (too large or too small) and parameter setting	Check motor capacity and related parameters. Set the correct parameters, that is Pr.01-01 01-02. Set Pr.01-00 larger than motor rated frequency.
Incorrect motor wiring	Check the wiring.
Motor shaft lock	Remove the cause of motor shaft lock.
The electromagnetic contactor is ON at output side (U/V/W) of the drive	Make sure the electromagnetic valve is OFF.
The load is too large.	Reduce the load. Replace the motor with a larger capacity model.
Accel./Decel. time is too short.	Increase the setting values for Pr.01-12–01-19 (Accel./Decel. time).

ID No.	Display	Fault Name	Description
41		PID loss ACI (AFE)	PID feedback loss (analog feedback signal is only valid when the PID function is enabled.)

Action and Reset		
Action level	When the analog input < 4 mA (only detects 4–20 mA analog input)	
Action time	Pr.08-08	
Fault treatment parameter	Pr.08-09 0: warn and continue operation 1: warn and ramp to stop 2: warn and coast to stop 3: warn and operate at last frequency	
Reset method	Auto	When Pr.08-09=3 or 4, AFE is a “Warning”. When the feedback signal is > 4 mA, the ”Warning” is automatically cleared.
	Manual	When Pr.08-09=1 or 2, AFE is a “Fault”. You must rest manually.
Reset condition	Immediately reset	
Record	When Pr.08-09=1 or 2, AFE is a “Fault”, and the fault is recorded; when Pr.08-09=3 or 4, AFE is a “Warning”, and the warning is not recorded.	

Cause	Corrective Actions
PID feedback cable is loose or cut off.	Tighten the terminal. Replace the cable with a new one.
Feedback device failure	Replace the device with a new one.
Hardware failure	Check all the wiring. If the AFE fault still displays on the keypad, return to the factory for repair.

ID No.	Display	Fault Name	Description
48		ACI loss (ACE)	Analog input loss (including all the 4–20 mA analog signal)

Action and Reset		
Action level	When the analog input is < 4 mA (only detects 4–20 mA analog input)	
Action time	Immediately act	
Fault treatment parameter	Pr.03-19 0: Disable 1: Continue operation at the last frequency (warning, ANL displays on the keypad) 2: Decelerate to 0 Hz (warning, ANL displays on the keypad) 3: Stop immediately and display “ACE”	
Reset method	Auto	When Pr.03-19=1 or 2, ACE is a “Warning”. When analog input signal is > 4 mA, the “Warning” is automatically cleared.
	Manual	When Pr.03-19=3, ACE is a “Fault”. You must reset manually.
Reset condition	Immediately reset	
Record	When Pr.03-19=3, ACE is a “Fault”, and the fault is recorded.	

Cause	Corrective Actions
ACI cable is loose or cut off.	Tighten the terminal. Replace the cable with a new one.
External device failure	Replace the device with a new one.
Hardware failure	Check all the wiring. If the ACE fault still displays on the keypad, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>49</td><td></td><td>External fault
(EF)</td><td>External fault. When the drive decelerates based on the setting of Pr.07-20, the EF fault displays on the keypad</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">MI=EF and the MI terminal is ON.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">Pr.07-20
0: Coast to stop
1: Stop by 1st deceleration time
2: Stop by 2nd deceleration time
3: Stop by 3rd deceleration time
4: Stop by 4th deceleration time
5: System deceleration
6: Automatic deceleration</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Manual reset only after the external fault is cleared (terminal status is recovered).</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">External fault</td><td colspan="2">Press RESET key after the fault is cleared.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>51</td><td></td><td>External base block
(bb)</td><td>When the contact of MI=bb is ON, the output stops immediately and displays bb on the keypad. The motor is in free running.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">MI=bb and the MI terminal is ON.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">The display “bb” is automatically cleared after the fault is cleared.</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">No</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">MI=bb activates</td><td colspan="2">Verify if the system is back to normal condition, and then press RESET key to return to the default.</td></tr>
</table>

ID No.	Display	Fault Name	Description
52	Pcod	Password is locked (Pcod)	Entering the wrong password three consecutive times

Action and Reset	
Action level	Entering the wrong password three consecutive times
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Power-off
Record	Yes

Cause	Corrective Actions
Incorrect password input through Pr.00-07	1. Input the correct password after rebooting the motor drive. 2. If you forget the password, enter 9999. 3. Press ENTER, and then enter 9999 again. 4. You must finish pressing ENTER within 10 seconds. If not, you must repeat the entering. After you successfully unlock the password, the parameter settings return to the default.

ID No.	Display	Fault Name	Description
54	CE1	Illegal command (CE1)	Communication command is illegal

Action and Reset	
Action level	When the function code is not 03, 06, 10, or 63.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	No

Cause	Corrective Actions
Incorrect communication command from the upper unit	Check if the communication command is correct.
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
Different communication setting from the upper unit	Check if the setting for Pr.09-02 is the same as the setting for the upper unit.
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.

ID No.	Display	Fault Name	Description
55	CE2	Illegal data address (CE2)	Data address is illegal.
Action and Reset			
Action level		When the data address is correct.	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		No	
Cause		Corrective Actions	
Incorrect communication command from the upper unit		Check if the communication command is correct.	
Malfunction caused by interference		Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
Different communication setting from the upper unit		Check if the setting for Pr.09-01 and Pr.09-04 are the same as the setting for the upper unit.	
Disconnection or bad connection of the cable		Check the cable and replace it if necessary.	

ID No.	Display	Fault Name	Description
56	CE3	Illegal data value (CE3)	Data value is illegal.
Action and Reset			
Action level		When the data length is too long.	
Action time		Immediately act	
Fault treatment parameter		N/A	
Reset method		Manual reset	
Reset condition		Immediately reset	
Record		No	
Cause		Corrective Actions	
Incorrect communication command from the upper unit		Check if the communication command is correct.	
Malfunction caused by interference		Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.	
Different communication setting from the upper unit		Check if the setting for Pr.09-01 and Pr.09-04 are the same as the setting for the upper unit.	
Disconnection or bad connection of the cable		Check the cable and replace it if necessary.	

ID No.	Display	Fault Name	Description
57		Data is written to read-only address (CE4)	Data is written to read-only address.
Action and Reset			
Action level	When the data is written to read-only address.		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	No		
Cause	Corrective Actions		
Incorrect communication command from the upper unit	Check if the communication command is correct.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-01 and Pr.09-04 are the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

ID No.	Display	Fault Name	Description
58		Modbus transmission time-out (CE10)	Modbus transmission time-out occurs.
Action and Reset			
Action level	When the communication time exceeds the detection time for Pr.09-03 time-out.		
Action time	Pr.09-03		
Fault treatment parameter	Pr.09-02 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and continue operation		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
The upper unit does not transmit the communication command within Pr.09-03 setting time.	Check if the upper unit transmits the communication command within the setting time for Pr.09-03.		
Malfunction caused by interference	Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.		
Different communication setting from the upper unit	Check if the setting for Pr.09-01 and Pr.09-04 are the same as the setting for the upper unit.		
Disconnection or bad connection of the cable	Check the cable and replace it if necessary.		

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>79</td><td></td><td>U-phase short circuit (Aoc)</td><td>U-phase short circuit detected when output wiring detection is performed before the drive runs.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">240% of the rated current</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect motor wiring</td><td colspan="2">Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.</td></tr>
<tr><td colspan="2">Short-circuit at motor output due to poor insulation wiring.</td><td colspan="2">Without considering the short circuits, check the motor cable or replace the cable before turning on the power.</td></tr>
<tr><td colspan="2">Check for possible burnout or aging insulation of the motor.</td><td colspan="2">Check the motor insulation value with megger. Replace the motor if the insulation is poor.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">The length of motor cable is too long.</td><td colspan="2">Increase the AC motor drive’s capacity.
Install AC reactor(s) on the output side (U/V/W).</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">The Aoc occurs due to short circuit or ground fault at the output side of the drive.
Check for possible short circuits between terminals with the electric meter:
B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W.
If short circuits occur, return to the factory for repair.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>80</td><td></td><td>V-phase short circuit (Boc)</td><td>V-phase short circuit detected when output wiring detection is performed before the drive runs.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">240% of the rated current</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset in 5 sec. after the fault is cleared.</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect motor wiring</td><td colspan="2">Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.</td></tr>
<tr><td colspan="2">Short-circuit at motor output due to poor insulation wiring.</td><td colspan="2">Without considering the short circuits, check the motor cable or replace the cable before turning on the power.</td></tr>
<tr><td colspan="2">Check for possible burnout or aging insulation of the motor.</td><td colspan="2">Check the motor insulation value with megger. Replace the motor if the insulation is poor.</td></tr>
<tr><td colspan="2">Malfunction caused by interference</td><td colspan="2">Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td colspan="2">The length of motor cable is too long.</td><td colspan="2">Increase the AC motor drive’s capacity.
Install AC reactor(s) on the output side (U/V/W).</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">The Boc occurs due to short circuit or ground fault at the output side of the drive.
Check for possible short circuits between terminals with the electric meter:
B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W.
If short circuits occur, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
81	CoC	W-phase short circuit (Coc)	W-phase short circuit detected when output wiring detection is performed before the drive runs.
Action and Reset			
Action level	240% of the rated current		
Action time	Immediately act		
Fault treatment parameter	N/A		
Reset method	Manual reset		
Reset condition	Reset in 5 sec. after the fault is cleared.		
Record	Yes		
Cause	Corrective Actions		
Incorrect motor wiring	Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.		
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.		
Check for possible burnout or aging insulation of the motor.	Check the motor insulation value with megger. Replace the motor if the insulation is poor.		
Malfunction caused by interference	Verify the wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.		
The length of motor cable is too long.	Increase the AC motor drive’s capacity. Install AC reactor(s) on the output side (U/V/W).		
Hardware failure	The Coc occurs due to short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with the electric meter: B1 corresponds to U, V, W; DC- corresponds to U, V, W; ⏚ corresponds to U, V, W. If short circuits occur, return to the factory for repair.		

ID No.	Display	Fault Name	Description
82	oPL1	Output phase loss U phase (oPL1)	U phase output phase loss
Action and Reset			
Action level	Pr.06-47		
Action time	Pr.06-46 Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46.		
Fault treatment parameter	Pr.06-45 0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	When Pr.06-45=1 or 2, OPL1 is a “Fault”, and the fault is recorded.		
Cause	Corrective Actions		
Unbalanced three-phase impedance of the motor	Replace the motor.		
Check if the wiring is incorrect.	Check the cable and replace it if necessary. Check the motor’s internal wiring. If the fault still exists, replace the motor.		
Check if the motor is a single-phase motor.	Choose a three-phase motor.		
Check if the current sensor is broken.	Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair. Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPL1 fault still exists, return to the factory for repair.		
Check if the drive capacity is larger than the motor capacity.	Choose the drive that matches the motor capacity.		

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>83</td><td></td><td>Output phase loss
V phase (oPL2)</td><td>V phase output phase loss</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Pr.06-47</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Pr.06-46
Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46.</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">Pr.06-45
0: Warn and continue operation
1: Warn and ramp to stop
2: Warn and coast to stop
3: No warning</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">When Pr.06-45=1 or 2, OPL2 is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Unbalanced three-phase impedance of the motor</td><td colspan="2">Replace the motor.</td></tr>
<tr><td colspan="2">Check if the wiring is incorrect.</td><td colspan="2">Check the cable and replace it if necessary.
Check the motor’s internal wiring. If the fault still exists, replace the motor.</td></tr>
<tr><td colspan="2">Check if the motor is a single-phase motor.</td><td colspan="2">Choose a three-phase motor.</td></tr>
<tr><td colspan="2">Check if the current sensor is broken.</td><td colspan="2">Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair.
Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPL2 fault still exists, return to the factory for repair.</td></tr>
<tr><td colspan="2">Check if the drive capacity is larger than the motor capacity.</td><td colspan="2">Choose the drive that matches the motor capacity.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>84</td><td></td><td>Output phase loss
W phase
(oPL3)</td><td>W phase output phase loss</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Pr.06-47</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Pr.06-46
Pr.06-48: Use the setting value of Pr.06-48 first. If DC braking function activates, use that of Pr.06-46..</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">Pr.06-45
0: Warn and continue operation
1: Warn and ramp to stop
2: Warn and coast to stop
3: No warning</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">When Pr.06-45=1 or 2, OPL3 is a “Fault”, and the fault is recorded.</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Unbalanced three-phase impedance of the motor</td><td colspan="2">Replace the motor.</td></tr>
<tr><td colspan="2">Check if the wiring is incorrect.</td><td colspan="2">Check the cable and replace it if necessary.
Check the motor’s internal wiring. If the fault still exists, replace the motor.</td></tr>
<tr><td colspan="2">Check if the motor is a single-phase motor.</td><td colspan="2">Choose a three-phase motor.</td></tr>
<tr><td colspan="2">Check if the current sensor is broken.</td><td colspan="2">Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the fault still exists, return to the factory for repair.
Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the OPL3 fault still exists, return to the factory for repair.</td></tr>
<tr><td colspan="2">Check if the drive capacity is larger than the motor capacity.</td><td colspan="2">Choose the drive that matches the motor capacity.</td></tr>
</table>

ID No.	Display	Fault Name	Description
87	oL3	Overload protection at low frequency (oL3)	Low frequency and high current protection

Action and Reset	
Action level	Software detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
The drive operates in the low frequency range (High HP: below 15 Hz; Low HP: below 5 Hz) and IGBT temperature (High HP: 20 C; Low HP: 50 C)	1. Enhance the heat dissipation capacity for the cabinet. 2. Lower the carrier frequency (Pr.00-17). 3. Decrease the voltage settings that correspond to frequency below 15 Hz in the V/F curve. 4. Change Pr.00-11 to general control mode. 5. Replace the drive with a larger power model.

ID No.	Display	Fault Name	Description
89	roPd	Rotor position detection error (RoPd)	Rotor position detection error protection

Action and Reset	
Action level	Reset the software.
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Check if the motor cable is abnormal or broken.	Check or replace the cable.
Motor coil error	Replace the motor.
Hardware failure	IGBT broken. Return to the factory for repair.
Drive’s current feedback line error	Cycle the power. If RoPd still occurs during operation, return to the factory for repair.

<table>
<tr><th>ID No.</th><th>Display on LCD Keypad</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>90</td><td>FStP</td><td>Force to stop (FStp)</td><td>Keypad forces PLC to Stop</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">When Pr. 00-32=1, STOP button on the keypad is valid. When giving the STOP command during the PLC operation, FStp fault occurs.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Act immediately</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Reset immediately</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Pr. 00-32=1: keypad STOP button is valid</td><td colspan="2">Check if it is necessary to set Pr. 00-32=0, so the keypad STOP button is invalid.</td></tr>
<tr><td colspan="2">Press STOP button during PLC operation</td><td colspan="2">Verify the timing of STOP function.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>140</td><td>Hd6</td><td>GFF detected when power is on (Hd6)</td><td>The ground current short circuit detected when power is on.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Reset the software.</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">The length of motor cable is too long.</td><td colspan="2">Use a shorter cable or install an output reactor.</td></tr>
<tr><td colspan="2">Check if the motor cable is abnormal or broken.</td><td colspan="2">Check or replace the cable.</td></tr>
<tr><td colspan="2">Hardware failure</td><td colspan="2">IGBT broken. Return to the factory for repair.</td></tr>
<tr><td colspan="2">Drive’s current feedback line error</td><td colspan="2">Cycle the power. If Hd6 still occurs during operation, return to the factory for repair.</td></tr>
</table>

ID No.	Display	Fault Name	Description
141		GFF occurs before running (b4GFF)	The ground short circuit detected when output wiring detection is performed before the drive runs.

Action and Reset	
Action level	240% of the rated current
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Reset in 5 sec. after the fault is cleared.
Record	Yes

Cause	Corrective Actions
Incorrect motor wiring	Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.
Short-circuit at motor output due to poor insulation wiring.	Without considering the short circuits, check the motor cable or replace the cable before turning on the power.
Check for possible burnout or aging insulation of the motor.	Check the motor insulation value with megger. Replace the motor if the insulation is poor.

ID No.	Display	Fault Name	Description
142		Auto-tune error 1 (AUE1)	No feedback current error when motor parameter automatically detects.

Action and Reset	
Action level	Software detection
Action time	Immediately act
Fault treatment parameter	N/A
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes

Cause	Corrective Actions
Motor is not wired.	Wire the motor correctly.
The electromagnetic contactor is used as an open state on the output side of the drive (U/V/W).	Verify that the electromagnetic valve is closed.

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>143</td><td>AUE2</td><td>Auto-tune error 2
(AUE2)</td><td>Motor phase loss error when motor parameter automatically detects.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Software detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect motor wiring</td><td colspan="2">Wire the motor correctly.</td></tr>
<tr><td colspan="2">Motor error</td><td colspan="2">Check if the motor works normally.</td></tr>
<tr><td colspan="2">The electromagnetic contactor is used as an open state on the output side of the drive (U/V/W).</td><td colspan="2">Verify that the three-phases of the electromagnetic valve are all closed.</td></tr>
<tr><td colspan="2">Motor U/V/W wire error</td><td colspan="2">Check if the wires are broken.</td></tr>
</table>

<table>
<tr><th>ID No.</th><th>Display</th><th>Fault Name</th><th>Description</th></tr>
<tr><td>144</td><td>AUE3</td><td>Auto-tune error 3
(AUE3)</td><td>No load current I_0 measurement error when motor parameter automatically detects.</td></tr>
<tr><th colspan="4">Action and Reset</th></tr>
<tr><td colspan="2">Action level</td><td colspan="2">Software detection</td></tr>
<tr><td colspan="2">Action time</td><td colspan="2">Immediately act</td></tr>
<tr><td colspan="2">Fault treatment parameter</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Reset method</td><td colspan="2">Manual reset</td></tr>
<tr><td colspan="2">Reset condition</td><td colspan="2">Immediately reset</td></tr>
<tr><td colspan="2">Record</td><td colspan="2">Yes</td></tr>
<tr><th colspan="2">Cause</th><th colspan="2">Corrective Actions</th></tr>
<tr><td colspan="2">Incorrect settings for the motor parameter (rated current)</td><td colspan="2">Check the settings for Pr.05-01 / Pr.05-13 / Pr.05-34.</td></tr>
<tr><td colspan="2">Motor error</td><td colspan="2">Check if the motor works normally.</td></tr>
</table>

ID No.	Display	Fault Name	Description
221	HPS	High water pressure (HPS)	The water pressure is Higher than the setting
Action and Reset			
Action level	The feedback pressure is higher than the setting in Pr.12-79, and continues as the time setting in Pr.12-79.		
Action time	Pr.12-80		
Fault treatment parameter	Pr.12-81 1: Fault and coast to stop 2: Fault and ramp to stop		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
The pressure sensor is broken	Change the pressure sensor		
The disconnection frequency setting of pump is too high	Decrease the setting value in Pr.12-12		

ID No.	Display	Fault Name	Description
222	LPSE	Low water pressure (LPSE)	The water pressure is lower than the setting
Action and Reset			
Action level	The feedback pressure is lower than the setting in Pr.12-82, and continues as the time setting in Pr.12-83.		
Action time	Pr.12-83		
Fault treatment parameter	Pr.12-84 1: Fault and coast to stop 2: Fault and ramp to stop		
Reset method	Manual reset		
Reset condition	Immediately reset		
Record	Yes		
Cause	Corrective Actions		
No water pressure	Check if water leakage occurs in pipe, or no water inputs		
Pressure sensor is broken	Change the pressure sensor.		

ID No.	Display	Fault Name	Description
223		Dry pump (dryE)	Dry pump continues when the restart times is larger than the setting in Pr.12-71

Action and Reset	
Action level	The power corresponds to the target frequency is under the dry pump curve.
Action time	Pr.12-69
Fault treatment parameter	Fault and coast to stop
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
The inlet of the water pump is broken	Check if the pipe is broken, or no water input.

ID No.	Display	Fault Name	Description
224		Water leaking (pipe explosion) (LEKE)	Triggered when heavy water leakage is detected

Action and Reset	
Action level	The feedback pressure is lower than the setting in Pr.12-73, and the load current is larger than the setting in Pr.12-75
Action time	Pr.12-74
Fault treatment parameter	Pr.12-76 1: Fault and coast to stop 2: Fault and ramp to stop
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
The outlet of the water pump is broken	Check if the pipe is broken.

ID No.	Display	Fault Name	Description
225		Clogged pipe (JAME)	The jam current is still higher than Pr.12-54 after finishing the cleaning process

Action and Reset	
Action level	The current is still larger than then setting in Pr.12-54 when the cleaning times reaches the setting in Pr.12-58.
Action time	N/A
Fault treatment parameter	Immediately coast to stop
Reset method	Manual reset
Reset condition	Immediately reset
Record	Yes
Cause	**Corrective Actions**
The pump vane is stuck by foreign matter	The clean function can not clear the foreign matter, you have to clear it manually.

ID No.	Display	Fault Name	Description
226		RTC error (rtF)	Remind user that there is hardware problem of the perpetual calendar

Action and Reset	
Action level	N/A
Action time	Immediately display while fault is detected
Fault treatment parameter	N/A
Reset method	N/A
Reset condition	Power off and then re-power on
Record	Yes
Cause	**Corrective Actions**
Hardware problem of the perpetual calendar	Re-power on, if it doesn't work, contact with dealer or original manufacturer.

ID No.	Display	Fault Name	Description
227	dAUE	Dry pump curve auto-measuring (dAUE)	The high speed power can not lower than the low speed power, and can not over the drive power. Give STOP command when fault occurs during auto-detection. High speed power Pr.12-67; low speed power Pr.12-66

Action and Reset	
Action level	The power after adjusting does not comply with the power value
Action time	Immediately act
Fault treatment parameter	Fault and coast to stop
Reset method	Manual reset
Reset condition	Immediately reset, does not memorize parameter
Record	Yes

Cause	Corrective Actions
The value auto-detect by the dry pump curve is abnormal	Restart the auto-tuning load curve, set Pr.12-65=1 to execute it.

Chapter 15 PLC Function Applications

15-1 PLC Summary

15-1-1 Introduction

The commands provided by the MP300'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.

15-1-2 WPLSoft ladder diagram editing tool

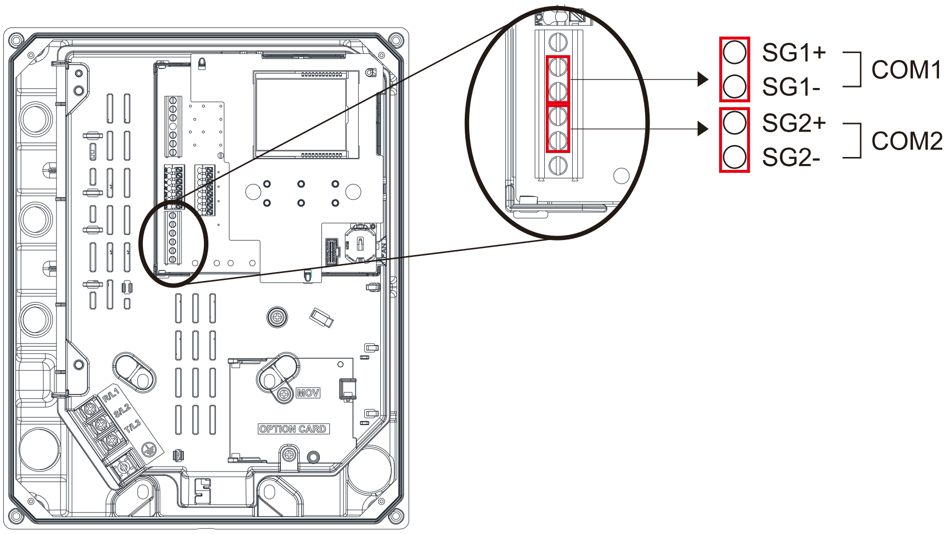
WPLSoft is Delta's program editing software for the DVP and MP300 programmable controllers in the Windows operating system environment. Apart from general PLC program design general Windows editing functions (such as cut, paste, copy, multiple windows, etc.), WPLSoft also provides many Chinese/ English 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

15-2 Notes Before Using PLC

1. MP300 provides COM2 port to upload / download PLC programs. See the figure below.
   The PLC has a preset communications format of 7, N, 2, 9600, with node 2; the PLC node can be changed in Pr. 09-35, but this address may not be the same as the drive's address setting of Pr. 09-00.
   When the built-in PLC is ON, the communication format of COM1 automatically sets as 115200, 8, E, 1 RTU for connecting multi-pump in serial.



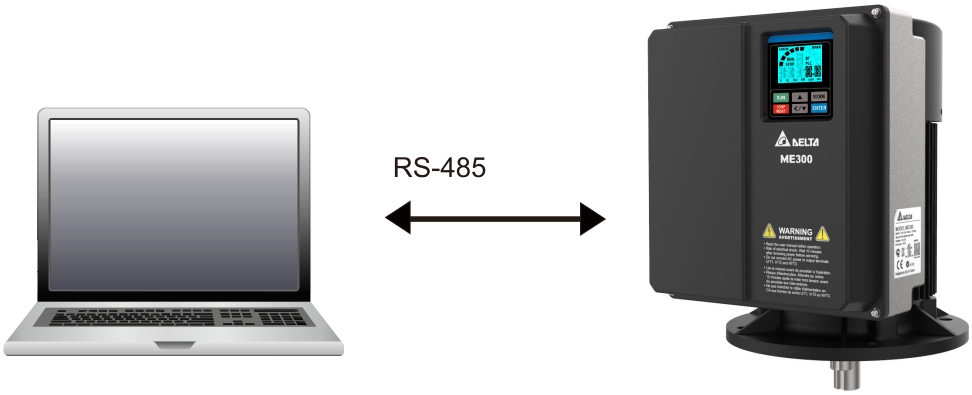
2. The client can simultaneously access data from the converter and internal PLC, which is performed through identification of the node. For instance, if the converter node is 1 and the internal PLC node is 2, then the client command will be
   01 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data in converter Pr. 04-00
   02 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data in internal PLC X0
3. The PLC program will be disabled when uploading/ downloading programs.
4. 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.
5. When Pr. 00-04 is set as 28, the displayed value will be the value of PLC register D1043 (see figure below):
6. In the PLC Run (PLC1) and PLC Stop (PLC1) mode, the content 9 and 10 of Pr. 00-02 cannot be set and cannot be reset to the default value.
7. If PLC function is OFF (PLC0), PLC can return to the default when Pr.00-02 = 6.
8. The corresponding MI function will be disabled when the PLC writes to input contact X.
9. When the PLC controls converter operation, control commands will be entirely controlled by the PLC and will not be affected by the setting of Pr. 00-21.
10. When the PLC controls converter frequency commands (FREQ commands), frequency commands will be entirely controlled by the PLC, and will not be affected by the setting of Pr. 00-20 or the Hand ON/OFF configuration.
11. When the PLC controls converter operation, if the keypad Stop setting is valid, this will trigger an FStP error and cause stoppage.

15-3 Turn On

15-3-1 Connect to PC

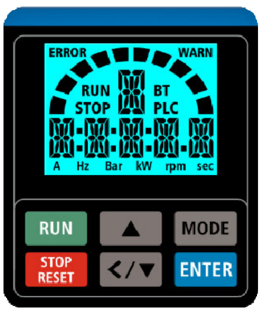
Start operation of PLC functions in accordance with the following steps.

1. Wiring: Connect the drive's RJ45 communications interface to a PC via the RS-485.



MP300

2. PLC function usage



Enter to PLC mode to set PLC1
PLC0: Disable PLC function
PLC1: Trigger PLC RUN
PLC2: Trigger PLC STOP

- When the external multifunctional input terminals (MI1–MI4) are in PLC Mode select bit0 (51) or PLC Mode select bit1 (52), and the terminal contact is closed or opened, it will compulsorily switch to the PLC mode, and keypad switching will be ineffective. Corresponding actions are as follows:

PLC mode Using KPC-CC01	PLC Mode select bit1(52)	PLC Mode select bit0 (51)
Disable	OFF	OFF
PLC Run	OFF	ON
PLC Stop	ON	OFF
Maintain previous state	ON	ON

NOTE

- When input / output terminals (MI1–MI4, Relay1, Relay2, MO) are included in the PLC program, these input / output terminals will only be used by the PLC. As an example, when the PLC program controls Y0 during PLC operation (PLC1 or PLC2), the corresponding output terminal relay (RA / RB / RC) will operate in accordance with the program. At this time, the multifunctional input/ output terminal setting will be ineffective. Because these terminal functions are already being used by the PLC, the DI/ DO/ AO in use by the PLC can be determined by looking at Pr. 02-52, Pr. 02-53, and Pr. 03-30.
- When the PLC's procedures use special register D1040, the corresponding AO contact AFM1 will be occupied, and AFM2 corresponding to special register D1045 will have the same situation.
- Pr. 03-30 monitors the state of action of the PLC function analog output terminal.

15-3-2 I/O device explanation

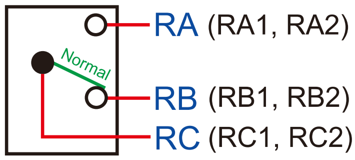
Input devices:

PLC Input Relay	X0	X1	X2	X3
AC motor drive Input terminal	MI1	MI2	MI3	MI4

Output devices

PLC Output Relay	Y0	Y1	Y2	Y3
AC motor drive Output terminal	RY1	RY2		MO

RY1 / RY2



15-3-3 Installation WPLSoft

Download and install WPLSoft editing software in Delta's website:

After completing installation, the WPLSoft program will be installed in the designated subfolder "C: \Program Files\Delta Industrial Automation\WPLSoft x.xx".

15-3-4 Program writing

Step 1: Click on the WPLSoft icon to start the editing software. (See figure 15-1)

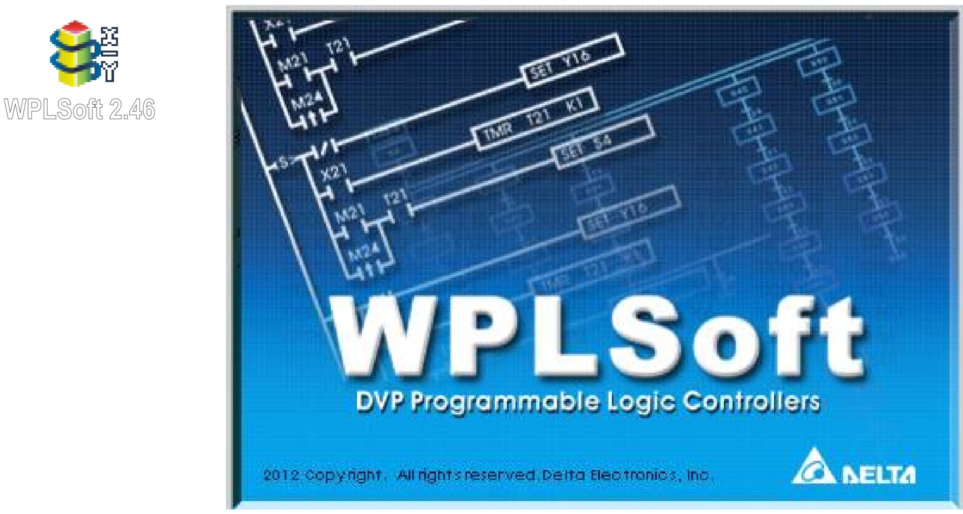


Figure 15-1 (Left: WPLSoft icon; Right: Start WPLSoft)

Step 2: The WPLSoft editing window appears (see figure 15-2 below). When running WPLSoft for the first time, before "New file" has been used, only the "File (F)," "Communications (C)," View (V)," "Options (O)," and "Help (H)" columns will appear on the function toolbar.

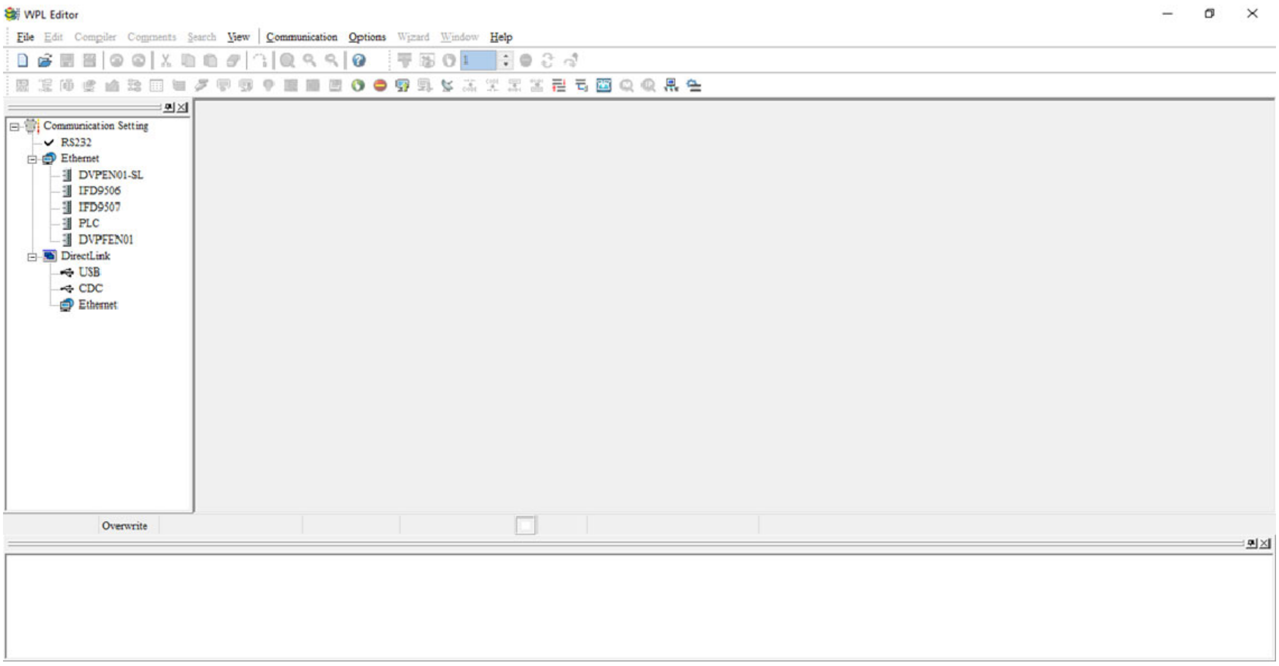


Figure 15-2

NOTE After running WPLSoft for the second time, the last file edited will open and be displayed in the editing window. The following figure 15-3 provides an explanation of the WPLSoft editing software window:

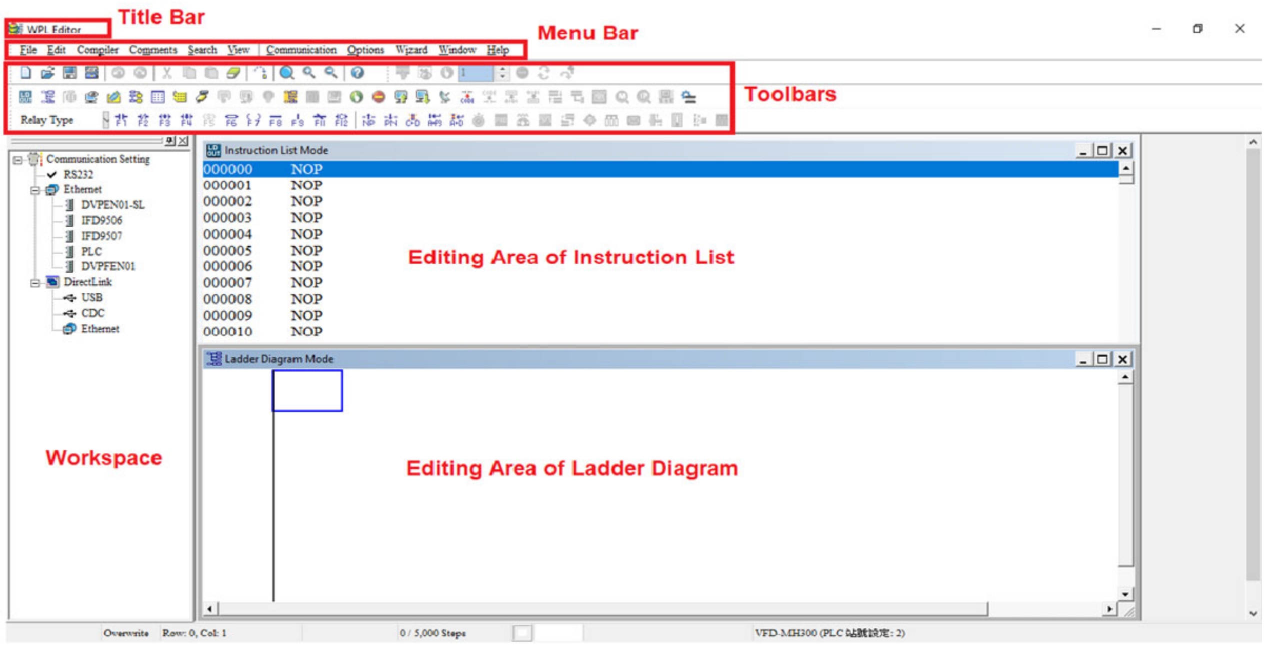


Figure 15-3

Step 3: Click on the  icon on the toolbar: opens new file (Ctrl+N), see figure 15-4 below

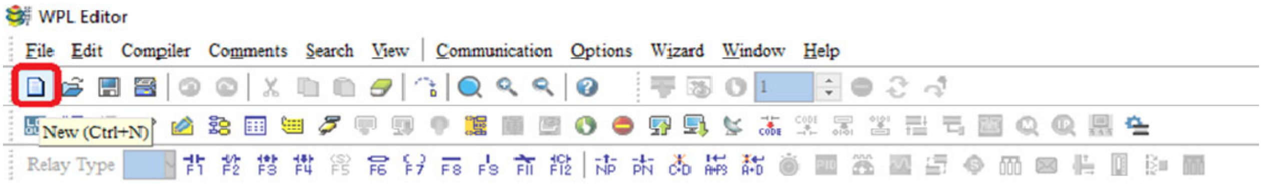


Figure 15-4

NOTE You can also find “New file (N) (Ctrl+N)” in the "File (F)", as shown in figure 15-5 below.

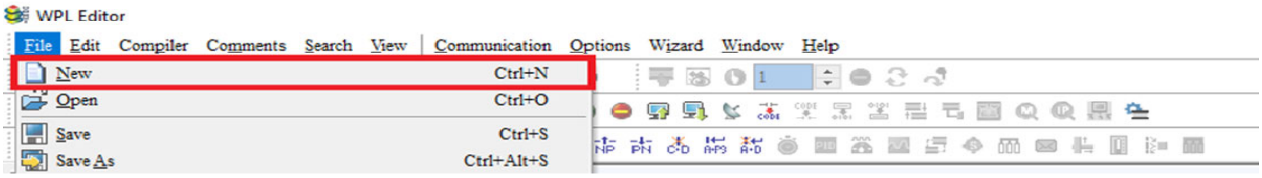


Figure 15-5

Step 4: The "Device settings" window will appear after clicking, see figure 15-6 below. You can now enter the project title and filename, and select the device and communication settings to be used.

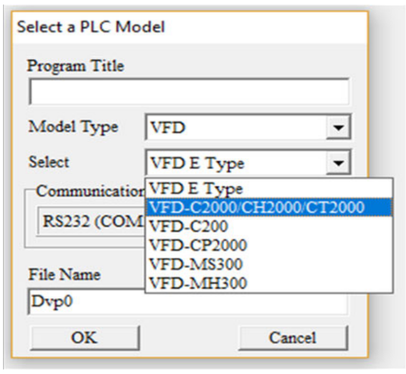


Figure 15-6

Communications settings: Perform settings in accordance with the desired communications method. See figure 15-7 below.

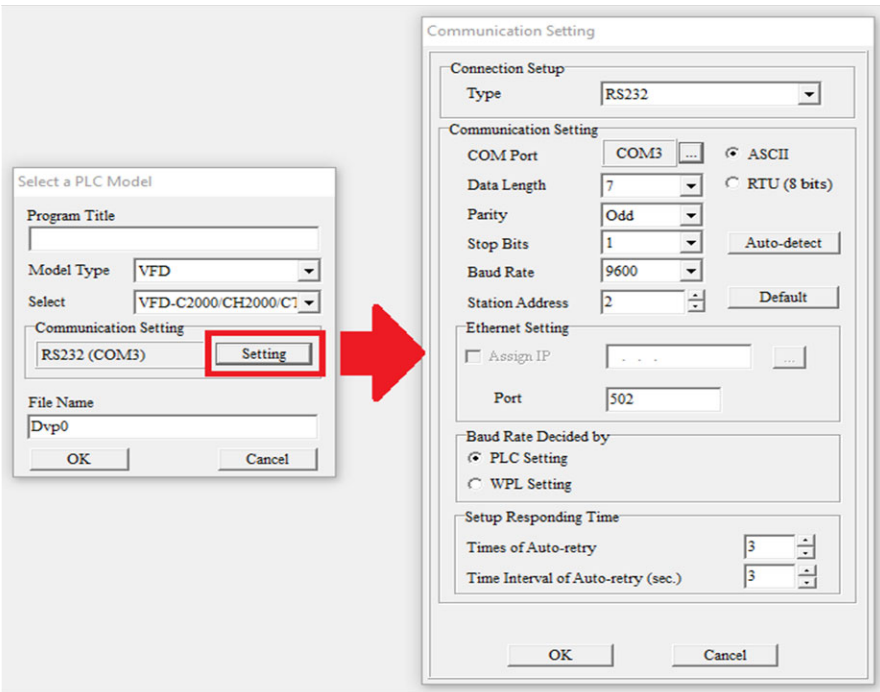


Figure 15-7

Step 5: Press Confirm after completing settings and begin program editing. There are two program editing methods; you can choose whether to perform editing in the command mode or the ladder diagram mode (see figure 15-8 below).

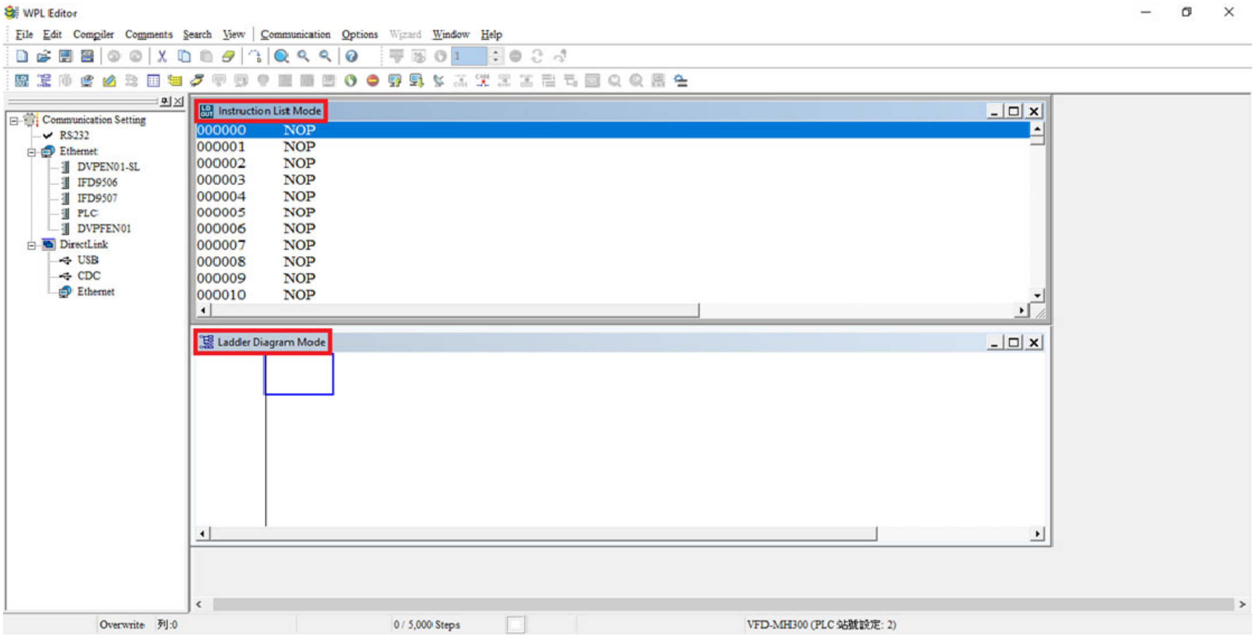


Figure 15-8

NOTE In ladder diagram mode, you can perform program editing using the buttons on the function icon row (see figure 15-9 below).

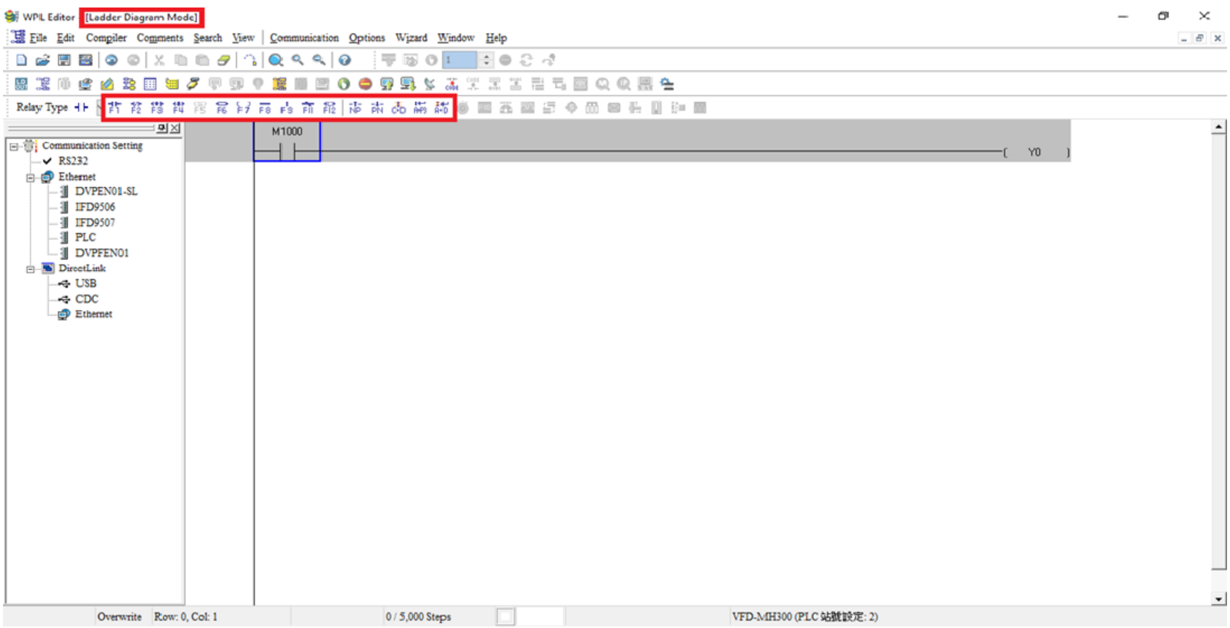


Figure 15-9

Basic Operation-Example

Input the ladder diagram as the figure below. The following steps can be operated through the mouse or function key (F1–F12) on the keyboard.

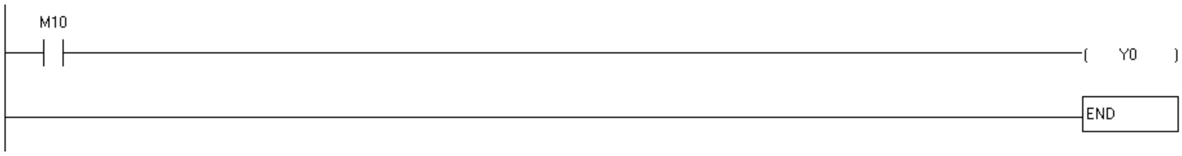


Figure 15-10

Step 1: The following screen will appear after a new file is established:

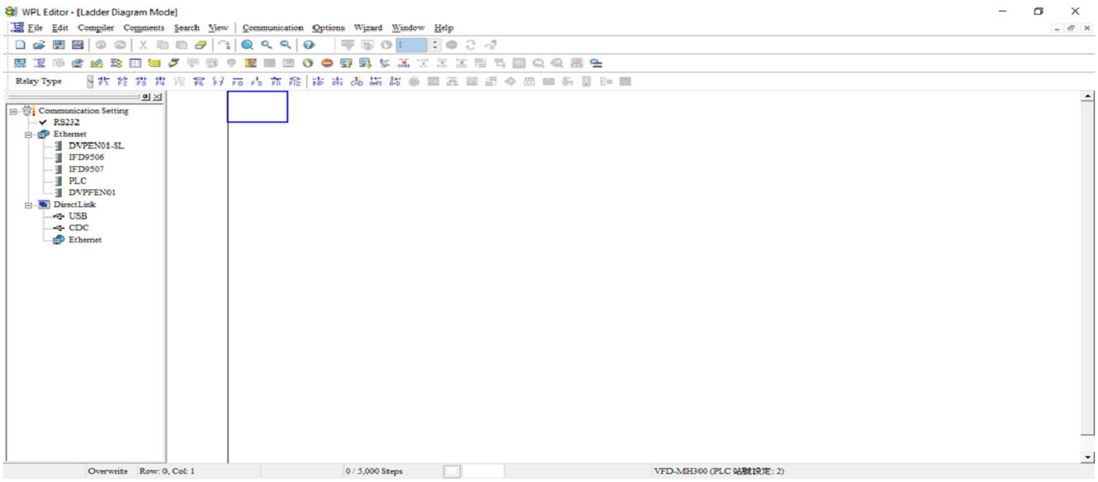


Figure 15-11

Step 2: Click on the always-open switch icon  or press the function key F1. After the name of the input device and the comment dialog box have appeared, the device name (such as "M"), device number (such as "10"), and input comments (such as "auxiliary contact") can be selected; press the OK button when finished (see figure 15-12 and 15-13 below).

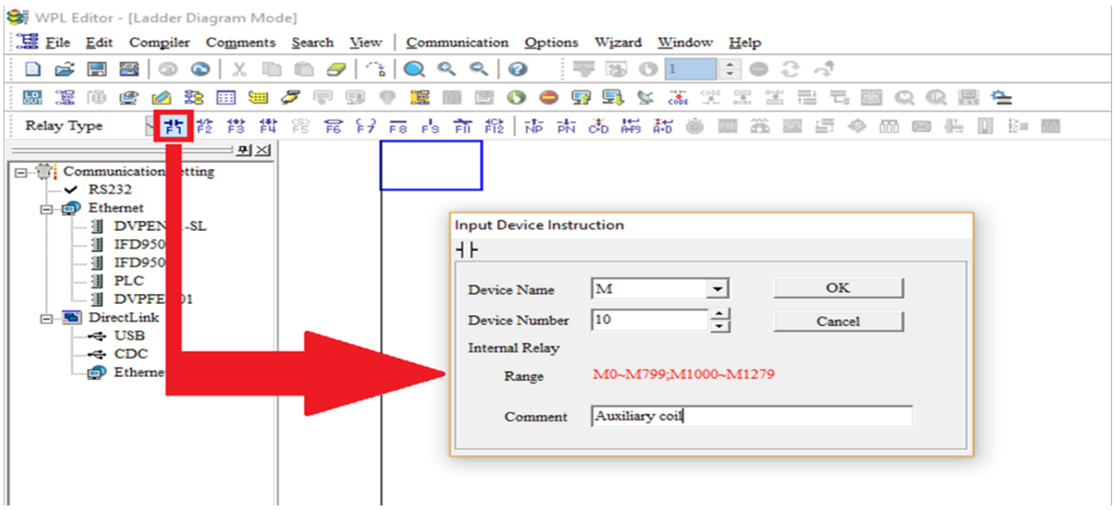


Figure 15-12

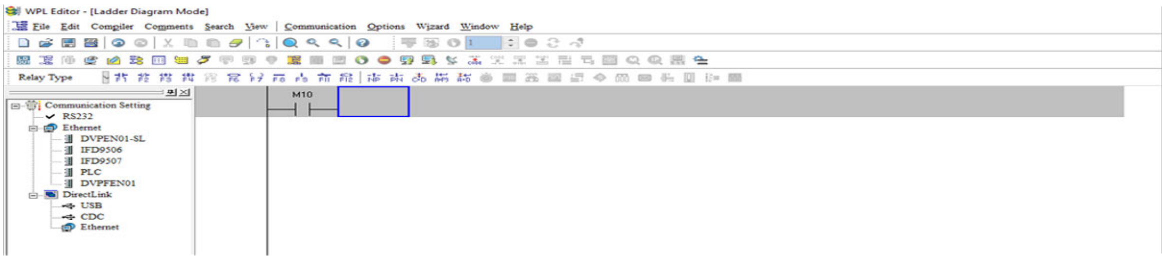


Figure 15-13

Step 3: Click on the output coil icon  or press function key F7. After the name of the input device and the comment dialog box have appeared, the device name (such as "Y"), device number (such as "0"), and input comments (such as "output coil") can be selected; press the OK button when finished (see figure 15-14 and 15-15 below).

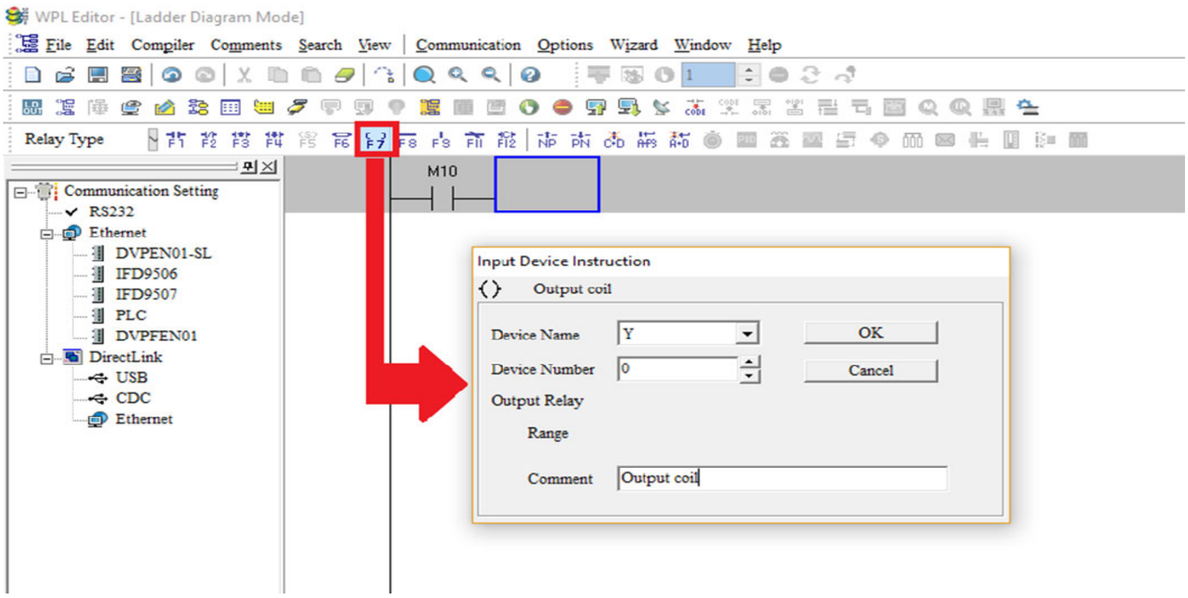


Figure 15-14

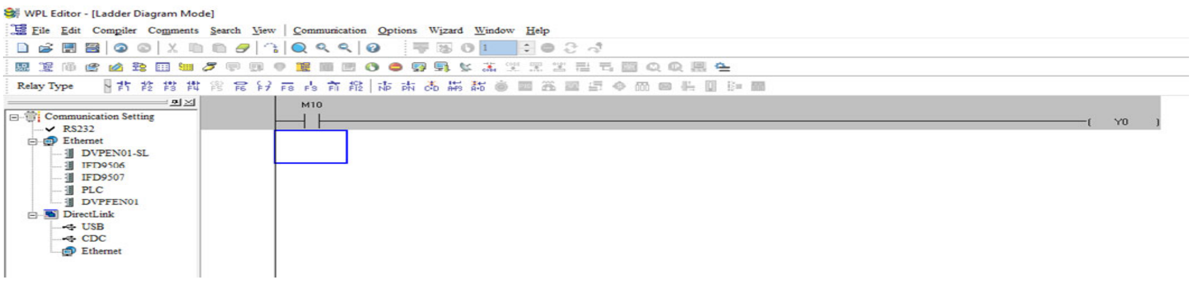


Figure 15-15

Step 4: Press "ENTER" button, when the "Input Instructions" window appears, key in "END" in the field and press the OK button (see figure 15-16 and 15-17 below).

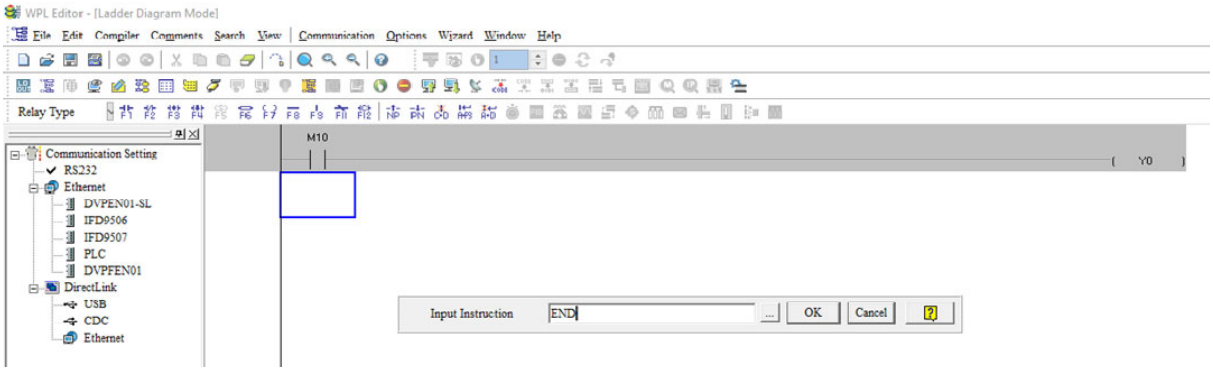


Figure 15-16

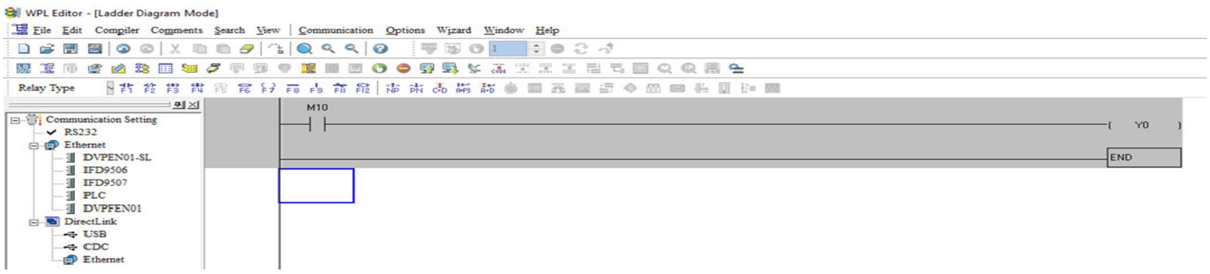
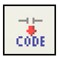


Figure 15-17

Step 5: Click on the  "Ladder diagram => Code" icon, which will compile the edited ladder diagram as a command program. After compiling, the number of steps will appear on the left side of the busbar (see figure 15-18 below).

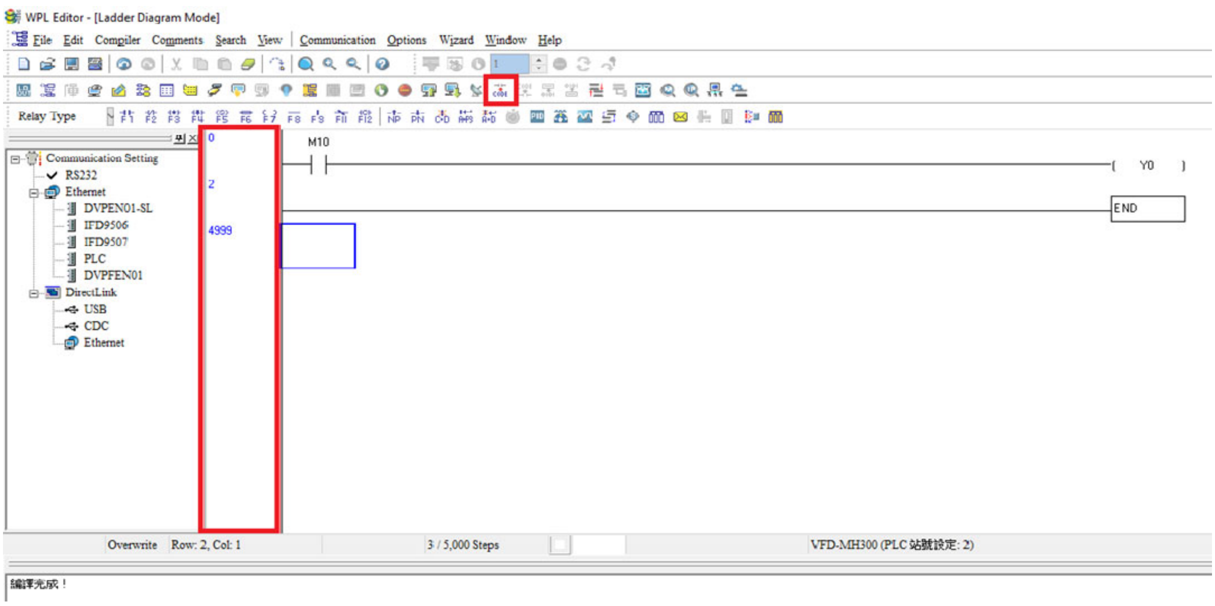


Figure 15-18

15-3-5 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.

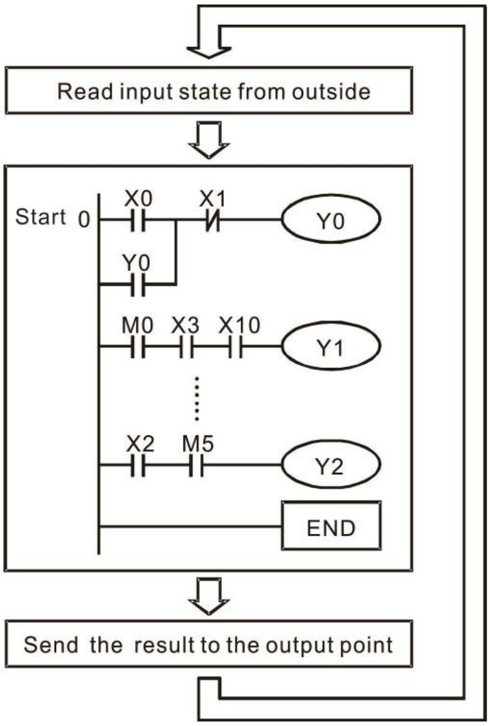
15-3-6 Program monitoring

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)

15-4 Basic Principles of PLC Ladder Diagrams

15-4-1 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

15-4-2 Introduction to ladder diagrams

Ladder diagrams comprise a graphic language widely applied in automatic control, and employs common electrical control circuit symbols. After a ladder diagram editor has been used to create a ladder pattern, PLC program designed is completed. The use of a graphic format to control processes is very intuitive, and is readily accepted by personnel who are familiar with electrical control circuit technology. Many of the basic symbols and actions in a ladder diagram comprise commonly seen electrical devices in conventional automatic control power distribution panels, such as buttons, switches, relays, timers, and counters.

Internal PLC devices: The types and quantities of internal PLC devices vary in different brands of products. Although these internal devices use the same names as conventional electrical control circuit elements such as relays, coils, and contacts, a PLC does not actually contain these physical devices, and they instead correspond to basic elements in the PLC's internal memory (bits). For instance, if a bit is 1, this may indicate that a coil is electrified, and if that bit is 0, it will indicate that the coil is not electrified. An N.O. contact (Normal Open, or contact a) can be used to directly read the value of the corresponding bit, and an N.C. contact (Normal Close, or contact b) can be used to obtain the inverse of the bit's value. Multiple relays occupy multiple bits, and 8 bits comprise one byte; two bytes comprise one word, and two words comprise a double word. When multiple relays are processing at the same time (such as addition/ subtraction or displacement, etc.), a byte, word, or double word can be used. Furthermore, a PLC contains two types of internal devices: a timer and a counter. It not only has a coil, but can count time and numerical values. Because of this, when it is necessary to process some numerical values, these values are usually in the form of bytes, words, or double words.

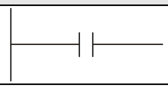
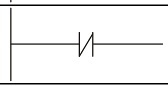
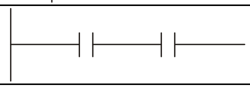
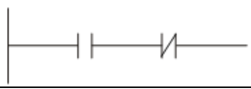
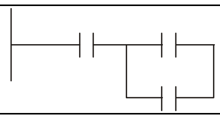
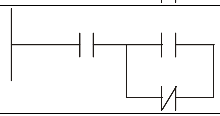
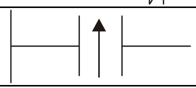
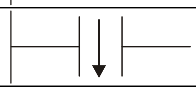
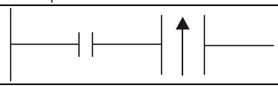
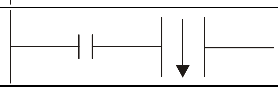
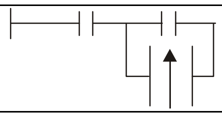
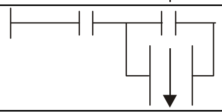
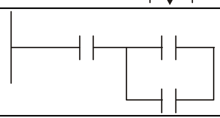
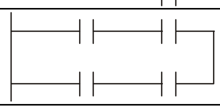
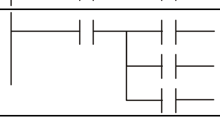
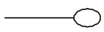
The various internal devices in a PLC all account for a certain quantity of storage units in the PLC's storage area. When these devices are used, the content of the corresponding storage area is read in the form of bits, bytes, or words.

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. Please refer to Chapter 15-3-2 I/O device explanation for input point numbers.
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. Please refer to Chapter 15-3-2 I/O device explanation for output point numbers.
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" , 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" , and its order is expressed as a decimal number.
Timer	A timer is used to complete control of timing. The timer contains a coil, contact, and a time value register. When the coil is electrified, if the preset time is reached, the contact will be actuated (contact a will close, contact b will open), and the timer's fixed value will 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.

Device type	Description of Function
Data register	When a PLC is used to perform various types of sequence control and set time value and count value control, it most commonly perform data processing and numerical operations, and data registers are used exclusively for storage of data and various parameters. Each data register contains 16 bits of binary data, which means that it can store one word. Two data registers with adjacent numbers can be used to process double words. ☑ Device indicated as: D0, D1 to D399, etc. The device is expressed as the symbol "D" , and its order is expressed as a decimal number.

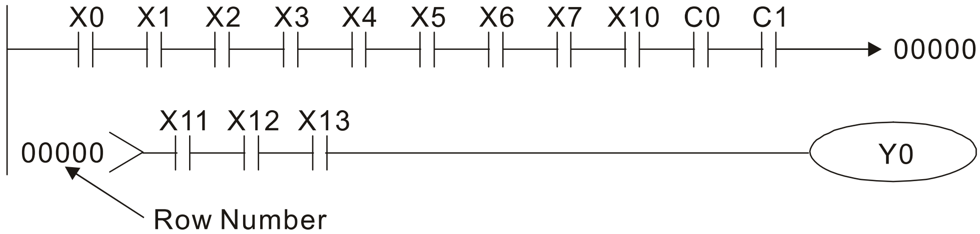
Ladder diagram images and their explanation

Ladder diagram structures	Explanation of commands	Command	Using Device
	NO switch, contact a	LD	X、Y、M、T、C
	NC switch, contact b	LDI	X、Y、M、T、C
	Series NO	AND	X、Y、M、T、C
	Series NC	ANI	X、Y、M、T、C
	Parallel NO	OR	X、Y、M、T、C
	Parallel NC	ORI	X、Y、M、T、C
	Positive edge-triggered switch	LDP	X、Y、M、T、C
	Negative edge-triggered switch	LDF	X、Y、M、T、C
	Positive edge-triggered series	ANDP	X、Y、M、T、C
	Negative edge-triggered series	ANDF	X、Y、M、T、C
	Positive edge-triggered parallel	ORP	X、Y、M、T、C
	Negative edge-triggered parallel	ORF	X、Y、M、T、C
	Block series	ANB	N/A
	Block parallel	ORB	N/A
	Multiple outputs	MPS MRD MPP	N/A
	Coil driven output commands	OUT	Y、M

Ladder diagram structures	Explanation of commands	Command	Using Device
	Some basic commands, applications commands	Some basic commands Applications commands	
	Inverted logic	INV	N/A

15-4-3 Overview of PLC ladder diagram editing

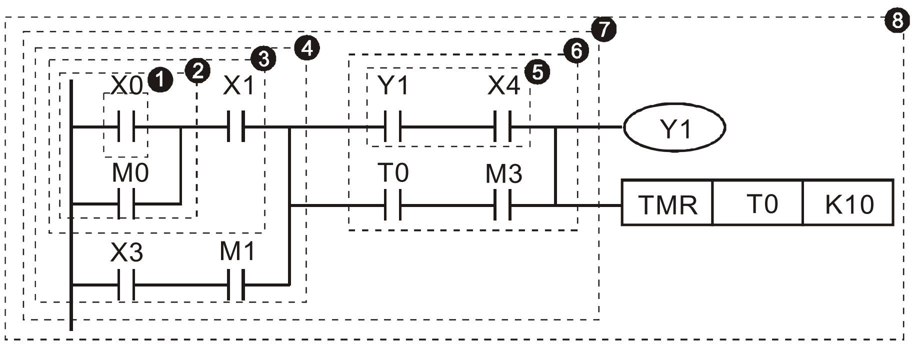
The program editing method begins from the left busbar and proceeds to the right busbar (the right busbar is omitted when editing using WPLSoft). Continue to the next row after completing each row; there is a maximum of 11 contacts on each row. If this is not sufficient, a continuous line will be generated 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.

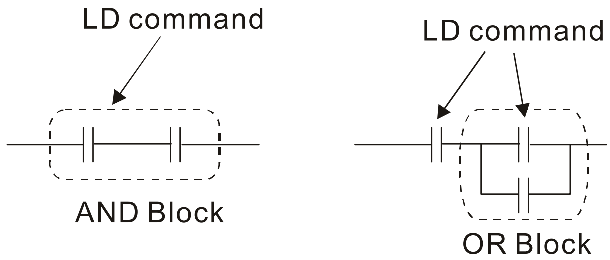
Explanation of command sequence

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

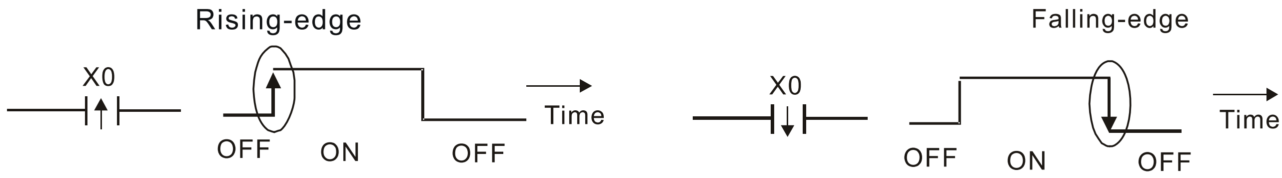


Explanation of basic structure of ladder diagrams

LD (LDI) command: An LD or LDI command is given at the start of a block.



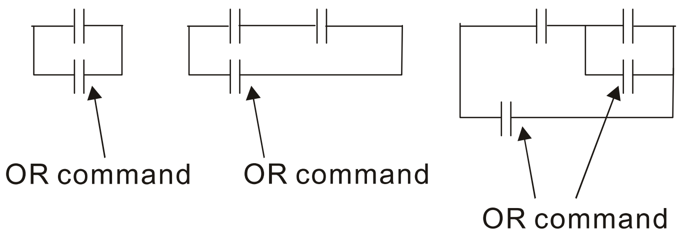
LDP and LDF have this command structure, but there are differences in their action state. LDP, LDF only act at the rising or falling edge of a conducting contact. (see figure below):



AND (ANI) command: A series configuration in which a single device is connected with one device or a block.

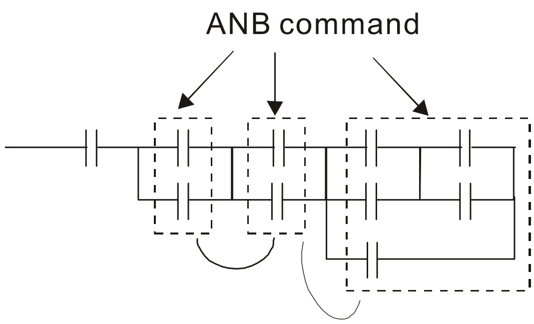
ANDP, ANDF also have structures like this, but their action occurs at the rising and falling edge.

OR (ORI) command: A single device is connected with one device or a block.

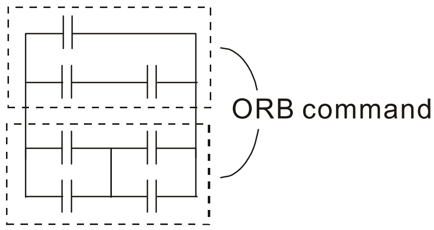


ORP, ORF also have identical structures, but their action occurs at the rising and falling edge.

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.



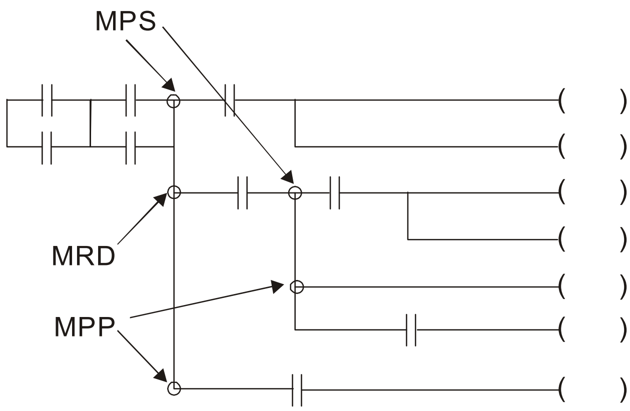
In the case of ANB and ORB operations, if a number of blocks are connected, they should be combined to form a block or network from the top down or from left to right.

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:



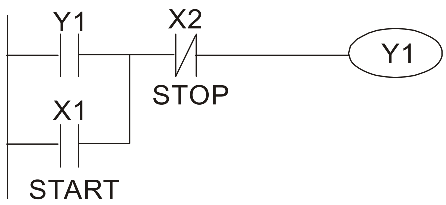
15-4-4 Commonly used basic program design examples

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:

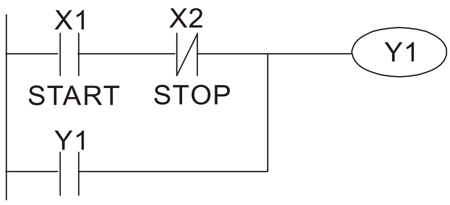
Example 1: Priority stop protective circuit

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.

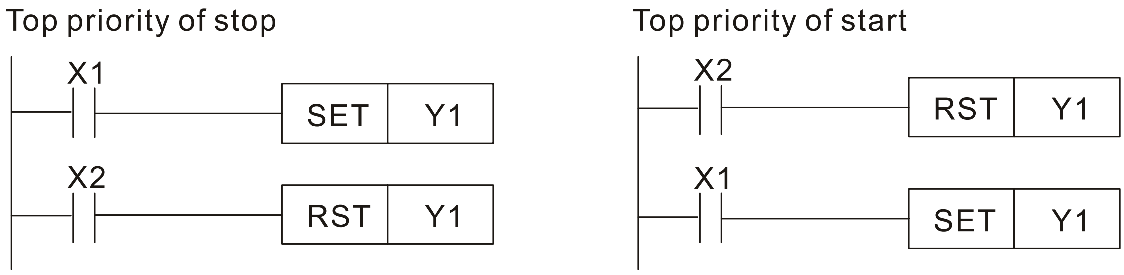


Example 3: Setting (SET) and reset (RST) command protective circuit

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.

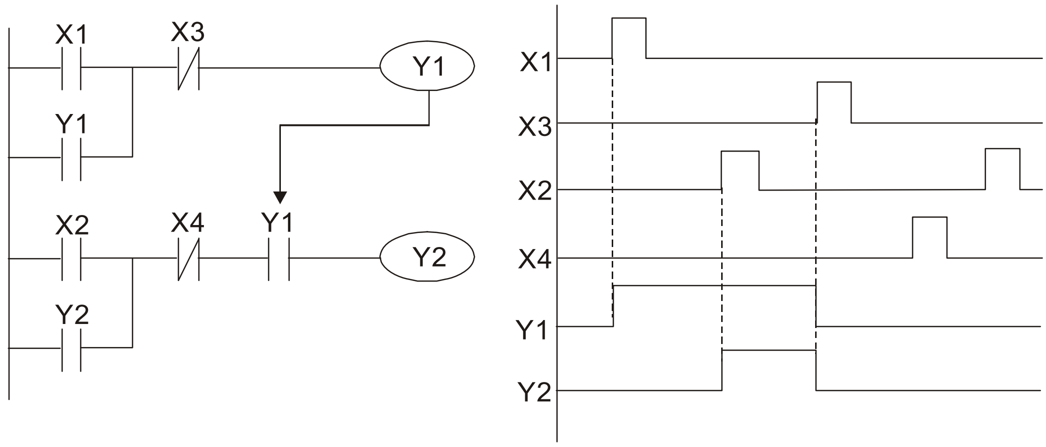
Priority start occurs when the SET command is placed after the RST command. When X1 and X2 are both actuated, Y1 will be electrified, and this is therefore priority start.



Commonly used control circuits

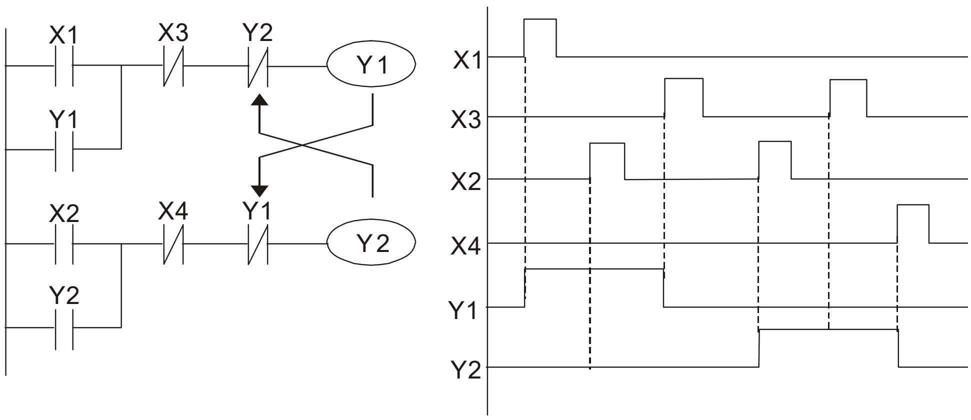
Example 4: Conditional control

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.



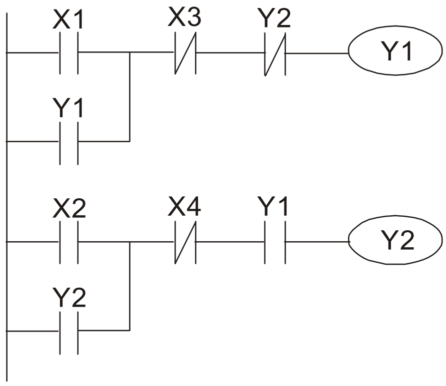
Example 5: Interlocking control

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

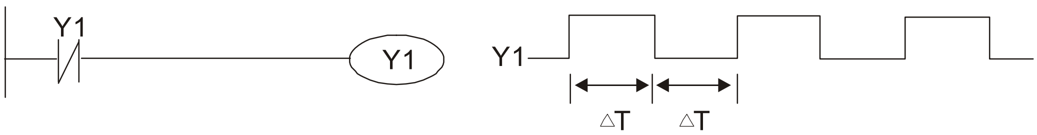
If the NC contact of Y2 in the interlocking control configuration of example 5 is put in series with the Y1 circuit, so that it is an AND condition for actuation of Y1 (see figure below), not only is Y1 a condition for the actuation of Y2 in this circuit, the actuation of Y2 will also stop the actuation of Y1. This configuration confirms the actuation order of Y1 and Y2.



Example 7: Oscillating circuit

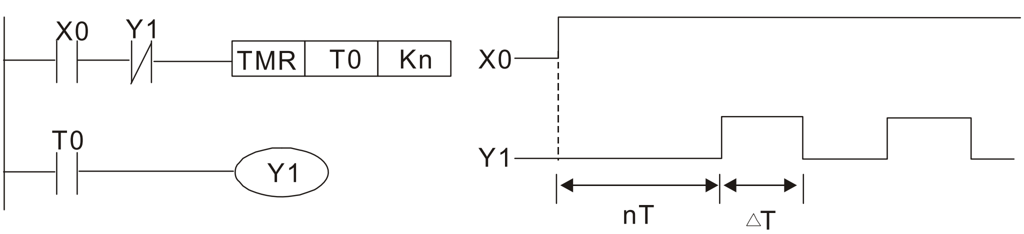
Oscillating circuit with a period of ΔT+ΔT

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 opened, 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).



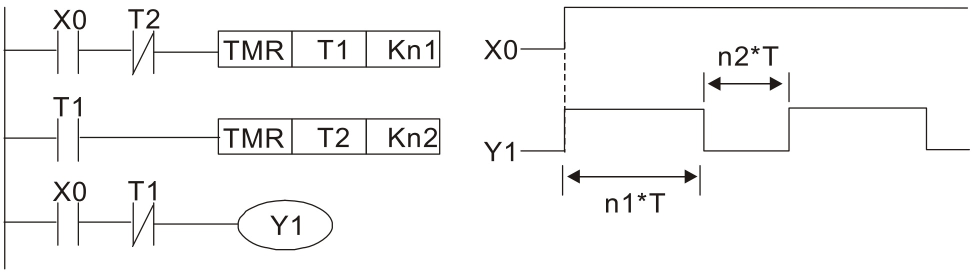
Oscillating circuit with a period of nT+ΔT

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.



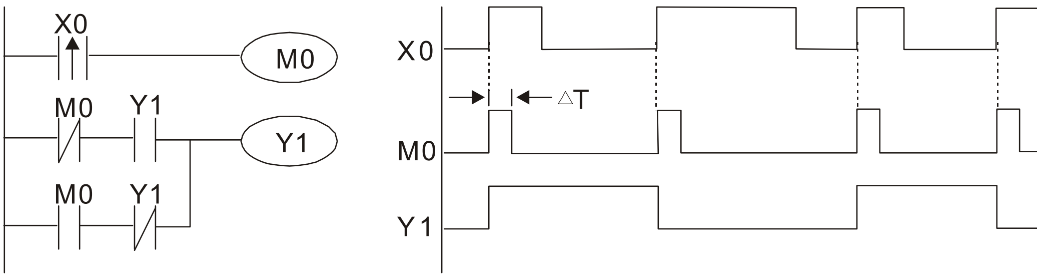
Example 8: Flashing circuit

The following figure shows an oscillating circuit of a type commonly used to cause an indicator light to flash or a buzzer 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.



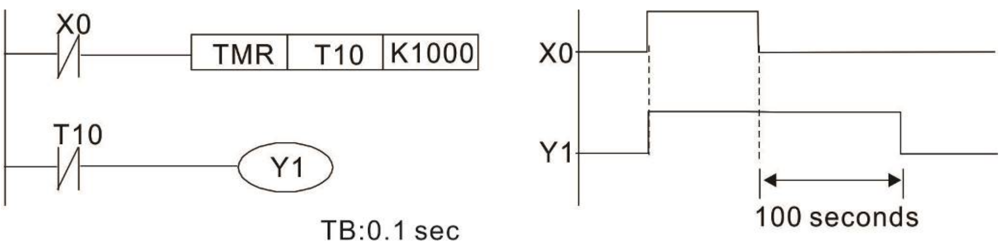
Example 9: Triggering circuit

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.

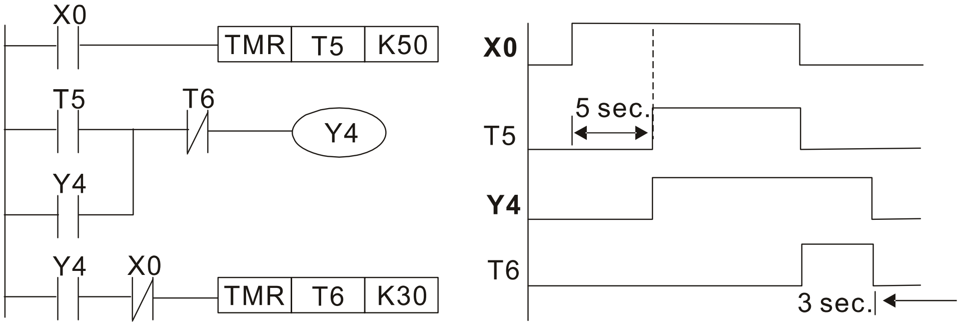


Example 10: Delay circuit

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.

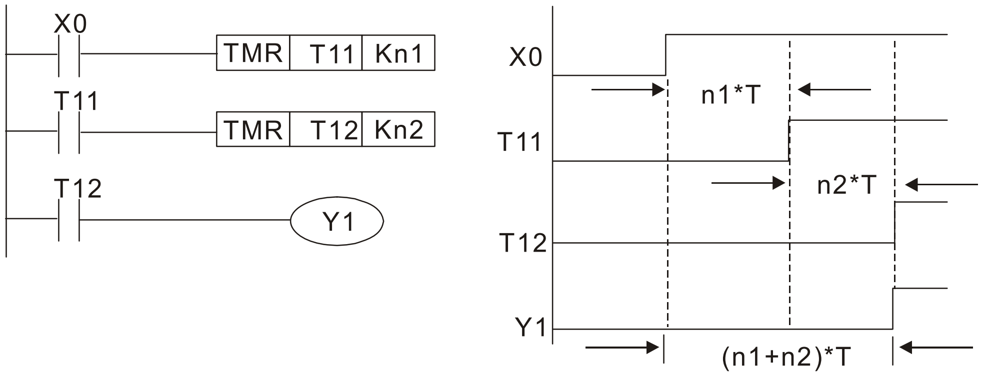


Example 11: The open/ close delay circuit is composed of two timers; output Y4 will have a delay whether input X0 is On or Off.



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.



15-5 Various PLC Device Functions

Item	Specifications	Notes
Algorithmic control method	Program stored internally, alternating back-and-forth scanning method	
Input/ output control method	When it starts again after ending (after execution to the END command), the input / output has an immediate refresh command	
Algorithmic processing speed	Basic commands (several μs);	Applications command (1 to several tens of μs)
Programming language	Command + ladder diagram	
Program capacity	14000 steps	
Input / output terminal	Input (X): 10, output (Y): 4 Digital input (X): 4, digital output (Y): 3 Analog input (AI): 2, analog output (AO): 1	This number of contacts constitutes MP300 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 1160 points	Contact can switch On / Off within the program
			Special purpose	M1000–M1359, 360 points		
	T	Timer	100m 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	Retentive	D0–D399, 400 points	Total 1620 points	Used as data storage memory area
			Non-retentive	D400–D999, 600 points		
			Special purpose	D1000–D1619, 620 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_1 (SG1) & 2 (SG2)		
Analog Input / output				Built-in two sets of analog inputs and one set of analog outputs		
I/O function expansion module			Optional Accessories	N/A		
Communication expansion module			Optional Accessories	DeviceNet, Profibus-DP, Modbus-TCP, EtherNet/IP, Blue Tooth		

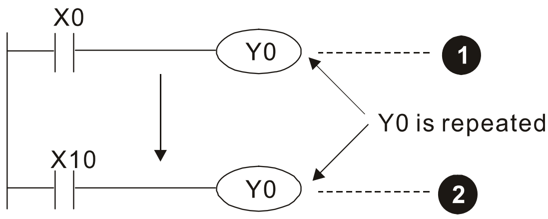
15-5-1 Introduction to The Command Window

Input / output contact function

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

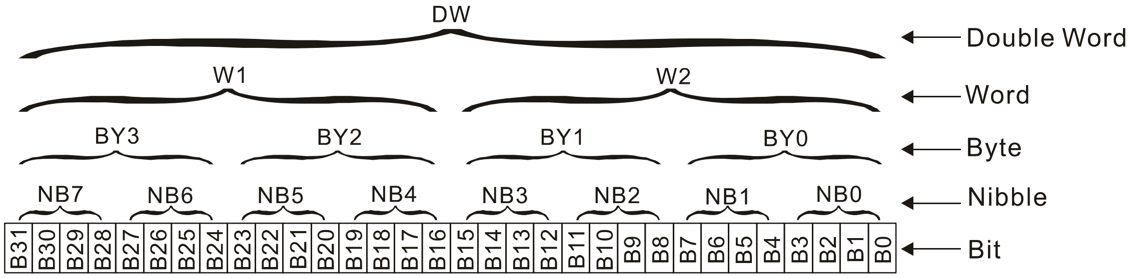
The PLC can use five types of numerical values to implement calculations based on its control tasks; the following is an explanation of the missions and functions of different numerical values.

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

Relation between bits, digits, nibbles, words, and double words in a binary system (see figure below):



Octal Number, OCT

The external input and output terminals of a DVP-PLC are numbered using octal numbers

Example: External input: X0–X7，X10–X17…(Device number table);

External output: Y0–Y7，Y10–Y17…(Device number table)

Decimal Number, DEC

Decimal numbers are used for the following purposes in a PLC system:

☑ The setting values of timer T or counter C, such as TMR C0 K50. (K constant)

☑ The numbers of devices including M, T, C, or D, such as M10 or T30. (device number)

☑ Used as an operand in an application command, such as MOV K123 D0. (K constant)

Binary Code Decimal, BCD

Uses one nibble or 4 bits to express the data in a decimal number; a series of 16 bits can therefore express a decimal number with 4 nibbles. Chiefly used to read the input value of a fingerwheel numerical switch input or output a numerical value to a seven-segment display drive.

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

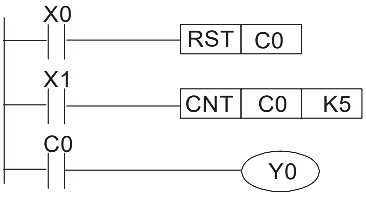
When a counter's counting pulse input signal goes Off→On, if the counter's current value is equal to the set value, the output coil will come On. The setting value will be a decimal K values, and the data register D can also serve as a setting value.

16-bit counter C0–C79:

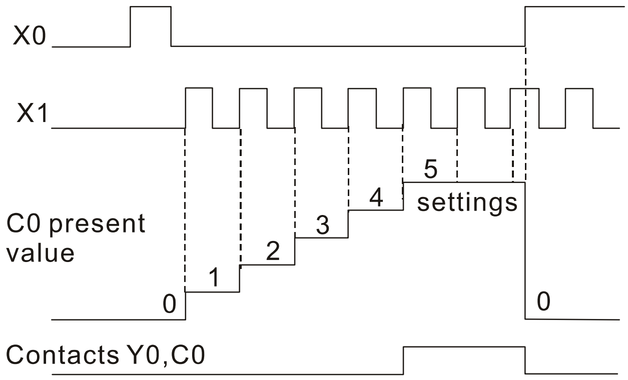
- ☑ 16-bit counter setting range: K0–K32,767. (when K0 and K1 are identical, the output contact will immediately be On during the first count.)
- ☑ The current counter value will be cleared from an ordinary counter when power is shut off to the PLC.
- ☑ If the MOV command or WPLSoft is used to transmit 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 or D2000–D2799).
- ☑ If the set value employs a constant K, it may only be a positive number; the set value may be either a positive or a negative number if the value in data register D is used. The current counter value will change from 32,767 to -32,768 as the count continues to accumulate.

Example

LD	X0
RST	C0
LD	X1
CNT	C0 K5
LD	C0
OUT	Y0



1. When X0=On and the RST command is executed, the current value of C0 will revert to 0, and the output contact will revert to Off.
2. When X1 changes from Off→On, the current value of the counter will execute an increase (add one).
3. When the count of counter C0 reaches the set value K5, the contact C0 will come On, and the current value of C0＝ set value =K5. Afterwards, signal C0 triggered by X1 cannot be received, and the current value of C0 will remain K5.
4.



15-5-2 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	Drive malfunction instructions	RO
M1006	Converter has no output (1 = no output, 0 = output)	RO
M1007	Drive direction FWD(0)/REV(1)	RO
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
M1016	Parameter read/write error	RO
M1017	Parameter write successful	RO
M1019	Instruction to the warning of AC motor drive	RO
M1020	Zero flag	RO
M1021	Borrow flag	RO

Special M	Description of Function	R/W *
M1022	Carry flag	RO
M1023	Divisor is 0	RO
M1025	Target drive frequency = set frequency (ON) Target drive frequency =0 (OFF)	RW
M1026	Drive operating direction FWD(OFF) / REV(ON)	RW
M1027	Drive Reset	RW
M1040	Excitation (Servo On)	RW
M1042	Quick stop	RW
M1044	Pause (Halt)	RW
M1052	Lock frequency (lock, frequency locked at the current operating frequency)	RW
M1056	Excitation ready (Servo On Ready)	RO
M1058	On Quick Stopping	RO
M1077	485 Read/write complete	RO
M1078	485 Read-write error	RO
M1079	485 Communications time out	RO
M1080	485 exception error	RO
M1081	485 check sum or data format is wrong	RO
M1090	OFF (Refer to Pr.00-29 for more information)	RO
M1091	HAND (Refer to Pr.00-29 for more information)	RO
M1092	AUTO (Refer to Pr.00-29 for more information)	RO
M1100	LOCAL (Refer to Pr.00-29 for more information)	RO
M1101	REMOTE (Refer to Pr.00-29 for more information)	RO
M1168	SBOV BCD and BIN mode switch	RW
M1260	PLC PID1 Enable	RW
M1261	The initial value of integration presets when enable PLC PID1 .	RW
M1262	PLC PID1 The setting to assign the initial value of integration, 0: assign as the minimum; 1: assign as the maximum.	RW
M1263	PLC PID1 The value of integration is forced to be D1208.	RW
M1264	Assign the last value of integration when enable PLC PID1.	RW
M1265	PLC PID1 The setting to assign the initial value of integration, 0: according to M1262; 1: assign as D1208.	RW
M1270	PLC PID2 Enable	RW
M1271	The initial value of integration presets when enable PLC PID2.	RW
M1272	PLC PID2 integral positive value limit	RW
M1273	PLC PID2 The value of integration is forced to be D1228.	RW
M1274	Assign the last value of integration when enable PLC PID2.	RW
M1275	PLC PID2 The setting to assign the initial value of integration, 0: according to M1272; 1: assign as D1228.	RW
M1280	PLC PID3 Enable	RW
M1281	The initial value of integration assigns when enable PLC PID3	RW
M1282	PLC PID3 The setting to assign the initial value of integration, 0: assign as the minimum; 1: assign as the maximum.	RW
M1283	PLC PID3 The value of integration is forced to be D1248.	RW
M1284	Assign the last value of integration when enable PLC PID3.	RW
M1285	PLC PID3 The setting to assign the initial value of integration, 0: According to M1282; 1: Preset as D1248	RW
M1290	PLC PID4 Enable	RW
M1291	The initial value of integration assigns when enable PLC PID4.	RW

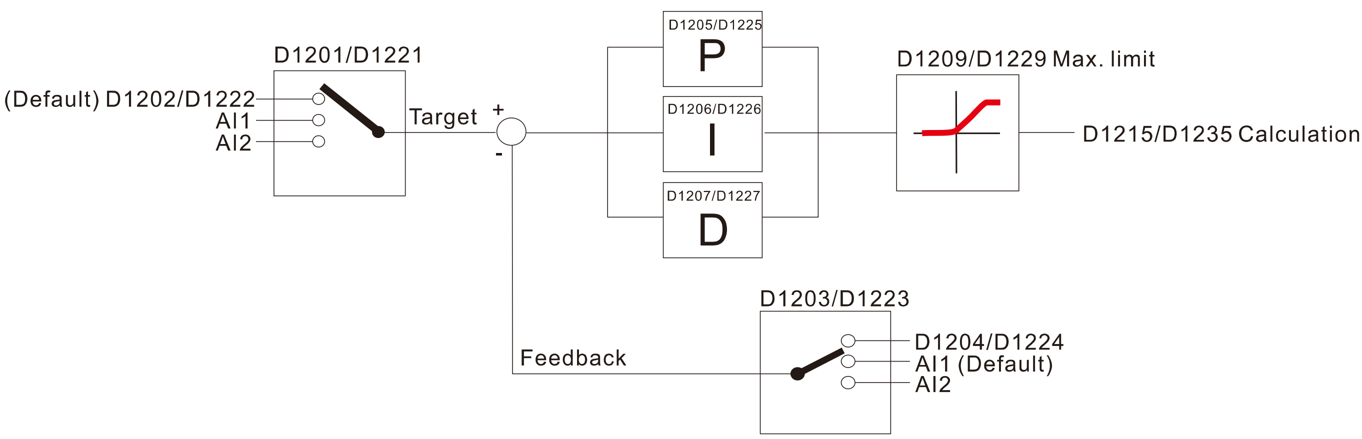
Special M	Description of Function	R/W *
M1292	PLC PID4 The setting to assign the initial value of integration, 0: assign as the minimum; 1: assign as the maximum.	RW
M1293	PLC PID4 The value of integration is forced to be D1268.	RW
M1294	Assign the last value of integration when enable PLC PID4.	RW
M1295	PLC PID4 The setting to assign the initial value of integration, 0: according to M1292; 1: assign as D1268.	RW
M1300	PLC PID5 Enable	RW
M1301	The initial value of integration presets when enable PLC PID5.	RW
M1302	PLC PID5 The setting to assign the initial value of integration, 0: assign as the minimum; 1: assign as the maximum.	RW
M1303	PLC PID5 The value of integration is forced to be D1288.	RW
M1304	Assign the last value of integration when enable PLC PID5.	RW
M1305	PLC PID5 The setting to assign the initial value of integration, 0: according to M1302; 1: assign as D1288.	RW
M1310	PLC PID6 Enable	RW
M1311	The initial value of integration assigns when enable PLC PID6.	RW
M1312	PLC PID6 The setting to assign the initial value of integration, 0: Preset as the minimum; 1: Preset as the maximum.	RW
M1313	PLC PID6 The value of integration is forced to be D1308.	RW
M1314	Assign the last value of integration when enable PLC PID6.	RW
M1315	PLC PID6 The setting to assign the initial value of integration, 0: according to M1312; 1: assign as D1308.	RW
M1320	PLC PID7 Enable	RW
M1321	The initial value of integration assigns when enable PLC PID7.	RW
M1322	PLC PID7 The setting to assign the initial value of integration, 0: assign as the minimum; 1: assign as the maximum.	RW
M1323	PLC PID7 The value of integration is forced to be D1328.	RW
M1324	Assign the last value of integration when enable PLC PID7.	RW
M1325	PLC PID7 The setting to assign the initial value of integration, 0: According to M1322; 1: Preset as D1328.	RW
M1330	PLC PID8 Enable	RW
M1331	The initial value of integration assigns when enable PLC PID8.	RW
M1332	PLC PID8 The setting to assign the initial value of integration, 0: assign as the minimum; 1: assign as the maximum.	RW
M1333	PLC PID8 The value of integration is forced to be D1348.	RW
M1334	Assign the last value of integration when enable PLC PID8.	RW
M1335	PLC PID8 The setting to assign the initial value of integration, 0: According to M1332; 1: Preset as D1348.	RW

15-5-3 Introduction to special register functions (special D)

Special D	Description of Function	R/W *
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
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
D1023	Communication expansion card number 0: No expansion card 1: DeviceNet Slave (CMC-DN01) 2: Profibus-DP Slave (CMC-PD01) 4: Modbus-TCP Slave (CMC-MOD01) 5: EtherNet/IP Slave (CMC-EIP01) 12: PROFINET Slave (CMC-PN01) 13: Bluetooth	RO
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
D1036	Servo error bit	RO
D1037	Drive output frequency	RO
D1038	DCBUS voltage	RO
D1039	Output voltage	RO
D1040	Analog output value AFM (-100.00–100.00%)	RW
D1043	Can be user-defined (will be displayed on panel when Pr. 00-04 is set as 28; display method is C xxx)	RW
D1061	485 COM1 communications time out time (ms)	RW
D1062	Torque command (torque limit in speed mode)	RW
D1064	Week (display range 1–7)	RO
D1065	Month (display range 1–12)	RO
D1066	Day (display range 1–31)	RO
D1067	Hour (display range 0–23)	RO
D1068	Minute (display range 0–59)	RO
D1069	Second (display range 0–59)	RO
D1100	Target frequency	RO
D1101	Target frequency (must be operating)	RO
D1102	Reference frequency	RO
D1107	π(Pi) Low word	RO
D1108	π(Pi) High word	RO
D1109	Random number	RO
D1200	PID 1 Mode	RW
D1201	PID 1 Target selection: 0: Refer to D1202 1: AI1 2: AI2	RW
D1202	PID 1 Target value (0.00%–100.00%)	RW
D1203	PID 1 Feedback selection: 0: Refer to D1204 1: AI1 2: AI2	RW
D1204	PID 1 Feedback value (0.00%–100.00%)	RW
D1205	PID 1 P value (decimal 2 points)	RW
D1206	PID 1 I value (decimal 2 points)	RW
D1207	PID 1 D value (decimal 2 points)	RW

Special D	Description of Function	R/W *
D1209	PID 1 Max. limit	RW
D1215	PID 1 calculation (decimal 2 points)	RO
D1216	PID 1 present I value	RW
D1220	PID2 mode	RW
D1221	PID 2 Target selection: 0: Refer to D1222 1: AI1 2: AI2	RW
D1222	PID 2 Target value (0.00%–100.00%)	RW
D1223	PID 2 Feedback selection: 0: Refer to D1224 1: AI1 2: AI2	RW
D1224	PID 2 Feedback value (0.00%–100.00%)	RW
D1225	PID 2 P value (decimal 2 points)	RW
D1226	PID 2 I value (decimal 2 points)	RW
D1227	PID 2 D value (decimal 2 points)	RW
D1228	Forced to assign a value to PID 2 integral value	RW
D1229	PID 2 Max. limit	RW
D1235	PID 2 calculation (decimal 2 points)	RO
D1236	PID 2 present I value	RW
D1240	PID 3 mode	RW
D1241	PID 3 target selection (0: refer to D1242; 1: AI1; 2: AI2)	RW
D1242	PID 3 target value (0.00–100.00%)	RW
D1243	PID 3 feedback selection (0: refer to D1244; 1: AI1; 2: AI2)	RW
D1244	PID 3 feedback value (0.00–100.00%)	RW
D1245	PID 3 P value (decimal 2 points)	RW
D1246	PID 3 I value (decimal 2 points)	RW
D1247	PID 3 D value (decimal 2 points)	RW
D1248	Forced to assign a value to PID 3 integral value	RW
D1249	PID 3 Max. limit	RW
D1255	PID 3 calculation	RO
D1256	PID 3 present I value	RW
D1260	PID 4 mode	RW
D1261	PID 4 target selection (0: refer to D1262; 1: AI1; 2: AI2)	RW
D1262	PID 4 target value (0.00~100.00%)	RW
D1263	PID 4 feedback selection (0: refer to D1264; 1: AI1; 2: AI2)	RW
D1264	PID 4 feedback value (0.00–100.00%)	RW
D1265	PID 4 P value (decimal 2 points)	RW
D1266	PID 4 I value (decimal 2 points)	RW
D1267	PID 4 D value (decimal 2 points)	RW
D1268	Forced to assign a value to PID 4 integral value	RW
D1269	PID 4 Max. limit	RW
D1275	PID 4 calculation	RO
D1276	PID 4 present I value	RW
D1280	PID 5 mode	RW
D1281	PID 5 target selection (0: refer to D1282; 1: AI1; 2:AI2)	RW
D1282	PID 5 target value (0.00–100.00%)	RW
D1283	PID 5 feedback selection (0: refer to D1284; 1: AI1; 2: AI2)	RW
D1284	PID 5 feedback value (0.00–100.00%)	RW
D1285	PID 5 P value (decimal 2 points)	RW
D1286	PID 5 I value (decimal 2 points)	RW
D1287	PID 5 D value (decimal 2 points)	RW
D1288	Forced to assign a value to PID 5 integral value	RW
D1289	PID 5 Max. limit	RW

Special D	Description of Function	R/W *
D1295	PID 5 calculation	RO
D1296	PID 5 present I value	RW
D1300	PID 6 mode	RW
D1301	PID 6 target selection (0: refer to D1302; 1: AI1; 2: AI2)	RW
D1302	PID 6 target value (0.00–100.00%)	RW
D1303	PID 6 target selection (0: refer to D1304; 1: AI1; 2: AI2)	RW
D1304	PID 6 feedback value (0.00–100.00%)	RW
D1305	PID 6 P value (decimal 2 points)	RW
D1306	PID 6 I value (decimal 2 points)	RW
D1307	PID 6 D value (decimal 2 points)	RW
D1308	Forced to assign a value to PID 6 integral value	RW
D1309	PID 6 Max. limit	RW
D1315	PID 6 calculation	RO
D1316	PID 6 present I value	RW
D1320	PID 7 mode	RW
D1321	PID 7 target selection (0: refer to D1322; 1: AI1; 2:AI2)	RW
D1322	PID 7 target value (0.00–100.00%)	RW
D1323	PID 7 feedback selection (0: refer to D1324; 1: AI1; 2: AI2)	RW
D1324	PID 7 feedback value (0.00–100.00%)	RW
D1325	PID 7 P value (decimal 2 points)	RW
D1326	PID 7 I value (decimal 2 points)	RW
D1327	PID 7 D value (decimal 2 points)	RW
D1328	Forced to assign a value to PID 7 integral value	RW
D1329	PID 7 Max. limit	RW
D1335	PID 7 calculation	RO
D1336	PID 7 present I value	RW
D1340	PID 8 mode	RW
D1341	PID 8 target selection (0: refer to D1342; 1: AI1; 2: AI2)	RW
D1342	PID 8 target value (0.00–100.00%)	RW
D1343	PID 8 feedback selection (0: refer to D1344; 1: AI1; 2: AI2)	RW
D1344	PID 8 feedback value (0.00–100.00%)	RW
D1345	PID 8 P value (decimal 2 points)	RW
D1346	PID 8 I value (decimal 2 points)	RW
D1347	PID 8 D value (decimal 2 points)	RW
D1348	Forced to assign a value to PID 8 integral value	RW
D1349	PID 8 Max. limit	RW
D1355	PID 8 calculation	RO
D1356	PID 8 present I value	RW



15-5-4 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	1000~1359	bit	0BE8~0C7F
C	0~79	bit / word	0E00~0E47
D	00~1000	word	1000~13E7
D	1000~1619	word	13E8~1653

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

1: When PLC function enables, MP300 can correspond to parameters of PLC and the drive by the PLC communication addresses mentioned above.
2: The default station address of drive is 1, and the default station address of PLC is 100.

15-6 Introduction to The Command Window

15-6-1 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

15-6-2 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.

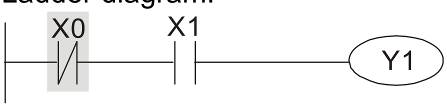
Example: Ladder diagram:

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:

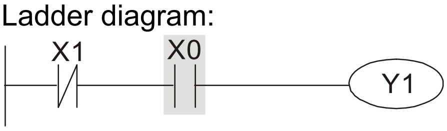


Command code:		Description:
LDI	**X0**	Load Contact b of X0
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

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

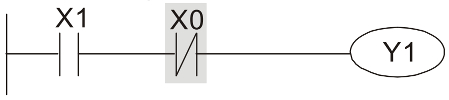
Command	Function					
ANI	Connect contact b in series					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

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

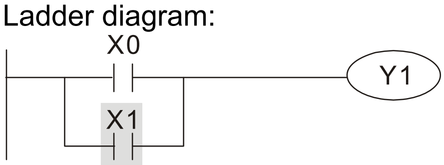
Command	Function					
OR	Connect contact a in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

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

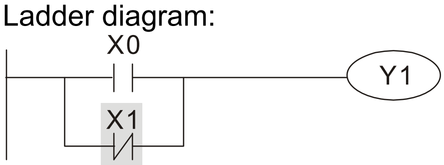
Command	Function					
ORI	Connect contact b in parallel					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

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

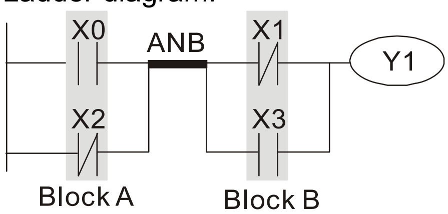
Command	Function
ANB	Series circuit block
Operand	N/A

Explanation

ANB performs an "AND" operation on the previously saved logic results and the current cumulative register content.

Example

Ladder diagram:

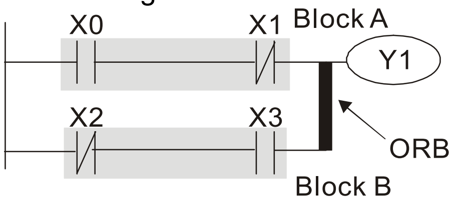


Command code:		Description:
LD	X0	Load Contact a of X0
ORI	X2	Establish parallel connection to contact b of X2
LDI	X1	Load Contact b of X1
OR	X3	Establish parallel connection to contact a of X3
ANB		Series circuit block
OUT	Y1	Drive Y1 coil

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)

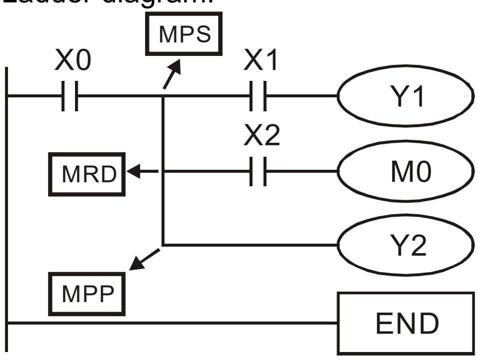
Command	Function
MRD	Read stack (pointer does not change)
Operand	N/A

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
	—	✓	✓	—	—	—

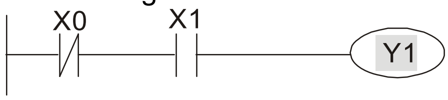
Explanation

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

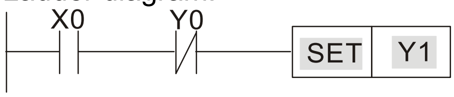
Command	Function					
SET	Action continues (ON)					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

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

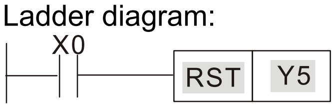
When the RST command is driven, the action of the designated element will be as follows:

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 will be set as Off.
D	The content value will be set as 0.

If the RST command has not been executed, the status of the designated element will remain unchanged.

Example

Ladder diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
RST	**Y5**	Clear contact or register

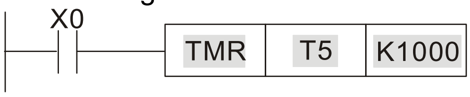
Command	Function	
TMR	16-bit timer	
Operand	T-K	T0–T159, K0–K32,767
	T-D	T0–T159, D0–D399

Explanation When the TMR command is executed, the designated timer coil will be electrified, and the timer will begin timing. The contact's action will be as follows when the timing value reaches the designated set value (timing value >= set value):

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

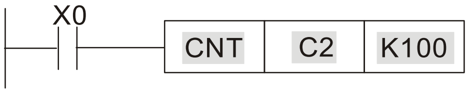
Command	Function	
CNT	16-bit counter	
Operand	C-K	C0–C79, K0–K32,767
	C-D	C0–C79, D0–D399

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:

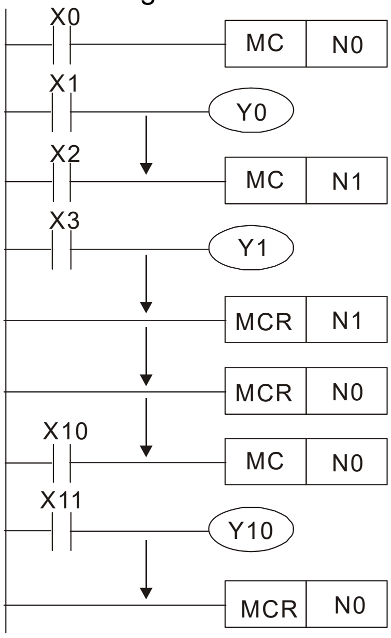
Determination of commands	Description
Ordinary timer	The timing value will revert to 0, the coil will lose power, and the contact will not operate
Counter	The coil will lose power, and the count value and contact will stay in their current state
Coil driven by OUT command	None receive power
Elements 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

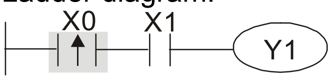
Command	Function					
LDP	Start of forward edge detection action					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

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.

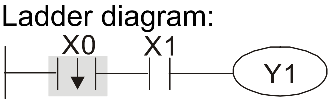
Command	Function					
LDF	Start of reverse edge detection action					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	✓	✓	✓	✓	✓	—

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:

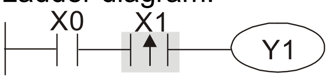


Command code:		Description:
LDF	**X0**	Start of X0 reverse edge detection action
AND	X1	Create series connection to contact a of X1
OUT	Y1	Drive Y1 coil

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:

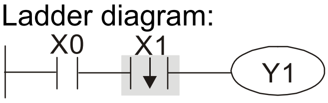


Command code:		Description:
LD	X0	Load Contact a of X0
ANDP	**X1**	X1 Forward edge detection series connection
OUT	Y1	Drive Y1 coil

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:

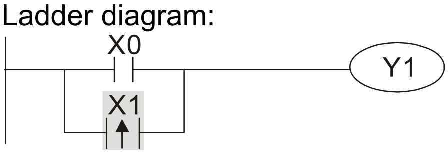


Command code:		Description:
LD	X0	Load Contact a of X0
ANDF	**X1**	X1 Reverse edge detection series connection
OUT	Y1	Drive Y1 coil

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:

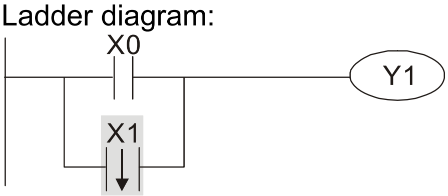


Command code:		Description:
LD	X0	Load Contact a of X0
ORP	**X1**	X1 Forward edge detection parallel connection
OUT	Y1	Drive Y1 coil

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:

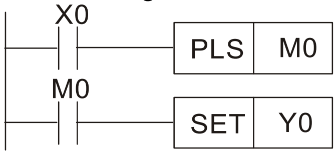


Command code:		Description:
LD	X0	Load Contact a of X0
ORF	**X1**	X1 Reverse edge detection parallel connection
OUT	Y1	Drive Y1 coil

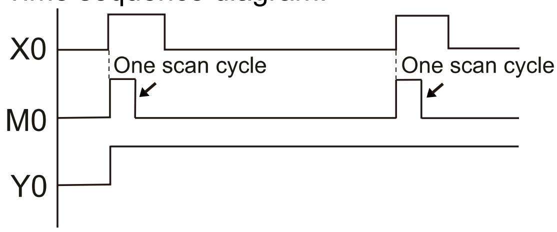
Command	Function					
PLS	Upper differential output					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

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:



Time sequence diagram:

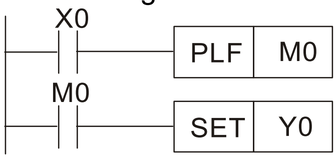


Command code:		Description:
LD	X0	Load Contact a of X0
PLS	**M0**	M0 Upper differential output
LD	M0	Load Contact a of M0
SET	Y0	Y0 Action continues (ON)

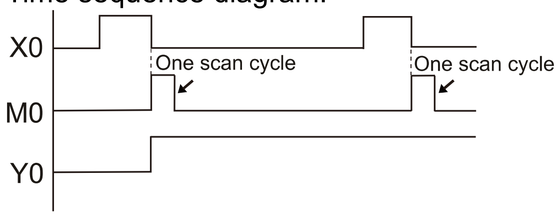
Command	Function					
PLF	Lower differential output					
Operand	X0–X17	Y0–Y17	M0–M799	T0–159	C0–C79	D0–D399
	—	✓	✓	—	—	—

Explanation: Lower differential output command. When X0= On→Off (negative edge-triggered), the PLF command will be executed, and M0 will send one pulse, with pulse length consisting of one scanning period.

Example: Ladder diagram:



Time sequence diagram:



Command code:		Description:
LD	X0	Load Contact a of X0
PLF	**M0**	M0 Lower differential output
LD	M0	Load Contact a of M0
SET	Y0	Y0 Action continues (ON)

Command	Function
END	Program conclusion
Operand	N/A

Explanation: An END command must be added to the end of a ladder diagram program or command program. The PLC will scan from address 0 to the END command, and will return to address 0 and begins scanning again after execution.

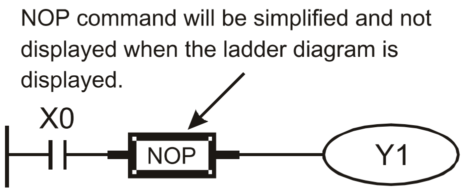
Command	Function
NOP	No action
Operand	N/A

Explanation

The command NOP does not perform any operation in the program. Because execution of this command will retain the original logical operation results, it can be used in the following situation: the NOP command can be used 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

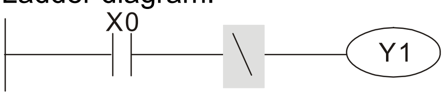
Command	Function
INV	Inverse of operation results
Operand	N/A

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

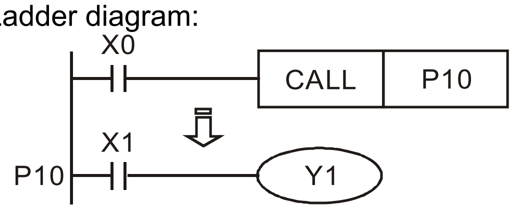
Command	Function
P	Index
Operand	P0–P255

Explanation

Pointer P is used to subprogram call command API 01 CALL. User 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

15-6-3 Overview of application commands

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16 bit	32 bit
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
	13	SMOV	DSMOV	✓	Nibble movement	11	21
	15	BMOV	–	✓	Send all	7	–
Four logical operations	18	BCD	DBCD	✓	BIN to BCD transformation	5	9
	19	BIN	DBIN	✓	BCD to BIN transformation	5	9
	20	ADD	DADD	✓	BIN addition	7	13
	21	SUB	DSUB	✓	BIN subtraction	7	13
	22	MUL	DMUL	✓	BIN multiplication	7	13
	23	DIV	DDIV	✓	BIN division	7	13
	24	INC	DINC	✓	BIN add one	3	5
	25	DEC	DDEC	✓	BIN subtract one	3	5
Rotational displacement	30	ROR	DROR	✓	Right rotation	5	–
	31	ROL	DROL	✓	Left rotation	5	–
Data Process	40	ZRST	–	✓	Clear range	5	-
	41	DECO	DDECO	✓	Decoder	7	13
	42	ENCO	DENCO	✓	Encoder	7	13
	43	SUM	DSUM	✓	ON bit number	5	9
	44	BON	DBON	✓	ON bit judgement	7	13
	49	FLT	DFLT	✓	BIN whole number → binary floating point number transformation	5	9
Floating point operation	110	–	DECMP	✓	Comparison of binary floating point numbers	–	13
	111	–	DEZCP	✓	Comparison of binary floating point number range	–	17
	116	–	DRAD	✓	Angle → 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	INT	DINT	✓	Binary floating point number → BIN whole number transformation	5	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

Classification	API	Command code		P command	Function	STEPS	
		16 bit	32 bit			16 bit	32 bit
	133	–	DASIN	✓	Binary floating point number ASIN operation	–	9
	134	–	DACOS	✓	Binary floating point number ACOS operation	–	9
	135	–	DATAN	✓	Binary floating point number ATAN operation	–	9
	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
Other	147	SWAP	DSWAP	✓	Exchange the up/down 8 bits	3	5
communication	150	MODRW	–	✓	MODBUS read/write	7	–
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 16 bit	STEPS 32 bit
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
Drive special command	139	RPR	–	✓	Read servo parameter	5	–
	140	WPR	–	✓	Write servo parameter	5	–
	141	FPID	–	✓	Drive PID control mode	9	–
	142	FREQ	–	✓	Drive 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
	323	WPRA	–	-	RAM write in drive parameters	5	-

15-6-4 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

MP300 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 06	FEND	–	Conclusion a main program

	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

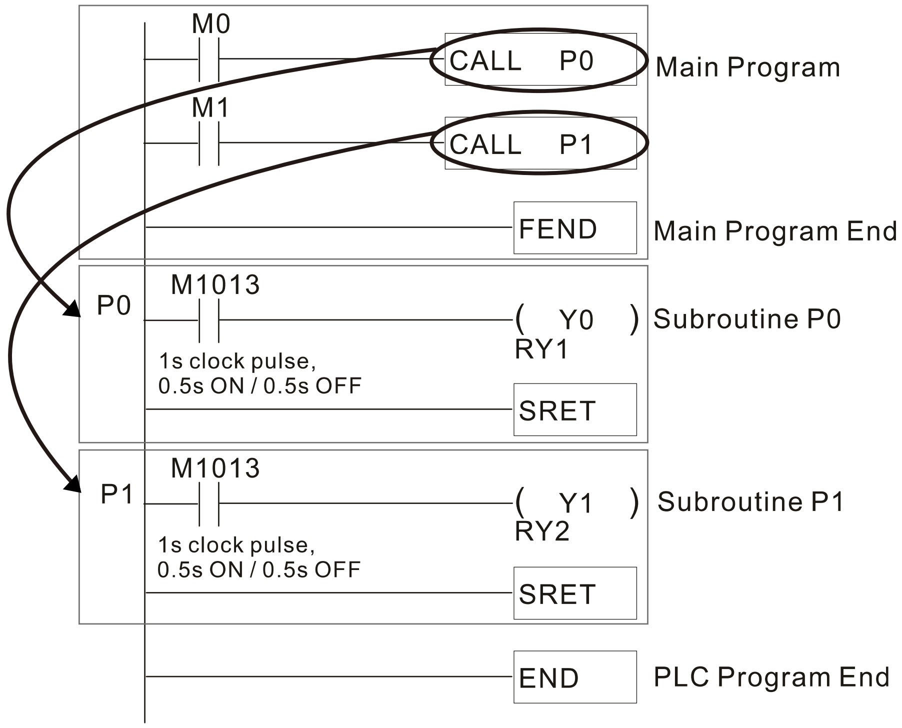
–	–	–	–

Flag signal: none

Explanation

- This command indicates the end of the main program. It is the same as the END command when the PLC executes this command.
- The CALL command program must be written after the FEND command, and the SRET command added to the end of the subprogram.
- When using the FEND command, an END command is also needed. However, the END command must be placed at the end, after the main program and subprogram.

CALL command process



API					
10	D	CMP	P	S1 S2 D	Compares set output

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D		*	*								

Notes on operand usage:
The operand D occupies three consecutive points

16-bit command (7 STEP)

CMP	Continuous execution type	CMPP	Pulse execution type

32-bit command (13 STEP)

DCMP	Continuous execution type	DCMPP	Pulse execution type

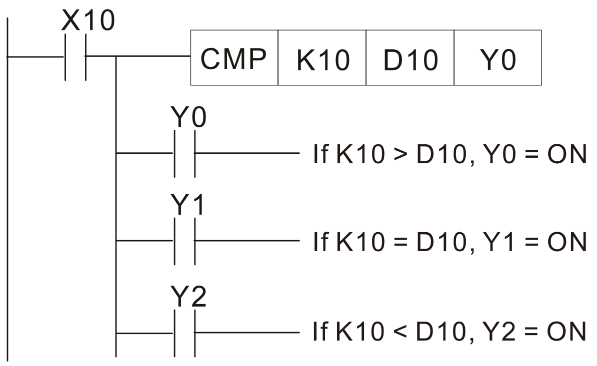
Flag signal: none

Explanation

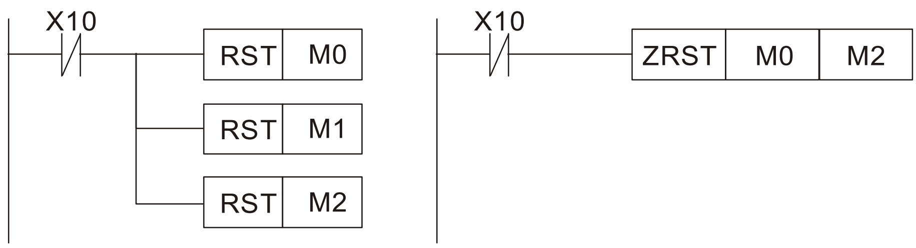
- S1: Compare value 1. S2: Compare value 2. D: Results of comparison.
- Compares the size of the content of operand S1 and S2; the results of comparison are expressed in D.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

Example

- When the designated device is Y0, it automatically occupies Y0, Y1 and Y2.
- When X10=On, the CMP command executes, and Y0, Y1 or Y2 will be On. When X10=Off, the CMP command will not execute, and the state of Y0, Y1 and Y2 will remain in the state prior to X10=Off.
- If ≥, ≤, or ≠ results are needed, they can be obtained via series/parallel connections of Y0–Y2.



- To clear results of comparison, use the RST or ZRST command.



API					
11	D	ZCP	P	S1 S2 S D	Range comparison

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S				*	*	*	*	*	*	*	*
D		*	*								

Notes on operand usage:
The content value of operand S1 is less than the content value of S2 operand
The operand D occupies three consecutive points

16-bit command (9 STEP)

ZCP	Continuous execution type	ZCPP	Pulse execution type

32-bit command (17 STEP)

DZCP	Continuous execution type	DZCPP	Pulse execution type

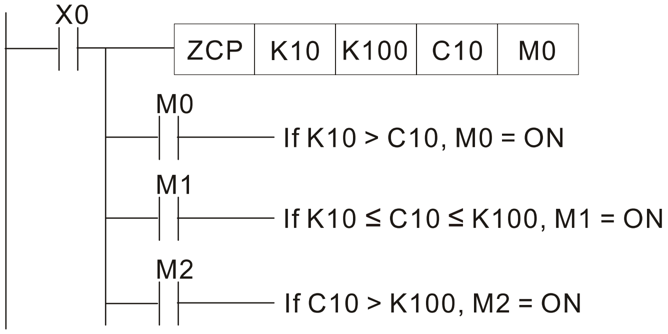
Flag signal: none

Explanation

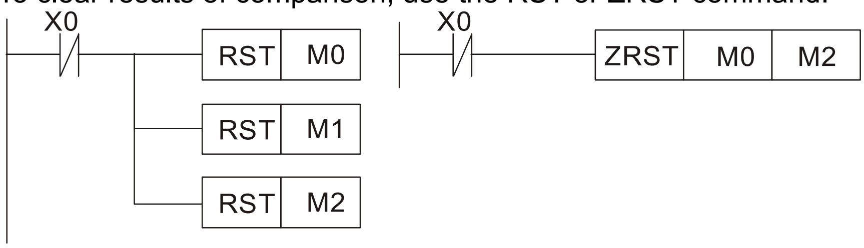
- S1: Lower limit of range comparison. S2: Upper limit of range comparison. S: Comparative value. D: Results of comparison.
- When the comparative value S is compared with the lower limit S1 and upper limit S2, the results of comparison are expressed in D.
- When lower limit S1 > upper limit S2, the command will use the lower limit S1 to perform comparison with the upper and lower limit.
- Size comparison is performed algebraically. All data is compared in the form of numerical binary values. Because this is a 16-bit command, when b15 is 1, this indicates a negative number.

Example

- When the designated device is M0, it automatically occupies M0, M1 and M2.
- When X0=On, the ZCP command executes, and M0, M1 or M2 will be On. When X0=Off, the ZCP command will not execute, and the state of M0, M1 or M2 will remain in the state prior to X0=Off.
- If ≥, ≤, or ≠ results are needed, they can be obtained via series/parallel connections of M0–M2.



- To clear results of comparison, use the RST or ZRST command.



API					
12	D	MOV	P	(S) (D)	Data movement

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

MOV	Continuous execution type	MOVP	Pulse execution type

32-bit command (9 STEP)

DMOV	Continuous execution type	DMOVP	Pulse execution type

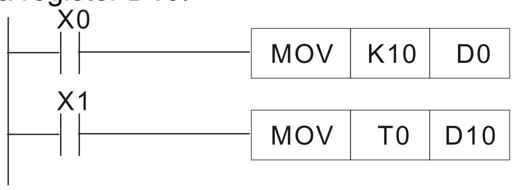
Flag signal:

Explanation

- (S): Data source. (D): Destination of data movement.
- When this command is executed, the content of (S) will be directly moved to (D). When the command is not executed, the content of (D) will not change.

Example

- When X0=Off, the content of D10 will not change; if X0=On, the value K10 will be sent to data register D10.
- When X1=Off, the content of D10 will not change; if X1=On, the current value of T0 will be sent to data register D10.



API					
13	D	SMOV	P	S m1 m2 D n	Nibble movement

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (11 STEP)

MOV	Continuous execution type	SMOVP	Pulse execution type

32-bit command (21 STEP)

DSMOV	Continuous execution type	DSMOVP	Pulse execution type

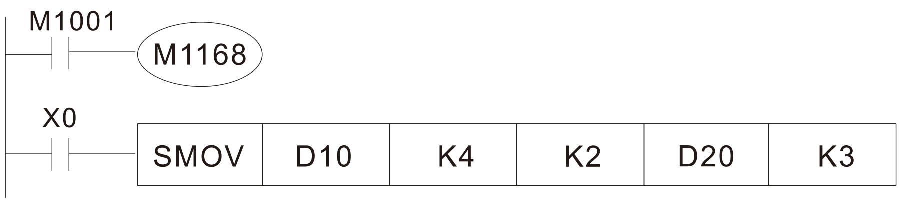
Flag signal: M1168

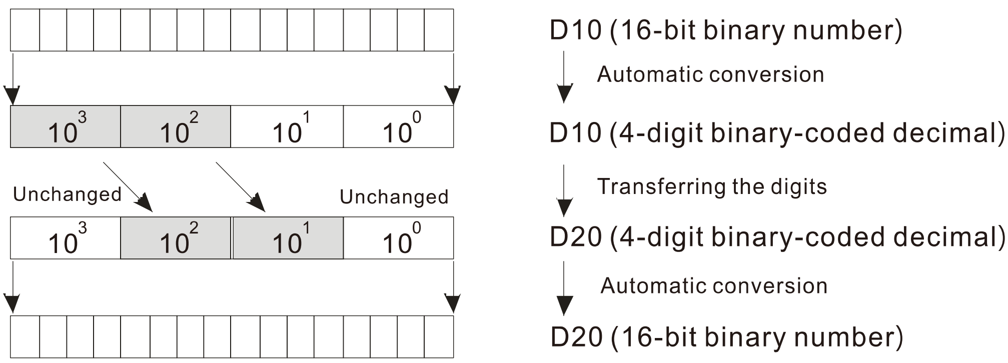
Explanation

- S: Data source. m1: The data source transfers starting bit number. m2: The data source transfers individual bit number. D: Transfer destination. n Transferring starting bit number of the destination.
- BCD mode (M1168 = Off):
  SMOV enables and operates BCD under this mode, the operation is similar to the way SMOV operates decimal numbers. The command copies specific bit number of arithmetic element S (S is a 4-figure decimal number), and sends the bit number to arithmetic element D (D is also a 4-figure decimal number). The current data on the target register will be covered.
- m_1 range: 1–4
- m_2 range: 1–m_1 (m_2 cannot be larger than m_1)
- n range: m_2–4 (n cannot be smaller than m_2)

Example 1

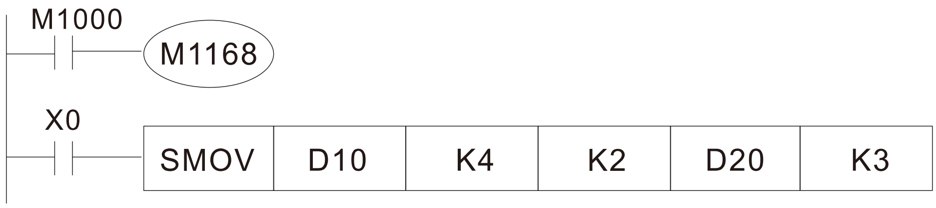
- When M1168 = Off (BCD mode), X0 is ON, the instruction transfers two digits of the decimal number starting from the fourth digit of the decimal number (the digit in the thousands place of the decimal number) in D10 to the two digits of the decimal number starting from the third digit of the decimal number (the digit in the hundreds place of the decimal number) in D20. After the instruction is executed, the digits in the thousands place of the decimal number (10^3) and the ones place of the decimal number (10^0) in D20 are unchanged.

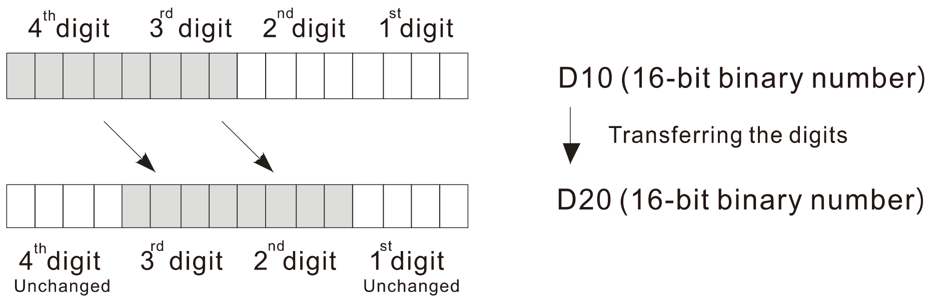




Example 2

- When M1168 is On (BIN mode), and the SMOV command is executed, D10 and D20 do not change in BCD mode, but send 4 digits as a unit in BIN mode.





API 15	BMOV P	(S) (D) (n)	Send all

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*
n				*	*				*	*	

Notes on operand usage:
n operand scope n ＝ 1 to 512

16-bit command (7 STEP)

BMOV	Continuous execution type	BMOVP	Pulse execution type

32-bit command

—	—	—	—

Flag signal: none

Explanation

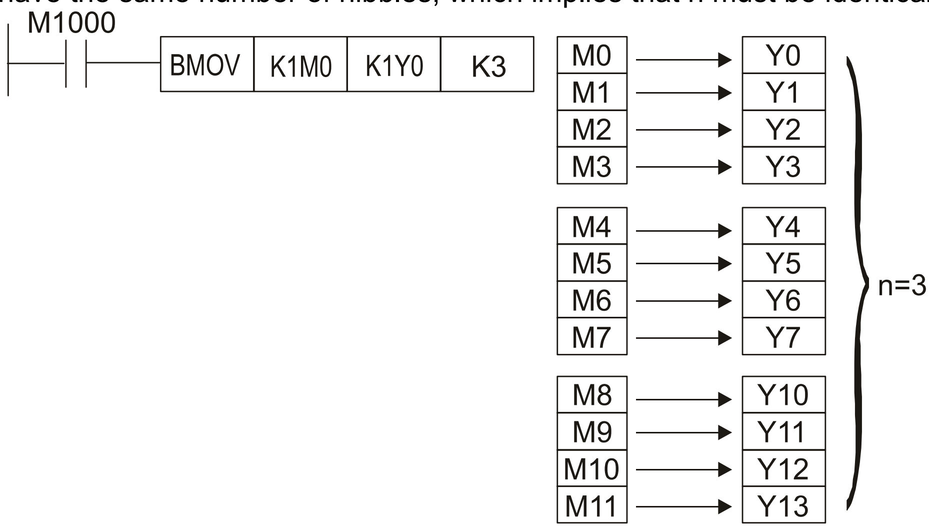
- (S): Initiate source device. (D): Initiate destination device. (n): Send block length.
- The content of n registers starting from the initial number of the device designated by (S) will be sent to the n registers starting from the initial number of the device designated by (n); if the number of points referred to by n exceeds the range used by that device, only points within the valid range will be sent.

Example 1

- When X10=On, the content of registers D0–D3 will be sent to the four registers D20 to D23.

Example 2

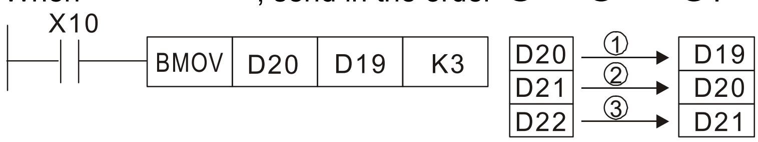
- If the designated bit devices KnX, KnY, and KnM are sent, (S) and (D) must have the same number of nibbles, which implies that n must be identical.



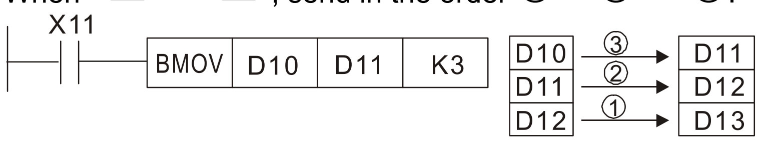
Example 3

- In order to prevent overlap between the transmission addresses of two operands, which would cause confusion, make sure that the addresses designated by the two operands have different sizes, as shown below:

When (S) > (D), send in the order ①→② →③.



When (S) < (D), send in the order ③→② →①.



API					
18	D	BCD	P	S D	BIN to BCD transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

BCD	Continuous execution type	BCDP	Pulse execution type

32-bit command (9 STEP)

DBCD	Continuous execution type	DBCDP	Pulse execution type

Flag signal: none

Explanation

- S: Data source. D: Destination of data movement.
- The content of data source S (BIN value, 0–9999) executes BCD transformation and saves in D.
- Arithmetic elements S and D use the F device, it can only use 16-bit command.

Example

- When X0 is ON, and the BIN value of D10 is transformed to BCD value, the digit is saved in 4-bit element of K1Y0 (Y0–Y3).

- If D10 = 001E (Hex) = 0030 (Decimal), the executed result will be Y0–Y3=0000 (BIN).

API					
19	D	BIN	P	(S) (D)	BCD to BIN transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

BIN	Continuous execution type	BINP	Pulse execution type

32-bit command (9 STEP)

DBIN	Continuous execution type	DBINP	Pulse execution type

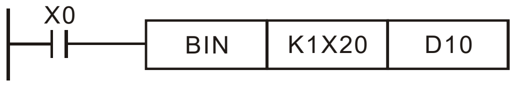
Flag signal: none

Explanation

- (S): Data source. (D): Transformation result.
- The content of data source (S) (BCD: 0–9,999) executes BIN transformation and saves in (D).
- Valid number range of the data source S: BCD (0–9,999), DBCD (0–99,999,999).

Example

- When X0 is ON, and the BCD value of K1X20 is transformed to BIN value, the result saves in D10.



Remark

- When PLC reads a BCD type switch-off from the outside, it has to use the BIN command to transform the read data to BIN value, then saves the value into PLC.

API				
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

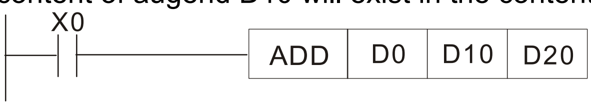
Explanation

- 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

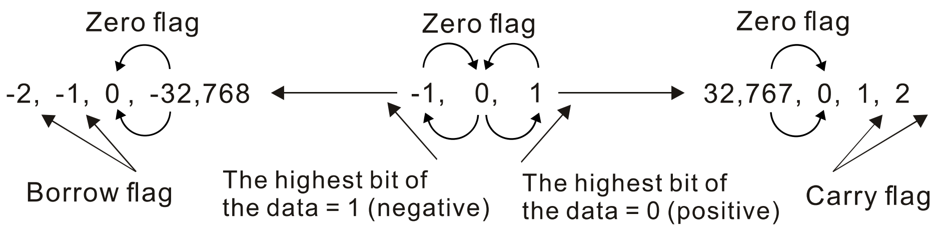
- 16-bit BIN addition: When X0=On, the result of the content of addend D0 plus the content of augend D10 will exist in the content of D20.



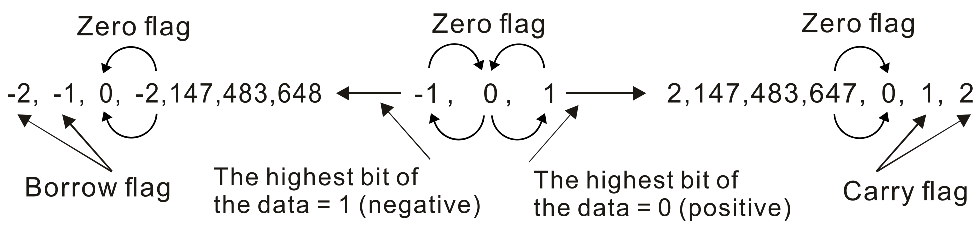
Remark

- Relationship between flag actions and negative/positive numbers:

16-bit:



32-bit:



API 21	D	SUB	P	(S1) (S2) (D)	BIN subtraction

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (7 STEP)

SUB	Continuous execution type	SUBP	Pulse execution type

32-bit command (13 STEP)

DSUB	Continuous execution type	DSUBP	Pulse execution type

Flag signal: M1020 Zero flag
M1021 Borrow flag
M1022 Carry flag
Please refer to the following supplementary explanation

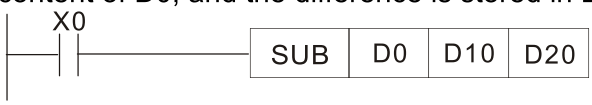
Explanation

- (S1): Minuend. (S2): Subtrahend. (D): Difference.
- Using two data sources: The result of subtraction of (S1) and (S2) using the BIN method is stored in (D).
- The highest bit of any data is symbolized as bit 0 indicating (positive) 1 indicating (negative), enabling the use of algebraic subtraction operations.
- Flag changes connected with subtraction.

1. When calculation results are 0, the zero flag M1020 will be On.
2. When calculation results are less than –32,768, the borrow flag M1021 will be On.
3. When calculation results are greater than 32,767, the carry flag M1022 will be On.

Example

- 16-bit BIN subtraction: When X0=On, the content of D10 is subtracted from the content of D0, and the difference is stored in D20.



API	D	MUL	P	S1 S2 D	BIN multiplication
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)

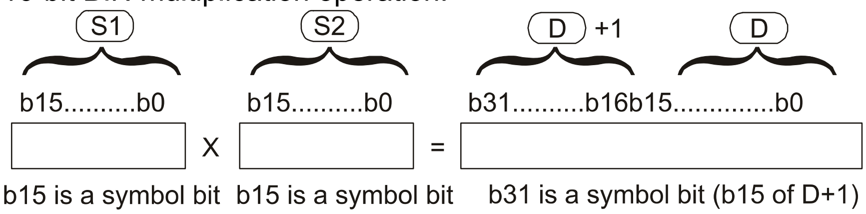
DMUL	Continuous execution type	DMULP	Pulse execution type

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:

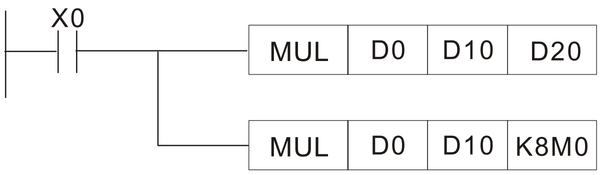


Symbol bit = 0 refers to a positive value
Symbol bit = 1 refers to a negative vlalue

When D is a bit device, K1–K4 can be designated as a hexadecimal number, which will occupy 2 consecutive units.

Example

- When 16-bit DO is multiplied by 16-bit D10, the result will be a 32-bit product; the upper 16 bits will be stored in D21, and the lower 16 bits will be stored in D20. Whether the bit at the farthest left is Off or On will indicate the sign of the result.



API					
23	D	DIV	P	S1 S2 D	BIN division

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
D							*	*	*	*	*

Notes on operand usage:
The 16-bit command operand D will occupy 2 consecutive points

16-bit command (7 STEP)

DIV	Continuous execution type	DIVP	Pulse execution type

32-bit command (13 STEP)

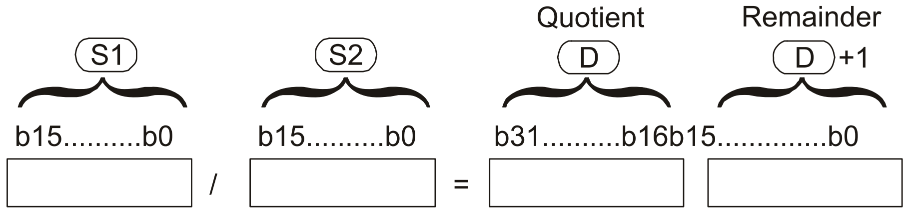
DDIV	Continuous execution type	DDIVP	Pulse execution type

Flag signal: none

Explanation

- S1: Dividend. S2: Divisor. D: Quotient and remainder.
- Using two data sources: The quotient and remainder will be stored in D when S1 and S2 are subjected to division using the BIN method. The sign bit for S1, S2 and D must be kept in mind when performing a 16-bit operation.

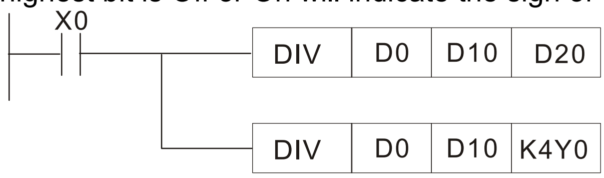
16-bit BIN division:



If D is a bit device, K1–K4 can be designated 16 bits, which will occupy 2 consecutive units and yield the quotient and remainder.

Example

- When X0=On, the quotient resulting from division of dividend D0 by divisor D10 will be placed in D20, and the remainder will be placed in D21. Whether the highest bit is Off or On will indicate the sign of the result.



API					
24	D	INC	P	D	BIN add one

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*

Notes on operand usage: none

16-bit command (3 STEP)

INC	Continuous execution type	INCP	Pulse execution type

32-bit command (5 STEP)

DINC	Continuous execution type	DINCP	Pulse execution type

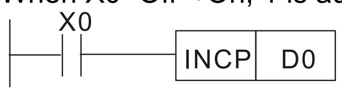
Flag signal: none

Explanation

- D: Destination device.
- If a command is not the pulse execution type, when the command is executed, the program will add 1 to the content of device D for each scanning cycle.
- This command is ordinarily used as a pulse execution type command (INCP).
- During 16-bit operation, 32,767 +1 will change the value to -32,768. During 32 bit operation, 2,147,483,647 +1 will change the value to -2,147,483,648.

Example

- When X0=Off→On, 1 is automatically added to the content of D0.



API					
25	D	DEC	P	D	BIN subtract one

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D				*	*	*	*	*			

Notes on operand usage: none

16-bit command (3 STEP)

DEC	Continuous execution type	DECP	Pulse execution type

32-bit command (5 STEP)

DDEC	Continuous execution type	DDECP	Pulse execution type

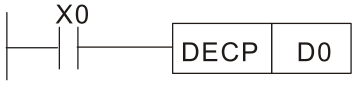
Flag signal: none

Explanation

- D: Destination device.
- If a command is not the pulse execution type, when the command is executed, the program will add 1 to the content of device D for each scanning cycle.
- This command is ordinarily used as a pulse execution type command (DECP).
- During 16-bit operation, -32,768 minus 1 will change the value to 32,767. During 32 bit operation, -2,147,483,648 minus 1 will change the value to -2,147,483,647.

Example

- When X0=Off→On, 1 is automatically subtracted from the content of D0.



API					
30	D	ROR	P	D n	Right rotation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D							*	*	*	*	*
n				*	*						

Notes on operand usage:
Only K4 (16-bit) will be valid if the operand D is designated as KnY or KnM.
n operand n=K1-K16 (16-bit)

16-bit command (5 STEP)

ROR	Continuous execution type	RORP	Pulse execution type

32-bit command (9 STEP)

DROR	Continuous execution type	DRORP	Pulse execution type

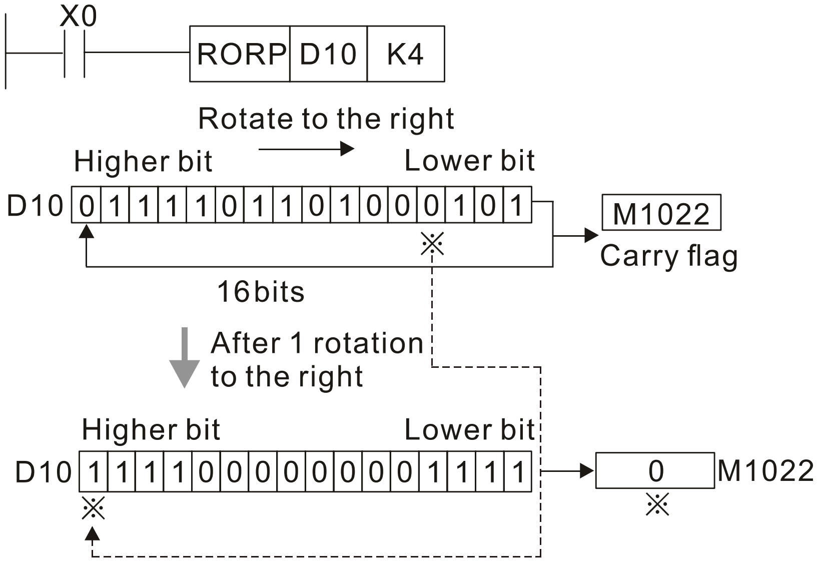
Flag signal: M1022 Carry flag

Explanation

- D: Device to be rotated. n: Number of bits for one rotation.
- Rotates the device designated by D to the right n bits.
- This command is ordinarily used as a pulse execution type command (RORP).

Example

- When X0=Off→On, 4 of the 16 bits in D10 specify a right rotation; the content of the bit indicated with * (see figure below) will be sent to the carry flag signal M1022.



API					
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

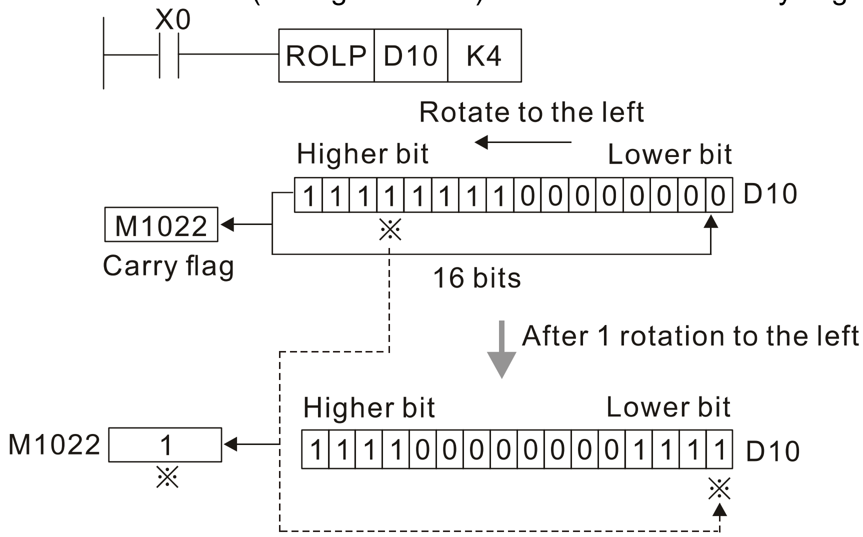
Flag signal: M1022 Carry flag

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

- When X0=Off→On, 4 of the 16 bits in D10 specify a left rotation; the content of the bit indicated with * (see figure below) will be sent to the carry flag signal M1022.



API					
40		ZRST	P	D1 D2	Clear range

	Bit device			Word device								
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D1		*	*						*	*	*
D2		*	*						*	*	*

Notes on operand usage:
Number of operand D_1 operand ≤ number of operand D_2
Operands D_1, D_2 must designate the same type of device
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)			
ZRST	Continuous execution type	ZRSTP	Pulse execution type

32-bit command			
–	–	–	–

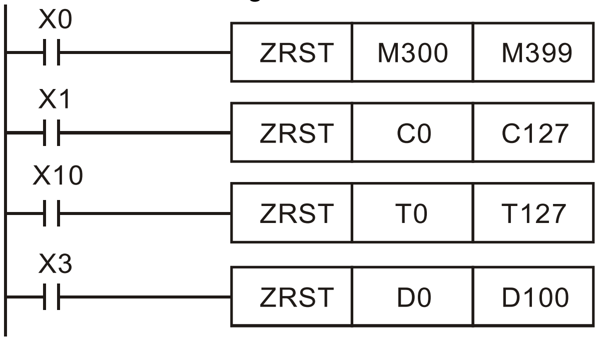
Flag signal: none

Explanation

- **D_1**: Clear range's initial device. **D_2**: Clear range's final device.
- When the number of operand D_1 > number of operand D_2, only the operand designated by D_2 will be cleared.

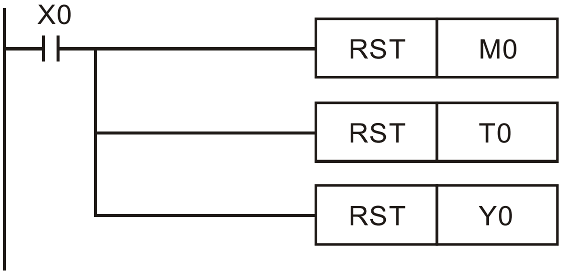
Example

- When X0 is On, auxiliary relays M300–M399 will be cleared and changed to Off.
- When X1 is On, 16-bit counters C0–C127 will all be cleared. (Writes 0, and clears and changes contact and coil to Off).
- When X10 is On, timer T0–T127 will all be cleared. (Writes 0, and clears and changes contact and coil to Off).
- When X3 is On, the data in data registers D0–D100 will be cleared and set as 0.



Remark

- Devices can independently use the clear command (RST), such as bit device Y, M and word device T, C, D.



API					
41	D	DECO	P	S D n	Decoder

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S	*	*	*	*	*				*	*	*
D		*	*				*	*	*	*	*
n				*	*						

Notes on operand usage: none

16-bit command (7 STEP)

DECO	Continuous execution type	DECOP	Pulse execution type

32-bit command (13 STEP)

DDECO	Continuous execution type	DDECOP	Pulse execution type

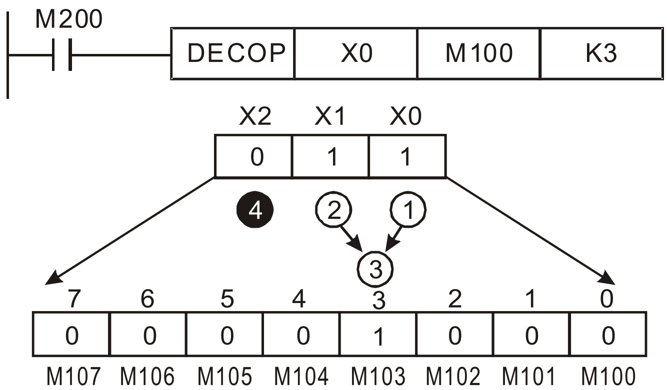
Flag signal: none

Explanation

- S: Decoding source device. D: Device that saves the decoding result. n: Length of decoding bit.
- Decodes with the lower "n" bit, and saves the length of "2^n" bit in D.
- This command usually uses pulse execution type command (DECOP).
- When D is the bit device, n = 1–8, when D is the word device, n = 1–4.

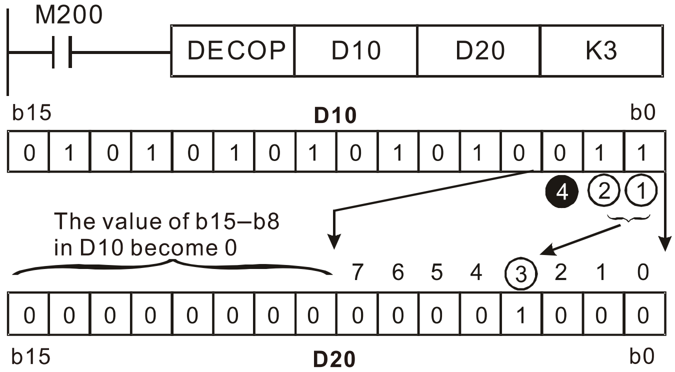
Example 1

- When Dis the bit device, the valid range of n is 0< **n** ≦8. If n = 0 or n > 8, a fault will occur.
- When n = 8, the maximum decoding will be 2^8 = 256 points.
- When M200 switches from Off to On, the content of X0–X2 is decoded to M100–M107.
- If S = 3, M103 (the third digit starting from M100) = On.
- When the command is executed, M200 turns to Off. The ones that are decoded and outputted act as usual.



Example 2

- When D is word device, the valid range of n is 0< **n** ≦4. If n = 0 or n > 4, the fault occurs.
- When n = 4, the maximum decoding will be 2^4 = 16 points.
- When M200 switches from Off to On, the content of D10 (b2–b0) is decoded to D20 (b7–b0). The unused digits (b15–b8) of D20 become 0.
- The lower 3 digits of D10 are decoded and saved in the lower 8 digits of D20, the upper 8 digits are 0.
- When the command is executed, M200 turns to Off. The ones that are decoded and outputted act as usual.



API 42	D	ENCO	P	(S) (D) (n)	Encoder

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S	*	*	*						*	*	*
D							*	*	*	*	*
n				*	*						

Notes on operand usage: none

16-bit command (7 STEP)

ENCO	Continuous execution type	ENCOP	Pulse execution type

32-bit command (13 STEP)

DENCO	Continuous execution type	DENCOP	Pulse execution type

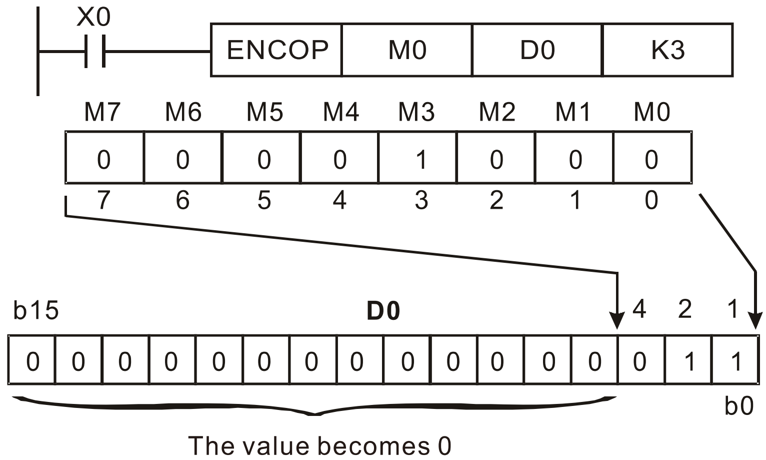
Flag signal: none

Explanation

- (S): Encoding source device. (D): Device that saves the encoding result. (n): Length of encoding bit.
- Encodes the data of lower "2^n" bit length from encoding source device S, and saves the encoding result in D.
- If multiple digits of encoding source device are 1, the command will process the first digit starting from high digit.
- This command usually uses pulse execution type command (ENCOP).
- When S is the bit device, n = 1–8, when S is the word device, n = 1–4.

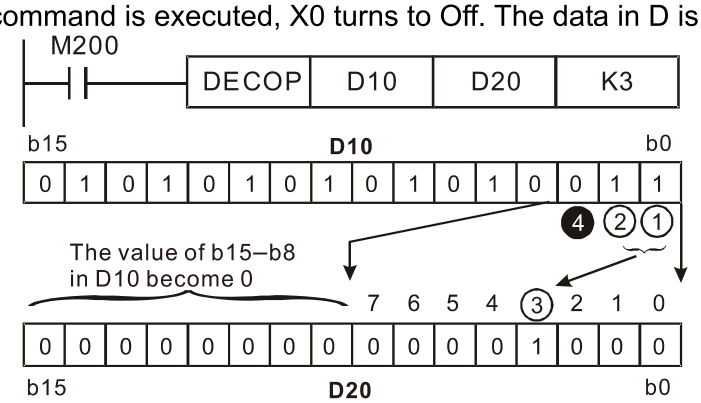
Example 1

- When S is the bit device, the valid range of n is 0< **n** ≦8. If n = 0 or n > 8, a fault will occur.
- When n = 8, the maximum decoding will be 2^8 = 256 points.
- When X0 switches from Off to On, the content of 2^3 digit (M0–M7) is encoded and saved in the lower 3 digits (b2–b0). The unused digits (b15–b3) in D0 become 0.
- When the command is executed, X0 turns to Off. The data in D is unchanged.



Example 2

- When S is word device, the valid range of n is 0< **n** ≦4. If n = 0 or n > 4, the fault occurs.
- When n = 4, the maximum decoding will be 2^4 = 16 points.
- When X0 switches from Off to On, 2^3 digit data of D10 (b0–b7) is encoded and saved in the lower 3 digits (b2–b0) of D20. The unused digits (b15–b3) of D20 become 0. (b8–b15 in D10 are invalid data)
- When the command is executed, X0 turns to Off. The data in D is unchanged.



API					
43	D	SUM	P	(S) (D)	ON bit number

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D									*	*	*

Notes on operand usage: none

16-bit command (5 STEP)

SUM	Continuous execution type	SUMP	Pulse execution type

32-bit command (9 STEP)

DSUM	Continuous execution type	DSUMP	Pulse execution type

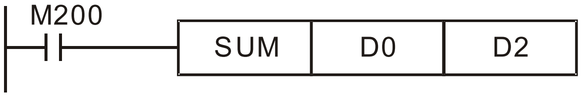
Flag signal: M1020

Explanation

- (S): Source device. (D): Destination of saving counter values.
- The total amount of all digits that is "1" in S will be saved in D.
- D will use 2 registers when use the 32-bit command.
- Arithmetic elements S and D use F device, and can only use 16-bit command.
- If there is no bit is ON, the flag signal M1020 will be ON.

Example

- When M200 = On, the total amount of content "1" digit in D0's 16-bit command will be saved in D2.



0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0

D0

3

D2

API					
44	D	BON	P	S D n	ON bit judgement

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*	*	*	*	*	*	*
D		*	*						*	*	*
n				*	*						

Notes on operand usage: none

16-bit command (7 STEP)

BON	Continuous execution type	BONP	Pulse execution type

32-bit command (9 STEP)

DBON	Continuous execution type	DBONP	Pulse execution type

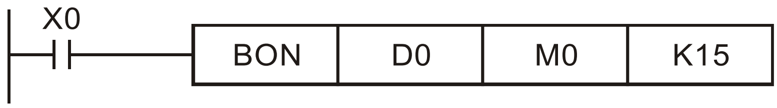
Flag signal: none

Explanation

- S: Source device. D: Destination of saving judging result. n: assign judged digit (numbering from 0)
- The status of specific digit from source device is shown on target position.
- Arithmetic element S uses F device, and can only use the 16-bit command.
- The valid range of arithmetic element n: n = 0–15 (16-bit), n = 0–31 (32-bit).

Example

- When X0 = On, if the 15th digit of D0 is “1”, M0 is On. If it is “0”, M0 is Off.
- When X0 turns to Off, M0 remains previous status.



b15 … b0

0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=Off

D0

b15 … b0

1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	M0=On

D0

API					
49	D	FLT	P	S D	BIN whole number → binary decimal transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S		*	*						*	*	*
D		*	*						*	*	*

Notes on operand usage: Please refer to the function specifications table for each device in series for the scope of device usage
The operand D will occupy 2 consecutive points

16-bit command (5 STEP)

FLT	Continuous execution type	FLTP	Pulse execution type

32-bit command (9 STEP)

DFLT	Continuous execution type	DFLTP	Pulse execution type

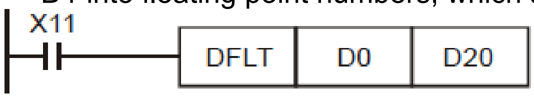
Flag signal: none

Explanation

- **S**: Transformation source device. **D**: Device storing transformation results.
- Transforms BIN whole number into a binary decimal value.

Example

- When M200 is On, converts the whole number of values corresponding to D0 and D1 into floating point numbers, which are placed in D20 and D21.



API				
110	D	ECMP	P	S1 S2 D	Comparison of binary floating point numbers

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
D				*	*						*

Notes on operand usage:
The operand D occupies three consecutive points
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (13 STEP)

DECMP	Continuous execution type	DECMP P	Pulse execution type

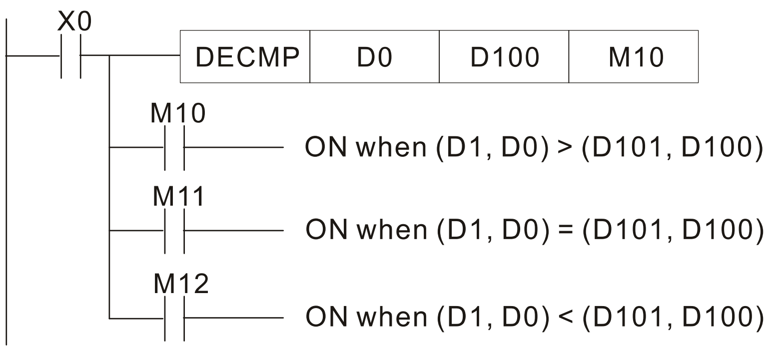
Flag signal: none

Explanation

- **S₁**: Comparison of binary floating point numbers value 1. **S₂**: 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 S₁** or **S₂** designates a constant K or H, the command will transform the constant to a binary floating-point number for the purpose of comparison.

Example

- When the designated device is M10, it will automatically occupy M10–M12.
- When X0=On, the DECMP command executes, and one of M10–M12 will be On. When X0=Off, the DECMP command will not execute, and M10–M12 will remain in the X0=Off state.
- If results in the form of ≥, ≤, or ≠ are needed, they can be obtained by series and parallel connection of M10–M12.
- Please use the RST or ZRST command to clear the result.



API				
111	D	EZCP	P	S1 S2 S D	Comparison of binary floating point number range

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S				*	*						*
D		*	*								

Notes on operand usage:
The operand D occupies three consecutive points
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (17 STEP)

DEZCP	Continuous execution type	DEZCP P	Pulse execution type

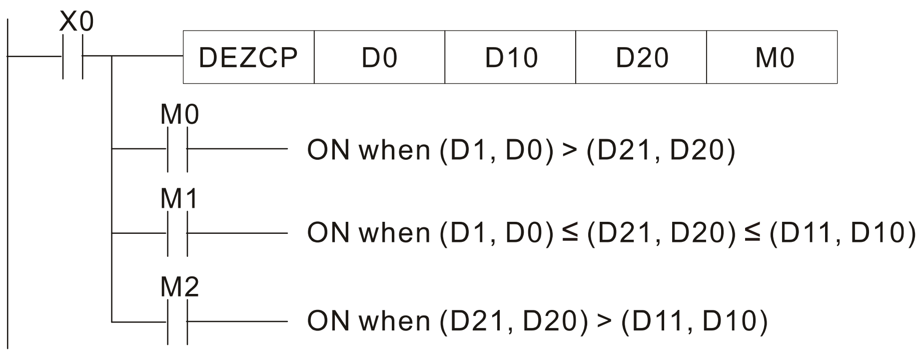
Flag signal: none

Explanation

- **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	Pulse execution type

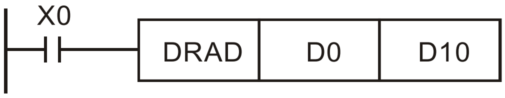
Flag signal: none

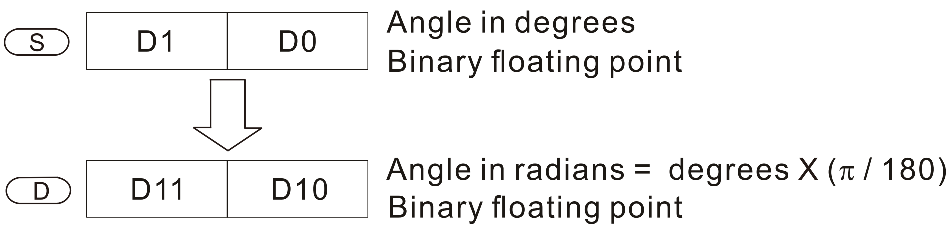
Explanation

- **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

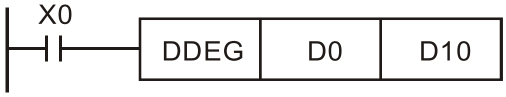
Flag signal: none

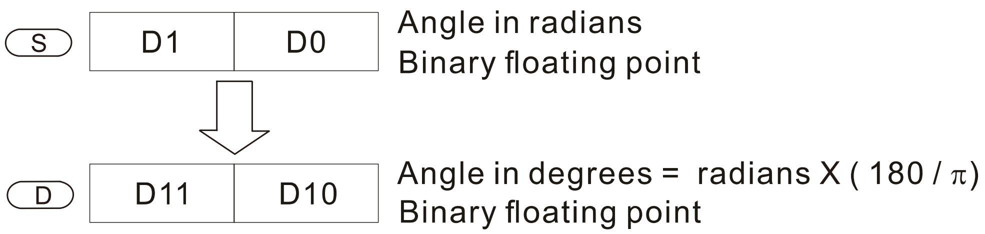
Explanation

- **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

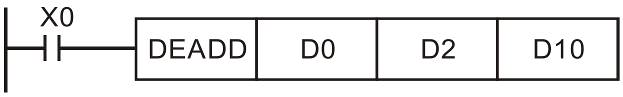
Flag signal: none

Explanation

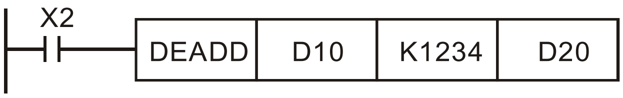
- **S_1**: addend. **S_2**: augend. **D**: sum.
- When the content of the register designated by **S_2** is added to the content of the register designated by **S_1**, and the result is stored in the register designated by **D**. Addition is performed entirely using binary floating-point numbers.
- **If 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

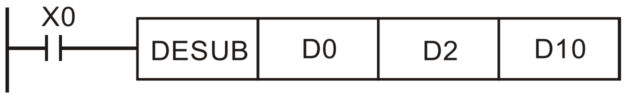
Flag signal: none

Explanation

- **S₁**: minuend. **S₂**: subtrahend. **D**: difference.
- When the content of the register designated by **S₂** is subtracted from the content of the register designated by **S₁**, the difference will be stored in the register designated by **D**; subtraction is performed entirely using binary floating-point numbers.
- **If the source operand S₁** or **S₂** 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 S₁** and **S₂** 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

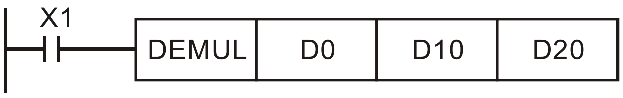
Flag signal: none

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

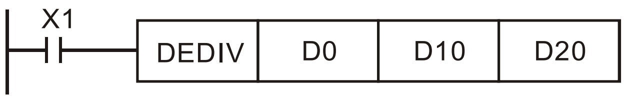
Flag signal: none

Explanation

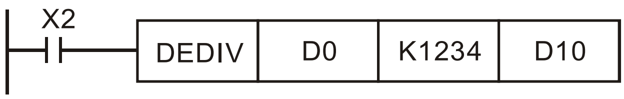
- **S₁**: dividend. **S₂**: divisor. **D**: quotient and remainder.
- When the content of the register designated by **S_1** is divided by the content of the register designated by **S_2**, the quotient will be stored in the register designated by **D**; division is performed entirely using binary floating-point numbers.
- **If the source operand S_1** or **S_2** designates a constant K or H, the command will transform that constant into a binary floating point number for use in division.

Example

- When X1=On, the binary floating point number (D1, D0) will be divided by the binary floating point number (D11, D10), and the quotient stored in the register designated by (D21, D20).



- When X2=On, the binary floating point number (D1, D0) will be divided by K1,234 (which has been automatically converted to a binary floating-point number), and the results stored in (D11, D10).



API					
124	D	EXP	P	S D	Binary floating point number obtain exponent

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

DEXP	Continuous execution type	DEXPP	Pulse execution type

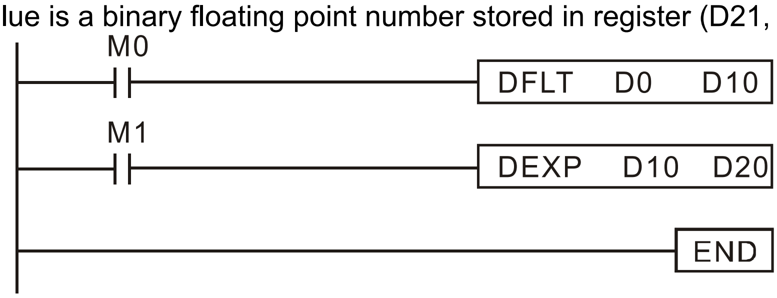
Flag signal: none

Explanation

- **S**: operation source device. **D**: operation results device.
- Taking e =2.71828 as a base, **S** is the exponent in the EXP operation.
- [**D** +1，**D**]=EXP [**S +1**，**S**]
- Valid regardless of whether the content of **S** has a positive or negative value. The designated register D must have a 32-bit data format. This operation is performed using floating-point numbers, and **S** must therefore be converted to a floating point number.
- Content of operand **D** $=e^{S}$; e=2.71828, **S** is the designated source data

Example

- When M0 is On, the value of (D1, D0) will be converted to a binary floating point number, which will be stored in register (D11, D10).
- When M1 is On, the EXP operation is performed on the exponent of (D11, D10); its value is a binary floating point number stored in register (D21, D20).



API 125	D	LN	P	S D	Binary floating point number obtain logarithm

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

DLN	Continuous execution type	DLNP	Pulse execution type

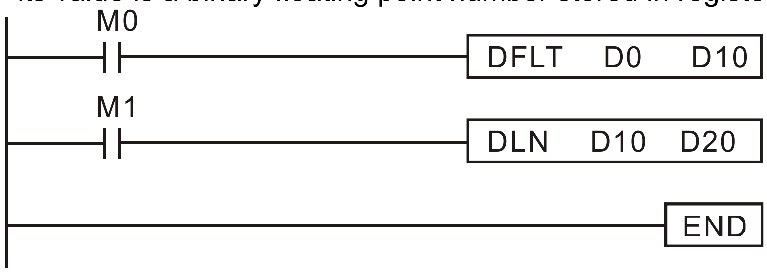
Flag signal: none

Explanation

- **S**: operation source device. **D**: operation results device.
- Taking e =2.71828 as a base, **S** is the exponent in the EXP operation.
- [**D** +1，**D**]=EXP [**S +1**，**S**]
- Valid regardless of whether the content of **S** has a positive or negative value. The designated register D must have a 32-bit data format. This operation is performed using floating-point numbers, and **S** must therefore be converted to a floating point number.
- Content of operand **D** =e^{S} ; e=2.71828， **S** is the designated source data

Example

- When M0 is On, the value of (D1, D0) will be converted to a binary floating point number, which will be stored in register (D11, D10).
- When M1 is On, the EXP operation is performed on the exponent of (D11, D10); its value is a binary floating point number stored in register (D21, D20).



API					
127	D	ESQR	P	S D	Binary floating point number find square root

	Bit device			Word device								16-bit command
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	– – – –
S				*	*						*	
D											*	32-bit command (9 STEP)

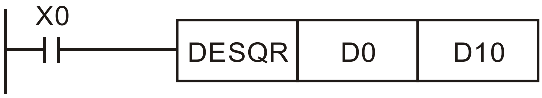
Notes on operand usage:	
Please refer to the function specifications table for each device in series for the scope of device usage	DESQR: Continuous execution type; DESQRP: Pulse execution type
	Flag signal: none

Explanation

- **S**: source device for which square root is desired **D**: result of finding square root.
- When the square root is taken of the content of the register designated by **S**, the result is temporarily stored in the register designated by **D**. Taking square roots is performed entirely using binary floating-point numbers.
- If the source operand **S** refers to a constant K or H, the command will transform that constant into a binary floating point number for use in the operation.

Example

- When X0=On, the square root is taken of the binary floating point number (D1, D0), and the result is stored in the register designated by (D11, D10).



$$\sqrt{(D1 \cdot D0)} \longrightarrow (D11 \cdot D10)$$

Binary floating point   Binary floating point

- When X2 =On, the square root is taken of K1,234 (which has been automatically converted to a binary floating-point number), and the results stored in (D11, D10).

API					
129	D	INT	P	S D	Binary floating point number → BIN whole number transformation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S											*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

INT	Continuous execution type	INTP	Pulse execution type

32-bit command (9 STEP)

DINT	Continuous execution type	DINTP	Pulse execution type

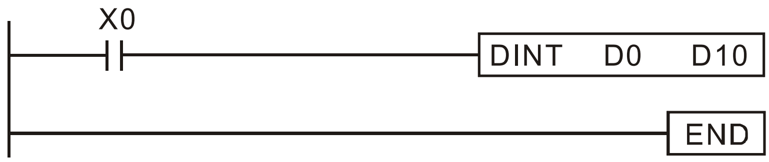
Flag signal: none

Explanation

- **S**: the source device to be transformed. **D**: results of transformation.
- The content of the register designated by **S** is transformed from a binary floating point number format into a BIN whole number, and is temporarily stored in **D**. The BIN whole number floating point number will be discarded.
- The action of this command is the opposite of that of command API 49 (FLT).

Example

- When X0=On, the binary floating point number (D1, D0) is transformed into a BIN whole number, and the result is stored in (D10); the BIN whole number floating point number will be discarded.



API	D	SIN	P	(S) (D)	Binary floating point number SIN operation
130					

	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)

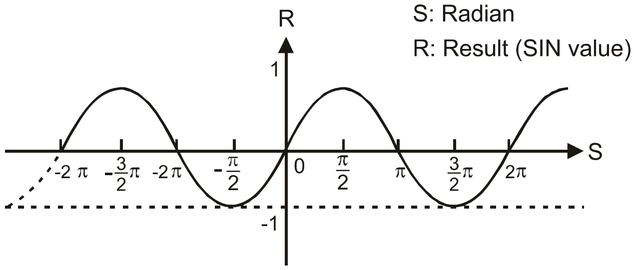
DSIN	Continuous execution type	DSINP	Pulse execution type

Flag signal: none

Explanation

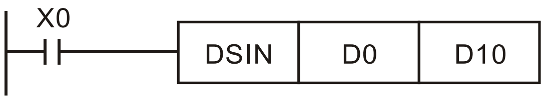
- **S**: the designated source value. **D**: the SIN value result.
- **S** is the designated source in radians.
- The value in radians (RAD) is equal to (angle ×π/180).
- The SIN obtained from the source value designated by **S** is stored in **D**.

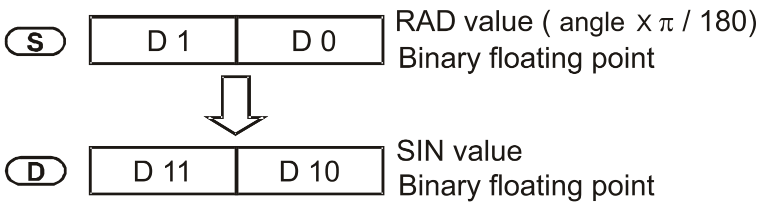
The following figure displays the relationship between the arc and SIN results:



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)

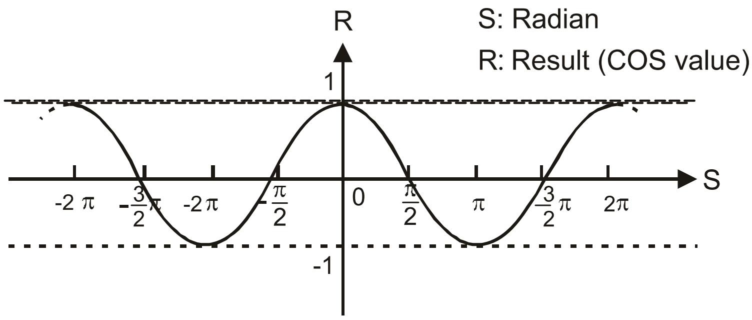
DCOS	Continuous execution type	DCOSP	Pulse execution type

Flag signal: none

Explanation

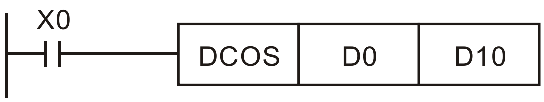
- **S**: the designated source value. **D**: the COS value result.
- The source designated by S can be given as radians or an angle; this is decided by flag M1018.
- When M1018=Off, the operation is in radians mode, where the radians (RAD) value is equal to (angle ×π/180).
- When M1018=On, the operation 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**.

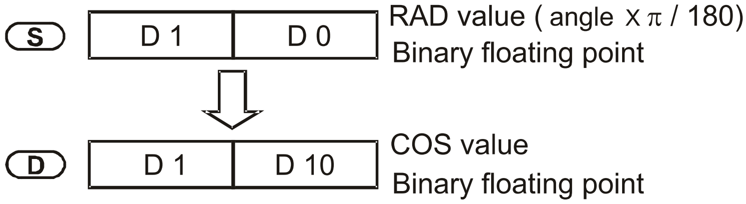
The following figure displays the relationship between the arc and SIN results:



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)

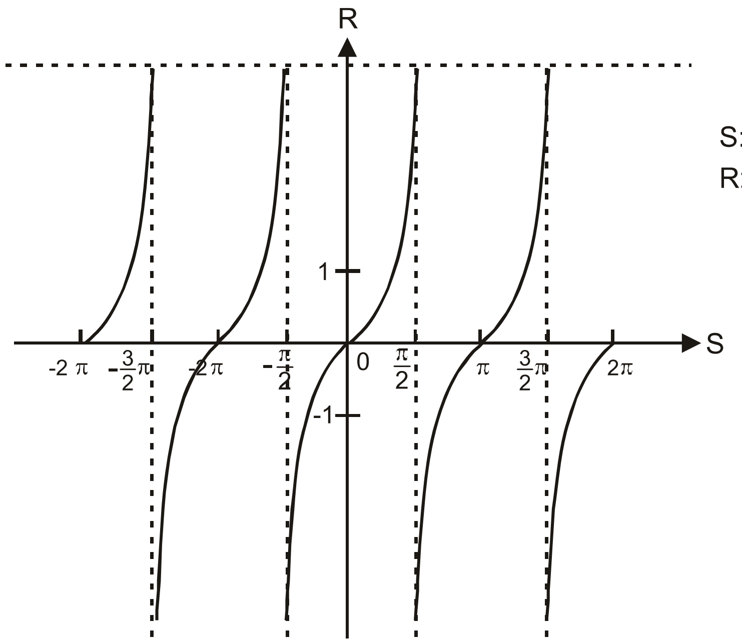
DTAN	Continuous execution type	DTANP	Pulse execution type

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**.

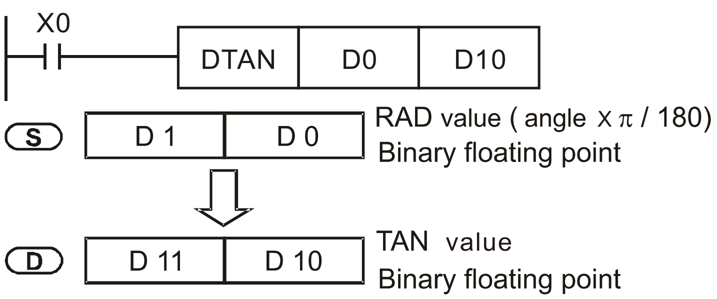
The following figure displays the relationship between the arc and TAN results:



S: Radian
R: Result (TAN value)

Example

- When X0=On, the TAN value of the designated binary floating point number (D1, D0) in radians (RAD) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API		Mnemonic		Operands	Function
133	D	ASIN	P	S D	Binary floating point number ASIN operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

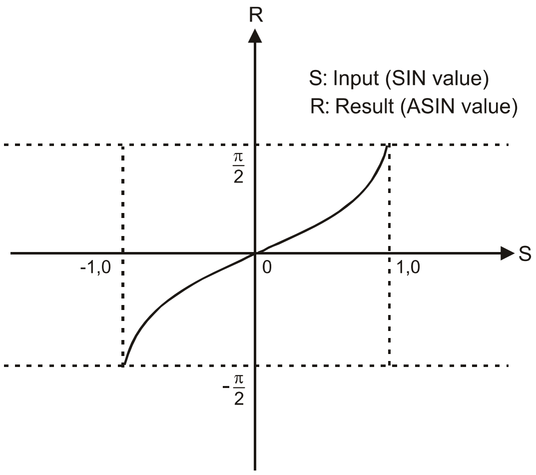
DASIN	Continuous execution type	DASINP	Pulse execution type

Flag signal: none

Explanation

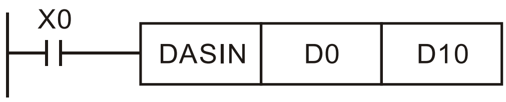
- **S**: the designated source (binary floating point number). **D**: the ASIN value result.
- ASIN value $=\sin^{-1}$

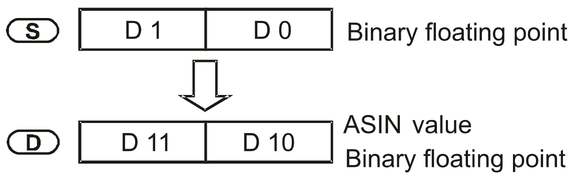
The figure below shows the relationship between input data and result:



Example

- When X0=On, the ASIN value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.





API 134	D	ACOS	P	S D	Binary floating point number ACOS operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command			
—	—	—	—

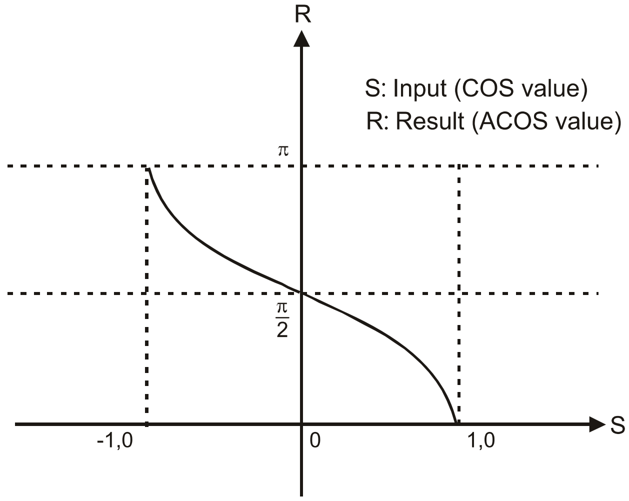
32-bit command (9 STEP)			
DACOS	Continuous execution type	DACOS P	Pulse execution type

Flag signal: none

Explanation

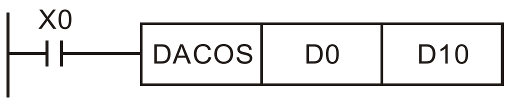
- **S**: the designated source (binary floating point number). **D**: the ACOS value result.
- ACOS value $=\cos^{-1}$

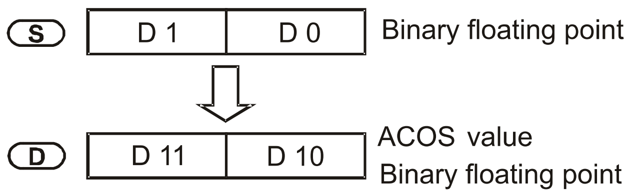
The figure below shows the relationship between input data and result:



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)

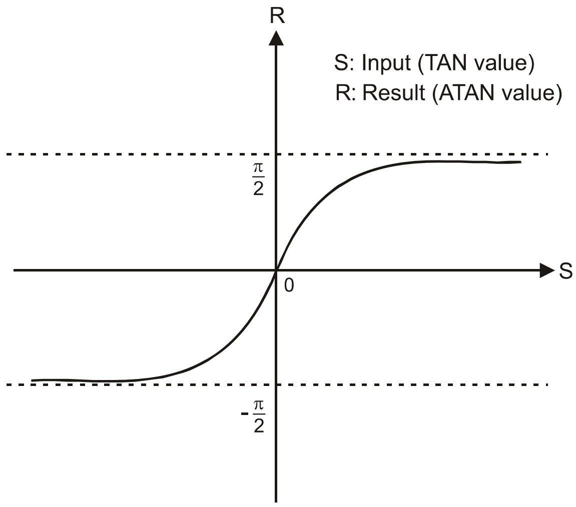
DATAN	Continuous execution type	DATANP	Pulse execution type

Flag signal: none

Explanation

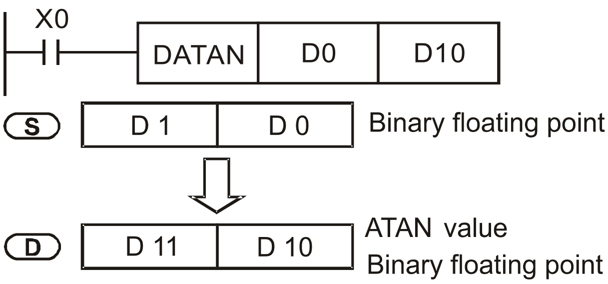
- **S**: the designated source (binary floating point number). **D**: the ATAN value result.
- ATAN value $=\tan^{-1}$

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								16-bit command
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	— — — —
S				*	*						*	
D											*	32-bit command (9 STEP)

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

32-bit command (9 STEP)			
DSINH	Continuous execution type	DSINHP	Pulse execution type

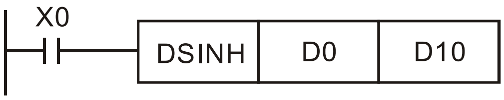
Flag signal: none

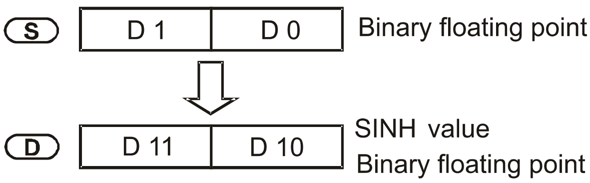
Explanation

- **S**: the designated source (binary floating point number). **D**: the SINH value result.
- SINH value $=(e^{s}-e^{-s})/2$

Example

- When X0=On, the SINH value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.





API 137	D	COSH	P	(S) (D)	Binary floating point number COSH operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

DCOSH	Continuous execution type	DCOSHP	Pulse execution type

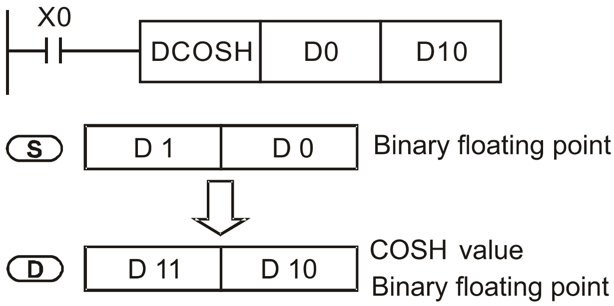
Flag signal: none

Explanation

- **S**: the designated source (binary floating point number). **D**: the COSH value result.
- COSH value $=(e^{s}+e^{-s})/2$

Example

- When X0=On, the COSH value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API					
138	D	TANH	P	S D	Binary floating point number TANH operation

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S				*	*						*
D											*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

—	—	—	—

32-bit command (9 STEP)

DTANH	Continuous execution type	DTANHP	Pulse execution type

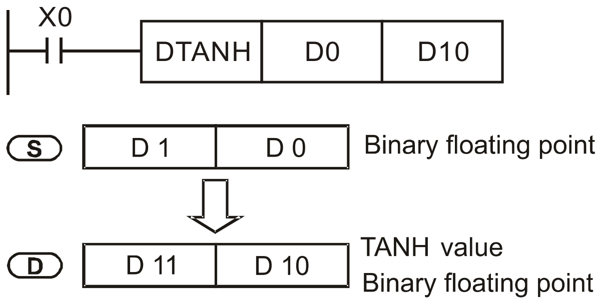
Flag signal: none

Explanation

- **S**: the designated source (binary floating point number). **D**: the TANH value result.
- TANH value $=(e^{s}-e^{-s})/(e^{s}+e^{-s})$

Example

- When X0=On, the TANH value obtained from the designated binary floating point number (D1, D0) will be stored in (D11, D10), with the content consisting of a binary floating point number.



API 147	D	SWAP	P	S	Exchange the up/down 8 bits

	Bit device			Word device						
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S						*	*	*	*	*	*

Notes on operand usage: none

16-bit command (3 STEP)
SWAP Continuous execution type SWAPP Pulse execution type

32-bit command (5 STEP)
DSWAP Continuous execution type DSWAPP Pulse execution type

Flag signal: none

Explanation

- S: The device that going to exchange its up/down 8 bits.
- When using 16-bit command, the upper 8-bit and lower 8-bit exchange.
- When using 32-bit command, the contents of upper 8-bit and lower 8-bit of the 2 registers exchange.
- This command usually uses pulse execution type (SWAPP, DSWAPP)

API				
150		MODRW P	S1 S2 S3 S n	MODBUS data read/write

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*
S											*
n				*	*						*

16-bit command (5 STEP)

MODRW	Continuous execution type	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 Pr.09-31 = -12) before using this command, and the corresponding communications speed and format must also be set (set Pr.09-01 and Pr.09-04). S2: communications function code. Currently only supports the following function code; the remaining function code cannot be executed.

Function	Description
H 02	Input read
H 03	Read word
H 06	Write single word
H 0F	Write multiple coils
H 10	Write single word

- After executing this command, M1077, M1078 and M1079 will be immediately changed to 0.
- As an example, when MP300 must control another converter and PLC, if the converter has a station address of 10 and the PLC has a station address of 20, see the following example:

Control slave device converter

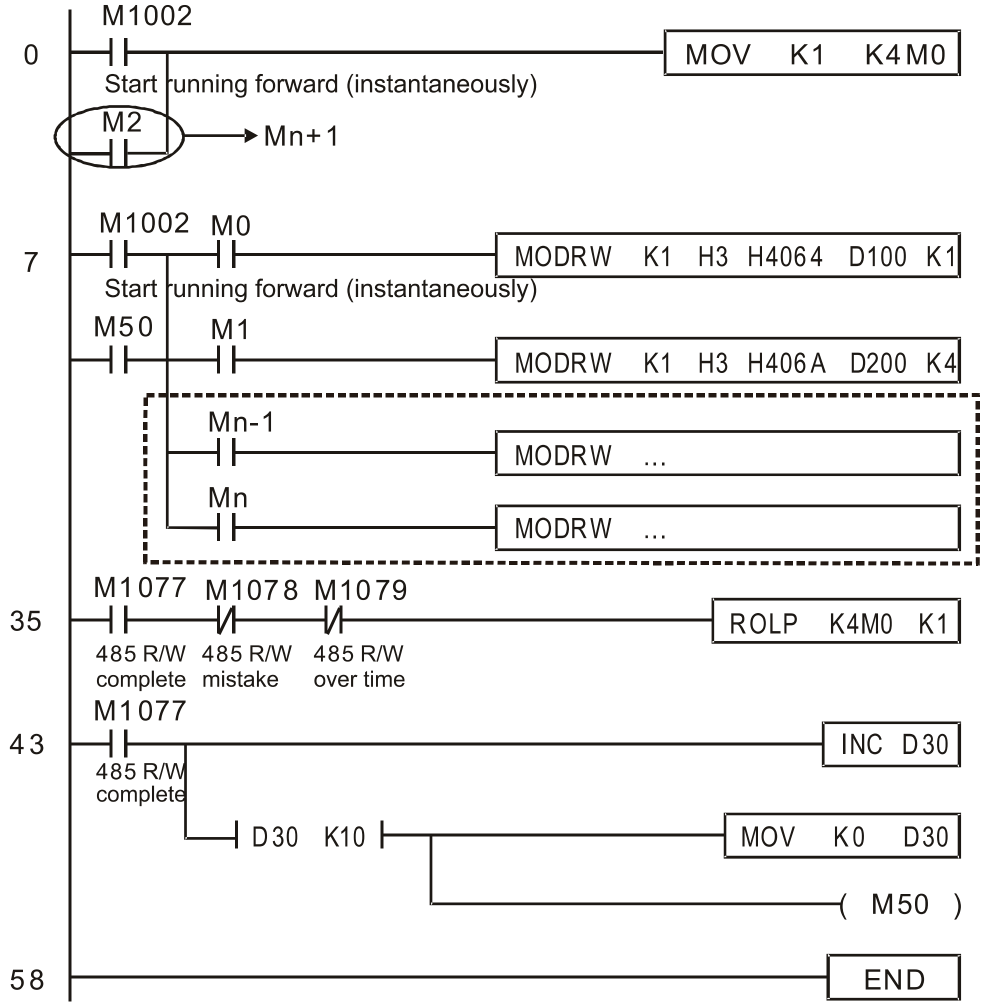
Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length:
1	Reads 4 sets of data comprising the converter slave device parameters Pr.01-00 to Pr.01-03, and saves the read data in D0 to D3	K10	H3	H100	D0	K4
2	Reads 3 sets of data comprising the converter slave device addresses H2100 to H2102, and saves the read data in D5 to D7	K10	H3	H2100	D5	K3
3	Writes 3 sets of data comprising the converter slave device parameters Pr.05-00 to Pr.05-03, and writes the values as D10 to D12	K10	H10	H500	D10	K3
4	Writes 2 sets of data comprising the converter slave device addresses H2000 to H2001, and writes the values as D15 to D16	K10	H10	H2000	D15	K2

PLC controlling slave device

Serial No.	Example	MODRW command				
		S1	S2	S3	S4	n
		Node ID	Function code	Address	Register	Length:
1	Reads 4 sets of data comprising the PLC slave device's X0 to X3 state, and saves the read data in bits 0 to 3 of D0	K20	H2	H400	D0	K4
2	Reads 4 sets of data comprising the PLC slave device's Y0 to Y3 state, and saves the read data in bits 0 to 3 of D1	K20	H2	H500	D1	K4
3	Reads 4 sets of data comprising the PLC slave device's M0 to M3 state, and saves the read data in bits 0 to 3 of D2	K20	H2	H800	D2	K4
4	Reads 4 sets of data comprising the PLC slave device's T0 to T3 state, and saves the read data in bits 0 to 3 of D3	K20	H2	H600	D3	K4
5	Reads 4 sets of data comprising the PLC slave device's C0 to C3 state, and saves the read data in bits 0 to 3 of D4	K20	H2	HE00	D4	K4
6	Reads 4 sets of data comprising the PLC slave device's T0 to T3 count value, and saves the read data of D10 to D13	K20	H3	H600	D10	K4
7	Reads 4 sets of data comprising the PLC slave device's C0 to C3 count value, and saves the read data of D20 to D23	K20	H3	HE00	D20	K4
8	Reads 4 sets of data comprising the PLC slave device's D0 to D3 count value, and saves the read data of D30 to D33	K20	H3	H1000	D30	K4
9	Writes 4 sets of the PLC slave device's Y0 to Y3 state, and writes the values as bits 0 to 3 of D1	K20	HF	H500	D1	K4
10	Writes 4 sets of the PLC slave device's M0 to M3 state, and writes the values as bits 0 to 3 of D2	K20	HF	H800	D2	K4
11	Writes 4 sets of the PLC slave device's T0 to T3 state, and writes the values as bits 0 to 3 of D3	K20	HF	H600	D3	K4
12	Writes 4 sets of the PLC slave device's C0 to C3 state, and writes the values as bits 0 to 3 of D4	K20	HF	HE00	D4	K4
13	Writes 4 sets of the PLC slave device's T0 to T3 state, and writes the values of D10 to D13	K20	H10	H600	D10	K4
14	Writes 4 sets of the PLC slave device's C0 to C3 state, and writes the values of D20 to D23	K20	H10	HE00	D20	K4
15	Writes 4 sets of the PLC slave device's D0 to D3 state, and writes the values of D30 to D33	K20	H10	H1000	D30	K4

Example

- Will trigger M0 On when the PLC begins to operate, and sends instruction to execute one MODRW command.
- After receiving the slave device's response, if the command is correct, it will execute one ROL command, which will cause M1 to be On.
- After receiving the slave device's response, will trigger M50 = 1 after a delay of 10 PLC scanning cycles, and then execute one MODRW command.
- After again receiving the slave device's response, if the command is correct, it will execute one ROL command, and M2 will change to On at this time (and M2 can be defined as a repeat of M); K4M0 will change to K1, and only M0 will remain 1. Transmission can proceed in a continuous cycle. If you wish to add a command, merely add the desired command in the empty frame, and change repeat M to Mn+1.



API		TCMP	P	S1 S2 S3 S D	Comparison of calendar data
160					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*
S3				*	*	*	*	*	*	*	*
S									*	*	*
D		*	*								

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (11 STEP)

TCMP	Continuous execution type	TCMPP	Pulse execution type

32-bit command

—	—	—	—

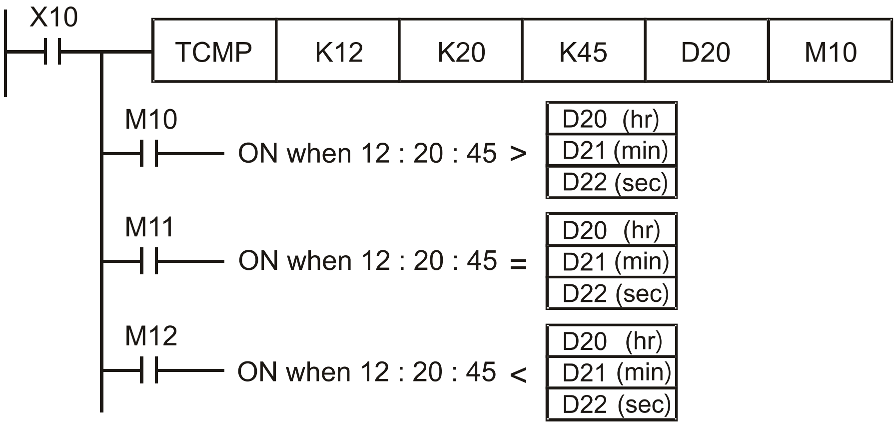
Flag signal: none

Explanation

- **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	P	S1 S2 S D	Comparison of calendar data
161					

	Bit device			Word device								16-bit command (9 STEP)			
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D	TZCP	Continuous execution type	TZCPP	Pulse execution type
S1									*	*	*				
S2									*	*	*	32-bit command			
S									*	*	*				
D		*	*									—	—	—	—

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

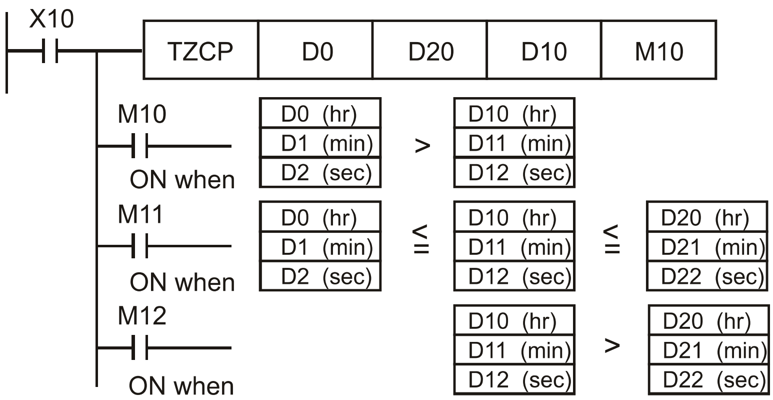
Flag signal: none

Explanation

- $\mathbf{S_1}$: Sets the lower limit of the comparison time. $\mathbf{S_2}$: 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 $\mathbf{S_1}$ and the upper limit of the comparison time set as $\mathbf{S_2}$, and expresses the results of comparison in **D**.
- $\mathbf{S_1}$ 、$\mathbf{S_1}$ +1 、$\mathbf{S_1}$ +2: Sets the hours, minutes, and seconds of the lower limit of the comparison time.
- $\mathbf{S_2}$ 、$\mathbf{S_2}$ +1 、$\mathbf{S_2}$ +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 $\mathbf{S_1}$, $\mathbf{S_2}$, 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 $\mathbf{S_1}$ and **S** is less than the upper limit value $\mathbf{S_2}$, **D** will be On. When the current time **S** is greater than the lower limit value $\mathbf{S_1}$ and **S** is greater than the upper limit value $\mathbf{S_2}$, **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

- $\mathbf{S_1}$: time addend. $\mathbf{S_2}$: time augend. **D**: time sum.
- The calendar data in hours, minutes, and seconds designated by $\mathbf{S_2}$ is added to the calendar data in hours, minutes, and seconds designated by $\mathbf{S_1}$, and the result is stored as hours, minutes, and seconds in the register designated by **D**.
- If the value of $\mathbf{S_1}$ or $\mathbf{S_2}$ 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.

X10

TADD	D0	D10	D20

D0	8(hr)	+	D10	6(hr)	→	D20	14(hr)
D1	10(min)		D11	40(min)		D21	50(min)
D2	20(sec)		D12	6(sec)		D22	26(sec)

8 : 10 : 20   6 : 40 : 6   14 : 50 : 26

API				
163		TSUB P	S1 S2 D	Calendar data subtraction

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*
D									*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (7 STEP)

TSUB	Continuous execution type	TSUBP	Pulse execution type

32-bit command

–	–	–	–

- Flag signal: M1020 Zero flag
  M1022 Carry flag
  M1068 Calendar error

Explanation

- **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.

X10

TSUB	D0	D10	D20

		–			→		
D0	20(hr)		D10	14(hr)		D20	5(hr)
D1	20(min)		D11	30(min)		D21	49(min)
D2	5(sec)		D12	8(sec)		D22	57(sec)
20 : 20 : 5			14 : 30 : 8			5 : 49 : 57	

API 166		TRD	P	(D)	Calendar data read

	Bit device			Word device						
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
D									*	*	*

Notes on operand usage:
Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (3 STEP)

TRD	Continuous execution type	TRDP	Pulse execution type

32-bit command

—	—	—	—

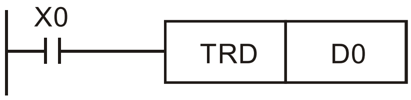
- Flag signal: none

Explanation

- 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

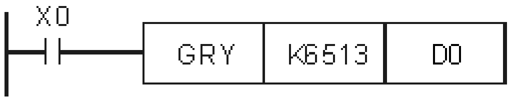
- **S**: source device. **D**: device storing GRAY code.
- Transforms the content value (BIN value) of the device designated by **S** to GRAY code, which is stored in the device designated by **D**.
- The valid range of **S** is as shown below; if this range is exceeded, it will be considered an error, and the command will not execute.

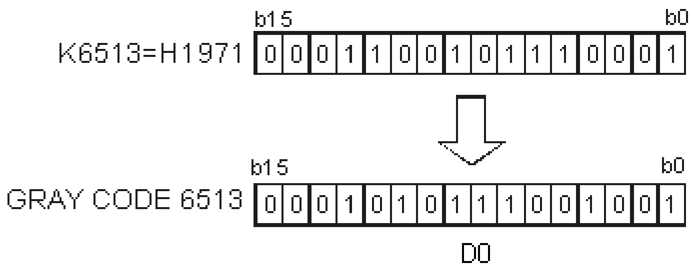
16-bit command: 0–32,767

- 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

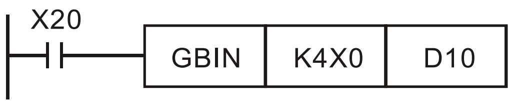
- **S**: source device used to store GRAY code. **D**: device used to store BIN value after transformation.
- The GRAY code corresponding to the value of the device designated by **S** is transformed into a BIN value, which is stored in the device designated by **D**.
- This command will transform the 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.

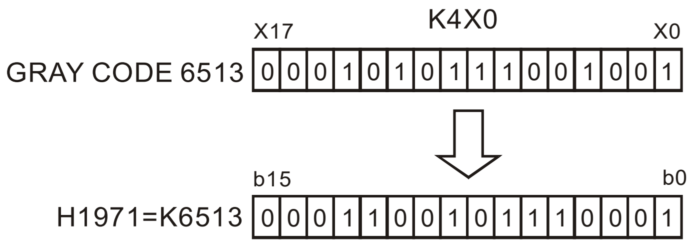
16-bit command: 0–32,767

- 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

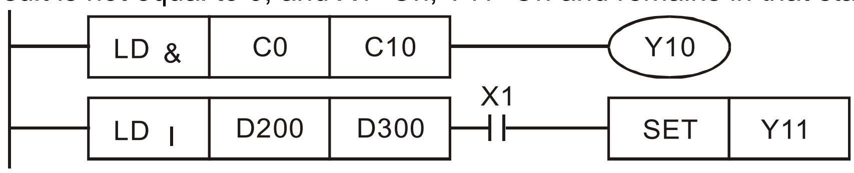
- **S_1**: data source device 1. **S_2**: data source device 2.
- This command performs comparison of the content of **S_1** and **S_2**; when the result of comparison is not 0, this command will be activated, but this command will not be activated when the result of comparison is 0.
- The LD#This command 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

- When the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y10=On.
- When the content of D200 and D300 is subjected to the logical OR operation, and the result is not equal to 0, and X1=On, Y11=On and remains in that state.



API 218–220	D	AND#		(S1) (S2)	Contact form logical operation 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

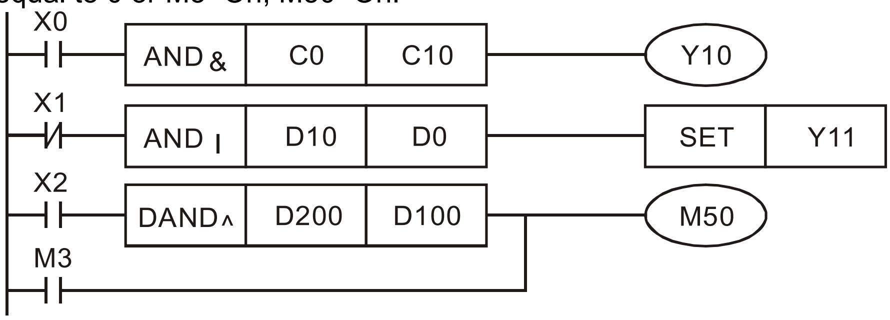
- **S1**: data source device 1. **S2**: data source device 2.
- This command performs comparison of the content of **S1** and **S2**; when the result of comparison is not 0, this command will be activated, but this command will not be activated when the result of comparison is 0.
- The AND# command is 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&	**S1**	&	**S2**	≠0	**S1**	&	**S2**	=0
219	AND|	DAND|	**S1**	|	**S2**	≠0	**S1**	|	**S2**	=0
220	AND^	DAND^	**S1**	^	**S2**	≠0	**S1**	^	**S2**	=0

- &: logical AND operation.
- |: logical OR operation.
- ^: logical XOR operation.

Example

- When X0=On and the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y10=On.
- When X1=Off and D10 and D0 is subjected to the logical OR operation, and the result is not equal to 0, Y11=On and remains in that state.
- When X2 =On and the content of the 32-bit register D200 (D201) and 32-bit register D100 (D101) is subjected to the logical XOR operation, and the result is not equal to 0 or M3=On, M50=On.



API	D	OR#		(S1) (S2)	Contact form logical operation OR#
221–223					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ＃：&、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

OR#	Continuous execution type	—	—

32-bit command (9 STEP)

DOR#	Continuous execution type	—	—

Flag signal: none

Explanation

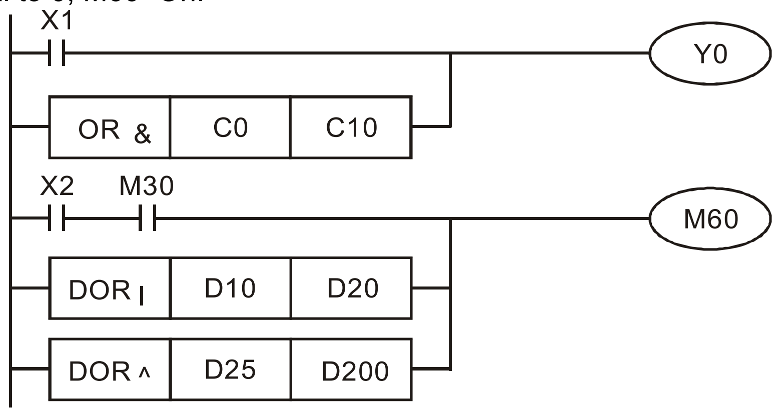
- **S_1**: data source device 1. **S_2**: data source device 2.
- This command performs comparison of the content of **S_1** and **S_2**; when the result of comparison is not 0, this command will be activated, but this command will not be activated when the result of comparison is 0.
- The OR# command is an operation command in series with the contact.

API No.	16-bit commands	32-bit commands	Conditions for activation				Conditions for inactivation			
221	OR&	**D**OR&	**S_1**	&	**S_2**	$\neq 0$	**S_1**	&	**S_2**	$=0$
222	OR|	**D**OR|	**S_1**	|	**S_2**	$\neq 0$	**S_1**	|	**S_2**	$=0$
223	OR^	**D**OR^	**S_1**	^	**S_2**	$\neq 0$	**S_1**	^	**S_2**	$=0$

- &: logical AND operation.
- |: logical OR operation.
- ^: logical XOR operation.

Example

- When X1=On or the content of C0 and C10 is subjected to the logical AND operation, and the result is not equal to 0, Y0=On.
- When X2 and M30 are both equal to On, or the content of 32-bit register D10 (D11) and 32-bit register D20 (D21) is subjected to the logical OR operation, and the result is not equal to 0, or the content of the 32-bit counter C235 and the 32-bit register D200 (D201) is subjected to the logical XOR operation, and the result is not equal to 0, M60=On.



API 224–230	D	LD※	S1 S2	Contact form compare LD*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※：=、>、<、<>、≦、≧

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)			
LD※	Continuous execution type	–	–

32-bit command (9 STEP)			
DLD※	Continuous execution type	–	–

Flag signal: none

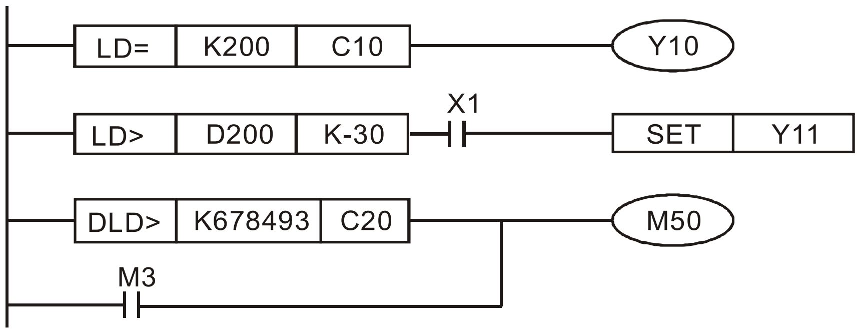
Explanation

- **S_1**: data source device 1. **S_2**: data source device 2.
- This command compares the content of **S_1** and **S_2**. Taking API 224 (LD=) as an example, this command will be activated when the result of comparison is "equal," and will not be activated when the result is "unequal."
- The LD* can be used while directly connected with the busbar

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
224	LD＝	**D**LD＝	$S_1 = S_2$	$S_1 \neq S_2$
225	LD＞	**D**LD＞	$S_1 > S_2$	$S_1 \leqq S_2$
226	LD＜	**D**LD＜	$S_1 < S_2$	$S_1 \geqq S_2$
228	LD＜＞	**D**LD＜＞	$S_1 \neq S_2$	$S_1 = S_2$
229	LD＜＝	**D**LD＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
230	LD＞＝	**D**LD＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When the content of C10 is equal to K200, Y10=On.
- When the content of D200 is greater than K-30, and X1=On, Y11=On and remains in that state.



API 232–238	D	AND※	(S1) (S2)	Contact form compare AND*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*	*	*	*	*	*	*
S2				*	*	*	*	*	*	*	*

Notes on operand usage: ※ : = 、> 、< 、<> 、≦ 、≧

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command (5 STEP)

AND※	Continuous execution type	–	–

32-bit command (9 STEP)

DAND※	Continuous execution type	–	–

Flag signal: none

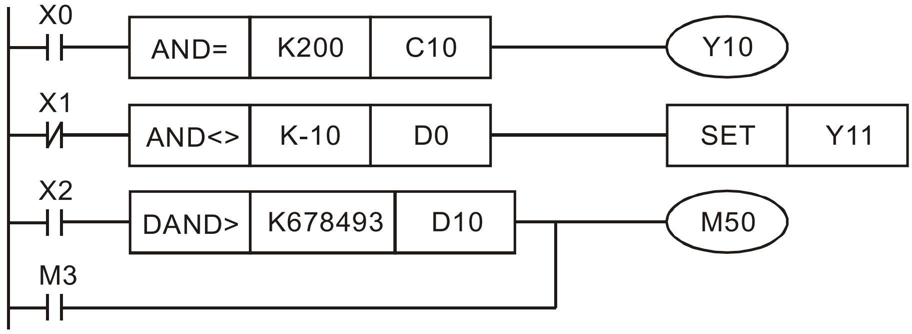
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking API 232 (AND=) as an example, when the result of comparison is equal, this command will be activated; when the result of comparison is unequal, this command will not be activated.
- The AND* command is a comparison command in series with a contact.

API No.	16-bit commands	32-bit commands	Conditions for activation	Conditions for inactivation
232	AND=	DAND=	$S_1 = S_2$	$S_1 \neq S_2$
233	AND>	DAND>	$S_1 > S_2$	$S_1 \leqq S_2$
234	AND<	DAND<	$S_1 < S_2$	$S_1 \geqq S_2$
236	AND<>	DAND<>	$S_1 \neq S_2$	$S_1 = S_2$
237	AND<=	DAND<=	$S_1 \leqq S_2$	$S_1 > S_2$
238	AND>=	DAND>=	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When X0=On and the current value of C10 is also equal to K200, Y10=On.
- When X1=Off and the content of register D0 is not equal to K-10, Y11=On and remains in that state.
- When X2 =On and the content of the 32-bit register D0 (D11) is less than 678,493, or M3=On, M50=On.



API 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

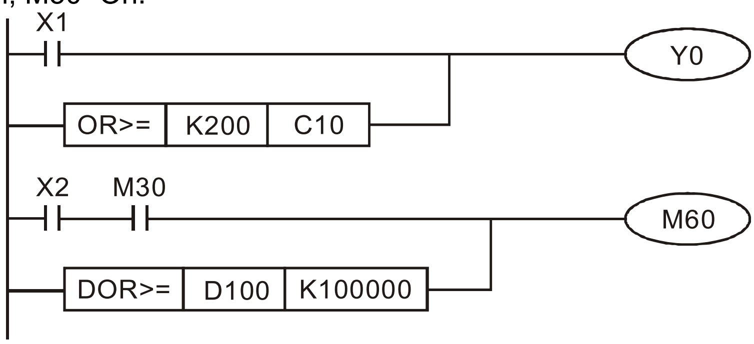
Explanation

- 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

- When X0=On and the current value of C10 is also equal to K200, Y10=On.
- When X1=Off and the content of register D0 is not equal to K-10, Y11=On and remains in that state.
- When X2 =On and the content of the 32-bit register D0 (D11) is less than 678,493, or M3=On, M50=On.



API				
275–280	FLD※		(S1) (S2)	Floating point number contact form compare LD*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ＃：&、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

FLD※	Continuous execution type	–	–

Flag signal: none

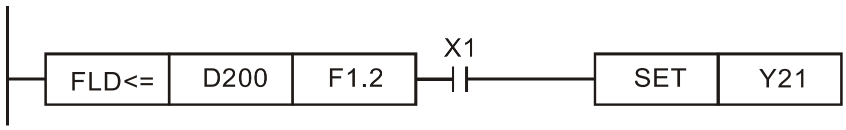
Explanation

- $\mathbf{S_1}$: 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							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ＃：&、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

FAND※	Continuous execution type	–	–

Flag signal: none

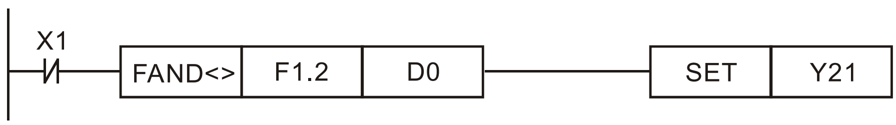
Explanation

- **S_1**: data source device 1. **S_2**: data source device 2.
- This command compares the content of **S_1** and **S_2**. Taking "FAND=" as an example, if the result of comparison is "equal," this command will be activated; but it will not be activated when the result is "unequal."
- The FAND* command can directly input floating point numerical values (for instance: F1.2) to the **S_1**, **S_2** operands, or store floating-point numbers in register D for use in operations.
- This command can be used while directly connected with the busbar

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
281	FAND=	**$S_1 = S_2$**	**$S_1 \neq S_2$**
282	FAND＞	**$S_1 > S_2$**	**$S_1 \leqq S_2$**
283	FAND＜	**$S_1 < S_2$**	**$S_1 \geqq S_2$**
284	FAND＜＞	**$S_1 \neq S_2$**	**$S_1 = S_2$**
285	FAND＜＝	**$S_1 \leqq S_2$**	**$S_1 > S_2$**
286	FAND＞＝	**$S_1 \geqq S_2$**	**$S_1 < S_2$**

Example

- When X1=Off, and the floating point number in register D100 (D101) is not equal to F1.2, Y21=On and remains in that state.



API 287–292	FOR※	(S1) (S2)	Floating point number contact form compare OR*

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1									*	*	*
S2									*	*	*

Notes on operand usage: ＃：&、|、^

Please refer to the function specifications table for each device in series for the scope of device usage

16-bit command

–	–	–	–

32-bit command (9 STEP)

FOR※	Continuous execution type	–	–

Flag signal: none

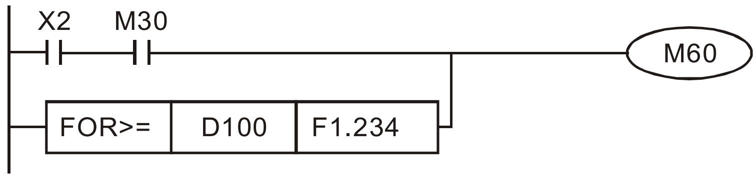
Explanation

- S_1: data source device 1. S_2: data source device 2.
- This command compares the content of S_1 and S_2. Taking "FOR=" as an example, if the result of comparison is "equal," this command will be activated; but it will not be activated when the result is "unequal."
- The FOR* command can directly input floating point numerical values (for instance: F1.2) to the S_1, S_2 operands, or store floating-point numbers in register D for use in operations.
- This command can be used while directly connected with the busbar

API No.	32-bit commands	Conditions for activation	Conditions for inactivation
287	FOR＝	$S_1 = S_2$	$S_1 \neq S_2$
288	FOR＞	$S_1 > S_2$	$S_1 \leqq S_2$
289	FOR＜	$S_1 < S_2$	$S_1 \geqq S_2$
290	FOR＜＞	$S_1 \neq S_2$	$S_1 = S_2$
291	FOR＜＝	$S_1 \leqq S_2$	$S_1 > S_2$
292	FOR＞＝	$S_1 \geqq S_2$	$S_1 < S_2$

Example

- When X2 and M30 are both equal to "On," or the floating point number in register D100 (D101) is greater than or equal to F1.234, M60=On.



15-6-5 Detailed explanation of drive special applications commands

API				
139	RPR	P	S1 S2	Read servo parameter

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2											*

Notes on operand usage: none

16-bit command (5 STEP)			
RPR	Continuous execution type	RPRP	Pulse execution type

32-bit command			
—	—	—	—

Flag signal: none

Explanation
- S1: Parameter address of data to be read. S2: Register where data to be read is stored.

API				
140	WPR	P	S1 S2	Write servo parameter

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*

Notes on operand usage: none

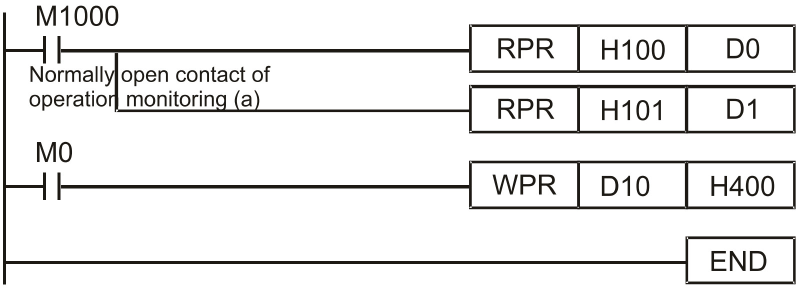
16-bit command (5 STEP)			
WPR	Continuous execution type	WPRP	Pulse execution type

32-bit command			
—	—	—	—

Flag signal: none

Explanation
- S1: Data to write to specified page. S2: Parameter address of data to be written.

Example
- When the data in the MP300 drive's parameter H01.00 is read and written to D0, data from H01.01 will be read and written to D1.
- When M0=On, the content of D10 will be written to the MP300 drive parameter 04.00 (first speed of multiple speed levels).
- When the parameter has been written successfully, M1017=On.
- The MP300's WPR command does not support writing to the 20XX address, but the RPR command supports reading of 21XX, 22XX.



Recommendation
Take care when using the WPR command. When writing parameters, because most parameters are recorded as they are written, these parameters may only be revised 109 times; a memory write error may occur if parameters are written more than 10^9 times.

Because the following commonly-used parameters have special processing, there are **no** restrictions on the number of times they may be written.

Pr. 00-10: Control method

Pr. 00-11: Speed mode selection

Pr. 00-12: P2P position mode

Pr. 00-13: Torque mode select

Pr. 00-27: User-defined value

Pr. 01-12: Acceleration time 1

Pr. 01-13: Deceleration time 1

Pr. 01-14: Acceleration time 2

Pr. 01-15: Deceleration time 2

Pr. 01-16: Acceleration time 3

Pr. 01-17: Deceleration time 3

Pr. 01-18: Acceleration time 4

Pr. 01-19: Deceleration time 4

Pr. 02-12: Select MI Conversion Time mode:

Pr. 02-18: Select MO Conversion Time mode:

Pr. 04-50–Pr. 04-69: PLC register parameter 0 - 19

Pr. 08-04: Upper limit of integral

Pr. 08-05: PID output upper limit

Pr. 10-17: Electronic gear A

Pr. 10-18: Electronic gear B

Pr. 11-34: Torque command

Pr. 11-43: P2P highest frequency

Pr. 11-44: Position control acceleration time

Pr. 11-45: 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				
141	FPID	P	S1 S2 S3 S4	Drive PID control mode

	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)

FPID	Continuous execution type	FPIDP	Pulse execution type

32-bit command

—	—	—	—

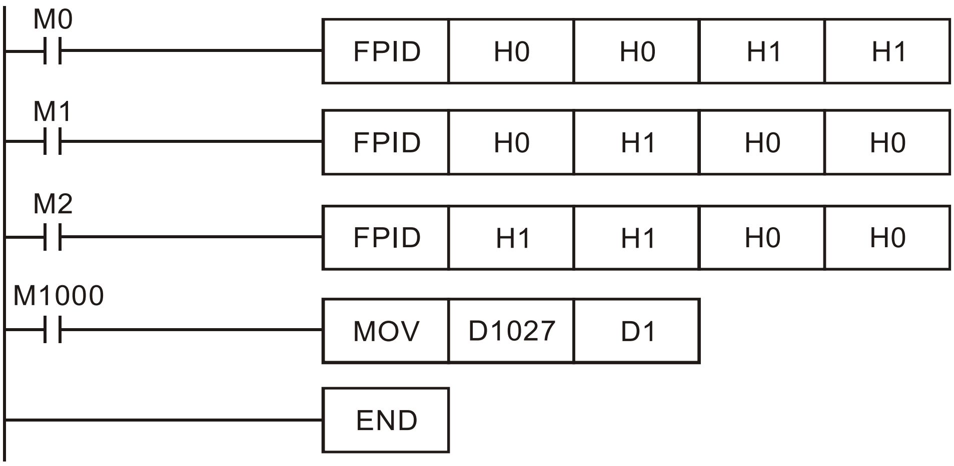
Flag signal: none

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 drive's feedback control of PID Pr. 08-00 PID reference target value input terminal selection, Pr. 08-01 proposal gain P, Pr. 08-02 integral time I, and Pr. 08-03 differential time D.

Example

- When M0=On, the set PID reference target value input terminal selection is 0 (no PID function), the PID function proportional gain P is 0, the PID function integral time I is 1 (units: 0.01 sec.), and the PID function differential time D is 1 (units: 0.01 sec.).
- When M1=On, the set PID reference target value input terminal selection is 0 (no PID function), the PID function proportional gain P is 1 (units: 0.01), the PID function integral time I is 0, and the PID function differential time D is 0.
- When M2=On, the set PID reference target value input terminal selection is 1 (target frequency input is controlled from the digital keypad), the PID function proportional gain P is 1 (units: 0.01), the PID function integral time I is 0, and the PID function differential time D is 0.
- D1027: Frequency command after PID operation.



API		FREQ	P	(S1) (S2) (S3)	Drive speed control mode
142					

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*
S3				*	*						*

Notes on operand usage: none

16-bit command (7 STEP)			
FREQ	Continuous execution type	FREQP	Pulse execution type
32-bit command			
—	—	—	—

Flag signal: M1015

Explanation

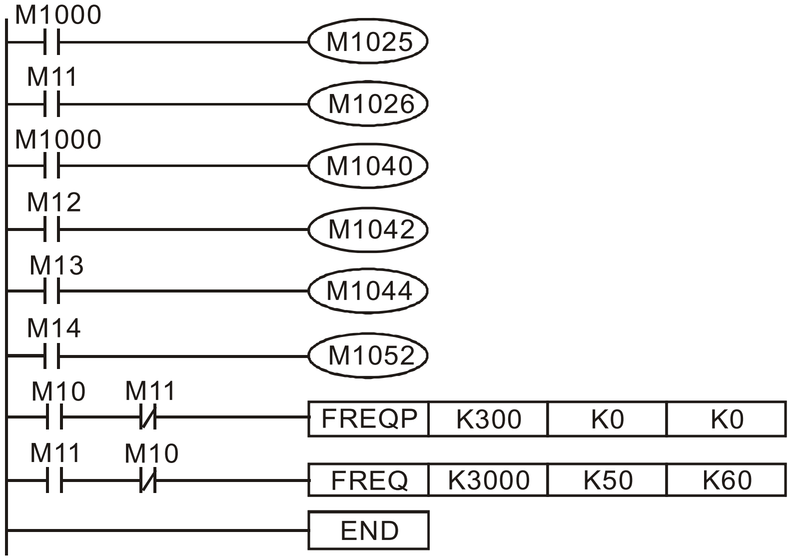
- (S1): Frequency command. (S2): Acceleration time. (S3): Deceleration time
- S2,S3: In acceleration/deceleration time settings, the number of decimal places is determined by the definitions of Pr. 01-45.

Example
When Pr. 01-45=0: units of 0.01 sec.
The setting of 50 for S2 (acceleration time) in the ladder diagram below implies 0.5 sec, and the S3 (deceleration time) setting of 60 implies 0.6 sec

- The FREQ command can control drive frequency commands, and acceleration and deceleration time; it also uses special register control actions, such as:
  M1025: Control drive RUN(On) / STOP(Off) (RUN requires Servo On (M1040 On) to be effective)
  M1026: Control drive operating direction FWD(Off) / REV(On)
  M1040: Control Servo On / Servo Off.
  M1042: Trigger quick stop (ON) / does not trigger quick stop (Off).
  M1044: Pause (On) / release pause (Off)
  M1052: Lock frequency (On) / release lock frequency (Off)

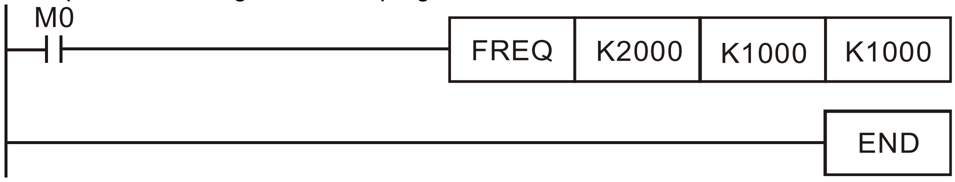
Example

- M1025: Drive RUN(On) / STOP(Off), M1026: drive operating direction FWD(Off) / REV(On). M1015: frequency reached.
- When M10=On, sets the drive frequency command K300 (3.00Hz), with an acceleration / deceleration time of 0.
  When M11=On, sets the drive frequency command K3000 (30.00Hz), with an acceleration time of 50 (0.5 sec.) and deceleration time of 60 (0.6 sec.). (When Pr. 01-45=0)
- When M11=Off, the drive frequency command will now change to 0



- Pr. 09-33 are defined on the basis of whether reference commands have been cleared before PLC operation.
  bit0: Prior to PLC scanning procedures, whether the target frequency has been cleared is 0. (This will be written to the FREQ command when the PLC is On)
  bit1: 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)
  bit2: 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 20.00Hz; but when M0 is set as 0, there will be a different situation.

Case 1: When the Pr.09-33 bit 0 is 0, and M0 is set as 0, the frequency command will remain at 20.00Hz.

Case 2: When the Pr.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 Pr.09-33 bit 0 is 1 prior to PLC scanning procedures, the frequency will first revert to 0.

When the Pr.09-33 bit 0 is 0, the frequency will not revert to 0.

API					
323		**WPRA**	P	S1 S2	Drive parameters write-in

	Bit device			Word device							
	X	Y	M	K	H	KnX	KnY	KnM	T	C	D
S1				*	*						*
S2				*	*						*

Notes on operand usage: none

16-bit command (5 STEP)			
WORA	Continuous execution type	WORAP	Pulse execution type

32-bit command			
-	-	-	-

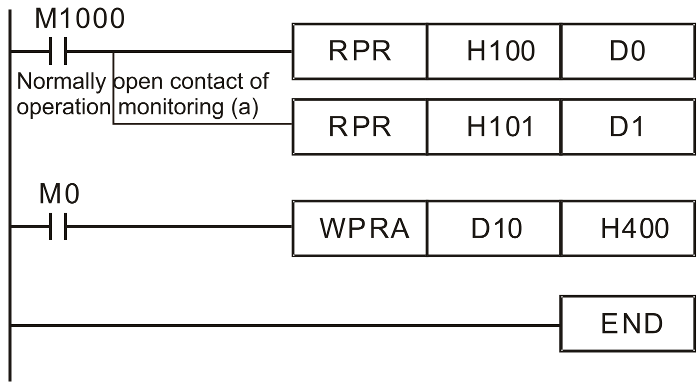
Flag signal: none

Explanation

S1: Data that is going to write in S2: Parameter address of the write-in data

Example

- Read the data of MP300 drive's parameter H01.00 and write into D0, read data of H01.01 and write into D1.
- When M0 is ON, write the content of D10 into MP300 drive's Pr.04-00 (1st step speed frequency).
- When parameter writes-in successfully, M1017 is ON.
- The WPR command does not support the write-in of 20XX address, but the RPR command supports the read-out of 21XX and 22XX.



Recommendation

- When WPRA executes, the data is only written into the RAM area, and will get back to previous record when the power is off.

15-7 Display and Treatment of PLC Related Faults and Codes

Code	ID	Description	Recommended treatment
PLod	50	Downloads PLC programs, the component in codes exceeds the range, for example, T component supports the range T0–T159, if there is T160 in grammar, then displays a PLod fault when downloading the programs.	Check if there are any faults in programs. Download the programs again and check after correcting.
PLSv	51	During the execution of PLC programs, discovers that the assigned address that PLC writes in is unreasonable, then displays a PLSv fault.	Check if there are any faults in programs. Download the programs again and check after correcting.
PLdA	52	During the execution of PLC programs, the external Modbus reads / writes unreasonable components to the internal PLC, then displays a PLdA fault.	Check if the commands send from the upper device are correct.
PLFn	53	Downloads PLC programs, discovers that there is unsupported command, then displays a PLFn fault.	Check if the firmware version of the drive is too old. If so, contact with the local dealer for assistance.
PLor	54	During the execution of PLC programs, discovers that internal programs are abnormal, then displays a PLor fault.	1. Disable PLC function 2. Clear PLC programs (Pr.00-02 sets as 6) 3. Enable PLC function 4. Re-download PLC programs
PLFF	55	During the execution of PLC programs, if PLC executes unreasonable commands, then displays a PLFF fault.	Enables PLC function, it's normal that displays PLFF when there is no program in PLC, just download the programs directly.
PLSn	56	Discovers checksum is wrong during the execution of PLC programs.	1. Disable PLC function 2. Clear PLC programs (Pr.00-02 sets as 6) 3. Enable PLC function 4. Re-download PLC programs
PLEd	57	During the execution of PLC programs, discovers that there is no END command in programs.	1. Disable PLC function 2. Clear PLC programs (Pr.00-02 sets as 6) 3. Enable PLC function 4. Re-download PLC programs
PLCr	58	Continuously use MC command over 9 times	MC command cannot be used continuously over 9 times. Download the programs again and check after correcting.
PLdF	59	The download process of PLC programs is interrupted compulsorily, and causes write in incompletely.	Check if there are any faults in programs. Download the programs again and check after correcting.
PLSF	60	PLC scan timeout	Check if any programs write wrongly. Download the programs again and check after correcting.

*ID: Warning code

15-8 Explanation of Speed Mode Control with PLC

Register table for speed mode:

Control special M

Special M	Description of Function	Attributes
M1025	Drive frequency = set frequency (ON) / drive frequency =0 (OFF)	RW
M1026	Drive 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:

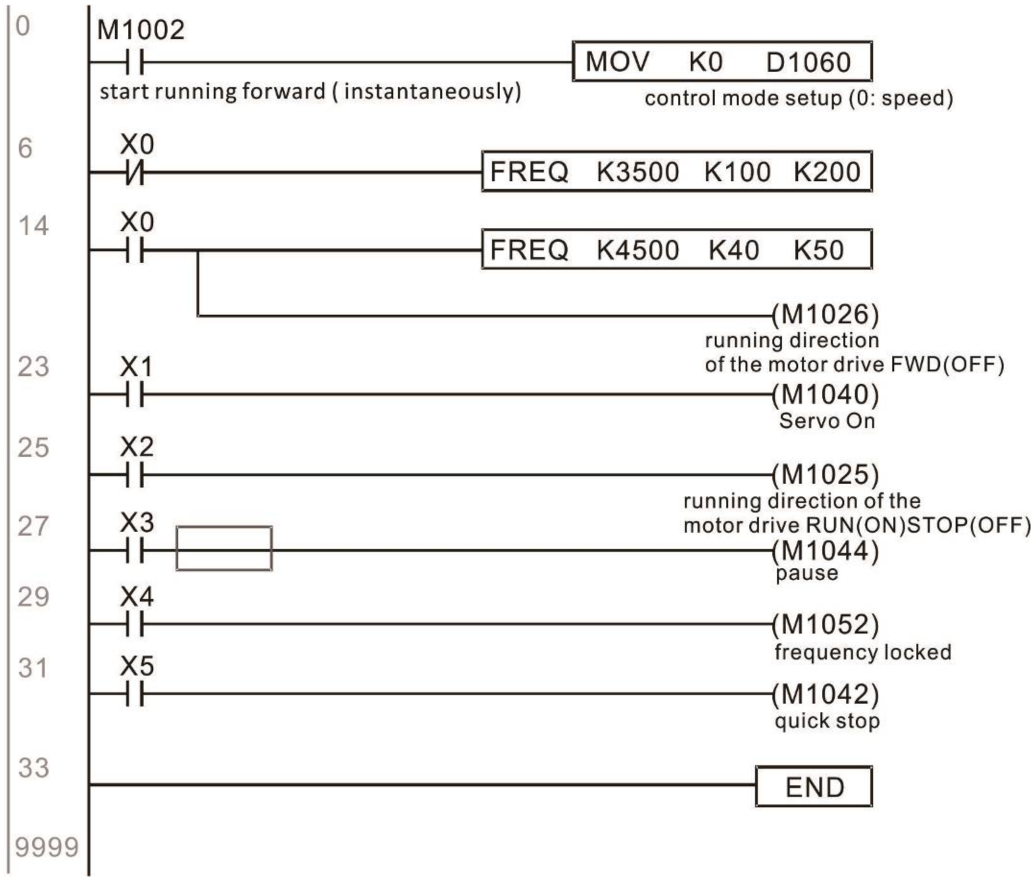
FREQ(P)	S1	S2	S3
	Target speed	The first acceleration time setting	The first deceleration time setting

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 drive will now be excited, but the frequency will be 0.
4. Set M1025 = 1, the drive 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)



15-9 Modbus Remote IO Control Applications (Use MODRW)

The MP300's internal PLC supports 485 read/write functions, which can be realized using the MODRW command. However, the 485 serial port must be defined as available for the PLC's 485 use before writing a program, and the Pr. 09-31 must be set as -12. After completing settings, the standard functions defined by 485 can be used to implement read/write commands at other stations. Communications speed is defined by parameter 09-01, the communications format is defined by Pr. 09-04, and the PLC's current station address is defined by Pr. 09-35. The MP300 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:

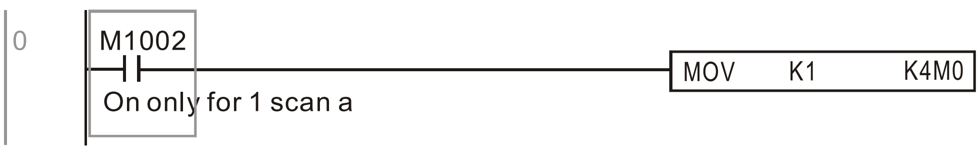
MODRW command					General meaning	Slave device is Delta's PLC meaning	Slave device is Delta's converter meaning
S1	S2	S3	S4	S5			
Node ID	Command	Address	Return: D area	Length			
K3	H01	H500	D0	K18	Read coil (bit)	Read 18 bits of data corresponding to slave station 3 PLC Y0 to Y21. This data is stored 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

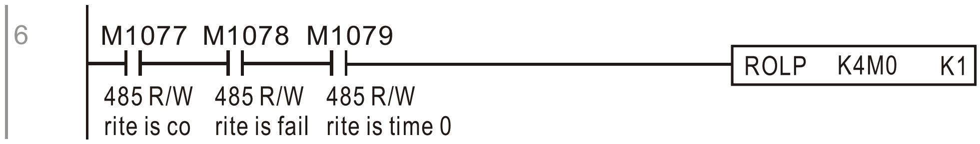
After implementing MODRW, the status will be displayed in M1077 (485 read/write complete), M1078 (485 read/write error), and M1079 (485 read/write time out). M1077 is defined so as to immediately revert to 0 after the MODRW command has been implemented. However, any of three situations—a report of no 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

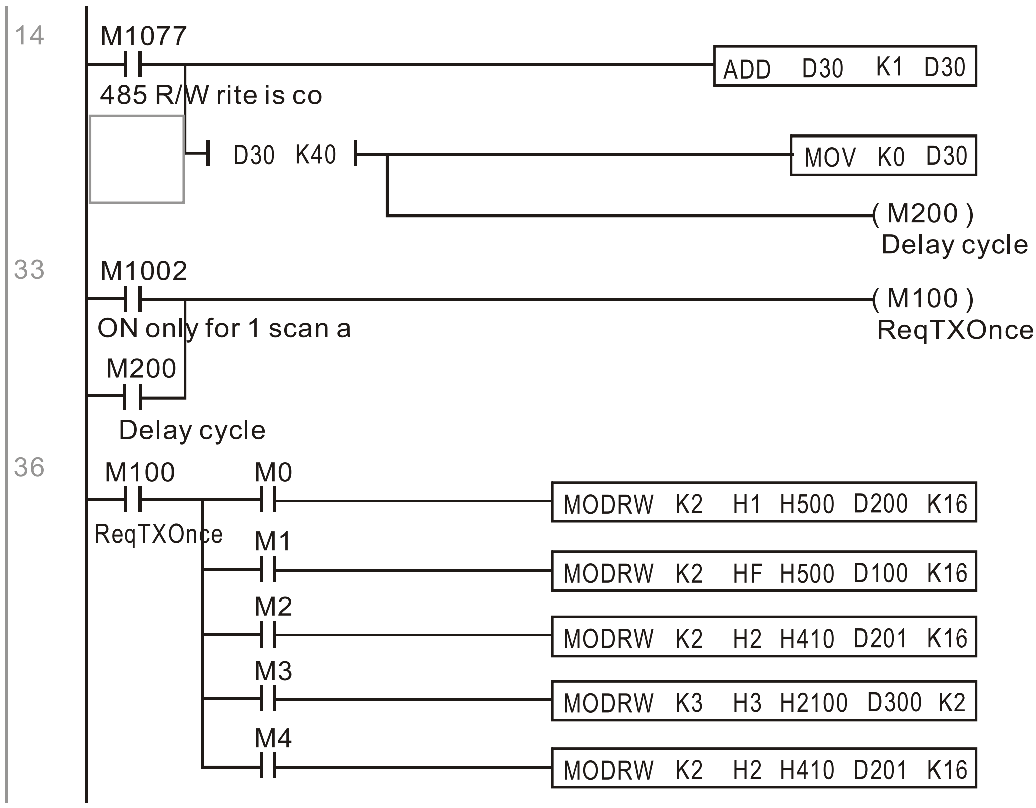
At the start, will cause the transmitted time sequence to switch to the first data unit.



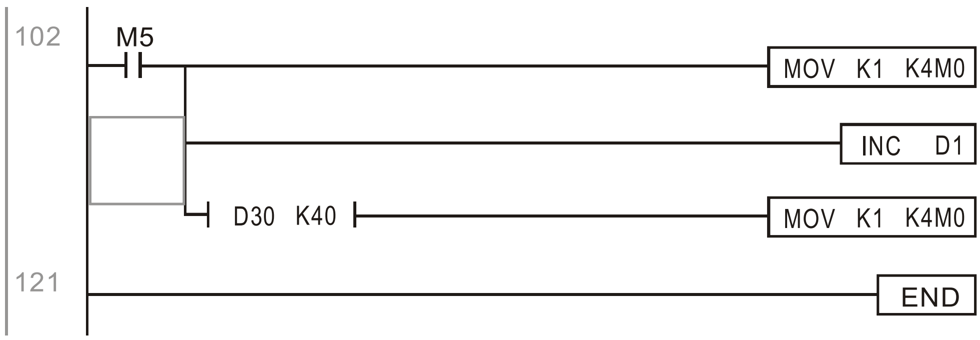
When the reported message indicates no error, it will switch to the next transmitted command



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

MP300：The default PLC station address is set as 2 (09-35)

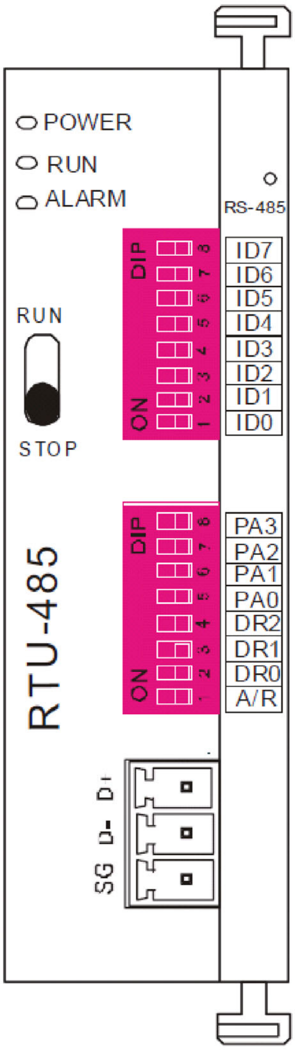
Pr. 09-31=-12 (COM1 is controlled by the PLC), Pr. 09-01=115.2 (The communications speed is 115200)

Pr. 09-04=13 (The format is 8,N,2, RTU)

RTU-485: The station address = 8 (give example)

ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
0	0	0	0	1	0	0	0

PA3	PA2	PA1	PA0	DR2	DR1	DR0	A/R
1	**0**	**0**	**0**	**1**	**1**	**1**	**0**



Communication station #:
ID0~ ID7 are defined as 2^0, 2^1, 2^2...2^6, 2^7

Communication protocol

PA3	PA2	PA1	PA0	A/R	Communication Protocol
OFF	OFF	OFF	OFF	ON	7,E,1, ASCII
OFF	OFF	OFF	ON	ON	7,O,1, ASCII
OFF	OFF	ON	OFF	ON	7,E,2, ASCII
OFF	OFF	ON	ON	ON	7,O,2, ASCII
OFF	ON	OFF	OFF	ON	7,N,2, ASCII
OFF	ON	OFF	ON	ON	8,E,1, ASCII
OFF	ON	ON	OFF	ON	8,O,1, ASCII
OFF	ON	ON	ON	ON	8,N,1, ASCII
ON	OFF	OFF	OFF	ON	8,N,2, ASCII
OFF	ON	OFF	ON	OFF	8,E,1, RTU
OFF	ON	ON	OFF	OFF	8,O,1, RTU
OFF	ON	ON	ON	OFF	8,N,1, RTU
ON	OFF	OFF	OFF	OFF	8,N,2, RTU

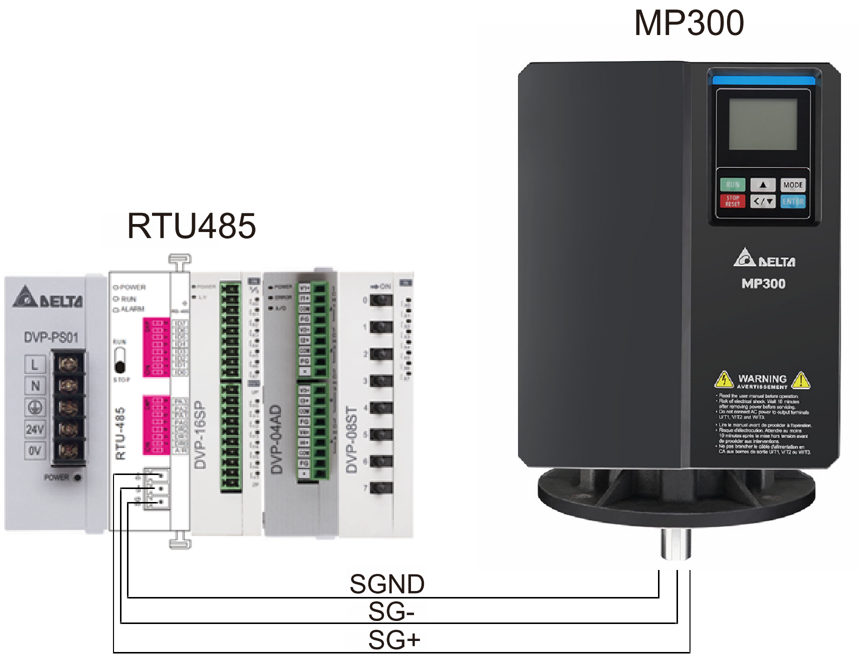
DR2	DR1	DR0	Communicaton Speed
OFF	OFF	OFF	1,200 bps
OFF	OFF	ON	2,400 bps
OFF	ON	OFF	4,800 bps
OFF	ON	ON	9,600 bps
ON	OFF	OFF	19,200 bps
ON	OFF	ON	38,400 bps
ON	ON	OFF	57,600 bps
ON	ON	ON	115,200 bps

Step 2: Install control equipment. We sequentially connect a DVP16-SP (8 IN 8 OUT), DVP-04AD (4 channels AD), DVP02DA (2 channels DA), and DVP-08ST (8 switches) to the RTU-485.

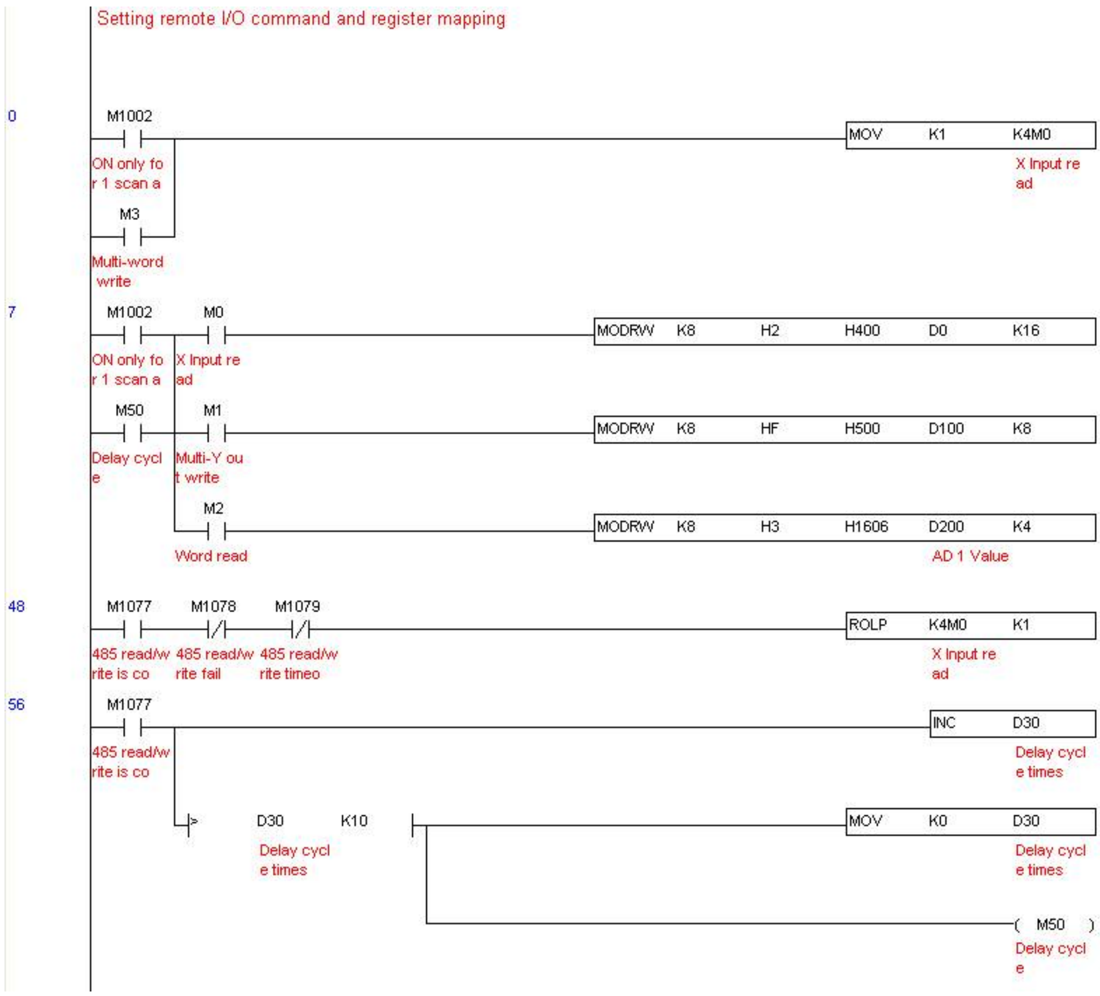
The following corresponding locations can be obtained from the RTU-485's configuration definitions:

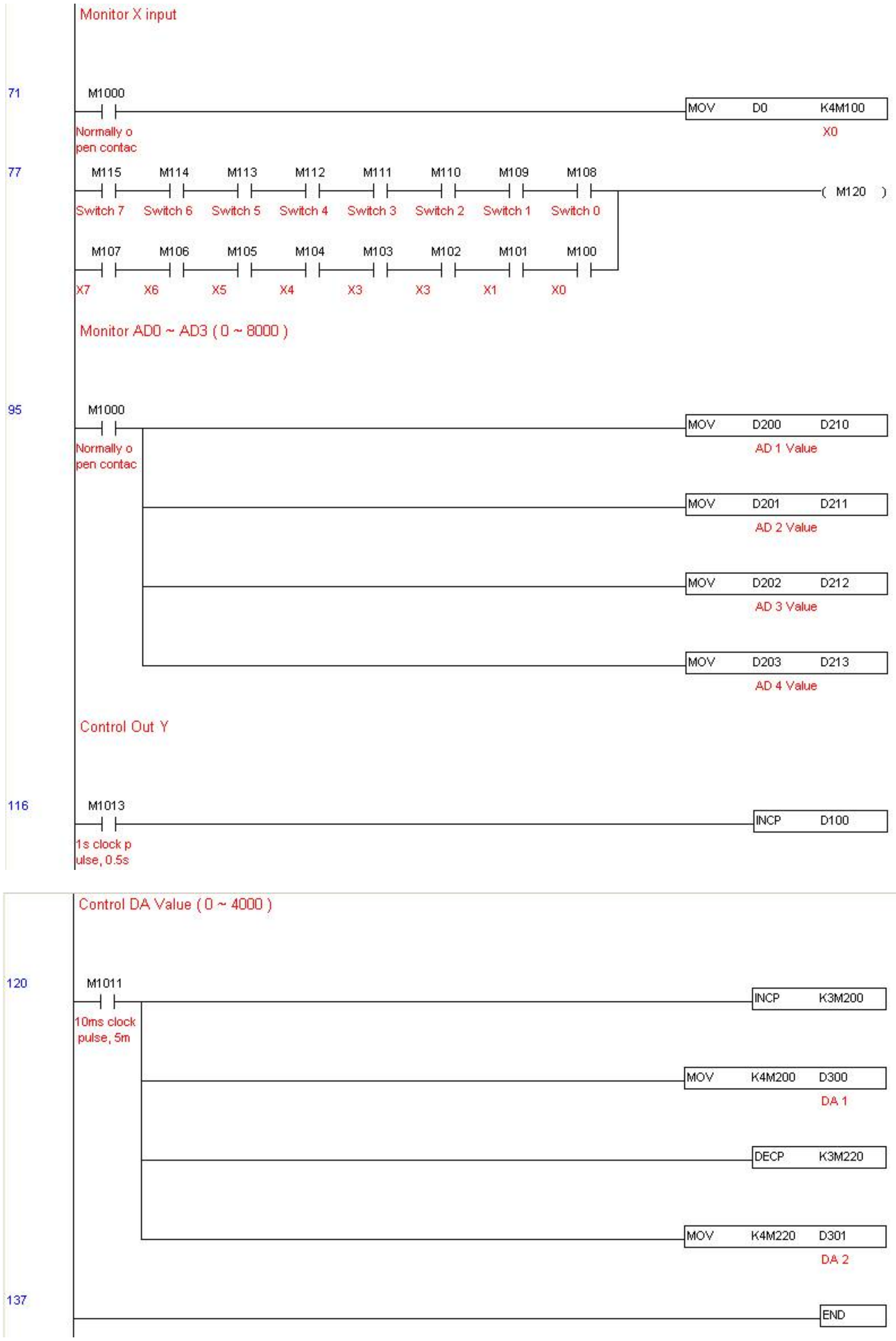
Module	Terminals	485 Address
DVP16-SP	X0–X7	0400H–0407H
	Y0–Y7	0500H–0507H
DVP-04AD	AD0–AD3	1600H–1603H
DVP02DA	DA0–DA1	1640H–1641H
DVP-08ST	Switch 0–7	0408H–040FH

Step 3: Physical configuration



Step 4: Write to PLC program

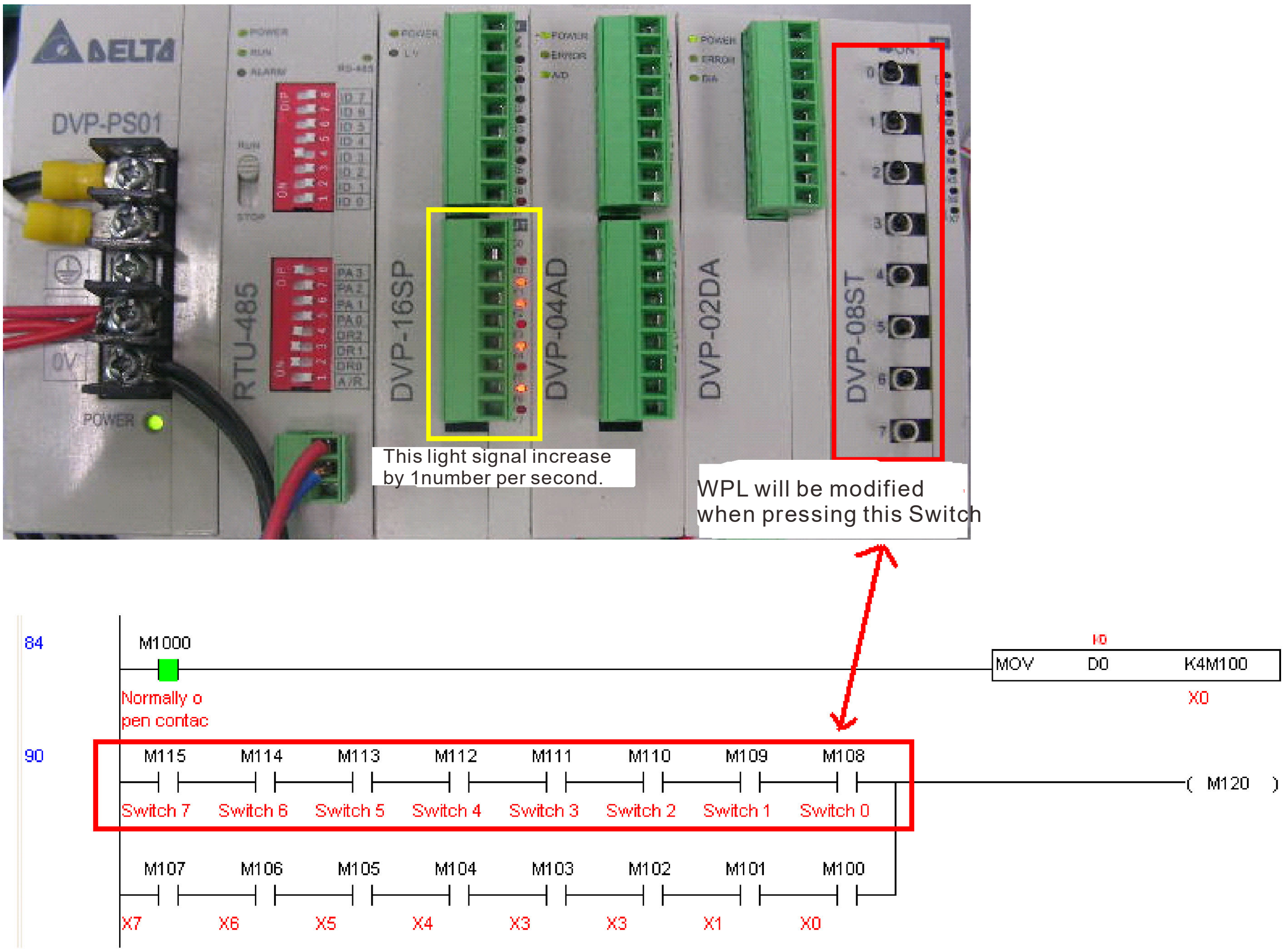




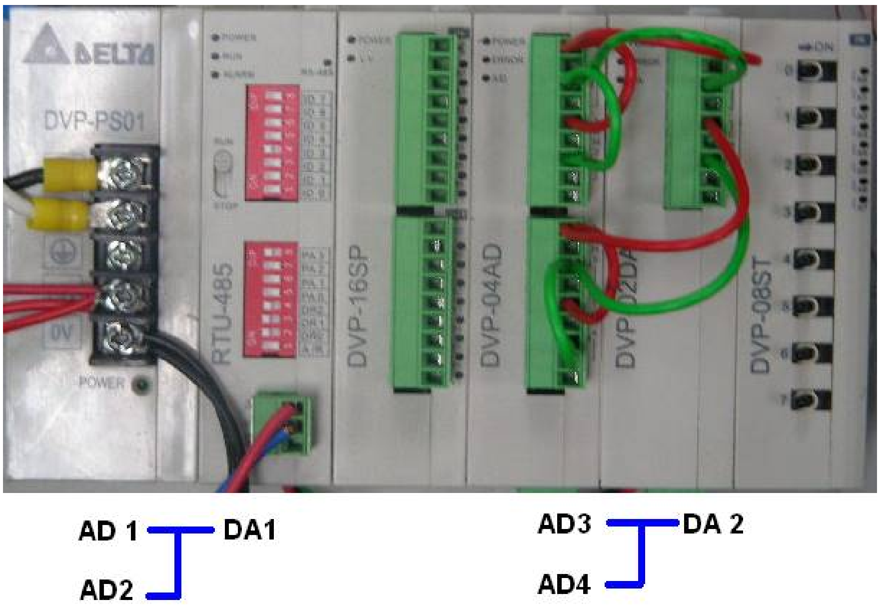
Monitor X input
71
M1000
MOV D0 K4M100
Normally o
pen contac
X0
77
M115 M114 M113 M112 M111 M110 M109 M108
(M120)
Switch 7 Switch 6 Switch 5 Switch 4 Switch 3 Switch 2 Switch 1 Switch 0
M107 M106 M105 M104 M103 M102 M101 M100
X7 X6 X5 X4 X3 X3 X1 X0
Monitor AD0 ~ AD3 (0 ~ 8000)
95
M1000
MOV D200 D210
Normally o
pen contac
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
INCP D100
1s clock p
ulse, 0.5s
Control DA Value (0 ~ 4000)
120
M1011
INCP K3M200
10ms clock
pulse, 5m
MOV K4M200 D300
DA 1
DECP K3M220
MOV K4M220 D301
DA 2
137
END

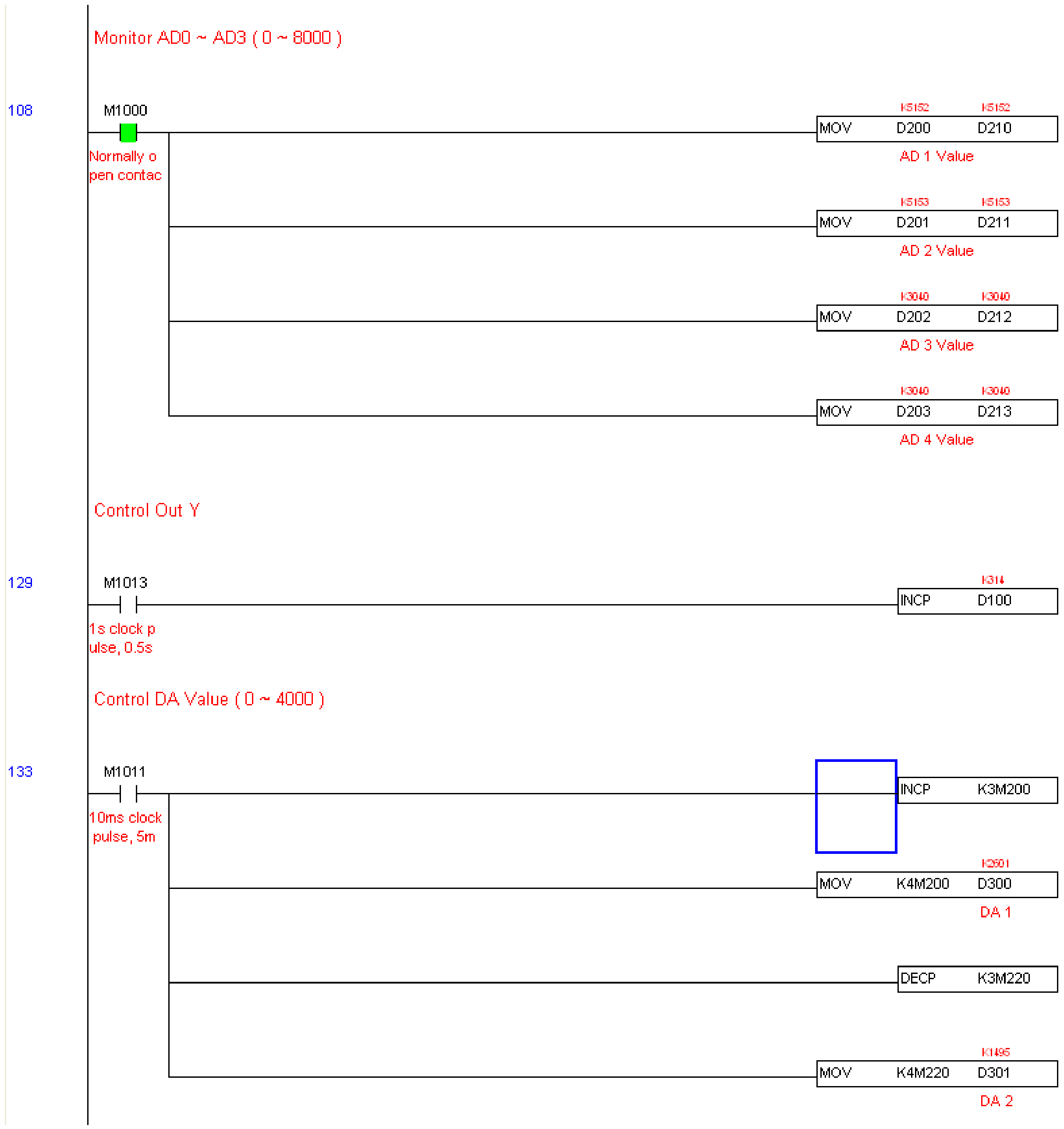
Step 5: Actual testing situation:

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
K5152
K5152
MOV
D200
D210
AD 1 Value
K5153
K5153
MOV
D201
D211
AD 2 Value
K3040
K3040
MOV
D202
D212
AD 3 Value
K3040
K3040
MOV
D203
D213
AD 4 Value
Control Out Y
129
M1013
1s clock p
ulse, 0.5s
K314
INCP
D100
Control DA Value (0 ~ 4000)
133
M1011
10ms clock
pulse, 5m
INCP
K3M200
K2601
MOV
K4M200
D300
DA 1
DECP
K3M220
K1496
MOV
K4M220
D301
DA 2

15-10 Calendar Function

The MP300's internal PLC includes calendar function. Currently-supported 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	Week	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:

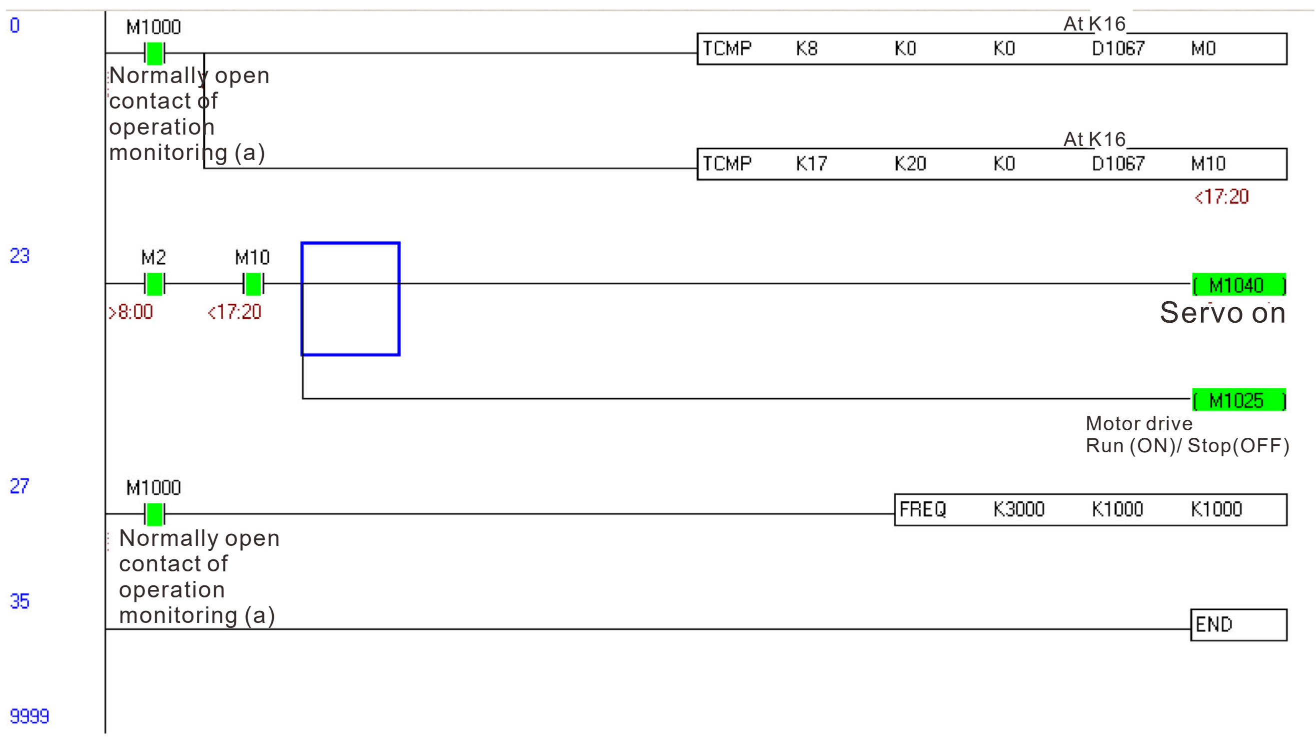
Special D	Item	Attributes
M1026	Calendar time error	RO

*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.

Example:

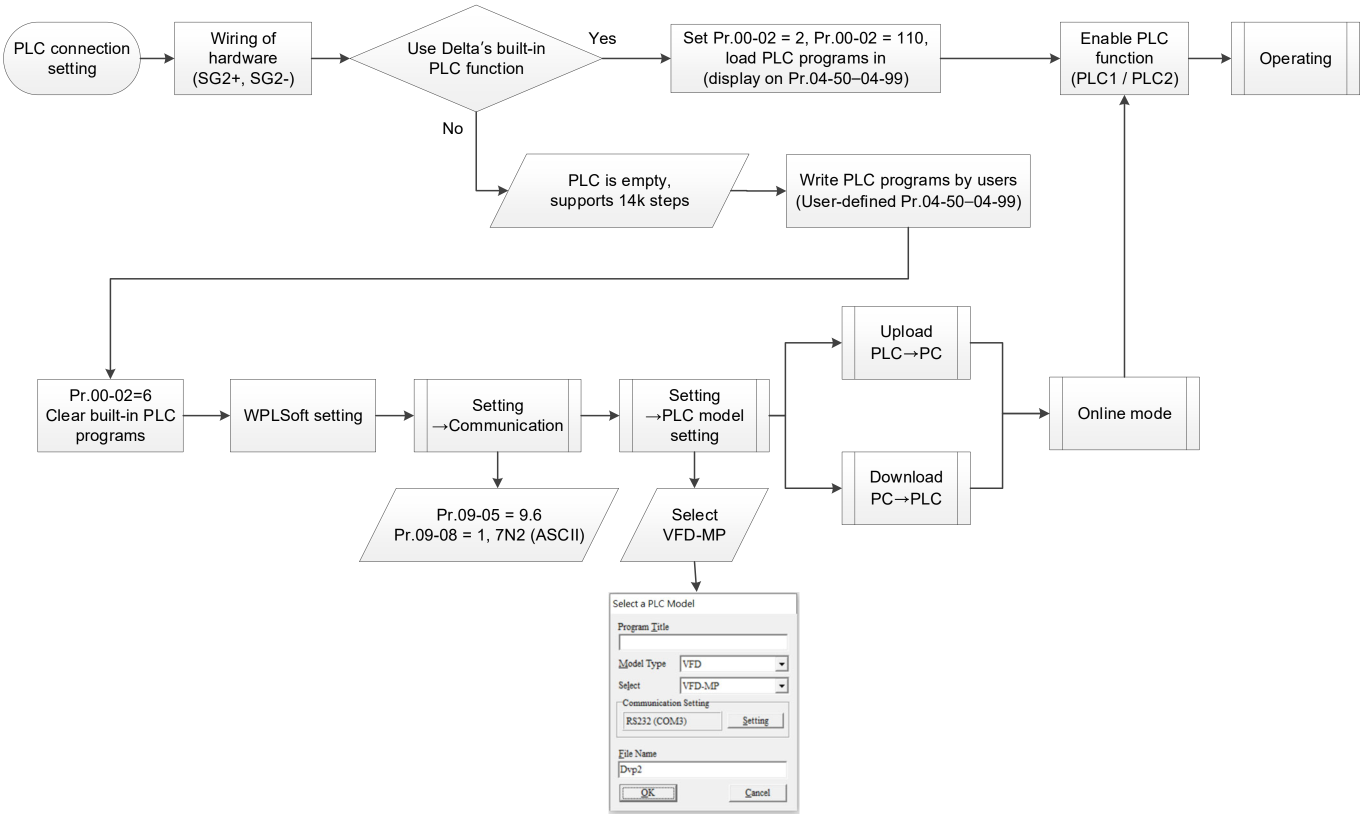
1. First, adjusts the time of the drive by the time setting in Pr.12-93–Pr.12-96, these settings react to the special D mentioned above.
2. Second, writes WPLsoft program to set the drive to be ON during the period of 08:00–17:20.

See the programs below



15-11 Enable The Built-in PLC Function of MPD (Scheduled Function, Multi-master Function)

MPD supports built-in PLC function for users to write programs according to user requirements. And also supports built-in PLC water pump function (scheduled function and multi-master function). Follow the instructions below to enable the built-in PLC function for using the related functions.



15-11-1 Scheduled function

To meet water requirements at different time, use this scheduled function to arrange the target pressure in the specific time interval for saving energy. After enabling the built-in PLC function, Pr.04-58–04-99 are displayed as the parameters of the scheduled function. Refer to the instructions of group 04 in chapter 12 for more details.

15-11-2 Multi-master function

The common multi-pump system can automatically add / reduce pumps according to water requirements, increase water-use efficiency. To keep the system stability and no water outage, use the redundancy of AC motor drive and pressure sensor that based on PLC's multi-master function to make the backup pump operates automatically when breakdown, power failure, disconnection occurs. By doing so, increase the pump's reliability, decrease the risk of water outage.

The multi-pump system with built-in PLC function use COM1 as communication interface, the communication format is fixed, the station address of the master is 1, and supports eight pumps. To provide convenience for users, the whole system stops when pressing STOP to the master, and starts to operate again after pressing RUN. Set Pr.00-32 = 1, press STOP to the slave to make it separate from multi-pump system for maintaining conveniently. At the same time, the slave displays a FSTP fault as a reminder. After finishing the maintenance, connect the slave back to the system and press STOP again, reset for FSTP, and the slave starts to operate while connecting with multi-pump system automatically.

About the display of warnings, only the master can display the warnings when there is any pressure deviation related warnings (high / low water pressure, heavy water leakage) occur in the multi-pump system. Other else warnings (dry pump, clean, cavitation) give warnings according to each parameter setting. If systematic faults [high water pressure (HPS), low water pressure (LPS), heavy water leakage (LEKE)], RTC error (rtf) occur or when the scheduled function is ON, ensure for the safety, low battery voltage (LBAt), adjust RTC (rCAL), force to stop (FStp) make the whole system stop in the first second of powering ON .

When using multi-master function, load the built-in PLC function of all MPD (master, slave) in the system in, switch ON and set the range of the pressure sensor (Pr.00-25, Pr.00-26), station address (Pr.09-00), pump system configuration setting (Pr.04-57), refer to the section 12-2 for more details about parameters and the setting procedures. For taking over the master, the wiring of hardware and the function parameters of backup master should be the same as the master. Refer to the section 4-4 Wiring Of Multi-pump Communication Cables and section 4-5 Wiring Of Pressure Sensor for more details about the wiring of hardware.

Station definitions of the built-in PLC function

Communication master	Slave	Absolute master	Backup master
The station to send commands (Display M on LCD)	Relative communication master The station to receive commands	Station address1, and is definitely the communication master	The other station addresses that Pr.04-57 bit8 = 1

The conditions to be master, backup master, slave:

Conditions for setting		Absolute master	Backup master	Slave
Essential setting	Enable / disable built-in PLC function	Enable (PLC1)	Enable (PLC1)	Enable (PLC1)
	Setting of communication address (Pr.09-00)	1	2–8 (cannot set doubly)	1–8 (cannot set doubly)
	Setting of backup master (Pr.04-57)	-	A. Backup master switch: bit 8 = 1 B. Warning of switching backup master to master PL00 switch: set bit 9 according to requirement	-
	User defined (Pr.00-26)	Should be set the same	Should be set the same	Should be set the same
Other conditions	Communication setting (Pr.09-31)	-12 (auto-setting)	0 (auto-setting) Note: Change to -12 automatically after changing to be master	0 (auto-setting)
	ANL, fault (except FStp, LVS) occurs in master	If a malfunction occurs, then the absolute master changes to be slave, and the communication master transfers to another station address.	If a malfunction occurs, then this cannot be communication master.	-
	Others	Cannot have other communication masters in communication	Cannot be master if there is another communication master	-

Note: The mark “ - ” means it does not refer to the parameter setting.

Take notice of this, when built-in PLC function is ON, the parameters listed below are set automatically or affect the function listed below. Switch to normal multi-pump mode when built-in PLC function is OFF, and remember to adjust the parameters listed below to prevent multi-pump function from being invalid.

Parameter setting	Disable PLC	Enable PLC (for multi-master)	Enable PLC and then disable it
PID mode (Pr.08-00)	-	0: Disabled	-
Internal communication protocol (Pr.09-31)	-	Master: -12 Slave: 0	-
Communication address (Pr.09-00)	-	1–8	-
Communication speed of COM1 (Pr.09-01)	-	115.2	-
Communication format of COM1 (Pr.09-04)	-	14: 8E1 (RTU)	12: 8N1 (RTU)
Treatment of pump's fault (Pr.12-13)	-	5	-
MI1	-	MI1 is not regulated by Pr.02-00. If Pr.04-57 = 002xh, then MI1 executes the operation of multi-pump system according to high and low input voltage.	-
Signal loss selection for the AI1 4–20 mA (Pr.03-19)	-	Pr.03-19 cannot be 2. But if Pr.03-19 = 2 originally, then the value changes to be 3 automatically.	-

Note: The mark " - " means does not do any other setting, but maintain parameter's last status.

If offline communication, power failure, breakdown, or offline pressure sensor occurs, then the communication master becomes slave, and the communication master transfer to another station address.

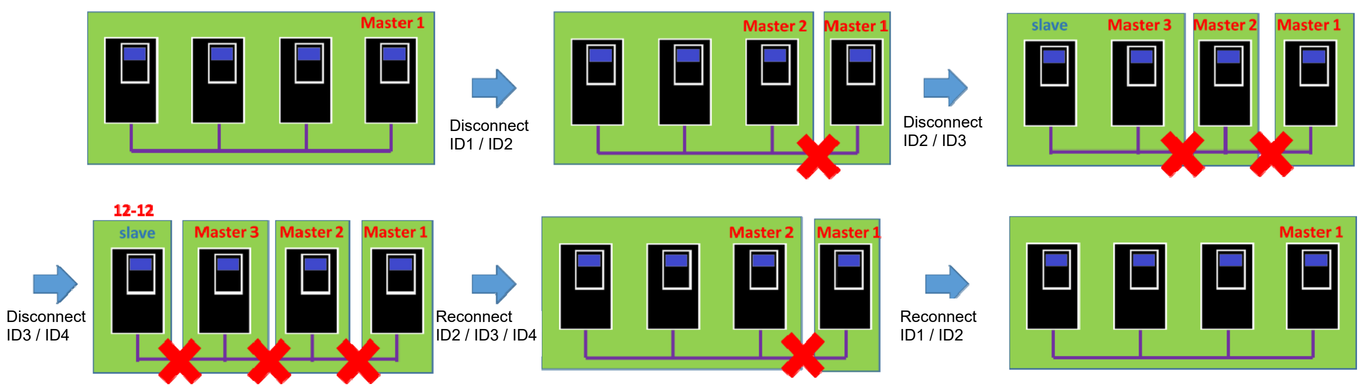
A. The communication is disconnected / reconnected:

a. When the communication is disconnected, the backup master in the communication block without communication master automatically becomes the communication master. The smaller the ID is, the easier it becomes communication master.

b. If the slave detects that it's not controlled by communication master, then the operation is according to Pr.12-12 (pump's frequency at time-out) and continues till the communication is online.

c. After reconnecting the communication, the absolute master re-controls the system (becomes communication master). If there is no absolute master, then the smaller the ID of backup master is, the easier it controls system. And it continues operating by the previous state.

In the system, ID1 is the absolute master, ID2 / ID3 are backup masters, ID4 is the slave.

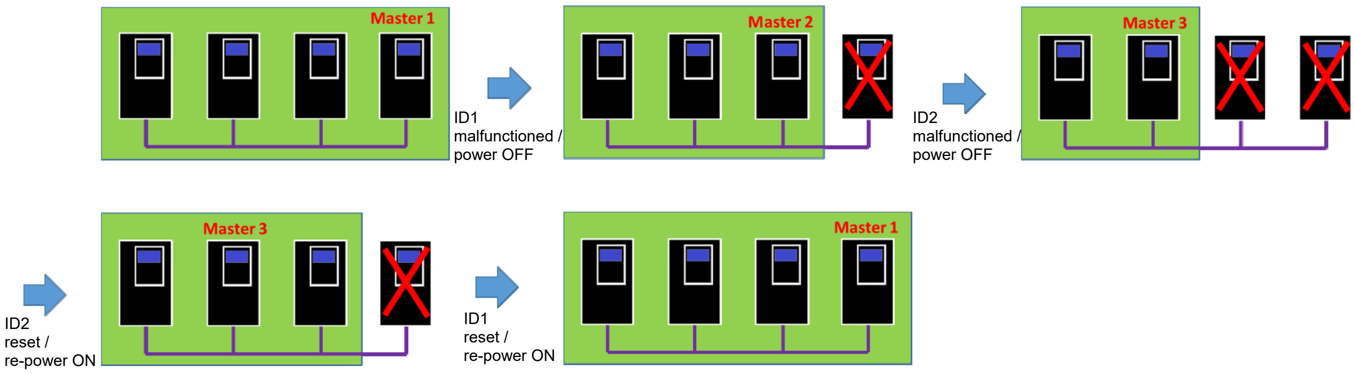


B. Power failure, breakdown / restore power, reset:

a. If the original communication master has power failure or breakdown, the backup master becomes communication master. The smaller the ID is, the easier it becomes communication master.

b. When the original communication master is back to normal (after reset or re-power on), if this is absolute master, then it becomes communication master again; if this is backup master, then it keeps the slave's state.

In the system, ID1 is the absolute master, ID2 / ID3 are backup masters, ID4 is the slave.



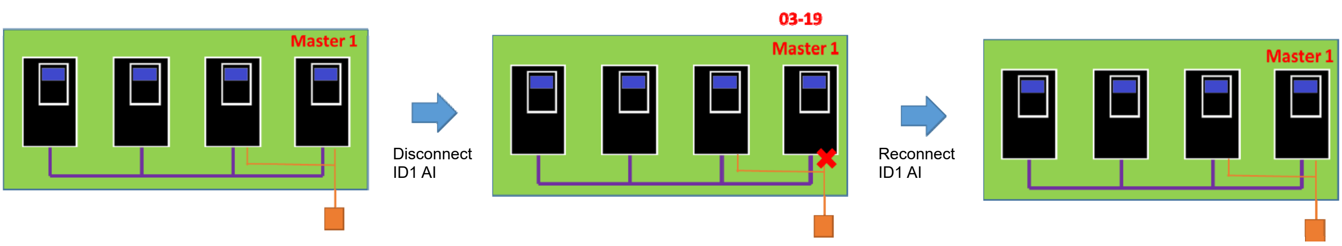
C. The pressure sensor is disconnected / reconnected:

a. When the absolute master loses the signal of pressure sensor, it cannot be communication master, but the backup master can be. The smaller the ID of backup master is, the easier it becomes communication master.

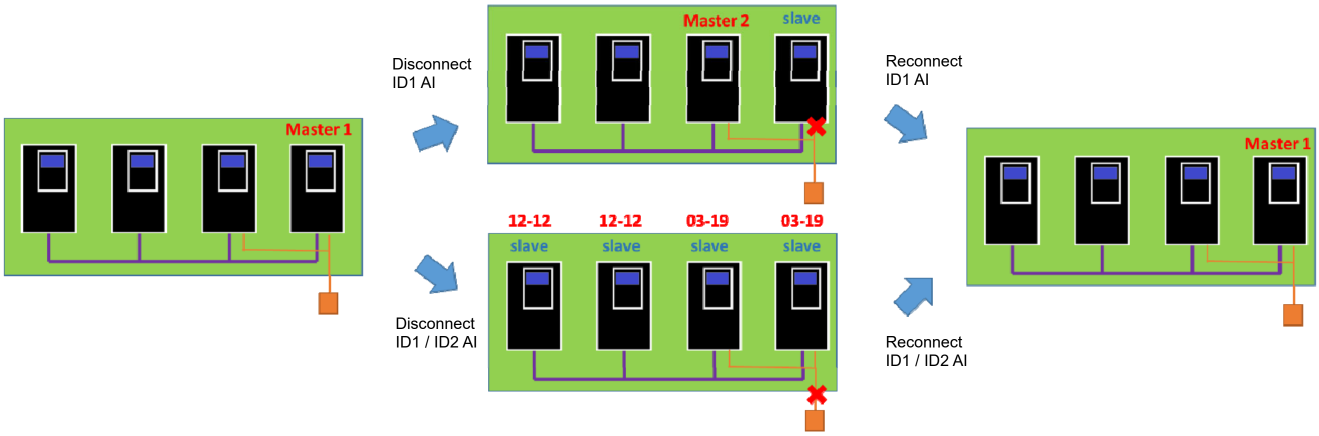
b. If the communication master loses the signal of pressure sensor, then it operates according to Pr.03-19 (signal loss selection for AI1 analog input 4–20 mA); if there is no communication master, then the slave operates according to Pr.12-12 till the communication master appears.

Pr.	Descriptions	Setting range of AC motor drive	Setting range of the enabled built-in PLC function
03-19	Signal loss selection for the AI1 4–20 mA	0: Disabled 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display ACE	0: No warning 1: Occurs a ANL warning and operates according to the command from communication master. If there is no communication master, then it operates according to Pr.12-12. 2: Disabled 3: Occurs a ACE fault to stop and withdraws from multi-pump system

In the system, ID1 is the absolute master, ID2 is the backup master, ID3 / ID4 are the slaves (Pr.03-19 = 0)

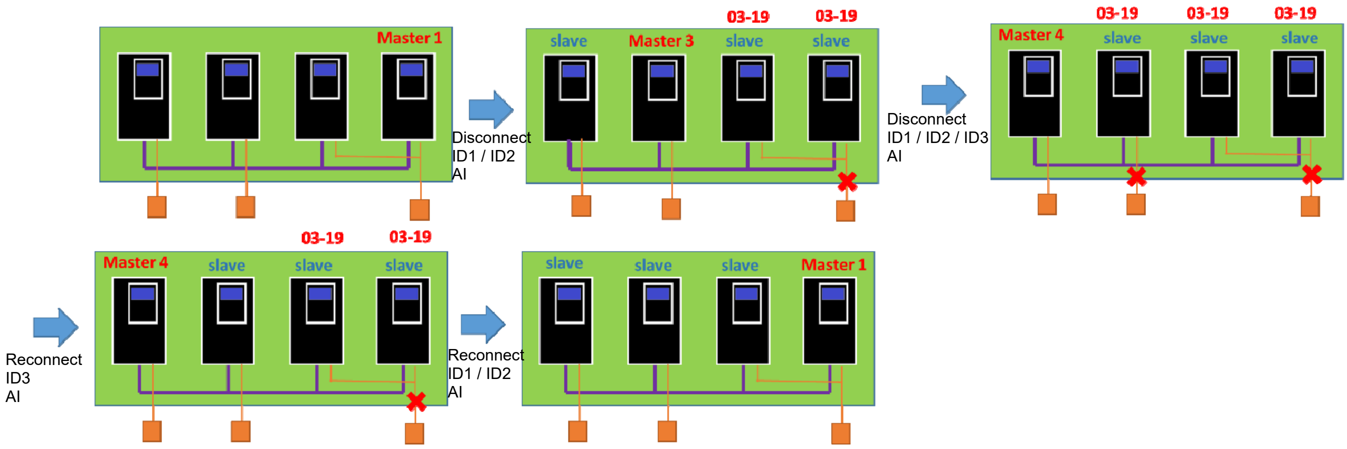


In the system, ID1 is the absolute master, ID2 is the backup master, ID3 / ID4 are the slaves (Pr.03-19 ≠ 0)



c. When the original communication master receives the signal of pressure sensor again, if this is absolute master, then it becomes communication master again; if this is backup master, then it keeps the slave's state.

In the system, ID1 is the absolute master, ID2 / ID3 / ID4 are the backup masters (Pr.03-19 ≠ 0)



The special D mentioned below is the settings for PID, you can use Pr.08-01–08-03 to set it synchronously.

N = 1–8

Special D	Function	Settings	R/W *
D1195 + 20N	P value of PIN N (two decimal places)	Pr.08-01	RW
D1196 + 20N	I value of PID1 (two decimal places)	Pr.08-02	RW
D1197 + 20N	D value of PID1 (two decimal places)	Pr.08-03	RW