## C aelta

IABU Headquarters
Delta Electronics, In
Taoyuan3
No. 18, Xinglong Rd., Taoyuan City
Taoyuan County 330 Taiwan R.
TEL: 886-3-362-6301 / FAX: 886-3-371-6301
Asia
Delta Electronics (Jiangsu) Ltd.
Wujiang Plant3
1688 Jiangxing East Road,
Wujiang Economic Developmen
Wujiang City, Jiang Su Province,
TEL: 86-512-6340-3008/FAX: 86-769-6340-729
Delta Greentech (China) Co., Ltd
238 Min-Xia Road, Cao-Lu Industry Zone, Pudong, Shanghai,
People's Republic of China
oost code : 201209
TEL: 021-58635678 / FAX: 021-58630003
Delta Electronics (Japan), Inc.
Tokyo Office
2-1-14 Minato-ku Shibadaimon
Tokyo 105-0012, Japan

Delta Electronics (Korea), Inc.
234-9, Duck Soo Building 7F, Nonhyun-Dong,
Kangnam-Gu, Seoul, Korea 135-010

Delta Electronics Int'l (S) Pte Ltd
TEL: 65-6747-5155/FAX: Singapore 417939
Delta Electronics (India) Pvt. Ltd.
Plot No. 43 Sector - 35 , HSIIDC
Gurgaon122001, Haryana Indi
TEL: 1-919-767-3800/FAX: 91-124-403-6045

## Americas

Delta Products Corporation (USA)
Raleigh Office
R.O. Box 12173,5101 Davis Drive

Research Triangle Park, NC 27709, U.S.A.
Delta Greentech (Brasil) S.A
Rua Itapeva, 26-30 Andar Edificio Itapeva One-Bela Vista
1332-000-Sao Paulo-SP-Braz
TEL: +55 11 3568-3850/FAX: +55 11 3568-3865

## Europe

Deltronics (The Netherlands) B.V.
Eindhoven Office
De Witbogt 15,5652 AG Eindhoven, The Netherland
TEL: 31-40-2592850 / FAX: 31-40-2592851

## Classical Field Oriented Control AC Motor Drive

 C2000 Series User Manual
## PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

$\square$ AC input power must be disconnected before any wiring to the AC motor drive is made.
$\boxtimes$ 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. Please do not touch the internal circuit and components.
$\square$ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Please do not touch these components or the circuit boards before taking anti-static measures. Never reassemble internal components or wiring.
$\boxtimes$ Ground the AC motor drive 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 place subjected to high temperature, direct sunlight and inflammables.
$\square$ Never connect the $A C$ motor drive output terminals $\mathrm{U} / \mathrm{T} 1, \mathrm{~V} / \mathrm{T} 2$ and $\mathrm{W} / \mathrm{T} 3$ directly to the AC mains circuit power supply.
$\boxtimes$ Only qualified persons are allowed to install, wire and maintain the AC motor drives.
$\square$ Even if the 3-phase AC motor is stop, a charge may still remain in the main circuit terminals of the AC motor drive with hazardous voltages.

V The performance of electrolytic capacitor will degrade if it is not charged for a long time. It is recommended to charge the driver which is stored in no charge condition every 2 years for 3~4 hours.
च Please use adjustable AC power source (ex: AC autotransformer) to charge the driver gradually to rated voltage, and should not charge it directly with rated voltage.
$\boxtimes$ 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, deworm the wooden crate or carton box, please do not use steamed smoking sterilization or you will damage the VFD.
2. Please use other ways to sterilize or deworm.
3. You may use high temperature to sterilize or deworm. Leave the packaging materials in an environment of over $56^{\circ} \mathrm{C}$ for 30 minutes.
4. It is strictly forbidden to use steamed smoking sterilization. The warranty does not covered VFD damaged by steamed smoking sterilization.

## NOTE

[^0]
## Table of Contents

CHAPTER 1 INTRODUCTION ..... 1-1
1-1 Receiving and Inspection ..... 1-1
1-2 Nameplate Information ..... 1-1
1-3 Model Name ..... 1-1
1-4 Serial Number. ..... 1-1
1-5 RFI Jumper ..... 1-1
1-6 Dimensions. ..... 1-1
CHAPTER 2 INSTALLATION ..... 2-1
2-1 Minimum Mounting Clearance and Installation ..... 1-1
2-2 Minimum mounting clearance ..... 1-1
2-3 Derating Curve Diagram of Normal Duty ..... 1-1
2-4 Derating Curve Diagram of Heavy Duty ..... 1-1
CHAPTER 3 UNPACKING ..... 3-1
3-1 Unpacking ..... 1-1
3-2 The Lifting Hook ..... 1-1
CHAPTER 4 WIRING ..... 4-1
CHAPTER 5 MAIN CIRCUIT TERMINALS ..... 5-1
5-1 Main Circuit Diagram. ..... 1-1
5-2 Main Circuit Terminals ..... 1-1
CHPATER 6 CONTROL TERMINALS ..... 6-1
6-1 Specifications of Control Terminal ..... 1-1
6-2 Analog input terminals (AVI, ACI, AUI, ACM) ..... 1-1
6-3 Remove the Terminal Block ..... 1-1
CHAPTER 7 OPTIONAL ACCESSORIES ..... 7-1
7-1 All Brake Resistors and Brake Units Used in AC Motor Drives ..... 1-1
7-2 Non-fuse Circuit Breaker ..... 1-1
7-3 Fuse (Specification Chart) ..... 1-1
7-4 AC Reactor ..... 1-1
7-5 Zero Phase Reactor ..... 1-1
7-6 DC Reactor ..... 1-1
7-7 EMI Filter ..... 1-1
7-8 Digital Keypad ..... 1-1
7-9 Panel Mounting. ..... 1-1
7-10 Conduit Box Kit. ..... 1-1
7-11 Fan Kit. ..... 1-1
7-12 Flange Mounting Kit ..... 1-1
7-13 USB/RS-485 Communication Interface IFD6530. ..... 1-1
CHAPTER 8 OPTION CARDS ..... 8-1
8-1 Removed key cover
8-2 Screws Speciation for option card terminals
8-3 EMC-D42A
8-4 EMC-D611A
8-5 EMC-R6AA
8-6 EMC-BPS01
8-7 EMC-PG01L
8-8 EMC-PG01O
8-9 EMC-PG01U
8-10 EMC-PG01R
8-11 CMC-MOD01
8-12 CMC-PD01
8-13 CMC-DN01
8-14 CMC-EIP01
8-15 EMC-COP01
CHAPTER 9 SPECIFICATION ..... 9-1
9-1 230V Series
9-2 460V Series
9-3 Environment for Operation, Storage and Transportation
9-4 Specification for Operation Temperature and Protection Level
CHAPTER 10 DIGITAL KEYPAD ..... 10-1
10-1 Descriptions of Digital Keypad
10-2 Function of Digital Keypad KPC-CC01
10-3 TPEditor Installation Instruction
10-4 Fault Code Description of Digital Keypad KPC-CC01
CHAPTER 11 SUMMARPY OF PARAMETERS ..... 11-1
CHAPTER 12 DESCRIPTION OF PARAMETER SETTINGS ..... 12-1
CHAPTER 13 WARNING CODES ..... 13-1
CHAPTER 14 FAULT CODES AND DESCRIPTIONS ..... 14-1
CHAPTER 15 CANOPEN OVERVIEW ..... 15-1
CHAPTER 16 PLC FUNCTION ..... 16-1
CHAPTER 17 HOW TO SELECT THE RIGHT AC MOTOR DIRVE ..... 17-1
CHAPTER 18 SUGGESTIONS AND ERROR CORRECTIONS FOR STANDARD AC MOTOR DRIVES18-1
CHAPTER 19 EMC STANDARD INSTALLATION GUIDE ..... 19-1
Application
Control BD V1.03;
Keypad ..... V1.03;

## Chapter 1 Introduction

## 1-1 Receiving and Inspection

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

1. Please inspect the unit after unpacking to assure it was not damaged during shipment. Make sure that the part number printed on the package corresponds with the part number indicated on the nameplate.
2. Make sure that the voltage for the wiring lie within the range as indicated on the nameplate. Please install the AC motor drive according to this manual.
3. Before applying the power, please make sure that all the devices, including power, motor, control board and digital keypad, are connected correctly.
4. When wiring the $A C$ motor drive, please make sure that the wiring of input terminals "R/L1, S/L2, T/L3" and output terminals" $\mathrm{U} / \mathrm{T} 1, \mathrm{~V} / \mathrm{T} 2, \mathrm{~W} / \mathrm{T} 3$ " are correct to prevent drive damage.
5. When power is applied, select the language and set parameter groups via the digital keypad (KPC-CC01). When executes trial run, please begin with a low speed and then gradually increases the speed untill the desired speed is reached.

## 1-2 Nameplate Information



## 1-3 Model Name



## 1-4 Serial Number



## 1-5 RFI Jumper

RFI Jumper: The AC motor drive may emit the electrical noise. The RFI jumper is used to suppress the interference (Radio Frequency Interference) on the power line.

## Frame A~C

Screw Torque: 8~10kg-cm(6.9-8.7 lb -in.)
Loosen the screws and remove the RFI-jumper. Fasten the screws back to the original position after RFI-jumper is removed.


## Frame D0~H

Remove the RFI-jumper by hands, no screws need to be loosen.


Main power isolated from earth:
If the AC motor drive is supplied from an isolated power (IT power), the RFI jumper must be cut off. Then the RFI capacities (filter capacitors) will be disconnected from ground to prevent circuit damage (according to IEC 61800-3) and reduce earth leakage current.

## CAUTION:

1. When power is applied to the AC motor drive, do not cut off the RFI jumper.
2. Make sure main power is switched off before cutting the RFI jumper.
3. The gap discharge may occur when the transient voltage is higher than $1,000 \mathrm{~V}$. Besides, electro-magnetic compatibility of the AC motor drives will be lower after cutting the RFI jumper.
4. Do NOT cut the RFI jumper when main power is connected to earth.
5. The RFI jumper cannot be cut when Hi-pot tests are performed. The mains power and motor must be separated if high voltage test is performed and the leakage currents are too high.
6. To prevent drive damage, the RFI jumper connected to ground shall be cut off if the AC motor drive is installed on an ungrounded power system or a high resistance-grounded (over 30 ohms) power system or a corner grounded TN system.

## 1-6 Dimensions

Frame A
VFD007C23A; VFD007C43A/E; VFD015C23A; VFD015C43A/E; VFD022C23A; VFD022C43A/E; VFD037C23A; VFD037C43A/E; VFD040C43A/E; VFD055C43A/E


See Detail B


Unit: mm [inch]

| Frame | W | H | D | W1 | H1 | D1 | S1 | Ф1 | Ф2 | Ф3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| A1 | 130.0 | 250.0 | 170.0 | 116.0 | 236.0 | 45.8 | 6.2 | 22.2 | 34.0 | 28.0 |
|  | $[5.12]$ | $[9.84]$ | $[6.69]$ | $[4.57]$ | $[9.29]$ | $[1.80]$ | $[0.24]$ | $[0.87]$ | $[1.34]$ | $[1.10]$ |

Frame B
VFD055C23A; VFD075C23A; VFD075C43A/E; VFD110C23A; VFD110C43A/E; VFD150C43A/E


## See Detail B

Unit: mm [inch]

| Frame | W | H | D | W 1 | H 1 | $\mathrm{D} 1^{*}$ | S 1 | Ф1 | Ф2 | Ф3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| B 1 | 190.0 | 320.0 | 190.0 | 173.0 | 303.0 | 77.9 | 8.5 | 22.2 | 34.0 | 28.0 |
|  | $[7.48]$ | $[12.60]$ | $[7.48]$ | $[6.81]$ | $[11.93]$ | $[3.07]$ | $[0.33]$ | $[0.87]$ | $[1.34]$ | $[1.10]$ |

D1*: Flange mounting

Frame C
VFD150C23A; VFD185C23A; VFD185C43A/E; VFD220C23A; VFD220C43A/E; VFD300C43A/E


## See Detail B



Detail A (Mounting Hole)


Detail B (Mounting Hole)

| Frame | W | H | D | W 1 | H 1 | $\mathrm{D} 1 *$ | S 1 | $\Phi 1$ | $\Phi 2$ | $\Phi 3$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| C 1 | 250.0 | 400.0 | 210.0 | 231.0 | 381.0 | 92.9 | 8.5 | 22.2 | 34.0 | 50.0 |
|  | $[9.84]$ | $[15.75]$ | $[8.27]$ | $[9.09]$ | $[15.00]$ | $[3.66]$ | $[0.33]$ | $[0.87]$ | $[1.34]$ | $[1.97]$ |

D1*: Flange mounting

Frame D0:
D0-1: VFD370C43S, VFD450C43S


| Frame | W | H1 | D | W1 | H2 | H3 | D1* | D2 | S1 | S2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| D0-1 | 280.0 | 500.0 | 255.0 | 235.0 | 475.0 | 442.0 | 94.2 | 16.0 | 11.0 | 18.0 |
|  | $[11.02]$ | $[19.69]$ | $[10.04]$ | $[9.25]$ | $[18.70]$ | $[17.40]$ | $[3.71]$ | $[0.63]$ | $[0.43]$ | $[0.71]$ |

Frame D0
D0-2: VFD370C43U; VFD450C43U


| Frame | W | H | D | W1 | H1 | H2 | H3 | D1 | D2 | S1 | S2 | Ф1 | Ф2 | Ф3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| D0-2 | 280.0 | 614.4 | 255.0 | 235.0 | 500.0 | 475.0 | 442.0 | 94.2 | 16.0 | 11.0 | 18.0 | 62.7 | 34.0 | 22.0 |
|  | $[11.02]$ | $[24.19]$ | $[10.04]$ | $[9.25]$ | $[19.69]$ | $[18.70]$ | $[17.40]$ | $[3.71]$ | $[0.63]$ | $[0.43]$ | $[0.71]$ | $[2.47]$ | $[1.34]$ | $[0.87]$ |

D1*: Flange Mounting

Frame D
D1: VFD300C23A; VFD370C23A; VFD370C43A; VFD450C43A; VFD550C43A; VFD750C43A


Unit: mm [inch]

| Frame | W | H | D | W 1 | H 1 | H 2 | H 3 | $\mathrm{D}^{*}$ | D 2 | S 1 | S 2 | Ф1 | Ф2 | Ф3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| D 1 | 330.0 | - | 275.0 | 285.0 | 550.0 | 525.0 | 492.0 | 107.2 | 16.0 | 11.0 | 18.0 |  |  |  |
|  | $[12.99]$ |  | $[10.83]$ | $[11.22]$ | $[21.65]$ | $[20.67]$ | $[19.37]$ | $[4.22]$ | $[0.63]$ | $[0.43]$ | $[0.71]$ | - | - | - |

D1*: Flange mounting

D2: VFD300C23E; VFD370C23E; VFD370C43E; VFD450C43E; VFD550C43E; VFD750C43E


Unit: mm [inch]

| Frame | W | H | D | W 1 | H 1 | H 2 | H 3 | $\mathrm{D} 1 *$ | D 2 | S 1 | S 2 | Ф1 | Ф2 | Ф3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| D 2 | 330.0 | 688.3 | 275.0 | 285.0 | 550.0 | 525.0 | 492.0 | 107.2 | 16.0 | 11.0 | 18.0 | 76.2 | 34.0 | 22.0 |
|  | $[12.99]$ | $[27.10]$ | $[10.83]$ | $[11.22]$ | $[21.65]$ | $[20.67]$ | $[19.37]$ | $[4.22]$ | $[0.63]$ | $[0.43]$ | $[0.71]$ | $[3.00]$ | $[1.34]$ | $[0.87]$ |

D1*: Flange mounting

## Frame E

E1: VFD450C23A; VFD550C23A; VFD750C23A; VFD900C43A; VFD1100C43A


Unit: mm [inch]

| Frame | W | H | D | W1 | H1 | H2 | H3 | D1* | D2 | S1, S2 | S3 | $\psi 1$ | $\psi 2$ | \%3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| E1 | $\begin{gathered} 370.0 \\ {[14.57]} \end{gathered}$ | - | $\left[\begin{array}{c} 300.0 \\ {[11.81]} \end{array}\right]$ | $\begin{aligned} & 335.0 \\ & {[13.19} \end{aligned}$ | $\left[\begin{array}{c} 589 \\ {[23.19]} \end{array}\right]$ | $\begin{aligned} & 560.0 \\ & {[22.05]} \end{aligned}$ | $\left[\begin{array}{l} 528.0 \\ {[20.80]} \end{array}\right]$ | $\begin{aligned} & 143.0 \\ & {[5.63]} \end{aligned}$ | $\begin{gathered} \hline 18.0 \\ {[0.71]} \end{gathered}$ | $\begin{gathered} 13.0 \\ {[0.51]} \end{gathered}$ | $\begin{gathered} \hline 18.0 \\ {[0.71]} \end{gathered}$ | - | - | - |

D1*: Flange mounting

Frame E
E2: VFD450C23E; VFD550C23E; VFD750C23E; VFD900C43E; VFD1100C43E



Detail A (Mounting Hole)


Detail B (Mounting Hole)

Unit: mm [inch]

| Frame | W | H | D | W 1 | H 1 | H 2 | H 3 | $\mathrm{D} 1^{*}$ | D 2 | $\mathrm{~S} 1, \mathrm{~S} 2$ | S 3 | $\psi 1$ | $\psi 2$ | $\psi 3$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| E 2 | 370.0 | 715.8 | 300.0 | 335.0 | 589 | 560.0 | 528.0 | 143.0 | 18.0 | 13.0 | 18.0 | 22.0 | 34.0 | 92.0 |
|  | $[14.57]$ | $[28.18]$ | $[11.81]$ | $[13.19$ | $[23.19]$ | $[22.05]$ | $[20.80]$ | $[5.63]$ | $[0.71]$ | $[0.51]$ | $[0.71]$ | $[0.87]$ | $[1.34]$ | $[3.62]$ |

## Frame F

F1: VFD900C23A; VFD1320C43A; VFD1600C43A


Unit: mm [inch]

| Frame | W | H | D | W 1 | H 1 | H 2 | H 3 | $\mathrm{D} 1^{*}$ | D 2 | S 1 | S 2 | S 3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| F 1 | 420.0 | - | 300.0 | 380.0 | 800.0 | 770.0 | 717.0 | 124.0 | 18.0 | 13.0 | 25.0 | 18.0 |
|  | $[16.54]$ |  | $[11.81]$ | $[14.96]$ | $[31.50]$ | $[30.32]$ | $[28.23]$ | $[4.88]$ | $[0.71]$ | $[0.51]$ | $[0.98]$ | $[0.71]$ |

D1*: Flange mounting

Frame F
F2: VFD900C23E; VFD1320C43E; VFD1600C43E


| Frame | W | H | D | W 1 | H 1 | H 2 | H 3 | $\mathrm{D} 1^{*}$ | D 2 | S 1 | S 2 | S 3 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| F 2 | 420.0 | 940.0 | 300.0 | 380.0 | 800.0 | 770.0 | 717.0 | 124.0 | 18.0 | 13.0 | 25.0 | 18.0 |
|  | $[16.54]$ | $[37.00]$ | $[11.81]$ | $[14.96]$ | $[31.50]$ | $[30.32]$ | $[28.23]$ | $[4.88]$ | $[0.71]$ | $[0.51]$ | $[0.98]$ | $[0.71]$ |


| Frame | $\psi 1$ | $\psi 2$ | $\psi 3$ |
| :---: | :---: | :---: | :---: |
| F2 | 92.0 | 35.0 | 22.0 |
|  | $[3.62]$ | $[1.38]$ | $[0.87]$ |

D1*: Flange mounting

## Frame G

G1: VFD1850C43A; VFD2200C43A


Detail A (Mounting Hole) Detail B (Mounting Hole)
Unit: mm [inch]

| Frame | W | H | D | W1 | H1 | H2 | H3 | S1 | S2 | S3 | $\psi 1$ | $\psi 2$ | $\psi 3$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| G1 | 500.0 | - | 397.0 | 440.0 | 1000.0 | 963.0 | 913.6 | 13.0 | 26.5 | 27.0 |  |  |  |
|  | $[19.69]$ | - | $[15.63]$ | $[217.32]$ | $[39.37]$ | $[37.91]$ | $[35.97]$ | $[0.51]$ | $[1.04]$ | $[1.06]$ | - | - | - |

Frame G
G2: VFD1850C43E; VFD2200C43E



Detai. B (Mounting Hole)

Frame H
H1: VFD2800C43A; VFD3150C43A; VFD3550C43A; VFD4500C43A



See Detail A(Mounting Hole)


See Detail B(Mounting Hole)

| Frame | W | H | D | W1 | W2 | W3 | W4 | W5 | W6 | H1 | H2 | H3 | H4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| H1 | $\begin{gathered} 700.0 \\ {[27.56]} \end{gathered}$ | $\begin{aligned} & 1435.0 \\ & {[56.5]} \end{aligned}$ | $\begin{gathered} 398.0 \\ {[15.67]} \\ \hline \end{gathered}$ | $\begin{aligned} & 630.0 \\ & {[24.8]} \end{aligned}$ | $\begin{array}{\|c} \hline 290.0 \\ {[11.42]} \end{array}$ | - | - | - | - | $\begin{aligned} & 1403.0 \\ & {[55.24]} \end{aligned}$ | $\begin{aligned} & 1346.6 \\ & {[53.02]} \end{aligned}$ | - | - |
| Frame | H5 | D1 | D2 | D3 | D4 | D5 | D6 | S1 | S2 | S3 | 41 | $\psi 2$ | \%3 |
| H1 | - | $\begin{gathered} 45.0 \\ {[1.77]} \end{gathered}$ | - | - | - | - | - | $\begin{gathered} 13.0 \\ {[0.51]} \end{gathered}$ | $\begin{gathered} 26.5 \\ {[1.04]} \end{gathered}$ | $\begin{array}{c\|} \hline 25.0 \\ {[0.98]} \end{array}$ | - | - | - |

Frame H
H2: VFD2800C43E-1; VFD3150C43E-1; VFD3550C43E-1; VFD4500C43E-1


See Detail A(Mounting Hole)
See Detail B(Mounting Hole)

Frame H
H3: VFD2800C43E; VFD3150C43E; VFD3550C43E; VFD4500C43E


See Detail A(Mounting Hole)

| Frame | W | H | D | W1 | W2 | W3 | W4 | W5 | W6 | H1 | H2 | H3 | H4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| H3 | $\begin{aligned} & \hline 700.0 \\ & {[27.56]} \end{aligned}$ | $\begin{aligned} & 1745.0 \\ & {[68.701} \end{aligned}$ | $\begin{gathered} 404.0 \\ {[15.91]} \end{gathered}$ | $\begin{aligned} & 630.0 \\ & {[24.8]} \end{aligned}$ | $\begin{gathered} \hline 500.0 \\ {[19.69]} \end{gathered}$ | $\begin{aligned} & \hline 630.0 \\ & {[24.8]} \end{aligned}$ | $\begin{array}{\|c\|} \hline 760.0 \\ \text { [29.92] } \end{array}$ | $\begin{aligned} & 800.0 \\ & {[31.51} \end{aligned}$ | - | $\begin{aligned} & 1729.0 \\ & {[68.07]} \end{aligned}$ | $\begin{array}{\|l\|} \hline 1701.6 \\ {[66.99]} \end{array}$ | - | - |
| Frame | H5 | D1 | D2 | D3 | D4 | D5 | D6 | S1 | S2 | S3 | ¢1 | Ф2 | Ф3 |
| H3 | - | 51.0 | 38.0 | 65.0 | 204.0 | 68.0 | 137.0 | 13.0 | 26.5 | 25.0 | 22.0 | 34.0 | 117.5 |
| H3 |  | [2.01] | [1.50] | [2.56] | [8.03] | [2.68] | [5.39] | [0.51] | [1.04] | [0.98] | [0.87] | [1.34] | [4.63] |

Digital Keypad
KPC-CC01


## Chapter 2 Installation

## 2-1 Minimum Mounting Clearance and Installation

## $\square$ NOTE

■ Prevent fiber particles, scraps of paper, shredded wood saw dust, metal particles, etc. from adhereing to the heat sink
Install the AC motor drive in a metal cabinet. When installing one drive below another one, use a metal separation between the AC motor drives to prevent mutual heating and to prevent the risk of fire accident.
■ Install the AC motor drive in Pollution Degree 2 environments only: normallyl only nonconductive pollution occurs and temporary conductivity caused by condensation is expected.
The appearances shown in the following figures are for reference only.
Airflow direction: (Blue arrow) inflow (Red arrow) outflow


Side-by-side installation(Frame A-C)


Multiple drives, side-by-side installation (Frame A,B,C, G, H)


Multiple drives, side-by-side installation (Frame D0, D, E, F) Install metal separation between the drives.


Multiple drives side-by-side installation and in rows (Frame A,B,C )
Ta: Frame A~G Ta*: Frame H
When installing one AC motor drive below another one (top-bottom installation), use a metal separation between the drives to prevent mutual heating. The temperature measured at the fan's inflow side must be lower than the temperature measured at the operation side. If the fan's inflow temperature is higher, use a thicker or larger size of metal seperature. Operation temperature is the temperature measured at 50 mm away from the fan's inflow side. (As shown in the figure below)


## 2-2 Minimum mounting clearance

| Frame | $A(\mathrm{~mm})$ | $B(\mathrm{~mm})$ | $C(\mathrm{~mm})$ | $D(\mathrm{~mm})$ |
| :--- | :---: | :---: | :---: | :---: |
| A~C | 60 | 30 | 10 | 0 |
| D0, D, E, F | 100 | 50 | - | 0 |
| G | 200 | 100 | - | 0 |
| H | 350 | 0 | 0 | $200\left(100, \mathrm{Ta}=40^{\circ} \mathrm{C}\right)$ |

Frame A VFD007C23A; VFD007C43A/E; VFD015C23A; VFD015C43A/E; VFD022C23A; VFD022C43A/E; VFD037C23A; VFD037C43A/E; VFD040C43A/E; VFD055C43A/E
Frame B VFD055C23A; VFD75C23A; VFD075C43A/E; VFD110C23A; VFD110C43A/E; VFD150C43A/E
Frame C VFD150C23A; VFD185C23A; VFD185C43A/E; VFD220C23A; VFD220C43A/E; VFD300C43A/E;
Frame VFD370C43S, VFD450C43S, VFD370C43U, VFD450C43U
D0

# Frame D VFD300C23A/E; VFD370C23A/E; VFD370C43A/E; VFD450C43A/E; VFD550C43A/E; VFD750C43A/E <br> Frame E VFD450C23A/E; VFD550C23A/E; VFD750C23A/E; VFD900C43A/E; VFD1100C43A/E <br> Frame F VFD900C23A/E; VFD1320C43A/E; VFD1600C43A/E <br> Frame G VFD1850C43A; VFD2200C43A; VFD1850C43E; VFD2200C43E <br> Frame H VFD2800C43A; VFD3150C43A; VFD3550C43A; VFD2800C43E-1; VFD3150C43E-1; VFD3550C43E-1;VFD2800C43E; VFD3150C43E; VFD3550C43E 

## NOTE

1. The minimum mounting clearances stated in the table above applies to $A C$ motor drives frame $A$ to $D$. A drive fails to follow the minimum mounting clearances may cause the fan to malfunction and heat dissipation problem.


| Air flow rate for cooling |  |  |  |  |  |  | Power dissipation of AC motor drive |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Flow Rate (cfm) |  |  | Flow Rate ( $\mathrm{m}^{3} / \mathrm{hr}$ ) |  |  | Power Dissipation |  |  |
| Model No. | External | Internal | Total | External | Internal | Total | Loss External (Heat sink) | Internal | Total |
| VFD007C23A | - | - | - | - | - | - | 33 | 27 | 61 |
| VFD015C23A | 14 | - | 14 | 24 | - | 24 | 56 | 31 | 88 |
| VFD022C23A | 14 | - | 14 | 24 | - | 24 | 79 | 36 | 115 |
| VFD037C23A | 10 | - | 10 | 17 | - | 17 | 113 | 46 | 159 |
| VFD055C23A | 40 | 14 | 54 | 68 | 24 | 92 | 197 | 67 | 264 |
| VFD075C23A | 66 | 14 | 80 | 112 | 24 | 136 | 249 | 86 | 335 |
| VFD110C23A | 58 | 14 | 73 | 99 | 24 | 124 | 409 | 121 | 529 |
| VFD150C23A | 166 | 12 | 178 | 282 | 20 | 302 | 455 | 161 | 616 |
| VFD185C23A | 166 | 12 | 178 | 282 | 20 | 302 | 549 | 184 | 733 |
| VFD220C23A | 146 | 12 | 158 | 248 | 20 | 268 | 649 | 216 | 865 |
| VFD300C23A/E | 179 | 30 | 209 | 304 | 51 | 355 | 913 | 186 | 1099 |
| VFD370C23A/E | 179 | 30 | 209 | 304 | 51 | 355 | 1091 | 220 | 1311 |
| VFD450C23A/E | 228 | 73 | 301 | 387 | 124 | 511 | 1251 | 267 | 1518 |
| VFD550C23A/E | 228 | 73 | 301 | 387 | 124 | 511 | 1401 | 308 | 1709 |
| VFD750C23A/E | 246 | 73 | 319 | 418 | 124 | 542 | 1770 | 369 | 2139 |
| VFD900C23A/E | 224 | 112 | 336 | 381 | 190 | 571 | 2304 | 484 | 2788 |
| VFD007C43A/E | - | - | - | - | - | - | 33 | 25 | 59 |
| VFD015C43A/E | - | - | - | - | - | - | 45 | 29 | 74 |


| Air flow rate for cooling |  |  |  |  |  |  | Power dissipation of AC motor drive |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Model No. | Flow Rate (cfm) |  |  | Flow Rate ( $\mathrm{m}^{3} / \mathrm{hr}$ ) |  |  | Power Dissipation |  |  |
|  | External | Internal | Total | External | Internal | Total | Loss External (Heat sink) | Internal | Total |
| VFD022C43A/E | 14 | - | 14 | 24 | - | 24 | 71 | 33 | 104 |
| VFD037C43A/E | 10 | - | 10 | 17 | - | 17 | 103 | 38 | 141 |
| VFD040C43A/E | 10 | - | 10 | 17 |  | 17 | 116 | 42 | 158 |
| VFD055C43A/E | 10 | - | 10 | 17 |  | 17 | 134 | 46 | 180 |
| VFD075C43A/E | 40 | 14 | 54 | 68 | 24 | 92 | 216 | 76 | 292 |
| VFD110C43A/E | 66 | 14 | 80 | 112 | 24 | 136 | 287 | 93 | 380 |
| VFD150C43A/E | 58 | 14 | 73 | 99 | 24 | 124 | 396 | 122 | 518 |
| VFD185C43A/E | 99 | 21 | 120 | 168 | 36 | 204 | 369 | 138 | 507 |
| VFD220C43A/E | 99 | 21 | 120 | 168 | 36 | 204 | 476 | 158 | 635 |
| VFD300C43A/E | 126 | 21 | 147 | 214 | 36 | 250 | 655 | 211 | 866 |
| VFD370C43A/E | 179 | 30 | 209 | 304 | 51 | 355 | 809 | 184 | 993 |
| VFD450C43A/E | 179 | 30 | 209 | 304 | 51 | 355 | 929 | 218 | 1147 |
| VFD550C43A/E | 179 | 30 | 209 | 304 | 51 | 355 | 1156 | 257 | 1413 |
| VFD750C43A/E | 186 | 30 | 216 | 316 | 51 | 367 | 1408 | 334 | 1742 |
| VFD900C43A/E | 257 | 73 | 330 | 437 | 124 | 561 | 1693 | 399 | 2092 |
| VFD1100C43A/E | 223 | 73 | 296 | 379 | 124 | 503 | 2107 | 491 | 2599 |
| VFD1320C43A/E | 224 | 112 | 336 | 381 | 190 | 571 | 2502 | 579 | 3081 |
| VFD1600C43A/E | 289 | 112 | 401 | 491 | 190 | 681 | 3096 | 687 | 3783 |
| VFD1850C43A/E |  |  | 454 |  |  | 771 |  |  | 4589 |
| VFD2200C43A/E |  |  | 454 |  |  | 771 |  |  | 5772 |
| VFD2800C43A/E |  |  | 769 |  |  | 1307 |  |  | 6381 |
| VFD3150C43A/E |  |  | 769 |  |  | 1307 |  |  | 7156 |
| VFD3550C43A/E |  |  | 769 |  |  | 1307 |  |  | 8007 |
| VFD4500C43A/E |  |  | 769 |  |  | 1307 |  |  | 11894 |
| ※ The required airflow shown in chart is for installing single drive in a confined space. <br> * When installing the multiple drives, the required air volume should be the required air volume for single drive $X$ the number of the drives. |  |  |  |  |  |  | The heat dissipation shown in the chart is for installing single drive in a confined space. <br> * When installing the multiple drives, volume of heat dissipation should be the heat dissipated for single drive $X$ the number of the drives. <br> \% Heat dissipation for each model is calculated by rated voltage, current and default carrier. |  |  |

## 2-3 Derating Curve Diagram of Normal Duty (Pr.00-16=0)

| - Set Pr.06-55 = 1 <br> - Set Pr.06-55 $=0$ or 2 <br> ( $50^{\circ} \mathrm{C}$ : UL open-type) <br> $\left(40^{\circ} \mathrm{C}\right.$ :UL type1 or open type_size by size) | - Set Pr.06-55 = 0 or 2 <br> ( $40^{\circ} \mathrm{C}$ : UL open-type) <br> ( $30^{\circ} \mathrm{C}$ : UL type 1 or open type_size by size) |
| :---: | :---: |
|  |  |
| - Set Pr.06-55 = 1 <br> - Set Pr.06-55 = 0 or 2 <br> $\left(50^{\circ} \mathrm{C}\right.$ : UL open-type) <br> $\left(40^{\circ} \mathrm{C}\right.$ :UL type1 or open type_size by size) <br> 230 V |  |

## 2-4 Derating Curve Diagram of Heavy Duty (Pr.00-16=1)

- Set Pr.06-55 $=0$ or 2
$\left(50^{\circ} \mathrm{C}\right.$ : UL open-type)
$\left(40^{\circ} \mathrm{C}\right.$ : UL type1 or open type_size by size)
460V

| - VFD007~150C43A/E <br> VFD185~550C43A/E <br> VFD370~450C43S/U <br> - - VFD750~4500C43A/E |  |
| :---: | :---: |



230 V


- Set Pr.06-55 = 0 or 2
( $40^{\circ} \mathrm{C}$ : UL open-type)
$\left(30^{\circ} \mathrm{C}\right.$ : UL type1 or open type_size by size)

460V

- VFD007~150C43A/E
- VFD185~550C43A/E

VFD370~450C43S/U

-     -         - VFD750~4500C43A/E


230V


## Chapter 3 Unpacking

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

## 3-1 Unpacking

The AC motor drive is packed in the crate. Follows the following step for unpack:
Frame D


Remove the EPEs and manual.

Loosen the 8 screws that fastened on the pallet and remove the wooden plate.


Crate 2 (VFDXXXCXXE)
Loosen the 4 screws on the iron plates. There are 4 iron plates and in total of 16 screws.

Remove the crate cover, EPEs, rubber and manual.


Lift the drive by hooking the lifting hole. It is now ready for installation.


Lift the drive by hooking the lifting hole. It is now ready for installation.


Frame E

## Crate 1 (VFDXXXCXXA)

Loosen the 4 screws on the iron plates. There are 4 iron plates and in total of 16 screws.


Crate 2 (VFDXXXCXXE)
Loosen the 4 screws on the iron plates. There are 4 iron plates and in total of 16 screws.



## Frame F

Crate 1 (VFDXXXCXXA)
Remove the 6 clips on the side of the crate with a flat-head screwdriver. (As shown in figure below.)


Loosen the 5 screws on the pallet as shown in the following figure.


Crate 2 (VFDXXXCXXE)
Remove the 6 clips on the side of the crate with a flat-head screwdriver. (As shown in figure below.)
Remove the crate cover, EPEs and manual.

Lift the drive by hooking the lifting hole. It is now ready for installation


Lift the drive by hooking the lifting hole. It is now ready for installation.


## Frame G

Crate 1 (VFDXXXCXXA)
Crate 2 (VFDXXXCXXE)
Remove the 6 clips on the side of the crate with a Remove the 6 clips on the side of the crate with a flathead screwdriver. (As shown in figure below.) flathead screwdriver. (As shown in figure below.)

4


Remove the crate cover, EPEs, rubber and manual.


Loosen the 5 screws as shown in following figure:


Lift the drive by hooking the lifting hole. It is now ready for installation.


Loosen the 9 screws and remove the wooden plate.


Lift the drive by hooking the lifting hole. It is now ready for installation.


## Frame H

Crate 1 (VFDXXXC43A)
Remove the 8 clips on the side of the crate with a flathead screwdriver. (As shown in figure below.)

Crate 2 (VFDXXXC43E-1)
Remove the 8 clips on the side of the crate with a flathead screwdriver. (As shown in figure below.)



Secure the drive from the external. (Skip to the next step if this situation does not apply to you.) Loosen 8 of M8 screws on the both sides and place the 2 plates that were removed from the last step. Fix the plates to AC motor drive by fasten 8 of the M8 screws. (As shown in below) Torque: $150 \sim 180 \mathrm{~kg}-\mathrm{cm}$ (130.20~156.24lb-in.)


Lift the drive by hooking the lifting hole. It is now ready for installation.


## Frame H

Crate 3 (VFDXXXC43E)
Use flathead screwdriver to remove the clips on the side of the crate, 8 clips in total.


Remove the crate cover, EPEs, rubber and manual.


Loosen the 6 screws on the cover, remove 6 metal washers and 6 plastic washers as shown in below:


Loosen 6 of the M6 screws on the side and removes the 2 plates, as shown in following figure. The removed screws and plates can be used to secure AC motor drive from the external.


## Secure the drive from the internal.

Loosen 18 of the M6 screws and remove the top cover as shown in figure 2. Mount the cover (figure 1) back to the drive by fasten the M6 screws to the two sides of the drive, as shown in figure 2.
Torque: $35 \sim 45 \mathrm{~kg}-\mathrm{cm}(30.38 \sim 39.06 \mathrm{lb}-\mathrm{in}$.)


Figure 1
Top cover (Use M12 screws)

## Secure the drive from the external.

Loosen 8 of the M8 screws on the both sides and place the 2 plates that were removed from the last step. Fix the plates to rive by fasten 8 of the M8 screws. (As shown in figure below).

Torque: $150 \sim 180 \mathrm{~kg}-\mathrm{cm}$ (130.20~156.24Ib-in.)



Figure 2
Fasten 6 of the M6 screws back to the original position where it was removed. As shown in the figure:


Lift the drive by hooking the lifting hole. It is now ready for installation.


Frame H Secure the drive
(VFDXXXC43A)
Screw: M12*6
Torque: $340-420 \mathrm{~kg}-\mathrm{cm}$ [295.1-364.6lb-in.]



Secure the drive from the internal.

Screw: M12*8
Torque: $340-420 \mathrm{~kg}-\mathrm{cm}$ [295.1-364.6lb-in.]


## 3-2 The Lifting Hook

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


Figure 1


Figure 2


Figure 3


Figure 4


Figure 5

Ensure the lifting hook properly goes through the lifting hole, as shown in the following diagram. (Applicable to Frame D~E)

(Applicable to Frame F~H)


Ensure the angle between the lifting holes and the lifting device is within the specification, as shown in the following figure. (Applicable to Frame D~E)

(Applicable to Frame F~H)


Weight


H1: VFD2800C43A; VFD3150C43A; VFD3550C43A; VFD4500C43A 235kg (518.1lbs)



H3: VFD2800C43E; VFD3150C43E; VFD3550C43E; VFD4500C43E 263kg (579.8lbs)


## Chapter 4 Wiring

After removing the front cover, examine if the power and control terminals are clearly noted. Please read following precautions before wiring.

■ Make sure that power is only applied to the R/L1, S/L2, T/L3 terminals. Failure to comply may result in damage to the equipments. The voltage and current should lie within the range as indicated on the nameplate (Chapter 1-1).
$\square$ All the units must be grounded directly to a common ground terminal to prevent lightning strike or electric shock.
$\square$ Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration


च It is crucial to turn off the AC motor drive power before any wiring installation are made. A charge may still remain in the DC bus capacitors with hazardous voltages even if the power has been turned off therefore it is suggested for users to measure the remaining voltage before wiring. For your personnel saftery, please do not perform any wiring before the voltage drops to a safe level < 25 Vdc . Wiring installation with remaninig voltage condition may caus sparks and short circuit.
च Only qualified personnel familiar with AC motor drives is allowed to perform installation, wiring and commissioning. Make sure the power is turned off before wiring to prevent electric shock.


V When wiring, please choose the wires with specification that complys with local regulation for your personnel safety.
$\boxtimes$ Check following items after finishing the wiring:

1. Are all connections correct?
2. Any loosen wires?
3. Any short-circuits between the terminals or to ground?


## Wiring Diagram for Frame D and Frames Above

* It provides 3-phase power


Figure 1


Figure 2
SINK (NPN) /SOURCE (PNP) Mode


## Figure 3

Function of DC Link

च Applicable to Frame E~H

- Operation Instruction

1. When RST power is off, please disconnect terminal $r$ and terminal $s$. (As circled in dotted line, uninstall the gray section and properly store cable $r$ and cable $s$. Cable $r$ and cable s are not available in optional accessories, do not dispose them.)

After terminal $r$ and terminal $s$ are cleared, user may now connect new power source to terminal $r$ and terminal s. Please connect 220Vac for 220 V model and 440 Vac for 440 V model.

When the drive power is on, if terminal $r$ and terminal s are not connected to new power source ( 220 Vac for 220 V model and 440 Vac for 440 V model), the digital keypad will display an error message "ryF".
2. When DC Link is used as a DC Bus connection (RST power is applied), it is not required to remove terminal $r$ and terminal $s$.

## \#, NOTE

Common DC Bus can only be applied to the drives with same power range. If in your case the drives are in different power range, please contact with us (Delta Industrial Automation Business Unit).


## Chapter 5 Main Circuit Terminals

## 5-1 Main Circuit Diagram

For frame A~C
Brake resistor
(optional)

* Provide 3-phase input power


For frame A~C

* Provide 3-phase input power

DC choke (optional)

Jumper

Brake resistor
(optional)


For frame D and above D

* Provide 3-phase input power




CAUTION

## Main power terminals

ஏ Do not connect 3-phase model to one-phase power. R/L1, S/L2 and T/L3 has no phase-sequence requirement, it can be used upon random selection.
$\square \quad \mathrm{It}$ is recommend to add a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunction when activating the protection function of the AC motor drive. Both ends of the MC should have an $\mathrm{R}-\mathrm{C}$ surge absorber.
$\square \quad$ Fasten the screws in the main circuit terminal to prevent sparks condition made by the loose screws due to vibration.
$\square \quad$ Please use voltage and current within the specification.
$\square$ When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200 mA or above and not less than 0.1 -second operation time to avoid nuisance tripping.
$\boxtimes \quad$ Please use the shield wire or tube for the power wiring and ground the two ends of the shield wire or tube.
च Do NOT run/stop AC motor drives by turning the power ON/OFF. Run/stop AC motor drives by RUN/STOP command via control terminals or keypad. If you still need to run/stop AC motor drives by turning power ON/OFF, it is recommended to do so only ONCE per hour.

## Output terminals for main circuit

$\square$ When it needs to install the filter at the output side of terminals U/T1, V/T2, W/T3 on the AC motor drive. Please use inductance filter. Do not use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.
$\boxtimes$ DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of AC motor drives.
■ Use well-insulated motor, suitable for inverter operation.
Terminals for connecting DC reactor, external brake resistor, external brake resistor and DC circuit
$\boxtimes \quad$ This is the terminals used to connect the DC reactor to improve the power factor. For the factory setting, it connects the short-circuit object. Please remove this short-circuit object before connecting to the DC reactor.

$\boxtimes \quad$ When the AC Motor Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, excess peak currents may occur in the power input circuit due to the load changes and the converter section may be damaged. To avoid this, it is recommend to use a serial connected AC input reactor(6\%) at the AC Motor Drive mains input side to reduce the current and improve the input power efficiency.
$\square$ Connect a brake resistor or brake unit in applications with frequent deceleration ramps, short deceleration time, too low brake torque or requiring increased brake torque.

$\boxtimes$ For Frame A~C, the external brake resistor should connect to the terminals (B1, B2) of AC motor drives.
$\boxtimes$ For those models without built-in braking chopper, please connect external brake unit and brake resistor (both of them are optional) to increase brake torque.
$\square$ When the terminals $+1,+2$ and - are not used, please leave the terminals open.
$\boxtimes$ DO NOT connect [+1, -], [+2, -], [+1/DC+, -/DC-] or brake resistor directly to prevent drive damage.
$\boxtimes \quad$ DC+ and DC- are connected by common DC bus, please refer to Chapter 5-1(Main Circuit Terminal) for the wiring terminal specification and the wire gauge information.
$\square$ Please refer to the VFDB manual for more information on wire gauge when installing the brake unit.

## 5-2 Main Circuit Terminals

Frame A


Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, © ${ }^{-}$, B1, B2, +1, +2, -

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque ( $\pm 10 \%$ ) |
| :---: | :---: | :---: | :---: |
| VFD007C23A | $\begin{gathered} 8 \mathrm{AWG} \\ \left(8.4 \mathrm{~mm}^{2}\right) \end{gathered}$ | 14 AWG (2.1mm ${ }^{2}$ ) | $\begin{gathered} \mathrm{M} 4 \\ 20 \mathrm{~kg}-\mathrm{cm} \\ (17.4 \mathrm{lb}-\mathrm{in} .) \\ (1.962 \mathrm{Nm}) \end{gathered}$ |
| VFD015C23A |  | 12 AWG (3.3mm ${ }^{2}$ ) |  |
| VFD022C23A |  | 10 AWG (5.3mm ${ }^{2}$ ) |  |
| VFD037C23A |  | 8 AWG (8.4mm²) |  |
| VFD007C43A |  | 14 AWG (2.1 $\mathrm{mm}^{2}$ ) |  |
| VFD007C43E |  | 14 AWG (2.1 $\mathrm{mm}^{2}$ ) |  |
| VFD015C43A |  | 14 AWG (2.1 mm ${ }^{2}$ ) |  |
| VFD015C43E |  | 14 AWG (2.1 $\mathrm{mm}^{2}$ ) |  |
| VFD022C43A |  | 14 AWG (2.1 $\mathrm{mm}^{2}$ ) |  |
| VFD022C43E |  | 14 AWG ( $2.1 \mathrm{~mm}^{2}$ ) |  |
| VFD037C43A |  | 10 AWG (5.3mm ${ }^{2}$ ) |  |
| VFD037C43E |  | 10 AWG (5.3mm ${ }^{2}$ ) |  |
| VFD040C43A |  | 10 AWG (5.3mm ${ }^{2}$ ) |  |
| VFD040C43E |  | 10 AWG (5.3mm²) |  |
| VFD055C43A |  | 10 AWG (5.3mm ${ }^{2}$ ) |  |
| VFD055C43E |  | 10 AWG (5.3mm ${ }^{2}$ ) |  |

UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only.

1. Figure 1 shows the terminal specification.
2. Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

Figure 1


Figure 2


Frame B


Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, © ${ }^{-}$, B1, B2, +1, +2, -

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD055C23A | $\begin{gathered} 4 \mathrm{AWG} \\ \left(21.2 \mathrm{~mm}^{2}\right) \end{gathered}$ | 8 AWG (8.4mm ${ }^{2}$ ) | $\begin{gathered} \text { M5 } \\ 35 \mathrm{~kg}-\mathrm{cm} \\ (30.4 \mathrm{lb}-\mathrm{in} .) \\ (3.434 \mathrm{Nm}) \end{gathered}$ |
| VFD075C23A |  | 6 AWG (13.3mm ${ }^{2}$ ) |  |
| VFD110C23A |  | 4 AWG (21.2mm ${ }^{2}$ ) |  |
| VFD075C43A |  | 8 AWG (8.4mm ${ }^{2}$ ) |  |
| VFD075C43E |  | 10 AWG ( $5.3 \mathrm{~mm}^{2}$ ) |  |
| VFD110C43A |  | 8 AWG (8.4mm ${ }^{2}$ ) |  |
| VFD110C43E |  | 8 AWG (8.4mm ${ }^{2}$ ) |  |
| VFD150C43A |  | 6 AWG (13.3mm ${ }^{2}$ ) |  |
| VFD150C43E |  | 8 AWG (8.4mm ${ }^{2}$ ) |  |
| UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only. |  |  |  |

## NOTE

Terminal D+ [+2 \& +1]: Torque: $45 \mathrm{~kg}-\mathrm{cm}[39.0 \mathrm{lb}-\mathrm{in}].(4.415 \mathrm{Nm})( \pm 10 \%)$

1. VFD110C23A must use $600 \mathrm{~V}, 90^{\circ} \mathrm{C}$ wire when surrounding temperature exceeds $45^{\circ} \mathrm{C}$.
2. Figure 1 shows the terminal specification.
3. Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

Figure 1


Figure 2
Ring lug

Heat Shrink Tube

Frame C


Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, © ${ }^{(2)}$, B1, B2, +1, +2, -

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD150C23A | 1/0 AWG$\left(53.5 \mathrm{~mm}^{2}\right)$ | 1 AWG (42.4mm²) | $\begin{gathered} \mathrm{M} 8 \\ 80 \mathrm{~kg}-\mathrm{cm} \\ (69.4 \mathrm{lb}-\mathrm{in} .) \\ (7.85 \mathrm{Nm}) \end{gathered}$ |
| VFD185C23A |  | 1/0 AWG ( $53.5 \mathrm{~mm}^{2}$ ) |  |
| VFD220C23A |  | 1/0 AWG ( $53.5 \mathrm{~mm}^{2}$ ) |  |
| VFD185C43A |  | 4 AWG (21.2mm²) |  |
| VFD185C43E |  | 6 AWG (13.3 $\mathrm{mm}^{2}$ ) |  |
| VFD220C43A |  | 4 AWG (21.2 $\mathrm{mm}^{2}$ ) |  |
| VFD220C43E |  | 4 AWG ( $21.2 \mathrm{~mm}^{2}$ ) |  |
| VFD300C43A |  | 2 AWG (33.6mm²) |  |
| VFD300C43E |  | 3 AWG ( $26.7 \mathrm{~mm}^{2}$ ) |  |

UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only.

## 目, NOTE

Terminal $\mathrm{D}+[+2$ \& +1]: Torque: $90 \mathrm{~kg}-\mathrm{cm}[78.2 \mathrm{lb}-\mathrm{in}].(8.83 \mathrm{Nm})( \pm 10 \%)$

1. VFD220C23A must use $600 \mathrm{~V}, 90^{\circ} \mathrm{C}$ wire when surrounding temperature exceeds $40^{\circ} \mathrm{C}$.
2. Figure 1 shows the terminal specification.
3. Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

Figure 1


Figure 2


Frame D0


Main circuit terminals :
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, © ${ }^{(2)}+1 / \mathrm{DC}+$, -/DC-

| Models | Max. Wire <br> Gauge | Min. Wire Gauge | Torque <br> $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD370C43S |  | $1 / 0$ AWG (53.5mm 2$)$ | M8 |
|  | VFD450C43S | $2 / 0$ AWG | 2/0 AWG (67.4mm 2$)$ | | $80 \mathrm{~kg}-\mathrm{cm}$ |
| :---: |
| $(70 \mathrm{lb}-\mathrm{in})$. |

UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only.
Specification of grounding wire: 2 AWG ${ }^{*} 2\left(33.6 \mathrm{~mm}^{2} * 2\right)$
Figure 1 shows the terminal specification.
Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

Figure 1


Figure 2


Heat Shrink Tube
WIRE

Frame D


Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ${ }^{-}$, +1/DC+, -/DC-

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD300C23A | $\begin{aligned} & 300 \mathrm{MCM} \\ & \left(152 \mathrm{~mm}^{2}\right) \end{aligned}$ | 4/0 AWG (107mm ${ }^{2}$ ) | M8$200 \mathrm{~kg}-\mathrm{cm}$$(173 \mathrm{lb}-\mathrm{in}$.$(19.62 \mathrm{Nm})$ |
| VFD370C23A |  | 250MCM ( $127 \mathrm{~mm}^{2}$ ) |  |
| VFD370C43A |  | 1/0 AWG ( $53.5 \mathrm{~mm}^{2}$ ) |  |
| VFD450C43A |  | 2/0 AWG ( $67.4 \mathrm{~mm}^{2}$ ) |  |
| VFD550C43A |  | 3/0 AWG (85mm ${ }^{2}$ ) |  |
| VFD750C43A |  | 300MCM ( $152 \mathrm{~mm}^{2}$ ) |  |
| VFD300C23E | 4/0 AWG. ( $107 \mathrm{~mm}^{2}$ ) | 3/0 AWG (85mm ${ }^{2}$ ) |  |
| VFD370C23E |  | 4/0 AWG (107 mm ${ }^{2}$ ) |  |
| VFD370C43E |  | 1/0 AWG ( $53.5 \mathrm{~mm}^{2}$ ) |  |
| VFD450C43E |  | 1/0 AWG ( $53.5 \mathrm{~mm}^{2}$ ) |  |
| VFD550C43E |  | 2/0 AWG ( $67.4 \mathrm{~mm}^{2}$ ) |  |
| VFD750C43E |  | 4/0 AWG (107 $\mathrm{mm}^{2}$ ) |  |

1. UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wires. Use copper wire only.
2. Figure 1 shows the terminal specification.
3. Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

Figure 1


Figure 2


## Frame E



Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, $\Theta$, +1/DC,$+-/ D C-$

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD450C23A | $\begin{aligned} & 300 \mathrm{MCM} * 2 \\ & \left(152 \mathrm{~mm}^{2} * 2\right) \end{aligned}$ | 1/OAWG*2 ( $53.5 \mathrm{~mm}^{2}$ 2) | $\begin{gathered} \text { M8 } \\ 200 \mathrm{~kg}-\mathrm{cm} \\ (173 \mathrm{lb}-\mathrm{in} .) \\ (19.62 \mathrm{Nm}) \end{gathered}$ |
| VFD550C23A |  | 3/0AWG*2 (85mm²*) |  |
| VFD750C23A |  | 4/0 AWG*2 (107 $\mathrm{mm}^{2} * 2$ ) |  |
| VFD900C43A |  | 1/OAWG*2 ( $53.5 \mathrm{~mm}^{2}$ 2) |  |
| VFD1100C43A |  | 3/0AWG*2 (85mm²*) |  |
| VFD450C23E | $\begin{gathered} \text { 4/0 AWG*2 } \\ \left(107 \mathrm{~mm}^{2 *} *\right) \end{gathered}$ | 1/OAWG*2 ( $53.5 \mathrm{~mm}^{2}$ 2) |  |
| VFD550C23E |  | 2/OAWG*2 (67.4mm ${ }^{2}$ 2) |  |
| VFD750C23E |  | 3/0AWG*2 (85mm²*) |  |
| VFD900C43E |  | 1/OAWG*2 ( $53.5 \mathrm{~mm}^{2}$ 2) |  |
| VFD1100C43E |  | 2/OAWG*2 (67.4mm ${ }^{2}$ 2) |  |

1. UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wires. Use copper wire only.
2. Specification of grounding wire $\triangle: 300 \mathrm{MCM}\left[152 \mathrm{~mm}^{2}\right]$ Torque: M8 180kg-cm (156 Ib-in.) (17.64Nm) ( $\pm 10 \%$ ), as shown in Figure 2.
3. Figure 1 shows the specification for ring lug.
4. Figure 3 shows the specification of insulated heat shrink tubing that comply with UL (600C, YDPU2).

Figure 1


Figure $2 \ominus \mathrm{E}$


Figure 3


## Frame F



Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, +1/DC+, -/DC-

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD900C23A | $\begin{aligned} & 300 \mathrm{MCM} * 2 \\ & \left(152 \mathrm{~mm}^{2} * 2\right) \end{aligned}$ | 300MCM*2 (152mm ${ }^{2}$ 2) | $\begin{gathered} \mathrm{M8} \\ 200 \mathrm{~kg}-\mathrm{cm} \\ (173 \mathrm{lb}-\mathrm{in} .) \\ (19.62 \mathrm{Nm}) \end{gathered}$ |
| VFD1320C43A |  | 4/0 AWG*2 (107mm ${ }^{2}$ 2) |  |
| VFD1600C43A |  | 300MCM*2 (152mm²) |  |
| VFD900C23E | $\begin{aligned} & \text { 4/0 AWG*2 } \\ & \left(107 \mathrm{~mm}^{2 *} *\right) \end{aligned}$ | 4/0 AWG*2 (107 $\mathrm{mm}^{2} * 2$ ) |  |
| VFD1320C43E |  | 3/0AWG*2 (85mm ${ }^{2}$ 2) |  |
| VFD1600C43E |  | 4/0 AWG*2 (107mm ${ }^{2}$ 2) |  |

1. VFD900C23A/E installations must use $90^{\circ} \mathrm{C}$ wire.
2. For other model, UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only.
3. Specification of grounding wire$300 \mathrm{MCM} * 2\left[152 \mathrm{~mm}^{2} * 2\right]$ Torque: M8 200kg-cm (173 lb-in.) (19.62Nm) ( $\pm 10 \%$ )
4. Figure 1 shows the specification for ring lug.
5. Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600C, YDPU2).

Figure 1


Figure 2


## Frame G



Main circuit terminals:
R/L11, R/L12, S/L21, S/L22, T/L31, T/L32

| Models | Max. Wire Gauge | Min. Wire Gauge | $\begin{aligned} & \text { Torque } \\ & ( \pm 10 \%) \end{aligned}$ |
| :---: | :---: | :---: | :---: |
| VFD1850C43A | $\begin{aligned} & 300 \mathrm{MCM} * 4 \\ & \left(152 \mathrm{~mm}^{2 *} * 4\right) \end{aligned}$ | 2/OAWG*4 (67.4mm ${ }^{2 * 4 \text { ) }}$ | $\begin{gathered} \mathrm{M8} \\ 200 \mathrm{~kg}-\mathrm{cm} \\ (173 \mathrm{lb}-\mathrm{in} .) \\ (19.62 \mathrm{Nm}) \end{gathered}$ |
| VFD2200C43A |  |  |  |
| VFD1850C43E |  | 1/OAWG*4 (53.5mm ${ }^{2 * 4 \text { ) }}$ |  |
| VFD2200C43E |  | 2/OAWG*4 (67.4mm ${ }^{2 * 4 \text { ) }}$ |  |

Main circuit terminals:
U/T1, V/T2, W/T3, +1/DC+, -/DC-

| Models | Max. Wire Gauge | Min. Wire Gauge | Torque $( \pm 10 \%)$ |
| :---: | :---: | :---: | :---: |
| VFD1850C43A | $\begin{aligned} & 500 \mathrm{MCM} * 2 \\ & \left(253 \mathrm{~mm}^{2} * 2\right) \end{aligned}$ | 400MCM*2 ${ }^{\text {(203mm }}{ }^{2} 2$ ) | $\begin{gathered} \text { M12 } \\ 408 \mathrm{~kg}-\mathrm{cm} \\ (354 \mathrm{lb}-\mathrm{in} .) \\ (40 \mathrm{Nm}) \end{gathered}$ |
| VFD2200C43A |  | 500MCM*2 $253 \mathrm{~mm}^{2}$ 2) |  |
| VFD1850C43E |  | $300 \mathrm{MCM} * 2\left(152 \mathrm{~mm}^{2}\right.$ 2) |  |
| VFD2200C43E |  | 400MCM*2 $203 \mathrm{~mm}^{2} * 2$ ) |  |

1. UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only.
2. Use $600 \mathrm{~V}, 90^{\circ} \mathrm{C}$ wire for VFD2200C43A when the surrounding temperature is over $45^{\circ} \mathrm{C}$.
3. Figure 1 and Figure 2 show the specification for using ring lug.
4. Specification for grounding wire $\Theta: 300 \mathrm{MCM}^{*} 4\left[152 \mathrm{~mm}^{2} * 2\right]$

Torque: M8 $180 \mathrm{~kg}-\mathrm{cm}$ ( $156 \mathrm{lb}-\mathrm{in}$.) ( 17.64 Nm ) ( $\pm 10 \%$ ), as shown in Figure 1
5. Figure 3 and Figure 4 shows the specification of insulated heat shrink tubing that comply with UL (600C, YDPU2).
Figure 1
R/L11, R/L12, S/L21, S/L22,
T/L31, T/L32,


Figure2
U/T1, V/T2, W/T3, +1/DC+, -/DC-


Figure 3
Figure 4


Frame H


Main circuit terminals:
R/11,R12,S/21,S/22,T/31,T/32, U/T1,V/T2, W/T3, +1/DC+, -/DC-

| Models | Max. Wire Gauge | Min. Wire Gauge | $\begin{aligned} & \text { Torque } \\ & ( \pm 10 \%) \end{aligned}$ |
| :---: | :---: | :---: | :---: |
| VFD2800C43A | $\begin{gathered} 300 \mathrm{MCM} * 4 \\ \left(152 \mathrm{~mm}^{2 *} *\right) \end{gathered}$ | 4/0 AWG*4 (107mm ${ }^{2 * 4 \text { ) }}$ | $\begin{gathered} \mathrm{M} 8 \\ 200 \mathrm{~kg}-\mathrm{cm} \\ (173 \mathrm{lb}-\mathrm{in} .) \\ (19.62 \mathrm{Nm}) \end{gathered}$ |
| VFD3150C43A |  | $300 \mathrm{MCM} * 4\left(152 \mathrm{~mm}^{2 *} 4\right)$ |  |
| VFD3550C43A |  | $300 \mathrm{MCM} * 4\left(152 \mathrm{~mm}^{2 * 4}\right)$ |  |
| VFD4500C43A |  | $300 \mathrm{MCM} * 4\left(152 \mathrm{~mm}^{2 * 4}\right)$ |  |
| VFD2800C43E-1 |  |  |  |
| VFD3150C43E-1 |  | 4/0 AWG*4 (107mm ${ }^{2 * 4)}$ |  |
| VFD3550C43E-1 |  | $250 \mathrm{MCM} * 4\left(127 \mathrm{~mm}^{2 *} 4\right)$ |  |
| VFD4500C43E-1 |  | $250 \mathrm{MCM} * 4\left(127 \mathrm{~mm}^{2} * 4\right)$ |  |
| VFD2800C43E |  |  |  |
| VFD3150C43E |  | 4/0 AWG*4 (107mm ${ }^{2}$ * 4 ) |  |
| VFD3550C43E |  | 250MCM*4 (127mm ${ }^{2 *}$ ) |  |
| VFD4500C43E |  | 250MCM*4 $\left(127 \mathrm{~mm}^{2} * 4\right)$ |  |

1. UL installations must use $600 \mathrm{~V}, 75^{\circ} \mathrm{C}$ or $90^{\circ} \mathrm{C}$ wire. Use copper wire only.
2. Figure 1 shows the specification for using the ring lug.
3. Specification of grounding wire $\fallingdotseq: 300 \mathrm{MCM} * 4\left[152 \mathrm{~mm}^{2 *} 4\right]$, Torque: M8 180kg-cm (156 lb-in.) (17.64Nm) ( $\pm 10 \%$ ), as shown in figure 1.
4. Figure 2 shows the specification of heat shrink tubing that comply with UL (600C, YDPU2).

Figure 1


Figure 2


## Chapter 6 Control Terminals

Please remove the top cover before wiring the multi-function input and output terminals,
The drive appearances shown in the figures are for reference only, a real drive may look different.
Remove the cover for wiring. Frame A~H
Frame A\&B
Frame C\&D
Loosen the screws and press the tabs on both sides Screw torque: 12~15Kg-cm [10.4~13lb-in.] to remove the cover.
Screw torque: 12~15Kg-cm [10.4~13lb-in.]


Frame E
Screw torque: $12 \sim 15 \mathrm{Kg}-\mathrm{cm}$ [10.4~13lb-in.] To remove the cover, lift it slightly and pull outward.


Frame F
Screw torque: $12 \sim 15 \mathrm{Kg}-\mathrm{cm}$ [10.4~13lb-in.] To remove the cover, lift it slightly and pull outward


## Frame G

Screw torque: $12 \sim 15 \mathrm{Kg}-\mathrm{cm}$ [10.4~13lb-in.] To remove the cover, lift it slightly and pull outward


Frame H
Screw torque: $14 \sim 16 \mathrm{Kg}-\mathrm{cm}$ [12.15~13.89Ib-in.] To remove the cover, lift it slightly and pull outward


## 6-1 Specifications of Control Terminal



## Removable Terminal Block

Wire Gauge: 26~16AWG ( $0.1281-1.318 \mathrm{~mm}^{2}$ ),
Torque: (A) $5 \mathrm{~kg}-\mathrm{cm}$ [4.31lb-in.] ( 0.49 Nm ) (As shown in figure above)
(B) $8 \mathrm{~kg}-\mathrm{cm}[6.94 \mathrm{lb}-\mathrm{in}$.$] ( 0.78 \mathrm{Nm}$ ) (As shown in figure above)

Wiring precautions:

- Reserves 5 mm and properly install the wire into the terminal; fasten the installation by a slotted screwdriver. If the wire is stripped, sort the wire before install into the terminal.
- Flathead screwdriver: blade width 3.5 mm , tip thickness 0.6 mm
- In the figure above, the factory setting for S1-SCM is short circuit. The factory setting for +24 V -COM is short circuit and SINK mode (NPN); please refer to Chapter 4 Wiring for more detail.

| Terminals | Terminal Function | Factory Setting (NPN mode) |
| :---: | :---: | :---: |
| +24V | Digital control signal common (Source) | +24V $\pm 5 \% 200 \mathrm{~mA}$ |
| COM | Digital control signal common (Sink) | Common for multi-function input terminals |
| FWD | Forward-Stop command | FWD-DCM: <br> ON $\rightarrow$ forward running <br> OFF $\rightarrow$ deceleration to stop |
| REV | Reverse-Stop command | REV-DCM: <br> ON $\rightarrow$ reverse running <br> OFF $\rightarrow$ deceleration to stop |
| $\begin{gathered} \text { MI1 } \\ \text { MI8 } \end{gathered}$ | Multi-function input 1~8 | Refer to parameters 02-01~02-08 to program the multi-function inputs MI1~MI8. <br> ON : the activation current is $6.5 \mathrm{~mA} \geqq 11 \mathrm{Vdc}$ OFF: leakage current tolerance is $10 \mu \mathrm{~A} \leqq 11 \mathrm{Vdc}$ |
| DFM | Digital frequency meter | Regard the pulse voltage as the output monitor signal Duty-cycle: 50\% <br> Min. load impedance: $1 \mathrm{k} \Omega / 100 \mathrm{pf}$ <br> Max. current: 30mA |
| DCM | Digital frequency signal common | Max. voltage: 30 Vdc |
| MO1 | Multi-function Output 1 (photocoupler) | The AC motor drive releases various monitor signals, such as drive in operation, frequency attained and overload indication, via transistor (open collector). |


| Terminals | Terminal Function | Factory Setting (NPN mode) |
| :---: | :---: | :---: |
| MO2 | Multi-function Output 2 (photocoupler) |  |
| MCM | Multi-function Output Common | Max 48Vdc 50mA |
| RA1 | Multi-function relay output 1 (N.O.) a | Resistive Load: 5A(N.O.)/3A(N.C.) 250VAC |
| RB1 | Multi-function relay output 1 (N.C.) b | 5A(N.O.)/3A(N.C.) 30VDC <br> Inductive Load (COS 0.4): |
| RC1 | Multi-function relay common | 2.0A(N.O.)/1.2A(N.C.) 250 VAC |
| RA2 | Multi-function relay output 2 (N.O.) a | 2.0A(N.O.)/1.2A(N.C.) 30VDC <br> These terminals are to output monitoring signals, such |
| RB2 | Multi-function relay output 2 (N.C.) b | indication. <br> Note: RA1 and RA2 have N.O. and N.C.. |
| RC2 | Multi-function relay common |  |
| +10V | Potentiometer power supply | Analog frequency setting: +10Vdc 20 mA |
| -10V | Potentiometer power supply | Analog frequency setting: -10Vdc 20 mA |
| AVI | Analog voltage input | Impedance: 20k $\Omega$ <br> Range: $0 \sim 20 \mathrm{~mA} / 4 \sim 20 \mathrm{~mA} / 0 \sim 10 \mathrm{~V}=0 \sim$ Max. Output Frequency (Pr.01-00) <br> AVI switch, factory setting is $0 \sim 10 \mathrm{~V}$ |
| ACI | Analog current input | Impedance: $250 \Omega$ <br> Range: $0 \sim 20 \mathrm{~mA} / 4 \sim 20 \mathrm{~mA} / 0 \sim 10 \mathrm{~V}=0 \sim$ Max. Output Frequency (Pr.01-00) <br> ACI Switch, factory setting is $4 \sim 20 \mathrm{~mA}$ |
| AUI | Auxiliary analog voltage input | Impedance: $20 \mathrm{k} \Omega$ <br> Range: -10~+10VDC=0 ~ Max. Output Frequency(Pr.01-00) |
| AFM1 |  | $0 \sim 10 \mathrm{~V}$ Max. output current 2 mA , Max. load $5 \mathrm{k} \Omega$ <br> $-10 \sim 10 \mathrm{~V}$ maximum output current 2 mA , maximum load $5 \mathrm{k} \Omega$ <br> Output current: 2 mA max <br> Resolution: 0~10V corresponds to Max. operation 6-4 |


| Terminals | Terminal Function | Factory Setting (NPN mode) |
| :---: | :---: | :---: |
|  |  | frequency <br> Range: $0 \sim 10 \mathrm{~V} \rightarrow-10 \sim+10 \mathrm{~V}$ <br> AFM 1 Switch, factory setting is $0 \sim 10 \mathrm{~V}$ |
| AFM2 |  | $0 \sim 10 \mathrm{~V}$ Max. output current 2 mA , Max. load $5 \mathrm{k} \Omega$ <br> $0 \sim 20 \mathrm{~mA}$ Max. load $500 \Omega$ <br> Output current: 20mA max <br> Resolution: 0~10V corresponds to Max. operation frequency <br> Range: $0 \sim 10 \mathrm{~V} \rightarrow 0 / 4 \sim 20 \mathrm{~mA}$ <br> AFM 2 Switch, factory setting is $0 \sim 10 \mathrm{~V}$ |
| ACM | Analog Signal Common | Common for analog terminals |
| S1 SCM | Power removal safety function for EN954-1 and IEC/EN61508 |  |
| $\begin{gathered} \text { SG+ } \\ \text { SG- } \end{gathered}$ | Modbus RS-485 |  |
| SGND |  |  |
| RJ-45 | PIN 1,2,7,8 :Reserved PIN 3, 6: SGND <br> PIN 4: SG- PIN 5: SG+ |  |

NOTE: Wire size of analog control signals: 18 AWG $\left(0.75 \mathrm{~mm}^{2}\right)$ with shielded wire

## 6-2 Analog input terminals (AVI, ACI, AUI, ACM)

$\checkmark$ Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible $(<20 \mathrm{~m})$ with proper grounding. If the noise is inductive, connecting the shield to terminal ACM can bring improvement.
$\checkmark \quad$ If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor and ferrite core as indicated in the following diagram.


Wind each wires 3 times or more around the core

## Digital inputs (FWD, REV, MI1~MI8, COM)

$\square$ When using contacts or switches to control the digital inputs, please use high quality components to avoid contact bounce.

## Transistor outputs (MO1, MO2, MCM)

च Make sure to connect the digital outputs to the right polarity.
$\square$ When connecting a relay to the digital outputs connect a surge absorber across the coil and check the polarity.

## 6-3 Remove the Terminal Block

1. Loosen the screws by screwdriver. (As shown in figure below).

2. Remove the control board by pulling it out for a distance $6 \sim 8 \mathrm{~cm}$ (as 1 in the figure) then lift the control board upward(as 2 in the figure).


## Chapter 7 Optional Accessories

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

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

230V

| Appl Mo | $\overline{\mathrm{able}}$ | ＊1 125\％Braking Torque 10\％ED |  |  |  |  |  | ＊2 Max．Brake Torque |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HP | kW | Braking Torque （kg－m） | $\begin{gathered}\text { Brake } \\ \text { Unit }\end{gathered}$ ${ }^{* 4}$ VFDB | ${ }^{* 3}$ Braking Resis for each Brak | tor series ke Unit | Resistor value spec．for each AC motor Drive | Total Braking Current（A） | Min． Resistor Value（ $\Omega$ ） | $\begin{aligned} & \text { Max. Total } \\ & \text { Braking } \\ & \text { Current (A) } \\ & \hline \end{aligned}$ | Peak Power （kW） |
| 1 | 0.7 | 0.5 | － | BR080W200 | 00＊1 | 80W200ת | 1.9 | 63.3 | 6 | 2.3 |
| 2 | 1.5 | 1.0 | － | BR200W09 | 91＊1 |  | 4.2 | 47.5 | 8 | 3.0 |
| 3 | 2.2 | 1.5 | － | BR300W070 | 70＊1 | 300W70 | 5.4 | 38.0 | 10 | 3.8 |
| 5 | 3.7 | 2.5 | － | BR400W040 | 40＊1 | 400W40』 | 9.5 | 19.0 | 20 | 7.6 |
| 7.5 | 5.5 | 3.7 | － | BR1K0W020 | 20＊1 | 1000W20』 | 19 | 14.6 | 26 | 9.9 |
| 10 | 7.5 | 5.1 | － | BR1K0W020 | 20＊1 | 1000W20， | 19 | 14.6 | 26 | 9.9 |
| 15 | 11 | 7.5 | － | BR1K5W0 | 13＊1 | 1500W13， | 29 | 13.6 | 28 | 10.6 |
| 20 | 15 | 10.2 | － | BR1K0W4P3＊2 | 2 series | 2000W8．6ת | 44 | 8.3 | 46 | 17.5 |
| 25 | 18 | 12.2 | － | BR1K0W4P3＊2 | 2 series | 2000W8．6ת | 44 | 8.3 | 46 | 17.5 |
| 30 | 22 | 14.9 | － | BR1K5W3P3＊2 | 2 series | 3000W6．6ת | 58 | 5.8 | 66 | 25.1 |
| 40 | 30 | 20.3 | 2015＊2 | BR1K0W5P1＊2 | 2 series | 4000W5．1行 | 75 | 4.8 | 80 | 30.4 |
| 50 | 37 | 25.1 | 2022＊2 | BR1K2W3P9＊2 | 2 series | 4800W3．98 | 97 | 3.2 | 120 | 45.6 |
| 60 | 45 | 30.5 | 2022＊2 | BR1K5W3P3＊2 | 2 series | 6000W3．3S | 118 | 3.2 | 120 | 45.6 |
| 75 | 55 | 37.2 | 2022＊3 | BR1K2W3P9＊2 | 2 series | 7200W2．6ת | 145 | 2.1 | 180 | 68.4 |
| 100 | 75 | 50.8 | 2022＊4 | BR1K2W3P9＊2 | 2 series | 9600W2， | 190 | 1.6 | 240 | 91.2 |
| 125 | 90 | 60.9 | 2022＊4 | BR1K5W3P3＊2 | 2 series | 12000W1．65ת | 230 | 1.6 | 240 | 91.2 |

460V

| Applicable Motor |  | ＊1 $125 \%$ Braking Torque 10\％ED |  |  |  |  |  | ＊2 Max．Brake Torque |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HP | kW | Braking Torque （kg－m） | Brake Unit | ${ }^{* 3}$ Braking Resistor series for each Brake Unit |  | Resistor value spec． for each AC motor Drive | Total Braking Currnet（A） | Min． <br> Resistor <br> Value（ $\Omega$ ） | Max．Total Braking Current（A） | Peak Power （kW） |
|  |  |  | ${ }^{4}$ VFDB |  |  |  |  |  |  |  |
| 1 | 0.7 | 0.5 | － | BR080W | 50＊1 | 80W750 | 1 | 190.0 | 4 | 3.0 |
| 2 | 1.5 | 1.0 | － | BR200W | 60＊1 | 200W360』 | 2.1 | 126.7 | 6 | 4.6 |
| 3 | 2.2 | 1.5 | － | BR300W2 | 50＊1 | 300W250』 | 3 | 108.6 | 7 | 5.3 |
| 5 | 3.7 | 2.5 | － | BR400W | 50＊1 | 400W150』 | 5.1 | 84.4 | 9 | 6.8 |
| 5.5 | 4.0 | 2.7 | － | BR1K0W075＊1 |  | 1000W75』 | 10.2 | 54.3 | 14 | 10.6 |
| 7.5 | 5.5 | 3.7 | － |  |  | 1000W75， | 10.2 | 54.3 | 14 | 10.6 |
| 10 | 7.5 | 5.1 | － | BR1K0W075＊1 |  | 1000W75』 | 10.2 | 47.5 | 16 | 12.2 |
| 15 | 11 | 7.5 | － | BR1K5W043＊1 |  | 1500W43』 | 17.6 | 42.2 | 18 | 13.7 |
| 20 | 15 | 10.2 | － | BR1K0W016＊2 | 2 series | 2000W32』 | 24 | 26.2 | 29 | 22.0 |
| 25 | 18 | 12.2 | － | BR1K0W016＊2 | 2 series | 2000W32』 | 24 | 23.0 | 33 | 25.1 |
| 30 | 22 | 14.9 | － | BR1K5W013＊2 | 2 series | 3000W26， | 29 | 23.0 | 33 | 25.1 |
| 40 | 30 | 20.3 | － | BR1K0W016＊4 | 2 parallel， 2 series | 4000W16』 | 47.5 | 14.1 | 54 | 41.0 |
| 50 | 40 | 25.1 | 4045＊1 | BR1K2W015＊4 | 2 parallel， 2 series | 4800W15 | 50 | 12.7 | 60 | 45.6 |
| 60 | 45 | 30.5 | 4045＊1 | BR1K5W013＊4 | 2 parallel， 2 series | 6000W13』 | 59 | 12.7 | 60 | 45.6 |
| 75 | 55 | 37.2 | 4030＊2 | BR1K0W5P1＊4 | 4 parallel | 8000W10．2』 | 76 | 9.5 | 80 | 60.8 |
| 100 | 75 | 50.8 | 4045＊2 | BR1K2W015＊4 | 2 parallel， 2 series | 9600W7．5』 | 100 | 6.3 | 120 | 91.2 |

460 V

| $\begin{array}{\|r} \hline \text { Appli } \\ \text { Mo } \end{array}$ | able | *1 $125 \%$ Braking Torque 10\%ED |  |  |  |  |  | *2 Max. Brake Torque |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HP | kW | Braking Torque (kg-m) | Brake Unit | *3Braking Resisto each Brake | series for Unit | Resistor value spec. for each AC motor Drive | Total Braking Currnet (A) | Min. <br> Resistor <br> Value ( $\Omega$ ) | Max. Total Braking Current (A) | Peak Power (kW) |
| 125 | 90 | 60.9 | 4045*2 | BR1K5W013*4 | 2 parallel, 2 series | 12000W6.5今 | 117 | 6.3 | 120 | 91.2 |
| 150 | 110 | 74.5 | 4110*1 | BR1K2W015*10 | 5 parallel, 2 series | 12000W6 6 | 126 | 6.0 | 126 | 95.8 |
| 175 | 132 | 89.4 | 4160*1 | BR1K5W012*12 | 6 parallel, 2 series | 18000W4 ${ }^{\text {a }}$ | 190 | 4.0 | 190 | 144.4 |
| 215 | 160 | 108.3 | 4160*1 | BR1K5W012*12 | 6 parallel, 2 series | 18000W4 ${ }^{\text {a }}$ | 190 | 4.0 | 190 | 144.4 |
| 250 | 185 | 125.3 | 4185*1 | BR1K5W012*14 | 7 parallel, 2 series | 21000W3.4 | 225 | 3.4 | 225 | 172.1 |
| 300 | 220 | 148.9 | 4110*2 | BR1K2W015*10 | 5 parallel, 2 series | 24000W3』 | 252 | 3.0 | 252 | 190.5 |
| 375 | 280 | 189.6 | 4160*2 | BR1K5W012*12 | 6 parallel, 2 series | $36000 \mathrm{~W} 2 \Omega$ | 380 | 2.0 | 380 | 288.8 |
| 425 | 315 | 213.3 | 4160*2 | BR1K5W012*12 | 6 parallel, 2 series | $36000 \mathrm{~W} 2 \Omega$ | 380 | 2.0 | 380 | 288.8 |
| 475 | 355 | 240.3 | 4185*2 | BR1K5W012*14 | 7 parallel, 2 series | 42000W1.7 | 450 | 1.7 | 450 | 344.2 |

*1 Calculation for $125 \%$ brake toque: (kw)*125\%*0.8; where 0.8 is motor efficiency.
Because there is a resistor limit of power consumption, the longest operation time for $10 \% \mathrm{ED}$ is 10 sec (on: $10 \mathrm{sec} /$ off: 90 sec ).
*2 Please refer to the Brake Performance Curve for "Operation Duration \& ED" vs. "Braking Current".
$*^{3}$ For heat dissipation, a resistor of 400 W or lower should be fixed to the frame and maintain the surface temperature below $50^{\circ} \mathrm{C}$; a resistor of 1000 W and above should maintain the surface temperature below $350^{\circ} \mathrm{C}$.
${ }^{* 4}$ Please refer to VFDB series Braking Module Instruction for more detail on braking resistor.

## П, №te

1. Definition for Brake Usage ED\%

Explanation: The definition of the brake usage ED (\%) is for assurance of enough time for the brake unit and brake resistor to dissipate away heat generated by braking. When the brake resistor heats up, the resistance would increase with temperature, and brake torque would decrease accordingly. Recommended cycle time is one minute.


For safety concern, install an overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) prior to the drive for abnormal protection. The purpose of installing the thermal overload relay is to protect the brake resistor from damage due to frequent brake, or due to brake unit keeping operating resulted from unusual high input voltage. Under such circumstance, just turn off the power to prevent damaging the brake resistor.

2. If damage to the drive or other equipment is due to the fact that the brake resistors and brake modules in use are not provided by Delta, the warranty will be void.
3. Take into consideration the safety of the environment when installing the brake resistors. If the minimum resistance value is to be utilized, consult local dealers for the calculation of Watt figures.
4. When using more than 2 brake units, equivalent resistor value of parallel brake unit can't be less than the value in the column "Minimum Equivalent Resistor Value for Each AC Drive" (the right-most column in the table). Please read the wiring information in the user manual of brake unit thoroughly prior to operation
5. This chart is for normal usage; if the $A C$ motor drive is applied for frequent braking, it is suggested to enlarge $2 \sim 3$ times of the Watts.
6. Thermal Relay:

Thermal relay selection is basing on its overload capability. A standard braking capacity for C2000 is 10\%ED (Tripping time=10s). The figure below is an example of $406 \mathrm{~V}, 110 \mathrm{kw}$ AC motor drive. It requires the thermal relay to take $260 \%$ overload capacity in 10s (Host starting) and the braking current is 126A. In this case, user should select a rated 50A thermal relay. The property of each thermal relay may vary among different manufacturer, please carefully read specification.


## 7-2 Non-fuse Circuit Breaker

Comply with UL standard: Per UL 508, paragraph 45.8.4, part a, The rated current of the breaker shall be 2~4 times of the maximum rated input current of AC motor drive.

| 3-phase 230V |  |
| :---: | :---: |
| Model | Recommended <br> non-fuse <br> breaker (A) |
| VFD007C23A | 15 |
| VFD015C23A | 20 |
| VFD022C23A | 30 |
| VFD037C23A | 40 |
| VFD055C23A | 50 |
| VFD075C23A | 60 |
| VFD110C23A | 100 |
| VFD150C23A | 125 |
| VFD185C23A | 150 |
| VFD220C23A | 200 |
| VFD300C23A/E | 225 |
| VFD370C23A/E | 250 |
| VFD450C23A/E | 300 |
| VFD550C23A/E | 400 |
| VFD750C23A/E | 450 |
| VFD900C23A/E | 600 |


| 3-phase 460V |  |
| :---: | :---: |
| Model | Recommended <br> non-fuse <br> breaker(A) |
| VFD007C43A/E | 5 |
| VFD015C43A/E | 10 |
| VFD022C43/E | 15 |
| VFD040C3A//E | 20 |
| VFD037C43A/E | 20 |
| VFD055C43A/E | 30 |
| VFD075C43A/E | 40 |
| VFD110C43A/E | 50 |
| VFD150C4A/E | 60 |
| VFD185C43A/E | 75 |
| VFD220C43A/E | 100 |
| VFD300C43A/E | 125 |
| VFD370C43A/E/S/U | 150 |
| VFD50C43A/E/S/U | 175 |
| VFD550C43A/E | 250 |
| VFD750C43A/E | 300 |
| VFD900C43A/E | 300 |
| VFD1100C43A/E | 400 |
| VFD120C43A/E | 500 |
| VFD1600C43A/E | 600 |
| VFD1850C43A/E | 600 |
| VFD2200C43A/E | 800 |
| VFD2800C43A/E | 1000 |
| VFD3150C43A// | 1200 |
| VFD3550C43A/E | 1350 |

## 7-3 Fuse Specification Chart

- Use only the fuses comply with UL certificated.
- Use only the fuses comply with local regulations.

| 230V Model | Input Current I(A) |  | Line Fuse |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Heavy Duty | Normal Duty | I (A) | Bussmann P/N |
| VFD007C23A | 6.1 | 6.4 | 20 | JJS-20 |
| VFD015C23A | 11 | 12 | 35 | JJS-35 |
| VFD022C23A | 15 | 16 | 50 | JJS-50 |
| VFD037C23A | 18.5 | 20 | 80 | JJS-80 |
| VFD055C23A | 26 | 28 | 100 | JJS-100 |
| VFD075C23A | 34 | 36 | 130 | JJS-130 |
| VFD110C23A | 50 | 52 | 175 | JJS-175 |
| VFD150C23A | 68 | 72 | 250 | JJS-250 |
| VFD185C23A | 78 | 83 | 300 | JJS-300 |
| VFD220C23A | 95 | 99 | 350 | JJS-350 |
| VFD300C23A/E | 118 | 124 | 400 | DLS-R-400 |
| VFD370C23A/E | 136 | 143 | 500 | DLS-R-500 |
| VFD450C23A/E | 162 | 171 | 700 | JJN-700 |
| VFD550C23A/E | 196 | 206 | 800 | JJN-800 |
| VFD750C23A/E | 233 | 245 | 1000 | JJN-1000 |
| VFD900C23A/E | 315 | 331 | 1000 | KTU-1000 |


| 460VModel | Input Current I(A) |  | Line Fuse |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Heavy Duty | Normal Duty | 1 (A) | Bussmann P/N |
| VFD007C43A/E | 4.1 | 4.3 | 10 | JJS-10 |
| VFD015C43A/E | 5.6 | 5.9 | 15 | JJS-15 |
| VFD022C43A/E | 8.3 | 8.7 | 20 | JJS-20 |
| VFD037C43A/E | 13 | 14 | 30 | JJS-30 |
| VFD040C43A/E | 14.5 | 15.5 | 35 | JJS-35 |
| VFD055C43A/E | 16 | 17 | 45 | JJS-45 |
| VFD075C43A/E | 19 | 20 | 70 | JJS-70 |
| VFD110C43A/E | 25 | 26 | 90 | JJS-90 |
| VFD150C43A/E | 33 | 35 | 125 | JJS-125 |
| VFD185C43A/E | 38 | 40 | 125 | JJS-125 |
| VFD220C43A/E | 45 | 47 | 150 | JJS-150 |
| VFD300C43A/E | 60 | 63 | 200 | JJS-200 |
| VFD370C43A/E/S/U | 70 | 74 | 300 | DLS-R-300 |
| VFD450C43A/E/S/U | 96 | 101 | 350 | DLS-R-350 |
| VFD550C43A/E | 108 | 114 | 400 | DLS-R-400 |
| VFD750C43A/E | 149 | 157 | 600 | DLS-R-600 |
| VFD900C43A/E | 159 | 167 | 600 | JJN-600 |
| VFD1100C43A/E | 197 | 207 | 800 | JJS-800 |
| VFD1320C43A/E | 228 | 240 | 800 | KTU-800 |
| VFD1600C43A/E | 285 | 300 | 800 | KTU-800 |
| VFD1850C43A/E | 361 | 380 | 800 | KTU-800 |
| VFD2200C43A/E | 380 | 400 | 1000 | KTU-1000 |
| VFD2800C43A/E | 469 | 494 | 1200 | KTU-1200 |
| VFD3150C43A/E | 527 | 555 | 1200 | KTU-1200 |
| VFD3550C43A/E | 594 | 625 | 1600 | KTU-1600 |

## 7-4 Line \& Load AC Reactors (Chokes)

When the AC Motor Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, excess peak currents may occur in the power input circuit due to the load changes and the converter section may be damaged. To avoid this, it is recommend to use a serial connected AC input reactor (6\%) at the AC Motor Drive mains input side to reduce the current and improve the input power efficiency.
$230 \mathrm{~V}, 50 / 60 \mathrm{~Hz}$, 3-phase

| kW | HP | Nominal Amps (rms) | Saturation Current <br> $(\mathrm{rms})$ | Inductance (mh) |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 0.75 | 1 | 5 | 10 | 2.113 | 3.522 |
| 1.5 | 2 | 8 | 16 | 1.321 | 2.201 |
| 2.2 | 3 | 11 | 22 | 0.961 | 1.601 |
| 3.7 | 5 | 17 | 34 | 0.622 | 1.036 |
| 5.5 | 7.5 | 25 | 50 | 0.423 | 0.704 |
| 7.5 | 10 | 33 | 66 | 0.320 | 0.534 |
| 11 | 15 | 49 | 98 | 0.216 | 0.359 |
| 15 | 20 | 65 | 130 | 0.163 | 0.271 |
| 18.5 | 25 | 75 | 150 | 0.141 | 0.235 |
| 22 | 30 | 90 | 180 | 0.117 | 0.196 |
| 30 | 40 | 120 | 240 | 0.088 | 0.147 |
| 37 | 50 | 146 | 292 | 0.072 | 0.121 |
| 45 | 60 | 180 | 360 | 0.059 | 0.098 |
| 55 | 75 | 215 | 430 | 0.049 | 0.082 |
| 75 | 100 | 255 | 510 | 0.041 | 0.069 |
| 90 | 125 | 346 | 692 | 0.031 | 0.051 |

$460 \mathrm{~V}, 50 / 60 \mathrm{~Hz}$, 3 -phase

| kW | HP | Nominal Amps (rms) | Saturation Current <br> $(\mathrm{rms})$ | Inductance (mh) |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $3 \%$ impedance $5 \%$ impedance |  |  |
| 0.75 | 1 | 3 | 6 | 7.045 | 11.741 |
| 1.5 | 2 | 4 | 8 | 5.284 | 8.806 |
| 2.2 | 3 | 6 | 12 | 3.522 | 5.871 |
| 3.7 | 5 | 9 | 18 | 2.348 | 3.914 |
| 4 | 5 | 10.5 | 21 | 2.013 | 3.355 |
| 5.5 | 7.5 | 12 | 24 | 1.761 | 2.935 |
| 7.5 | 10 | 18 | 36 | 1.174 | 1.957 |
| 11 | 15 | 24 | 48 | 0.881 | 1.468 |
| 15 | 20 | 32 | 64 | 0.660 | 1.101 |
| 18.5 | 25 | 38 | 76 | 0.556 | 0.927 |
| 22 | 30 | 45 | 90 | 0.470 | 0.783 |
| 30 | 40 | 60 | 120 | 0.352 | 0.587 |
| 37 | 50 | 73 | 146 | 0.290 | 0.483 |
| 45 | 60 | 91 | 182 | 0.232 | 0.387 |
| 55 | 75 | 110 | 220 | 0.192 | 0.320 |
| 75 | 100 | 150 | 300 | 0.141 | 0.235 |
| 90 | 125 | 180 | 360 | 0.117 | 0.196 |
| 110 | 150 | 220 | 440 | 0.096 | 0.160 |
| 132 | 175 | 260 | 520 | 0.081 | 0.135 |
| 160 | 215 | 310 | 620 | 0.068 | 0.114 |
| 185 | 250 | 370 | 740 | 0.057 | 0.095 |
| 220 | 300 | 460 | 920 | 0.046 | 0.077 |
| 280 | 375 | 550 | 1100 | 0.038 | 0.064 |
| 315 | 425 | 616 | 1232 | 0.034 | 0.057 |
| 355 | 475 |  | 1366 | 0.031 | 0.052 |

* Please contact Delta for VFD4500C43A/E Lin \& Load AC Reactor


## 7-5 Zero Phase Reactors (Chokes)

## RF220X00A



| Cable type (Note) | Recommended Wire Size ( $\mathrm{mm}^{2}$ ) |  |  | Qty. | Wiring Method |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | AWG | $\mathrm{mm}^{2}$ | Nominal ( $\mathrm{mm}^{2}$ ) |  |  |
| Singlecore | $\leq 10$ | $\leq 5.3$ | $\leq 5.5$ | 1 | Diagram A |
|  | $\leq 2$ | $\leq 33.6$ | $\leq 38$ | 4 | Diagram |
| Threecore | $\leq 12$ | $\leq 3.3$ | $\leq 3.5$ | 1 | $\begin{gathered} \text { Diagram } \\ \mathrm{A} \\ \hline \end{gathered}$ |
|  | $\leq 1$ | $\leq 42.4$ | $\leq 50$ | 4 | $\underset{B}{\text { Diagram }}$ |

## NOTE

600 V insulated cable wire

1. The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and the diameter of the cable, i.e. the cable diameter must small enough to go through the center of the zero phase reactor.
2. When wiring, do not goes through the earth core. It only needs to pass through the motor cable or the power cable.
3. When a long motor cable for output is used, a zero phase reactor may be necessary to reduce the radiated emission.

UNIT: mm (inch)


Diagram A
Wind each wire around the core for 4 times. The reactor must be placed at the AC motor drive output side as close as possible.


Diagram B
Put the wires/cables through the middle of the 4 cores that lines in parallel.


## 7-6 DC Reactors (Chokes)

## 230V DC Choke

| Input Voltage | kW | HP | Nominal Amperes (rms) | Saturation Current (rms) | Inductance 3\% (mh) | Inductance 5\% (mh) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & 230 \mathrm{Vac} \\ & 50 / 60 \mathrm{~Hz} \\ & \text { 3-Phase } \end{aligned}$ | 0.75 | 1 | 5.65 | 11.3 | 3.660 | 6.10 |
|  | 1.5 | 2 | 9.04 | 18.08 | 2.288 | 3.81 |
|  | 2.2 | 3 | 12.43 | 24.86 | 1.664 | 2.77 |
|  | 3.7 | 5 | 19.21 | 38.42 | 1.077 | 1.80 |
|  | 5.5 | 7.5 | 28.25 | 56.5 | 0.732 | 1.22 |
|  | 7.5 | 10 | 37.29 | 74.58 | 0.555 | 0.93 |
|  | 11 | 15 | 55.37 | 110.74 | 0.374 | 0.62 |
|  | 15 | 20 | 73.45 | 146.9 | 0.282 | 0.47 |
|  | 18.5 | 25 | 84.75 | 169.5 | 0.244 | 0.41 |
|  | 22 | 30 | 101.7 | 203.4 | 0.203 | 0.34 |

460V DC Choke

| Input Voltage | kW | HP | Nominal Amperes (rms) | Saturation Current (rms) | Inductance 3\% (mh) | Inductance 5\% (mh) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 460Vac <br> 50/60Hz | 0.75 | 1 | 3.39 | 6.78 | 12.202 | 20.34 |
|  | 1.5 | 2 | 4.52 | 9.04 | 9.151 | 15.25 |
|  | 2.2 | 3 | 6.78 | 13.56 | 6.101 | 10.17 |
|  | 3.7 | 5 | 10.17 | 20.34 | 4.067 | 6.78 |
|  | 4 | 5 | 11.865 | 23.73 | 3.486 | 5.81 |
|  | 5.5 | 7.5 | 13.56 | 27.12 | 3.050 | 5.08 |
|  | 7.5 | 10 | 20.34 | 40.68 | 2.034 | 3.39 |
| 3-Phase | 11 | 15 | 27.12 | 54.24 | 1.525 | 2.54 |
|  | 15 | 20 | 36.16 | 72.32 | 1.144 | 1.91 |
|  | 18.5 | 25 | 42.94 | 85.88 | 0.963 | 1.61 |
|  | 22 | 30 | 50.85 | 101.7 | 0.813 | 1.36 |
|  | 30 | 40 | 67.8 | 135.6 | 0.610 | 1.02 |

## 7-7 EMI Filter

| Model | Applicable EMI Filter | Reference Website |
| :---: | :---: | :---: |
| VFD007C23A; <br> VFD015C23A; <br> VFD022C23A; <br> VFD037C23A; | KMF325A | http://www.dem-uk.com/roxburgh/products/industrial emc filters/kmfa three phase indu strial mains filters high performance/ <br> KMF325A Three Phase Industrial Mains Filters - High Performance 25 Amps |
| VFD055C23A; <br> VFD075C23A; <br> VFD110C23A | KMF370A | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_indu strial_mains_filters_high_performance/ <br> KMF370A Three Phase Industrial Mains Filters - High Performance 70 Amps |
| VFD150C23A; VFD185C23A; VFD220C23A; | KMF3100A | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_indu strial_mains_filters_high_performance/ <br> KMF3100A Three Phase Industrial Mains Filters - High Performance 100 Amps |
| $\begin{aligned} & \text { VFD300C23A; } \\ & \text { VFD370C23A; } \end{aligned}$ | MIF3150 | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_indu strial_multi_stage_drive_filters/ <br> MIF3150 Three Phase Industrial Multi Stage Drive Filters - Very High Performance 150 Amps |
| VFD450C23A; <br> VFD550C23A; <br> VFD750C23A; <br> VFD900C23A; | MIF3400B | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_indu strial_multi_stage_drive_filters/ <br> MIF3400 Three Phase Industrial Drive Filters - Very High Performance 340 Amps |
| VFD007C43A/E; VFD015C43A/E; VFD022C43A/E; VFD037C43A/E; VFD040C43A/E; VFD055C43A/E; | KMF318A | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_indu strial_mains_filters_high_performance/ <br> KMF318A Three Phase Industrial Mains Filters - High Performance 18 Amps |
| VFD075C43A/E; VFD110C43A/E; VFD150C43A/E; | KMF350A | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_indu strial_mains_filters_high_performance/ <br> KMF350A Three Phase Industrial Mains Filters - High Performance 50 Amps |
| VFD185C43A/E; VFD220C43A/E; VFD300C43A/E; | KMF370A | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/kmfa_three_phase_indu strial_mains_filters_high_performance/ <br> KMF370A Three Phase Industrial Mains Filters - High Performance 70 Amps |
| VFD370C43A/E; VFD450C43A/E; VFD550C43A/E; VFD750C43A/E; | MIF3150 | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_indu strial_multi_stage_drive_filters/ <br> MIF3150 Three Phase Industrial Multi Stage Drive Filters - Very High Performance 150 Amps |
| VFD900C43A/E; VFD1100C43A/E; VFD1320C43A/E; VFD1600C43A/E; | MIF3400B | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_indu strial_multi_stage_drive_filters/ <br> MIF3400B Three Phase Industrial Multi Stage Drive Filters - Very High Performance 400 Amps |
| VFD1850C43A/E; <br> VFD2200C43A/E; | $\begin{gathered} \text { MIF3800 \& } \\ \text { Ring Cores *3 } \end{gathered}$ | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_indu strial_multi_stage_drive_filters/ <br> MIF3800 Three Phase Industrial Drive Filters - Very High Performance 800 Amps <br> Ring Core Part No. : T102-15 |


| Model | Applicable <br> EMI Filter | Reference Website |
| :---: | :---: | :--- |
| VFD2800C43A/E; $;$ | MIF3800 \& | http://www.dem-uk.com/roxburgh/products/industrial_emc_filters/mif3_three_phase_indu |
| Strial_multi_stage_drive_filters/ |  |  |
| VFD3150C43A/E; |  |  |
| VFD3550C43A/E; | Ring Cores *2 | MIF3800 Three Phase Industrial Drive Filters - Very High Performance 800 Amps <br> Ring Core Part No. : T102-15 |

* Please contact Delta for VFD4500C43A/E EMI filter


## EMI Filter Installation

All electrical equipment, including AC motor drives, will generate high-frequency/low-frequency noise and will interfere with peripheral equipment by radiation or conduction when in operation. By using an EMI filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EMI filter to have the best interference elimination performance.
We assure that it can comply with following rules when AC motor drive and EMI filter are installed and wired according to user manual:

- EN61000-6-4
- EN61800-3: 1996
- EN55011 (1991) Class A Group 1 (1 ${ }^{\text {st }}$ Environment, restricted distribution)


## General precaution

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

## Choose suitable motor cable and precautions

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

1. Use the cable with shielding (double shielding is the best).
2. The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.
3. Remove any paint on metal saddle for good ground contact with the plate and shielding.

Remove any paint on metal saddle for good ground contact with the plate and shielding.


Figure 1


Figure 2

## The length of motor cable

1. Cable length suggestion for Drive in full load
a. Non-shielded cables:

For $5.5 \mathrm{~kW}(7.5 \mathrm{HP})$ model and below, max. cable length between the drive and motor is 328 ft (100m). For $7.5 \mathrm{~kW}(10 \mathrm{HP})$ model and above is $656 \mathrm{ft}(200 \mathrm{~m})$.
b. Shielded cables:

For $5.5 \mathrm{~kW}(7.5 \mathrm{HP})$ model and below, max. cable length between the drive and motor is 164 ft $(50 \mathrm{~m})$. For $7.5 \mathrm{~kW}(10 \mathrm{HP})$ model and above is $328 \mathrm{ft}(100 \mathrm{~m})$.

If cable length is longer than the suggested above, 3-phase load reactor is required.
2. Effect of Surge voltages for motor and suggestion

When motor is driven by an AC motor drive with PWM control, the motor terminals will experience surge voltages easily due to power transistors operation of AC motor drive and cable capacitance. When the motor cable is very long (especially for the 460 V series), surge voltages may reduce insulation quality. To prevent this situation, please follow the rules below:
a. Use a motor with enhanced insulation (Please refer to following charts)
b. Connect an output reactor (optional) to the output terminals of the AC motor drive
c. The length of the cable between AC motor drive and motor should be as short as possible (10 to 20 m or less)
For drive power range $\geqq 7.5 \mathrm{~kW}(10 \mathrm{HP})$

| Motor Insulation level | 1000 V | 1300 V | 1600 V |
| :--- | :---: | :---: | :---: |
| Input 460VAC | $66 \mathrm{ft}(20 \mathrm{~m})$ | $328 \mathrm{ft}(100 \mathrm{~m})$ | $1312 \mathrm{ft}(400 \mathrm{~m})$ |
| Input 230VAC | $1312 \mathrm{ft}(400 \mathrm{~m})$ | $1312 \mathrm{ft}(400 \mathrm{~m})$ | $1312 \mathrm{ft}(400 \mathrm{~m})$ |

For drive power range $\leqq 5.5 \mathrm{~kW}$ ( 7.5 HP )

| Motor Insulation level | 1000 V | 1300 V | 1600 V |
| :--- | :---: | :---: | :---: |
| Input 460VAC | $66 \mathrm{ft}(20 \mathrm{~m})$ | $165 \mathrm{ft}(100 \mathrm{~m})$ | $165 \mathrm{ft}(400 \mathrm{~m})$ |
| Input 230VAC | $328 \mathrm{ft}(400 \mathrm{~m})$ | $328 \mathrm{ft}(400 \mathrm{~m})$ | $328 \mathrm{ft}(400 \mathrm{~m})$ |

## 7-8 Digital Keypad

## 7-8-1 KPC-CE01



## A: LED Display

Display frequency, current, voltage and error etc.
B: Status Indicator
F: Frequency Command
H: Output Frequency
U: User Defined Units ERR: CAN Error Indicator
RUN: CAN Run Indicator

## C: Function

(Refer to the chart follows for detail description)

| Key | Description |
| :---: | :--- | :--- |
| ESC | ESC Key <br> Press ESC key to return to the previous page. It also functions as a return to last category key in the sub-menu. |
| MENU | Menu Key <br> Press MENU key under any condition will return to the main MENU. <br> Menu content: <br> 1. Parameter Detail <br> 2. Copy Parameter |
| ENTER | ENTER Key <br> Press ENTER and go to the next level. If it is the last level then press ENTER to execute the command. |
| HAND | HAND ON Key <br> 1. HAND key will operates according to the parameter settings when the source of HAND master frequency <br> command and the source of HAND operation command is properly set,. The factory setting of the source <br> command for frequency and operation are from the digital keypad. |
| AUTO | 2. Press HAND key in stop status, the drive setting switches to the parametr setting of HAND. Press HAND key <br> in during operation, the drive will come to stop then switches to the parameter setting of HAND. <br> 3. When process complete: H/A LED ON. |
| Auto Operation Key |  |
| 1. AUTO function executes according to the parameter settings of the source of AUTO frequency and AUTO |  |
| operation. The factory setting is the external terminal (source of operation is 4-20mA). |  |
| 2. Press the ATUO key in stop status, the drivel switches to auto-setting. Press the auto key during operation |  |
| statu, the drivel will come to stop and switch to auto-setting. |  |

## 7-8-2 Dimension



## 7-8-3 RJ45 Extension Lead for Digital Keypad

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

## 7-9 Panel Mounting (MKC-KPPK)

For MKC-KPPK model, user can choose wall mounting or embedded mounting, protection level is IP56.
Applicable to the digital keypads (KPC-CC01 \& KPC-CE01).



## 7－10 Conduit Box Kit

## －Appearance

Frame D
Applicable models
VFD300C23A／23E；VFD370C23A／23E；VFD370C43A／43E；
VFD450C43A／43E；VFD550C43A／43E；VFD750C43A／43E

Frame E
Applicable models
VFD450C23A／23E；VFD550C23A／23E；VFD750C23A／23E； VFD900C43A／43E；VFD1100C43A／43E

Model number『 ${ }^{\text {MKC－EN1CB }}$ 』

| ITEM | Description | Qty． |
| :---: | :--- | :---: |
| 1 | Screw M5 ${ }^{*} 0.8^{*} 10 \mathrm{~L}$ | 6 |
| 2 | Bushing Rubber 28 | 2 |
| 3 | Bushing Rubber 44 | 4 |
| 4 | Bushing Rubber 100 | 2 |
| 5 | Conduit box cover | 1 |
| 6 | Conduit box base | 1 |

ITEM 1


Frame F
Applicable models
VFD900C23A／23E；VFD1320C43A／43E；VFD1600C43A／43E


ITEM 5

| Model number『 MKC－FN1CB |
| :--- |
| ITEM Description Qty． <br> 1 Screw M5＊0．8＊10L 8 <br> 2 Bushing Rubber28 2 <br> 3 Bushing Rubber 44 4 <br> 4 Bushing Rubber 100 2 <br> 5 Conduit box cover 1 <br> 6 Conduit box base 1 |



Frame G
Applicable models
VFD1850C43A／43E；VFD2200C43A／43E
Model number『MKC－GN1CB』

| ITEM | Description | Qty． |
| :---: | :--- | :---: |
| 1 | Screw M5 ${ }^{*} 0.8^{*} 10 \mathrm{~L}$ | 12 |
| 2 | Bushing Rubber 28 | 2 |
| 3 | Bushing Rubber 44 | 2 |
| 4 | Bushing Rubber 130 | 3 |
| 5 | Conduit box base | 1 |
| 6 | Conduit box cover | 1 |



- Conduit Box Installation


## Frame D

1. Loosen the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 10~12kg-cm (8.66~10.39lb-in)

2. Remove the 5 screws shown in the following figure. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}(20.8 \sim 22.6 \mathrm{lb}-\mathrm{in})$.

3. Install the conduit box by fasten the 5 screws shown in the following figure.

Screw torque: 24~26kg-cm (20.8~22.6lb-in).

4. Fasten the 4 screws shown in the following figure. Screw torque: $10 \sim 12 \mathrm{~kg}-\mathrm{cm}(8.66 \sim 10.39 \mathrm{lb}-\mathrm{in})$.


## Frame E

1. Loosen the 4 cover screws and lift the cover; Screw torque: $12 \sim 15 \mathrm{~kg}-\mathrm{cm}(10.4 \sim 13 \mathrm{lb}-\mathrm{in})$.

2. Fasten the 6 screws shown in the following figure and place the cover back to the original position. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~22.6lb-in).

3. Fasten the 4 screws shown in the following figure. Screw torque:12~15kg-cm (10.4~13lb-in)』


## Frame F

1. Loosen the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 14~16kg-cm (12.2~13.9lb-in).

2. Install the conduit box by fastens the 4 screws, as shown in the following figure.

Screw torque: 24~26kg-cm (20.8~22.6lb-in).

3. Install the conduit box by fasten all the screws shown in the following figure


## Frame G

1. On the conduit box, loosen 7 of the cover screws and remove the cover. On the drive, loosen 4 of the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 12~15kg-cm (10.4~13lb-in).


Remove the top cover and loosen the screws. Screw torque: 12~15kg-cm (10.4~13lb-in).

2. Install the conduit box by fastening all the screws shown in the following figure.

Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}$ (20.8~30lb-in); Screw torque: 12~15kg-cm (10.4~13lb-in)


Fasten all the screws. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}$ (20.8~30 lb-in).


Place the cover back to the top and fasten the screws (as shown in the figure).
Screw torque: 12~15kg-cm (10.4~13lb-in).


## 7-11 Fan Kit

- Frames of the fan kit
Frame A
Applicable Model
VFD015C23A; VFD022C23A; VFD037C23A;VFD022C43A/43E;
VFD037C43A/43E;VFD040C43A/43E; VFD055C43A/43E
Frame B
Applicable Model
VFD055C23A; VFD075C43A/43E
Frame B
Applicable Model
VFD075C23A; VFD110C23A; VFD110C43A/43E;
VFD150C43A/43E
Frame B
Applicable Model
VFD055C23A; VFD075C23A; VFD110C23A; VFD075C43A/43E;
VFD110C43A/43E;VFD150C43A/43E
FFD150C23A; VFD185C23A; VFD220C23A
Frame C
Applicable Model
VFD185C43A/43E; VFD220C43A/43E;VFD300C43A/43E
Frame D0
Applicable Model
VFD370C43S/43U; VFD450C43S/43U;
Frame
Applicable Model
FFD750C23A/23E; VFD900C43A/43E; VFD1100C43A/43E
Frable Model
FFD300C23A/23E; VFD370C23A/23E; VFD370C43A/43E;
VFD450C43A/43E; VFD550C43A/43E; VFD750C43A/43E


| Frame F <br> Applicable Model VFD900C23A/23E; VFD1320C43A/43E; VFD1600C43A/43E | Model 『MKC-FFKM 』 |
| :---: | :---: |
| Frame F <br> Applicable Model VFD900C23A/23E; VFD1320C43A/43E; VFD1600C43A/43E |  |
| Frame G <br> Applicable Model VFD1850C43A/43E; VFD2200C43A/43E |  |


| Frame H | Model 『MKC-HFKM |
| :--- | :--- |
| Applicable Model |  |
| VFD2800C43A/43E; VFD3150C43A/43E; VFD3550C43A/43E; |  |
| VFD4500C43A/43E;VFD2800C43E-1; VFD3150C43E-1; |  |
| VFD3550C43E-1; VFD4500C43E-1 |  |

## - Fan Removal

Frame A
Applicable model
VFD015C23A; VFD022C23A; VFD022C43A/43E; VFD037C23A; VFD037C43A/43E; VFD040C43A/43E; VFD055C43A/43E

1. Press the tabs on both side of the fan to successfully remove the fan. (The arrow)

2. Disconnect the power terminal before removing the fan. (As shown below.)


## Frame B

Applicable model
VFD055C23A; VFD075C43A/43E;VFD075C23A; VFD110C23A; VFD110C43A/43E; VFD150C43A/43E

1. Press the tab on both side of the fan to successfully remove the fan.
2. Disconnect the power terminal before removing the fan.


## Frame B\&C

Applicable model
VFD055C23A; VFD075C23A; VFD075C43A/43E; VFD110C23A; VFD110C43A/43E; VFD150C43A/43E; VFD150C23A; VFD185C23A; VFD220C23A; VFD185C43A/43E; VFD220C43A/43E; VFD300C43A/43E

Disconnect the power terminal by slotted screwdriver to remove the fan cover.


Frame C
Applicable model
Single fan applicable model: VFD185C43A/E; VFD220C43A/E; VFD300C43A
Dual fans applicable model: VFD150C23A; VFD185C23A; VFD220C23A; VFD300C43E
Step 1. (Figure 1) Use slotted screwdriver to remove cover


Step 2. (Figure 2) Disconnect the fan power, pull out the fan after loosening screws. The label of fan should face towards drive inside. Screw torque 10~12kgf-cm (8.7~10.4in-lbf)


Figure 2

## Frame D0

Applicable model
VFD370C43S/43U; VFD450C43S/43U;

1. (Figure 1) Loosen screw 1 and 2, press the on the right and the left to remove the cover, follow the direction the arrows indicate. Press on top of digital keypad KPC-CE01 to properly remove the keypad. Screw torque: $10 \sim 12 \mathrm{~kg}-\mathrm{cm}$ (8.6~10.4in-lbf)


Figure 1
3. Loosen screw 4 and disconnect the fan power. Screw torque: $10 \sim 12 \mathrm{~kg}-\mathrm{cm}$ (8.6~10.4in-lbf).


Figure 3
2. (Figure 2) Loosen screw 3, press the tab on the right and the left to remove the cover. Screw torque: $6 \sim 8 \mathrm{~kg}-\mathrm{cm}$ (5.2~6.9in-lbf).


Figure 2
For heat sink fan:
Step1. (Figure 4) Loosen the screws. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~25.6in-lbf).
Step2. Disconnect fan power and pull out the fan. (As shown in the larger picture)


Figure 4

## Frame D

Applicable model
VFD300C23A/23E; VFD370C23A/23E; VFD370C43A/43E; VFD450C43A/43E; VFD550C43A/43E; VFD750C43A/43E
4. (Figure 1) Loosen screw 1 and screw 2, press the on the right and the left to remove the cover, follow the direction the arrows indicate. Press on top of digital keypad KPC-CE01 to properly remove the keypad. Screw torque: 10~12kg-cm (8.6~10.4in-lbf).


Figure 1
6. (Figure 3) Loosen screw 5 and disconnect the fan power. Screw torque: $10 \sim 12 \mathrm{~kg}-\mathrm{cm}$ (8.6~10.4in-lbf).


Figure 3
5. (Figure 2) Loosen screw 3 and screw 4, press the tab on the right and the left to remove the cover. Screw torque: $6 \sim 8 \mathrm{~kg}-\mathrm{cm}(5.2 \sim 6.9 \mathrm{in}-\mathrm{lbf})$.


Figure 2
For heat sink fan
Step1. (Figure 4) Loosen the screws. Screw torque: 24~26kg-cm (20.8~25.6in-lbf).
Step2. Disconnect fan power and pull out the fan.
(As shown in the larger picture)


Figure 4

## Frame E

Applicable model:
VFD450C23A/23E; VFD550C23A/23E; VFD750C23A/23E; VFD900C43A/43E; VFD1100C43A/43E

Loosen screw 1~4 (as shown in the figure below), and disconnect the fan power then remove the fan. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~25.6in-lbf).


Loosen screw 1~4(as shown in the figure below), and disconnect the fan power then remove the fan. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~25.6in-lbf).


Loosen screw 1 and screw 2 （as shown in the figure below），and disconnect fan power before removing the fan．Screw torque： 24～26kg－cm（20．8～25．6in－lbf）．


## Frame F

Applicable model
VFD900C23A／23E；VFD1320C43A／43E；VFD1600C43A／43E；
Fan model『MKC－FFKM
Loosen the screws and removes the fan（as shown in figure below）．Screw torque：24～26kg－cm（20．8～22．6lb－in』


Fan model 『MKC－FFKB
（1）Loosen the screw（as shown in figure below）and removes（2）Loosen the screw（as shown in figure below）and removes the cover．Screw torque： $14 \sim 16 \mathrm{~kg}-\mathrm{cm}(12.2 \sim 13.9 \mathrm{lb}-\mathrm{in})$ ．

the cover．Screw torque： $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$（20．8～22．6lb－in）．

(3) Loosen the screws and remove the fan. (As shown in the figure below) Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}(20.8 \sim 22.6 \mathrm{lb}-\mathrm{in})$.


## Frame G

Applicable model
VFD1800C43A/43E; VFD2200C43A/43E;

## Fan model『 MKC-GFKM 』

(1) Loosen the screw (as shown in figure below) and remove the cover. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}(20.8 \sim 22.6 \mathrm{lb}-\mathrm{in})$.

(3) Loosen screw 1,2,3 and remove the protective ring (as shown in figure below) Screw torque: $15 \sim 20 \mathrm{~kg}-\mathrm{cm}$ (12.2~13.91b-in).

(2) For 1~8 shown in the figure: Loosen the screws Screw torque:35~40kg-cm (30.4~34.7lb-in)
For 9~10 shown in the figure: Loosen the screws and removes the cover.
Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~22.6Ib-in).

(4) Lift the fan by putting your fingure through the protective holes, as indicates in 1 and 2 on the figure.

Frame H
Applicable model
VFD2800C43A/43E; VFD3150C43A/43E; VFD3550C43A/43E; VFD4500C43A/43E

Fan model 『MKC-HFKM $』$
(1) Loosen the screw and remove the top cover. Screw torque: $14 \sim 16 \mathrm{~kg}-\mathrm{cm}$ (12.2~13.91b-in)

(3) Disconnect the fan.

(2) Loosen the screw and remove the top cover. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~22.6 lb-in).

(4) Loosen the screw and remove the fan. Make sure fan power is properly disconnected before removal. Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~22.61b-in).


## 7－12 Flange Mounting Kit

## Applicable Models，Frame A～F

Frame A
『MKC－AFM1』

Applicable model
VFD015C23A；VFD022C23A；VFD022C43A／43E


Accessories 1＊1


Accessories 2＊2

Screw 1 ＊4 M3＊P 0．5；L＝6mm

Screw 2＊8
M6＊P 1．0；L＝16mm

『MKC－AFM』
Applicable model
VFD007C23A；VFD007C43A／43E；VFD015C43A／43E；VFD037C23A；VFD037C43A／43E；VFD040C43A／43E； VFD055C43A／43E


Accessories 2＊2

Screw＊8 M6＊P 1．0；L＝16mm

Accessories t $3^{*} 2$

Cutout dimension
Unit：mm［inch］


『MKC-AFM1』Installation

1. Install accessory 1 by fastening 4 of the screw $1(\mathrm{M} 3)$. Screw torque: $6 \sim 8 \mathrm{~kg}-\mathrm{cm}(5.21 \sim 6.94 \mathrm{lb}-\mathrm{in})$.

2. Install accessory $2 \& 3$ by fastening 2 of the screw $2(M 6)$. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}$ (5.21~6.94lb-in).

3. Install accessory $2 \& 3$ by fastening 2 of the screw $2(\mathrm{M} 6)$. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}(5.21 \sim 6.94 \mathrm{lb}-\mathrm{in})$.

4. Plate installation, place 4 of the screw 2 (M6) through accessory $2 \& 3$ and the plate then fasten the screws. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}$ (5.21~6.94lb-in).

${ }^{『}$ MKC-AFM』 Installation
5. Install accessory $1 \& 2$ by fastening 2 of the screw $1(\mathrm{M} 3)$. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}(5.21 \sim 6.94 \mathrm{lb}-\mathrm{in})$. (As shown in following figure)

6. Install accessory $1 \& 2$ by fastening 2 of the screw 1 (M3). Screw torque: 25~30kg-cm (5.21~6.94Ib-in). (As shown in following figure)

7. Plate installation, place 4 of the screw $2(\mathrm{M} 6)$ through accessory $1 \& 2$ and the plate then fasten the screws. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}(5.21 \sim 6.94 \mathrm{lb}-\mathrm{in})$. (As shown in following figure)


Frame B

## ${ }^{『}$ MKC-BFM』

Applicable model
VFD055C23A; VFD075C23A; VFD110C23A; VFD075C43A/43E; VFD110C43A/43E; VFD150C43A/43E


## Cutout dimension

Unit: mm [inch]

${ }^{『}$ MKC-BFM』Installation

1. Install accessory $1 \& 2$ by fastening 4 of the screw 1 (M8). Screw torque: $40 \sim 45 \mathrm{~kg}-\mathrm{cm}$ (34.7~39.0lb-in). (As shown in the following figure)

2. Plate installation, place 6 of the screw 2 (M6) through accessory $1 \& 2$ and the plate then fasten the screws. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}$ (5.21~6.94lb-in). (As shown in the following figure)


Frame C
${ }^{\text {『 }}$ MKC-CFM』
Applicable model
VFD150C23A; VFD185C23A; VFD220C23A; VFD185C43A/43E; VFD220C43A/43E; VFD300C43A/43E


Accessories 1*2


Accessories 2*2

## Screw 1*4~M8*P 1.25 Screw 2*8~M6*P 1.0;

Cutout dimension
Unit: mm [inch]

${ }^{『}$ MKC-CFM』 Installation

1. Install accessory $1 \& 2$ by fastening 4 of the screw 1 (M8). Screw torque: $50 \sim 55 \mathrm{~kg}-\mathrm{cm}$ (43.4~47.7lb-in). (As shown in the following figure)

2. Plate installation, place 8 of the screw 2 (M6) through accessories $1 \& 2$ and the plate then fasten the screws. Screw torque: $25 \sim 30 \mathrm{~kg}-\mathrm{cm}$ (5.21~6.94lb-in). (As shown in the following figure)


## Frame D

Applicable model
VFD300C23A/23E; VFD370C23A/23E; VFD370C43A/43E; VFD450C43A/43E; VFD550C43A/43E;
VFD750C43A/43E
Cutout dimension
Unit: mm [inch]


## Frame D0\&D\&E

1. Loosen 8 screws and remove Fixture 2 (as shown in the following figure).

2. Fasten 4 screws (as shown in the following figure). Screw torque: $30 \sim 32 \mathrm{~kg}-\mathrm{cm}$ (26.0~27.8lb-in).

3. Fasten 4 screws (as shown in the following figure). Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~22.6 $\mathrm{lb}-\mathrm{in}$ ).

4. Place 4 screws (M10) through Fixture 1\&2 and the plate then fasten the screws. (as shown in the following figure)
Screw torque: 200~240kg-cm (173.6~208.3lb-in).

5. Loosen 10 screws and remove Fixture 1 (as shown
6. Fasten 5 screws (as shown in the following figure). Screw torque: 30~32kg-cm (26.0~27.8lb-in).
7. Fasten 5 screws (as shown in the following figure). Screw torque: $24 \sim 26 \mathrm{~kg}-\mathrm{cm}$ (20.8~22.6lb-in).

## in the following figure).



## Frame E

Applicable model
VFD450C23A/23E; VFD550C23A/23E; VFD750C23A/23E; VFD900C43A/43E; VFD1100C43A/43E

## Cutout dimension

Unit: mm [inch]


Applicable model
VFD900C23A/23E; VFD1320C43A/43E; VFD1600C43A/43E

## Cutout dimension

Unit: mm [inch]


Frame F

5. Place 4 of the M12 screws through Fixture 1\&2 and plate then fasten the screws.
Screw torque: 300~400kg-cm (260~347lb-in).


## 7-13 USB/RS-485 Communication Interface IFD6530

## . Warning

$\checkmark$ Please thoroughly read this instruction sheet before installation and putting it into use.
$\checkmark$ 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 at
http://www.delta.com.tw/product/em/control/cm/control_cm_main.asp

## 1. Introduction

IFD6530 is a convenient RS-485-to-USB converter, which does not require external power-supply and complex setting process. It supports baud rate from 75 to 115.2 kbps and auto switching direction of data transmission. In addition, it adopts RJ-45 in RS-485 connector for users to wire conveniently. And its tiny dimension, handy use of plug-and-play and hot-swap provide more conveniences for connecting all DELTA IABU products to your PC.
Applicable Models: All DELTA IABU products.
(Application \& Dimension)


## 2. Specifications

| Power supply | No external power is needed |
| :--- | :--- |
| Power consumption | 1.5 W |
| Isolated voltage | $2,500 \mathrm{VDC}$ |
| Baud rate | $75,150,300,600,1,200,2,400,4,800,9,600,19,200,38,400,57,600,115,200 \mathrm{bps}$ |
| RS-485 connector | RJ-45 |
| USB connector | A type (plug) |
| Compatibility | Full compliance with USB V2.0 specification |
| Max. cable length | RS-485 Communication Port: 100 m |
| Support RS-485 half-duplex transmission |  |

- RJ-45

|  |  | PIN | Description | PIN | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 1 | Reserved | 5 | SG+ |
|  |  | 2 | Reserved | 6 | GND |
|  |  | 3 | GND | 7 | Reserved |
|  |  | 4 | SG- | 8 | +9V |

## 3. Preparations before Driver Installation

Please extract the driver file (IFD6530_Drivers.exe) by following steps. You could find driver file (IFD6530_Drivers.exe) in the CD supplied with IFD6530.

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

## STEP 1



STEP 3

| Installshield Fizard |
| :--- |
| Choose Destination Location <br> Select folder where Setup will install files. <br> Setup will install Silicon Laboratories CP210x Evaluation Kit Tools Release 3.31 <br> in the following folder. <br> To install to this folder, click Next. To install to a different folder, click Browse and select <br> another folder. <br> Destination Folder - <br> CiSiLabsIMCUICP210x <br> <Back Next > |

STEP 2


## STEP 4



## STEP 5

You should have a folder marked SiLabs under drive C .

[^1]
## 4. Driver Installation

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

STEP 1

| Found New Hardware Wizard |  |
| :---: | :---: |
|  | Welcome to the Found New Hardware Wizard <br> Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your pernission) <br> Read ou privacy policy <br> Can Windows connect to Windows Update to search for softwase? Yes, this time only Yes, now and every tirne I connect a device No, not this time <br> Click Next to conkinue. |
|  | <Back Next> Cancel |

STEP 2



Browse and select directory, or enter C:ISiLabs\MCU\CP210xIWIN


STEP 4


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

## 5. LED Display

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

## Chapter 8 Option Cards

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

## 8-1 Removed key cover

## Frame A\&B\&C

Screw Torque: 8~10Kg-cm [6.9~8.7lb-in.]


## Frame D

Screw Torque: 8~10Kg-cm [6.9~8.7lb-in.]


Frame E
Slightly lift the cover then pull to remove. Screw Torque: $12 \sim 15 \mathrm{Kg}-\mathrm{cm}$ [10.4~13Ib-in.]


Frame F
Screw Torque: 12~ $15 \mathrm{Kg}-\mathrm{cm}$ [10.4~13lb-in.]


## Frame G

Screw Torque: $12 \sim 15 \mathrm{Kg}-\mathrm{cm}$ [10.4~13lb-in.]


Frame H
Screw Torque: 14~16Kg-cm [12.15~13.89Ib-in.]



1
RJ45 (Socket) for digital keypad KPC-CC01; KPC-CE01

Please refer to CH 10 Digital Keypad for more details on KPC-CE01.

Please refer to CH 10 Digital Keypad for more details on optional accessory RJ45 extension cable.

2 Communication extension card (Slot 1)
CMC-MOD01;
CMC-PD01;
CMC-DN01;
CMC-EIP01;
EMC-COP01;
3 I/O \& Relay extension card (Slot 3)
EMC-D42A;
EMC-D611A;
EMC-R6AA;
EMC-BPS01;
4 PG Card (Slot 2)
EMC-PG01L;
EMC-PG010;
EMC-PG01U;
EMC-PG01R;

## 8-2 Screws Speciation for option card terminals:

| EMC-D42A <br> EMC-D611A | Wire gauge | $24 \sim 12 A W G\left(0.205 \sim 3.31 \mathrm{~mm}^{2}\right)$ |
| :---: | :---: | :--- |
|  | Torque | $4 \mathrm{Kg}-\mathrm{cm}[3.47 \mathrm{Ib}-\mathrm{in}]$ |
| EMC-R6AA | Wire gauge | $24 \sim 16 A W G\left(0.205 \sim 1.31 \mathrm{~mm}^{2}\right)$ |
|  | Torque | $6 \mathrm{Kg}-\mathrm{cm}[5.21 \mathrm{lb}-\mathrm{in}]$ |
| EMC-PG01L |  |  |
| EMC-PG01O | Wire gauge | $30 \sim 16 A W G\left(0.0509 \sim 1.31 \mathrm{~mm}^{2}\right)$ |
| EMC-PG01R | Torque | $2 \mathrm{Kg}-\mathrm{cm}[1.74 \mathrm{lb}-\mathrm{in}]$ |
| EMC-PG01U |  |  |

## 8-3 EMC-D42A

| I/O Extension Card | Terminals | Descriptions |
| :---: | :---: | :---: |
|  | COM | Common for Multi-function input terminals <br> Select SINK (NPN )/SOURCE (PNP )in J1 jumper / external power supply |
|  | MI10~ MI13 | Refer to parameters 02-26~02-29 to program the multi-function inputs MI10~MI13. <br> Internal power is applied from terminal E24: $+24 \mathrm{Vdc} \pm 5 \% 200 \mathrm{~mA}$, 5W <br> External power +24VDC: max. voltage 30VDC, min. voltage 19VDC, 30W <br> ON : the activation current is 6.5 mA <br> OFF: leakage current tolerance is $10 \mu \mathrm{~A}$ |
|  | MO10~MO11 | Multi-function output terminals (photocoupler) <br> Duty-cycle: 50\% <br> Max. output frequency: 100 Hz <br> Max. current: 50 mA <br> Max. voltage: 48 Vdc |
|  | MXM | Common for multi-function output terminals MO10, MO11 (photocoupler) <br> Max 48VDC 50mA |

## 8-4 EMC-D611A

| I/O Extension Card | Terminals | Descriptions |
| :---: | :---: | :---: |
|  | AC | AC power Common for multi-function input terminal (Neutral) |
|  | MI10~ MI15 | Refer to Pr. 02.26~ Pr. 02.31 for multi-function input selection Input voltage: 100~130VAC <br> Input frequency: 47~63Hz <br> Input impedance: 27Kohm <br> Terminal response time: <br> ON: 10ms <br> OFF: 20ms |

## 8-5 EMC-R6AA

|  | Terminals | Descriptions |
| :---: | :---: | :---: |
| Relay Extension Card | $\begin{aligned} & \text { RA10~RA15 } \\ & \text { RC10~RC15 } \end{aligned}$ | Refer to Pr. 02.36~ Pr. 02.41 for multi-function input selection <br> Resistive load: $\begin{aligned} & 5 \mathrm{~A}(\mathrm{~N} . \mathrm{O} .) / 250 \mathrm{Vac} \\ & 5 \mathrm{~A}(\mathrm{~N} . \mathrm{O} .) / 30 \mathrm{Vdc} \end{aligned}$ <br> Inductive load (COSPHI 0.4) $\begin{aligned} & \text { 2.0A(N.O.) } / 250 \mathrm{Vac} \\ & \text { 2.0A(N.O.) } / 30 \mathrm{Vdc} \end{aligned}$ <br> It is used to output each monitor signal, such as drive is in operation, frequency attained or overload indication. |

## 8-6 EMC-BPS01

|  | Terminals | Descriptions |
| :---: | :---: | :---: |
| External Power Supply | $\begin{gathered} 24 \mathrm{~V} \\ \text { GND } \end{gathered}$ | Input power: $24 \mathrm{~V} \pm 5 \%$ <br> Maximum input current:0.5A <br> Note: <br> 1) Do not connect control terminal +24 V (Digital control signal common: SOURCE) directly to the EMC-BPS01input terminal 24 V . <br> 2) Do not connect control terminal GND directly to the EMC-BPS01 input termina GND. |

## 8-7 EMC-PG01L

## - Terminal description

Set by Pr. 10-00~10-02

| Terminals |  | Descriptions |
| :---: | :---: | :--- |
| PG1 | VP | Output voltage for power: $+5 \mathrm{~V} /+12 \mathrm{~V} \pm 5 \%$ (use FSW3 to <br> switch +5V/+12V) <br> Max. output current: 200mA |
|  | DCM | Common for power and signal |

Note 1: Open Collector application, input current $5 \sim 15 \mathrm{~mA}$ to each set then each set needs one pull-up resistor.
5 V Recommended pull-up resistor: above100~220 $2,1 / 2 \mathrm{~W}$
12V Recommended pull-up resistor: above 510~1.35k $\Omega, 1 / 2 \mathrm{~W}$
24 V
Recommended pull-up resistor, above1.8k~3.3k $\Omega, 1 / 2 \mathrm{~W}$
PG2 Wiring Diagram


## - Wiring Diagram

$\square \quad$ Please use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line ( 200 V and above).
$\boxtimes \quad$ Recommended wire size 0.21 to $0.81 \mathrm{~mm}^{2}$ (AWG24 to AWG18).
$\checkmark \quad$ Cable length: Less than 100 m


## 8-8 EMC-PG01O

## - Terminal descriptions

Set by Pr. 10-00~10-02

| Terminals |  | Descriptions |
| :---: | :---: | :---: |
| PG1 | VP | Output voltage for power: $+5 \mathrm{~V} /+12 \mathrm{~V} \pm 5 \%$ (use FSW3 to switch $+5 \mathrm{~V} /+12 \mathrm{~V}$ ) Max. output current: 200mA |
|  | DCM | Common for power and signal |
|  | $\begin{aligned} & \mathrm{A} 1, / \mathrm{A} 1, \mathrm{~B} 1, \\ & \text { /B1, Z1, /Z1 } \end{aligned}$ | Encoder Input signal (Line Driver or Open Collector) <br> Open Collector Input Voltage: $+5 \mathrm{~V} /+12 \mathrm{~V}$ <br> It can be 1-phase or 2-phase input. <br> Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$ |
| PG2 | $\begin{aligned} & \text { A2, /A2, } \\ & \text { B2, /B2 } \end{aligned}$ | Pulse Input Signal (Line Driver or Open Collector) Open Collector Input Voltage: +5~+24V It can be 1-phase or 2-phase input. Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$. |
| PG OUT | V+, V+ | Needs external power source for PG OUT circuit. Input voltage of power:+12V $\sim+24 \mathrm{~V}$ |
|  | V- | Input voltage for the negative side |
|  | A/O, B/O, Z/O | PG Card Output signals has division frequency function: 1~255 times. <br> On the open collector's output signal, add a high-pull resistor on the external power $\mathrm{V}+\sim \mathrm{V}$ - (e.g. power of PLC) to prevent the interference of the receiving signal. Max. 。 [Three pull-up resistor are included in the package ( $1.8 \mathrm{~kW} / 1 \mathrm{~W}$ )] Max. output frequency: 300KP/Sec |

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

| 5 V | Recommended pull-up resistor: above100~220, $1 / 2 \mathrm{~W}$ |
| :---: | :--- |
| 12 V | Recommended pull-up resistor: above $510 \sim 1.35 \mathrm{k} \Omega, 1 / 2 \mathrm{~W}$ |
| 24 V | Recommended pull-up resistor, above1.8k $\sim 3.3 \mathrm{k} \Omega, 1 / 2 \mathrm{~W}$ |

PG1 Wiring Diagram


## PG2 Wiring Diagram



## - Wiring Diagram

■ Please use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line ( 200 V and above).

■ Recommended wire size 0.21 to $0.81 \mathrm{~mm}^{2}$ (AWG24 to AWG18).
$\square \quad$ Cable length: Less than 100 m


## 8-9 EMC-PG01U

■ FJMP1 S: Standard UVW Output Encoder; D: Delta Encoder

- Set by Pr.10-00~10-02

| Terminals |  | Descriptions |
| :---: | :---: | :---: |
| PG1 | VP | Output voltage for power: $+5 \mathrm{~V} /+12 \mathrm{~V} \pm 5 \%$ (use FSW3 to switch $+5 \mathrm{~V} /+12 \mathrm{~V}$ ) <br> Max. output current: 200mA |
|  | DCM | Common for power and signal |
|  | A1, /A1, B1, /B1, Z1, /Z1 | Encoder input signal (Line Driver) It can be 1-phase or 2-phase input. Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$ |
|  | U1, /U1, V1, /V1, W1, /W1 | Encoder input signal |
| PG2 | $\begin{aligned} & \text { A2, IA2, } \\ & \text { B2, /B2 } \end{aligned}$ | Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: $+5 \sim+24 \mathrm{~V}$ (Note1) It can be 1-phase or 2-phase input. Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$. |
| PG OUT | $\begin{gathered} \mathrm{AO}, ~ / \mathrm{AO}, \mathrm{BO}, / \mathrm{BO}, \mathrm{ZO}, \\ \text { IZO, SG } \end{gathered}$ | PG Card Output signals. <br> It has division frequency function: 1~255 times <br> Max. output voltage for Line driver: 5Vdc <br> Max. output current: 50mA <br> Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$ <br> SG is the GND of PG card. It is also the GND of position machine or PLC to make the ouput signal to be the common pivot point. |

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

| 5 V | Recommended pull-up resistor: above100~220 $\Omega, 1 / 2 \mathrm{~W}$ |
| :---: | :--- |
| 12 V | Recommended pull-up resistor: above $510 \sim 1.35 \mathrm{k} \Omega, 1 / 2 \mathrm{~W}$ |
| 24 V | Recommended pull-up resistor, above1.8k~3.3k $\Omega, 1 / 2 \mathrm{~W}$ |

PG2 Wiring Diagram


## - Wiring Diagram

$\checkmark \quad$ Please use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line ( 200 V and above).
$\checkmark$ Recommended wire size 0.21 to $0.81 \mathrm{~mm}^{2}$ (AWG24 to AWG18).
$\checkmark \quad$ Cable length: Less than 100 m


## 8-10 EMC-PG01R

## - Terminal Descriptions

Set by Pr. 10-00~10-02

| Terminals |  | Descriptions |
| :---: | :---: | :---: |
| PG1 | R1-R2 | Resolver Output Power 7 Vrms , 10kHz |
|  | S1,S2, S3, S4, | Resolver Input Signal $3.5 \pm 0.175 \mathrm{Vrms}, 10 \mathrm{kHz}$ |
| PG2 | $\begin{aligned} & \text { A2, IA2, } \\ & \text { B2, /B2 } \end{aligned}$ | Pulse Input signal (Line Driver or Open Collector) Open Collector Input Voltage: $+5 \sim+24 \mathrm{~V}$ (Note1) It can be 1-phase or 2-phase input. Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$. |
| PG OUT | $\begin{gathered} \text { AO, /AO, } \\ \text { BO, /BO, } \\ \text { ZO, /ZO, } \\ \text { SG, } \end{gathered}$ | PG Card Output signals. It has division frequency function: 1~255 times <br> Max. output voltage for Line driver: 5VDC <br> Max. output current: 50 mA <br> Max. output frequency: $300 \mathrm{kP} / \mathrm{sec}$ <br> SG is the GND of PG card. It is also the GND of position machine or PLC to make the ouput signal to be the common pivot point. |

Note 1: Open Collector application, input current $5 \sim 15 \mathrm{~mA}$ to each set then each set needs one pull-up resistor.

| 5 V | Recommended pull-up resistor: above100~220, $1 / 2 \mathrm{~W}$ |
| :---: | :--- |
| 12 V | Recommended pull-up resistor: above $510 \sim 1.35 \mathrm{k} \Omega, 1 / 2 \mathrm{~W}$ |
| 24 V | Recommended pull-up resistor, above1.8k $\sim 3.3 \mathrm{k} \Omega, 1 / 2 \mathrm{~W}$ |

PG2 Wiring Diagram


## - Wiring Diagram

$\checkmark \quad$ Please use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line ( 200 V and above).
$\checkmark$ Recommended wire size 0.21 to $0.81 \mathrm{~mm}^{2}$ (AWG24 to AWG18).
$\square \quad$ Cable length: Less than 100 m


## 8-11 CMC-MOD01

## - Features

1. Supports Modbus TCP protocol
2. MDI/MDI-X auto-detect
3. Baud rate: $10 / 100 \mathrm{Mbps}$ auto-detect
4. E-mail alarm
5. AC motor drive keypad/Ethernet configuration
6. Virtual serial port.

- Product File


| (1) | I/O CARD \& Relay Card |
| :--- | :--- |
| ${ }^{(2)}$ | PG Card |
| ${ }^{(3)}$ | Comm. Card |
| (4) | RJ-45 connection port |
| (5) | Removable control circuit |
|  | terminal |

## - Specifications

Network Interface

| Interface | RJ-45 with Auto MDI/MDIX |
| :---: | :--- |
| Number of ports | 1 Port |
| Transmission method | IEEE 802.3, IEEE 802.3u |
| Transmission cable | Category 5e shielding 100M |
| Transmission speed | $10 / 100$ Mbps Auto-Detect |
| Network protocol | ICMP, IP, TCP, UDP, DHCP, HTTP, SMTP, MODBUS OVER TCP/IP, <br> Delta Configuration |

## Electrical Specification

| Power supply voltage | 5 VDC (supply by the AC motor drive) |
| :--- | :--- |
| Insulation voltage | 2 KV |
| Power consumption | 0.8 W |
| Weight | 25 g |

## Environment

| Noise immunity | ESD (IEC 61800-5-1, IEC 61000-4-2) <br> EFT (IEC 61800-5-1, IEC 61000-4-4) <br> Surge Test (IEC 61800-5-1, IEC 61000-4-5) <br> Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6) |
| :--- | :--- |
| Operation/storage | Operation: $-10^{\circ} \mathrm{C} \sim 50^{\circ} \mathrm{C}$ (temperature), 90\% (humidity) <br> Storage: $-25^{\circ} \mathrm{C} \sim 70^{\circ} \mathrm{C}$ (temperature), 95\% (humidity) |
| Vibration/shock immunity | International standard: IEC 61800-5-1, IEC 60068-2-6/IEC <br> $61800-5-1$, IEC $60068-2-27$ |

## - Install CMC-MOD01 to VFD-C2000

1. Switch off the power supply of VFD-C2000.
2. Open the front cover of VFD-C2000.
3. Place the insulation spacer into the positioning pin at Slot 1 (shown in Figure 3), and aim the two holes on the PCB at the positioning pin. Press the pin to clip the holes with the PCB (shown in Figure 4).
4. Screw up at torque $6 \sim 8 \mathrm{~kg}-\mathrm{cm}(5.21 \sim 6.94 \mathrm{in}-\mathrm{lbs})$ after the PCB is clipped with the holes (shown in Figure 5).

| [Figure 3] | [Figure 4] |
| :---: | :---: |
| [Figure 5] |  |

## - Communication Parameters for VFD-C2000 Connected to Ethernet

When VFD-C2000 is link to Ethernet, please set up the communication parameters base on the table below. Ethernet master will be able to read/write the frequency word and control word of VFD-C2000 after communication parameters setup.

| Parameter | Function | Set value (Dec) | Explanation |
| :--- | :--- | :---: | :--- |
| P00-20 | Source of frequency <br> command setting | 8 | The frequency command is controlled by <br> communication card. |
| P00-21 | Source of operation <br> command setting | 5 | The operation command is controlled by <br> communication card. |
| P09-30 | Decoding method for <br> communication | 0 | Decoding method for Delta AC motor <br> drive |
| P09-75 | IP setting | 0 | Static IP(0) / Dynamic distribution IP(1) |
| P09-76 | IP address -1 | 192 | IP address 192.168.1.5 |
| P09-77 | IP address -2 | 168 | IP address 192.168.1.5 |
| P09-78 | IP address -3 | 1 | IP address 192.168.1.5 |
| P09-79 | IP address -4 | 5 | IP address 192.168.1.5 |
| P09-80 | Netmask -1 | 255 | Netmask 255.255.255.0 |
| P09-81 | Netmask -2 | 255 | Netmask 255.255.255.0 |
| P09-82 | Netmask -3 | 255 | Netmask 255.255.255.0 |
| P09-83 | Netmask -4 | 0 | Netmask 255.255.255.0 |
| P09-84 | Default gateway -1 | 192 | Default gateway 192.168.1.1 |
| P09-85 | Default gateway -2 | 168 | Default gateway 192.168.1.1 |
| P09-86 | Default gateway -3 | 1 | Default gateway 192.168.1.1 |
| P09-87 | Default gateway -4 | 1 | Default gateway 192.168.1.1 |

## - Disconnecting CMC- MOD01 from VFD-C2000

1. Switch off the power supply of VFD-C2000.
2. Remove the two screws (shown in Figure 6).
3. Twist opens the card clip and inserts the slot type screwdriver to the hollow to prize the PCB off the card clip (shown in Figure 7).
4. Twist opens the other card clip to remove the PCB (shown in Figure 8).


- Basic Registers

| BR\# | R/W | Content | Explanation |
| :---: | :---: | :--- | :--- |
| \#0 | $R$ | Model name | Set up by the system; read only. The model code of <br> CMC-MOD01=H'0203 |
| \#1 | $R$ | Firmware <br> version | Displaying the current firmware version in hex, e.g. H'0100 indicates the <br> firmware version V1.00. |
| \#2 | $R$ | Release date of <br> the version | Displaying the data in decimal form. 10,000s digit and 1,000s digit are for <br> "month"; 100s digit and 10s digit are for "day". <br> For 1 digit: 0 = morning; 1 = afternoon. |
| \#11 | R/W | Modbus Timeout | Pre-defined setting: 500 (ms) |
| \#13 | R/W | Keep Alive Time | Pre-defined setting: 30 (s) |

## - LED Indicator \& Troubleshooting

LED Indicators

| LED | Status |  | Indication | How to correct it? |
| :---: | :---: | :---: | :--- | :--- |
| POWER | Green | On | Power supply in normal status | -- |
|  |  | Off | No power supply | Check the power supply |
|  | Green | On | Network connection in normal status | -- |
|  |  | Flashes | Network in operation | -- |
|  |  | Off | Network not connected | Check if the network cable is <br> connected |

Troubleshooting

| Abnormality | Cause | How to correct it? |
| :--- | :--- | :--- |
| POWER LED off | AC motor drive not powered | Check if AC motor drive is powered, and if the <br> power supply is normal. |
|  | CMC-MOD01 not connected <br> to AC motor drive | Make sure CMC-MOD01 is connected to AC motor <br> drive. |
|  | CMC-MOD01 not connected <br> to network | Make sure the network cable is correctly connected <br> to network. |
|  | Poor contact to RJ-45 <br> connector | Make sure RJ-45 connector is connected to <br> Ethernet port. |
| Fail to open <br> CMC-MOD01 <br> setup page | PC and CMC-MOD01 not connected <br> to <br> different networks and <br> blocked by network firewall. | Make sure CMC-MOD01 is connected to network. |
|  |  |  |

Chapter 8 Optional Cards | C2000 Series

| Abnormality | Cause | How to correct it? |
| :---: | :--- | :--- |
| Fail to send e-mail | Incorrect network setting in <br> CMC-MOD01 | Check if the network setting for CMC-MOD01 is <br> correct. |
|  | Incorrect mail server setting | Please confirm the IP address for SMTP-Server. |

## 8-12 CMC-PD01

## - Features

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

## - Product Profile




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

## - Specifications

PROFIBUS DP Connector

| Interface | DB9 connector |
| :--- | :--- |
| Transmission method | High-speed RS-485 |
| Transmission cable | Shielded twisted pair cable |
| Electrical isolation | 500VDC |

Communication

| Message type | Cyclic data exchange |
| :--- | :--- |
| Module name | CMC-PD01 |
| GSD document | DELA08DB.GSD |
| Company ID | 08DB (HEX) |
| Serial transmission <br> speed supported <br> (auto-detection) | 9.6kbps; 19.2kbps; 93.75kbps; $187.5 \mathrm{kbps} ; 125 \mathrm{kbps} ; 250 \mathrm{kbps} ; 500 \mathrm{kbps} ; 1.5 \mathrm{Mbps} ;$ |

## Electrical Specification

| Power supply | 5 VDC (supplied by AC motor drive) |
| :--- | :--- |
| Insulation voltage | 500 VDC |
| Power consumption | 1 W |
| Weight | 28 g |

## Environment

| Noise immunity | ESD(IEC 61800-5-1,IEC 6100-4-2) <br> EFT(IEC 61800-5-1,IEC 6100-4-4) <br> Surge Teat(IEC 61800-5-1,IEC 6100-4-5) <br> Conducted Susceptibility Test(IEC 61800-5-1, IEC 6100-4-6) |
| :--- | :--- |
| Operation /storage | Operation: $-10^{\circ} \mathrm{C} \sim 50^{\circ} \mathrm{C}$ (temperature), 90\% (humidity) <br> Storage: $-25^{\circ} \mathrm{C} \sim 70^{\circ} \mathrm{C}$ (temperature), 95\% (humidity) |
| Shock / vibration <br> resistance | International standards: IEC61131-2, IEC68-2-6 (TEST Fc)/IEC61131-2 \& IEC <br> $68-2-27$ <br> (TEST Ea) |

## - Installation

PROFIBUS DP Connector

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



## - LED Indicator \& Troubleshooting

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

| LED status | Indication | How to correct it? |
| :--- | :--- | :--- |
| Green light on | Power supply in normal status. | -- |
| Off | No power | Check if the connection between CMC-PD01 and AC <br> motor drive is normal. |

## NET LED

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

## 8-13 CMC-DN01

## - Functions

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

- Product Profile

- Specifications

DeviceNet Connector

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

AC Motor Drive Connection Port

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

Electrical Specification

| Power supply voltage | 5 VDC (supplied by AC motor drive) |
| :--- | :--- |
| Insulation voltage | 500 VDC |
| Communication wire <br> power consumption | 0.85 W |
| Power consumption | 1 W |
| Weight | 23 g |

Environment

|  | ESD (IEC 61800-5-1, IEC 6100-4-2) |
| :--- | :--- |
| Noise immunity | EFT (IEC 61800-5-1, IEC 6100-4-4) <br> Surge Teat(IEC 61800-5-1, IEC 6100-4-5) <br> Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6) |
| Operation /storage | Operation: $-10^{\circ} \mathrm{C} \sim 50^{\circ} \mathrm{C}$ (temperature), 90\% (humidity) <br> Storage: $-25^{\circ} \mathrm{C} \sim 70^{\circ} \mathrm{C}$ (temperature), 95\% (humidity) |
| Shock / vibration <br> resistance |  <br> IEC 68-2-27 (TEST Ea) |

DeviceNet Connector

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



- LED Indicator \& Troubleshooting

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

POWER LED

| LED status | Indication | How to correct it? |
| :--- | :--- | :--- |
| On | Power supply in abnormal status. | Check the power supply of CMC-DN01. |
| Off | Power supply in normal status | -- |

NS LED

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

MS LED

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

## 8-14 CMC-EIP01

## - Features

1. Supports Modbus TCP and Ethernet/IP protocol
2. MDI/MDI-X auto-detect
3. Baud rate: $10 / 100 \mathrm{Mbps}$ auto-detect
4. AC motor drive keypad/Ethernet configuration
5. Virtual serial port

- Product Profile



## - Specifications

Network Interface

| Interface | RJ-45 with Auto MDI/MDIX |
| :--- | :--- |
| Number of ports | 1 Port |
| Transmission method | IEEE 802.3, IEEE 802.3u |
| Transmission cable | Category 5e shielding 100M |
| Transmission speed | $10 / 100$ Mbps Auto-Detect |
| Network protocol | ICMP, IP, TCP, UDP, DHCP, HTTP, SMTP, MODBUS OVER TCP/IP, EtherNet/IP, Delta <br> Configuration |

## Electrical Specification

| Weight | 25 g |
| :--- | :--- |
| Insulation voltage | 500 VDC |
| Power consumption | 0.8 W |
| Power supply voltage | 5 VDC |

## Environment

|  | ESD (IEC 61800-5-1,IEC 61000-4-2) <br> EFT (IEC 61800-5-1,IEC 61000-4-4) |
| :--- | :--- |
| Noise immunity | Surge Test (IEC 61800-5-1, IEC 61000-4-5) <br> Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6) |
| Operation/storage | Operation: $-10^{\circ} \mathrm{C} \sim 50^{\circ} \mathrm{C}$ (temperature), 90\% (humidity) <br> Storage: $-25^{\circ} \mathrm{C} \sim 70^{\circ} \mathrm{C}$ (temperature), 95\% (humidity) |
| Vibration/shock <br> immunity | International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27 |

- Installation


## Connecting CMC-EIP01 to Network

1. Turn off the power of $A C$ motor drive.
2. Open the cover of AC motor drive.
3. Connect CAT-5e network cable to RJ-45 port on CMC-EIP01 (See Figure 2).

[Figure 2]

## RJ-45 PIN Definition

| PIN | Signal | Definition |
| :---: | :---: | :---: |
| 1 | Tx+ | Positive pole for <br> data transmission |
| 2 | Tx- | Negative pole for <br> data transmission |
| 3 | Rx+ | Positive pole for <br> data receiving |
| 4 | -- | N/C |


| PIN | Signal | Definition |
| :---: | :---: | :---: |
| 5 | -- | N/C |
| 6 | Rx- | Negative pole for <br> data receiving |
| 7 | -- | N/C |
| 8 | -- | N/C |



- Connecting CMC-EIP01 to VFD-C2000

1. Switch off the power of AC motor drive.
2. Open the front cover of AC motor drive.
3. Place the insulation spacer into the positioning pin at Slot 1 (shown in Figure 3), and aim the two holes on the PCB at the positioning pin. Press the pin to clip the holes with the PCB (see Figure 4).
4. Screw up at torque $6 \sim 8 \mathrm{~kg}-\mathrm{cm}(5.21 \sim 6.94 \mathrm{in}$-lbs) after the PCB is clipped with the holes (see Figure 5).

[Figure 3]

[Figure 4]

[Figure 5]

## - Communication Parameters for VFD-C2000 Connected to Ethernet

When VFD-C2000 is connected to Ethernet network, please set up the communication parameters for it according to the table below. The Ethernet master is only able to read/write the frequency word and control word of VFD-C2000 after the communication parameters are set.

| Parameter <br> (Dec) | Function | Set value (Dec) | Explanation |
| :--- | :---: | :---: | :--- |
| P00-20 | Source of frequency <br> command setting | 8 | The frequency command is controlled by <br> communication card. |
| P00-21 | Source of operation <br> command setting | 5 | The operation command is controlled by <br> communication card. |
| P09-30 | Decoding method for <br> communication | 0 | The decoding method for Delta AC motor <br> drive |
| P09-75 | IP setting | 0 | Static IP(0) / Dynamic distribution IP(1) |
| P09-76 | IP address -1 | 192 | IP address 192.168.1.5 |
| P09-77 | IP address -2 | 168 | IP address 192.168.1.5 |
| P09-78 | IP address -3 | 1 | IP address 192.168.1.5 |
| P09-79 | IP address -4 | 5 | IP address 192.168.1.5 |
| P09-80 | Netmask -1 | 255 | Netmask 255.255.255.0 |
| P09-81 | Netmask -2 | 255 | Netmask 255.255.255.0 |
| P09-82 | Netmask -3 | 255 | Netmask 255.255.255.0 |
| P09-83 | Netmask -4 | 0 | Netmask 255.255.255.0 |
| P09-84 | Default gateway -1 | 192 | Default gateway 192.168.1.1 |
| P09-85 | Default gateway -2 | 168 | Default gateway 192.168.1.1 |
| P09-86 | Default gateway -3 | 1 | Default gateway 192.168.1.1 |
| P09-87 | Default gateway -4 | 1 | Default gateway 192.168.1.1 |

## - Disconnecting CMC- EIP01 from VFD-C2000

1. Switch off the power supply of VFD-C2000.
2. Remove the two screws (see Figure 6).
3. Twist opens the card clip and inserts the slot type screwdriver to the hollow to prize the PCB off the card clip (see Figure 7).
4. Twist opens the other card clip to remove the PCB (see Figure 8).

[Figure 6]

[Figure 7]

[Figure 8]

## - LED Indicator \& Troubleshooting

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

## LED Indicators

| LED | Status |  | Indication | How to correct it? |
| :--- | :---: | :---: | :--- | :--- |
| POWER | Green | On | Power supply in normal status | -- |
|  |  | Off | No power supply | Check the power supply. |
|  | On | Network connection in normal <br> status | -- |  |
|  | Green | Flashes | Network in operation | -- |
|  | Off | Network not connected | Check if the network cable is <br> connected. |  |

Troubleshooting

| Abnormality | Cause | How to correct it? |
| :--- | :--- | :--- |
| POWER LED off | AC motor drive not powered | Check if AC motor drive is powered, and if the <br> power supply is normal. |
|  | CMC-EIP01 not connected to <br> AC motor drive | Make sure CMC-EIP01 is connected to AC motor <br> drive. |
|  | CMC-EIP01 not connected to <br> network | Make sure the network cable is correctly connected <br> to network. |


| Abnormality | Cause | How to correct it? |
| :---: | :---: | :---: |
|  | Poor contact to RJ-45 connector | Make sure RJ-45 connector is connected to Ethernet port. |
| No communication card found | CMC-EIP01 not connected to network | Make sure CMC-EIP01 is connected to network. |
|  | PC and CMC-EIP01 in different networks and blocked by network firewall. | Search by IP or set up relevant settings by AC motor drive keypad. |
| Fail to open CMC-EIP01 setup page | CMC-EIP01 not connected to network | Make sure CMC-EIP01 is connected to the network. |
|  | Incorrect communication setting in DCISoft | Make sure the communication setting in DCISoft is set to Ethernet. |
|  | PC and CMC-EIP01 in different networks and blocked by network firewall. | Conduct the setup by AC motor drive keypad. |
| Able to open CMC-EIP01 setup page but fail to utilize webpage monitoring | Incorrect network setting in CMC-EIP01 | Check if the network setting for CMC-EIP01 is correct. For the Intranet setting in your company, please consult your IT staff. For the Internet setting in your home, please refer to the network setting instruction provided by your ISP. |
| Fail to send e-mail | Incorrect network setting in CMC-EIP01 | Check if the network setting for CMC-EIP01 is correct. |
|  | Incorrect mail server setting | Please confirm the IP address for SMTP-Server. |

## 8-15 EMC-COP01

Built-in EMC-COP01 card are available in VFDXXXC23E/VFDXXXC43E series.

## RJ-45 Pin definition



| Pin | Pin name | Definition |  |
| :---: | :---: | :--- | :---: |
| 1 | CAN_H | CAN_H bus line (dominant <br> high) |  |
| 2 | CAN_L | CAN_L bus line (dominant low) |  |
| 3 | CAN_GND | Ground/OV/V- |  |
| 7 | CAN_GND | Ground/OV/V- |  |

- Specifications

| Interface | RJ-45 |
| :---: | :--- |
| Number of ports | 1 Port |
| Transmission method | CAN |
| Transmission cable | CAN standard cable |
| Transmission speed | 1M 500k 250k 125k 100k 50k |
| Communication protocol | CANopen |

- CANopen Communication Cable

Model: TAP-CB05, TAP-CB10


- CANopen Dimension

Model: TAP-CN03


NOTE
For more information on CANopen, please refer to Chapter 15 CANopen Overview or CANopen user manual can also be downloaded on Delta website: http://www.delta.com.tw/industrialautomation/.

## Chapter 9 Specification

## 9-1 230V Series

| Frame Size |  |  | A |  |  |  | B |  |  | C |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Model VFD-_ _ C |  |  | 007 | 015 | 022 | 037 | 055 | 075 | 110 | 150 | 185 | 220 |
| Power of corresponding heavy duty motor (kW) |  |  | 0.4 | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 |
| Power of corrsponding normal duty motor (kW) |  |  | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 |
|  |  | Rated Output Capacity (kVA) | 1.9 | 2.8 | 4.0 | 6.4 | 9.6 | 12 | 19 | 25 | 28 | 34 |
|  |  | Rated Output Current (A) | 4.8 | 7.1 | 10 | 16 | 24 | 31 | 47 | 62 | 71 | 86 |
|  |  | $\begin{aligned} & \text { Carrier Frequency } \\ & (\mathrm{kHz}) \end{aligned}$ | 2~6kHz |  |  |  |  |  |  |  |  |  |
|  |  | Rate Output Capacity (kVA) | 2.0 | 3.2 | 4.4 | 6.8 | 10 | 13 | 20 | 26 | 30 | 36 |
|  |  | Rated Output Current (A) | 5 | 8 | 11 | 17 | 25 | 33 | 49 | 65 | 75 | 90 |
|  |  | $\begin{aligned} & \text { Carrier Frequency } \\ & (\mathrm{kHz}) \end{aligned}$ | 2~15kHz |  |  |  |  |  |  | 2~10kHz |  |  |
|  | Inpu | Current (A) Heavy Duty | 6.1 | 11 | 15 | 18.5 | 26 | 34 | 50 | 68 | 78 | 95 |
|  | $\begin{aligned} & \text { Inpu } \\ & \text { Norn } \end{aligned}$ | Current (A) mal Duty | 6.4 | 12 | 16 | 20 | 28 | 36 | 52 | 72 | 83 | 99 |
|  | Rate | d Voltage/Frequency | 3-phase AC 200V 240 V (-15\% ~ +10\%), 50/60Hz |  |  |  |  |  |  |  |  |  |
|  | Ope | ating Voltage Range | 170~265Vac |  |  |  |  |  |  |  |  |  |
|  | Freq | uency Tolerance | $47 \sim 63 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |
| AC Drive Weight |  |  | $2.6 \pm 0.3 \mathrm{Kg}$ |  |  | $5.4 \pm 1 \mathrm{Kg}$ |  |  |  | $9.8 \pm 1.5 \mathrm{Kg}$ |  |  |
| Cooling method |  |  | Natural cooling |  |  | Fan cooling |  |  |  |  |  |  |
| Braking Chopper |  |  | Frame A to C (built-in); Frame D and above (optional) |  |  |  |  |  |  |  |  |  |
| DC reactor |  |  | Frame A to C (optional); Frame D and above (built-in) |  |  |  |  |  |  |  |  |  |
| EMC Filter |  |  | Frame A to C (optional); Frame D and above (optional) |  |  |  |  |  |  |  |  |  |
| EMC-COP01 |  |  | VFDXXC23A (optional); VFDXXXC23E (built-in) |  |  |  |  |  |  |  |  |  |


| Frame Size |  |  | D |  | E |  |  | F |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Model VFD-_C |  |  | 300 | 370 | 450 | 550 | 750 | 900 |
| Power of corresponding heavy duty motor (kW) |  |  | 22 | 30 | 37 | 45 | 55 | 75 |
| Power of corrsponding normal duty motor (kW) |  |  | 30 | 37 | 45 | 55 | 75 | 90 |
|  | $\underset{\substack{\zeta \\ \underset{\sim}{4} \\ \hline \\ \hline}}{ }$ | Rated Output Capacity (kVA) | 45 | 55 | 68 | 81 | 96 | 131 |
|  |  | Rated Output Current (A) | 114 | 139 | 171 | 204 | 242 | 329 |
|  |  | Carrier Frequency (kHz) | 2~6kHz |  |  |  |  |  |
|  |  | Rate Output Capacity (kVA) | 48 | 58 | 72 | 86 | 102 | 138 |
|  |  | Rated Output Current (A) | 120 | 146 | 180 | 215 | 255 | 346 |
|  |  | Carrier Frequency (kHz) | 2~10kHz |  | 2~9 kHz |  |  |  |
|  | Inpu | Current (A) Heavy Duty | 118 | 136 | 162 | 196 | 233 | 315 |
|  | Inpu <br> Norm | Current (A) al Duty | 124 | 143 | 171 | 206 | 245 | 331 |
|  | Rate | d Voltage/Frequency | 3-phase AC 200V 240 V (-15\% ~ +10\%), 50/60Hz |  |  |  |  |  |
|  | Ope | ating Voltage Range | 170~265Vac |  |  |  |  |  |
|  | Freq | uency Tolerance | $47 \sim 63 \mathrm{~Hz}$ |  |  |  |  |  |
| AC Drive Weight |  |  |  | . 5 Kg | $64.8 \pm 1.5 \mathrm{Kg}$ |  |  | $86.5 \pm 1.5 \mathrm{Kg}$ |
| Cooling method |  |  | Fan Cooling |  |  |  |  |  |
| Braking Chopper |  |  | Frame A to C (built-in); Frame D and above (optional) |  |  |  |  |  |
| DC reactor |  |  | Frame A to C (optional); Frame D and above (built-in) |  |  |  |  |  |


| DC reactor | Frame A to C (optional); Frame D and above (built-in) |
| :--- | :---: |
| EMI Filter | Frame A to C (optional); Frame D and above |
| (optional) |  |

## 9－2 460V Series

| Frame Size |  |  | A |  |  |  |  |  | B |  |  | C |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Model VFD－＿＿C |  |  | 007 | 015 | 022 | 037 | 040 | 055 | 075 | 110 | 150 | 185 | 220 | 300 |
| Power of corresponding heavy duty motor（kW） |  |  | 0.4 | 0.75 | 1.5 | 2.2 | 2.2 | 4.0 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 |
| Power of corrsponding normal duty motor（kW） |  |  | 0.75 | 1.5 | 2.2 | 3.7 | 4.0 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 |
|  |  | Rated Output Capacity（kVA） | 2.3 | 3.0 | 4.5 | 6.5 | 7.6 | 9.6 | 14 | 18 | 24 | 29 | 34 | 45 |
|  |  | Rated Output Current（A） | 2.9 | 3.8 | 5.7 | 8.1 | 9.5 | 11 | 17 | 23 | 30 | 36 | 43 | 57 |
|  |  | Carrier Frequency （kHz） | 2～6kHz |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Rate Output Capacity（kVA） | 2.4 | 3.2 | 4.8 | 7.2 | 8.4 | 10 | 14 | 19 | 25 | 30 | 36 | 48 |
|  |  | Rated Output Current（A） | 3.0 | 4.0 | 6.0 | 9.0 | 10.5 | 12 | 18 | 24 | 32 | 38 | 45 | 60 |
|  |  | $\begin{aligned} & \text { Carrier Frequency } \\ & (\mathrm{kH} 7) \end{aligned}$ | 2～15kHz |  |  |  |  |  |  |  |  | 2～10kHz |  |  |
|  | Inpu Duty | Current（A）Heavy | 4.1 | 5.6 | 8.3 | 13 | 14.5 | 16 | 19 | 25 | 33 | 38 | 45 | 60 |
|  | Inpu <br> Norm | Current（A） <br> mal Duty | 4.3 | 5.9 | 8.7 | 14 | 15.5 | 17 | 20 | 26 | 35 | 40 | 47 | 63 |
|  | Rated Voltage／Frequency |  | 3－Phase AC 380V～480V（－15\％～＋10\％），50／60Hz |  |  |  |  |  |  |  |  |  |  |  |
|  | $\triangle$ Operating Voltage Range |  | 323～528Vac |  |  |  |  |  |  |  |  |  |  |  |
|  | Freq | uency Tolerance | $47 \sim 63 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |  |  |
| AC Drive Weight |  |  | $2.6 \pm 0.3 \mathrm{Kg}$ |  |  |  |  | $5.4 \pm 1 \mathrm{Kg}$ |  |  |  | $9.8 \pm 1.5 \mathrm{Kg}$ |  |  |
| Cooling method |  |  | Natural cooling |  |  |  |  | Fan cooling |  |  |  |  |  |  |
| Braking Chopper |  |  | Frame A to C（built－in）；Frame D and above（optional） |  |  |  |  |  |  |  |  |  |  |  |
| DC reactor |  |  | Frame A to C（optional）；Frame D and above（built－in） |  |  |  |  |  |  |  |  |  |  |  |
| EMI Filter |  |  | VFDXXXC43A Frame A to C：No EMI Filter； VFDXXXC43E：Built－in EMI Filter VFDXXXC43A／43E Frame D and above：EMI Filter is optional |  |  |  |  |  |  |  |  |  |  |  |
| EMC－COP01 |  |  | VFDXXXC43A／43E Frame D and above：EMI Filter is optional |  |  |  |  |  |  |  |  |  |  |  |


| Frame Size |  | D |  |  |  | E |  | ＊F |  | ＊G |  | ＊H |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Model VFD－＿＿C |  | 370 | 450 | 550 | 750 | 900 | 1100 | 1320 | 1600 | 1850 | 2200 | 2800 | 3150 | 3550 | 4500 |
| Power of corresponding heavy duty motor（kW） |  | 30 | 37 | 45 | 55 | 75 | 90 | 110 | 132 | 160 | 185 | 220 | 280 | 315 | 450 |
| Power of corrsponding normal duty motor（kW） |  | 37 | 45 | 55 | 75 | 90 | 110 | 132 | 160 | 185 | 220 | 280 | 315 | 355 | 600 |
|  | Rated Output Capacity（kVA） | 55 | 69 | 84 | 114 | 136 | 167 | 197 | 235 | 280 | 348 | 417 | 466 | 517 | 677 |
|  | Rated Output Current（A） | 69 | 86 | 105 | 143 | 171 | 209 | 247 | 295 | 352 | 437 | 523 | 585 | 649 | 816 |
|  | $\begin{aligned} & \text { Carrier Frequency } \\ & (\mathrm{kHz}) \end{aligned}$ | 2～6kHz |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 言 | Rate Output Capacity（kVA） | 58 | 73 | 88 | 120 | 143 | 175 | 207 | 247 | 295 | 367 | 438 | 491 | 544 | 720 |
|  | Rated Output Current（A） | 73 | 91 | 110 | 150 | 180 | 220 | 260 | 310 | 370 | 460 | 550 | 616 | 683 | 866 |
|  | $\begin{aligned} & \text { Carrier Frequency } \\ & (\mathrm{kHz}) \end{aligned}$ | 2～10kHz |  |  |  | 2～9kHz |  |  |  |  |  |  |  |  |  |
| $\begin{array}{l\|l} \hline \text { Inpu } \\ \text { Dut } \end{array}$ | Current（A）Heavy | 70 | 96 | 108 | 149 | 159 | 197 | 228 | 285 | 361 | 380 | 469 | 527 | 594 | 816 |
| $$ | t Current（A） mal Duty | 74 | 101 | 114 | 157 | 167 | 207 | 240 | 300 | 380 | 400 | 494 | 555 | 625 | 866 |
| 訁 Rat | d Voltage／Frequency | 3－Phase AC 380V～480V（－15\％～＋10\％），50／60Hz |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ㄷ Ope | rating Voltage Range | 323～528Vac |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fre | quency Tolerance | $47 \sim 63 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AC Drive Weight |  | $38.5 \pm 1.5 \mathrm{Kg}$ |  |  |  | $64.8 \pm 1.5 \mathrm{Kg}$ |  | $86.5 \pm 1.5 \mathrm{Kg}$ |  |  | $134 \pm 4 \mathrm{Kg}$ |  | 228 |  |  |
| Cooling method |  | Fan cooling |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Braking Chopper |  | Frame A to C（built－in）；Frame D and above（optional） |  |  |  |  |  |  |  |  |  |  |  |  |  |
| DC reactor |  | Frame A to C（optional）；Frame D and above（built－in） |  |  |  |  |  |  |  |  |  |  |  |  |  |


| EMI Filter | VFDXXXC43A：No EMI Filter； <br> VFDXXXC43E：Built－in EMI Filter |
| :--- | :---: |
| EMC－COP01 | VFDXXXC43A／43E Frame D and above：EMI Filter is optional |

## NOTE

－For FRAME A，B and C，Model VFDXXXC43A the enclosure type is IP20／NEMA1／UL TYPE1．
－For FRAME D and above，if the last character of the model is A then the enclosure type is IP20 but the wiring terminal is IP00；if the last character of the model is E，the enclosure type is IP20／NEMA1／UL TYPE1．

## General Specifications

|  | Control Method | 1：V／F，2：SVC，3：VF＋PG，4：FOC＋PG，5：TQC＋PG， |
| :---: | :---: | :---: |
|  | Starting Torque | Reach up to $150 \%$ or above at 0.5 Hz ． Under FOC＋PG mode，starting torque can reach $150 \%$ at 0 Hz ． |
|  | V／F Curve | 4 point adjustable V／F curve and square curve |
|  | Speed Response Ability | 5 Hz （vector control can reach up to 40 Hz ） |
|  | Torque Limit | Max．200\％torque current |
|  | Torque Accuracy | $\pm 5 \%$ |
|  | Max．Output Frequency（ Hz ） | Light duty and normal duty：0．01～600．00Hz；Heavy duty： $0.00 \sim 300.00 \mathrm{~Hz}$ |
|  | Frequency Output Accuracy | Digital command： $\pm 0.01 \%,-10^{\circ} \mathrm{C} \sim+40^{\circ} \mathrm{C}$ ，Analog command： $\pm 0.1 \%, 25 \pm 10^{\circ} \mathrm{C}$ |
|  | Output Frequency Resolution | Digital command： 0.01 Hz ，Analog command： $0.03 \times$ max．output frequency／ 60 Hz （ $\pm 11$ bit） |
|  | Overload Tolerance | Light duty：rated output current is 110 \％for 60 seconds Normal duty：rated output current is $120 \%$ for 60 seconds Heavy duty：rated output current is $150 \%$ for 60 seconds |
|  | Frequency Setting Signal | ＋10V～－10，0～＋10V，4～20mA，0～20mA，Pulse input |
|  | Accel．／decel．Time | 0．00～600．00／0．0～6000．0 seconds |
|  | Main control function | Torque control，Droop control，Speed／torque control switching，Feed forward control， Zero－servo control，Momentary power loss ride thru，Speed search，Over－torque detection，Torque limit，17－step speed（max），Accel／decel time switch，S－curve accel／decel，3－wire sequence，Auto－Tuning（rotational，stationary），Dwell，Cooling fan on／off switch，Slip compensation，Torque compensation，JOG frequency，Frequency upper／lower limit settings，DC injection braking at start／stop，High slip braking，PID control（with sleep function），Energy saving control，MODOBUS communication （RS－485 RJ45，max． 115.2 kbps），Fault restart，Parameter copy |
|  | Fan Control | 230V model <br> VFD150C23A（include）and series above：PMW control；VFD150C23A and series below：on／off switch control <br> 460V model <br> VFD150C23A（include）and series above：PMW control；VFD150C23A and series below：on／off switch control |
| 0000000000 | Motor Protection | Electronic thermal relay protection |
|  | Over－current Protection | For drive model 230 V and 440 V Over－current protection for 220\％rated current current clamp『 Normal duty：170～175\％』；『Heavy duty：180～185\％』 |
|  | Over－voltage Protection | 230：drive will stop when DC－BUS voltage exceeds 410 V 460：drive will stop when DC－BUS voltage exceeds 820 V |
|  | Over－temperature Protection | Built－in temperature sensor |
|  | Stall Prevention | Stall prevention during acceleration，deceleration and running independently |
|  | Restart After Instantaneous Power Failure | Parameter setting up to 20 seconds |
|  | Grounding Leakage Current Protection | Leakage current is higher than 50\％of rated current of the AC motor drive |
| Certifications |  | GB／T12668－2， <br> （certification in progress） |

## 9-3 Environment for Operation, Storage and Transportation

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


## 9-4 Specification for Operation Temperature and Protection Level

| Model | Frame | Top cover | Conduit Box | Protection Level | Operation Temperature |
| :---: | :---: | :---: | :---: | :---: | :---: |
| VFDxxxCxxA | $\begin{aligned} & \text { Frame A~C } \\ & 230 \mathrm{~V} \text { : } \end{aligned}$ | Top cover Removed | Standard conduit plate | IP20/UL Open Type | $-10 \sim 50^{\circ} \mathrm{C}$ |
|  | $\begin{aligned} & 0.75 \sim 22 \mathrm{~kW} \\ & 460 \mathrm{~V}: \\ & 0.75 \sim 30 \mathrm{~kW} \end{aligned}$ | Standard <br> with top cover |  | IP20/UL Type1/NEMA1 | $-10 \sim 40^{\circ} \mathrm{C}$ |
|  | $\begin{aligned} & \text { Frame D~H } \\ & 230 \mathrm{~V}: ~>22 \mathrm{~kW} \\ & 460 \mathrm{~V}:>30 \mathrm{~kW} \end{aligned}$ | N/A | No conduit box | IP00/IP20/UL Open Type | $-10 \sim 50^{\circ} \mathrm{C}$ |
| VFDxxxCxxE | $\begin{aligned} & \text { Frame A~C } \\ & 460 \mathrm{~V} \text { : } \end{aligned}$ | Top cover <br> Removed | Standard conduit plate | IP20/UL Open Type | $-10 \sim 50^{\circ} \mathrm{C}$ |
|  | 0.75~30kW | Standard with top cover |  | IP20/UL Type1/NEMA1 | $-10 \sim 40^{\circ} \mathrm{C}$ |
|  | $\begin{aligned} & \text { Frame } \mathrm{D} \sim \mathrm{H} \\ & 230 \mathrm{~V}: ~>22 \mathrm{~kW} \\ & 460 \mathrm{~V}:>30 \mathrm{~kW} \end{aligned}$ | N/A | Standard conduit box | IP20/UL Type1/NEMA1 | $-10 \sim 40^{\circ} \mathrm{C}$ |

## Derating of ambient tempeture and altitude



## C Type Derating for Altitude



* Stardard Ambient Temperature= 50 degC for UL Open Type / IP20

Stardard Ambient Temperature= 40 degC for UL Type I /IP 20 \& UL Open Type / IP20 Side by Side

| Protection Level | Operating Environment |
| :---: | :--- |
| UL Type I / IP20 | When the AC motor drive is operating at the rated <br> current and the ambient temperature has to be <br> between $10^{\circ} \mathrm{C} \sim+40^{\circ} \mathrm{C}$. When the temperature is <br> over $40^{\circ} \mathrm{C}$, for every increase by $1^{\circ} \mathrm{C}$, decrease $2 \%$ <br> of the rated current. The maimum allowable <br> temperature is $60^{\circ} \mathrm{C}$. |
| UL Open Type / | When the AC motor drive is operating at the rated <br> current and the ambient temperature has to be <br> between $-10^{\circ} \mathrm{C} \sim+50^{\circ} \mathrm{C}$. When the temperature is <br> over $50^{\circ} \mathrm{C}$, for every increase by $1^{\circ} \mathrm{C}$, decrease $2 \%$ <br> of the rated current. The maimum allowable <br> temperature is $60^{\circ} \mathrm{C}$. |
| IP20 | If AC motor drive is installed at altitude $0 \sim 1000 \mathrm{~m}$, <br> follow normal operation restriction. If it is install at <br> altitude $1000 \sim 3000 \mathrm{~m}$, decrease $2 \%$ of rated current <br> or lower $0.5^{\circ} \mathrm{C}$ of temeperature for every 100 m <br> increase in altitude. Maximum altitude for Corner <br> Grounded is 2000 m. |
| High Altitude |  |

# Chapter 10 Digital Keypad 

## 10-1 Descriptions of Digital Keypad

10-2 Function of Digital Keypad KPC-CC01
10-3 TPEditor Installation Instruction
10-4 Fault Code Description of Digital Keypad KPC-CC01

## 10-1 Descriptions of Digital Keypad

KPC-CC01


KPC-CE01(Option)


Communication Interface
RJ-45 (socket) , RS-485 interface;
Installation Method
Embedded type and can be put flat on the surface of the control box. The front cover is water proof.

The maximum RJ45 extension lead is $5 \mathrm{~m}(16 \mathrm{ft})$

## Descriptions of Keypad Functions

| Key | Descriptions |
| :---: | :---: |
| RUN | Start Operation Key <br> 1. It is only valid when the source of operation command is from the keypad. <br> 2. It can operate the AC motor drive by the function setting and the RUN LED will be ON. <br> 3. It can be pressed again and again at stop process. <br> 4. When enabling "HAND" mode, it is only valid when the source of operation command is from the keypad. |
| STOP RESET | Stop Command Key. This key has the highest processing priority in any situation. <br> 1. When it receives STOP command, no matter the AC motor drive is in operation or stop status, the AC motor drive needs to execute "STOP" command. <br> 2. The RESET key can be used to reset the drive after the fault occurs. For those faults that can't be reset by the RESET key, see the fault records after pressing MENU key for details. |
| $\begin{gathered} \mathrm{FWD} \\ \mathrm{REV} \end{gathered}$ | Operation Direction Key <br> 1. This key is only control the operation direction NOT for activate the drive. FWD: forward, REV: reverse. <br> 2. Refer to the LED descriptions for more details. |
| ENTER | ENTER Key <br> Press ENTER and go to the next level. If it is the last level then press ENTER to execute the command. |
| ESC | ESC Key <br> ESC key function is to leave current menu and return to the last menu. It is also functioned as a return key in the sub-menu. |


| MENU | Press menu to return to main menu. <br> Menu content: <br> KPC-CE01 does not support function 5~13. <br> 1. Detail Parameter <br> 7. Quick/Simple Setup <br> 13. PC Link <br> 2. Copy Parameter <br> 8. Display Setup <br> 3. Keypad Locked <br> 9. Time Setup <br> 4. PLC Function <br> 10. Language Setup <br> 5. Copy PLC <br> 11. Startup Menu <br> 6. Fault Record <br> 12. Main Page |
| :---: | :---: |
|  | Direction: Left/Right/Up/Down <br> 1. In the numeric value setting mode, it is used to move the cursor and change the numeric value. <br> 2. In the menu/text selection mode, it is used for item selection. |
| F1 F2 <br> F3 F4 | Function Key <br> 1. It has the factory setting function and the function can be set by the user. The present factory setting: F1 is JOG function. <br> 2. Other functions must be defined by TPEditor first. TPEditor software V1.30.6 is available for download at: <br> http://www.delta.com.tw/ch/product/em/download/download main.asp?act=3\&pid=1\&cid=1\&tp id=3 <br> 3. Installation Instruction for TPEditor is on page 10-15 of this chapter. |
| HAND | HAND ON Key <br> 1. This key is executed by the parameter settings of the source of Hand frequency and hand operation. The factory settings of both source of Hand frequency and hand operation are the digital keypad. <br> 2. Press HAND ON key at stop status, the setting will switch to hand frequency source and hand operation source. Press HAND ON key at operation status, it stops the AC motor drive first (display AHSP warning), and switch to hand frequency source and hand operation source. <br> 3. Successful mode switching for KPC-CE01, "H/A" LED will be on; for KPC-CC01, it will display HAND mode/ AUTO mode on the screen. |
| AUTO | 1. This key is executed by the parameter settings of the source of AUTO frequency and AUTO operation. The factory setting is the external terminal (source of operation is 4-20mA). <br> 2. Press Auto key at stop status, the setting will switch to hand frequency source and hand operation source. Press Auto key at operation status, it stops the AC motor drive first (display AHSP warning), and switch to hand frequency source and hand operation source. <br> 3. Successful mode switching for KPC-CE01, "H/A" LED will be off; for KPC-CC01, it will display HAND mode/ AUTO mode on the screen |

## Descriptions of LED Functions

| LED | Descriptions |
| :--- | :--- |
| RUN | Steady ON: operation indicator of the AC motor drive, including DC brake, zero speed, <br> standby, restart after fault and speed search. <br> Blinking: drive is decelerating to stop or in the status of base block. <br> Steady OFF: drive doesn't execute the operation command |
| RESET | Steady ON: stop indicator of the AC motor drive. <br> Blinking: drive is in the standby status. <br> Steady OFF: drive doesn't execute "STOP" command. |
| Aperation Direction LED |  |
| 1. Green light is on, the drive is running forward. |  |
| 2. Red light is on, the drive is running backward. |  |
| 3. Twinkling light: the drive is changing direction. |  |


| CANopen ~"RUN" | RUN LED: |  |
| :---: | :---: | :---: |
|  | $\begin{aligned} & \text { LED } \\ & \text { status } \end{aligned}$ | Condition/State |
|  | OFF | CANopen at initial <br> No LED |
|  | Blinking |  |
|  | Single flash | CANopen at stopped |
|  | No LED |  |
| CANopen ~"ERR" | ERR LED: |  |
|  | $\begin{aligned} & \text { LED } \\ & \text { status } \end{aligned}$ | Condition/ State |
|  | OFF | No Error |
|  | Single flash | One message fail |
|  | Double flash | Guarding fail or heartbeat fail |
|  | Triple flash |  |
|  | ON | Bus off |

## 10-2 Function of Digital Keypad KPC-CC01 POWER ON



## Start-up

Skip to main page afer 3 sec .
1)The default Start-up page is Delta Logo. (Default 1and 2)
2) User can customize their start-up page through the edited function. (Need to purchase the optional accessories)


After main menu is selected, the start-up page will display in the format user defined. The page shown on the left is display as Delta default setting.
$\longrightarrow$ The button line of LCD displays time and JOG.



MENU
1.Detail Parameter
5. Copy PLC
2.Copy Parameter
3.Keypad Locked
4.PLC Function

Item 1~4 are the common items for KPC-CC01 \&KPC-CE01
6. Fault Record
7. Quick/Simple Setup
8. Display Setup
9. Time Setup
10. Language Setup
11. Start-up
12. Main page

1. Startup page can only display pictures, no flash.
2. When Power ON, it will display startup page then the main page. The main page displays Delta's default setting F/H/A/U, the display order can be set by Pr. 00.03 (Startup display). When the selected item is $U$ page, use left key and right key to switch between the items, the display order of $U$ page is set by Pr.00.04 (User display).

## Display Icon



Display item


Item 1~4 are the common items for KPC-CC01 \&KPC-CE01

MENU
1.Detail Parameter
2.Copy Parameter
3.Keypad Locked
4.PLC Function
5. Copy PLC
6. Fault Record
7. Quick/Simple Setup
8. Display Setup
9. Time Setup
10. Language Setup
11. Start-up
12. Main page
13. PC Link

1. Detail Parameter

2. Copy Parameter

3. Keypad locked

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

4. PLC Function

| PLC | When activate and stop PLC function, the PLC status will be displayed on main page of Delta default setting. |
| :---: | :---: |
| 1.Disable <br> 2.PLC Run <br> 3.PLC Stop <br> PLC function |  |
| 1. Disable <br> 2. PLC run <br> 3. PLC stop | The PLC function of KPC-CE01 can only displays: <br> 1. PLCO <br> 2. PLC1 <br> 3. PLC2 |

5. Copy PLC

|  | Copy PLC |
| :---: | :---: |
| Copy PLC <br> $\boldsymbol{\nabla} 1$. <br> 2. <br> 3. | 1. Duplicate 4 sets of parameters. |
|  | 2. When the setting is complete, the date will be written to the Copy PLC page. |
|  | Copy PLC |
|  | 1.2010/03/14 <br> 2. <br> 3. <br> Press <br> ENTER <br> to setting menu. |
|  | File 1 <br> 1. Save to the drive <br> Press <br> to select where to save the file <br> 2. Save to the digital display <br> Press <br> ENTER <br> execute filesaving process. |
|  | If select save to the drive and press enter, the file will be saved to the drive. <br> NOTE <br> If password protection for WPLSoft editor was set, it is required to enter the password before the file can successfully be saved onto the digital display. |
|  | $\text { File } 1$ |
|  | Password 0000 <br> Input Times 0 |

6. Fault record

|  | Fault Record |
| :---: | :---: |
| Fault record | It can accumulate 6 sets of recent fault records with keypad V1.02 and below; |
| - 1:GFF | 20 sets of recent fault records with keypad V1.03 and above |
|  | The first fault code displays in the record is the latest fault. Select the fault code for details on time, date, frequency, current, voltage and DC BUS Volt.. |
| Press ENTER to select. | Fault record |
|  |  |
| KPC-CE01 does not support this function. | current and voltage of the fault |
|  | 2: ocA |
|  | Time: 19:47:00 <br> Frequency: 0.00 <br> Current: $\quad 0.00$ |
|  | I五NOTE |
|  | Fault actions of AC motor drive are record and save to KPC-CC01. When KPC-CC01 is removed and apply to another AC motor drive, the previous fault records will not be deleted. The new fault records of the present AC motor drive will accumulate to KPC-CC01. |

7. Quick/Simple Setting


Quick Setting:

1. V/F Mode


Items

1. Parameter Protection Password Input (P00-07)
2. Parameter Protection Password Setting (P00-08)
3. Control Mode (P00-10)
4. Control of Speed Mode (P00-11)
5. Load Selection (P00-16)
6. Carrier Frequency (P00-17)
7. Source of the Master Frequency Command (AUTO) (P00-20)
8. Source of the Operation Command (AUTO) (P00-21)
9. Stop Method (POO-22)
10. Digital Keypad STOP function (P00-32)
11. Max. Operation Frequency (P01-00)
12. Base Frequency of Motor 1 (P01-01)
13. Max. Output Voltage Setting of Motor 1 (P01-02)
14. Mid-point Frequency 1 of Motor 1 (P01-03)
15. Mid-point Voltage 1 of Motor 1 (P01-04)
16. Mid-point Frequency 2 of Motor 1 (P01-05)
17. Mid-point Voltage 2 of Motor 1 (P01-06)
18. Min. Output Frequency of Motor 1 (P01-07)
19. Min. Output Voltage of Motor 1 (P01-08)
20. Output Frequency Upper Limit (P01-10)
21. Output Frequency Lower Limit (P01-11)
22. Accel. Time 1 (P01-12)
23. Decel Time 1 (P01-13)
24. Over-voltage Stall Prevention (P06-01)
25. Derating Protection (P06-55)
26. Software Brake Level (P07-00)
27. Speed Search during Start-up (P07-12)
28. Emergency Stop (EF) \& Force to Stop Selection (P07-20)
29. Filter Time of Torque Command (P07-24)
30. Filter Time of Slip Compensation (P07-25)
31. Torque Compensation Gain (P07-26)
32. Slip Compensation Gain (P07-27)
33. VFPG Mode

01: Password Input (Decode)


Items

1. Parameter Protection Password Input (P00-07)
2. Parameter Protection Password Setting (P00-08)
3. Control Mode (P00-10)
4. Control of Speed Mode (P00-11)
5. Load Selection (P00-16)
6. Source of the Master Frequency Command (AUTO) (P00-20)
7. Source of the Operation Command (AUTO) (P00-21)




8．Display setup


9．Time setting


10．Language setup

| Language <br> 1：English <br> 2：繁體中文 <br> $3:$ 简体中文 | Language selection． |
| :--- | :--- |

11．Startup Page Setting

|  | 1．Default picture 1 <br> DELTA LOGO <br> 2．Default picture 2 <br> DELTA Text <br> 3．User defined：optional accessory is require（TPEditor \＆USB／RS－485 Communication Interface－IFD6530） <br> Install an editing accessory would allow users to design their own start－up page．If editor accessory is not installed，＂user defined＂option will dispay a blank page． <br> USB／RS－485 Communication Interface－IFD6530 <br> Please refer to Chapter 07 Optional Acessories for more detail． <br> TPEditor <br> TPEditor Installation Instruction is on page 10－15 and TPEditor V1．03．6 is available for download at： <br> http：／／www．delta．com．tw／ch／product／em／download／download main．asp？act ＝3\＆pid＝1\＆cid＝1\＆tpid＝3 |
| :---: | :---: |
| Start－up |  |
| 1．Default 1 <br> 2．Default 2 <br> 3．User define |  |
|  |  |
|  |  |
|  |  |
|  |  |

12. Main page

|  | 1. Default page |
| :---: | :---: |
| Main Page | Default picture and editable picture are available upon selection. |
| 1.Default <br> 2. User define | $$ |
| Press ENTER to select. | $F 600.00 \mathrm{~Hz} \ggg \mathrm{H} \ggg \mathrm{A} \ggg \mathrm{U}$ (circulate) <br> 2. User defined: optional accessory is require (TPEditor \& USB/RS-485 Communication Interface-IFD6530) <br> Install an editing accessory would allow users to design their own start-up page.If editor accessory is not installed, "user defined" option will dispay a blank page. <br> USB/RS-485 Communication Interface-IFD6530 |
|  | Please refer to Chapter 07 Optional Acessories for more detail. TPEditor |
|  | TPEditor Installation Instruction is on page 10-15 and TPEditor V1.30.6 is available for download at: <br> http://www.delta.com.tw/ch/product/em/download/download main.asp?act =3\&pid=1\&cid=1\&tpid=3 |

13. PC Link


## Other display

When fault occur, the menu will display:


1. Press ENTER and start RESET. If still no response, please contact local distributor or return to the factory. To view the fault DC BUS voltage, output current and output voltage, press "MENU" $\rightarrow$ "Fault Record".
2. Press ENTER again, if the screen returns to main page, the fault is clear.
3. When fault or warning message appears, backlight LED will blinks until the fault or the warning is cleared.

## Optional accessory: RJ45 Extension Lead for Digital Keypad

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

## 10-3 TPEditor Installation Instruction

TP functions can edit up to 256 pages (keypad), total capacity is 256 KB .50 normal objects and 10 communicationobjects can be edited per page.

1) TPEditor: Setup \& Basic Functions
1. Run TPEditor version 1.30
2. Go to File(F) $\rightarrow$ Click on New. The Window below will pop up. At the device type, click on the drop down menu and choose DELTA VFD-C Inverter. At the TP type, click on the drop down menu and choose VFD-C KeyPad. As for File Name, enter TPE0. Now click on OK.

| Hew Project |  |
| :---: | :---: |
| $\begin{aligned} & \mathrm{HMI} \Leftrightarrow \text { PLC } \\ & \text { Set Devioe Type } \end{aligned}$ |  |
|  |  |
| DELTA VFD-C Inverter | $\checkmark$ |
| TP Type |  |
| VFD-C KeyPad | $\checkmark$ |
| File Name |  |
| TPED |  |
|  | Canoel |

3. You are now at the designing page. Go to Edit (E) $\rightarrow$ Click on Add a New Page (A) or go to the TP page on the upper right side, right click once on TP page and choose Add to increase one more page for editing. The current firmware of Keypad is version 1.00 and can support up to 4 pages.

4. Download setting, Go to Tool $\rightarrow$ Communication settings (C) to set up the PC Com Port and Baud Rate. The supporting speeds of Baud rate are 9600 bps , 19200bps and 38400 bps . The default setting of TP address is 1, please do not modify.

2) Edit Startup Page
1. Click once on the Boot Page on the right hand side of your computer screen or click on View ( V ) $\rightarrow$ click on Boot Page (B). Then a blank Boot Page window will pop up. Use the circled items to design your Startup page.

2. Static Text $\mathbf{A}$ Open a blank page, click once on this button A and then double click on that blank page. The following windows will pop up.


On the right hand side of the Static Text Setting, you can adjust the frame setting, the text direction, the alignment and the font setting. Once you finish all the adjustments that you need.
You can continue to input your text in the blank space of Static Text Setting window. When you finish inputting your text, click on OK to continue your next step or click cancel to abort the current step.
3. Static Bitmap $\rightarrow$ Open a blank page, then click once on this button and then double click on that blank page. The following window will pop up.


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

$\rightarrow$ As shown in the picture on the left side, there are 11 kinds of geometric bitmap to choose. Open a new blank page then click once on a geometric bitmap
icon that you need. Then drag that icon and enlarge it to the size that you need on that blank page. For example, if you drag this iconto a blank page, you will see the following window.

5. Download---Take the image below as an example. The sentence "Boot page" is static text, the 11 images below are geometric bitmaps. The image on the right hand side is a Static Bitmap. To upload a start up page, double click to activate "Boot page. Make sure that you have followed the instruction on page 3 to choose the right com port. Then go to "Communication (M)" $\rightarrow$ Click on "Write Boot Page TP (B)." When you see the pop up message below


Go to the C2000 Keypad, press Menu then keep on pressing the Upward key until you see "PC Link," then press ENTER once, when you see "Press Enter to PC Link" on the keypad, press the ENTER again. Then click the YES button to begin the upload.

3) Edit Main Page

1. Click on a page under the TP Page to edit or go to View $\rightarrow$ click on Boot Page to begin to edit main page. The objects available for you to use are in the red circles below.


From left to right: Static Text, ASCII Display, Static Bitmap, Scale, Bar Graph, Button, Clock Display, Units, Numeric Input, 11 geometric bitmaps and different width of lines. The application of Static Text, Static Bitmap, and geometric bitmap is the same as the editing startup page.
2. Numeric/ASCII Display A): Go to Objects $(\mathrm{O}) \rightarrow$ Click once on the Numeric/ASCII Display $(\mathrm{A})$ $\mathbf{N}$ NumeridASCII Display $(\hat{A}) \quad \rightarrow$ Drag to enlarge to reach the size that you need to add objects in the screen where you want to create an object $\rightarrow$ Double click on the object to set up Related Devices, Frame Setting, Fonts and Alignment.


Related Device: Choose the VFD Communication Port that you need, if you want to read output frequency (H), set the VFD Communication Port to $\$ 2202$. For other values, please refer to ACMD ModBus Comm Address List.
3. Scale Setting $\frac{\overline{7 \cdot 1}}{\sqrt{2}}$ : On the Tool Bar, click on this $\frac{\overline{7} \cdot \frac{1}{2}}{}$ for Scale Setting. You can also edit Scale Setting in the Property Window on the right hand side of your computer screen.

a. Scale Position: Click on the drop down list to choose which position that you need to place a scale.
b. Scale Side: Click on the drop down list to choose if you want to number your scale from smaller number to bigger number or from big to small. Click OK to accept this setting or click Cancel to abort.
c. Font Setting: Click on the drop down list to choose the Font setting that you need then click OK to accept the setting or click Cancel to abort.
d. Value Length: Click on the drop down to choose 16bits or 32 bits. Then click OK to accept the setting or click Cancel to abort.
e. Main Scale \& Sub Scale: In order to divide the whole scale into equal parts, key in the numbers of your choices for main scale and sub scale.
f. Maximum value \& Minimum Value are the numbers on the two ends of a scale. They can be negative numbers but the input numbers are limited by value.
g. Follow the Scale setting mentioned above; you will have a scale as shown below.

4. Bar Graph setting

a. Related Device: Choose the VFD Communication Port that you need.
b. Direction Setting: Click on the drop down menu to choose one of the following directions: From Bottom to Top, From Top to Bottom, From Left to Right or From Right to Left.
c. Maximum Value \& Minimum Value: They define the range covered by the maximum value and minimum value. If a value is smaller than or equal to the minimum value, then the bar graph will be blank. If a value is bigger or equal to the maximum value, then the bar graph will be full. If a value is between minimum and maximum value, then the bar graph will be filled proportionally.
5. Button : Currently this function only allows the Keypad to switch pages, other functions are not yet available. Text input function and Image inserted functions are not yet supported.
Double click on 8 to open set up window.

a. <Button Type> allows you set up buttons' functions. But Page Jump is the only supported function currently.
b. Page Jump setting: After you choose the Page Jump function in the drop down list, you will see this Page Jump Setting Menu
c. <Function Key> allows you to assign functions to the following keys on the KPC-CC01 keypad: F1, F2, F3, F4, Up, Down, Left and Right. Please note that the Up and Down keys are locked by TPEditor. These two keys cannot be programmed. If you want to program Up and Down keys, go to Tool $\rightarrow$ Function Key Settings $(F) \rightarrow$ Re-Define Up/Down Key(R).

d. There are no supported functions other than the setting mentioned above.
6. Clock Display Setting 1 : Click once on this button 1

Open a new file and click once in that window, you will see the following


In the clock display setting, you can choose to display Time, Day or Date on the Keypad. To adjust time, go to \#9 on the Keypad's menu. You can also adjust Frame Setting, Font Setting and Alignment.
7. Unit Measurement : Click once on this Button:
Open a new file and double click on that window, you will see the following


Choose from the drop down list the Metrology and the Unity Name that you need.
As for Metrology, you have the following choices Length, Square Measure, Volume/Solid Measure, Weight, Speed, Time and Temperature. The unit name changes automatically when you change metrology type.
8. Numeric Input Setting ${ }^{\underline{23} \text { : }}$

This menu allows you to provide parameters or communication ports and to input numbers.
Click once on this button 른.
Open a new file and double click on that window, you will see the following:

a. Related Device: There are two blank spaces to fill in, one is <Write> and another one is <Read>. Input the numbers that you want to display and the corresponding numbers of a parameter and that of a communication port. For example, input 012C to Read and Write Parameter P01-44.
b. OutLine Setting: The Frame setting, Font setting, Vertical Alignment and Horizontal Alignment are the same as mentioned before. Click on the drop down menu and choose the setting that you need.
c. Function key: The setting here allows you to program keys on the keypad. Press the key on the menu then the corresponding key on the keypad will start to blink, then press Enter to confirm the setting.
d. Value Type \& Value Length: These two factors influence the range of the Minimum and Maximum Value of the Limit Setting. Please note that the corresponding supporting values for C 2000 have to be 16bits. The 32bits values are not supported.
e. Value Setting: This part is set automatically by the keypad itself.
f. Limit Setting: Input the range the security setting here.
g. For example, if you set Function Key as F1, Minimum Value as 0 and Maximum Value ias 4, then press F1 on Keypad Then you can press Up and Down key on the keypad to increase or decrease the value. Press Enter Key on the keypad to confirm your setting. You can also go to parameter table 01-44 to verify if your input correctly the value.

- TP Page

0 :
9. Download TP Page

Boot Page
: Press Up or Down key on the keypad until you reach \#13 PC
Link.
Then press Enter on the keypad and you will see the word "Waiting" on keypad's screen. Now choose a page that you have created then go to Communication $(\mathrm{M}) \rightarrow$ Write to $\mathrm{TP}(\mathrm{W})$ to start downloading the page to the keypad


When you see the word Completed on the keypad's screen, that means the download is done. Then you can press ESC on the keypad to go back to the menu of the keypad.

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

Following fault codes and description are for digital keypad KPC-CC01 with version V1.01 and version higher.

| LCM Display | Description |
| :---: | :---: |
| Fault <br> FrEr <br> kpdFlash Read Er | Keypad flash memory read error |
| Fault <br> FSEr <br> kpdFlash Save Er | Keypad flash memory save error |
|  | Keypad flash memory parameter error |
|  | Keypad flash memory when read AC drive data error |


| LCM Display | Description |
| :---: | :---: |
| Warning CE01 Comm Command Er | Modbus function code error |
| Warning CE02 <br> Comm Address E | Modbus data address error |
| Warning CEO3 <br> Comm Data Error | Modbus data value error |
| Warning CEO4 <br> Comm Slave Error | Modbus slave drive error |
| Warning CE10 KpaND Kpomm Time Out | Modbus transmission time-Out |
| Warning TPNO TP No Object | Object not supported by TP Editor |

Fault Descriptoin of File Copy and Setting Errors

| LCM Display | Description |
| :---: | :---: |
| File 1 <br> Err <br> Read Only | Parameter and rile are read only |
| File 1 <br> Err <br> Write Fail | Fail to write parameter and file |
| File 1 <br> Err <br> VFD Running | AC drive is in operating status |
| $\square$ | AC drive parameter is locked |
| HAND <br> File 1 <br> Err Pr Changing | AC drive parameter changing |
| File 1 <br> Err <br> Fault Code | Fault code |
| File 1 <br> Err <br> Warning Code | Warning code |
| HAND <br> File 1 <br> Err <br> Type Dismatch | File type dismatch |
| $\square$ <br> File 1 <br> Err <br> Password Lock | File is locked with password |
| HAND <br> File 1 <br> Err <br> Version Fail | File version dismatch |
|  | AC drive copy function time-out |
| File 1 <br> Err <br> Keypad Issue | Other keypad error |

Chapter 10 Digital Keypad | C2000 Series

| LCM Display |  |
| :---: | :--- |
| File 1HAND <br> Err <br> VFD Issue |  |
| Other AC drive error |  |

## Chapter 11 Summary of Parameter Settings

This chapter provides summary of parameter settings for user to gather the parameter setting ranges, factory settings and set parameters. The parameters can be set, changed and reset by the digital keypad.

1) $N$ : the parameter can be set during operation
2) For more detail on parameters, please refer to Ch12 Description of Parameter Settings.

## 00 Drive Parameters

## NOTE

IM: Induction Motor; PM: Permanent Magnet Motor

| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| 00-00 | Identity Code of the AC Motor Drive | 4: 230V, 1HP <br> 5: $460 \mathrm{~V}, 1 \mathrm{HP}$ <br> 6: 230V,2HP <br> 7: $460 \mathrm{~V}, 2 \mathrm{HP}$ <br> 8: 230V, 3HP <br> 9: $460 \mathrm{~V}, 3 \mathrm{HP}$ <br> 10: 230V, 5HP <br> 11: 460 V, 5HP <br> 12: 230V, 7.5 HP <br> 13: $460 \mathrm{~V}, 7.5 \mathrm{HP}$ <br> 14: 230V, 10HP <br> 15: 460V, 10HP <br> 16: 230V, 15HP <br> 17: 460V, 15HP <br> 18: 230V, 20HP <br> 19: 460V, 20HP <br> 20: 230V, 25HP <br> 21: 460V, 25HP <br> 22: 230V, 30HP <br> 23: 460V, 30HP <br> 24: 230V, 40HP <br> 25: 460V, 40HP <br> 26: 230V, 50HP <br> 27: 460V, 50HP <br> 28: 230V, 60HP <br> 29: 460V, 60HP <br> 30: 230V, 75HP <br> 31: 460V, 75HP <br> 32: 230V, 100HP <br> 33: 460V, 100HP <br> 34: 230V, 125HP <br> 35: 460V, 125HP <br> 37: 460V, 150HP <br> 39: 460V, 175HP <br> 41: 460V, 215HP <br> 43: 460V, 250HP <br> 45: 460V, 300HP <br> 47: 460V, 375HP <br> 49: 460V, 425HP <br> 51: 460V, 475HP <br> 55: 460V, 600HP <br> 93: 460V, 5HP (4kW) | Read only |
| 00-01 | Display AC Motor Drive Rated Current | Display by models | Read only |



Chapter 11 Summary of Parameter Settings


|  |  |  | 4: Pulse input without direction command (Pr.10-16 without direction) <br> 5: Pulse input with direction command (Pr.10-16) <br> 6: CANopen communication card <br> 7: Reserved <br> 8: Communication card (no CANopen card) |  |
| :---: | :---: | :---: | :---: | :---: |
| N | 00-21 | Source of the Operation Command (AUTO) | 0: Digital keypad <br> 1: External terminals. Keypad STOP disabled. <br> 2: RS-485 serial communication. Keypad STOP disabled. <br> 3: CANopen communication card <br> 4: Reserved <br> 5: Communication card (no CANopen card) | 0 |
| $N$ | 00-22 | Stop Method | 0: Ramp to stop <br> 1: Coast to stop | 0 |
| N | 00-23 | Control of Motor Direction | 0: Enable forward/reverse <br> 1: Reverse disable <br> 2: Forward disable | 0 |
|  | 00-24 | Memory of Frequency Command | Read only | Read only |
|  | 00-25 | User Defined Characteristics | Bit 0~3: user defined decimal place 0000b: no decimal place 0001b: one decimal place 0010b: two decimal place 0011b: three decimal place Bit 4~15: user define on unit 000xh: Hz 001xh: rpm 002xh: \% 003xh: kg 004xh: M/S 005xh: kW 006xh: HP 007xh: PPM 008xh: //m 009xh: kg/s 00Axh: kg/m 00Bxh: kg/h 00Cxh: $\mathrm{lb} / \mathrm{s}$ 00Dxh: $\mathfrak{1 6} / \mathrm{m}$ 00Exh: $\uparrow 6 / \hbar$ 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 | 0 |



2: Forward run to home. Set ORG : OFF $\rightarrow$ ON as check point.
11-3: Reverse to home. Set ORG: OFF $\rightarrow O N$ as check point.

\begin{tabular}{|c|c|c|c|c|c|}
\hline \multicolumn{2}{|r|}{} \& \& $Y$

Z \& | 5: Forward run and search for Z-pulse as check point. |
| :--- |
| 6: Forward run to home. Set ORG: ON $\rightarrow$ OFF as check point. |
| 7: Reverse run to home. Set ORG: ON $\rightarrow$ OFF as check point. |
| 8: Define current position as home. |
| Set $X$ to $0,1,2,3,6,7$ first. |
| 0 : reverse run to $Z$ pulse |
| 1: continue forward run to $Z$ pulse |
| 2: Ignore $Z$ pulse |
| When home limit is reached, set $X$ to $2,3,4,5$, |
| 6, 7 first. |
| 0 : display the error |
| 1: reverse the direction | \& <br>

\hline \& 00-41 \& Homing by frequency 1 \& \& 00~600.00Hz \& 8.00 <br>
\hline \& 00-42 \& Homing by frequency 2 \& \& 00~600.00Hz \& 2.00 <br>

\hline \& $$
\begin{gathered}
00-43 \\
\underset{00-47}{ }
\end{gathered}
$$ \& \multicolumn{4}{|l|}{Reserved} <br>

\hline $N$ \& 00-48 \& Display Filter Time (Current) \& \& .001~65.535 sec \& 0.100 <br>
\hline N \& 00-49 \& Display Filter Time (Keypad) \& \& .001~65.535 sec \& 0.100 <br>
\hline \& 00-50 \& Software Version (date) \& \& ead only \& \#\#\#\#\# <br>

\hline \& $$
\begin{aligned}
& 00-51 \\
& \underset{00-61}{ }
\end{aligned}
$$ \& \multicolumn{4}{|l|}{Reserved} <br>

\hline
\end{tabular}

## 01 Basic Parameters



Chapter 11 Summary of Parameter Settings \| C2000 Series

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| $N$ | 01-22 | JOG Frequency | 0.00~600.00Hz | 6.00 |
| $N$ | 01-23 | 1st/4th Accel/decel Frequency | 0.00~600.00Hz | 0.00 |
| $N$ | 01-24 | S-curve Acceleration Begin Time 1 | Pr.01-45=0: 0.00~25.00 second Pr.01-45=1: 0.0~250.0 second | $\begin{gathered} 0.20 \\ 0.2 \end{gathered}$ |
| $N$ | 01-25 | S-curve Acceleration Arrival Time 2 | $\begin{aligned} & \text { Pr. } 01-45=0: 0.00 \sim 25.00 \text { second } \\ & \text { Pr. } 01-45=1: 0.0 \sim 250.0 \text { second } \end{aligned}$ | $\begin{gathered} 0.20 \\ 0.2 \end{gathered}$ |
| N | 01-26 | S-curve Deceleration Begin Time 1 | Pr.01-45=0: 0.00~25.00 second Pr.01-45=1: $0.0 \sim 250.0$ second | $\begin{gathered} 0.20 \\ 0.2 \end{gathered}$ |
| $N$ | 01-27 | S-curve Deceleration Arrival Time 2 | Pr.01-45=0: 0.00~25.00 second Pr.01-45=1: 0.0~250.0 second | $\begin{gathered} 0.20 \\ 0.2 \end{gathered}$ |
|  | 01-28 | Skip Frequency 1 (upper limit) | 0.00~600.00Hz | 0.00 |
|  | 01-29 | Skip Frequency 1 (lower limit) | 0.00~600.00Hz | 0.00 |
|  | 01-30 | Skip Frequency 2 (upper limit) | 0.00~600.00Hz | 0.00 |
|  | 01-31 | Skip Frequency 2 (lower limit) | 0.00~600.00Hz | 0.00 |
|  | 01-32 | Skip Frequency 3 (upper limit) | 0.00~600.00Hz | 0.00 |
|  | 01-33 | Skip Frequency 3 (lower limit) | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0.00 |
|  | 01-34 | Zero-speed Mode | 0: Output waiting <br> 1: Zero-speed operation <br> 2: Fmin (Refer to Pr.01-07, 01-41) | 0 |
|  | 01-35 | Output Frequency of Motor 2 | 0.00~600.00Hz | $\begin{aligned} & 60.00 / \\ & 50.00 \end{aligned}$ |
|  | 01-36 | Output Voltage of Motor 2 | $\begin{aligned} & 230 \mathrm{~V}: 0.0 \mathrm{~V} \sim 255.0 \mathrm{~V} \\ & 460 \mathrm{~V}: 0.0 \mathrm{~V} \sim 510.0 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 200.0 \\ & 400.0 \end{aligned}$ |
|  | 01-37 | Mid-point Frequency 1 of Motor 2 | 0.00~600.00Hz | 3.00 |
| $N$ | 01-38 | Mid-point Voltage 1 of Motor 2 | $\begin{aligned} & 230 \mathrm{~V}: 0.0 \mathrm{~V} \sim 240.0 \mathrm{~V} \\ & 460 \mathrm{~V}: 0.0 \mathrm{~V} \sim 480.0 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 11.0 \\ & 22.0 \end{aligned}$ |
|  | 01-39 | Mid-point Frequency 2 of Motor 2 | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0.50 |
| $N$ | 01-40 | Mid-point Voltage 2 of Motor 2 | $\begin{aligned} & 230 \mathrm{~V}: 0.0 \mathrm{~V} \sim 240.0 \mathrm{~V} \\ & 460 \mathrm{~V}: 0.0 \mathrm{~V} \sim 480.0 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 2.0 \\ & 4.0 \end{aligned}$ |
|  | 01-41 | Min. Output Frequency of Motor 2 | 0.00~600.00Hz | 0.00 |
| $N$ | 01-42 | Min. Output Voltage of Motor 2 | $\begin{aligned} & 230 \mathrm{~V}: 0.0 \mathrm{~V} \sim 240.0 \mathrm{~V} \\ & 460 \mathrm{~V}: 0.0 \mathrm{~V} \sim 480.0 \mathrm{~V} \end{aligned}$ | $\begin{aligned} & 0.0 \\ & 0.0 \end{aligned}$ |
|  | 01-43 | V/f Curve Selection | 0: V/f curve determined by Pr.01-00~01-08 <br> 1: Curve to the power of 1.5 <br> 2: Curve to the power of 2 | 0 |
| $N$ | 01-44 | Optimal Acceleration/Deceleration Setting | 0: Linear accel. /decel. <br> 1: Auto accel.; linear decel. <br> 2: Linear accel.; auto decel. <br> 3: Auto accel./decel. <br> 4: Linear, stall prevention by auto accel./decel. (limit by Pr.01-12~01-21) | 0 |
|  | 01-45 | Time Unit for Accel. /Decel. and S Curve | 0 : Unit: 0.01 sec <br> 1: Unit: 0.1 sec | 0 |
|  | 01-46 | CANopen Quick Stop Time | Pr. 01-45=0: 0.00~600.00 sec Pr. 01-45=1: 0.0~6000.0 sec | 1.00 |

## 02 Digital Input/Output Parameters

| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| 02-00 | 2-wire/3-wire Operation Control | 0: 2-wire mode, power on for operation control <br> 1: 2-wire mode 2, power on for operation control <br> 2: 3-wire, power on for operation control | 0 |
| 02-01 | Multi-function Input Command 1 (MI1) | 0: No function | 1 |
| 02-02 | Multi-function Input Command 2 (MI2) | 1: Multi-step speed command $1 /$ multi-step position command 1 | 2 |
| 02-03 | Multi-function Input Command 3 (MI3) | 2: Multi-step speed command $2 /$ multi-step position command 2 | 3 |
| 02-04 | Multi-function Input Command 4 (M14) | 3: Multi-step speed command $3 /$ multi-step position command 3 | 4 |
| 02-05 | Multi-function Input Command 5 (MI5) | 4: Multi-step speed command 4/multi-step position command 4 | 0 |
| 02-06 | Multi-function Input Command 6 (MI6) | 5: Reset | 0 |
| 02-07 | Multi-function Input Command 7 (MI7) | 6: JOG command (By KPC-CC01 or external control) | 0 |
| 02-08 | Multi-function Input Command 8 (MI8) | 7: Acceleration/deceleration speed inhibit | 0 |
| 02-26 | Input terminal of I/O extension card (MI10) | 8: The $1^{\text {st }}, 2^{\text {nd }}$ acceleration/deceleration time selection | 0 |
| 02-27 | Input terminal of I/O extension card (MI11) | 9: The $3^{\text {rd }}, 4^{\text {th }}$ acceleration/deceleration time selection | 0 |
| 02-28 | Input terminal of I/O extension card (MI12) | 10: EF Input (Pr.07-20) | 0 |
| 02-29 | Input terminal of I/O extension card (MI13) | 11: B.B input from external (Base Block) | 0 |
| 02-30 | Input terminal of I/O extension card (MI14) | 12: Output stop | 0 |
| 02-31 | Input terminal of I/O extension card (MI15) | 13: Cancel the setting of optimal accel. /decel. time | 0 |
|  |  | 14: Switch between motor 1 and motor 2 |  |
|  |  | 15: Operation speed command from AVI |  |
|  |  | 16: Operation speed command from ACI |  |
|  |  | 17: Operation speed command from AUI |  |
|  |  | 18: Emergency stop (Pr.07-20) |  |
|  |  | 19: Digital up command |  |
|  |  | 20: Digital down command |  |
|  |  | 21: PID function disabled |  |
|  |  | 22: Clear counter |  |
|  |  | 23: Input the counter value (MI6) |  |
|  |  | 24: FWD JOG command |  |
|  |  | 25: REV JOG command |  |
|  |  | 26: TQC/FOCmodel selection |  |
|  |  | 27: ASR1/ASR2 selection |  |
|  |  | 28: Emergency stop (EF1) |  |
|  |  | 29: Signal confirmation for Y-connection |  |
|  |  | 30: Signal confirmation for $\Delta$-connection |  |
|  |  | 31: High torque bias (Pr.11-30) |  |
|  |  | 32: Middle torque bias (Pr.11-31) |  |
|  |  | 33: Low torque bias (Pr.11-32) |  |
|  |  | 34: Switch between multi-step position and multi-speed control |  |
|  |  | 35: Enable single point position control |  |
|  |  | 36: Enable multi-step position learning function (valid at stop) |  |
|  |  | 37: Full position control pulse command input enable |  |
|  |  | 38: Disable EEPROM write function |  |



|  |  | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | 18: Preliminary count value attained, returns to 0 (Pr.02-19) |  |
|  |  |  | 19: Base Block |  |
|  |  |  | 20: Warning output |  |
|  |  |  | 21: Over voltage warning |  |
|  |  |  | 22: Over-current stall prevention warning |  |
|  |  |  | 23: Over-voltage stall prevention warning |  |
|  |  |  | 24: Operation mode indication |  |
|  |  |  | 25: Forward command |  |
|  |  |  | 26: Reverse command |  |
|  |  |  | 27: Output when current >= Pr.02-33 (>= 02-33) |  |
|  |  |  | 28: Output when current $<=$ Pr.02-33( $<=02-33$ ) |  |
|  |  |  | 29: Output when frequency >= Pr.02-34 (>= 02-34) |  |
|  |  |  | 30: Output when frequency <= Pr.02-34 (<= 02-34) |  |
|  |  |  | 31: Y -connection for the motor coil |  |
|  |  |  | 32: $\triangle$-connection for the motor coil |  |
|  |  |  | 33: Zero speed (actual output frequency) |  |
|  |  |  | 34: Zero speed include stop(actual output frequency) |  |
|  |  |  | 35: Error output selection 1(Pr.06-23) |  |
|  |  |  | 36: Error output selection 2(Pr.06-24) |  |
|  |  |  | 37: Error output selection 3(Pr.06-25) |  |
|  |  |  | 38: Error output selection 4(Pr.06-26) |  |
|  |  |  | 39: Position attained (Pr.10-19) |  |
|  |  |  | 40: Speed attained (including Stop) |  |
|  |  |  | 41: Multi-position attained |  |
|  |  |  | 42: Crane function |  |
|  |  |  | 43: Actual motor speed slower than Pr.02-47 |  |
|  |  |  | 44: Low current output (use with Pr.06-71~06-73) |  |
|  |  |  | 45: UVW Output Electromagnetic valve Switch |  |
|  |  |  | 46: Master dEb warning output |  |
|  |  |  | 47: Closed brake output |  |
|  |  |  | 48: Reserved |  |
|  |  |  | 49: Homing action complete |  |
|  |  |  | 50: Output for CANopen control |  |
|  |  |  | 51: Output for communication card |  |
|  |  |  | 52: Output for RS485 |  |
|  |  |  | 53~62: Reserved |  |
|  | 02-18 | Multi-function output direction | 0000h~FFFFh (0: N.O.; 1: N.C.) | 0000 |
|  | 02-19 | Terminal counting value attained (returns to 0) | 0~65500 | 0 |
|  | 02-20 | Preliminary counting value attained (not return to 0) | 0~65500 | 0 |
|  | 02-21 | Digital Output Gain (DFM) | 1~166 | 1 |
|  | 02-22 | Desired Frequency Attained 1 | $0.00 \sim 600.00 \mathrm{~Hz}$ | $\begin{aligned} & 60.00 / \\ & 50.00 \end{aligned}$ |
|  | 02-23 | The Width of the Desired Frequency Attained 1 | $0.00 \sim 600.00 \mathrm{~Hz}$ | 2.00 |
|  | 02-24 | Desired Frequency Attained 2 | $0.00 \sim 600.00 \mathrm{~Hz}$ | $\begin{aligned} & 60.00 / \\ & 50.00 \end{aligned}$ |
|  | 02-25 | The Width of the Desired Frequency Attained 2 | $0.00 \sim 600.00 \mathrm{~Hz}$ | 2.00 |
|  | 02-32 | Brake Delay Time | $0.000 \sim 65.000 \mathrm{sec}$. | 0.000 |
|  | 02-33 | Output Current Level Setting for Multi-function External Terminals | 0~100\% | 0 |
|  | 02-34 | Output frequency setting for multi-function output terminal | 0.00~600.00Hz (Motor speed when using PG Card) | 0.00 |


| N | 02-35 | External Operation Control Selection after Reset and Activate | 0: Disable <br> 1: Drive runs if run command exists after reset | 0 |
| :---: | :---: | :---: | :---: | :---: |
| N | 02-47 | Zero-speed Level of Motor | 0~65535 rpm | 0 |
| N | 02-48 | Max. Frequency of Resolution Switch | 0.01~600.00Hz | 60.00 |
| N | 02-49 | Switch the delay time of Max. output frequency | 0.000~65.000 sec. | 0.000 |
| N | 02-50 | Status of Multi-function Input Terminal | Monitor the status of multi-function input terminals | Read only |
|  | 02-51 | Status of Multi-function Output Terminal | Monitor the status of multi-function output terminals | Read only |
|  | 02-52 | Display External Output terminal occupied by PLC | Monitor the status of PLC input terminals | Read only |
|  | 02-53 | Display Analog Input Terminal occupied by PLC | Monitor the status of PLC output terminals | Read only |
|  | 02-54 | Display the Frequency Command Executed by External Terminal | Read only | Read only |
|  | 02-55 | Reserved |  |  |
|  | 02-56 | Reserved |  |  |
|  | 02-57 | Multi-function output terminal: Function 42: Brake Current Checking Point | 0~150\% | 0 |
|  | 02-58 | Multi-function output terminal: Function 42: Brake Frequency Checking Point | 0.00~655.35Hz | 0.00 |

## 03 Analog Input/Output Parameters

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| N | 03-00 | Analog Input Selection (AVI) | 0 : No function | 1 |
| $N$ | 03-01 | Analog Input Selection (ACI) | 1: Frequency command (speed limit under torque control mode) | 0 |
| N | 03-02 | Analog Input Selection (AUI) | 2: Torque command (torque limit under speed mode) | 0 |
|  |  |  | 3: Torque compensation command |  |
|  |  |  | 4: PID target value |  |
|  |  |  | 5: PID feedback signal |  |
|  |  |  | 6: PTC thermistor input value |  |
|  |  |  | 7: Positive torque limit |  |
|  |  |  | 8: Negative torque limit |  |
|  |  |  | 9: Regenerative torque limit |  |
|  |  |  | 10: Positive/negative torque limit |  |
|  |  |  | 11: PT100 thermistor input value |  |
|  |  |  | 12: Reserved |  |
|  |  |  | 13: PID Offset (\%) (h.) |  |
|  |  |  | 14~17: Reserved |  |
| N | 03-03 | Analog Input Bias (AVI) | -100.0~100.0\% | 0 |
| N | 03-04 | Analog Input Bias (ACI) | -100.0~100.0\% | 0 |
| $N$ | 03-05 | Analog Positive Voltage Input Bias (AUI) | -100.0~100.0\% | 0 |
| $N$ | 03-06 | Reserved |  |  |
| $N$ | 03-07 | Positive/negative Bias Mode (AVI) | 0: No bias <br> 1: Lower than or equal to bias <br> 2: Greater than or equal to bias <br> 3: The absolute value of the bias voltage while serving as the center <br> 4: Serve bias as the center | 0 |
| $N$ | 03-08 | Positive/negative Bias Mode (ACl) |  |  |
| N | 03-09 | Positive/negative Bias Mode (AUI) |  |  |
|  | 03-10 | Analog Frequency Command for Reverse Run | 0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal. <br> 1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control. | 0 |
| $N$ | 03-11 | Analog Input Gain (AVI) | -500.0~500.0\% | 100.0 |
| $N$ | 03-12 | Analog Input Gain (ACI) | -500.0~500.0\% | 100.0 |
| $N$ | 03-13 | Analog Positive Input Gain (AUI) | -500.0~500.0\% | 100.0 |
| $N$ | 03-14 | Analog Negative Input Gain (AUI) | -500.0~500.0\% | 100.0 |
| $N$ | 03-15 | Analog Input Filter Time (AVI) | 0.00~20.00 sec. | 0.01 |
| $N$ | 03-16 | Analog Input Filter Time (ACI) | 0.00~20.00 sec. | 0.01 |
| $N$ | 03-17 | Analog Input Filter Time (AUI) | 0.00~20.00 sec. | 0.01 |
| $N$ | 03-18 | Addition Function of the Analog Input | 0: Disable (AVI, ACI, AUI) <br> 1: Enable | 0 |


| $N$ | 03-19 | ACI Signal Loss | 0: Disable <br> 1: Continue operation at the last frequency <br> 2: Decelerate to 0 Hz <br> 3: Stop immediately and display ACE | 0 |
| :---: | :---: | :---: | :---: | :---: |
| $N$ | 03-20 | Multi-function Output 2 (AFM2) | 0 : Output frequency (Hz) | 0 |
| N | $03-23$ | Multi-function Output 2 (AFM2) | 1: Frequency command (Hz) | 0 |
|  |  |  | 2: Motor speed (Hz) |  |
|  |  |  | 3: Output current (rms) |  |
|  |  |  | 4: Output voltage |  |
|  |  |  | 5: DC Bus voltage |  |
|  |  |  | 6: Power factor |  |
|  |  |  | 7: Power |  |
|  |  |  | 8: Output torque |  |
|  |  |  | 9: AVI |  |
|  |  |  | 10: ACI |  |
|  |  |  | 11: AUI |  |
|  |  |  | 12: Iq current |  |
|  |  |  | 13: Iq feedback value |  |
|  |  |  | 14: Id current |  |
|  |  |  | 15: Id feedback value |  |
|  |  |  | 16: Vq-axis voltage |  |
|  |  |  | 17: Vd-axis voltage |  |
|  |  |  | 18: Torque command |  |
|  |  |  | 19: PG2 frequency command |  |
|  |  |  | 20: CANopen analog output |  |
|  |  |  | 21: RS485 analog output |  |
|  |  |  | 22: Communication card analog output |  |
|  |  |  | 23: Constant voltage/current output |  |
| N | 03-21 | Gain of Analog Output 1 (AFM1) | 0~500.0\% | 100.0 |
|  | 03-22 | Analog Output 1 when in REV Direction (AFM1) | 0 : Absolute output voltage <br> 1: Reverse output 0V; Positive output 0-10V <br> 2: Reverse output 5-0V; Positive output 5-10V | 0 |
| $N$ | 03-24 | Gain of Analog Output 2 (AFM2) | 0~500.0\% | 100.0 |
|  | 03-25 | Analog Output 2 when in REV Direction (AFM2) | 0 : Absolute output voltage <br> 1: Output 0 V in REV direction; output $0-10 \mathrm{~V}$ in FWD direction <br> 2: Output $5-0 \mathrm{~V}$ in REV direction; output $5-10 \mathrm{~V}$ in FWD direction | 0 |
| $N$ | 03-26 | Reserved |  |  |
| $N$ | 03-27 | AFM2 Output Bias | -100.00~100.00\% | 0.00 |
| $N$ | 03-28 | AVI Selection | $\begin{aligned} & 0: 0-10 \mathrm{~V} \\ & 1: 0-20 \mathrm{~mA} \\ & 2: 4-20 \mathrm{~mA} \end{aligned}$ | 0 |
| $N$ | 03-29 | ACI Selection | $\begin{aligned} & 0: 4-20 \mathrm{~mA} \\ & 1: 0-10 \mathrm{~V} \\ & 2: 0-20 \mathrm{~mA} \end{aligned}$ | 0 |
| $N$ | 03-30 | Status of PLC Output Terminal | Monitor the status of PLC output terminals | Read only |
|  | 03-31 | AFM2 0-20mA Output Selection | 0: 0-20mA Output <br> 1: 4-20mA Output | 0 |
|  | 03-32 | AFM1 DC output setting level | 0.00~100.00\% | 0.00 |
|  | 03-33 | AFM2 DC Output Setting Level | 0.00~100.00\% | 0.00 |
|  | 03-34 | Reserved |  |  |

Chapter 11 Summary of Parameter Settings
C2000 Series

| 03-35 | AFM1 filter output time | $0.00 \sim 20.00$ Seconds | 0.01 |
| :---: | :---: | :---: | :---: |
| 03-36 | AFM2 filter output time | $0.00 \sim 20.00$ Seconds | 0.01 |
| $\begin{gathered} 03-37 \\ \sim \\ 03-49 \end{gathered}$ | Reserve |  |  |
| 03-50 | Analog Input Curve Selection | 0 : Regular Curve <br> 1: 3 point curve of AVI <br> 2: 3 point curve of ACI <br> 3: 3 point curve of AVI \& ACI <br> 4: 3 point curve of AUI <br> 5: 3 point curve of AVI \& AUI <br> 6: 3 point curve of $\mathrm{ACI} \& A U I$ <br> 7: 3 point curve of AVI \& ACI \& AUI | 0 |
| 03-51 | AVI Low Point | $\begin{aligned} & \text { Pr. } 03-28=0,0.00 \sim 10.00 \mathrm{~V} \\ & \text { Pr. } 03-28 \neq 0,0.00 \sim 20.00 \mathrm{~mA} \end{aligned}$ | 0.00 |
| 03-52 | AVI Proportional Low Point | 0.00~100.00\% | 0.00 |
| 03-53 | AVI Mid Point | $\begin{aligned} & \text { Pr.03-28=0, } 0.00 \sim 10.00 \mathrm{~V} \\ & \text { Pr.03-28 }=0,0.00 \sim 20.00 \mathrm{~mA} \end{aligned}$ | 5.00 |
| 03-54 | AVI Proportional Mid Point | 0.00~100.00\% | 50.00 |
| 03-55 | AVI High Point | $\begin{aligned} & \text { Pr.03-28=0, } 0.00 \sim 10.00 \mathrm{~V} \\ & \text { Pr.03-28 }=0,0.00 \sim 20.00 \mathrm{~mA} \end{aligned}$ | 10.00 |
| 03-56 | AVI Proportional High Point | 0.00~100.00\% | 100.00 |
| 03-57 | ACI Low Point | $\begin{aligned} & \text { Pr.03-29=1, } 0.00 \sim 10.00 \mathrm{~V} \\ & \text { Pr. } 03-29 \neq 1,0.00 \sim 20.00 \mathrm{~mA} \end{aligned}$ | 4.00 |
| 03-58 | ACI Proportional Low Point | 0.00~100.00\% | 0.00 |
| 03-59 | ACI Mid Point | $\begin{aligned} & \text { Pr. } 03-29=1,0.00 \sim 10.00 \mathrm{~V} \\ & \text { Pr.03-29 }=1,0.00 \sim 20.00 \mathrm{~mA} \end{aligned}$ | 12.00 |
| 03-60 | ACI Proportional Mid Point | 0.00~100.00\% | 50.00 |
| 03-61 | ACI High Point | $\begin{aligned} & \text { Pr.03-29=1, } 0.00 \sim 10.00 \mathrm{~V} \\ & \text { Pr.03-29キ1, } 0.00 \sim 20.00 \mathrm{~mA} \end{aligned}$ | 20.00 |
| 03-62 | ACI Proportional High Point | 0.00~100.00\% | 100.00 |
| 03-63 | Positive AUI Voltage Low Point | 0.00~10.00V | 0.00 |
| 03-64 | Positive AUI Voltage Proportional Low Point | 0.00~100.00\% | 0.00 |
| 03-65 | Positive AUI Voltage Mid Point | 0.00~10.00V | 5.00 |
| 03-66 | Positive AUI Voltage Proportional Mid Point | 0.00~100.00\% | 50.00 |
| 03-67 | Positive AUI Voltage High Point | 0.00~10.00V | 10.00 |
| 03-68 | Positive AUI Voltage Proportional High Point | 0.00~100.00\% | 100.00 |
| 03-69 | Negative AUI Voltage Low Point | 0.00~ -10.00V | 0.00 |
| 03-70 | Negative AUI Voltage Proportional Low Point | 0.00~-100.00\% | 0.00 |
| 03-71 | Negative AUI Voltage Mid Point | 0.00~ -10.00V | -5.00 |
| 03-72 | Negative AUI Voltage Proportional Mid Point | 0.00~-100.00\% | -50.00 |
| 03-73 | Negative AUI Voltage High Point | 0.00~ -10.00V | -10.00 |
| 03-74 | Negative AUI Voltage Proportional High Point | 0.00~-100.00\% | -100.00 |

## 04 Multi-step Speed Parameters

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| N | 04-00 | 1st Step Speed Frequency | 0.00~600.00Hz | 0 |
| $N$ | 04-01 | 2nd Step Speed Frequency | 0.00~600.00Hz | 0 |
| N | 04-02 | 3rd Step Speed Frequency | 0.00~600.00Hz | 0 |
| $N$ | 04-03 | 4th Step Speed Frequency | 0.00~600.00Hz | 0 |
| $N$ | 04-04 | 5th Step Speed Frequency | 0.00~600.00Hz | 0 |
| $N$ | 04-05 | 6th Step Speed Frequency | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0 |
| N | 04-06 | 7th Step Speed Frequency | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0 |
| N | 04-07 | 8th Step Speed Frequency | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0 |
| $N$ | 04-08 | 9th Step Speed Frequency | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0 |
| $N$ | 04-09 | 10th Step Speed Frequency | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0 |
| $N$ | 04-10 | 11th Step Speed Frequency | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0 |
| N | 04-11 | 12th Step Speed Frequency | 0.00~600.00Hz | 0 |
| N | 04-12 | 13th Step Speed Frequency | 0.00~600.00Hz | 0 |
| N | 04-13 | 14th Step Speed Frequency | 0.00~600.00Hz | 0 |
| $N$ | 04-14 | 15th Step Speed Frequency | 0.00~600.00Hz | 0 |
|  | 04-15 | Position command 1 (revolution) | -30000~30000 | 0 |
| N | 04-16 | Position command 1 (pulse) | -32767~32767 | 0 |
|  | 04-17 | Position command 2 (revolution) | -30000~30000 | 0 |
| N | 04-18 | Position command 2 (pulse) | -32767~32767 | 0 |
|  | 04-19 | Position command 3 (revolution) | -30000~30000 | 0 |
| $N$ | 04-20 | Position command 3 (pulse) | -32767~32767 | 0 |
|  | 04-21 | Position command 4 (revolution) | -30000~30000 | 0 |
| $N$ | 04-22 | Position command 4 (pulse) | -32767~32767 | 0 |
|  | 04-23 | Position command 5 (revolution) | -30000~30000 | 0 |
| N | 04-24 | Position command 5 (pulse) | -32767~32767 | 0 |
|  | 04-25 | Position command 6 (revolution) | -30000~30000 | 0 |
| N | 04-26 | Position command 6 (pulse) | -32767~32767 | 0 |
|  | 04-27 | Position command 7 (revolution) | -30000~30000 | 0 |
| $N$ | 04-28 | Position command 7 (pulse) | -32767~32767 | 0 |
|  | 04-29 | Position command 8 (revolution) | -30000~30000 | 0 |
| N | 04-30 | Position command 8 (pulse) | -32767~32767 | 0 |
|  | 04-31 | Position command 9 (revolution) | -30000~30000 | 0 |
| N | 04-32 | Position command 9 (pulse) | -32767~32767 | 0 |
|  | 04-33 | Position command 10 (revolution) | -30000~30000 | 0 |
| $N$ | 04-34 | Position command 10 (pulse) | -32767~32767 | 0 |
|  | 04-35 | Position command 11 (revolution) | -30000~30000 | 0 |
| $N$ | 04-36 | Position command 11 (pulse) | -32767~32767 | 0 |



## 05 Motor Parameters



| 05-25 | Delay Time for Y-connection/ $\triangle$-connection Switch of Induction Motor | 0.000~60.000 sec. | 0.200 |
| :---: | :---: | :---: | :---: |
| 05-26 | Accumulative Watt-second of Motor in Low Word (W-sec) | Read only | \#.\# |
| 05-27 | Accumulative Watt-second of Motor in High Word (W-sec) | Read only | \#.\# |
| 05-28 | Accumulative Watt-hour of Motor (W-Hour) | Read only | \#.\# |
| 05-29 | Accumulative Watt-hour of Motor in Low Word (KW-Hour) | Read only | \#.\# |
| 05-30 | Accumulative Watt-hour of Motor in High Word (KW-Hour) | Read only | \#.\# |
| 05-31 | Accumulative Motor Operation Time (Min) | 00~1439 | 0 |
| 05-32 | Accumulative Motor Operation Time (day) | 00~65535 | 0 |
| 05-33 | Induction Motor and Permanent Magnet Motor Selection | 0: Induction Motor <br> 1: Permanent Magnet Motor | 0 |
| 05-34 | Full-load current of Permanent Magnet Motor | 0.00~655.35Amps | 0.00 |
| 05-35 | Rated Power of Permanent Magnet Motor | 0.00~655.35kW | 0.00 |
| 05-36 | Rated speed of Permanent Magnet Motor | 0~65535rpm | 2000 |
| 05-37 | Pole number of Permanent Magnet Motor | 0~65535 | 10 |
| 05-38 | Inertia of Permanent Magnet Motor | $0.0 \sim 6553.5 \mathrm{~kg} . \mathrm{cm}^{2}$ | 0.0 |
| 05-39 | Stator Resistance of PM Motor | 0.000~65.535 | 0.000 |
| 05-40 | Permanent Magnet Motor Ld | $0.00 \sim 655.35 \mathrm{mH}$ | 0.000 |
| 05-41 | Permanent Magnet Motor Lq | $0.00 \sim 655.35 \mathrm{mH}$ | 0.000 |
| 05-42 | PG Offset angle of PM Motor | 0.0~360.0 ${ }^{\circ}$ | 0.0 |
| 05-43 | Ke parameter of PM Motor | 0~65535 (Unit: V/1000rpm) | 0 |

## 06 Protection Parameters

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| $N$ | 06-00 | Low Voltage Level | 230V: <br> Frame A to D: 150.0~220.0Vdc <br> Frame E and frames above E: 190.0~220.0V 460V: <br> Frame A to D: 300.0~440.0Vdc <br> Frame E and frames above E: 380.0~440.0V | $\begin{aligned} & 180.0 \\ & 200.0 \\ & \\ & 360.0 \\ & 400.0 \end{aligned}$ |
| N | 06-01 | Over-voltage Stall Prevention | $\begin{aligned} & \text { 0: Disabled } \\ & \text { 230V: } 0.0 \sim 450.0 \mathrm{Vdc} \\ & 460 \mathrm{~V}: 0.0 \sim 900.0 \mathrm{Vdc} \end{aligned}$ | $\begin{aligned} & 380.0 \\ & 760.0 \end{aligned}$ |
| N | 06-02 | Selection for Over-voltage Stall Prevention | 0 : Traditional over-voltage stall prevention <br> 1: Smart over-voltage prevention | 0 |
| $N$ | 06-03 | Over-current Stall Prevention during Acceleration | Normal Load: 0~160\%(100\%: drive's rated current) Heavy Load: 0~180\%(100\%: drive's rated current) | $\begin{aligned} & 120 \\ & 150 \end{aligned}$ |
| $N$ | 06-04 | Over-current Stall Prevention during Operation | Normal Load: 0~160\%(100\%: drive's rated current) Heavy Load: 0~180\%(100\%: drive's rated current) | $\begin{aligned} & 120 \\ & 150 \end{aligned}$ |
| $N$ | 06-05 | Accel. /Decel. Time Selection of Stall Prevention at Constant Speed | 0 : by current accel/decel time 1: by the 1st accel/decel time 2: by the 2nd accel/decel time 3: by the 3rd accel/decel time 4: by the 4th accel/decel time 5: by auto accel/decel | 0 |
| N | 06-06 | Over-torque Detection Selection (OT1) | 0 : No function <br> 1: Over-torque detection during constant speed operation, continue to operate after detection 2: Over-torque detection during constant speed operation, stop operation after detection <br> 3: Over-torque detection during operation, continue to operate after detection <br> 4: Over-torque detection during operation, stop operation after detection | 0 |
| $N$ | 06-07 | Over-torque Detection Level (OT1) | 10~250\% (100\%: drive's rated current) | 120 |
| $N$ | 06-08 | Over-torque Detection Time (OT1) | 0.0~60.0 sec. | 0.1 |
| $N$ | 06-09 | Over-torque Detection Selection (OT2) | 0 : No function <br> 1: Over-torque detection during constant speed operation, continue to operate after detection <br> 2: Over-torque detection during constant speed operation, stop operation after detection <br> 3: Over-torque detection during operation, continue to operation after detection <br> 4: Over-torque detection during operation, stop operation after detection | 0 |
| $N$ | 06-10 | Over-torque Detection Level (OT2) | 10~250\% (100\%: drive's rated current) | 120 |
| $N$ | 06-11 | Over-torque Detection Time (OT2) | 0.0~60.0 sec. | 0.1 |
| $N$ | 06-12 | Current Limit | 0~250\% (100\%: drive's rated current) | 150 |
| $N$ | 06-13 | Electronic Thermal Relay Selection (Motor 1) | 0 : Inverter motor <br> 1: Standard motor <br> 2: Disable | 2 |
| $N$ | 06-14 | Electronic Thermal Characteristic for Motor 1 | 30.0~600.0 sec. | 60.0 |
| N | 06-15 | Heat Sink Over-heat (OH) Warning | $0.0 \sim 110.0^{\circ} \mathrm{C}$ | 85.0 |


| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| 06-16 | Stall Prevention Limit Level | 0~100\% (Pr.06-03, Pr.06-04) | 50 |
| 06-17 | Present Fault Record | 0: No fault record | 0 |
| 06-18 | Second Most Recent Fault Record | 1: Over-current during acceleration (ocA) | 0 |
| 06-19 | Third Most Recent Fault Record | 2: Over-current during deceleration (ocd) | 0 |
| 06-20 | Fourth Most Recent Fault Record | 3: Over-current during constant speed(ocn) | 0 |
| 06-21 | Fifth Most Recent Fault Record | 4: Ground fault (GFF) | 0 |
| 06-22 | Sixth Most Recent Fault Record | 5: IGBT short-circuit (occ) | 0 |
|  |  | 6: Over-current at stop (ocS) |  |
|  |  | 7: Over-voltage during acceleration (ovA) |  |
|  |  | 8: Over-voltage during deceleration (ovd) |  |
|  |  | 9: Over-voltage during constant speed (ovn) |  |
|  |  | 10: Over-voltage at stop (ovS) |  |
|  |  | 11: Low-voltage during acceleration (LvA) |  |
|  |  | 12: Low-voltage during deceleration (Lvd) |  |
|  |  | 13: Low-voltage during constant speed (Lvn) |  |
|  |  | 14: Stop mid-low voltage (LvS) |  |
|  |  | 15: Phase loss protection (OrP) |  |
|  |  | 16: IGBT over-heat (oH1) |  |
|  |  | 17: Capacitance over-heat ( oH 2 ) |  |
|  |  | 18: tH1o (TH1 open: IGBT over-heat protection error) |  |
|  |  | 19: tH2o (TH2 open: capacitance over-heat protection error) |  |
|  |  | 20: Reserved |  |
|  |  | 21: Drive over-load (oL) |  |
|  |  | 22: Electronics thermal relay 1 (EoL1) |  |
|  |  | 23: Electronics thermal relay 2 (EoL2) |  |
|  |  | 24: Motor overheat (oH3) (PTC) |  |
|  |  | 25: Reserved |  |
|  |  | 26: Over-torque 1 (ot1) |  |
|  |  | 27: Over-torque 2 (ot2) |  |
|  |  | 28: Low current (uC) |  |
|  |  | 29: Home limit error (LMIT) |  |
|  |  | 30: Memory write-in error (cF1) |  |
|  |  | 31: Memory read-out error (cF2) |  |
|  |  | 32: Reserved |  |
|  |  | 33: U-phase current detection error (cd1) |  |
|  |  | 34: V-phase current detection error (cd2) |  |
|  |  | 35: W-phase current detection error (cd3) |  |
|  |  | 36: Clamp current detection error (Hd0) |  |
|  |  | 37: Over-current detection error (Hd1) |  |
|  |  | 38: Over-voltage detection error (Hd2) |  |
|  |  | 39: Ground current detection error (Hd3) |  |
|  |  | 40: Auto tuning error (AUE) |  |
|  |  | 41: PID feedback loss (AFE) |  |
|  |  | 42: PG feedback error (PGF1) |  |
|  |  | 43: PG feedback loss (PGF2) |  |
|  |  | 44: PG feedback stall (PGF3) |  |
|  |  | 45: PG slip error (PGF4) |  |
|  |  | 46: PG ref loss (PGr1) |  |
|  |  | 47: PG ref loss (PGr2) |  |
|  |  | 48: Analog current input loss (ACE) |  |
|  |  | 49: External fault input (EF) |  |
|  |  | 50: Emergency stop (EF1) |  |
|  |  | 51: External Base Block (bb) |  |
|  |  | 52: Password error (PcodE) |  |


| Explanation | Settings | Factory Setting |
| :---: | :---: | :---: |
|  | 53: Reserved |  |
|  | 54: Communication error (CE1) |  |
|  | 55: Communication error (CE2) |  |
|  | 56: Communication error (CE3) |  |
|  | 57: Communication error (CE4) |  |
|  | 58: Communication Time-out (CE10) |  |
|  | 59: PU Time-out (CP10) |  |
|  | 60: Brake transistor error (bF) |  |
|  | 61: Y-connection/ $\triangle$-connection switch error (ydc) |  |
|  | 62: Decel. Energy Backup Error (dEb) |  |
|  | 63: Slip error (oSL) |  |
|  | 64: Electromagnet switch error (ryF) |  |
|  | 65 : PG Card Error (PGF5) |  |
|  | 66-72: Reserved |  |
|  | 73: External safety gate S1 |  |
|  | 74~78: Reserved |  |
|  | 79: U phase over current (Uocc) |  |
|  | 80: V phase over current (Vocc) |  |
|  | 81: W phase over current (Wocc) |  |
|  | 82: U phase output phase loss (OPHL) |  |
|  | 83: V phase output phase loss (OPHL) |  |
|  | 84: W phase output phase loss (OPHL) |  |
|  | 85: PG-02U ABZ hardware disconnection |  |
|  | 86: PG-02U UVW hardware disconnection |  |
|  | 87~89: Reserved |  |
|  | 90: Inner PLC function is forced to stop |  |
|  | 100: Reserved |  |
|  | 101: CANopen software disconnect1 (CGdE) |  |
|  | 102: CAN open software disconnect2 (CHbE) |  |
|  | 103: CANopen synchronous error (CSYE) |  |
|  | 104: CANopen hardware disconnect (CbFE) |  |
|  | 105: CANopen index setting error (CIdE) |  |
|  | 106: CANopen slave station number setting error (CAdE) |  |
|  | 107: CANopen index setting exceed limit (CFrE) |  |
|  | 111: Internal communication overtime error(InrCOM) |  |
| Fault Output Option 1 | 0~65535(refer to bit table for fault code) | 0 |
| Fault Output Option 2 | 0~65535(refer to bit table for fault code) | 0 |
| Fault Output Option 3 | 0~65535(refer to bit table for fault code) | 0 |
| Fault Output Option 4 | 0~65535(refer to bit table for fault code) | 0 |
| Electronic Thermal Relay Selection 2 (Motor 2) | 0: Inverter motor <br> 1: Standard motor <br> 2: Disable | 2 |
| Electronic Thermal Characteristic for Motor 2 | 30.0~600.0 sec | 60.0 |
| PTC Detection Selection | 0 : Warn and keep operation <br> 1: Warn and ramp to stop <br> 2: Warn and coast to stop <br> 3: No warning | 0 |
| PTC Level | 0.0~100.0\% | 50.0 |
| Frequency Command for Malfunction | 0.00~655.35 Hz | Read only |
| Output Frequency at Malfunction | 0.00~655.35 Hz | Read only |
| Output Voltage at Malfunction | 0.0~6553.5 V | Read only |


| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| 06-34 | DC Voltage at Malfunction | 0.0~6553.5 V | Read only |
| 06-35 | Output Current at Malfunction | 0.00~655.35 Amp | Read only |
| 06-36 | IGBT Temperature at Malfunction | 0.0~6553.5 ${ }^{\circ} \mathrm{C}$ | Read only |
| 06-37 | Capacitance Temperature at Malfunction | 0.0~6553.5 ${ }^{\circ} \mathrm{C}$ | Read only |
| 06-38 | Motor Speed in rpm at Malfunction | 0~65535 | Read only |
| 06-39 | Torque Command at Malfunction | 0~65535 | Read only |
| 06-40 | Status of Multi-function Input Terminal at Malfunction | 0000h~FFFFh | Read only |
| 06-41 | Status of Multi-function Output Terminal at Malfunction | 0000h~FFFFh | Read only |
| 06-42 | Drive Status at Malfunction | 0000h~FFFFh | Read only |
| 06-43 | Reserved |  |  |
| 06-44 | Reserved |  |  |
| 06-45 | Treatment to Output Phase Loss Detection (OPHL) | 0: Warn and keep operation <br> 1: Warn and ramp to stop <br> 2: Warn and coast to stop <br> 3: No warning | 3 |
| 06-46 | Deceleration Time of Output Phase Loss | 0.000~65.535 sec | 0.500 |
| 06-47 | Current Bandwidth | 0.00~655.35\% | 1.00 |
| 06-48 | DC Brake Time of Output Phase Loss | 0.000~65.535sec | 0.100 |
| 06-49 | Reserved |  |  |
| 06-50 | Reserved |  |  |
| 06-51 | Reserved |  |  |
| 06-52 | Reserved |  |  |
| 06-53 | Treatment for the detected Input Phase Loss (OrP) | 0 : warn and ramp to stop <br> 1: warn and coast to stop | 0 |
| 06-54 | Reserved |  |  |
| 06-55 | Derating Protection | 0 : constant rated current and limit carrier wave by load current and temperature <br> 1: constant carrier frequency and limit load current by setting carrier wave <br> 2: constant rated current(same as setting 0 ), but close current limit | 0 |
| 06-56 | PT100 Detected Level 1 | 0.000~10.000V | 5.000 |
| 06-57 | PT100 Detected Level 2 | 0.000~10.000V | 7.000 |
| 06-58 | PT100 Level 1 Frequency Protect | 0.00~600.00Hz | 0.00 |
| 06-59 | Reserved |  |  |
| 06-60 | Software Detection GFF Current Level | 0.0~6553.5 \% | 60.0 |
| 06-61 | Software Detection GFF Filter Time | 0.0~6553.5 \% | 0.10 |
| 06-62 | Disable Level of dEb | 230V series: 0.0~220.0 Vdc 460 V series: $0.0 \sim 440.0 \mathrm{Vdc}$ | $\begin{array}{r} 180.0 \\ / 360.0 \end{array}$ |

Chapter 11 Summary of Parameter Settings \| C2000 Series

| Pr. | Explanation | Settings | Factory <br> Setting |
| :---: | :--- | :--- | :---: |
| $06-63$ | Fault Record 1 (Day) | $0 \sim 65535$ days | Read <br> only |
| $06-64$ | Fault Record 1 (Min) | $0 \sim 1439$ min | Read <br> only |
| $06-65$ | Fault Record 2 (Day) | $0 \sim 65535$ days | Read <br> only |
| $06-66$ | Fault Record 2 (Min) | $0 \sim 1439$ min | Read <br> only |
| $06-67$ | Fault Record 3 (Day) | $0 \sim 65535$ days | Read <br> only |
| $06-68$ | Fault Record 3 (Min) | $0 \sim 1439$ min | Read <br> only |
| $06-69$ | Fault Record 4 (Day) | $0 \sim 65535$ days | Read <br> only |
| $06-70$ | Fault Record 4 (Min) | $0 \sim 1439$ min | Read <br> only |
| $06-71$ | Low Current Setting Level | $0.0 \sim 6553.5 \%$ | 0.0 |
| $06-72$ | Low Current Detection Time | $0.00 \sim 655.35$ sec | 0.00 <br> $06-73$ |
| Treatment for low current | $0:$ No function <br> $1:$ Warn and coast to stop <br> $2:$ Warn and ramp to stop by 2nd deceleration time <br> $3:$ Warn and operation continue | 0 |  |

## 07 Special Parameters

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| $N$ | 07-00 | Software Brake Level | 230V: 350.0~450.0Vdc 460V: 700.0~900.0Vdc | $\begin{aligned} & 380.0 \\ & 760.0 \end{aligned}$ |
| $N$ | 07-01 | DC Brake Current Level | 0~100\% | 0 |
| $N$ | 07-02 | DC Brake Time at Start-up | 0.0~60.0 sec. | 0.0 |
| $N$ | 07-03 | DC Brake Time at Stop | 0.0~60.0 sec. | 0.0 |
| $N$ | 07-04 | Startup Frequency for DC Brake | 0.00~600.00Hz | 0.00 |
| $N$ | 07-05 | Maximum Power Loss Duration | 1~200\% | 100 |
| $N$ | 07-06 | Restart after Momentary Power Loss | 0: Stop operation <br> 1: Speed search for last frequency command <br> 2: Speed search for minimum output frequency | 0 |
| $N$ | 07-07 | Maximum Power Loss Duration | 0.1~20.0 sec. | 2.0 |
| $N$ | 07-08 | Base Block Time | $0.1 \sim 5.0 \mathrm{sec}$. | 0.5 |
| $N$ | 07-09 | Current Limit for Speed Search | 20~200\% | 50 |
| $N$ | 07-10 | Treatment to Restart After Fault | 0 : Stop operation <br> 1: Speed search starts with current speed <br> 2: Speed search starts with minimum output frequency | 0 |
| $N$ | 07-11 | Number of Times of Auto Restart After Fault | 0~10 | 0 |
| $N$ | 07-12 | Speed Search during Start-up | 0: Disable <br> 1: Speed search for maximum output frequency <br> 2: Speed search for start-up motor frequency <br> 3: Speed search for minimum output frequency | 0 |
| $N$ | 07-13 | Decel. Time to Momentary Power Loss | 0: Disable <br> 1: 1st decel. time <br> 2: 2nd decel. time <br> 3: 3rd decel. time <br> 4: 4th decel. time <br> 5: current decel. time <br> 6: Auto decel. time | 0 |
| $N$ | 07-14 | DEB Return Time | 0.0~25.0sec | 0.0 |
| $N$ | 07-15 | Dwell Time at Accel. | $0.00 \sim 600.00 \mathrm{sec}$ | 0.00 |
| $N$ | 07-16 | Dwell Frequency at Accel. | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0.00 |
| $N$ | 07-17 | Dwell Time at Decel. | $0.00 \sim 600.00 \mathrm{sec}$ | 0.00 |
| $N$ | 07-18 | Dwell Frequency at Decel. | $0.00 \sim 600.00 \mathrm{~Hz}$ | 0.00 |
| $N$ | 07-19 | Fan Cooling Control | 0 : Fan always ON <br> 1: 1 minute after the AC motor drive stops, fan will be OFF <br> 2: When the AC motor drive runs, the fan is ON. When the AC motor drive stops, the fan is OFF <br> 3: Fan turns ON when preliminary heat sink temperature (around $60^{\circ} \mathrm{C}$ ) is attained. <br> 4: Fan always OFF | 0 |
| $N$ | 07-20 | Emergency Stop (EF) \& Force to Stop Selection | 0 : Coast stop <br> 1: By deceleration Time 1 <br> 2: By deceleration Time 2 <br> 3: By deceleration Time 3 <br> 4: By deceleration Time 4 <br> 5: System Deceleration <br> 6: Automatic Deceleration | 0 |

Chapter 11 Summary of Parameter Settings | C2000 Series

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| N | 07-21 | Auto Energy-saving Operation | 0: Disable <br> 1: Enable | 0 |
| N | 07-22 | Energy-saving Gain | 10~1000\% | 100 |
| N | 07-23 | Auto Voltage Regulation(AVR) Function | 0: Enable AVR <br> 1: Disable AVR <br> 2: Disable AVR during deceleration | 0 |
| N | 07-24 | Filter Time of Torque Compensation (V/F and SVC control mode) | $0.001 \sim 10.000 \mathrm{sec}$ | 0.020 |
| N | 07-25 | Filter Time of Slip Compensation (V/F and SVC control mode) | 0.001~10.000 sec | 0.100 |
| N | 07-26 | Torque Compensation Gain (V/F and SVC control mode) | 0~10 | 0 |
| N | 07-27 | Slip Compensation Gain (V/F and SVC control mode) | 0.00~10.00 | 0.00 |
| $N$ | 07-28 | Reserved |  |  |
| N | 07-29 | Slip Deviation Level | 0.0~100.0\% | 0 |
| N | 07-30 | Detection Time of Slip Deviation | 0.0~10.0 sec | 1.0 |
| N | 07-31 | Over Slip Treatment | 0 : Warn and keep operation <br> 1: Warn and ramp to stop <br> 2: Warn and coast to stop <br> 3: No warning | 0 |
| N | 07-32 | Motor Hunting Gain | 0~10000 | 1000 |
|  | 07-33 | Auto Reset Time for Restart after Fault | $0.0 \sim 6000.0 \mathrm{sec}$ | 60.0 |

## 08 High-function PID Parameters



|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| N | 09-00 | COM1 Communication Address | 1~254 | 1 |
| N | 09-01 | COM1 Transmission Speed | $4.8 \sim 115.2 \mathrm{Kbps}$ | 9.6 |
| N | 09-02 | COM1 Transmission Fault Treatment | 0 : Warn and continue operation <br> 1: Warn and ramp to stop <br> 2: Warn and coast to stop <br> 3: No warning and continue operation | 3 |
| N | 09-03 | COM1 Time-out Detection | $0.0 \sim 100.0 \mathrm{sec}$. | 0.0 |
| N | 09-04 | COM1 Communication Protocol | 1: 7N2 (ASCII) <br> 2: 7E1 (ASCII) <br> 3: 701 (ASCII) <br> 4: 7E2 (ASCII) <br> 5: 702 (ASCII) <br> 6: 8N1 (ASCII) <br> 7: 8N2 (ASCII) <br> 8: 8E1 (ASCII) <br> 9: 801 (ASCII) <br> 10: 8E2 (ASCII) <br> 11: 802 (ASCII) <br> 12: 8N1 (RTU) <br> 13: 8N2 (RTU) <br> 14: 8E1 (RTU) <br> 15: 801 (RTU) <br> 16: 8E2 (RTU) <br> 17: 8 O 2 (RTU) | 1 |
| $N$ | $\begin{gathered} 09-05 \\ \sim \\ 09-08 \end{gathered}$ | Reserved |  |  |
| N | 09-09 | Response Delay Time | 0.0~200.0ms | 2.0 |
| $N$ | 09-10 | Main Frequency of the Communication | 0.00~600.00Hz | 60.00 |
| $N$ | 09-11 | Block Transfer 1 | 0~65535 | 0 |
| $N$ | 09-12 | Block Transfer 2 | 0~65535 | 0 |
| N | 09-13 | Block Transfer 3 | 0~65535 | 0 |
| N | 09-14 | Block Transfer 4 | 0~65535 | 0 |
| $N$ | 09-15 | Block Transfer 5 | 0~65535 | 0 |
| N | 09-16 | Block Transfer 6 | 0~65535 | 0 |
| $N$ | 09-17 | Block Transfer 7 | 0~65535 | 0 |
| $N$ | 09-18 | Block Transfer 8 | 0~65535 | 0 |
| $N$ | 09-19 | Block Transfer 9 | 0~65535 | 0 |
| N | 09-20 | Block Transfer 10 | 0~65535 | 0 |
| N | 09-21 | Block Transfer 11 | 0~65535 | 0 |
| $N$ | 09-22 | Block Transfer 12 | 0~65535 | 0 |
| $N$ | 09-23 | Block Transfer 13 | 0~65535 | 0 |
| $N$ | 09-24 | Block Transfer 14 | 0~65535 | 0 |
| $N$ | 09-25 | Block Transfer 15 | 0~65535 | 0 |
| $N$ | 09-26 | Block Transfer 16 | 0~65535 | 0 |


| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| $\begin{gathered} 09-27 \\ \tilde{09-29} \end{gathered}$ | Reserved |  |  |
| 09-30 | Communication Decoding Method | 0 : Decoding Method 1 <br> 1: Decoding Method 2 | 1 |
| 09-31 | Internal Communication Protocol | 0: Modbus 485 <br> -1: Internal Communication Slave 1 <br> -2: Internal Communication Slave 2 <br> -3: Internal Communication Slave 3 <br> -4: Internal Communication Slave 4 <br> -5 : Internal Communication Slave 5 <br> -6: Internal Communication Slave 6 <br> -7: Internal Communication Slave 7 <br> -8: Internal Communication Slave 8 <br> -9: Reserved <br> -10: Internal Communication Master <br> -11: Reserve <br> -12: Internal PLC Control | 0 |
| $\begin{gathered} 09-32 \\ \underset{09-34}{ } \end{gathered}$ | Reserved |  |  |
| 09-35 | PLC Address | 1~254 | 2 |
| 09-36 | CANopen Slave Address | $\begin{aligned} & \text { 0: Disable } \\ & \text { 1~127 } \end{aligned}$ | 0 |
| 09-37 | CANopen Speed | $\begin{aligned} & 0: 1 \mathrm{M} \\ & 1: 500 \mathrm{k} \\ & \text { 2: 250k } \\ & 3: 125 \mathrm{k} \\ & \text { 4: 100k (Delta only) } \\ & \text { 5: 50k } \end{aligned}$ | 0 |
| 09-38 | CANopen Frequency Gain | $1.00 \sim 2.00$ | 1.00 |
| 09-39 | CANopen Warning Record | bit 0: CANopen Guarding Time out bit 1: CANopen Heartbeat Time out bit 2: CANopen SYNC Time out bit 3: CANopen SDO Time out bit 4: CANopen SDO buffer overflow bit 5: Can Bus Off bit 6: Error protocol of CANopen | 0 |
| 09-40 | CANopen Decoding Method | 0 : Delta defined decoding method <br> 1: CANopen DS402 Standard | 1 |
| 09-41 | CANopen Communication Status | 0: Node Reset State <br> 1: Com Reset State <br> 2: Boot up State <br> 3: Pre Operation State <br> 4: Operation State <br> 5: Stop State | Read Only |
| 09-42 | CANopen Control Status | 0: Not ready for use state <br> 1: Inhibit start state <br> 2: Ready to switch on state <br> 3: Switched on state <br> 4: Enable operation state <br> 7: Quick Stop Active state <br> 13: Err Reaction Activation state <br> 14: Error state | Read Only |
| 09-43 | Reset CANopen Index | bit0: reset address 20XX to 0 . bit1: reset address 264X to 0 bit2: reset address 26AX to 0 bit3: reset address 60XX to 0 | 65535 |

Chapter 11 Summary of Parameter Settings \| C2000 Series

| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| 09-44 | Reserved |  |  |
| 09-45 | CANopen Master Function | 0 : Disable <br> 1: Enable | 0 |
| 09-46 | CANopen Master Address | 1~127 | 100 |
| $\begin{gathered} 09-47 \\ \sim \\ 09-59 \end{gathered}$ | Reserved |  |  |
| 09-60 | Identifications for Communication Card | 0: No communication card <br> 1: DeviceNet Slave <br> 2: Profibus-DP Slave <br> 3: CANopen Slave/Master <br> 4: Modbus-TCP Slave <br> 5: Ethernet/IP Slave <br> 6~8: Reserved | \#\# |
| 09-61 | Firmware Version of Communication Card | Read only | \#\# |
| 09-62 | Product Code | Read only | \#\# |
| 09-63 | Error Code | Read only | \#\# |
| $\begin{gathered} 09-64 \\ \sim \\ 09-69 \end{gathered}$ | Reserved |  |  |
| 09-70 | Address of Communication Card | DeviceNet: 0-63 Profibus-DP: 1-125 | 1 |
| 09-71 | Setting of DeviceNet Speed | Standard DeviceNet: <br> 0: 125Kbps <br> 1: 250Kbps <br> 2: 500Kbps <br> Non standard DeviceNet: (Delta Only) <br> 0: 10Kbps <br> 1: 20Kbps <br> 2: 50Kbps <br> 3: 100Kbps <br> 4: 125Kbps <br> 5: 250Kbps <br> 6: 500Kbps <br> 7: 800Kbps <br> 8: 1Mbps | 2 |
| 09-72 | Other Setting of DeviceNet Speed | 0: Disable <br> In this mode, baud rate can only be $0,1,2,3$ in standard DeviceNet speed <br> 1: Enable In this mode, the baud rate of DeviceNet can be same as CANopen (0-8). | 0 |
| 09-73 | Reserved |  |  |
| 09-74 | Reserved |  |  |
| 09-75 | IP Configuration of the Communication Card | 0 : Static IP <br> 1: Dynamic IP (DHCP) | 0 |
| 09-76 | IP Address 1 of the Communication Card | 0~255 | 0 |
| 09-77 | IP Address 2 of the Communication Card | 0~255 | 0 |
| 09-78 | IP Address 3 of the Communication Card | 0~255 | 0 |
| 09-79 | IP Address 4 of the Communication Card | 0~255 | 0 |


| Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: |
| 09-80 | Address Mask 1 of the Communication Card | 0~255 | 0 |
| 09-81 | Address Mask 2 of the Communication Card | 0~255 | 0 |
| 09-82 | Address Mask 3 of the Communication Card | 0~255 | 0 |
| 09-83 | Address Mask 4 of the Communication Card | 0~255 | 0 |
| 09-84 | Getway Address 1 of the Communication Card | 0~255 | 0 |
| 09-85 | Getway Address 2 of the Communication Card | 0~255 | 0 |
| 09-86 | Getway Address 3 of the Communication Card | 0~255 | 0 |
| 09-87 | Getway Address 4 of the Communication Card | 0~255 | 0 |
| 09-88 | Password for Communication Card (Low word) | 0~255 | 0 |
| 09-89 | Password for Communication Card (High word) | 0~255 | 0 |
| 09-90 | Reset Communication Card | 0 : No function <br> 1: Reset, return to factory setting | 0 |
| 09-91 | Additional Setting for Communication Card | Bit0: Enable IP filter <br> Bit 1: Enable to write internet parameters (1bit). This bit will change to disable when it finishes saving the internet parameter updates. <br> Bit 2: Enable login password (1bit). This bit will be changed to disable when it finishes saving the internet parameter updates. | 0 |
| 09-92 | Status of Communication Card | Bit 0: password enable <br> When the communication card is set with password, this bit is enabled. When the password is clear, this bit is disabled. | 0 |

## 10 Speed Feedback Control Parameters




## 11 Advanced Parameters

IM: Induction Motor; PM: Permanent Magnet Motor

|  | Pr. | Explanation | Settings | Factory Setting |
| :---: | :---: | :---: | :---: | :---: |
| $N$ | 11-00 | System Control | bit 0: Auto tuning for ASR and APR <br> bit 1: Inertia estimate (only for FOCPG mode) <br> bit 2: Zero servo <br> bit 3: Dead Time compensation closed <br> Bit 7: Selection to save or not save the frequency <br> Bit 8: Maximum speed of point to point position control | 0 |
| $N$ | 11-01 | Per Unit of System Inertia | 1~65535 (256=1PU) | 400 |
| $N$ | 11-02 | ASR1/ASR2 Switch Frequency | $5.00 \sim 600.00 \mathrm{~Hz}$ | 7.00 |
| $N$ | 11-03 | ASR1 Low-speed Bandwidth | 1~40Hz (IM)/ 1~100Hz (PM) | 10 |
| $N$ | 11-04 | ASR2 High-speed Bandwidth | 1~40Hz (IM)/ 1~100Hz (PM) | 10 |
| $N$ | 11-05 | Zero-speed Bandwidth | 1~40Hz (IM)/ 1~100Hz (PM) | 10 |
| $N$ | 11-06 | ASR Control ( P) 1 | $0 \sim 40 \mathrm{~Hz}$ (IM)/ 1~100Hz (PM) | 10 |
| $N$ | 11-07 | ASR Control (I) 1 | $0.000 \sim 10.000 \mathrm{sec}$ | 0.100 |
| $N$ | 11-08 | ASR Control ( P) 2 | $0 \sim 40 \mathrm{~Hz}$ (IM)/ $0 \sim 100 \mathrm{~Hz}$ (PM) | 10 |
| $N$ | 11-09 | ASR Control (I) 2 | $0.000 \sim 10.000 \mathrm{sec}$ | 0.100 |
| $N$ | 11-10 | P Gain of Zero Speed | $0 \sim 40 \mathrm{~Hz}$ (IM)/ $0 \sim 100 \mathrm{~Hz}$ (PM) | 10 |
| $N$ | 11-11 | I Gain of Zero Speed | $0.000 \sim 10.000 \mathrm{sec}$ | 0.100 |
| $N$ | 11-12 | Gain for ASR Speed Feed Forward | 0~100\% | 0 |
| $N$ | 11-13 | PDFF Gain | 0~200\% | 30 |
| $N$ | 11-14 | Low-pass Filter Time of ASR Output | $0.000 \sim 0.350 \mathrm{sec}$ | 0.008 |
| $N$ | 11-15 | Notch Filter Depth | 0~20db | 0 |
| $N$ | 11-16 | Notch Filter Frequency | $0.00 \sim 200.00 \mathrm{~Hz}$ | 0.0 |
| $N$ | 11-17 | Forward Motor Torque Limit | 0~500\% | 200 |
| $N$ | 11-18 | Forward Regenerative Torque Limit | 0~500\% | 200 |
| $N$ | 11-19 | Reverse Motor Torque Limit | 0~500\% | 200 |
| $N$ | 11-20 | Reverse Regenerative Torque Limit | 0~500\% | 200 |
| $N$ | 11-21 | Gain Value of Flux Weakening Curve for Motor 1 | 0~200\% | 90 |
| $N$ | 11-22 | Gain Value of Flux Weakening Curve for Motor 2 | 0~200\% | 90 |
| $N$ | 11-23 | Speed Response of Flux Weakening Area | 0~150\% | 65 |
| $N$ | 11-24 | APR Gain | $0.00 \sim 40.00 \mathrm{~Hz}$ (IM)/ 0~100.00Hz (PM) | 10.00 |
| $N$ | 11-25 | Gain Value of APR Feed Forward | 0~100 | 30 |
| $N$ | 11-26 | APR Curve Time | 0.00~655.35 sec | 3.00 |
| $N$ | 11-27 | Max. Torque Command | 0~500\% | 100 |
| $N$ | 11-28 | Source of Torque Offset | 0 : No function <br> 1: Analog signal input (Pr.03-00) <br> 2: RS485 communication (Pr.11-29) <br> 3: Control by external terminal (Pr.11-30~11-32) | 0 |


| Pr. | Explanation | Settings | Factory |
| :---: | :--- | :--- | :---: |
| $N$ | Setting |  |  |

## Chapter 12 Description of Parameter Settings

## 00 Drive Parameters

$\wedge$ This parameter can be set during operation.

## 19-9.9 Identity Code of the AC Motor Drive

Factory Setting: \#.\#
Settings Read Only
7n- I Display AC Motor Drive Rated Current
Factory Setting: \#.\#

## Settings Read Only

10 Pr. 00-00 displays the identity code of the AC motor drive. Using the following table to check if Pr.00-01 setting is the rated current of the AC motor drive. Pr.00-01 corresponds to the identity code Pr.00-00.
$\square$ The factory setting is the rated current for normal duty. Please set Pr.00-16 to 1 to display the rated current for the heavy duty.

| 230V Series |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Frame | A |  |  |  | B |  |  | C |  |  |
| kW | 0.75 | 1.5 | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 |
| HP | 1.0 | 2.0 | 3.0 | 5.0 | 7.5 | 10 | 15 | 20 | 25 | 30 |
| Pr.00-00 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
| Rated Current for Heavy Duty (A) | 4.8 | 7.1 | 10 | 16 | 24 | 31 | 47 | 62 | 71 | 86 |
| Rated Current for Normal Duty (A) | 5 | 8 | 11 | 17 | 25 | 33 | 49 | 65 | 75 | 90 |
|  |  |  |  |  |  |  |  |  |  |  |
| Frame |  |  |  | E |  | F |  |  |  |  |
| kW | 30 | 37 | 45 | 50 | 75 | 90 |  |  |  |  |
| HP | 40 | 50 | 60 | 75 | 100 | 125 |  |  |  |  |
| Pr.00-00 | 24 | 26 | 28 | 30 | 32 | 34 |  |  |  |  |
| Rated Current for Heavy Duty (A) | 114 | 139 | 171 | 204 | 242 | 329 |  |  |  |  |
| Rated Current for Normal Duty (A) | 120 | 146 | 180 | 215 | 255 | 346 |  |  |  |  |


| 460V Series |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Frame | A |  |  |  |  |  |  | B |  |  | C |  |  |
| kW | 0.75 | 1.5 | 2.2 | 3.7 | 4.0 | 5. |  | 7.5 | 11 | 15 | 18.5 | 22 | 30 |
| HP | 1 | 2 | 3 | 5 | 5 | 7. |  | 10 | 15 | 20 | 25 | 30 | 40 |
| Pr.00-00 | 5 | 7 | 9 | 11 | 93 | 13 |  | 15 | 17 | 19 | 21 | 23 | 25 |
| Rated Current for Heavy Duty (A) | 2.9 | 3.8 | 5.7 | 8.1 | 9.5 | 1 |  | 17 | 23 | 30 | 36 | 43 | 57 |
| Rated Current for Normal Duty (A) | 3.0 | 4.0 | 6.0 | 9.0 | 10.5 | 12 |  | 18 | 24 | 32 | 38 | 45 | 60 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Frame |  | D |  |  | E |  |  | F |  | G |  | H |  |
| kW | 37 | 45 | 55 | 75 | 90 | 110 | 132 | 160 | 185 | 220 | 280 | 315 | 355 |
| HP | 50 | 60 | 75 | 100 | 125 | 150 | 175 | 215 | 250 | 300 | 375 | 425 | 475 |
| Pr.00-00 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 49 | 51 |
| Rated Current for Heavy Duty (A) | 69 | 86 | 105 | 143 | 171 | 209 | 247 | 295 | 352 | 437 | 523 | 585 | 649 |
| Rated Current for Normal Duty (A) | 73 | 91 | 110 | 150 | 180 | 220 | 260 | 310 | 370 | 460 | 550 | 616 | 683 |

Factory Setting: 0
Settings 0: No Function
1: Write protection for parameters
5: Reset KWH display to 0
6: Reset PLC (including CANopen Master Index)
7: Reset CANopen Index (Slave)
8: keypad lock
9: All parameters are reset to factory settings(base frequency is 50 Hz )
10: All parameters are reset to factory settings (base frequency is 60 Hz )
@】 When it is set to 1 , all parameters are read only except Pr.00-02~00-08 and it can be used with password setting for password protection. It needs to set Pr.00-02 to 0 before changing other parameter settings.
When it is set to 9 or 10: all parameters are reset to factory settings. If password is set in Pr.00-08, input the password set in Pr.00-07 to reset to factory settings.
[a] When it is set to 5 , KWH display value can be reset to 0 even when the drive is operating. Pr. 05-26, 05-27, 05-28, 05-29, 05-30 reset to 0 .

When it is set to 6: clear internal PLC program (includes the related settings of PLC internal CANopen master)
[a] When it is set to 7: reset the related settings of CANopen slave.

## 58-93 Start-up Display Selection

Factory setting: 0
Settings 0: Display the frequency command (F)
1: Display the actual output frequency $(\mathrm{H})$
2: Display User define (U)
3: Output current (A)This parameter determines the start-up display page after power is applied to the drive. User defined choice display according to the setting in Pr.00-04.

## 195-94 Content of Multi-function Display

Factory setting: 3
Settings 0: Display output current (A)
1: Display counter value (c)
2: Display actual output frequency (H.)
3: Display DC-BUS voltage (v)
4: Display output voltage (E)
5: Display output power angle ( n )
6: Display output power in kW (P)
7: Display actual motor speed rpm ( $r=00$ : positive speed; -00 negative speed)

8: Display estimate output torque \% ( $\mathrm{t}=00$ : positive torque; -00 negative torque) (t)
9: Display PG feedback (G) (refer to Note 1)
10: Display PID feedback in \% (b)
11: Display AVI in \% (1.), $0 \sim 10 \mathrm{~V} / 4-20 \mathrm{~mA} / 0-20 \mathrm{~mA}$ corresponds to $0 \sim 100 \%$ (Refer to Note 2)
12: Display ACl in \% (2.), $4 \sim 20 \mathrm{~mA} / 0 \sim 10 \mathrm{~V} / 0-20 \mathrm{~mA}$ corresponds to 0~100\% (Refer to Note 2)
13: Display AUI in \% (3.), -10V~10V corresponds to -100~100\%(Refer to Note 2)
14: Display the temperature of IGBT in oC (i.)
15: Display the temperature of capacitance in oC (c.)
16: The status of digital input (ON/OFF) refer to Pr.02-12 (i) (Refer to Note3)
17: Display digital output status ON/OFF (Pr.02-18) (o) (refer to NOTE 4)
18: Display the multi-step speed that is executing ( S )
19: The corresponding CPU pin status of digital input (d) (refer to NOTE 3)
20: The corresponding CPU pin status of digital output (0.) (refer to NOTE 4)

21: Actual motor position (PG1 of PG card). When the motor direction changes or the drive stops, the counter will start from 0 (display value restarts counting from 0) (Max. 65535) (P.)
22: Pulse input frequency (PG2 of PG card) (S.)
23: Pulse input position (PG2 of PG card) (max. 65535) (q.)
24: Position command tracing error (E.)
25: Overload counting (0.00~100.00\%) (o.) (Refer to Note 6)
26: GFF Ground Fault (Unit :\%)(G.)
27: DC Bus voltage ripple (Unit: Vdc)(r.)
28: Display PLC register D1043 data (C) display in hexadecimal
29: Display PM motor pole section (EMC-PG01U application) (4.)
30 : Display output of user defined (U)
31 : H page x 00-05 Display user Gain(K)
32: Number of actual motor revolution during operation (PG card plug in and $Z$ phase signal input) (Z.)
33: Motor actual position during operation (when PG card is connected)(q)
34: Operation speed of fan(\%) (F.)
35: Control Mode display: 0= Speed control mode (SPD), $1=$ torque control mode (TQR) (t.)
36: Present operating carrier frequency of drive (Hz) (J.)
37: Reserved
38: Display drive status (6.) (Refer to Note 7)
40: Torque command, unit: \%(L.)

## $\Rightarrow$ NOTE

1. When Pr. $10-01$ is set to 1000 and Pr. $10-02$ is set to $1 / 2$, the display range for $P G$ feedback will be from 0 to 4000 .
When Pr.10-01 is set to 1000 and Pr.10-02 is set to $3 / 4 / 5$, the display range for PG feedback will be from 0 to 1000.
Home position: If it has $Z$ phase, $Z$ phase will be regarded as home position. Otherwise, home position will be the encoder start up position.
2. It can display negative values when setting analog input bias (Pr.03-03~03-10).

Example: assume that AVI input voltage is 0V, Pr.03-03 is $10.0 \%$ and $\operatorname{Pr} .03-07$ is 4 (Serve bias as the center).
3. Example: If REV, MI1 and MI6 are ON, the following table shows the status of the terminals.

0: OFF, 1: ON

| Terminal | MI 15 | MI 14 | MI 13 | MI 12 | MI 11 | MI 10 | MI 8 | MI 7 | MI 6 | $\mathrm{MI5}$ | $\mathrm{MI4}$ | MI 3 | MI 2 | MI 1 | REV | FWD |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Status | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |

MI10~MI15 are the terminals for extension cards (Pr.02-26~02-31).
If REV, MI1 and MI6 are ON, the value is 0000000010000110 in binary and 0086h in HEX. When Pr.00-04 is set to " 16 " or " 19 ", it will display " 0086 " with LED U is ON on the keypad KPC-CE01. The setting 16 is the status of digital input by Pr.02-12 setting and the setting 19 is the corresponding CPU pin status of digital input, the FWD/REV action and the three-wire MI are not controlled by Pr.02-12. User can set to 16 to monitor digital input status and then set to 19 to check if the wire is normal.
4. Assume that RY1: Pr.02-13 is set to 9 (Drive ready). After applying the power to the AC motor drive, if there is no other abnormal status, the contact will be ON. The display status will be shown as follows.
N.O. switch status:

| Terminal | Reserved |  |  |  | Reserved |  |  |  | Reserved |  |  |  | MO2 | MO1 | Reserved | RY2 | RY1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Status | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

At the meanwhile, if Pr.00-04 is set to 17 or 20, it will display in hexadecimal " 0001 h " with LED U is ON on the keypad. The setting 17 is the status of digital output by Pr.02-18 setting and the setting 20 is the corresponding CPU pin status of digital output. User can set 17 to monitor the digital output status and then set to 20 to check if the wire is normal.
5. Setting 8: $100 \%$ means the motor rated torque. Motor rated torque $=($ motor rated power $\times 60 / 2 \pi) /$ motor rated speed
6. If Pr. $00-04=25$, when display value reaches $100.00 \%$, the drive will show "oL" as an overload warning.
7. If Pr.00-04 $=38$,

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 on the drive.

Factory Setting: 0
Settings 0~160.00
This parameter is to set coefficient gain in actual output frequency. Set Pr.00-04=31 to display the calculation result on the screen (calculation $=$ output frequency * Pr.00-05).

## MA M S Software Version

Factory Setting: \#.\#
Settings Read only

## 50, 9 Parameter Protection Password Input

Factory Setting: 0
Settings 1~9998, 10000~65535
Display $0 \sim 3$ (the times of password attempts)
[1] This parameter allows user to enter their password (which is set in Pr.00-08) to unlock the parameter protection and to make changes to the parameter.

1 Pr.00-07 and Pr.00-08 are used to prevent the personal misoperation.
$\square$ When the user have forgotten the password, clear the setting by input 9999 and press ENTER key, then input 9999 again and press Enter within 10 seconds. After decoding, all the settings will return to factory setting.

## 日昌 - 9 Parameter Protection Password Setting

Factory Setting: 0
Settings 1~9998, 10000~65535
0: No password protection / password is entered correctly (Pr00-07)
1: Password has been set
[1] To set a password to protect your parameter settings. If the display shows 0 , no password is set nor password has been correctly entered in Pr.00-07. All parameters can then be changed, including Pr.00-08. The first time you can set a password directly. After successful setting of password the display will show 1 . Be sure to write down the password for later use. To cancel the parameter lock, set the parameter to 0 after inputting correct password into Pr. 00-07.
[0] How to retrieve parameter protection after decoding by Pr.00-07:
Method 1: Re-enter the password to Pr.00-08 (input the password once).
Method 2: After reboots, password function will be recovered.
Method 3: Input any value into Pr.00-07 (Do not enter the password).

## Password Decode Flow Chart



## 79-93 Reserved

## 97-19Control Mode

Factory Setting: 0
Settings 0 : Speed mode
1: Point-to-Point position control
2: Torque mode
3: Home mode
[1] This parameter determines the control mode of C2000 series AC motor drive.
7n- : : Control of Speed Mode
Factory Setting: 0
Settings 0: VF (IM V/f control)
1: VFPG (IM V/f control+ Encoder)
2: SVC(IM sensorless vector control)
3: FOCPG (IM FOC vector control+ encoder)
4: FOCPG (PM FOC vector control + Encoder)
5: FOC Sensorless (IM field oriented sensorless vector control)
6 : PM Sensorless (PM field oriented sensorless vector control)
1 This parameter determines the control method of the AC motor drive:

0: (IM V/f control): user can design proportion of V/f as required and can control multiple motors simultaneously.
1: (IM V/f control + Encoder): user can use optional PG card with encoder for the closed-loop speed control.

2: (IM Sensorless vector control): get the optimal control by the auto-tuning of motor parameters.
3: (IM FOC vector control+ encoder): besides torque increases, the speed control will be more accurate (1:1000).

4: (PM FOC vector control + Encoder): besides torque increases, the speed control will be more accurate (1:1000).
5: FOC Sensorless: IM field oriented sensorless vector control
6: PM Sensorless (PM field oriented sensorless vector control)
1 When setting Pr.00-11 to 0 , the V/F control diagram is shown as follows.


1 When setting Pr.00-11 to 1 , the V/F control + encoder diagram is shown as follows.

[1] When setting Pr.00-11 to 2 , the sensorless vector control diagram is shown as follows.

[1] When setting Pr.00-11 to 3, the FOCPG control diagram is shown as follows.

[al When setting Pr.00-11 to 4, the FOCPG control diagram is shown as follows.

(1) When setting Pr.00-11 to 5, FOC sensorless control diagram is shown as follows.


1 When setting Pr.00-11 to 6, PM FOC sensorless control diagram is shown as follows:


## 日雷- 3 Point to Point Position control

Factory Settings: 0
Settings: 0: Incremental Type
1: Absolute Type
(1) Pr. $00-12=0$ is incremental type P2P; Pr.00-12 $=1$ is absolute type P 2 P


## 59-13

## Control of Torque Mode

Factory Setting: 0
Settings 0: TQCPG (IM Torque control + Encoder)
1: TQCPG (PM Torque control + Encoder)
2: TQC Sensorless (IM Sensorless torque control)
TQCPG control diagram is shown in the following:


Ila TQC Sensorless control diagram is shown in the following:


## 99- 16 Load Selection

Factory Setting: 0
Settings 0: Normal load
1: Heavy load
Normal duty: over load, rated output current 160\% in 3 second. Please refer to Pr.00-17 for the setting of carrier wave. Refer to chapter specifications or Pr.00-01 for the rated current.
[1 Heavy duty: over load, rated output current 180\% in 3 second. Please refer to Pr.00-17 for the setting of carrier wave. Refer to chapter specifications or Pr.00-01 for the rated current.
1 Pr.00-01 changes as the setting of Pr.00-16 changes.

## 78-17 Carrier Frequency

Factory setting: Table below
Settings 2~15kHz
110 This parameter determinates the PWM carrier frequency of the AC motor drive.

| 230 V Series |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Models | $1-15 \mathrm{HP}[0.75-11 \mathrm{~kW}]$ | $20-50 \mathrm{HP}[15-37 \mathrm{~kW}]$ | $60-125 \mathrm{HP}[45-90 \mathrm{~kW}]$ |  |
| Setting Range | $02 \sim 15 \mathrm{kHz}$ | $02 \sim 10 \mathrm{kHz}$ | $02 \sim 09 \mathrm{kHz}$ |  |
| Normal Duty Factory <br> Setting | 8 kHz | 6 kHz | 4 kHz |  |


| Heavy Duty Factory <br> Setting | 2 kHz |  |  |
| :---: | :---: | :---: | :---: |
| 460 V Series |  |  |  |
| Models | $1-20 \mathrm{HP}[0.75-15 \mathrm{~kW}]$ | $25-75 \mathrm{HP}[18.5-55 \mathrm{~kW}]$ | $100-475 \mathrm{HP}[75-355 \mathrm{~kW}]$ |
| Setting Range | $02 \sim 15 \mathrm{kHz}$ | $02 \sim 10 \mathrm{kHz}$ | $02 \sim 09 \mathrm{kHz}$ |
| Normal Duty Factory <br> Setting | 8 kHz | 6 kHz | 4 kHz |
| Heavy Duty Factory <br> Setting |  | 2 kHz |  |


| Carrier Frequency | Acoustic Noise | Electromagnetic Noise or Leakage Current | Heat <br> Dissipation | Current <br> Wave |
| :---: | :---: | :---: | :---: | :---: |
| 1 kHz |  |  |  | $\begin{aligned} & M N A- \\ & M N+ \end{aligned}$ |
| 8 kHz |  |  |  |  |
| 15 kHz |  |  |  |  |

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

## 78－98 <br> Reserved

## 9月－ 19 PLC Command Mask

Settings Bit 0：Control command by PLC force control
Bit 1：Frequency command by PLC force control
Bit 2：Position command by PLC force control
Bit 3：Torque command by PLC force control
［1］This parameter determines if frequency command or control command is occupied by PLC

## 万号－3 Source of the Master Frequency Command（AUTO）

Factory Setting： 0
Settings 0：Digital keypad
1：RS－485 serial communication
2：External analog input（Pr．03－00）
3：External UP／DOWN terminal

4: Pulse input without direction command (Pr.10-16 without direction)
5: Pulse input with direction command (Pr.10-16)
6: CANopen communication card
7: Reserved
8: Communication card (no CANopen card)It is used to set the source of the master frequency in AUTO mode.Pr.00-20 and 00-21 are for the settings of frequency source and operation source in AUTO mode. Pr.00-30 and 00-31 are for the settings of frequency source and operation source in HAND mode. The AUTO/HAND mode can be switched by the keypad KPC-CC01 or multi-function input terminal (MI).The factory setting of frequency source or operation source is for AUTO mode. It will return to AUTO mode whenever power on again after power off. If there is multi-function input terminal used to switch AUTO/HAND mode. The highest priority is the mutli-function input terminal. When the external terminal is OFF, the drive won't receive any operation signal and can't execute JOG.

## 9月15 9 Source of the Operation Command (AUTO)

Factory Setting: 0
Settings 0: Digital keypad
1: External terminals. Keypad STOP disabled.
2: RS-485 serial communication. Keypad STOP disabled.
3: CANopen card
4: Reserved
5: Communication card (not includes CANopen card)
1 It is used to set the source of the operation frequency in AUTO mode.
When the operation command is controlled by the keypad KPC-CC01, keys RUN, STOP and JOG (F1) are valid.

Factory Setting: 0
Settings 0: Ramp to stop
1:Coast to stop
The parameter determines how the motor is stopped when the AC motor drive receives a valid stop command.


Rampto Stop and Coast to Stop
Ramp to stop: the AC motor drive decelerates from the setting of deceleration time to 0 or minimum output frequency (Pr. 01-09) and then stop (by Pr.01-07).
[a] Coast to stop: the AC motor drive stops the output instantly upon a STOP command and the motor free runs until it comes to a complete standstill.
(1) It is recommended to use "ramp to stop" for safety of personnel or to prevent material from being wasted in applications where the motor has to stop after the drive is stopped. The deceleration time has to be set accordingly.
(2) If the motor free running is allowed or the load inertia is large, it is recommended to select "coast to stop". For example, blowers, punching machines and pumps

The stop method of the torque control is also set by Pr.00-22.

## 19- 〕〕Control of Motor Direction

Factory Setting: 0
Settings 0: Enable forward/ reverse
1: Disable reverse
2: Disable forward
$\square$ This parameter enables the AC motor drives to run in the forward/reverse Direction. It may be used to prevent a motor from running in a direction that would consequently injure the user or damage the equipment.

## 78-34 Memory of Frequency Command

Factory Setting: Read Only

## Settings Read only

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

## 19-25 User Defined Characteristics

Factory Setting: 0

| Settings | Bit 0~3: user defined decimal place <br> 0000b: no decimal place |
| :--- | :--- |
|  | 0001 b : one decimal place |
| 0010b: two decimal place |  |
|  | 0011b: three decimal place |

Bit 4~15: user defined unit
000xh: Hz
001xh: rpm
002xh: \%
003xh: kg
[1] Bit 0~3: Control F page, unit of user defined value (Pr00-04 =d10, PID feedback) and the decimal point of Pr00-26 which supports up to 3 decimal points.
[1] Bit 4~15: Control F page, unit of user defined value (Pr00-04=d10, PID feedback) and the display units of Pr00-26 which supports up to 4 units

| 0 | 0 | 0 | h |
| :---: | :---: | :---: | :---: |
|  |  |  | $\longrightarrow$ user defined decimal place |
|  |  |  | $\begin{aligned} & 0: \mathrm{Hz} \\ & 1: \mathrm{rpm} \\ & 2: \% \\ & 3: \mathrm{kg} \end{aligned}$ |

## 78-96 Max. User Defined Value

Factory Setting: 0
Settings 0: Disable
0~65535 (when Pr.00-25 set to no decimal place)
$0.0 \sim 6553.5$ (when Pr.00-25 set to 1 decimal place)
$0.0 \sim 655.35$ (when Pr.00-25 set to 2 decimal place)
$0.0 \sim 65.535$ (when Pr.00-25 set to 3 decimal place)
[1] When Pr.00-26 is NOT set to 0 . The user defined value is enabled. The value of this parameter should correspond to the frequency setting at Pr.01-00.
Example:
When the frequency at Pr. 01-00=60.00Hz, the max. user defined value at Pr. 00-26 is $100.0 \%$.
That also means Pr.00-25 is set at 0021 h to select $\%$ as the unit.

## NOTE

The drive will display as Pr.00-25 setting when Pr.00-25 is properly set and Pr.00-26 is not 0 .

## 78-27 User Defined Value

Factory Setting: Read only
Settings Read only
[0] Pr.00-27 will show user defined value when Pr.00-26 is not set to 0 .
(1) User defined function is valid when:

1. Pr.00-20 is set to digital keypad control
2. RS-285 communication input control.
3. PID function enable

Factory Setting: 0

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

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

When MI is set to 56 for LOC/REM selection, if Pr.00-29 is set to 0 , then the external terminal is disabled.
When MI is set to 56 for LOC/REM selection, if Pr.00-29 is not set to 0 , the external terminal has the highest priority of command and the ATUO/HAND keys will be disabled.

## 19-3 9 Source of the Master Frequency Command (HAND)

Factory Setting: 0

| Settings | 0: Digital keypad |
| :--- | :--- |
| 1: RS-485 serial communication |  |
| 2: External analog input (Pr.03-00) |  |
| 3: External UP/DOWN terminal |  |
| 4: Pulse input without direction command (Pr.10-16 without direction) |  |
| 5: Pulse input with direction command (Pr.10-16) |  |
| 6: CANopen communication card |  |
| 7: Reserved |  |
| 8: Communication card (no CANopen card) |  |

[10] It is used to set the source of the master frequency in HAND mode.

## 95－3 ！Source of the Operation Command（HAND）

Factory Setting： 0
Settings 0：Digital keypad
1：External terminals．Keypad STOP disabled．
2：RS－485 serial communication．Keypad STOP disabled．
3：CANopen communication card
4：Reserved
5：Communication card（not include CANopen card
［1］It is used to set the source of the operation frequency in HAND mode．
Pld Pr．00－20 and 00－21 are for the settings of frequency source and operation source in AUTO mode． Pr．00－30 and 00－31 are for the settings of frequency source and operation source in HAND mode． The AUTO／HAND mode can be switched by the keypad KPC－CC01 or multi－function input terminal （MI）．
The factory setting of frequency source or operation source is for AUTO mode．It will return to AUTO mode whenever power on again after power off．If there is multi－function input terminal used to switch AUTO／HAND mode．The highest priority is the multi－function input terminal．When the external terminal is OFF，the drive won＇t receive any operation signal and can＇t execute JOG．

## 78－32 Digital Keypad STOP Function

Factory Setting： 0
Settings 0：STOP key disable
1：STOP key enable

## 58－33

～Reserved
昭－39

## 日相－4 Homing mode

Factory Setting：0000h
Settings：


Note：Forward run＝clockwise（CW）
Reverse run＝counterclockwise（CCW）

X 0: Forward run to home. Set PL forward limit as check point.
1: Reverse run (CCW) to home. Set NL reverse limit (CCWL) as check point.
2: Forward run to home. Set ORG : OFF $\rightarrow$ ON as check point.
3: Reverse to home. Set ORG : OFF $\rightarrow$ ON as check point.
4: Forward run and search for Z-pulse as check point.
5: Forward run and search for Z-pulse as check point.
6: Forward run to home. Set ORG: ON $\rightarrow$ OFF as check point.
7: Reverse run to home. Set ORG : ON $\rightarrow$ OFF as check point.
8: Define current position as home.
$Y \quad$ Set $X$ to $0,1,2,3,6,7$.
0 : reverse run to $Z$ pulse
1: continue forward run to $Z$ pulse
2: Ignore $Z$ pulse
$Z$ When home limit is reached, set $X$ to $2,3,4,5,6,7$ first.
0 : display error
1: reverse the direction
[a] Homing action is control by Pr. 00-40, 00-41, 00-42 and 02-01~02-08.

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

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

3. When $Y=1, X=2$

4. When $Y=1, X=3$

5. When $Y=2, X=2$

6. When $Y=2, X=3$

7. When $Y=2, X=4$


8．When $Y=2, X=5$


## 87－4：Homing by Frequency 1

Factory Setting： 8.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
日合－4 Homing by Frequency 2
Factory Setting： 2.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$
［1］Control by Multi－funcion Input Terminal Pr．02－01～02－08（44～47）．
44：Reverse direction homing
45：Forward direction homing
46：Homing（ORG）
47：Homing function enabled
10．If the drive is not control by CAN or PLC，set Pr．00－10 $=1$（Contorl mode $=$ P2P position control）and set external output terminal to 47 （homing function enable）for homing．
1 When Pr．00－10 is set to 3 ，after homing is complete，user must set control mode setting Pr．00－10 to 1 in order to perform P2P position control．

## 昭－43

～Reserved
日里－ 17

## 5月－48 Display Filter Time（Current）

Factory Settings： 0.100
Settings： $0.001 \sim 65.535 \mathrm{sec}$Set this parameter to minimize the current fluctuation displayed by digital keypad．

## 98－49 Display Filter Time（Keypad）

Factory Settings： 0.100
Settings： $0.001 \sim 65.535 \mathrm{sec}$
Set this parameter to minimize the display value fluctuation displayed by digital keypad．

## 99－59 Software Version（date）

Factory Settings：\＃\＃\＃\＃

## Settings：Read only

10 This parameter displays the drive＇s software version by date．

## 70－5 <br> ～Reserve <br> 7日－61

## Group 1 Basic Parameters

$\wedge$ This parameter can be set during operation.

## 7: $\boldsymbol{7}$ : Maximum Output Frequency

Settings $50.00 \sim 600.00 \mathrm{~Hz}$
[1] This parameter determines the AC motor drive's Maximum Output Frequency. All the AC motor drive frequency command sources (analog inputs 0 to $+10 \mathrm{~V}, 4$ to $20 \mathrm{~mA}, 0$ to 20 mA and $\pm 10 \mathrm{~V}$ ) are scaled to correspond to the output frequency range.

| 9: 9 | Output Frequency of Motor 1 (base frequency and motor rated frequency) |
| :---: | :---: |
| \% | Output Frequency of Motor 2 |

Settings $0.00 \sim 600.00 \mathrm{~Hz}$
Whis value should be set according to the rated frequency of the motor as indicated on the motor nameplate. If the motor is 60 Hz , the setting should be 60 Hz . If the motor is 50 Hz , it should be set to 50 Hz .

B: 3 O Output Voltage of Motor 2 (base frequency and motor rated frequency)
Factory Setting: 200.0/400.0
Settings 230V series: 0.0~255.0V
460 V series: $0.0 \sim 510.0 \mathrm{~V}$
1 This value should be set according to the rated voltage of the motor as indicated on the motor nameplate. If the motor is 220 V , the setting should be 220.0 . If the motor is 200 V , it should be set to 200.0.

1 There are many motor types in the market and the power system for each country is also difference. The economic and convenience method to solve this problem is to install the AC motor drive. There is no problem to use with the different voltage and frequency and also can amplify the original characteristic and life of the motor.

## if 3 Mid-point Frequency 1 of Motor 1

Factory Setting: 3.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$


Mid-point Voltage 1 of Motor 1
Factory Setting: 11.0/22.0
Settings 230 V series: $0.0 \sim 240.0 \mathrm{~V}$
460V series: $0.0 \sim 480.0 \mathrm{~V}$

Factory Setting: 3.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$

## 7:-38

Mid-point Voltage 1 of Motor 2

Settings 230V series: 0.0~240.0V
460 V series: $0.0 \sim 480.0 \mathrm{~V}$

## 18:

Factory Setting: 0.50
Settings $0.00 \sim 600.00 \mathrm{~Hz}$


Mid-point Voltage 2 of Motor 1
Factory Setting: 2.0/4.0
Settings 230 V series: $0.0 \sim 240.0 \mathrm{~V}$
460V series: $0.0 \sim 480.0 \mathrm{~V}$
5: 39 Mid-point Frequency 2 of Motor 2
Factory Setting: 0.50
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$

## : 1 - Mid-point Voltage 2 of Motor 2

Factory Setting: 2.0/4.0
Settings 230V series: 0.0~240.0V
460V series: $0.0 \sim 480.0 \mathrm{~V}$
1]:7 Min. Output Frequency of Motor 1
Factory Setting: 0.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
[in $\boldsymbol{\square}$ Min. Output Voltage of Motor 1
Factory Setting: 0.0/0.0
Settings 230 V series: $0.0 \sim 240.0 \mathrm{~V}$
460 V series: $0.0 \sim 480.0 \mathrm{~V}$
[if: \% Min. Output Frequency of Motor 2
Factory Setting: 0.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
6i-42
Min. Output Voltage of Motor 2
Factory Setting: 0.0/0.0
Settings 230V series: 0.0~240.0V
460 V series: $0.0 \sim 480.0 \mathrm{~V}$
$\square$ V/f curve setting is usually set by the motor's allowable loading characteristics. Pay special attention to the motor's heat dissipation, dynamic balance, and bearing lubricity, if the loading characteristics exceed the loading limit of the motor.
1 There is no limit for the voltage setting, but a high voltage at low frequency may cause motor damage, overheat, and stall prevention or over-current protection. Therefore, please use the low voltage at the low frequency to prevent motor damage.
© Pr.01-35 to Pr.01-42 is the V/f curve for the motor 2. When multi-function input terminals

Pr.02-01~02-08 and Pr.02-26 ~Pr.02-31 are set to 14 and enabled, the AC motor drive will act as the 2nd V/f curve.

Dal The $\mathrm{V} / \mathrm{f}$ curve for the motor 1 is shown as follows. The V/f curve for the motor 2 can be deduced from it.


V/f Curve
Common settings of $\mathrm{V} / \mathrm{f}$ curve:
(1) General purpose

| Motor spec. 60 Hz |  |  |
| :---: | :---: | :---: |
| V |  |  |
| 220 | Pr. | Setting |
|  | 01-00 | 60.0 |
|  | 01-01 | 60.0 |
|  | 01-02 | 220.0 |
|  | 01-03 | 1.50 |
|  | 01-05 | 1.50 |
|  | 01-04 |  |
| 10 | 01-06 | 10.0 |
| 1.560 .0 | 01-07 | 1.50 |
|  | 01-08 | 10.0 |

(2) Fan and hydraulic machinery

Motor spec. 60 Hz

| V4 | Pr. | Setting |
| :---: | :---: | :---: |
| $220$ | 01-00 | 60.0 |
| , | 01-01 | 60.0 |
|  | 01-02 | 220.0 |
|  | $\begin{aligned} & \hline 01-03 \\ & 01-05 \end{aligned}$ | 30.0 |
| 10 ? | $\begin{aligned} & 01-04 \\ & 01-06 \end{aligned}$ | 50.0 |
| $\xrightarrow{\text { b0.0 }} \mathrm{F}$ | 01-07 | 1.50 |
| 1.5 | 01-08 | 10.0 |

(3) High starting torque



Motor spec. 50 Hz

|  | Pr. | Setting |
| :---: | :---: | :---: |
|  | 01-00 | 50.0 |
|  | 01-01 | 50.0 |
|  | 01-02 | 220.0 |
|  | $\begin{aligned} & \hline 01-03 \\ & 01-05 \end{aligned}$ | 25.0 |
|  | $\begin{aligned} & 01-04 \\ & 01-06 \end{aligned}$ | 50.0 |
|  | 01-07 | 1.30 |
| $1.3 \quad 25 \quad 50.0$ | 01-08 | 10.0 |

Motor spec. 50 Hz

| V4 | Pr. | Setting |
| :---: | :---: | :---: |
| 220 | 01-00 | 50.0 |
| - | 01-01 | 50.0 |
|  | 01-02 | 220.0 |
|  | $01-03$ | 2.20 |
| $23 \cdots$ |  |  |
| - | 01-04 | 23 |
| 14 - | 01-06 | 23 |
| F | 01-07 | 1.30 |
| 1.32 .250 .0 | 01-08 | 14.0 |

Factory Setting: 0.50
Settings $0.0 \sim 600.00 \mathrm{~Hz}$
[1] When start frequency is higher than the min. output frequency, drives' output will be from start frequency to the setting frequency. Please refer to the following diagram for details.Fcmd=frequency command,
Fstart=start frequency (Pr.01-09),
fstart=actual start frequency of drive,
Fmin=4th output frequency setting (Pr.01-07/Pr.01-41),
Flow=output frequency lower limit (Pr.01-11)
[10] Fcmd>Fmin and Fcmd<Fstart:
If If $\mathrm{Flow}<\mathrm{Fcmd}$, drive will run with Fcmd directly.
凹l If Flow>=Fcmd, drive will run with Fcmd firstly, then, accelerate to Flow according to acceleration time.
[1] The drive's output will stop immediately when output frequency has reach to Fmin during deceleration.


Output Frequency Upper Limit
Factory Setting: 600.00
Settings $0.0 \sim 600.00 \mathrm{~Hz}$

## I ! - ! Output Frequency Lower Limit

Factory Setting: 0.00
Settings $0.0 \sim 600.00 \mathrm{~Hz}$The upper/lower output frequency setting is used to limit the actual output frequency. If the frequency setting is higher than the upper limit, it will run with the upper limit frequency. If output frequency lower than output frequency lower limit and frequency setting is higher than min. frequency, it will run with lower limit frequency. The upper limit frequency should be set to be higher than the lower limit frequency.
1 Pr.01-10 setting must be $\geq$ Pr.01-11 setting.Upper output frequency will limit the max. Output frequency of drive. If frequency setting is higher than Pr.01-10, the output frequency will be limited by Pr.01-10 setting.When the drive starts the function of slip compensation (Pr.07-27) or PID feedback control, drive output frequency may exceed frequency command but still be limited by this setting.
1 Related parameters: Pr.01-00 Max. Operation Frequency and Pr.01-11 Output Frequency Lower Limit


10 Lower output frequency will limit the min. output frequency of drive. When drive frequency command or feedback control frequency is lower than this setting, drive output frequency will limit by the lower limit of frequency.
11 When the drive starts, it will operate from min. output frequency (Pr.01-05) and accelerate to the setting frequency. It won't limit by lower output frequency.setting.
[1] The setting of output frequency upper/lower limit is used to prevent personal misoperation, overheat due to too low operation frequency or damage due to too high speed.If the output frequency upper limit setting is 50 Hz and frequency setting is 60 Hz , max. output frequency will be 50 Hz .
$\square$ If the output frequency lower limit setting is 10 Hz and min. operation frequency setting (Pr.01-05) is 1.5 Hz , it will operate by 10 Hz when the frequency command is greater than Pr.01-05 and less than 10 Hz . If the frequency command is less than Pr.01-05, the drive will be in ready status and no output.

If the frequency output upper limit is 60 Hz and frequency setting is also 60 Hz , it won't exceed 60 Hz even after slip compensation. If the output frequency needs to exceed 60 Hz , it can increase output
frequency upper limit or max. operation frequency.

| $N$ | 71-19 | Accel. Time 1 |
| :---: | :---: | :---: |
| N | I! ! ! | Decel. Time 1 |
| $N$ | 51-1! | Accel. Time 2 |
| $N$ | I! 15 | Decel. Time 2 |
| $N$ | I! 16 | Accel. Time 3 |
| N | I! ! ! | Decel. Time 3 |
| N | 星 ! ; 昜 | Accel. Time 4 |
| $N$ | 9! ! ! ${ }^{\text {9 }}$ | Decel. Time 4 |
| $N$ | [19 59 | JOG Acceleration Time |
| $N$ | if i-2 | JOG Deceleration Time |

Factory Setting: 10.00/10.0
Factory Setting for AC drive with power greater than 30HP: 60.00/60.0

$$
\begin{array}{ll}
\text { Settings } & \text { Pr. } 01-45=0: 0.00 \sim 600.00 \text { seconds } \\
& \text { Pr. } 01-45=1: 0.00 \sim 6000.00 \text { seconds }
\end{array}
$$

1 The Acceleration Time is used to determine the time required for the AC motor drive to ramp from 0 Hz to Maximum Output Frequency (Pr.01-00).The Deceleration Time is used to determine the time require for the AC motor drive to decelerate from the Maximum Output Frequency (Pr.01-00) down to 0Hz.
lad The Acceleration/Deceleration Time is invalid when using Pr.01-44 Optimal Acceleration/Deceleration Setting.
Tad The Acceleration/Deceleration Time 1, 2, 3, 4 are selected according to the Multi-function Input Terminals settings. The factory settings are Accel./Decel. time 1.
1 When enabling torque limits and stalls prevention function, actual accel./decel. time will be longer than the above action time.

Please note that it may trigger the protection function (Pr.06-03 Over-current Stall Prevention during Acceleration or Pr.06-01 Over-voltage Stall Prevention) when the setting of accel./decel. time is too short.
$1 \times$ Please note that it may cause motor damage or drive protection enabled due to over current during acceleration when the setting of acceleration time is too short.

1 Please note that it may cause motor damage or drive protection enabled due to over current during deceleration or over-voltage when the setting of deceleration time is too short.It can use suitable brake resistor (see Chapter 06 Accessories) to decelerate in a short time and prevent over-voltage.
1 When enabling Pr.01-24~Pr.01-27, the actual accel./decel. time will be longer than the setting.


Factory Setting: 6.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
1 Both external terminal JOG and key "F1" on the keypad KPC-CC01 can be used. When the jog command is ON , the AC motor drive will accelerate from OHz to jog frequency (Pr.01-22). When the jog command is OFF, the AC motor drive will decelerate from Jog Frequency to zero. The Jog Accel./Decel. time (Pr.01-20, Pr.01-21) is the time that accelerates from 0.0Hz to Pr.01-22 JOG Frequency.The JOG command can't be executed when the AC motor drive is running. In the same way, when the JOG command is executing, other operation commands are invalid except forward/reverse commands and STOP key on the digital keypad.It does not support JOG function in the optional keypad KPC-CE01.

## 1- $\boldsymbol{1}$ 引 1st/4th Accel./decel. Frequency

Factory Setting: 0.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$The transition from acceleration/deceleration time 1 to acceleration/deceleration time 4, may also be enabled by the external terminals. The external terminal has priority over Pr. 01-23.When using this function, please set S-curve acceleration time as 0 if 4 acceleration time is set too short.


## 7:

S-curve Acceleration Arrival Time 2
S-curve Deceleration Begin Time 1
S-curve Deceleration Arrival Time 2
Factory Setting: 0.20/0.2
Settings Pr.01-45=0: 0.00~25.00 seconds
Pr.01-45=1: 0.00~250.0 seconds
It is used to give the smoothest transition between speed changes. The accel./decel. curve can adjust the S-curve of the accel./decel. When it is enabled, the drive will have different accel./decel. curve by the accel./decel. time.
[1] The S-curve function is disabled when accel./decel. time is set to 0 .
1 When Pr.01-12, 01-14, 01-16, 01-18 $\geq$ Pr.01-24 and Pr.01-25,
The Actual Accel. Time = Pr.01-12, 01-14, 01-16, 01-18 + (Pr.01-24 + Pr.01-25)/2When Pr.01-13, 01-15, 01-17, 01-19 $\geq$ Pr.01-26 and Pr.01-27,
The Actual Decel. Time = Pr.01-13, 01-15, 01-17, 01-19 + (Pr.01-26 + Pr.01-27)/2


Skip Frequency 1 (lower limit)
Skip Frequency 2 (upper limit)
Skip Frequency 2 (lower limit)
Skip Frequency 3 (upper limit)
Skip Frequency 3 (lower limit)
Factory Setting: 0.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$
1 These parameters are used to set the skip frequency of the AC drive. But the frequency output is continuous. There is no limit for the setting of these six parameters and can be used as required.
$10]$ The skip frequencies are useful when a motor has vibration at a specific frequency bandwidth. By skipping this frequency, the vibration will be avoided. It offers 3 zones for use.
[1] These parameters are used to set the skip frequency of the AC drive. But the frequency output is continuous. The limit of these six parameters is $01-28 \geq 01-29 \geq 01-30 \geq 01-31 \geq 01-32 \geq 01-33$. This function will be invalid when setting to 0.0 .The setting of frequency command (F) can be set within the range of skip frequencies. In this moment, the output frequency (H) will be limited by these settings.
1 When accelerating/decelerating, the output frequency will still pass the range of skip frequencies.


## 7: i- 3 Zero-speed Mode

Factory Setting: 0
Settings 0: Output waiting
1: Zero-speed operation
2: Fmin (Refer to Pr.01-07, 01-41)
[a] When the frequency is less than Fmin (Pr.01-07 or Pr.01-41), it will operate by this parameter.When it is set to 0 , the AC motor drive will be in waiting mode without voltage output from terminals U/V/W.When setting 1, it will execute DC brake by Vmin(Pr.01-08 and Pr.01-42) in V/f, FOC Sensorless, and SVC modes. It executes zero-speed operation in VFPG and FOCPG mode.When it is set to 2 , the AC motor drive will run by Fmin (Pr.01-07, Pr.01-41) and Vmin (Pr.01-08, Pr.01-42) in V/F, VFPG, SVC, FOC Sensorless and FOCPG modes.In V/F, VFPG, SVC and FOC Sensorless modes
fout

01-34=0 stop output
$01-34=1$
$01-34=2$
$\begin{array}{ll}\text { fmin } & \\ 01-07 & 0 \mathrm{OHz} \\ & \\ \text { stop waiting for output } & \text { OHz operation } \\ \text { (DC brake) }\end{array}$
In FOCPG mode, when Pr.01-34 is set to 2 , it will act according Pr.01-34 setting. fout

$$
01-34=0 \quad 01-34=1 \quad 01-34=2
$$

fmin
01-07
frequency command frequency command

## If 1 - 13 V/f Curve Selection

Factory Setting: 0
Settings 0 : V/f curve determined by group 01
1: 1.5 power curve
2: Square curve

1 When setting to 0 , refer to Pr.01-01~01-08 for motor 1 V/f curve. For motor 2, please refer to Pr.01-35~01-42.When setting to 1 or $2,2^{\text {nd }}$ and $3^{\text {rd }}$ voltage frequency setting are invalid.
If If motor load is variable torque load (torque is in direct proportion to speed, such as the load of fan or pump), it can decrease input voltage to reduce flux loss and iron loss of the motor at low speed with low load torque to raise the entire efficiency.When setting higher power V/f curve, it is lower torque at low frequency and is not suitable for rapid acceleration/deceleration. It is recommended Not to use this parameter for the rapid acceleration/deceleration.


## A: -14 Optimal Acceleration/Deceleration Setting

Factory Setting: 0
Settings 0: Linear accel./decel.
1: Auto accel., linear decel.
2: Linear accel., auto decel.
3: Auto accel./decel. (auto calculate the accel./decel. time by actual load)
4: Stall prevention by auto accel./decel. (limited by 01-12 to 01-21)
@ Setting 0 Linear accel./decel.: it will accelerate/decelerate according to the setting of Pr.01-12~01-19.Setting to Auto accel./decel.: it can reduce the mechanical vibration and prevent the complicated auto-tuning processes. It won't stall during acceleration and no need to use brake resistor. In addition, it can improve the operation efficiency and save energy.Setting 3 Auto accel./decel. (auto calculate the accel./decel. time by actual load): it can auto detect the load torque and accelerate from the fastest acceleration time and smoothest start current to the setting frequency. In the deceleration, it can auto detect the load re-generation and stop the motor smoothly with the fastest decel. time.Setting 4 Stall prevention by auto accel./decel. (limited by 01-12 to 01-21): if the acceleration/deceleration is in the reasonable range, it will accelerate/decelerate by Pr.01-12~01-19. If the accel./decel. time is too short, the actual accel./decel. time is greater than the setting of accel./decel. time.

(1) When Pr.01-44 is set to 0 .
(2) When Pr.01-44 is set to 3 .

## II : - 45 Time Unit for Acceleration/Deceleration and S Curve

Factory Setting: 0
Settings 0: Unit 0.01 sec
1: Unit 0.1 sec

19:-45 Time for CANopen Quick Stop
Factory Setting: 1.00
Settings Pr. 01-45=0: 0.00~600.00 sec
Pr. 01-45=1: $0.0 \sim 6000.0 \mathrm{sec}$
1 It is used to set the time that decelerates from the max. operation frequency (Pr.01-00) to 0.00 Hz in CANopen control

Factory Setting: 0
Settings 0: 2 wire mode 1
1: 2 wire mode 2
2: 3 wire mode
[1] It is used to set the operation control method:

| Pr.02-00 | Control Circuits of the External Terminal |
| :---: | :---: | :---: | :---: |
| 0 |  |


Factory Setting: 1


Multi-function Input Command 2 (MI2)
Factory Setting: 2
BE
Factory Setting: 3
ME M M Multi-function Input Command 4 (MI4)

Factory Setting: 4

|  | 72- 5 M M lti-function Input Command 5 (MI5) |
| :---: | :---: |
|  |  |
|  | BE- 7 M Multi-function Input Command 7 (MI7) |
|  | 52-98 Multi-function Input Command 8 (M18) |
|  |  |
|  |  |
|  |  |

Input terminal of I/O extension card (MI13)
Input terminal of I/O extension card (MI14)
Input terminal of I/O extension card (MI15)
Factory Setting: 0
Settings
0 : no function
1: multi-step speed command $1 /$ multi-step position command 1
2: multi-step speed command $2 /$ multi-step position command 2
3: multi-step speed command 3 /multi-step position command 3
4: multi-step speed command 4/multi-step position command 4
5: Reset
6: JOG command (By KPC-CC01 or external control )
7: acceleration/deceleration speed not allow
8: the $1^{\text {st }}, 2^{\text {nd }}$ acceleration/deceleration time selection
9: the $3^{\text {rd }}, 4^{\text {th }}$ acceleration/deceleration time selection
10: EF Input (Pr.07-20)
11: B.B input from external (Base Block)
12: Output stop
13: cancel the setting of the optimal acceleration/deceleration time
14: switch between motor 1 and motor 2
15: operation speed command from AVI
16: operation speed command from ACI
17: operation speed command from AUI
18: Emergency stop (Pr.07-20)
19: Digital up command
20: Digital down command
21: PID function disabled
22: Clear counter
23: Input the counter value (MI6)
24: FWD JOG command
25: REV JOG command
26: FOCG/TQC model selection
27: ASR1/ASR2 selection
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for $\Delta$-connection
31: High torque bias (Pr.11-30)
32: Middle torque bias (Pr.11-31)
33: Low torque bias (Pr.11-32)
34: Switch between multi-step position and multi-speed control
35: Enable position control
36: Enable multi-step position learning function (valid at stop)
37: Enable pulse position input command
38: Disable write EEPROM function
39: Torque command direction
40: Force coast to stop
41: HAND switch
42: AUTO switch
43: Enable resolution selection (Pr.02-48)
44: Reverse direction homing
45: Forward direction homing
46: Homing ORG
47: Homing function enable
48: Mechanical gear ratio switch
49: Drive enable
50: Master dEb action input
51: Selection for PLC mode bit0

## 52: Selection for PLC mode bit1

53: Trigger CANopen quick stop
54~55: Reserve
56: Local/Remote Selection
57~70: Reserve
11 This parameter selects the functions for each multi-function terminal.
The terminals of Pr.02-26~Pr.02-29 are virtual and set as MI10~MI13 when using with optional card EMC-D42A. Pr.02-30~02-31 are virtual terminals.

When being used as a virtual terminal, it needs to change the status (0/1: ON/OFF) of bit $8-15$ of Pr.02-12 by digital keypad KPC-CC01 or communication.If Pr.02-00 is set to 3 -wire operation control. Terminal MI1 is for STOP contact. Therefore, MI1 is not allowed for any other operation.
1 Summary of function settings (Take the normally open contact for example, ON: contact is closed, OFF: contact is open)



| Settings | Functions | Descriptions |
| :---: | :---: | :---: |
| 19 | Digital Up command | When the contact is ON, the frequency will be increased and decreased. If this function is constantly ON , the frequency will be increased/decreased by Pr.02-09/Pr.02-10. |
| 20 | Digital Down command |  |
| 21 | PID function disabled | When the contact is ON, the PID function is disabled. |
| 22 | Clear counter | When the contact is ON, it will clear current counter value and display " 0 ". Only when this function is disabled, it will keep counting upward. |
| 23 | Input the counter value (multi-function input command 6) | The counter value will increase 1 once the contact is ON. It needs to be used with Pr.02-19. |
| 24 | FWD JOG command | This function is valid when the source of operation command is external terminals. <br> When the contact is ON, the drive will execute forward Jog command. <br> When execute JOG command under torque mode, the drive will automatically switch to speed mode; after JOG command is done, the drive will return to torque mode. |
| 25 | REV JOG command | This function is valid when the source of operation command is external terminals. <br> When the contact is ON the drive will execute reverse Jog command. <br> When execute JOG command under torque mode, the drive will automatically switch to speed mode; after JOG command is done, the drive will return to torque mode. |
|  |  | When the contact is ON: TQCPG mode. |
|  |  | When the contact is OFF: FOCPG mode. RUN/STOP |
|  |  | $\underset{\substack{\text { RUNSTOP } \\ \text { command } \\ \text { SUN } \\ \text { STOP } \\ \hline}}{ }$ |
|  |  | ter minalis set to 26 (torquelspeed mod OFF ON |
| 26 | FOCPG/TQCPG mode selection |  |
|  |  |  |
|  |  |  |
|  |  | Switch timing for torque/speed control ( $00-10=0 / 4$, multi-fu nction inputterminal is set to 26 ) |
| 27 | ASR1/ASR2 selection | When the contact is ON: speed will be adjusted by ASR 2 setting. OFF: speed will be adjusted by ASR 1 setting. Refer to Pr.11-02 for details. |
| 28 | Emergency stop (EF1) | When the contact is ON , the drive will execute emergency stop and display EF1 on the keypad. The motor won't run and be in the free run until the fault is cleared after pressing RESET" (EF: External Fault) |






| Settings | Functions | Descriptions |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | Bit 0 |  |
|  |  | REM | 0 |  |
|  |  | LOC | 1 |  |
| 57~70 | Reserved |  |  |  |

## 92-9! UP/DOWN Key Mode

Factory Setting: 0
Settings 0: Up/down by the accel/decel time
1: Up/down constant speed (Pr.02-10)

## [2- 19 Constant speed. The Accel. /Decel. Speed of the UP/DOWN Key

Factory Setting: 0.01
Settings $\quad 0.01 \sim 1.00 \mathrm{~Hz} / \mathrm{ms}$
1 These settings are used when multi-function input terminals are set to 19/20. Refer to Pr.02-09 and 02-10 for the frequency up/down command.
1 Pr.02-09 set to 0: it will increase/decrease frequency command (F) by the external terminal UP/DOWN key as shown in the following diagram. In this mode, it also can be controlled by UP/DOWN key on the digital keypad.


1 Pr.02-09 set to 1: it will increase/decrease frequency command (F) by the setting of acceleration/deceleration (Pr.01-12~01-19) and only be valid during operation.


## BI - ! : Digital Input Response Time

Factory Setting: 0.005
Settings $0.000 \sim 30.000 \mathrm{sec}$
1 This parameter is used to set the response time of digital input terminals FWD, REV and MI1~MI8.It is used for digital input terminal signal delay and confirmation. The delay time is confirmation time
to prevent some uncertain interference that would cause error in the input of the digital terminals. Under this condition, confirmation for this parameter would improve effectively, but the response time will be somewhat delayed.
Ild When using MI8 as encoder pulse feedback input, this parameter will not be refered

## 

Factory Setting: 0000
Settings 0000h~FFFFh (0:N.O; 1:N.C)
$\square$ The setting of this parameter is in hexadecimal.
10 This parameter is to set the status of multi-function input signal ( 0 : Normal Open ; 1: Normal Close) and it is not affected by the SINK/SOURCE status..
[1] Bit0 is for FWD terminal, bit1 is for REV terminal and bit2 to bit15 is for MI1 to MI14.
1 User can change terminal status by communicating.
For example, MI1 is set to 1 (multi-step speed command 1), MI2 is set to 2 (multi-step speed command 2). Then the forward $+2^{\text {nd }}$ step speed command=1001(binary) $=9$ (Decimal). Pr.02-12=9 needs to be set by communication to run forward with $2 n d$ step speed. No need to wire any multi-function terminal.

| Bit15 | bit14 | bit13 | bit12 | bit11 | bit10 | bit9 | bit8 | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| MIt0 | bit |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MI13 | MI12 | MI11 | MI10 | MI9 | MI8 | MI7 | MI6 | MI5 | MI4 | MI3 | MI2 | MI1 |  |  |

Factory Setting: 11
Multi-function Output 2 (Relay2)
Factory Setting: 1
BE

2: Operation speed attained
3: Desired frequency attained 1 (Pr.02-22)
4: Desired frequency attained 2 (Pr.02-24)
5: Zero speed (Frequency command)
6: Zero speed, include STOP(Frequency command)
7: Over torque 1(Pr.06-06~06-08)
8: Over torque 2(Pr.06-09~06-11)
9: Drive is ready
10: Low voltage warning (LV) (Pr.06-00)
11: Malfunction indication
12: Mechanical brake release(Pr.02-32)
13: Overheat warning (Pr.06-15)
14: Software brake signal indication(Pr.07-00)
15: PID feedback error
16: Slip error (oSL)
17: Terminal count value attained (Pr.02-20; not return to 0)
18: Preliminary count value attained (Pr.02-19; returns to 0 )
19: Base Block
20: Warning output
21: Over voltage warning
22: Over-current stall prevention warning
23: Over-voltage stall prevention warning
24: Operation mode indication
25: Forward command
26: Reverse command
27: Output when current $>=$ Pr.02-33 ( $>=02-33$ )
28: Output when current <=Pr.02-33 (<= 02-33)
29: Output when frequency $>=$ Pr.02-34 ( $>=02-34$ )
30: Output when frequency $<=\operatorname{Pr} .02-34$ ( $<=02-34$ )
31: Y-connection for the motor coil
32: $\triangle$-connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed include stop(actual output frequency)
35: Error output selection 1(Pr.06-23)
36: Error output selection 2(Pr.06-24)
37: Error output selection 3(Pr.06-25)
38: Error output selection 4(Pr.06-26)
39: Position attained (Pr.10-19)
40: Speed attained (including Stop)
41: Multi-position attained
42: Crane function
43: Actual motor speed slower than Pr.02-47

44: Low current output (Pr.06-71 to Pr.06-73)
45: UVW Output Electromagnetic valve On/Off Switch
46: Master dEb action output
47: Closed brake output
48: Reserved
49: Homing action complete
50: Output for CANopen control
51: Output for communication card
52: Output for RS485
53~62: Reserved
10 This parameter is used for setting the function of multi-function terminals.
1 Pr.02-36~Pr.02-41 requires additional extension cards to display the parameters, the choices of optional cards are EMC-D42A and EMC-R6AA.
The optional card EMC-D42A provides 2 output terminals and can be used with Pr.02-36~02-37.
$1 \mathbb{1}$ The optional card EMC-R6AA provides 6 output terminals and can be used with Pr.02-36~02-41.
1 Summary of function settings (Take the normally open contact for example, ON: contact is closed, OFF: contact is open)

| Settings | Functions | Descriptions |
| :---: | :---: | :---: |
| 0 | No Function |  |
| 1 | Operation Indication | Active when the drive is not at STOP. |
| 2 | Master Frequency Attained | Active when the AC motor drive reaches the output frequency setting. |
| 3 | Desired Frequency <br> Attained 1 (Pr.02-22) | Active when the desired frequency (Pr.02-22) is attained. |
| 4 | Desired Frequency Attained 2 (Pr.02-24) | Active when the desired frequency ( $\mathrm{Pr} .02-24$ ) is attained. |
| 5 | Zero Speed (frequency command) | Active when frequency command $=0$. (the drive should be at RUN mode) |
| 6 | Zero Speed with Stop (frequency command) | Active when frequency command $=0$ or stop. |
| 7 | Over Torque 1 | Active when detecting over-torque. Refer to Pr.06-07 (over-torque detection level-OT1) and Pr.06-08 (over-torque detection time-OT1). Refer to Pr.06-06~06-08. |
| 8 | Over Torque 2 | Active when detecting over-torque. Refer to Pr.06-10 (over-torque detection level-OT2) and Pr.06-11 (over-torque detection time-OT2). Refer to Pr.06-09~06-11. |
| 9 | Drive Ready | Active when the drive is ON and no abnormality detected. |
| 10 | Low voltage warn (Lv) | Active when the DC Bus voltage is too low. (refer to Pr.06-00 low voltage level) |
| 11 | Malfunction Indication | Active when fault occurs (except Lv stop). |
| 12 | Mechanical Brake Release (Pr.02-32) | When drive runs after Pr.02-32, it will be ON. This function should be used with DC brake and it is recommended to use contact "b"(N.C). |
| 13 | Overheat | Active when IGBT or heat sink overheats to prevent OH turn off the drive. (refer to Pr.06-15) |
| 14 | Software Brake Signal Indication | Active when the soft brake function is ON. (refer to Pr.07-00) |
| 15 | PID Feedback Error | Active when the feedback signal is abnormal. |
| 16 | Slip Error (oSL) | Active when the slip error is detected. |
| 17 | Terminal Count Value | Active when the counter reaches Terminal Counter Value |


| Settings | Functions | Descriptions |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Attained (Pr.02-20; not return to 0 ) | (Pr.02-19). This contact won't active when Pr.02-20>Pr.02-19. |  |  |  |  |
| 18 | Preliminary Counter Value Attained (Pr.02-19; returns to 0) | Active when the counter reaches Preliminary Counter Value (Pr.02-19). |  |  |  |  |
| 19 | External Base Block input (B.B.) | Active when the output of the AC motor drive is shut off during base block. |  |  |  |  |
| 20 | Warning Output | Active when the warning is detected. |  |  |  |  |
| 21 | Over-voltage Warning | Active when the over-voltage is detected. |  |  |  |  |
| 22 | Over-current Stall Prevention Warning | Active when the over-current stall prevention is detected. |  |  |  |  |
| 23 | Over-voltage Stall prevention Warning | Active when the over-voltage stall prevention is detected. |  |  |  |  |
| 24 | Operation Mode Indication | Active when the operation command is controlled by external terminal. (Pr.00-20キ0) |  |  |  |  |
| 25 | Forward Command | Active when the operation direction is forward. |  |  |  |  |
| 26 | Reverse Command | Active when the operation direction is reverse. |  |  |  |  |
| 27 | Output when Current >= Pr.02-33 | Active when current is >= Pr.02-33. |  |  |  |  |
| 28 | $\begin{aligned} & \text { Output when Current <= } \\ & \text { Pr.02-33 } \end{aligned}$ | Active when current is $<=$ Pr.02-33 |  |  |  |  |
| 29 | Output when frequency >= Pr.02-34 | Active when frequency is >= Pr.02-34. |  |  |  |  |
| 30 | Output when Frequency $<=\text { Pr.02-34 }$ | Active when frequency is <= Pr.02-34. |  |  |  |  |
| 31 | Y-connection for the Motor Coil | Active when PR.05-24 is less than Pr.05-23 and time is more than Pr.05-25. |  |  |  |  |
| 32 | -connection for the Motor Coil | Active when PR.05-24 is higher than Pr.05-23 and time is more than Pr.05-25. |  |  |  |  |
| 33 | Zero Speed (actual output frequency) | Active when the actual output frequency is 0 . (the drive should be at RUN mode) |  |  |  |  |
| 34 | Zero Speed with Stop (actual output frequency) | Active when the actual output frequency is 0 or Stop. |  |  |  |  |
| 35 | Error Output Selection 1 (Pr.06-23) | Active when Pr.06-23 is ON. |  |  |  |  |
| 36 | Error Output Selection 2 (Pr.06-24) | Active when Pr.06-24 is ON. |  |  |  |  |
| 37 | $\begin{aligned} & \text { Error Output Selection } 3 \\ & \text { (Pr.06-25) } \end{aligned}$ | Active when Pr.06-25 is ON. |  |  |  |  |
| 38 | Error Output Selection 4 (Pr.06-26) | Active when Pr.06-26 is ON. |  |  |  |  |
| 39 | Position Attained (Pr.10-19) | Active when the PG position control point reaches Pr.10-19. |  |  |  |  |
| 40 | Speed Attained (including zero speed) | Active when the output frequency reaches frequency setting or stop. |  |  |  |  |
| 41 | Multi-position Attained | User can set any three multi-function input terminals to 41. The current position action status of these three terminals will be outputted. Example: if setting Pr.02-36~02-38 to 41 and only the multi-position of the second point has been done. Therefore current status is RA (ON), RA (OFF) and MO1 (OFF). In this way their status is 010 . Bit0 is RA and so on. |  |  |  |  |
|  |  |  | $\begin{gathered} \text { MO2 } \\ \text { Pr. } 02-17=41 \end{gathered}$ | $\begin{gathered} \text { MO1 } \\ \text { Pr. } 02-16=41 \end{gathered}$ | $\begin{gathered} \text { RY2 } \\ \text { Pr. } 02-14=41 \end{gathered}$ | $\begin{gathered} \text { RY1 } \\ \text { Pr. } 02-13=41 \end{gathered}$ |
|  |  | Pr.04-16 | 0 | 0 | 0 | 1 |
|  |  | Pr.04-18 | 0 | 0 | 1 | 0 |
|  |  | Pr.04-20 | 0 | 0 | 1 | 1 |
|  |  | Pr.04-22 | 0 | 1 | 0 | 0 |
|  |  | Pr.04-24 | 0 | 1 | 0 | 1 |




| Settings | Functions | Descriptions |  |  |  |
| :---: | :--- | :---: | :---: | :---: | :---: |
|  |  | MO6 | P2-21 $=51$ | RW | The bit 82640 |
|  |  | MO7 | P2-22 $=51$ | RW | The bit 92640 |
|  |  | MO8 | P2-23 $=51$ | RW | The bit 102640 |
|  |  | For RS-485 output |  |  |  |
| $53 \sim 62$ | Reserved |  |  |  |  |

Example: Crane Application
Output
Frequency


It is recommended to be used with Dwell function as shown in the following:


## M2-:8 Multi-function Output Setting

Factory Setting: 0000
Settings 0000h~FFFFh (0:N.O.; 1:N.C.)
1 The setting of this parameter is in hexadecimal.This parameter is set via bit setting. If a bit is 1 , the corresponding output acts in the opposite way.
Example:
If $\operatorname{PrO2-13=1}$ and Pr02-18=0, Relay 1 is ON when the drive runs and is open when the drive is stopped.

If $\operatorname{Pr} 02-13=1$ and Pr02-18=1, Relay 1 is open when the drive runs and is closed when the drive is stopped.

Bit setting

| bit15 | bit14 | bit13 | bit12 | bit11 | bit10 | bit9 | bit8 | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| MO 20 | MO 19 | MO 18 | MO 17 | MO 16 | MO 15 | MO 14 | MO 13 | MO 12 | MO 11 | MO 10 | MO 2 | MO 1 | Reserved | RY2 | RY1 |

## $95-19$ Terminal Counting Value Attained（return to 0）

Factory Setting： 0
Settings 0～65535
［1］The counter trigger can be set by the multi－function terminal MI6（set Pr．02－06 to 23）．Upon completion of counting，the specified output terminal will be activated（Pr．02－13～02－14，Pr．02－36， $02-37$ is set to 18）．Pr．02－19 can＇t be set to 0 ．
［1］When the display shows c5555，the drive has counted 5,555 times．If display shows c5555•，it means that real counter value is between 55,550 to 55,559 ．

## 日2－3 Preliminary Counting Value Attained（not return to 0 ）

Factory Setting： 0
Settings 0～65535
1 When the counter value counts from 1 and reaches this value，the corresponding multi－function output terminal will be activated，provided one of Pr．02－13，02－14，02－36，02－37 set to 17 （Preliminary Count Value Setting）．This parameter can be used for the end of the counting to make the drive runs from the low speed to stop．

（output signal）
Preliminary Counter Value
RY1 Pr．02－13＝17
$02-13,02-14,02-36,02-37$

Terminal Counter Value
RY2 Pr．02－14＝18
$02-14=17$


## M2－コ ：Digital Output Gain（DFM）

Factory Setting： 1
Settings 1～166
［10］It is used to set the signal for the digital output terminals（DFM－DCM）and digital frequency output （pulse X work period＝50\％）．Output pulse per second＝output frequency X Pr．02－21．

## 

Factory Setting：60．00／50．00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$

Factory Setting： 2.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$

## O25 The Width of the Desired Frequency Attained 2

Factory Setting： 2.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$
Once output frequency reaches desired frequency and the corresponding multi－function output terminal is set to 3 or 4 （Pr．02－13，02－14，02－36，and 02－37），this multi－function output terminal will be ON．


## 日コ一3 Brake Delay Time

Factory Setting： 0.000
Settings $0.000 \sim 65.000 \mathrm{sec}$When the AC motor drive runs after Pr．02－32 delay time，the corresponding multi－function output terminal（12：mechanical brake release）will be ON．It is recommended to use this function with DC brake．


Ila If this parameter is used without DC brake, it will be invalid. Refer to the following operation timing.


## M2-3 Output Current Level Setting for Multi-function Output Terminals

Factory Setting: 0
Settings 0~100\%
When output current is higher or equal to Pr.02-33, it will activate multi-function output terminal (Pr.02-13, 02-14, 02-16, and 02-17 is set to 27).
[a] When output current is lower or equal to Pr.02-33, it will activate multi-function output terminal
(Pr.02-13, 02-14, 02-16, and 02-17 is set to 28).

## B2-34Output Boundary for Multi-function Output Terminals

Factory Setting: 3.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
When output frequency is higher or equal to Pr.02-34, it will activate the multi-function terminal (Pr.02-13, 02-14, 02-16, 02-17 is set to 29).
When output frequency is lower or equal to Pr.02-34, it will activate the multi-function terminal (Pr.02-13, 02-14, 02-16, 02-17 is set to 30).

## [20-35 External Operation Control Selection after Reset and Activate

Factory Setting: 0

| Settings | 0 : Disable |
| :--- | :--- |
|  | 1: Drive runs if the run command still exists after reset or re-boots. |

Setting 1:
Status 1: After the drive is powered on and the external terminal for RUN keeps ON, the drive will run.
Status 2: After clearing fault once a fault is detected and the external terminal for RUN keeps ON, the drive can run after pressing RESET key.

## [02-4]

Zero-speed Level of Motor
Factory Setting: 0
Settings 0~65535 rpm
1 This parameter should be used with the multi-function output terminals (set to 43). It needs to be used with PG cared and motor with encoder feedback.
1 This parameter is used to set the level of motor zero-speed. When the actual speed is lower than this setting, the corresponding multi-function output terminal 43 will be ON as shown as follows.


## M2 - 48 Max. Frequency of Resolution Switch

Factory Setting: 60.00
Settings $\quad 0.01 \sim 600.00 \mathrm{~Hz}$
Switch the delay time of Max. output frequency
Factory Setting: 0.000
Settings $\quad 0.000 \sim 65.000 \mathrm{sec}$
10. It is used to improve the unstable speed or unstable position due to the insufficient of analog resolution. It needs to be used with external terminal (set to 43). After setting this parameter, it needs to adjust the analog output resolution of controller simultaneously by this setting.


## B-5 Display the Status of Multi-function Input Terminal

Factory Setting: Read only


## For Example:

If Pr.02-50 displays 0034h (Hex), i.e. the value is 52, and 110100 (binary). It means MI1, MI3 and MI4 are active.

Weights
$0=\mathrm{ON}$
Bit

$1=O$ FF
Settings
$=$ bit $5 \times 2^{5}+$ bit $4 \times 2^{4}+$ bit $2 \times 2^{2}$
$=1 \times 2^{5}+1 \times 2^{4}+1 \times 2^{2}$ $=32+16+4=52$

## Status of Multi-function Output Terminal

Factory Setting: Read only
(1) For Example:

If Pr.02-51 displays 000Bh (Hex), i.e. the value is 11, and 1011 (binary). It means RY1, RY2 and MO1 are ON.


## (12-52

 Display External Output terminal occupied by PLCFactory Setting: Read only
P.02-52 shows the external multi-function input terminal that used by PLC.

[1] For Example:
When Pr.02-52 displays 0034h(hex) and switching to 110100 (binary), it means MI1, MI3 and MI4
are used by PLC.


```
0: not used by PLC
1: used by PLC
Displays
= bit5x 2 + bit 4 }\times\mp@subsup{2}{}{4}+\mathrm{ bit 2 }\times\mp@subsup{2}{}{2
=1\times2 + +1\times2 4 + 1 x 2 
=32+16+4=52
```

```
NOTE
2 14 =16384 2 ' = 8192 2 2 =4096
2 11 =2048 2 2 = 1024 2 =512
2 }\mp@subsup{}{}{8}=256\quad\mp@subsup{2}{}{7}=128\quad\mp@subsup{2}{}{6}=6
2 5}=32\mp@subsup{2}{}{4}=16\quad\mp@subsup{2}{}{3}=8\quad\mp@subsup{2}{}{2}=
2 =2 2 - =1
```


## 

Factory Setting: Read onlyP.02-53 shows the external multi-function output terminal that used by PLC.

[1] For Example:
If the value of Pr.02-53 displays 0003h (Hex), it means RY1and RY2 are used by PLC.


## 日2-54

Display the Frequency Command Executed by External Terminal
Factory Setting: Read only
Settings Read only
When the source of frequency command comes from the external terminal, if Lv or Fault occurs at this time, the frequency command of the external terminal will be saved in this parameter.

## T2 5 Multi-function output terminal: Function 42: Brake Current Checking Point

Factory setting: 0
Settings 0~150\%

## BE-58

Multi-function output terminal: Function 42: Brake Frequency Checking Point
Factory setting : 0.00
Settings $\quad 0.00 \sim 655.35 \mathrm{~Hz}$
凹1 Pr02-32, Pr02-33, Pr02-34, Pr02-57 and Pr02-58 can be applied on setting up cranes. (Choose crane action \#42 to set up multi-functional output Pr02-13, Pr02-14, Pr02-16, and Pr02-17)

1 When output current of a drive is higher than the setting of Pr02-33 Pivot Point of the Current (>=02-33) and when output frequency is higher than the setting of Pr02-34 Pivot Point of the Frequency (>= 02-34), choose \#42 to set up Multi-functional output Pr02-13, Pr02-14, Pr02-16 and Pr002-17 after the delay time set at Pr02-32.

10 When the Pivot Point of the Current 's setting 02-57 $=0$ and when the output current of the drive is lower than the setting of Pr02-57 (<02-57), or when the output frequency is lower than the setting of Pr02-58 (<02-58), the disable the setting \#42 of the multi-functional output Pr02-13, Pr02-14, Pr02-16, Pr02-17

When Pr02-57 = 0, the output current is lower than setting of Pr02-33 Pivot Point of the current (<02-33) or when output frequency is lower than the setting of $\operatorname{Pr02-58(<02-58),~disable~the~setting~}$ of \#42 of the multi-functional output Pr02-13, Pr02-14, Pr02-16, Pr02-17.

This parameter can be set during operation.

## - 33-0日 <br> Analog Input Selection (AVI)

Factory Setting: 1
$N$ 표 in Analog Input Selection (ACI)
Factory Setting: 0
83-92
Analog Input Selection (AUI)
Factory Setting: 0

## Settings

0 : No function
1: Frequency command (speed limit under torque control mode)
2: Torque command (torque limit under speed mode)
3: Torque compensation command
4: PID target value
5: PID feedback signal
6: PTC thermistor input value
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive/negative torque limit
11: PT100 thermistor input value
12~17: Reserved
13: PID compensation value
1 When use analog input as PID reference value, Pr00-20 must set 2(analog input).
Setting method 1: Pr03-00~03-02 set 1 as PID reference input
Setting method 2: Pr03-00~03-02 set 4 as PID reference input
If the setting value 1 and set value 4 existed at the same time, AVI input has highest priority to become PID reference input.When use analog input as PID compensation value, Pr08-16 must set 1(Source of PID compensation is analog input). The compensation value can be observed via Pr08-17.When it is frequency command or TQC speed limit, the corresponding value for $0 \sim \pm 10 \mathrm{~V} / 4 \sim 20 \mathrm{~mA}$ is 0 - max. output frequency(Pr.01-00)
When it is torque command or torque limit, the corresponding value for $0 \sim \pm 10 \mathrm{~V} / 4 \sim 20 \mathrm{~mA}$ is $0-$ max. output torque (Pr.11-27).When it is torque compensation, the corresponding value for $0 \sim \pm 10 \mathrm{~V} / 4 \sim 20 \mathrm{~mA}$ is $0-$ rated torque.

[D] When Pr.03-00~Pr.03-02 have the same setting, then the AVI will be the prioritized selection.

## 83-83

Analog Input Bias (AVI)
Factory Setting: 0
Settings -100.0~100.0\%
IId is used to set the corresponding AVI voltage of the external analog input 0 .

## [3-74 Analog Input Bias (ACI)

Factory Setting: 0
Settings -100.0~100.0\%
1 It is used to set the corresponding ACI voltage of the external analog input 0 .
73-95 Analog Voltage Input Bias (AUI)
Factory Setting: 0
Settings -100.0~100.0\%
凹l It is used to set the corresponding AUI voltage of the external analog input 0 .
The relation between external input voltage/current and setting frequency: 0~10V ( $4-20 \mathrm{~mA}$ ) corresponds to $0-60 \mathrm{~Hz}$.


Reserved


Positive/negative Bias Mode (AVI)
Positive/negative Bias Mode (ACI)
Positive/negative Bias Mode (AUI)
Factory Setting: 0

## Settings 0: Zero bias

1: Lower than or equal to bias
2: Greater than or equal toe bias
3: The absolute value of the bias voltage while serving as the center

In a noisy environment, it is advantageous to use negative bias to provide a noise margin. It is recommended NOT to use less than 1V to set the operation frequency.

| In the diagram below: Black color line: Frequency. Gray color line: Voltage |
| :--- | :--- | :--- |



Pr.03-03=10\% Pr.03-07~03-09 (Positive/Negative Bias Mode)

0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.03-11Analog Input Gain (AVI) $=100 \%$


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.03-11 Analog Input Gain (AVI) $=100 \%$


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain $(A V I)=100 \%$

Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid.
Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.03-11 Analog Input Gain (AVI) $=100 \%$

Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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

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


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center

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

Pr.03-11 Analog Input Gain $(\mathrm{AVI})=100 \%$


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control

Pr.03-11 Analog Input Gain (AVI) $=100 \%$
Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain $(A V I)=100 \%$


Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.03-11 Analog Input Gain (AVI) $=100 \%$


Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11 Analog Input Gain $(A V I)=100 \%$

Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.03-11 Analog Input Gain $(A V I)=100 \%$


Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control

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


Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control
Pr.03-11 Analog Input Gain (AVI)=100\%

Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control

Pr.03-11 Analog Input Gain $(A V I)=100 \%$


Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control

Pr.03-11 Analog Input Gain $(A V I)=100 \%$


Pr.03-03=-10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.

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


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-11Analog Input Gain $(A V I)=111.1 \%$ $10 / 9=111.1 \%$


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.

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


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control

Pr.03-11 Analog Input Gain $(A V I)=111.1 \%$

$$
10 / 9=111.1 \%
$$



Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr03-11 Analog Input Gain $(A V I)=111.1 \%$

$$
10 / 9=111.1 \%
$$



Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr03-11Analog Input Gain $(A V I)=111.1 \%$
10/9 =111.1 \%


Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control

Pr03-11 Analog Input Gain $(A V I)=111.1 \%$
$10 / 9=111.1 \%$

Pr.03-03=10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control

Pr03-11 Analog Input Gain $(A V I)=100 \%$

$$
10 / 9=111.1 \%
$$



Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Calculate the bias: $\frac{60-6 \mathrm{~Hz}}{10 \mathrm{~V}}=\frac{6-0 \mathrm{~Hz}}{\mathrm{XV}} \quad \mathrm{XV}=\frac{10}{9}=1.11 \mathrm{~V}$

$$
\therefore \operatorname{Pr} .03-03=\frac{1.11}{10} \times 10 \% \%
$$

Calculate the gain: $\operatorname{Pr} .03-11=\frac{10 \mathrm{~V}}{11.1 \mathrm{~V}} \times 100 \%=90.0 \%$


Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control
Calculate the bias: $\frac{60-6 \mathrm{~Hz}}{10 \mathrm{~V}}=\frac{6-0 \mathrm{~Hz}}{\mathrm{XV}} \quad \mathrm{XV}=\frac{10}{9}=1.11 \mathrm{~V}$
$\therefore$ Pr. $03-03=\frac{1.11}{10} \times 10 \%$
Calculate the gain: Pr.03-11= $\frac{10 \mathrm{~V}}{11.1 \mathrm{~V}} \times 100 \%=90.0 \%$


Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.


Calculate the gain: $\operatorname{Pr} .03-11=\frac{10 \mathrm{~V}}{11.1 \mathrm{~V}} \times 100 \%=90.0 \%$

Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid.
Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.03-07~03-09 (Positive/Negative Bias Mode) 0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Calculate the bias: $\frac{60-6 \mathrm{~Hz}}{10 \mathrm{~V}}=\frac{6-0 \mathrm{~Hz}}{\mathrm{XV}} \quad \square \quad X V=\frac{10}{9}=1.11 \mathrm{~V}$

$$
\therefore \text { Pr. } 03-03=\frac{1.11}{10} \times 100 \%
$$

Calculate the gain: $\operatorname{Pr} .03-11=\frac{10 \mathrm{~V}}{11.1 \mathrm{~V}} \times 100 \%=90.0 \%$

Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Calculate the bias: $\frac{60-6 \mathrm{~Hz}}{10 \mathrm{~V}}=\frac{6-0 \mathrm{~Hz}}{\mathrm{XV}} \Rightarrow X V=\frac{10}{9}=1.11 \mathrm{~V}$
$\therefore$ Pr.03-03 $=\frac{1.11}{10} \times 100 \%$
Calculate the gain: $\operatorname{Pr} .03-11=\frac{10 \mathrm{~V}}{11.1 \mathrm{~V}} \times 100 \%=90.0 \%$


Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Calculate the bias: $\frac{60-6 \mathrm{~Hz}}{10 \mathrm{~V}}=\frac{6-0 \mathrm{~Hz}}{\mathrm{XV}} \Rightarrow \mathrm{XV}=\frac{10}{9}=1.11 \mathrm{~V}$

$$
\therefore \text { Pr. } 03-03=\frac{1.11}{10} \times 100 \%
$$

Calculate the gain: Pr. $03-11=\frac{10 \mathrm{~V}}{11.1 \mathrm{~V}} \times 100 \%=90.0 \%$

Pr.00-21=0 (Dgital keypad control and d run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias $(\mathrm{AUI})=10 \%$
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid.
Forward and reverse run is controlled
by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive
frequency = forward run; negative
frequency $=$ reverse run. Direction
can not be switched by digital keypad or external teriminal control.

Pr.00-13 Analog Positive Input Gain (AUI)=100\%
Pr.03-14 Analog Negative Input Gain (AUI)= 100\%


Pr.00-21=0 (Dgital keypad control and d run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) $=10 \%$
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI) $=100 \%$
Pr.03-14 Analog Negative Input Gain (AUI) $=100 \%$

Pr.00-21=0 (Dgital keypad control and d run in FWD direction) Pr.03-05 Analog Positive Voltage Input Bias (AUI) $=10 \%$
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.00-13 Analog Positive Input Gain (AUI) $=100 \%$
Pr.03-14 Analog Negative Input Gain (AUI) $=100 \%$

Pr.00-21=0 (Dgital keypad control and d run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) $=10 \%$
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI) $=100 \%$
Pr.03-14 Analog Negative Input Gain (AUI) $=100 \%$


Pr.00-21=0 (Digital keypad control and run in FWD direction )
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI)=100\%
Pr.03-14 Analog Negative Input Gain (AUI)= 100\%

Pr.00-21=0 (Digital keypad control and run in FWD direction) Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\% Pr.03-07~03-09 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.00-13 Analog Positive Input Gain (AUI)= 100\%
Pr.03-14 Analog Negative Input Gain (AUI)=100\%

Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.00-13 Analog Positive Input Gain (AUI)= 100\%
Pr.03-14 Analog Negative Input Gain (AUI)=100\%


Pr.00-21=0 (Digital keypad control and run in FWD direction ) Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\% Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias

## 1: Lower than or equal to bias <br> 1. Lower than or equal to bias

2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid.
Forward and reverse run is controlled
1: Neagtive frequency is valid. Positive
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.00-13 Analog Positive Input Gain (AUI)=111.1\%
$(10 / 9) * 100 \%=111.1 \%$
Pr.00-14 Analog Negative Input Gain $(A U I)=100 \%$
Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid.
Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI)=100\%
Pr.03-14 Analog Negative Input Gain (AUI) $=100 \%$

Pr.00-21 = 0 (Digital keypad control and run in FWD direction )
Pr.03-05 Analog Positive Voltage Input Bias $(A U I)=10 \%$
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage
while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI)=111.1\%
$(10 / 9) * 100 \%=111.1 \%$
Pr.00-14 Analog Negative Input Gain (AUI) $=100 \%$


Pr.00-21=0 (Digital keypad control and run in FWD direction ) Pr.03-05 Analog Positive Voltage Input Bias (AUI) $=10 \%$
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0 : No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.

Pr.00-13 Analog Positive Input Gain (AUI)= 111.1\%
(10/9)*100\% = 111.1\%
Pr.00-14 Analog Negative Input Gain $($ AUI $)=100 \%$

Pr.00-21=0 (Digital keypad control and run in FWD direction ) Pr.03-05 Analog Positive Voltage Input Bias (AUI) $=10 \%$ Pr.03-07~03-09 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control
Pr.00-13 Analog Positive Input Gain (AUI) $=111.1 \%$
(10/9)*100\% = 111.1\%
Pr.00-14 Analog Negative Input Gain $(A U I)=100 \%$

Pr.00-21=0 (Digital keypad control and run in FWD direction) Pr.03-05 Analog Positive Voltage Input Bias (AUI) $=10 \%$ Pr.03-07~03-09 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI) $=111.1 \%$
(10/9) * $100 \%=111.1 \%$
Pr.00-14 Analog Negative Input Gain (AUI) $=90.9 \%$
(10/11)*100\% = 90.9\%



Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\%
Pr.03-07~03-09 (Positive/Negative Bias Mode)
0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid.
Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI)= 111.1 \%
$(10 / 9) * 100 \%=111.1 \%$
Pr.00-14 Analog Negative Input Gain (AUI) $=90.9 \%$
$(10 / 11) * 100 \%=90.9 \%$

Pr.00-21=0 (Digital keypad control and run in FWD direction) Pr.03-05 Analog Positive Voltage Input Bias (AUI) = 10\% Pr.03-07~03-09 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal to bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Neagtive frequency is valid. Positive frequency = forward run; negative frequency $=$ reverse run. Direction can not be switched by digital keypad or external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI)= 111.1\%
$(10 / 9) * 100 \%=111.1 \%$
Pr.00-14 Analog Negative Input Gain (AUI) $=90.9 \%$
$(10 / 11) * 100 \%=90.9 \%$


```
Pr.00-21=0 (Digital keypad control and run in FWD direction)
Pr.03-05 Analog Positive Voltage Input Bias (AUI) \(=10 \%\)
Pr.03-07~03-09 (Positive/Negative Bias Mode)
    0: No bias
    1: Lower than or equal to bias
    2: Greater than or equal to bias
    3: The absolute value of the bias voltage
        while serving as the center
    4: Serve bias as the center
Pr.03-10 (Analog Frequency Command for Reverse Run)
    0 : Negative frequency is not valid.
        Forward and reverse run is controlled
        by digital keypad or external terminal.
    1: Neagtive frequency is valid. Positive
        frequency = forward run; negative
        frequency = reverse run. Direction
        can not be switched by digital keypad or
        external teriminal control.
Pr.00-13 Analog Positive Input Gain (AUI)= 111.1\%
                            \((10 / 9) * 100 \%=111.1 \%\)
Pr.00-14 Analog Negative Input Gain \((A U I)=90.9 \%\)
                            \((10 / 11) * 100 \%=90.9 \%\)
```

Settings 0 : Negative frequency is not valid. Forward and reverse run is controlled by digital keypad or external terminal.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Run direction can not be switched by digital keypad or the external terminal control.
10. Parameter 03-10 is used to enable reverse run command when a negative frequency (negative bias and gain) is input to AVI or ACl analog signal input.

Analog Input Gain (AVI)
Analog Input Gain (ACI)
Analog Positive Input Gain (AUI)
Analog Negative Input Gain (AUI)
Factory Setting: 100.0
Settings -500.0~500.0\%
(1) Parameters 03-03 to 03-14 are used when the source of frequency command is the analog voltage/current signal.

Analog Input Filter Time (AVI)
Analog Input Filter Time (ACI)
Analog Input Filter Time (AUI)
Factory Setting: 0.01
Settings $0.00 \sim 20.00 \mathrm{sec}$
In These input delays can be used to filter noisy analog signal.
11 When the setting of the time constant is too large, the control will be stable but the control response will be slow. When the setting of time constant is too small, the control response will be faster but the control may be unstable. To find the optimal setting, please adjust the setting according to the control stable or response status.

## 93-98

Addition Function of the Analog Input
Factory Setting: 0
Settings 0: Disable (AVI, ACI, AUI)
1: Enable
When Pr.03-18 is set to 0 and the analog input setting is the same, the priority for $\mathrm{AVI}, \mathrm{ACI}$ and AUI are $\mathrm{AVI}>\mathrm{ACl}>\mathrm{AUI}$.

Frequency


Fcommand=[(ay bias)*gain] ${ }^{*} \frac{\max (01-00)}{10 \mathrm{~V} \text { or } 16 \mathrm{~mA}}$
Fcommand: the corresponding
frequen cy for 10 V or 20 mA ay: 10 or 16 mA bias : Pr.03-03, Pr. 03-04, Pr. $03-05$ gain : Pr.03-11, Pr.03-12, Pr. 03-13, Pr.03-14

## 93-19

Treatment to $4-20 \mathrm{~mA}$ Analog Input Signal Loss
Factory Setting: 0
Settings 0: Disable
1: Continue operation at the last frequency
2: Decelerate to stop
3: Stop immediately and display ACE
(1) This parameter determines the behavior when 4~20mA signal is loss, when AVIc(Pr.03-28=2) or AClc (03-29=0).
1 When Pr.03-28 is not set to 2 , it means the voltage input to AVI terminal is $0-10 \mathrm{~V}$ or $0-20 \mathrm{~mA}$. At this moment, Pr.03-19 will be invalid.

When Pr.03-29 is set to 1 , it means the voltage input to ACI terminal is for $0-10 \mathrm{~V}$. At this moment, Pr.03-19 will be invalid.
1 When setting is 1 or 2 , it will display warning code "AnL" on the keypad. It will be blinking until the loss of the ACl signal is recovered or drive is stop.


Multi-function Output 1 (AFM1)
Factory Setting: 0

## 13-23

Multi-function Output 2 (AFM2)
Factory Setting: 0
Settings 0~23

## Function Chart

| Settings | Functions | Descriptions |
| :---: | :--- | :--- |
| 0 | Output frequency $(\mathrm{Hz})$ | Max. frequency Pr.01-00 is regarded as $100 \%$. |
| 1 | Frequency command $(\mathrm{Hz})$ | Max. frequency Pr.01-00 is regarded as $100 \%$. |
| 2 | Motor speed $(\mathrm{Hz})$ | 600 Hz is regarded as $100 \%$ |
| 3 | Output current $(\mathrm{rms})$ | $(2.5 \mathrm{X}$ rated current) is regarded as $100 \%$ |
| 4 | Output voltage | $(2 \mathrm{X}$ rated voltage) is regarded as $100 \%$ |
| 5 | DC Bus Voltage | $450 \mathrm{~V}(900 \mathrm{~V})=100 \%$ |


| 6 | Power factor | $-1.000 \sim 1.000=100 \%$ |
| :---: | :--- | :--- |
| 7 | Power | Rated power is regarded as $100 \%$ |
| 8 | Output torque | Full－load torque is regarded as $100 \%$ |
| 9 | AVI | $0 \sim 10 \mathrm{~V}=0 \sim 100 \%$ |
| 10 | ACI | $0 \sim 20 \mathrm{~mA}=0 \sim 100 \%$ |
| 11 | AUI | $-10 \sim 10 \mathrm{~V}=0 \sim 100 \%$ |
| 12 | q－axis current（Iq） | $(2.5 \mathrm{X}$ rated current）is regarded as 100\％ |
| 13 | q－axis feedback value（Iq） | $(2.5 \mathrm{X}$ rated current）is regarded as 100\％ |
| 14 | d－axis current（Id） | $(2.5 \mathrm{X}$ rated current）is regarded as 100\％ |
| 15 | d－axis feedback value（Id） | $(2.5 \mathrm{X}$ rated current）is regarded as 100\％ |
| 16 | q－axis voltage（Vq） | 250 V （500V）$=100 \%$ |
| 17 | d－axis voltage（Vd） | 250 V （500V）$=100 \%$ |
| 18 | Torque command | Rated torque is regarded as 100\％ |
| 19 | PG2 frequency command | Max．frequency Pr．01－00 is regarded as 100\％． |
| 20 | Output for CANopen control | For CANopen analog output |
| 21 | RS485 analog output | For communication output（CMC－MOD01，CMC－EIP01， <br> CMC－PN01，CMC－DN01） |
| 22 | Analog output for |  |
| communication card | For communication output（CMC－MOD01，CMC－EIP01， <br> CMC－PN01，CMC－DN01） |  |
| 23 | Constant voltage／current output | Pr．03－32 and Pr．03－33 controls voltage／current output <br> level <br> $0 \sim 100 \%$ of Pr．03－32 corresponds to 0～10V of AFM1． |

## 19－3：Gain of Analog Output 1 （AFM1）

Factory Setting： 100.0
35－54 Gain of Analog Output 2 （AFM2）
Factory Setting： 100.0
Settings 0～500．0\％
10 It is used to adjust the analog voltage level（Pr．03－20）that terminal AFM outputs．
［a］This parameter is set the corresponding voltage of the analog output 0 ．
日コーゴ Analog Output 1 when in REV Direction（AFM1）
Factory Setting： 0
73－55 Analog Output 2 when in REV Direction（AFM2）
Factory Setting： 0
Settings 0 ：Absolute value in REV direction
1：Output 0 V in REV direction；output $0-10 \mathrm{~V}$ in FWD direction
2：Output 5－0V in REV direction；output 5－10V in FWD direction


## (43-25 <br> Reserve

## [3-27AFM2 Output Bias

Factory Setting: 0.00
Settings -100.00~100.00\%
Example 1, AFM2 0-10V is set output frequency, the output equation is
$10 \mathrm{~V} \times\left(\frac{\text { Output Frequency }}{01-00}\right) \times 03-24+10 \mathrm{~V} \times 03-27$
$\square$ Example 2, AFM2 $0-20 \mathrm{~mA}$ is set output frequency, the output equation is
$20 \mathrm{~mA} \times\left(\frac{\text { Output Frequency }}{01-00}\right) \times 03-24+20 \mathrm{~mA} \times 03-27$Example 3, AFM2 $4-20 \mathrm{~mA}$ is set output frequency, the output equation is
$4 \mathrm{~mA}+16 \mathrm{~mA} \times\left(\frac{\text { Output Frequency }}{01-00}\right) \times 03-24+16 \mathrm{~mA} \times 03-27$

## 175-28 AVI Selection

Factory Setting: 0
Settings $0: 0-10 \mathrm{~V}$
1: $0-20 \mathrm{~mA}$
2: $4-20 \mathrm{~mA}$

1: $0-10 \mathrm{~V}$
2: $0-20 \mathrm{~mA}$
$\square$ When changing the input mode, please check if the switch of external terminal (SW3, SW4) corresponds to the setting of Pr.03-28~03-29.

## 63-30

Status of PLC Output Terminal
Factory Setting: \#\#
Settings 0~65535
Monitor the status of PLC analog output terminals
[1] P.03-30 shows the external multi-function output terminal that used by PLC.


| NOTE |  |  |
| :---: | :---: | :---: |
|  | 6 |  |
| $\begin{gathered} 2=128 \\ 5 \end{gathered}$ | $24{ }_{4} 64$ |  |
| $2=32$ | $2=16$ | $2=8$ |
| 2 |  |  |
| $2=4$ | $2=2$ | $2=$ |

[10] For Example:
If the value of Pr.02-30 displays $0002 \mathrm{~h}(\mathrm{Hex})$, it means AFM1and AFM2 are used by PLC.

$$
0=\text { Not used by PLC }
$$ $1=$ Used by PLC



$$
\begin{aligned}
& \text { Display value } \\
& \begin{aligned}
& 2=1 \times 2^{1}+0 \times 2^{0} \\
&= \text { bit } 1 \times 2^{1}+\text { bit } 0 \times 2^{0}
\end{aligned}
\end{aligned}
$$

## 73-3 : AFM2 0-20mA Output Selection

Factory Setting: 0
Settings 0 : $0-20 \mathrm{~mA}$ output
1: 4-20mA output

## 63-32

AFM1 DC output setting level AFM2 DC Output Setting Level

Factory Setting: 0.00
Settings $0.00 \sim 100.00 \%$

## 日3-30 <br> Reserve

## ㅍㅋ- ヨ5 AFM1 Filter Output Time <br> 

Factory Setting: 0.01
Settings $0.00 \sim 20.00$ Seconds

## ㅁ․ 37

Reserve

## ［83－49

63－5日
Analog Input Curve Selection
Factory Setting： 0
Settings 0：Regular Curve
1： 3 point curve of AVI
2： 3 point curve of ACI
3： 3 point curve of AVI \＆ACI
4： 3 point curve of AUI
5： 3 point curve of AVI \＆AUI
6： 3 point curve of ACI \＆AUI
7： 3 point curve of AVI \＆ACI \＆AUI

## 日3－5：AVI Low Point

Factory Setting： 0.00
Settings $03-28=0,0.00 \sim 10.00 \mathrm{~V}$
03－28 $=0,0.00 \sim 20.00 \mathrm{~mA}$
［3－5〕 AVI Proportional Low Point
Factory Setting： 0.00

## 63－53

Settings 0．00～100．00\％
AVI Mid Point
Factory Setting： 5.00
Settings $03-28=0,0.00 \sim 10.00 \mathrm{~V}$
03－28 $=0,0.00 \sim 20.00 \mathrm{~mA}$
53－54 AVI Proportional Mid Point
Factory Setting： 50.00

## 53－5 5 AVI High Point

Factory Setting： 10.00
Settings $03-28=0,0.00 \sim 10.00 \mathrm{~V}$
03－28 $=0,0.00 \sim 20.00 \mathrm{~mA}$

## 53－56 AVI Proportional High Point

Factory Setting： 100.00
Settings $0.00 \sim 100.00 \%$
When Pr．03－28 $=0$ ， AVI setting is $0-10 \mathrm{~V}$ and the unit is in voltage $(\mathrm{V})$ ．
［a］When Pr．03－28 $\neq 0$ ，AVI setting is $0-20 \mathrm{~mA}$ or $4-20 \mathrm{~mA}$ and the unit is in current（mA）．
When setting analog input AVI to frequency command，it 100\％corresponds to Fmax（Pr．01－00 Max．operation frequency）．The 3 parameters (Pr03-51, Pr03-53 and Pr03-53) must meet the following argument: P03-51 < P03-53 < P03-55. The 3 proportional points (Pr03-52, Pr03-54 and Pr03-56) doesn't have any limit. Between two points is a linear calculation. The ACI and AUI are same as AVI.
$[\square$ The output $\%$ will become $0 \%$ when the AVI input value is lower than low point setting.
For example:
P03-51 = 1V; P03-52 = 10\%. The output will become $0 \%$ when AVI input is lower than 1 V . If the AVI input is swing between 1 V and 1.1 V , drive's output frequency will beats between $0 \%$ and $10 \%$

## 93-57 ACI Low Point

Factory Setting: 4.00
Settings Pr.03-29=1, 0.00~10.00V

$$
\text { Pr.03-29 }=1,0.00 \sim 20.00 \mathrm{~mA}
$$

## 83-58

ACI Proportional Low Point
Factory Setting: 0.00
Settings 0.00~100.00\%

## 13-53 ACI Mid Point

Factory Setting: 12.00
Settings $03-29=1,0.00 \sim 10.00 \mathrm{~V}$
03-29 $\neq 1,0.00 \sim 20.00 \mathrm{~mA}$

## 5-6. ACI Proportional Mid Point

Factory Setting: 50.00
Settings 0.00~100.00\%

## 75-6:ACI High Point

Factory Setting: 20.00
Settings 03-29=1, 0.00~10.00V
03-29キ1, 0.00~20.00mA

## 183-63

ACI Proportional High Point
Factory Setting: 100.00
Settings $0.00 \sim 100.00 \%$
1 When Pr.03-29=1, ACI setting is $0-10 \mathrm{~V}$ and the unit is in voltage $(\mathrm{V})$.
$\square$ When Pr. $03-29 \neq 1$, ACl setting is $0-20 \mathrm{~mA}$ or $4-20 \mathrm{~mA}$ and the unit is in current ( mA ).
When setting analog input ACI to frequency command, it 100\% corresponds to Fmax (Pr.01-00 Max. operation frequency).
1 The 3 parameters (Pr03-57, Pr03-59 and Pr03-61) must meet the following argument: P03-57 < P03-59 < P03-61. The 3 proportional points (Pr03-58, Pr03-60 and Pr03-62) doesn't have any limit. Between two points is a linear calculation.
[1] The output \% will become $0 \%$ when the ACI input value is lower than low point setting. For example:

P03-57 = 2mA; P03-58 = 10\%. The output will become $0 \%$ when AVI input is lower than 2 mA . If the ACl input is swing between 2 mA and 2.1 mA , drive's output frequency will beats between $0 \%$ and $10 \%$.

## 53-63 Positive AUI Voltage Low Point

Factory Setting: 0.00
Settings $0.00 \sim 10.00 \mathrm{~V}$
[3-64 Positive AUI Voltage Proportional Low Point
Factory Setting: 0.00
Settings 0.00~100.00\%

Factory Setting: 5.00
Settings $0.00 \sim 10.00 \mathrm{~V}$
Positive AUI Voltage Proportional Mid Point
Factory Setting: 50.00
Settings 0.00~100.00\%
IJ-5 Positive AUI Voltage High Point
Factory Setting: 10.00
Settings $0.00 \sim 10.00 \mathrm{~V}$

## 5-68 Positive AUI Voltage Proportional High Point

Factory Setting: 100.00
Settings 0.00~100.00\%
(1) When setting positive voltage AUI to frequency command, it 100\% corresponds to Fmax (Pr.01-00 Max. operation frequency) and the motor runs in forward direction.
[1] Three of the positive voltage AUI points can be set according to user's demand on voltage and proportion, there is no setting limit for AUI points.

## 5-69 Negative AUI Voltage Low Point

Factory Setting: 0.00
Settings 0.00~-10.00V

## 73-75

Negative AUI Voltage Proportional Low Point
Factory Setting: 0.00

## 日3-7;

Settings 0.00~-100.00\%
Negative AUI Voltage Mid Point
Factory Setting: -5.00
Settings 0.00~-10.00V
Negative AUI Voltage Proportional Mid Point
Factory Setting: -50.00

## [73-73

Negative AUI Voltage High Point
Factory Setting: -10.00
Settings 0.00~-10.00V
II 3 - 7 Negative AUI Voltage Proportional High Point
Factory Setting: -100.00
Settings 0.00~-100.00\%
When setting negative voltage AUI to frequency command, it 100\% corresponds to Fmax (Pr.01-00 Max. operation frequency) and the motor runs in reverse direction.
1 Three of the negative voltage AUI points can be set according to user's demand on voltage and proportion, there is no setting limit for AUI points.The 3 parameters (Pr03-69, Pr03-71 and Pr03-73) must meet the following argument: P03-69 < P03-71 < P03-73. The 3 proportional points (Pr03-70, Pr03-72 and Pr03-74) doesn't have any limit. Between two points is a linear calculation.
1 The output \% will become $0 \%$ when the negative AUI input value is lower than low point setting. For example:
P03-63=-1V; P03-64 $=10 \%$. The output will become $0 \%$ when AUI input is bigger than -1 V . If the AUI input is swing between -1 V and -1.1 V , drive's output frequency will beats between $0 \%$ and 10\%.

04 Multi-Step Speed Parameters $N$ This parameter can be set during operation.


## 1st Step Speed Frequency



2nd Step Speed Frequency
3rd Step Speed Frequency

Factory Setting: 0.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
1 The Multi-function Input Terminals (refer to setting 1~4 of Pr.02-01~02-08 and 02-26~02-31) are used to select one of the AC motor drive Multi-step speeds(max. 15 speeds). The speeds (frequencies) are determined by Pr.04-00 to 04-14 as shown in the following.
IT The run/stop command can be controlled by the external terminal/digital keypad/communication via Pr.00-21.
ITd Each one of multi-step speeds can be set within $0.0 \sim 600.0 \mathrm{~Hz}$ during operation.
[0] Explanation for the timing diagram for multi-step speeds and external terminals The Related parameter settings are:

1. Pr.04-00~04-14: setting multi-step speeds (to set the frequency of each step speed)
2. Pr.02-01~02-08, 02-26~02-31: setting multi-function input terminals (multi-step speed 1~4)

■ Related parameters: 01-22 JOG Frequency, 02-01 Multi-function Input Command 1 (MI1), 02-02 Multi-function Input Command 2 (MI2), 02-03 Multi-function Input Command 3 (MI3), 02-04 Multi-function Input Command 4 (MI4)


Position command 1 (pulse)
Position command 2 (pulse)
Position command 3 (pulse)
Position command 4 (pulse)
Position command 5 (pulse)
Position command 6 (pulse)
Position command 7 (pulse)
Position command 8 (pulse)
Position command 9 (pulse)
Position command 10 (pulse)
Position command 11 (pulse)
Position command 12 (pulse)
Position command 13 (pulse)
Position command 14 (pulse)
Position command 15 (pulse)
Factory Setting: 0
Settings -32767~32767
1 Please refer to Pr.02-01~02-08 (Multi-function Input Command) for description on setting 34 (Switch between multi-step position and multi-speed control) and setting 36 (Enable multi-step position learning function).

| Multi-step position corresponding | MI4 | MI3 | MI2 | MI1 | Multi-step speed corresponding |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $10-19$ | 0 | 0 | 0 | 0 | Positioning for Encoder Position |
| 04-16 Position command 1 (pulse) | 0 | 0 | 0 | 1 | $04-001^{\text {st }}$ step speed frequency |
| 04-18 Position command 2 (pulse) | 0 | 0 | 1 | 0 | $04-012^{\text {nd }}$ step speed frequency |
| 04-20 Position command 3 (pulse) | 0 | 0 | 1 | 1 | $04-023^{\text {rd }}$ step speed frequency |


| $04-22$ Position command 4 (pulse) | 0 | 1 | 0 | 0 | $04-034^{\text {th }}$ step speed frequency |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $04-24$ Position command 5 (pulse) | 0 | 1 | 0 | 1 | $04-045^{\text {th }}$ step speed frequency |
| $04-26$ Position command 6 (pulse) | 0 | 1 | 1 | 0 | $04-056^{\text {th }}$ step speed frequency |
| $04-28$ Position command 7 (pulse) | 0 | 1 | 1 | 1 | $04-067^{\text {th }}$ step speed frequency |
| $04-30$ Position command 8 (pulse) | 1 | 0 | 0 | 0 | $04-078^{\text {th }}$ step speed frequency |
| $04-32$ Position command 9 (pulse) | 1 | 0 | 0 | 1 | $04-089^{\text {th }}$ step speed frequency |
| $04-34$ Position command 10 (pulse) | 1 | 0 | 1 | 0 | $04-0910^{\text {th }}$ step speed frequency |
| $04-36$ Position command 11 (pulse) | 1 | 0 | 1 | 1 | $04-1011^{\text {th }}$ step speed frequency |
| $04-38$ Position command 12 (pulse) | 1 | 1 | 0 | 0 | $04-1112^{\text {th }}$ step speed frequency |
| $04-40$ Position command 13 (pulse) | 1 | 1 | 0 | 1 | $04-1213^{\text {th }}$ step speed frequency |
| $04-42$ Position command 14 (pulse) | 1 | 1 | 1 | 0 | $04-1314^{\text {th }}$ step speed frequency |
| $04-44$ Position command 15 (pulse) | 1 | 1 | 1 | 1 | $04-1415^{\text {th }}$ step speed frequency |


| 94- ! Position command 1 (revolution) |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 174- 17 Position | Position command 2 (revolution) |  |  |  |  |
| 94-19 Position | Position command 3 (revolution) |  |  |  |  |
|  | Position command 4 (revolution) |  |  |  |  |
| [14-3 3 Position | Position command 5 (revolution) |  |  |  |  |
|  | Position command 6 (revolution) |  |  |  |  |
| [14-2 ${ }^{1 / 8}$ Position | Position command 7 (revolution) |  |  |  |  |
| [14-3 $0^{19}$ Position | Position command 8 (revolution) |  |  |  |  |
|  | Position command 9 (revolution) |  |  |  |  |
| 194-3 3 Position | Position command 10 (revolution) |  |  |  |  |
| 174-35 Position | Position command 11 (revolution) |  |  |  |  |
| 744-37 Position | Position command 12 (revolution) |  |  |  |  |
| 94, 38 Position | Position command 13 (revolution) |  |  |  |  |
| [14-1! Position | Position command 14 (revolution) |  |  |  |  |
| [14-43 Position | Position command 15 (revolution) |  |  |  |  |
| 10 To switch the target position of the external terminal, set external terminal parameters Pr.02-01=1, Pr.02-02=2, Pr.02-03=3, Pr.02-04= 4 by selecting the P2P target position speed. <br> Setting: Target Position $=04-15 \times(10-01 * 4)+04-16$ |  |  |  |  |  |
| Multi-step Speed Status |  | ition of |  | Maximum | eed of P2P |
| 0000 |  | 0 |  | 11-00 bit8=0 | 11-00 bit8=1 |
| 0001 | Position 1 | 04-15 | 04-16 | 11-43 | 04-00 |
| 0010 | Position 2 | 04-17 | 04-18 |  | 04-01 |
| 0011 | Position 3 | 04-19 | 04-20 |  | 04-02 |
| 0100 | Position 4 | 04-21 | 04-22 |  | 04-03 |
| 0101 | Position 5 | 04-23 | 04-24 |  | 04-04 |
| 0110 | Position 6 | 04-25 | 04-26 |  | 04-05 |
| 0111 | Position 7 | 04-27 | 04-28 |  | 04-06 |
| 1000 | Position 8 | 04-29 | 04-30 | 11-43 | 04-07 |


| Multi-step <br> Speed Status | Target Position of P2P |  | Maximum Speed of P2P |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- |
| 1001 | Position 9 | $04-31$ | $04-32$ |  | $04-08$ |
| 1010 | Position 10 | $04-33$ | $04-34$ |  |  |
| 1011 | Position 11 | $04-35$ | $04-36$ |  | $04-09$ |
| 1100 | Position 12 | $04-37$ | $04-38$ |  | $04-10$ |
| 1101 | Position 13 | $04-39$ | $04-40$ |  | $04-11$ |
| 1110 | Position 14 | $04-41$ |  |  | $04-12$ |
| 1111 | Position 15 | $04-43$ | $04-44$ |  | $04-13$ |
|  |  |  |  |  | $04-14$ |



Factory Setting: 0
Settings 0~65535The Pr 04-50~Pr04-59 can be combined with PLC or HMI programming for variety application.The Pr04-50~Pr04-59 will record last data before power off.

Motor Auto Tuning
Factory Setting： 0
Settings 0：No function
1：Rolling test for induction motor（Rs，Rr，Lm，Lx，no－load current）
2：Rolling test for induction motor
3：No function
4：Rolling test for PM motor magnetic pole
5：Rolling test for PM motor
6：Rolling test for IM motor flux curve
12：FOC Sensorless inertia estimation
13：High frequency and blocked rotor test for PM motor parameter
Induction MotorPress 【Run】to beging auto tuning．The measured value will be written into motor 1 （Pr．05－05 $\sim 05-09$ ，Rs，Rr，Lm，Lx，no－load current）and motor 2 （Pr．05－17 to Pr．05－21）automatically．

To begin AUTO－Tuning in rolling test：
1．Make sure that all the parameters are set to factory settings and the motor wiring is correct．
2．Make sure the motor has no－load before executing auto－tuning and the shaft is not connected to any belt or gear motor．It is recommended to set to 2 if the motor can＇t separate from the load．
3.

|  | Motor 1 Parameter | Motor 2 Parameter |
| :--- | :---: | :---: |
| Motor Rated Frequency | $01-01$ | $01-35$ |
| Motor Rated Voltage | $01-02$ | $01-36$ |
| Motor Full－load Current | $05-01$ | $05-13$ |
| Motor Rated Power | $05-02$ | $05-14$ |
| Motor Rated Speed | $05-03$ | $05-15$ |
| Motor Pole Numbers | $05-04$ | $05-16$ |

4．Set Pr． $05-00=1$ and press【Run】，the drive will begin auto－tuning．Please be aware of the motor that it starts spinning as【Run】 is pressed．
5．When auto－tuning is completed，please check if the measured values are written into motor 1 （Pr．05－05～05－09）and motor 2 （Pr．05－17～05－21）automatically．
6．Mechanical equivalent circuit

※ If Pr．05－00 is set to 2 （static test），user needs to input the no－load current value of motor into Pr．05－05 for motor 1／Pr．05－17 for motor 2.
［10］Set Pr．05－00＝6 to begin rolling test for IM motor flux curve．This function is available when the drive is in FOC／TQC Sensorless control．User may begin auto－tuning after setting up the motor information．
$\square$ Set up Pr．01－01，01－02，05－01～05－04 according to the motor nameplate information $\circ$
－Set Pr．05－00＝6 and press【Run】，make sure no loading is applied to the motor before setting Pr．05－00 to 6 and before performing auto－tuning．

When Pr．05－00＝12，the drive begins FOC Sensorless inertia estimation for IM motor．This function is available when the drive is in FOC／TQC Sensorless control．User may begin auto－tuning after setting up the motor information．
$\square$ Note：Make sure the motor parameters（no－load current，Rs，Rr，Lm and Lx）of the drive are set before performing Pr．05－00＝12（auto－tuningfor FOC Sensorless interia estimation for IM motor）．

1．Set Pr．00－10＝2（torque mode）
2．Set Pr．00－13＝2（TQCPG，Open－loop torque mode）
3．Set Pr．05－00＝12 and press【Run】 to begin FOC Sensorless inertia measure
4．When the process of inertia estimation is completed，check Pr．11－01（unit：PU Q8）and see if the measured value is acceptable．
Set up Sensorless FOC Mode
1．Set Pr．00－10＝ 0 （speed mode）
2．Set Pr．00－11＝ 5 （FOC sensorless mode）
3．Set bit0 of Pr．11－00 to 1 （use ASR gain function to automatically adjust the ASR bandwidth in Pr．11－03，11－04，11－05）

## NOTE

■ In torque／vector control mode，it is not recommended to have motors run in parallel．
$\square \quad$ It is not recommended to use torque／vector control mode if motor rated power exceeds the rated power of the AC motor drive．
$\boxtimes \quad$ When auto－tuning 2 motors，it needs to set multi－function input terminals（setting 14）or change Pr．05－22 for motor $1 /$ motor 2 selection．
$\square \quad$ The no－load current is usually $20 \sim 50 \% \mathrm{X}$ rated current．
$\square \quad$ The rated speed can not be greater than or equal to $120 f / p$（ $f=$ rated frequency Pr．01－01／01－35；P：number of motor poles Pr．05－04／05－16）．

Permanent Magnet Motor（PM）
［10】 Set Pr．05－00＝5 or 13 and press 【Run】 to begin auto tuning for PM motor．The measured values will be written into Pr．05－39（Rs），Pr．05－40 \＆ 41 （Ld \＆Lq）and Pr．05－43（PM motor＇s Ke parameter）．

To begin AUTO－Tuning for PM motor in rolling test：
1．Make sure all the parameters are reset to factory setting and the motor wiring installtion is
correct．
2．For PM motor，set Pr．05－33＝1 and complete the following settings according to your motor specifications，Pr．05－34 rated current，Pr．05－35 rated power，Pr．05－36 rated speed and Pr． $05-37$ pole number．The acceleration time and deceleration time should be set according to your motor capacity．
3．Set Pr．05－00 to 5 and press 【Run】 to begin auto tuning for PM motor．Please be aware of the motor that it starts spinning as【Run】 is pressed．
4．When auto－tuning is completed，please check if the measured values are written into Pr．05－39～05－41 and Pr．05－43 automatically．
（1）Set Pr．05－00＝4 and press【Run】 to begin auto－tuning for PM motor PG offset angle．The measured value will be written into Pr．05－42 automatically．
$\square$ Note 1：When execute auto－tuning for PM motor PG origin，please make sure the encoder setting are correct（Pr．10－00，10－01，10－02），otherwise the PG origin measure error and motor stall may occur．

Note 2：If PM motor runs in an opposite direction of the drive＇s command，switch any two of the UVW cable and re－connect，then execute PG origin search again．It is crucial to execute auto－tuning after the switch otherwise PG origin measure error and motor stall may occur．
［1］Auto－tuning process for measuring PG offset angle of PM motor：
1．Set Pr．05－00＝5 and press RUN，or manually input the values into Pr．01－01，05－34～－541 and Pr．05－43．
2．It is strongly suggested to remove the motor and unload before beings auto－tuning．
3．Set Pr． $05-00=4$ and press【Run】 to begin auto－tuning．Please be aware of the motor that it starts spinning as 【Run】is pressed．
4．When auto－tuning is completed，please check if the PG offset angle is written into Pr．05－42 automatically．

## NOTE

When auto－tuning for PM motor is completed and the control mode setting is done，it is recommend to turn the drive＇s power off and restart again to ensure the drive operates according to the motor parameter settings．

> Unit: Amper
> Factory Setting: \#.\#\#

Settings 10 to $120 \%$ of drive＇s rated current
This value should be set according to the rated current of the motor as indicated on the motor nameplate．The factory setting is $90 \% \mathrm{X}$ rated current．
Example：The rated current for $7.5 \mathrm{HP}(5.5 \mathrm{~kW})$ is 25 and factory setting is 22.5 A ．The range for setting will be $10 \sim 30 \mathrm{~A}$ ．$(25 * 40 \%=10 \mathrm{~A}$ and $25 * 120 \%=30 \mathrm{~A}$ ）

## 85-02

Rated Power of Induction Motor 1(kW)
Factory Setting: \#.\#\#
Settings $0 \sim 655.35 \mathrm{~kW}$
It is used to set rated power of the motor 1 . The factory setting is the power of the drive.
Rated Speed of Induction Motor 1 (rpm)
Factory Setting:
1710 ( 60 Hz 4 poles)
1410 (50Hz 4 poles )
Settings 0~65535
1 It is used to set the rated speed of the motor and need to set according to the value indicated on the motor nameplate.Before set up this parameter, you need to set up Pr05-04.

## [85-84

Pole Number of Induction Motor 1
Factory Setting: 4
Settings 2~20
[1] It is used to set the number of motor poles (must be an even number).
Set up Pr.05-04 before you set up Pr.05-03.


No-load Current of Induction Motor 1 (A)
Unit: Amper
Factory Setting: \#.\#\#
Settings 0 to the factory setting in Pr.05-01
[1] The factory setting is $40 \% \mathrm{X}$ rated current.


Stator Resistance(Rs) of Induction Motor 1
Rotor Resistance(Rr) of Induction Motor 1
Factory Setting: \#.\#\#\#
Settings 0~65.535 $\Omega$

Magnetizing Inductance(Lm) of Induction Motor 1
Stator inductance(Lx) of Induction Motor 1
Factory Setting: \#.\#
Settings $0 \sim 6553.5 \mathrm{mH}$

## 55-19

Reserved

65-: 3
Full-load Current of Induction Motor 2 (A )

Settings 10~120\%
1 This value should be set according to the rated frequency of the motor as indicated on the motor nameplate. The factory setting is $90 \% \mathrm{X}$ rated current.
Example: The rated current for $7.5 \mathrm{HP}(5.5 \mathrm{~kW})$ is 25 A and factory setting is 22.5 A . The range for setting will be $10 \sim 30 \mathrm{~A}$. $(25 * 40 \%=10 \mathrm{~A}$ and $25 * 120 \%=30 \mathrm{~A}$ )

## 55- : 4 Rated Power of Induction Motor 2 (kW)

Factory Setting: \#.\#\#
Settings $\quad 0 \sim 655.35 \mathrm{~kW}$
It is used to set rated power of the motor 2. The factory setting is the power of the drive.
©5-15
Rated Speed of Induction Motor 2 (rpm)
Factory Setting: 1710
Settings 0~65535
10 It is used to set the rated speed of the motor and need to set according to the value indicated on the motor nameplate.

## 55-15

Pole Number of Induction Motor 2
Factory Setting: 4
Settings 2~20
Ifl It is used to set the number of motor poles (must be an even number).
日5-17 No-load Current of Induction Motor 2 (A)
Unit: Amper
Factory Setting: \#.\#\#
Settings 0 to the factory setting in Pr.05-13
[1] The factory setting is $40 \% \mathrm{X}$ rated current.


Stator Resistance (Rs) of Induction Motor 2
Rotor Resistance (Rr) of Induction Motor 2

## Factory Setting: \#.\#\#\#

Settings 0~65.535 $\Omega$


Magnetizing Inductance (Lm) of Induction Motor 2
Stator Inductance (Lx) of Induction Motor 2
Factory Setting: \#.\#
Settings $\quad 0 \sim 6553.5 \mathrm{mH}$

## 85-32

Induction Motor 1/ 2 Selection
Factory Setting: 1

## Settings 1: Motor 1 <br> 2: Motor 2

Ifal It is used to set the motor that driven by the AC motor drive.

## 55-23 <br> Frequency for Y-connection/ $\triangle$-connection Switch of Induction Motor

Factory Setting: 60.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$

## 55-54 Y-connection/ $\triangle$-connection Switch of Induction Motor IM

Factory Setting: 0
Settings 0: Disable
1: Enable

## 55-25 <br> Delay Time for Y-connection/ $\triangle$-connection Switch of Induction Motor

Factory Setting: 0.200
Settings $\quad 0.000 \sim 60.000 \mathrm{sec}$
$1 \mathbb{1}$ P.05-23 and Pr.05-25 are applied in the wide range motors and the motor coil will execute the switch of Y-connection/ $\Delta$-connection as required. (The wide range motors has relation with the motor design. In general, it has higher torque at low speed and Y -connection and it has higher speed at high speed and . connection.
$\square$ Pr.05-24 is used to enable/disable Y-connection/公connection Switch.When Pr.05-24 is set to 1, the drive will select by Pr.05-23 setting and current motor frequency to switch motor to Y -connection or $\tilde{\Delta}$-connection, At the same time, it will also affect motor parameters.
1 Pr.05-25 is used to set the switch delay time of $Y$-connection/ $/ \overline{-}$-connection.When output frequency reaches $Y$-connection/ $\Delta$-connection switch frequency, drive will delay by Pr.05-25 before multi-function output terminals are active.



Accumulative Watt Per Second of Motor in Low Word (W-sec)
Factory Setting: 0.0
Settings Read only

## 55-27

Accumulative Watt Per Second of Motor in High Word (W-sec)
Factory Setting: 0.0
Settings Read only
[55-28
Accumulative Watt-hour of Motor (W-Hour)
Factory Setting: 0.0
Settings Read only
Accumulative Watt-hour of Motor in Low Word (KW-Hour)
Factory Setting: 0.0
Settings Read only
Accumulative Watt-hour of Motor in High Word (KW-Hour)

## Settings Read only

Pal Pr.05-26~05-29 records the amount of power consumed by motors. The accumulation begins when the drive is activated and record is saved when the drive stops or turns OFF. The amount of consumed watts will continue to accumulate when the drive activate again. To clear the accumulation, set Pr.00-02 to 5 then the accumulation record will return to 0 .

## 185-3 : Accumulative Motor Operation Time (Min)

Factory Setting: 0
Settings 00~1439
75-35
Accumulative Motor Operation Time (day)
Factory Setting: 0
Settings 00~65535
(1) Pr. 05-31 and Pr.05-32 are used to record the motor operation time. To clear the operation time, set Pr.05-31 and Pr.05-32 to 00. Operation time shorter than 60 seconds will not be recorded.

55-35 Induction Motor (IM) and Permanent Magnet Motor Selection
Factory Setting: 0
Settings 0: Induction Motor
1: Permanent Magnet Motor

55-34 Full-load current of Permanent Magnet Motor
Factory Setting: 0.00
Settings $\quad 0.00 \sim 655.35 \mathrm{Amps}$

## 515-35 Rated Power of Permanent Magnet Motor

Factory Setting: 0.00
Settings $\quad 0.00 \sim 655.35 \mathrm{~kW}$

## 15-36 Rated speed of Permanent Magnet Motor

Factory Setting: 2000
Settings 0~65535 rpm

## 日5-37

Pole number of Permanent Magnet Motor
Factory Setting: 10
Settings 0~65535

Settings $\quad 0.0 \sim 6553.5 \mathrm{~kg} . \mathrm{cm}^{2}\left(0.0001 \mathrm{~kg} . \mathrm{m}^{2}\right)$
1 This parameter setting is defined in $\mathbf{k g - c m}{ }^{2}$. If this measure is not familiar to you, please refer to the chart below. (Delta's motor inertia chart is for reference purpose only.)

Delta Motor (Low inertia model)

| Rated Power(kW) | 0.1 | 0.2 | 0.4 | 0.4 | 0.75 | 1 | 2 |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Rotor inertia (kg.m^2) | $3.70 \mathrm{E}-06$ | $1.77 \mathrm{E}-05$ | $2.77 \mathrm{E}-05$ | $6.80 \mathrm{E}-05$ | $1.13 \mathrm{E}-04$ | $2.65 \mathrm{E}-04$ | $4.45 \mathrm{E}-04$ |  |

## Delta Motor (Mid to High Inertia model)

| Rated Power(kW) | 0.5 | 1 | 1.5 | 2 | 2 | 0.3 | 0.6 | 0.9 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Rotor inertia (kg.m^2) | $8.17 \mathrm{E}-04$ | $8.41 \mathrm{E}-04$ | $1.12 \mathrm{E}-03$ | $1.46 \mathrm{E}-03$ | $3.47 \mathrm{E}-03$ | $8.17 \mathrm{E}-04$ | $8.41 \mathrm{E}-04$ | $1.12 \mathrm{E}-03$ |

※ For more information on motor inertia value, please refer to Pr.11-01.

## 55-33 Stator Resistance of PM Motor

Factory Setting: 0.000
Settings $0.000 \sim 65.535 \Omega$

| $85-4$ Permanent Magnet Motor Ld |  |
| ---: | ---: |
| Settings $\quad 0.00 \sim 655.35 \mathrm{mH}$ | Factory Setting: 0.00 |

55-4 : Permanent Magnet Motor Lq
Factory Setting: 0.00
Settings $\quad 0.00 \sim 655.35 \mathrm{mH}$

Factory Setting: 0
Settings $0.0 \sim 360.0^{\circ}$
[1] When Pr.05-00 is set to 4, the drive will detect offset angle and write into Pr.05-42.
Ke parameter of PM Motor
Unit: V/1000rpm
Factory Setting: 0
Settings 0~65535

## 06 Protection Parameters

$\wedge$ This parameter can be set during operation．

## 䀼－时 <br> Low Voltage Level

Factory Setting：
Settings 230V Series：
Frame A to D：150．0～220．0 Vdc 180.0
Frame E and frames above E：190．0～220．0V 200.0
Frame A to D：
460V Series：300．0～440．0V
360.0

Frame E and frames above E：380．0～440．0V
400.0
［D］It is used to set the level．When the DC BUS voltage is lower than Pr06－00 Low voltage level，drive will stop output and free to stop．


## 日6－i ；Over－voltage Stall Prevention

Factory Setting：380．0／760．0
Settings 230V Series： $0.0 \sim 450.0 \mathrm{~V}$
460V Series：0．0～900．0V
0 ：Disabled
When Pr．06－01 is set to 0.0 ，the over－voltage stall prevention function is disabled．When braking units or resistors are connected to the drive，this setting is suggested．
$1 \square 1$ During deceleration，the DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration．When this function is enabled，the AC motor drive will not decelerate further and keep the output frequency constant until the voltage drops below the preset value again．
1 This function is used for the occasion that the load inertia is unsure．When it stops in the normal load，the over－voltage won＇t occur during deceleration and fulfill the setting of deceleration time． Sometimes，it may not stop due to over－voltage during decelerating to stop when increasing the load regenerative inertia．At this moment，the AC drive will auto add the deceleration time until drive stop．
1 When the over－voltage stall prevention is enabled，drive deceleration time will be larger than the setting．
［1］When there is any problem as using deceleration time，refer to the following items to solve it．
1．Add the suitable deceleration time．
2．Add brake resistor（refer to appendix B－1 for details）to consume the electrical energy that
regenerated from the motor with heat type.

- Related parameters: Pr.01-13, 01-15, 01-17, 01-19 (settings of decel. time 1~4), Pr.02-13~02-14 (Multi-function Output 1 RY1, RY2), Pr. 02-16~02-17 Multi-function Output (MO1, 2)



## 

Selection for Over-voltage Stall Prevention
Factory Setting: 0
Settings 0: Traditional over-voltage stall prevention
1: Smart over-voltage prevention
When Pr.06-02 is set to 1 , the drive will maintain DCbus voltage when decelerating and prevent OV.


## 86-83

 Over-current Stall Prevention during AccelerationSettings Normal duty: 0~160\% (100\%: drive's rated current)
Heavy duty: 0~180\% (100\%: drive's rated current)

Factory Setting: 150
[D] If the motor load is too large or drive acceleration time is too short, the AC drive output current may increase abruptly during acceleration and it may cause motor damage or trigger protection functions (OL or OC). This parameter is used to prevent this situation.
[ad During acceleration, the AC drive output current may increase abruptly and exceed the value specified by Pr.06-03 due to rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and keep the output frequency constant until the current drops below the maximum value.
(1)] When the over-current stall prevention is enabled, drive acceleration time will be larger than the setting.
(1a) When the Over-Current Stall Prevention occurs due to too small motor capacity or in the factory setting, please decrease Pr.06-03 setting.
[D] When there is any problem by using acceleration time, refer to the following items to solve it.
®al Related parameters: Pr.01-12, 01-14, 01-16, 01-18 (settings of accel. time 1~4), Pr.01-44

1. dd the suitable acceleration time.
2. Setting Pr.01-44 Optimal Acceleration/Deceleration Setting to 1, 3 or 4 (auto accel.)
[D] Optimal Acceleration/Deceleration Setting, Pr.02-13~02-14 (Multi-function Output 1 RY1, RY2), Pr. 02-16~02-17 Multi-function Output (MO1, 2)


## -66-04

Over-current Stall Prevention during Operation

$$
\begin{array}{lll}
\text { Settings } & \text { Normal duty: } 0 \sim 160 \% ~(100 \% \text { : drive's rated current) } & \text { Factory Setting: } 120 \\
& \text { Heavy duty: } 0 \sim 180 \% \text { (100\%: drive's rated current) } & \text { Factory Setting: } 150
\end{array}
$$

[d] It is a protection for drive to auto decrease output frequency when the motor is over-load abruptly during motor constant operation.
[1] If the output current exceeds the setting specified in Pr.06-04 when the drive is operating, the drive will decrease its output frequency (according to Pr.06-05) to prevent the motor stall. If the output current is lower than the setting specified in Pr.06-04, the drive will accelerate (according to

Pr.06-05) again to catch up with the set frequency command value.
Over-Current
Detection Level
06-04


## [65-05

Accel./Decel. Time Selection of Stall Prevention at Constant Speed
Factory Setting: 0
Settings 0: by current accel/decel time
1: by the 1 st accel/decel time
2: by the 2nd accel/decel time
3: by the 3rd accel/decel time
4: by the 4th accel/decel time
5: by auto accel/decel
It is used to set the accel./decel. time selection when stall prevention occurs at constant speed.

## 日6-45

Over-torque Detection Selection (OT1)
Factory Setting: 0
Settings 0: Disable
1: Over-torque detection during constant speed operation, continue to operate after detection
2: Over-torque detection during constant speed operation, stop operation after detection

3: Over-torque detection during operation, continue to operate after detection
4: Over-torque detection during operation, stop operation after detection

Factory Setting: 0
Settings 0: Disable
1: Over-torque detection during constant speed operation, continue to operate after detection
2: Over-torque detection during constant speed operation, stop operation after detection

3: Over-torque detection during operation, continue to operation after detection

When Pr.06-06 and Pr.06-09 are set to 1 or 3 , it will display a warning message and won't have an abnormal record.

1 When Pr.06-06 and Pr.06-09 are set to 2 or 4 , it will display a warning message and will have an abnormal record.

## 75-77 Over-torque Detection Level (OT1)

Factory Setting: 120
Settings 10 to 250\% (100\%: drive's rated current)
76-98
Over-torque Detection Level (OT1)
Factory Setting: 0.1
Settings $0.0 \sim 60.0 \mathrm{sec}$

## 56-17

Over-torque Detection Level (OT2)
Factory Setting: 120
Settings 10 to $250 \%$ (100\%: drive's rated current)
^ B5- : : Over-torque Detection Time (OT2)
Factory Setting: 0.1
Settings $0.0 \sim 60.0 \mathrm{sec}$
(1) NOTE 01: Over torque detection is determined by the following method. if the output current exceeds the over-torque detection level (Pr06-07, factory setting: 150\%) and also exceeds Pr06-08, the Over Torque Detection will follow the setting of Pr06-06 and Pr06-09.

Nad NOTE02: When Pr06-06 or Pr06-09 is set to 1 or 3 , the motor drive will have the ot $1 /$ ot 2 warning after Over Torque Detection. But the motor drive will keep running but only until the output current is smaller than the $5 \%$ of the rated current, the warning will be off.

[al NOTE03: When Pr06-06 or Pr06-09 is set to 2 or 4 , the morot drive will have the ot $1 /$ ot2 fault after Over Torque Detection. Then the motor drive stop running until it is mnually reset.

Factory Setting: 170
Settings 0~250\% (100\%: drive's rated current)
1 Pr.06-12 sets the maximum output current of the drive. Pr.06-12 and Pr.11-17 ~ Pr.11-20 are used to set the drive's output current limit. When the drive is in VF, SVC or VFPG control mode, output frequency will decreases as the output current reaches current limit. It is a current stall prevention.

Electronic Thermal Relay Selection (Motor 1)
-65-27
Electronic Thermal Relay Selection (Motor 2)
Factory Setting: 2

## Settings 0: Constant torque output motor <br> 1: Variable torque output motor <br> 2: Disable

It is used to prevent self-cooled motor overheats under low speed. User can use electronic thermal relay to limit driver's output power.

Electronic Thermal Characteristic for Motor 1
Electronic Thermal Characteristic for Motor 2
Factory Setting: 60.0
Settings $30.0 \sim 600.0 \mathrm{sec}$
(1) The parameter is set by the $150 \%$ of motor rated current and the setting of Pr.06-14 and Pr.06-28 to prevent the motor damaged from overheating. When it reaches the setting, it will display "EoL1/EoL2" and the motor will be in free running.


## 日5-15

Heat Sink Over-heat (OH) Warning
Factory Setting: 85.0
Settings $\quad 0.0 \sim 110.0^{\circ} \mathrm{C}$
(1) Pr.06-15 sets the heatsink temperature level of the drive. The drive will output an overheating warning when the temperature exceeds the setting of Pr.06-15. If the setting of Pr.06-15 is higher than the default setting of the drive, the drive will use the default setting level for warning output. Capacitor (CAP) overheating level is set by the drive's default setting, it can not be adjusted.

| Over-heating Level $\left({ }^{\circ} \mathrm{C}\right)$ |  |  |
| :---: | :---: | :---: |
| Model | IGBT OH1 | CAP OH 2 |
| VFD007C23A/E | 100 | 90 |
| VFD015C23A/E | 100 | 90 |
| VFD022C23A/E | 100 | 90 |
| VFD037C23A/E | 100 | 95 |
| VFD055C23A/E | 100 | 75 |
| VFD075C23A/E | 100 | 75 |


| Over-heating Level ( ${ }^{\circ} \mathrm{C}$ ) |  |  |
| :---: | :---: | :---: |
| Model | IGBT OH1 | CAP OH 2 |
| VFD055C43A/E | 100 | 95 |
| VFD075C43A/E | 95 | 75 |
| VFD110C43A/E | 95 | 75 |
| VFD150C43A/E | 95 | 75 |
| VFD185C43A/E | 95 | 80 |
| VFD220C43A/E | 95 | 80 |


| Over-heating Level ( ${ }^{\circ} \mathrm{C}$ ) |  |  | Over-heating Level ( ${ }^{\circ} \mathrm{C}$ ) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| VFD110C23A/E | 100 | 75 | VFD300C43A/E | 100 | 80 |
| VFD150C23A/E | 95 | 70 | VFD370C43A/E | 95 | 60 |
| VFD185C23A/E | 95 | 70 | VFD450C43A/E | 95 | 60 |
| VFD220C23A/E | 95 | 70 | VFD550C43A/E | 100 | 60 |
| VFD300C23A/E | 95 | 60 | VFD750C43A/E | 100 | 60 |
| VFD370C23A/E | 95 | 60 | VFD900C43A/E | 100 | 60 |
| VFD450C23A/E | 100 | 60 | VFD1100C43A/E | 100 | 60 |
| VFD550C23A/E | 100 | 60 | VFD1320C43A/E | 100 | 60 |
| VFD750C23A/E | 100 | 60 | VFD1600C43A/E | 100 | 60 |
| VFD900C23A/E | 100 | 60 | VFD1850C43A/E | 100 | 65 |
| VFD007C43A/E | 100 | 90 | VFD2200C43A/E | 100 | 65 |
| VFD015C43A/E | 100 | 90 | VFD2800C43A/E | 100 | 65 |
| VFD022C43A/E | 100 | 95 | VFD3150C43A/E | 100 | 65 |
| VFD037C43A/E | 100 | 100 | VFD3550C43A/E | 100 | 65 |
| VFD040C43A/E | 100 | 95 |  |  |  |

Stall Prevention Limit Level (Flux weakening area current stall prevention level)
Factory Setting: 50
Settings 0~100\% (Refer to Pr.06-03, Pr.06-04)
When operation frequency is larger than Pr.01-01; e.g. Pr06-03=150\%, Pr. 06-04=100\% and Pr. 06-16=80\%:
Calculate the Stall Prevention Level during acceleration: Pr.06-03 * Pr.06-16=150x80\%=120\%. Calculate the Stall Prevention Level at constant speed: Pr.06-04 * Pr.06-16=100x80\%=80\%.

| 75- 7 | Present Fault Record |  |
| :---: | :---: | :---: |
| 55-18 | Second Most Recent Fault Record |  |
| 56-13 | Third Most Recent Fault Record |  |
| B5-3 | Fourth Most Recent Fault Record |  |
| 75-3 | Fifth Most Recent Fault Record |  |
| B6-3 | Sixth Most Recent Fault Record |  |
|  | Settings | Can auto-reset after fault |
|  | 0: No fault record | $\begin{gathered} \mathrm{V}(\mathrm{P} 07-10 \neq 0 \text { \& } \\ \mathrm{P} 07-11 \neq 0) \end{gathered}$ |
|  | 1: Over-current during acceleration (ocA) | $\begin{gathered} V(P 07-10 \neq 0 \& \\ P 07-11 \neq 0) \end{gathered}$ |
|  | 2. Over-current during deceleration (ocd) | $\begin{gathered} V(P 07-10 \neq 0 \& \\ P 07-11 \neq 0) \end{gathered}$ |
|  | 3: Over-current during constant speed(ocn) | $\begin{gathered} V(P 07-10 \neq 0 \& \\ P 07-11 \neq 0) \end{gathered}$ |
|  | 4: Ground fault (GFF) |  |
|  | 5: IGBT short-circuit (occ) <br> 6: Over-current at stop (ocS) | $\begin{gathered} \mathrm{V}(\mathrm{P} 07-10 \neq 0 \text { \& } \\ \mathrm{P} 07-11 \neq 0) \end{gathered}$ |

7: Over-voltage during acceleration (ovA)

8: Over-voltage during deceleration (ovd)

9: Over-voltage during constant speed (ovn)

V (P07-10 $=0$ \&
P07-11 = 0 )
V (P07-10キ0 \&
P07-11 $=0$ )
V (P07-10 $=0$ \&
P07-11 $=0$ )

10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Stop mid-low voltage (LvS)
15: Phase loss protection (OrP)
16: IGBT over-heat (oH1)
17: Capacitance over-heat (oH2) (for 40hp above)
18: tH1o (TH1 open: IGBT over-heat protection error)
19: tH2o (TH2 open: capacitance over-heat protection error)

20: Reserved
21: Drive over-load (oL)
22: Electronics thermal relay 1 (EoL1)
23: Electronics thermal relay 2 (EoL2)
24: Motor PTC overheat (oH3) (PTC)
25: Reserved
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Low current (uC)
29: Home limit error (LMIT)
30: Memory write-in error (cF1)
31: Memory read-out error (cF2)
32: Reserved
33: U-phase current detection error (cd1)
34: V-phase current detection error (cd2)
35: W-phase current detection error (cd3)
36: Clamp current detection error (HdO)
37: Over-current detection error (Hd1)
38: Over-voltage detection error (Hd2)
39: occ IGBT short circuit detection error (Hd3)
40: Auto tuning error (AUE)
41: PID feedback loss (AFE)
42: PG feedback error (PGF1)
43: PG feedback loss (PGF2)

44: PG feedback stall (PGF3)
45: PG slip error (PGF4)
46: PG ref loss (PGr1)
47: PG ref loss (PGr2)
48: Analog current input loss (ACE)
49: External fault input (EF)
50: Emergency stop (EF1)
51: External Base Block (bb)
52: Password error (PcodE)
53: Reserved
54: Communication error (CE1)
55: Communication error (CE2)
56: Communication error (CE3)
57: Communication error (CE4)
58: Communication Time-out (CE10)
59: PU Time-out (CP10)
60: Brake transistor error (bF)
61: Y-connection/ $\triangle$-connection switch error (ydc)
62: Decel. Energy Backup Error (dEb)
63: Slip error (oSL)
64: Electromagnet switch error (ryF)
65 : PG Card Error (PGF5)
66-72: Reserved
73: External safety gate S1
74~78: Reserved
79: Uocc U phase over current (Detection begins as RUN is pressed, software protection)
80: Vocc $V$ phase over current (Detection begins as RUN is pressed, software protection)
81: Wocc W phase over current (Detection begins as RUN is pressed, software protection)
82: OPHL U phase output phase loss
83: OPHL Vphase output phase loss
84: OPHL Wphase output phase loss
85~100: Reserved
101: CGdE CANopen software disconnect1
102: CHbE CANopen software disconnect2
103: CSYE CANopen synchronous error
104: CbFE CANopen hardware disconnect
105: CIdE CANopen index setting error
106: CAdE CANopen slave station number setting error
107: CFrE CANopen index setting exceed limit
108~110: Reserved

111: InrCOM Internal communication overtime error
(1) When the fault occurs and force stopping, it will record in this parameter.
[D] At stop with low voltage Lv (LvS warn, no record). During operation with mid-low voltage Lv (LvA, Lvd, Lvn error, will record).

Lad Setting 62: when dEb function is enabled, the drive will execute dEb and record to the Pr.06-17 to Pr.06-22 simultaneously.

Fault Output Option 1
Fault Output Option 2
Fault Output Option 3
Fault Output Option 4
Factory Setting: 0
Settings 0 to 65535 sec (refer to bit table for fault code)
$\square \boxtimes$ These parameters can be used with multi-function output (set to 35-38) for the specific requirement. When the fault occurs, the corresponding terminals will be activated (It needs to convert binary value to decimal value to fill in Pr.06-23 to Pr.06-26).

| Fault Code | Bit0 | Bit1 | Bit2 | Bit3 | Bit4 | Bit5 | Bit6 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | current | Volt. | OL | SYS | FBK | EXI | CE |
| 0: No fault |  |  |  |  |  |  |  |
| 1: Over-current during acceleration (ocA) | $\bullet$ |  |  |  |  |  |  |
| 2: Over-current during deceleration (ocd) | $\bullet$ |  |  |  |  |  |  |
| 3: Over-current during constant speed(ocn) | $\bullet$ |  |  |  |  |  |  |
| 4: Ground fault (GFF) | $\bullet$ |  |  |  |  |  |  |
| 5: IGBT short-circuit (occ) | $\bullet$ |  |  |  |  |  |  |
| 6: Over-current at stop (ocS) | $\bullet$ |  |  |  |  |  |  |
| 7: Over-voltage during acceleration (ovA) |  | $\bullet$ |  |  |  |  |  |
| 8: Over-voltage during deceleration (ovd) |  | $\bullet$ |  |  |  |  |  |
| 9: Over-voltage during constant speed (ovn) |  | $\bullet$ |  |  |  |  |  |
| 10: Over-voltage at stop (ovS) |  | $\bullet$ |  |  |  |  |  |
| 11: Low-voltage during acceleration (LvA) |  | $\bullet$ |  |  |  |  |  |
| 12: Low-voltage during deceleration (Lvd) |  | $\bullet$ |  |  |  |  |  |
| 13: Low-voltage during constant speed (Lvn) |  | $\bullet$ |  |  |  |  |  |
| 14: Stop mid-low voltage (LvS ) |  | $\bullet$ |  |  |  |  |  |
| 15: Phase loss protection (OrP) |  |  |  |  |  |  |  |
| 16: IGBT over-heat (oH1) |  |  |  |  |  |  |  |
| 17: Capacitance over-heat (oH2) |  |  |  |  |  |  |  |
| 18: tH1o (TH1 open) |  |  |  |  |  |  |  |
| 19: tH2o (TH2 open) |  |  |  |  |  |  |  |
| 20: Reserved |  |  |  |  |  |  |  |
| 21: Drive over-load (oL) |  |  |  |  |  |  |  |
| 22: Electronics thermal relay 1 (EoL1) |  |  |  |  |  |  |  |


| Fault Code | Bit0 | Bit1 | Bit2 | Bit3 | Bit4 | Bit5 | Bit6 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | current | Volt. | OL | SYS | FBK | EXI | CE |
| 23: Electronics thermal relay 2 (EoL2) |  |  | $\bullet$ |  |  |  |  |
| 24: Motor PTC overheat (oH3) (PTC) |  |  | $\bullet$ |  |  |  |  |
| 25: Reserved |  |  |  |  |  |  |  |
| 26: Over-torque 1 (ot1) |  |  | $\bullet$ |  |  |  |  |
| 27: Over-torque 2 (ot2) |  |  | $\bullet$ |  |  |  |  |
| 28: Low current (uC) | - |  |  |  |  |  |  |
| 29: Home limit error (LMIT) |  |  |  |  |  | - |  |
| 30: Memory write-in error (cF1) |  |  |  | $\bullet$ |  |  |  |
| 31: Memory read-out error (cF2) |  |  |  | $\bullet$ |  |  |  |
| 32: Reserved |  |  |  |  |  |  |  |
| 33: U-phase current detection error (cd1) |  |  |  | - |  |  |  |
| 34: V-phase current detection error (cd2) |  |  |  | $\bullet$ |  |  |  |
| 35: W-phase current detection error (cd3) |  |  |  | $\bullet$ |  |  |  |
| 36: Clamp current detection error (Hd0) |  |  |  | $\bullet$ |  |  |  |
| 37: Over-current detection error (Hd1) |  |  |  | - |  |  |  |
| 38: Over-voltage detection error (Hd2) |  |  |  | - |  |  |  |
| 39: occ IGBT short circuit detection error (Hd3) |  |  |  | $\bullet$ |  |  |  |
| 40: Auto tuning error (AUE) |  |  |  | - |  |  |  |
| 41: PID feedback loss (AFE) |  |  |  |  | - |  |  |
| 42: PG feedback error (PGF1) |  |  |  |  | - |  |  |
| 43: PG feedback loss (PGF2) |  |  |  |  | $\bullet$ |  |  |
| 44: PG feedback stall (PGF3) |  |  |  |  | $\bullet$ |  |  |
| 45: PG slip error (PGF4) |  |  |  |  | - |  |  |
| 46: PG ref loss (PGr1) |  |  |  |  | $\bullet$ |  |  |
| 47: PG ref loss (PGr2) |  |  |  |  | - |  |  |
| 48: Analog current input loss (ACE) |  |  |  |  | - |  |  |
| 49: External fault input (EF) |  |  |  |  |  | - |  |
| 50: Emergency stop (EF1) |  |  |  |  |  | - |  |
| 51: External Base Block (bb) |  |  |  |  |  | - |  |
| 52: Password error (PcodE) |  |  |  | $\bullet$ |  |  |  |
| 53: Reserved |  |  |  |  |  |  |  |
| 54: Communication error (CE1) |  |  |  |  |  |  | $\bullet$ |
| 55: Communication error (CE2) |  |  |  |  |  |  | $\bullet$ |
| 56: Communication error (CE3) |  |  |  |  |  |  | - |
| 57: Communication error (CE4) |  |  |  |  |  |  | $\bullet$ |
| 58: Communication Time-out (CE10) |  |  |  |  |  |  | $\bullet$ |
| 59: PU Time-out (CP10) |  |  |  |  |  |  | - |
| 60: Brake transistor error (bF) |  |  |  |  |  | - |  |


| Fault Code | Bit0 | Bit1 | Bit2 | Bit3 | Bit4 | Bit5 | Bit6 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | current | Volt． | OL | SYS | FBK | EXI | CE |
| 61：Y－connection／$\triangle$－connection switch error <br> （ydc） |  |  |  |  |  | $\bullet$ |  |
| 62：Decel．Energy Backup Error（dEb） |  |  |  |  |  |  |  |
| 63：Slip error（oSL） |  | $\bullet$ |  |  |  |  |  |
| 64：Electromagnet switch error（ryF） |  |  |  |  |  | $\bullet$ |  |
| 65：PG Card Error（PGF5） |  |  |  |  |  | $\bullet$ |  |
| 66－72：Reserved |  |  |  |  |  | $\bullet$ |  |
| 73：External safety gate S1 |  |  |  |  |  |  |  |
| 74～78：Reserved |  |  |  | $\bullet$ |  |  |  |
| 79：U phase over current（Uocc） |  |  |  |  |  |  |  |
| 80：V phase over current（Vocc） | $\bullet$ |  |  |  |  |  |  |
| 81：W phase over current（Wocc） | $\bullet$ |  |  |  |  |  |  |
| 82：OPHL U phase output phase loss | $\bullet$ |  |  |  |  |  |  |
| 83：OPHL Vphase output phase loss | $\bullet$ |  |  |  |  |  |  |
| 84：OPHL Wphase output phase loss | $\bullet$ |  |  |  |  |  |  |
| 85～100：Reserved |  |  |  |  |  |  |  |
| 101：CGdE CANopen software disconnect1 |  |  |  |  |  |  | $\bullet$ |
| 102：CHbE CANopen software disconnect2 |  |  |  |  |  |  | $\bullet$ |
| 103：CSYE CANopen synchronous error |  |  |  |  |  |  | $\bullet$ |
| 104：CbFE CANopen hardware disconnect |  |  |  |  |  |  | $\bullet$ |
| 105：CldE CANopen index setting error |  |  |  |  |  |  | $\bullet$ |
| 106：CAdE CANopen slave station number |  |  |  |  |  |  |  |
| setting error |  |  |  |  |  |  |  |

Factory Setting： 0
Settings 0 ：Warn and keep operating
1：Warn and ramp to stop
2：Warn and coast to stop
3：No warning
（1）Pr．06－29 setting defines how the will drive operate after PTC detection．再補充 03－00 d6

Settings 0．0～100．0\％
Ila It needs to set AVI／ACI／AUI analog input function Pr．03－00～03－02 to 6 （P．T．C．thermistor input value）．

In It is used to set the PTC level, and the corresponding value for $100 \%$ is max. analog input value.

## 75-3 1 Frequency Command for Malfunction

Factory Setting: Read only
Settings $\quad 0.00 \sim 655.35 \mathrm{~Hz}$
1 When malfunction occurs, use can check the frequency command. If it happens again, it will overwrite the previous record.

## E5-32 <br> Output Frequency at Malfunction

Factory Setting: Read only
Settings $\quad 0.00 \sim 655.35 \mathrm{~Hz}$
$\mathbb{1}$ When malfunction occurs, use can check the current frequency command. If it happens again, it will overwrite the previous record.

## 95-33 Output Voltage at Malfunction

Factory Setting: Read only
Settings $0.0 \sim 6553.5 \mathrm{~V}$
1 When malfunction occurs, user can check current output voltage. If it happens again, it will overwrite the previous record.

## 56-34 DC Voltage at Malfunction

Factory Setting: Read only
Settings $0.0 \sim 6553.5 \mathrm{~V}$
1 When malfunction occurs, user can check the current DC voltage. If it happens again, it will overwrite the previous record.

## 56-35 Output Current at Malfunction

Factory Setting: Read only
Settings 0.00~655.35Amp
1 When malfunction occurs, user can check the current output current. If it happens again, it will overwrite the previous record.

## 76-36 IGBT Temperature at Malfunction

Factory Setting: Read only
Settings $0.0 \sim 6553.5^{\circ} \mathrm{C}$
When malfunction occurs, user can check the current IGBT temperature. If it happens again, it will overwrite the previous record.

```
[G5-3]
Capacitance Temperature at Malfunction
Factory Setting: Read only
Settings \(\quad 0.0 \sim 6553.5^{\circ} \mathrm{C}\)
© When malfunction occurs, user can check the current capacitance temperature. If it happens again, it will overwrite the previous record.
```

Settings $0.0 \sim 6553.5^{\circ} \mathrm{C}$
1 When malfunction occurs, user can check the current motor speed in rpm. If it happens again, it will overwrite the previous record.

## 56-39

Torque Command at Malfunction
Factory Setting: Read only
Settings 0~65535
1 When malfunction occurs, user can check the current torque command. If it happens again, it will overwrite the previous record.


Status of Multi-function Input Terminal at Malfunction
Factory Setting: Read only
Settings 0000h~FFFFh

## 75-4i

Status of Multi-function Output Terminal at Malfunction
Factory Setting: Read only
Settings 0000h~FFFFh
11 When malfunction occurs, user can check the status of multi-function input/output terminals. If it happens again, it will overwrite the previous record.

## 156-40 Drive Status at Malfunction

Factory Setting: Read only
Settings 0000H~FFFFh
When malfunction occurs, please check the drive status (communication address 2119H). If malfunction happens again, the previous record will be overwritten by this parameter.

## 50-43 Reserved <br> 55-4 <br> Reserved

75-45 Treatment to Output Phase Loss (OPHL)
Factory Setting: 3
Settings 0: Warn and keep operating
1: Warn and ramp to stop
2: Warn and coast to stop
3: No warning
1 Pr.06-45 defines how the drive will operates when output phase loss occur.

## 56-46 <br> Deceleration Time of Output Phase Loss

Factory Setting:0.500
Settings $0.000 \sim 65.535 \mathrm{sec}$

[^2]
## 56-48

Output phase loss detection function executing time before run
Factory Setting:0.000
Settings $\quad 0.000 \sim 65.535 \mathrm{sec}$
Dal During the run: Any output phase current is smaller than the level of Pr06-47 and starts to count time to surpass Pr06-46

Before the run:
01 When performing output phase loss detection, if any output phase is smaller than the level of Pr06-47 and starts to count time to surpass Pr06-46, that means the motor drive has an output phase loss and the motor drive will follow the setting of Pr06-45.

02 When Pr06-48 = 0 , output phase loss detection before the run is disable.
03 The setting value of Pr06-48 must be larger than the setting of Pr06-46.

## 50-49 Reserved

## 96-59 Reserved

56-5 : Reserved
50-52 Reserved
56-53 Treatment for the detected Input Phase Loss (OrP)
Factory Setting: 0

## Settings 0: warn, ramp to stop <br> 1: warn, coast to stop

[1] Over ripple protection
10 When the DC BUS ripple is bigger than protection level, drive will trip up OrP and depending on how the parameter 06-53 is set to stop.

## 日6-54 <br> Reserved

Derating Protection
Factory Setting: 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

1 Setting 0 :
When the rated current is constant, carrier frequency (Fc) outputted by PWM will auto decrease according to surrounding temperature, overload output current and time. If overload situation is not frequent and only cares the carrier frequency operated with the rated current for a long time and carrier wave changes during short overload, it is recommended to set to 0 .

Refer to the following diagram for the level of carrier frequency. Take VFD007C43A in normal duty as example, surrounding temperature 50 oC with independent installation and UL open-type.
When the carrier frequency is set to 15 kHz , it corresponds to $72 \%$ rated output current. When it outputs higher than the value, it will auto decrease the carrier frequency. If the output is $83 \%$ rated current and the carrier frequency will decrease to 12 kHz . In addition, it will also decrease the carrier frequency when overload. When the carrier frequency is 15 kHz and the current is $120 \%{ }^{*} 72 \%=86 \%$ for a minute, the carrier frequency will decrease to the factory setting.
[1] Setting 1:
It is used for the fixed carrier frequency and prevents the carrier wave changes and motor noise caused by the surrounding temperature and frequent overload.

Refer to the following for the derating level of rated current. Take VFD007C43A in normal duty as example, when the carrier frequency keeps in 15 kHz and the rated current is decreased to $72 \%$, it will have OL protection when the current is $120 \%{ }^{*} 72 \%=86 \%$ for a minute. Therefore, it needs to operate by the curve to keep the carrier frequency.Setting 2 :
It sets the protection method and action to 0 and disables the current limit for the Ratio*160\% of output current in the normal duty and Ratio* $180 \%$ of output current in the heavy duty. The advantage is that it can provide higher output current when the setting is higher than the factory setting of carrier frequency. The disadvantage is that it decreases carrier wave easily when overload.

Derating curve diagram in the normal duty (Pr.00-16=0)


## Derating curve diagram in the heavy duty (Pr.00-16=1)



It should be used with Pr. 00-16 and Pr.00-17 for setting.


## NOTE

※ The mounting clearances stated in the figure is for installing the drive in an open area. To install the drive in a confined space (such as cabinet or electric box), please follow the following three rules: (1) Keep the minimum mounting clearances. (2) Install a ventilation equipment or an air conditioner to keep surrounding temperature lower than operation temperature. (3) Refer to parameter setting and set up Pr. 00-16, Pr.00-17, and Pr. 06-55.
※ The following table shows heat dissipation and the required air volume when installing a single drive in a confined space. When installing multiple drives, the required air volume shall be multiplied by the number the drives.
※ Refer to the chart (Air flow rate for cooling) for ventilation equipment design and selection.
※ Refer to the chart (Power dissipation) for air conditioner design and selection. Minimum mounting clearances:

| Frame | $A(\mathrm{~mm})$ | $B(\mathrm{~mm})$ | $C(\mathrm{~mm})$ | $D(\mathrm{~mm})$ |
| :---: | :---: | :---: | :---: | :---: |
| A~C | 60 | 30 | 10 | 0 |
| D~F | 100 | 50 | - | 0 |
| G | 200 | 100 | - | 0 |
| H | 350 | 0 | 0 | $200\left(100, \mathrm{Ta}=40^{\circ} \mathrm{C}\right)$ |


| Air flow rate for cooling |  |  |  |  |  |  | Power dissipation of AC motor drive |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Model No. | Flow Rate (cfm) |  |  | Flow Rate ( $\mathrm{m}^{3} / \mathrm{hr}$ ) |  |  | Power Dissipation |  |  |
|  | External | Internal | Total | External | Internal | Total | Loss External (Heat sink) | Internal | Total |
| VFD007C23A | - | - | - | - | - | - | 33 | 27 | 61 |
| VFD015C23A | 14 | - | 14 | 24 | - | 24 | 56 | 31 | 88 |
| VFD022C23A | 14 | - | 14 | 24 | - | 24 | 79 | 36 | 115 |
| VFD037C23A | 10 | - | 10 | 17 | - | 17 | 113 | 46 | 159 |
| VFD055C23A | 40 | 14 | 54 | 68 | 24 | 92 | 197 | 67 | 264 |
| VFD075C23A | 66 | 14 | 80 | 112 | 24 | 136 | 249 | 86 | 335 |
| VFD110C23A | 58 | 14 | 73 | 99 | 24 | 124 | 409 | 121 | 529 |
| VFD150C23A | 166 | 12 | 178 | 282 | 20 | 302 | 455 | 161 | 616 |
| VFD185C23A | 166 | 12 | 178 | 282 | 20 | 302 | 549 | 184 | 733 |
| VFD220C23A | 146 | 12 | 158 | 248 | 20 | 268 | 649 | 216 | 865 |
| VFD300C23A/E | 179 | 30 | 209 | 304 | 51 | 355 | 913 | 186 | 1099 |
| VFD370C23A/E | 179 | 30 | 209 | 304 | 51 | 355 | 1091 | 220 | 1311 |
| VFD450C23A/E | 228 | 73 | 301 | 387 | 124 | 511 | 1251 | 267 | 1518 |
| VFD550C23A/E | 228 | 73 | 301 | 387 | 124 | 511 | 1401 | 308 | 1709 |
| VFD750C23A/E | 246 | 73 | 319 | 418 | 124 | 542 | 1770 | 369 | 2139 |
| VFD900C23A/E | 224 | 112 | 336 | 381 | 190 | 571 | 2304 | 484 | 2788 |
| VFD007C43A/E | - | - | - | - | - | - | 33 | 25 | 59 |
| VFD015C43A/E | - | - | - | - | - | - | 45 | 29 | 74 |
| VFD022C43A/E | 14 | - | 14 | 24 | - | 24 | 71 | 33 | 104 |
| VFD037C43A/E | 10 | - | 10 | 17 | - | 17 | 103 | 38 | 141 |
| VFD040C43A/E | 10 | - | 10 | 17 | - | 17 | 116 | 42 | 158 |
| VFD055C43A/E | 10 | - | 10 | 17 | - | 17 | 134 | 46 | 180 |
| VFD075C43A/E | 40 | 14 | 54 | 68 | 24 | 92 | 216 | 76 | 292 |
| VFD110C43A/E | 66 | 14 | 80 | 112 | 24 | 136 | 287 | 93 | 380 |
| VFD150C43A/E | 58 | 14 | 73 | 99 | 24 | 124 | 396 | 122 | 518 |
| VFD185C43A/E | 99 | 21 | 120 | 168 | 36 | 204 | 369 | 138 | 507 |
| VFD220C43A/E | 99 | 21 | 120 | 168 | 36 | 204 | 476 | 158 | 635 |
| VFD300C43A/E | 126 | 21 | 147 | 214 | 36 | 250 | 655 | 211 | 866 |
| VFD370C43A/E | 179 | 30 | 209 | 304 | 51 | 355 | 809 | 184 | 993 |
| VFD450C43A/E | 179 | 30 | 209 | 304 | 51 | 355 | 929 | 218 | 1147 |
| VFD550C43A/E | 179 | 30 | 209 | 304 | 51 | 355 | 1156 | 257 | 1413 |
| VFD750C43A/E | 186 | 30 | 216 | 316 | 51 | 367 | 1408 | 334 | 1742 |
| VFD900C43A/E | 257 | 73 | 330 | 437 | 124 | 561 | 1693 | 399 | 2092 |
| VFD1100C43A/E | 223 | 73 | 296 | 379 | 124 | 503 | 2107 | 491 | 2599 |
| VFD1320C43A/E | 224 | 112 | 336 | 381 | 190 | 571 | 2502 | 579 | 3081 |
| VFD1600C43A/E | 289 | 112 | 401 | 491 | 190 | 681 | 3096 | 687 | 3783 |
| VFD1850C43A/E |  |  | 454 |  |  | 771 |  |  | 4589 |
| VFD2200C43A/E |  |  | 454 |  |  | 771 |  |  | 5772 |
| VFD2800C43A/E |  |  | 769 |  |  | 1307 |  |  | 6381 |
| VFD3150C43A/E |  |  | 769 |  |  | 1307 |  |  | 7156 |
| VFD3550C43A/E |  |  | 769 |  |  | 1307 |  |  | 8007 |
| ※ The required airflow shown in chart is for installing one drive in confined space. <br> ※ When installing the multiple drives, the required air volume should be the required air volume for single drive X the number of the drives. |  |  |  |  |  |  | ※ The heat dissipation shown in the chart is for installing single drive in a confined space. <br> ※ When installing multiple drives, volume of heat dissipation should be the heat dissipated for single drive $X$ the number of the drives. <br> ※ Heat dissipation for each model is calculated by rated voltage, current and default carrier. |  |  |

PT100 Detection Level 1
Factory Setting:5.000
Settings 0.000~10.000V

## I5-57 PT100 Detection Level 2

Factory Setting: 7.000
Settings $0.000 \sim 10.000 \mathrm{~V}$Make sure Pr. 06-57 > Pr.06-56.

## 日6-58

PT100 Level 1 Frequency Protection
Factory Setting: 0.00

## Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$

1 PT100 operation
(1) Use AVI, AUI or $\mathrm{ACI}($ set to $0-10 \mathrm{~V}$ ) for analog voltage input and select PT100 mode.
(2) Choose one of the analog voltage input type: (a)AVI (Pr.03-00=11), (b) AUI (Pr.03-02=11), or (c) ACl (Pr.03-01=11 and Pr.03-29=1).
(3) When using ACl as analog voltage input, set Pr.03-01=11 and Pr.03-29=1. Then switch SW2 to $0-10 \mathrm{~V}$ on the $\mathrm{I} / \mathrm{O}$ control terminal block.
(4) Set Pr.03-23=23 and AFM2 to constant current output. Switch AFM2 (SW2) to 0-20mA on the I/O control terminal block and set constant current output to 9 mA by setting Pr.03-33=45. The AFM2 constant output current is $20 \mathrm{~mA} * 45 \%=9 \mathrm{~mA}$.
(5) Pr.03-33 is for adjusting the constant voltage or constant current of AFM2, the setting range is 0~100.00\%.
(6) There are two types of action level for PT100. The diagram of PT protecting action is shown as below:

(7) PT100 wiring diagram:


Figure 1
(1) When Pr.06-58 $=0.00 \mathrm{~Hz}$, PT100 function is disabled.

## Example:

A PT100 is installed to the drive. If motor temperature reaches $135^{\circ} \mathrm{C}\left(275^{\circ} \mathrm{F}\right)$ or higher, the drive will decrease motor frequency to the setting of Pr.06-58. Motor will operate at this frequency (Pr.06-58) till the motor temperature decreases to $135^{\circ} \mathrm{C}\left(275^{\circ} \mathrm{F}\right)$ or lower. If motor temperature exceeds $150^{\circ} \mathrm{C}\left(302^{\circ} \mathrm{F}\right)$, the motor will decelerate to stop and outputs an ' $\mathrm{OH} 3^{\prime}$ ' warning.

Set up process:

1. Switch AFM2 (SW2) to $0-20 \mathrm{~mA}$ on the I/O control terminal block. (Refer to Figure 1, PT100 wiring diagram)
2. Wiring (Refer to Figure 1, PT100 wiring diagram):

Connect external terminal AFM2 to (+)
Connect external terminal ACM to (-)
Connect external terminals AFM2 and AVI to short-circuit
3. Set Pr. $03-00=11$ or Pr. $03-23=23$ or Pr. $03-33=45 \%(9 \mathrm{~mA})$
4. Refer to RTD temperature and resistance comparison table

Temperature $=135^{\circ} \mathrm{C}$, resistance $=151.71 \Omega$; Input current: 9 mA , Voltage: approximately: 1.37 Vdc Temperature $=150^{\circ} \mathrm{C}$, resistance $=157.33 \Omega$; Input current: 9 mA , Voltage: approximately: 1.42 Vdc
5. Set Pr. $06=56=1.37$ and Pr. $06-58=10 \mathrm{~Hz}$. When RTD temperature increases to $135^{\circ} \mathrm{C}$ or higher, the drive will decelerate to the selected frequency. When Pr.06-58=0, the drive will not run.
6. Set Pr.06-57=1.42 and Pr.06-29=1 (warning and decelerate to stop). When RTD temperature increases to $150^{\circ} \mathrm{C}$ or higher, the drive will decelerate to stop and outputs an 'OH3' warning.


Reserved

## 日6-6日 <br> Software Detection GFF Current Level

Factory Setting: 60.0
Settings 0.0~6553.5 \%

## 18-6 : Software Detection GFF Filter Time

Factory Setting: 0.10
Settings 0.0~6553.5 \%
When the motor drive detects the unbalanced three-phase out current is higher than the setting of Pr06-60, GFF protection will be activated. Then the motor drive will stop outputting.
[1] When 3-phase current output unbalance value has exceeds Pr06-60 setting, drive will trip up GFF and stop output immediately.

## 56-63 <br> Disable Level of dEb

Factory Setting: 180.0/360.0
Settings 230V series: 0.0~220.0 Vic
460V series: 0.0~440.0 Vic


Fault Record 1 (day)
Fault Record 2 (day)
Fault Record 3 (day)
Fault Record 4 (day)
Factory Setting: Read only
Settings 0~65535 days


Fault Record 1 (min)
Fault Record 2 (min)
Fault Record 3 (min)
Fault Record 4 (min)
Factory Setting: Read only
Settings 0~1439 min

1 Pr.06-63 to Pr.06-68 are used to record the operation time for 6 malfunctions and it can also check if there is any wrong with the drive according to the internal time.
[1] When the malfunction occurs during operation, it records fault in Pr.06-17~06-22 and operation time is recorded in Pr.06-63~06-68.
For example: When the first fault ovA occurs after operation 3000 min., second fault ovd occurs at 3482 min., third fault ovA occurs at 4051 min., fourth fault ocA at 5003 min., fifth fault ocA at 5824 min., sixth fault ocd occurs at 6402 min . and seven fault ocS at 6951 min .
It'll be recorded as the following table:
It will be recorded as the following table:

| First fault | Pr.06-17 ovA |
| :--- | :--- |


| Pr.06-63 3000 | ovA occurs at the 3000 min <br> after operating. |
| :--- | :--- | :--- |


| Second fault | Pr.06-17 | ovd |
| :--- | :---: | :---: |
|  |  |  |
|  | Pr.06-18 | ovA |


| Pr.06-63 | 3482 | $3482-3000=482$ min <br> ovd occurs at 482 min after <br> last fault (ovA) |
| :---: | :---: | :---: |
| Pr.06-64 | 3000 |  |


| Third fault | Pr.06-17 |
| :--- | :--- |
|  |  |


| Pr.06-63 4051 | $4051-3482=569 \mathrm{~min}$ <br> ovA occurs at 569 min after <br> last fault (ovd) |
| :--- | :--- | :--- |


|  | Pr.06-18 |  | Pr.06-64 | 3482 |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Pr.06-19 | ovA | Pr.06-65 | 3000 |  |
| Seven fault | Pr.06-17 | ocS | Pr.06-63 | 12 | (12-5824) $+64800=58988 \mathrm{~min}$ ocS occurs at 58988 min after last fault (ocA) |
|  | Pr.06-18 | ocA | Pr.06-64 | 5824 |  |
|  | Pr.06-19 | ocA | Pr.06-65 | 5003 |  |
|  | Pr.06-20 | ovA | Pr.06-66 | 4051 |  |
|  | Pr.06-21 | ovd | Pr.06-67 | 3482 |  |
|  | Pr.06-22 | ovA | Pr.06-68 | 3000 |  |

## 106-7 Low Current Setting Level

Factory Setting: 0.0
Settings $0.0 \sim 6553.5 \%$

Low Current Detection Time
Factory Setting: 0.00
Settings $\quad 0.00 \sim 655.35 \mathrm{sec}$

## 95-73 <br> Treatment for low current

Factory Setting: 0
Settings 0 : No function
1 : warn and coast to stop
2 : warn and ramp to stop by $2^{\text {nd }}$ deceleration time
3 : warn and operation continue
IId The drive will operate as the setting of Pr.06-73 when output current is lower than the setting of Pr.06-71 and when low current continues for a period longer than the setting of Pr.06-72. This parameter can also be used with external multi-function output terminal 44 (MO44) for low current output.
The low current detection function will not be executed when drive is at sleep or standby status.

BLANK PAGE

## 07 Special Parameters

This parameter can be set during operation.

Factory Setting: 380.0/760.0

| Settings | 230 V series: $350.0 \sim 450.0 \mathrm{Vdc}$ |
| :--- | :--- |
|  | 460 V series: $700.0 \sim 900.0 \mathrm{Vdc}$ |

$\square$ This parameter sets the DC-bus voltage at which the brake chopper is activated. Users can choose the suitable brake resistor to have the best deceleration. Refer to Chapter 7 Accessories for the information of the brake resistor
$\square$ It is only valid for the models below 30 kW of 460 series and 22 kW of 230 series.

## 79-9 : DC Brake Current Level

Factory Setting: 0
Settings 0~100\%
11 This parameter sets the level of DC Brake Current output to the motor during start-up and stopping. When setting DC Brake Current, the Rated Current is regarded as $100 \%$. It is recommended to start with a low DC Brake Current Level and then increase until proper holding torque has been attained.
1 When it is in FOCPG control mode, DC brake is zero-speed operation. It can enable DC brake function by setting to any value. The drive will output an appropriate current to meet the actual need.

N 7-9 DC Brake Time at Start-up
Factory Setting: 0.0
Settings $0.00 \sim 60.0 \mathrm{sec}$
$\mathbb{1}$ The motor may be in the rotation status due to external force or itself inertia. If the drive is used with the motor at this moment, it may cause motor damage or drive protection due to over current. This parameter can be used to output DC current before motor operation to stop the motor and get a stable start. This parameter determines the duration of the DC Brake current after a RUN command. When it is set to 0.0 , it is invalid.

## 77-93 <br> DC Brake Time at Stop

Factory Setting: 0.00
Settings $0.00 \sim 60.00 \mathrm{sec}$
[1] The motor may be in the rotation status after drive stop outputting due to external force or itself inertia and can't stop accurately. This parameter can output DC current to force the motor drive stop after drive stops to make sure that the motor is stop.

1 This parameter determines the duration of the DC Brake current during stopping. To DC brake at stop, this function will be valid when Pr.00-22 is set to 0 or 2 . When setting to 0.0 , it is invalid.Related parameters: Pr.00-22 Stop Method, Pr.07-04 Start-point for DC Brake

## 77-74 Start-Point for DC Brake

Factory Setting: 0.00

## Settings $0.00 \sim 600.00 \mathrm{~Hz}$

[a] This parameter determines the frequency when DC Brake will begin during deceleration. When this setting is less than start frequency (Pr.01-09), the start-point for DC brake will start from the $\min$. frequency.

D. DC Brake at Start-up is used for loads that may move before the AC drive starts, such as fans and pumps. Under such circumstances, DC Brake can be used to hold the load in position before setting it in motion.

DC Brake at stop is used to shorten the stopping time and also to hold a stopped load in position, such as crane or cutting machine.
(1) DC Brake at Start-up is used for loads that may move before the AC drive starts, such as fans and pumps. Under such circumstances, DC Brake can be used to hold the load in position before setting it in motion.
11 DC Brake at stop is used to shorten the stopping time and also to hold a stopped load in position, such as crane or cutting machine.
[7-75Voltage Incrasing Gain
Factory Setting: 100
Settings 1~200\%
When the user is using speed tracking, adjut Pr07-05 to slow down the increasing of voltage if there are errors such as oL or ocv.

## 87-96

Restart after Momentary Power Loss
Factory Setting: 0
Settings 0: Stop operation
1: Speed search for last frequency command
2: Speed search for the minimum output frequency
[1] This parameter determines the operation mode when the AC motor drive restarts from a momentary power loss.

1 The power connected to the drive may power off momentarily due to many reasons. This function allows the drive to keep outputting after power is on again after power off and won't cause drive stops.
[4] Setting 1: Operation continues after momentary power loss, speed search starts with the Master Frequency reference value after drive output frequency and motor rotator speed is synchronous. The motor has the characteristics of big inertia and small obstruction. For example, in the equipment with big inertia wheel, it doesn't need to wait to execute operation command until wheel is complete stop after re-start to save time.
1 Setting 2: Operation continues after momentary power loss, speed search starts with the master frequency after drive output frequency and motor rotator speed is synchronous. The motor has the characteristics of small inertia and bigger obstruction.
[1] In PG control mode, the AC motor drive will execute the speed search function automatically by the PG speed when this setting isn't set to 0 .

## 17-97 Maximum Power Loss Duration

Factory Setting: 2.0
Settings $0.1 \sim 20.0 \mathrm{sec}$
[1] If the duration of a power loss is less than this parameter setting, the AC motor drive will resume operation. If it exceeds the Maximum Allowable Power Loss Time, the AC motor drive output is then turned off (coast stop).
[10] The selected operation after power loss in Pr.07-06 is only executed when the maximum allowable power loss time is $\leq 5$ seconds and the AC motor drive displays "LU".
But if the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is $\leq 5$ seconds, the operation mode as set in Pr.07-06 is not executed. In that case it starts up normally.

Factory Setting: 0.5
Settings $0.1 \sim 5.0 \mathrm{sec}$
$\square$ When momentary power loss is detected, the AC drive will block its output and then wait for a specified period of time (determined by Pr.07-08, called Base-Block Time) before resuming operation. This parameter should be set at a value to ensure that any residual regeneration voltage from the motor on the output has disappeared before the drive is activated again.


B.B. Search with minimum output frequency upward timing chart

B.B. Search with minimum output frequency upward timing chart

## 97-93 Current Limit for Speed Search

Factory Setting: 50

## Settings 20~200\%

1 Fll Following a momentary power loss, the AC motor drive will start its speed search operation only if the output current is greater than the value set by Pr.07-09.
$\square$ When executing speed search, the V/f curve is operated by group 1 setting. The maximum current for the optimum accel./decel. and start speed search is set by Pr.07-09.
1 The speed search level will affect the synchronous time. It will get the synchronization faster when this parameter is set to larger value. But too large value may activate overload protection.

## 67-17

Treatment after Fault
Factory Setting: 0
Settings 0: Stop operation
1: Speed search starts with current speed
2: Speed search starts with minimum output frequency
(1) In PG control mode, the AC motor drive will execute the speed search function automatically by the PG speed when this setting isn't set to 0 .
[a] Fault includes: bb,oc,ov,occ. To restart after oc, ov, occ, Pr.07-11 can not be set to 0 .

## 17- : Auto Restart Time after Fault

Factory Setting: 0
Settings $0 \sim 10$
(1) After fault (oc, ov, occ) occurs, the AC motor drive can be reset/restarted automatically up to 10 times.
[4] Setting this parameter to 0 will disable the reset/restart operation after any fault has occurred. When enabled, the AC motor drive will restart with speed search, which starts at the frequency before the fault.
[0] If the drive execute reset/restart after fault more than the numbers of time set in Pr.07-11 and the limit is reached within the time period in Pr.07-33, the drive will stop execute reset/restart after fault function. User will be need to input RESET manually for the drive to continue operation.

## 17-12 Speed Search during Start-up

Factory Setting: 0

## Settings 0: Disable

1: Speed search from maximum output frequency
2: Speed search from start-up motor frequency
3: Speed search from minimum output frequency
(1) This parameter is used for starting and stopping a motor with a high inertia. A motor with high inertia will take 2-5 minutes or longer to stop completely. By setting this parameter, the user does not need to wait for the motor to come to a complete stop before restarting the AC motor drive. If a PG card and encoder is used on the drive and motor, then the speed search will start from the speed that is detected by the encoder and accelerate quickly to the commanded frequency. The output current is set by the Pr.07-09.
(1) In PG control mode, the AC motor drive will execute the speed search function automatically by the PG speed when this setting isn't set to 0 .

## 17-13

Decel. Time at Momentary Power Loss (dEb function)

## Factory Setting: 0

Settings 0: Disable
1: 1st decel. time
2: 2nd decel. time
3: 3rd decel. time
4: 4th decel. time
5: Current decel. time
6: Auto decel. time
1 This parameter is used for the decel. time selection for momentary power loss.

## 77-14dEb Return Time

Factory Setting: 0.0
Settings $0.0 \sim 25.0 \mathrm{sec}$

1 function is the AC motor drive decelerates to stop after momentary power loss. When the momentary power loss occurs, this function can be used for the motor to decelerate to 0 speed with deceleration stop method. When the power is on again, motor will run again after DEB return time. (has applied on high-speed spindle)

Status 1: Insufficient power supply due to momentary power-loss/unstable power (due to low voltage)/sudden heavy-load


Note (1)When Pr07-14 is set to 0 , the motor drive will stop and will not accelerate to the frequency before dEb even the power is on again. But when Pr07-14 is NOT set to 0 , then a commad of zero speed will be sent to wait for power on.

Note (2) dEb activation level is when DCBUS voltage level is lower than (230V series : Lv level +20Vdc)
(460V series: Lv level +40 Vdc )

Status 2: unexpected power off, such as momentary power loss


## NOTE

For example, in textile machinery, you will hope that all the machines can be decelerated to stop to prevent broken stitching when power loss. In this case, the host controller will send a message to the AC motor drive to use dEb function with deceleration time via EF.

Factory Setting： 0.00
Settings $0.00 \sim 600.00 \mathrm{sec}$
19－16
Dwell Frequency at Accel．
Factory Setting： 0.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
日 7－17
Dwell Time at Decel．
Factory Setting： 0.00
Settings $\quad 0.00 \sim 600.00 \mathrm{sec}$

## 77－18

Dwell Frequency at Decel．
Factory Setting： 0.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$
［1］In the heavy load situation，Dwell can make stable output frequency temporarily，such as crane or elevator．
［⿴囗 Pr．07－15 to Pr．07－18 is for heavy load to prevent OV or OC occurs．


Dwell at accel．／decel．

## 17－19

Fan Cooling Control
Factory Setting： 0
Settings 0：Fan always ON
1： 1 minute after the AC motor drive stops，fan will be OFF
2：When the AC motor drive runs，the fan is ON．When the AC motor drive stops，the fan is OFF
3：Fan turns ON when preliminary heat sink temperature（around $60^{\circ} \mathrm{C}$ ）is attained．
4：Fan always OFF
［a］This parameter is used for the fan control．
（1）Setting 0：Fan will be ON as the drive＇s power is turned ON．
（1）Setting 1： 1 minute after AC motor drive stops，fan will be OFF
（1）Setting 2：AC motor drive runs and fan will be ON．AC motor drive stops and fan will be OFF．
［al Setting 3：Fan run according to IGBT and capacitance temperature．Fan will be ON when preliminary capacitance temperature is higher than 600 C ．Fan will be OFF，when capacitance temperature is lower than 40oC．
（1）Setting 4：Fan is always OFF

## 77-37 <br> Emergency Stop (EF) \& Force Stop

Factory Setting: 0
Settings 0: Coast to stop
1: Stop by $1^{\text {st }}$ deceleration time
2: Stop by $2^{\text {nd }}$ deceleration time
3: Stop by $3^{\text {rd }}$ deceleration time
4: Stop by $4^{\text {th }}$ deceleration time
5: System Deceleration (According to original deceleration time)
6: Automatic Deceleration (Pr01-46)
When the multi-function input terminal is set to 10(EF) or 18(Emergency stop) and is activated, the drive will stop according to the setting in Pr.07-20.

## 

Factory Setting: 0
Settings 0: Disable
1: Enable
When Pr.07-21 is set to 1 , the acceleration and deceleration will operate with full voltage. During constant speed operation, it will auto calculate the best voltage value by the load power for the load. This function is not suitable for the ever-changing load or near full-load during operation.
When the output frequency is constant, i.e. constant operation, the output voltage will auto decrease by the load reduction. Therefore, the drive will operate with min. power, multiplication of voltage and current.

[al FOCPG(IM) control mode:
When drive is running at constant speed and torque current is lower than $35 \%$ of drive rated current, drive will start to count. After 5 seconds, power save function will enable (can max. reduce $30 \%$ of output voltage). Return conditions: torque higher than $50 \%$ of drive rated current.
(1) VF, VFPG, SVC control mode:

When drive is running at constant speed and the $\mathrm{U}, \mathrm{V}, \mathrm{W}$ output power factor angle $\cos ($ phi $)>=65.0^{\circ}$ (Pr00-04 set 5 for monitor power factor angle $\cos ($ phi)), drive will start to do "Power saving enable time counting". After 5 seconds, power save function will enable.
Return conditions: $\left(\cos (\mathrm{phi})<60.0^{\circ}\right)$ or drive is operating at acceleration or deceleration status.

When drive is at FOCPM or FOC sensor-less control mode, this function will be disable.


## Output voltage

 1Output current
Output current<(0.35* Drive rated current)


## 日 7-22

Energy-saving Gain
Factory Setting: 100
Settings 10~1000\%
[1] When Pr. 07-21 is set to 1 , this parameter can be used to adjust the gain of energy-saving. The factory setting is $100 \%$. If the result is not good, it can adjust by decreasing the setting. If the motor oscillates, it should increase the setting value.
[1] At some special application such as High speed spindle, the motor temperature rise is been highly concern. Thus, when the motor is not working with load, the motor current will requested to reduce to a lower level. To Lowering this parameter setting can meet this requirement.

## 77-23 <br> Auto Voltage Regulation(AVR) Function

Factory Setting: 0

## Settings 0: Enable AVR <br> 1: Disable AVR <br> 2: Disable AVR during deceleration

The rated voltage of the motor is usually $220 \mathrm{~V} / 200 \mathrm{VAC} 60 \mathrm{~Hz} / 50 \mathrm{~Hz}$ and the input voltage of the AC motor drive may vary between 180 V to $264 \mathrm{VAC} 50 \mathrm{~Hz} / 60 \mathrm{~Hz}$. Therefore, when the AC motor drive is used without AVR function, the output voltage will be the same as the input voltage. When the motor runs at voltages exceeding the rated voltage with $12 \%-20 \%$, its lifetime will be shorter and it can be damaged due to higher temperature, failing insulation and unstable torque output.
Lad AVR function automatically regulates the AC motor drive output voltage to the motor rated voltage. For instance, if $\mathrm{V} / \mathrm{f}$ curve is set at $200 \mathrm{VAC} / 50 \mathrm{~Hz}$ and the input voltage is at 200 V to 264 VAC , then the motor Output Voltage will automatically be reduced to a maximum of $200 \mathrm{VAC} / 50 \mathrm{~Hz}$. If the input voltage is at 180 V to 200 VAC , output voltage to motor and input power will be in direct proportion.
[】 Setting 0 : when AVR function is enabled, the drive will calculate the output voltage by actual

DC-bus voltage. The output voltage won't be changed by DC bus voltage.
M Setting 1: when AVR function is disabled, the drive will calculate the output voltage by DC-bus voltage. The output voltage will be changed by DC bus voltage. It may cause insufficient/over current.
[al Setting 2: the drive will disable the AVR during deceleration, such as operated from high speed to low speed.
(1) When the motor ramps to stop, the deceleration time is longer. When setting this parameter to 2 with auto acceleration/deceleration, the deceleration will be quicker.
[a] When it is in FOCPG or TQCPG, it is recommended to set to 0 (enable AVR).

## 717-2 Filter Time of Torque Command (V/F and SVC control mode)

Factory Setting: 0.020

$$
\text { Settings } 0.001 \sim 10.000 \mathrm{sec}
$$

1 When the setting is too long, the control will be stable but the control response will be delay. When the setting is too short, the response will be quickly but the control may be unstable. User can adjust the setting by the control and response situation.

## 17-3 Filter Time of Slip Compensation (V/F and SVC control mode)

Factory Setting: 0.100
Settings $0.001 \sim 10.000 \mathrm{sec}$
[1] It can set Pr.05-22 and 05-23 to change the response time of compensation.
凹】 If Pr.05-22 and 05-23 are set to 10seconds, the response time of compensation is the slowest. But the system may be unstable when the setting is too short.

7 7-3 Torque Compensation Gain (V/F and SVC control mode)
Factory Setting: 0
Settings 0~10
[1] When the motor load is large, a part of drive output voltage is absorbed by the resistor of stator winding and causes insufficient voltage at motor induction and result in over output current and insufficient output torque. It can auto adjust output voltage by the load and keep the air gap magnetic fields stable to get the optimal operation.
[1] In the V/F control, the voltage will be decreased in direct proportion when the frequency is decreased. It'll cause decrease torque at low speed due to small AC resistor and the same DC resistor. Therefore, Auto torque compensation function will increase the output voltage in the low frequency to get higher start torque.
[1] When Pr.07-26 is set to large, it may cause motor overflux and result in too large output current, motor overheat or triggers protection function.

Slip Compensation Gain (V/F and SVC control mode)
Factory Setting: 0.00
Settings $0.00 \sim 10.00$
$\square$ The induction motor needs the constant slip to produce magnetic torque. It can be ignore in the higher motor speed, such as rated speed or 2-3\% slip.
$1 \mathbb{1}$ In the operation with variable frequency, the slip and the synchronous frequency will be in reverse
proportion to produce the same magnetic torque. That is the slip will be larger with the reduction of synchronous frequency. The motor may stop when the synchronous frequency is decreased to a specific value. Therefore, the slip serious affects the accuracy of motor speed at low speed.
In In another situation, when the drive uses with induction motor, the slip will be increased by the increasing load. It also affects the accuracy of motor speed.
凹 This parameter can be used to set compensation frequency and reduce the slip to close the synchronous speed when the motor runs in the rated current to raise the drive accuracy. When the drive output current is larger than Pr.05-05 No-load Current of Induction Motor 1 (A), the drive will compensation the frequency by this parameter.
1 When the control method (Pr.00-11) is changed from V/f mode to vector mode, this parameter will auto be set to 1.00 . Otherwise, it will be set to 0.00 . Please do the compensation of slip after overload and acceleration. The compensation value should be increased from small to large gradually. That is to add the output frequency with motor rated slip X Pr.07-27 Slip Compensation Gain when the motor is rated load. If the actual speed ratio is slow than expectation, please increase the setting. Otherwise, decrease the setting.

## 97-3 Slip Deviation Level

## Factory Setting: 0

Settings 0~100.0\%
0 : No detection

Factory Setting:1.0
Settings $0.0 \sim 10.0 \mathrm{sec}$

## 17-3:Over Slip Treatment

Factory Setting:0

| Settings | $0:$ Warn and keep operation |
| :--- | :--- |
|  | 1: Warn and ramp to stop |
|  | 2: Warn and coast to stop |
|  | 3: No warning |

[a] The Pr.07-29 to Pr.07-31 are to set allowable slip level/time and over slip treatment when the drive is running.

## 67-32

Motor Hunting Gain
Factory Setting:1000
Settings 0~10000
0: Disable
The motor will have current wave motion in some specific area. It can improve this situation by setting this parameter. (When it is high frequency or run with PG, it can be set to 0 . when the current wave motion happens in the low frequency, please increase Pr.07-32.)

## [7] 3 ? Recovery Time to Pr.07-11 (\# of automatic reboots after fault)

Factory Setting:60.0
Settings 00~6000.0 sec
[a] When a reset/restart after fault occurs, the drive will regards Pr.07-33 as a time boundary and beging counting the numbers of faults occur within this time period. Within the period, if numbers of faults occurred did not exceed the setting in Pr.07-11, the counting will be cleared and starts from 0 when next fault occurs. However, if the numbers of faults occurred within this time period have exceed the setting in Pr.07-11, user will need to press RESET key manually for the drive to operate again.

## 08 High-function PID Parameters

This parameter can be set during operation.

## 昭-明

Input Terminal for PID Feedback
Factory Setting:0
Settings 0: No function
1: Negative PID feedback: on analogue input acc. To setting 5 of Pr. 03-00 to Pr.03-02.

2: Negative PID feedback from PG card (Pr.10-15, skip direction)
3: Negative PID feedback from PG card (Pr.10-15)
4: Positive PID feedback from external terminal AVI (Pr.03-00)
5: Positive PID feedback from PG card (Pr.10-15, skip direction)
6: Positive PID feedback from PG card (Pr.10-15)
7: Negative PID feeback from communication protocol
8: Positive PID feedback from communication protocol
[1] Negative feedback means: +target value - feedback. It is used for the detection value will be increased by increasing the output frequency.

When Pr.03-00 to Pr.03-02 have the same setting, then the AVI will be the prioritized selection.
[1] Positive feedback means: -target value + feedback. It is used for the detection value will be decreased by increasing the output frequency.
[1] When Pr08-00 $\neq 7$ neither $\neq 8$, input value is disabled. The value of the setting remain the same after the derive is off.

## Common applications for PID control

■ Flow control: A flow sensor is used to feedback the flow data and performs accurate flow control.

च Pressure control: A pressure sensor is used to feedback the pressure data and performs precise pressure control.
$\square \quad$ Air volume control: An air volume sensor is used to feedback the air volume data to have excellent air volume regulation.
■ Temperature control: A thermocouple or thermistor is used to feedback temperature data for comfortable temperature control.
$\square$ Speed control: A speed sensor or encoder is used to feedback motor shaft speed or input another machines speed as a target value for closed loop speed control of master-slave operation. Pr. 10.00 sets the PID set point source (target value).

■ PID control operates with the feedback signal as set by Pr. 10.01 either 0~+10V voltage or 4-20mA current.PID control loop:

(1) Concept of PID control

1. Proportional gain $(P)$ :
the output is proportional to input. With only proportional gain control, there will always be a steady-state error.
2. Integral time(I):
the controller output is proportional to the integral of the controller input. To eliminate the steady-state error, an "integral part" needs to be added to the controller. The integral time decides the relation between integral part and error. The integral part will be increased by time even if the error is small. It gradually increases the controller output to eliminate the error until it is 0 . In this way a system can be stable without steady-state error by 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. The differential control can be used to suppress these effects by acting before the error. That is, when the error is near 0 , the differential control should be 0. Proportional gain(P) + differential control(D) can be used to improve the system state during PID adjustment.
[1] When PID control is used 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 will send the actual value as PID feedback value. After comparing the PID set point and PID feedback, there will be an error. Thus, the PID controller needs to calculate the output by using proportional gain(P), integral time(I) and differential time(D) to control the pump. It controls the drive to have different pump speed and achieves constant pressure control by using a $4-20 \mathrm{~mA}$ signal corresponding to 0-10 bar as feedback to the drive.

4. Pr.00-04 is set to 10 (Display PID analog feedback signal value (b) (\%))
5. Pr.01-12 Acceleration Time will be set as required
6. Pr.01-13 Deceleration Time will be set as required
7. Pr. $00-21=0$ to operate from the digital keypad
8. Pr. $00-20=0$, the set point is controlled by the digital keypad
9. Pr.08-00=1 (Negative PID feedback from analog input)
10. ACI analog input Pr. 03-01 set to 5, PID feedback signal.
11. Pr.08-01-08-03 will be set as required
8.1 If there is no vibration in the system, increase Pr.08-01(Proportional Gain (P))
8.2 If there is no vibration in the system, reduce Pr.08-02(Integral Time (I))
8.3 If there is no vibration in the system, increase Pr.08-03(Differential Time(D))
[1] Refer to Pr.08-00 to 08-21 for PID parameters settings.

## 日昌 - : Proportional Gain (P)

Factory Setting:80.0

## Settings 0.0~500.0\%

- It is used to eliminate the system error. It is usually used to decrease the error and get the faster response speed. But if setting too large value in Pr.08-01, it may cause the system oscillation and instability.
■ If the other two gains (I and D) are set to zero, proportional control is the only one effective.


## -88-42

Integral Time (I)
Factory Setting:1.00
Settings $0.00 \sim 100.00 \mathrm{sec}$
0.00: Disable
[a] The integral controller is used to eliminate the error during stable system. The integral control doesn't stop working until error is 0 . The integral is acted by the integral time. The smaller integral time is set, the stronger integral action will be. It is helpful to reduce overshoot and oscillation to make a stable system. At this moment, the decreasing error will be slow. The integral control is often used with other two controls to become PI controller or PID controller.
$\square \square$ This parameter is used to set the integral time of I controller. When the integral time is long, it will have small gain of I controller, the slower response and bad external control. When the integral time is short, it will have large gain of I controller, the faster response and rapid external control.
(1) When the integral time is too small, it may cause system oscillation.
[1] If the integral time is set as 0.00 , $\mathrm{Pr} .08-02$ will be disabled.

## 98-93 Derivative Control (D)

Factory Setting:0.00
Settings $0.00 \sim 1.00 \mathrm{sec}$
[10] The differential controller is used to show the change of system error and it is helpful to preview the change of error. So the differential controller can be used to eliminate the error to improve system state. With the suitable differential time, it can reduce overshoot and shorten adjustment time. However, the differential operation will increase the noise interference. Please note that too large differential will cause big noise interference. Besides, the differential shows the change and the output of the differential will be 0 when there is no change. Therefore, the differential control can't be used independently. It needs to be used with other two controllers to make a PD controller or PID controller.
[1] This parameter can be used to set the gain of $D$ controller to decide the response of error change. The suitable differential time can reduce the overshoot of P and I controller to decrease the oscillation and have a stable system. But too long differential time may cause system oscillation.
[1] The differential controller acts for the change of error and can't reduce the interference. It is not recommended to use this function in the serious interference.

## 78-94 Upper limit of Integral Control

Factory Setting:100.0
Settings 0.0~100.0\%
[a] This parameter defines an upper bound or limit for the integral gain (I) and therefore limits the Master Frequency. The formula is: Integral upper bound = Maximum Output Frequency (Pr.01-00) $x$ (Pr.08-04 \%).

Ild Too large integral value will make the slow response due to sudden load change. In this way, it may cause motor stall or machine damage.

## 58-85 PID Output Frequency Limit

Factory Setting:100.0
Settings 0.0~110.0\%
[10] This parameter defines the percentage of output frequency limit during the PID control. The formula is Output Frequency Limit $=$ Maximum Output Frequency $(\operatorname{Pr} .01-00) \times$ Pr.08-05 \%.

## 58-5 PID feedback value by communication protocol

Factory Setting: 0.00
Settings $0.00 \sim 200.00 \%$

When setting is 0 , it uses conventional PID control structure.
When setting is 1 , proportional gain, integral gain and derivative gain are independent. The P, I and $D$ can be customized to fit users' demand.
$\llbracket$ Pr.08-07 determines the primary low pass filter time when in PID control. Setting a large time constant may slow down the response rate of drive.
(1) Output frequency of PID control will filter by primary low pass function. This function could filtering a mix frequencies. A long primary low pass time means filter degree is high and vice versa.
凹】 Inappropriate setting of delay time may cause system error.
[1] PI Control: controlled by the P action only, and thus, the deviation cannot be eliminated entirely. To eliminate residual deviations, the $\mathrm{P}+\mathrm{I}$ control will generally be utilized. And when the PI control is utilized, it could eliminate the deviation incurred by the targeted value changes and the constant external interferences. However, if the I action is excessively powerful, it will delay the responding toward the swift variation. The P action could be used solely on the loading system that possesses the integral components.
[a] PD Control: when deviation occurred, the system will immediately generate some operation load that is greater than the load generated single handedly by the $D$ action to restrain the increment of the deviation. If the deviation is small, the effectiveness of the P action will be decreasing as well. The control objects include occasions with integral component loads, which are controlled by the $P$ action only, and sometimes, if the integral component is functioning, the whole system will be vibrating. On such occasions, in order to make the P action's vibration subsiding and the system stabilizing, the PD control could be utilized. In other words, this control is good for use with loadings of no brake functions over the processes.
(1) PID Control: Utilize the I action to eliminate the deviation and the D action to restrain the vibration, thereafter, combine with the P action to construct the PID control. Use of the PID method could obtain a control process with no deviations, high accuracies and a stable system.

Serial connection


Parallel connection


## 88-98

Feedback Signal Detection Time
Factory Setting: 0.0
Settings $0.0 \sim 3600.0 \mathrm{sec}$
Pr.08-08 is valid only for ACI $4-20 \mathrm{~mA}$.This parameter sets the detection time of abnormal PID derative. If detection time is set to 0.0 , detection function is disabled.

Settings 0：Warn and keep operation

1：Warn and ramp to stop

2：Warn and coast to stop

3：Warn and operate at last frequency

凹 This parameter is valid only for $\mathrm{ACl} 4-20 \mathrm{~mA}$ ．
［1］AC motor drive acts when the feedback signals analog PID feedback is abnormal．

Factory Setting： 0.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$
（1）Setting value of Pr08－10 determines if sleep reference and wake－up reference is enable or disable． When Pr08－10＝0，it means disable．When 08－10 $=0$ ，it means enable．

## 78－：：Wake－up Reference

Factory Setting： 0.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
$\square$ When $\operatorname{Pr} 08-18=0$ ，the unit of Pr08－10 and that of Pr08－11 become frequency．The settings then become $0 \sim 600.0 \mathrm{~Hz}$ ．
［10］When Pr08－18＝1，the unit of Pr08－10 and that of Pr08－11 switch to percentage．The settings then switch to 0～200．00\％．
［10］And the percentage is based on the input command not maximum．E．g．If the maximum is 100 Kg ， the command now is 30 kg ，if $08-11=40 \%$ ，it is 12 kg ．
［1］The same to 08－10．

Factory Setting： 0.0
Settings $0.00 \sim 6000.0 \mathrm{sec}$
When the frequency command is smaller than the sleep frequency and less than the sleep time， the frequency command is equal to the sleep frequency．However the frequency command remains at 0.00 Hz until the frequency command becomes equal to or bigger than the wake－up frequency．

## 98－ 3 PID Deviation Level

Factory Setting： 10.0
Settings 1．0～50．0\％
日8－17
PID Deviation Time
Factory Setting： 5.0
Settings $0.1 \sim 300.0 \mathrm{sec}$

Factory Setting： 5.0
Settings $0.1 \sim 300.0 \mathrm{sec}$
When the PID control function is normal，it should calculate within a period of time and close to the
target value.
[1] Refer to the PID control diagram for details. When executing PID feedback control, if |PID reference target value - detection value| > Pr.08-13 PID Deviation Level and exceeds Pr.08-14 setting, the PID control fault occurs. The treatment will be done as Pr.08-09 setting.

## 98-9 <br> PID Compensation Selection

Factory Setting: 0

## Settings 0: Parameter setting (Pr.08-17)

1: ReservedPr08-16=0: PID compensation value is given via Pr08-17 setting.
Pr08-16=1: The PID compensation value is given via analog input(Pr03-00~03-02=13) and display at Pr08-17(at this moment, Pr08-17 become read only).

## 98-17 <br> PID Compensation

Factory Setting: 0
Settings -100.0~+100.0\%
[1] The PID compensation value=Max. PID target value $\times$ Pr08-17. For example, the max. output frequency Pr01-00=60Hz, Pr08-17=10.0\%, PID compensation value will increase output frequency $6.00 \mathrm{~Hz} .60 .00 \mathrm{~Hz} \times 100.00 \% \times 10.0 \%=6.00 \mathrm{~Hz}$

## 日8-18

Setting of Sleep Mode Function
Factory Setting: 0
Settings 0: Follow PID output command
1: Follow PID feedback signal
When Pr08-18=0, the unit of Pr08-10 and that of Pr08-11 becomes frequency. The settings then become 0~600.00Hz.
[4] When Pr08-19=1, the unit of Pr08-10 and that of Pr08-11 switches to percentage. The settings then switch to 0~200.00\%.

## 68-19

Wake-up Integral Limit
Factory Setting: 50.0
Settings 0.0~200.0\%
(1) The wake-up integral limit of the VFD is to prevent sudden high speed running when the VFD wakes up.

The wake-up integral frequency limit=(01-00×08-19\%)
$10]$ The $\operatorname{Pr08-19}$ is used to reduce the reaction time from sleep to wake-up.

Enable PID to Change the Operation Direction
Factory Setting: 0
$\begin{array}{ll}\text { Settings } & 0 \text { : Disable change of direction } \\ & 1 \text {. Enable change of direction }\end{array}$
1: Enable change of direction

Factory Setting： 0.00

$$
\text { Settings } \quad 0.00 \sim 600.00 \mathrm{sec} .
$$

$1 \square$ Refer to Pr08－18 for more information．

## 明－こコ PID Control Bit

Factory Setting： 0.00

$$
\text { Settings Bit0 }=1, \text { PID reverse running must follow the setting of Pr00-23 }
$$

Bit0 $=0$ ，PID reverse running follows PID＇s calculated valueBit0，When Pr08－21＝1，PID reverse running is enable．．Bit0 $=0$ ，if the PID calculated value is positive，it will be forward running．If the PID calculated value is negative，it will be reverse running．

There are three scenarios for sleep and wake－up frequency．
1）Frequency Command（PID is not in use，Pr08－＝00
When the output frequency $\leqq$ the sleep frequency，and the VFD reaches the preset sleep time， then the VFD will be at the sleep mode．
When the frequency command reaches the wake－up frequency，the VFD will start to count the wake－up delay time．Then when the VFD reaches the wake－up delay time，the VFD will begin acceleration time to reach the frequency command．


## 2）Frequency Command Calculation of the Internal PID

When the PID calculation reaches the sleep frequency，the VFD will start to count the sleep time and the output frequency will start to decrease．If the VFD exceeds the preset sleep time，it will directly go to sleep mode which is 0 Hz ．But if the VFD doesn＇t reach the sleep time，it will remain at the lower limit（if there is a preset of lower limit．）．Or it will remain at the lowest output frequency set at Pr01－07 and wait to reach the sleep time then go to sleep mode $(0 \mathrm{~Hz})$ ．
When the calculated frequency command reaches the wake－up frequency，the VFD will start to count the wake－up delay time．Once reaching the wake－up delay time，the VFD will start the acceleration time to reach the PID frequency command．


## 3) PID Feedback Rate Percentage ( Use PID, Pr08-00 $=0$ and Pr08-18=1)

When the PID feedback rate reaches the sleep level percentage, the VFD starts to count the sleep time. The output frequency will also decrease. If the VFD exceeds the preset sleep time, it will go to sleep mode which is 0 Hz . But if the VFD doesn't reach the sleep time, it will remain at the lower limit (if there is a preset of lower limit.). Or it will remain at the lowest output frequency set at Pr01-07 and wait to reach the sleep time then go to sleep mode $(0 \mathrm{~Hz})$.
When PID feedback value reaches the wake up percentagethe motor drive will start to count the wake up delay time. Once reaches the wake up delay time, the motor drives starts the accelerating time to reach PID frequency command


## 09 Communication Parameters

 connects AC drive with PC by using Delta IFD6530 or IFD6500.
$N$ The parameter can be set during the operation.

COM1 Communication Address
Factory Setting: 1
Settings 1~254
[a] If the AC motor drive is controlled by RS-485 serial communication, the communication address for this drive must be set via this parameter and each AC motor drive's communication address must be different

COM1 Transmission Speed
Factory Setting: 9.6
Settings 4.8~115.2Kbits/s
[1] This parameter is for set up the RS485 communication transmission speed.

## -99-83

COM1 Transmission Fault Treatment
Factory Setting: 3
Settings 0 : Warn and keep operation
1: Warn and ramp to stop
2: Warn and coast to stop
3: No warning and continue operation
[a] This parameter is set to how to react if transmission errors occur.

## 89-83

COM1 Time-out Detection
Factory Setting: 0.0
Settings $0.0 \sim 100.0 \mathrm{sec}$
0.0: DisableIt is used to set the communication transmission time-out..
78-94 COM1 Communication Protocol
Factory Setting: 1
Settings 1: 7, N, 2 for ASCII
2: 7, E, 1 for ASCII
3: 7, O, 1 for ASCII
4: 7, E, 2 for ASCII
5: 7, O, 2 for ASCII
6: 8, N, 1 for ASCII
7: 8, N, 2 for ASCII
8: 8, E, 1 for ASCII
9: 8, O, 1 for ASCII

10: 8, E, 2 for ASCII
11: 8, O, 2 for ASCII
12: 8, N, 1 for RTU
13: 8, N, 2 for RTU
14: 8, E, 1 for RTU
15: 8, O, 1 for RTU
16: 8, E, 2 for RTU
17: 8, O, 2 for RTU
(al Control by PC or PLC (Computer Link)
[1] A VFD-C2000 can be set up to communicate on Modbus networks using one of the following modes: ASCII (American Standard Code for Information Interchange) or RTU (Remote Terminal Unit).Users can select the desired mode along with the RS-485 serial port communication protocol in Pr.09-00.
IId MODBUS ASCII (American Standard Code for Information Interchange) : Each byte data is the combination of two ASCII characters. For example, a 1-byte data: 64 Hex , shown as ' 64 ' in ASCII, consists of ' 6 ' (36Hex) and '4' (34Hex).

1. Code Description

Communication protocol is in hexadecimal, ASCII: "0", "9", "A", "F", every 16 hexadecimal represent ASCII code. For example:

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


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

2. Data Format

10-bit character frame (For ASCII):
( $7, \mathrm{~N}, 2$ )

(7, E, 1)

(7, O, 1)

| Start bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Odd parity | Stop bit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 7-data bits <br> 10-bits character frame |  |  |  |  |  |  |

11-bit character frame (For RTU):

3. Communication Protocol

Communication Data Frame: ASCII mode

| STX | Start character $=\because \ddots(3$ AH $)$ |
| :---: | :--- |
| Address Hi | Communication address: |
| Address Lo | 8-bit address consists of 2 ASCII codes |
| Function Hi | Command code: |
| Function Lo | 8-bit command consists of 2 ASCII codes |
| DATA ( $\mathrm{n}-1$ ) | Contents of data: |
| $\ldots \ldots$. | Nx8-bit data consist of 2 n ASCII codes |
| DATA 0 | $\mathrm{n}<=16$, maximum of 32 ASCII codes |
| LRC CHK Hi | LRC check sum: |
| LRC CHK Lo | 8-bit check sum consists of 2 ASCII codes |
| END Hi | End characters: |
| END Lo | END1= CR (0DH), END0 $=$ LF(OAH) |

Communication Data Frame: RTU mode

| START | A silent interval of more than 10 ms |
| :---: | :--- |
| Address | Communication address: 8-bit address |
| Function | Command code: 8-bit command |


| DATA $(\mathrm{n}-1)$ | Contents of data: |
| :---: | :--- |
| $\ldots \ldots .$. |  |
| DATA 0 |  |
| CRC CHK Low |  |
| CRC CHK High | CRC check sum: |
| 16-bit check sum consists of 2 2-bit characters |  |
| END | A silent interval of more than 10 ms |

## Address (Communication Address)

Valid communication addresses are in the range of 0 to 254 . A communication address equal to 0 , means broadcast to all AC drives (AMD). In this case, the AMD will not reply any message to the master device.
00H: broadcast to all AC drives
01 H : AC drive of address 01
OFH: AC drive of address 15
10H: AC drive of address 16
:
FEH: AC drive of address 254

## Function (Function code) and DATA (data characters)

The format of data characters depends on the function code.
03H: read data from register
06 H : write single register
Example: reading continuous 2 data from register address 2102 H, AMD address is 01 H . ASCII mode:

Command Message:

| STX | ':' |
| :---: | :---: |
| Address | '0' |
|  | '1' |
| Function | '0' |
|  | '3' |
| Starting address | '2' |
|  | '1' |
|  | '0' |
|  | '2' |
| Number of data (count by word) | '0' |
|  | '0' |
|  | '0' |
|  | '2' |
| LRC Check | 'D' |
|  | '7' |
| END | CR |
|  | LF |

Response Message

| STX | $\because$ |
| :---: | :---: |
| Address | '0' |
|  | '1' |
| Function | '0' |
|  | '3' |
| Number of data (count by byte) | '0' |
|  | '4' |
| Content of starting address 2102H | '1' |
|  | '7' |
|  | '7' |
|  | '0' |
| Content of address 2103H | '0' |
|  | '0' |
|  | '0' |
|  | '0' |
| LRC Check | '7' |
|  | '1' |
| END | CR |
|  | LF |

RTU mode:

| Command Message: |  | Response Message |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Address | 01 H |  |  |  |
| Function | 03 H | Address | 01 H |  |
| Starting data address | 21 H |  |  |  |
|  | 02 H |  |  |  |
| Number of data | 00 H |  |  |  |
| (count by world) | 02 H | Fumction | 03 H |  |


| CRC CHK Low | 6FH | Content of data | 00H |
| :---: | :---: | :---: | :---: |
| CRC CHK High | F7H | address 2103H | 00H |
|  |  | CRC CHK Low | FEH |
|  |  | CRC CHK High | 5 CH |

06 H : single write, write single data to register.
Example: writing data $6000(1770 \mathrm{H})$ to register 0100 H . AMD address is 01 H .
ASCII mode:

Command Message:

| STX | ' ${ }^{\prime}$ |
| :---: | :---: |
| Address | '0' |
|  | '1' |
| Function | '0' |
|  | '6' |
| Data address | '0' |
|  | '1' |
|  | '0' |
|  | '0' |
| Data content | '1' |
|  | '7' |
|  | '7' |
|  | '0' |
| LRC Check | '7' |
|  | '1' |
| END | CR |
|  | LF |


| STX | ' ${ }^{\prime}$ |
| :---: | :---: |
| Address | '0' |
|  | '1' |
| Function | '0' |
|  | '6' |
| Data address | '0' |
|  | '1' |
|  | '0' |
|  | '0' |
| Data content | '1' |
|  | '7' |
|  | '7' |
|  | '0' |
| LRC Check | '7' |
|  | '1' |
| END | CR |
|  | LF |

RTU mode:
Command Message:

| Address | 01 H |
| :---: | :---: |
| Function | 06 H |
| Data address | 01 H |
|  | 00 H |
| Data content | 17 H |
|  | 70 H |
| CRC CHK High | 86 H |
|  | 22 H |


| Response Message |  |
| :---: | :---: |
| Address | 01 H |
| Function | 06 H |
| Data address | 01 H |
|  | 00 H |
| Data content | 17 H |
|  | 70 H |
| CRC CHK Low | 86 H |
| CRC CHK High | 22 H |

10H: write multiple registers (write multiple data to registers) (at most 20 sets of data can be written simultaneously)
Example: Set the multi-step speed,
Pr. $04-00=50.00(1388 \mathrm{H})$, $\operatorname{Pr} .04-01=40.00$ ( 0 FAOH ). AC drive address is 01 H .
ASCII Mode

| Command Message: |  | Response Message |  |
| :---: | :---: | :---: | :---: |
| STX | $\because$ | STX | $\because$ |
| ADR 1 | '0' | ADR 1 | '0' |
| ADR 0 | '1' | ADR 0 | '1' |
| CMD 1 | '1' | CMD 1 | '1' |
| CMD 0 | '0' | CMD 0 | '0' |
|  | '0' |  | '0' |
| Starting data address | '5' | Starting data address | '5' |
| Starting data address | '0' | Starting data address | '0' |
|  | '0' |  | '0' |
| Number of data | '0' | Number of data | '0' |
| (count by word) | '0' | (count by word) | '0' |
|  | '0' |  | '0' |


|  | '2' |
| :---: | :---: |
| Number of data (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 |


|  | '2' |
| :---: | :---: |
| LRC Check | 'E' |
|  | '8' |
| END | CR |
|  | LF |

RTU mode:
Command Message:
Response Message

| ADR | 01 H |
| :---: | :---: |
| CMD | 10 H |
| Starting data address | 05 H |
| Number of data | 00 H |
| (count by word) | 00 H |
| Number of data | 02 H |
| (count by byte) | 04 |
| The first data content | 13 H |
| The second data content | 88 H |
| CRC Check Low | AFH |
| CRC Check High | AOH |


| ADR |  |
| :---: | :---: |
| CMD 1 | 01 H |
| Starting data address | 10 H |
| Number of data | 05 H |
| (count by word) | 00 H |
| CRC Check Low | 02 H |
| CRC Check High | 41 H |

## Check sum

ASCII mode:
LRC (Longitudinal Redundancy Check) is calculated by summing up, module 256, and the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.
For example,
$01 \mathrm{H}+03 \mathrm{H}+21 \mathrm{H}+02 \mathrm{H}+00 \mathrm{H}+02 \mathrm{H}=29 \mathrm{H}$, the 2 's-complement negation of 29 H is $\underline{\mathrm{D}} \mathrm{H} \mathrm{H}$.
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 with MSB zero filling, then repeat step 3. If the LSB of CRC register is 1 , shift the CRC register one bit to the right with MSB zero filling, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

## Step 5:

Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8 -bit byte will have been processed.

## Step 6:

Repeat step 2 to 5 for the next 8 -bit byte of the command message. Continue doing this until all bytes have been 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, i.e. the lower order byte will be transmitted first.

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

Unsigned char* data $\leftarrow$ a pointer to the message buffer
Unsigned char length $\leftarrow$ 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 \({ }^{\wedge=}\) *data++;
        for( \(\mathrm{j}=0 ; \mathrm{j}<8 ; \mathrm{j}++\) )
        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 | Address | Function |
| :---: | :---: | :---: |
|  | 2211H | The status of digital output (ON/OFF), refer to Pr.02-18 (as Pr. 00-04 NOTE 4) |
|  | 2212H | The multi-step speed that is executing (S) |
|  | 2213H | The corresponding CPU pin status of digital input (d.) (as Pr. 00-04 NOTE 3) |
|  | 2214H | The corresponding CPU pin status of digital output (O.) (as Pr. 00-04 NOTE 4) |
|  | 2215H | Number of actual motor revolution (PG1 of PG card) (P.) it will start from 9 when the actual operation direction is changed or keypad display at stop is 0 . Max. is 65535 |
|  | 2216H | Pulse input frequency (PG2 of PG card)(S.) |
|  | 2217H | Pulse input position (PG card PG2), maximum setting is 65535. |
|  | 2218H | Position command tracing error |
|  | 2219H | Display times of counter overload (0.00~100.00\%) |
|  | 221AH | GFF in \% (G.) |
|  | 221BH | DCbus voltage ripples (Unit: Vdc) (r.) |
|  | 221CH | PLC register D1043 data (C) |
|  | 221DH | Pole of Permanent Magnet Motor |
|  | 221EH | User page displays the value in physical measure |
|  | 221FH | Output Value of Pr.00-05 |
|  | 2220 H | Number of motor tunrns when drive operates (keeping when drive stops, and reset to zero when operation) |
|  | 2221H | Opeartion position of motor (keeping when drive stops, and reset to zero when operation) |
|  | 2222H | Fan speed of the drive (\%) |
|  | 2223H | Control mode of the drive 0: speed mode 1: torque mode |
|  | 2224H | Carrier frequency of the drive |
| Content | Address | Function |
| AC drive Parameters | GGnnH | GG means parameter group, nn means parameter number, for example, the address of $\operatorname{Pr} 4-01$ is 0401 H . |
|  | 2225H | Carrier frequency of the drive |
|  | 2226H | Drive status |
|  | 2227H | Drive's estimated output torque(positive or negative direction) |
|  | 2228 H | Torque command |
|  | 2229H | KWH display |
|  | 222AH | PG2 pulse input in Low Word |
|  | 222BH | PG2 pulse input in High Word |
|  | 222CH | Motor actual position in Low Word |
|  | 222DH | Motor actual position in High Word |
|  | 222EH | PID reference |
|  | 222FH | PID offset |
|  | 2230 H | PID output frequency |

## 5. Exception response:

The AC motor drive is expected to return a normal response after receiving command messages from the master device. The following depicts the conditions when no normal response is replied to the master device.
The AC motor drive does not receive the messages due to a communication error; thus, the AC motor drive has no response. The master device will eventually process a timeout condition. The AC motor drive receives the messages without a communication error, but cannot handle them. An exception response will be returned to the master device and an error message "CExx" will be displayed on the keypad of AC motor drive. The xx of "CExx" is a decimal code equal to the exception code that is described below.

In the exception response, the most significant bit of the original command code is set to 1 , and an exception code which explains the condition that caused the exception is returned.

Example:

| ASCII mode: |  | RTU mode: |  |
| :---: | :---: | :---: | :---: |
| STX | ' ${ }^{\prime}$ | Address | 01H |
| Address | '0' | Function | 86H |
| Address | '1' | Exception code | 02H |
| Function | '8' | CRC CHK Low | C3H |
|  | '6' | CRC CHK High | A1H |
| Exception code | '0' |  |  |
| Exception code | '2' |  |  |
| LRC CHK | '7' |  |  |
| LRC CHK | '7' |  |  |
| END | CR |  |  |
| END | LF |  |  |

The explanation of exception codes:

| Exception <br> code | Explanation |
| :---: | :--- |
| 1 | Illegal data value: <br> The data value received in the command message is not available for the AC drive. |
| 2 | Illegal data address: <br> The data address received in the command message is not available for the AC <br> motor drive. |
| 3 | Parameters are locked: parameters can't be changed |
| 4 | Parameters can't be changed during operation |
| 10 | Communication time-out. |

## 59-95

59-98

## 79-9 Response Delay Time

Factory Setting: 2.0
Settings $0.0 \sim 200.0 \mathrm{~ms}$
[1] This parameter is the response delay time after AC drive receives communication command as shown in the following.


## 日9-沺

Main Frequency of the Communication
Factory Setting: 60.00
Settings $0.00 \sim 600.00 \mathrm{~Hz}$
[1] When Pr.00-20 is set to 1 (RS485 communication). The AC motor drive will save the last frequency command into Pr.09-10 when abnormal turn-off or momentary power loss. After reboots the power, it will regards the frequency set in Pr.09-10 if no new frequency command is inputted.


## Block Transfer 1

Block Transfer 2
Block Transfer 3
Block Transfer 4
Block Transfer 5
Block Transfer 6
Block Transfer 7
Block Transfer 8
Block Transfer 9
Block Transfer 10
Block Transfer 11
Block Transfer 12
Block Transfer 13
Block Transfer 14
Block Transfer 15
Block Transfer 16
Factory Setting: 0
Settings 0~65535
[1] There is a group of block transfer parameter available in the AC motor drive (Pr.09-11 to Pr.09-26). Through communication code 03H, user can use them (Pr.09-11 to Pr.09-26) to save those parameters that you want to read.

## 199-27

~ Reserved
79-93

## 89-30

Communication Decoding Method
Factory Setting: 1
Settings 0: Decoding Method 1
1: Decoding Method 2


Internal Communication Protocol
Factory Setting: 0
Settings 0: Modbus 485
-1: Internal Communication Slave 1
-2: Internal Communication Slave 2
-3: Internal Communication Slave 3
-4: Internal Communication Slave 4
-5 : Internal Communication Slave 5
-6: Internal Communication Slave 6
-7: Internal Communication Slave 7
-8: Internal Communication Slave 8
-9: Reserve
-10: Internal Communication Master
-11: Reserve
-12: Internal PLC Control
[a] When it is defined as internal communication, see $\mathrm{CH} 16-10$ for information on Main Control Terminal of Internal Communication.
[] When it is defined as internal PLC control, see CH16-12 for Remote IO control application ( by using MODRW)

## 199-32

~ Reserved

## 日9-39

## 89-35 PLC Address

Factory Setting: 2
Settings 1~254

## 79-36 CANopen Slave Address

Factory Setting: 0
Settings 0: Disable
1~127

79-37CANopen Speed
Factory Setting: 0
Settings 0:1M
1: 500 k
2: 250k
3: 125k
4: 100k (Delta only)
5: 50k
99-38 ..... Reserved
83-39 CANopen Warning Record
Factory Setting: 0
Settings bit 0: CANopen Guarding Time out
bit 1: CANopen Heartbeat Time out
bit 2: CANopen SYNC Time out
bit 3: CANopen SDO Time out
bit 4: CANopen SDO buffer overflow
bit 5: Can Bus Off
bit 6: Error protocol of CANOPEN
bit 8: The setting values of CANopen indexs are failbit 9 : The setting value of CANopen address is failbit10: The checksum value of CANopen indexs is fail
89-47CANopen Decoding Method
Factory Setting: 1
Settings 0: Delta defined decoding method
1: CANopen Standard DS402 protocol
©9-4: ..... CANopen Status
Factory Setting: 0
Settings 0: Node Reset State
1: Com Reset State
2: Boot up State
3: Pre Operation State
4: Operation State
5: Stop StateSettings 0: Not ready for use state1: Inhibit start state2: Ready to switch on state3: Switched on state
4: Enable operation state
7: Quick stop active state
13: Err reaction activation state
14: Error state

## 69-43 <br> Reset CANopen Index

Factory Setting: 65535
Settings: bit0: reset address 20XX to 0
bit1: reset address 264X to 0
bit2: reset address 26AX to 0
bit3: reset address 60XX to 0

## 89-44

Reserved

## [9-45CANopen Master Function

Factory Setting: 0
Settings 0: Disable
1: Enable

79-46 CANopen Master Address
Factory Setting: 100
Settings 1~127

## 59-47

~ Reserved

## 89-53

53-69
Identifications for Communication Card
Factory Setting: \#\#
Settings 0: No communication card
1: DeviceNet Slave
2: Profibus-DP Slave
3: CANopen Slave/Master
4: Modbus-TCP Slave
5: EtherNet/IP Slave
6~8: Reserved

## 59-6: Firmware Version of Communication Card

Factory Setting: \#\#
Settings Read only

Product Code
Factory Setting: \#\#
Settings Read only
Dad Different communication cards have their own product codes with different value.
DeviceNet: As it connects to different kind of motor drive, it will have different product code.

Profibus: ID number of a communication card. Each Profibus selling in the market must apply for an ID number at the Profibus International to be a unique product.

## 59-59 Fault Code

Factory Setting: \#\#
Settings Read only
[10] For more information about Fault codes, refer to Pr. 06-17~06-22 and Chapter 14.

## 59-64

~ Reserved

## ©9-69

## 93-78

Address of Communication Card
Factory Setting: 1
Settings DeviceNet: 0-63
Profibus-DP: 1-125

## 09-7 7

Setting of DeviceNet Speed (according to Pr.09-72)
Factory Setting: 2
Settings Standard DeviceNet:
0: 125Kbps
1: 250Kbps
2: 500Kbps
Non standard DeviceNet: (Delta only)
0: 10Kbps
1: 20Kbps
2: 50Kbps
3: 100Kbps
4: 125Kbps
5: 250Kbps
6: 500Kbps
7: 800Kbps
8: 1Mbps

Other Setting of DeviceNet Speed
Factory Setting: 0
Settings 0: Disable
1: Enable
[1] It needs to use with Pr.09-71.
(1) Setting 0 : the baud rate can only be set to $0,1,2$ or 3 .
[al Setting 1: setting of DeviceNet baud rate can be the same as CANopen (setting 0-8).

| 79-75 IP Configuration of the Communication Card |  |
| :---: | :---: |
|  | Factory Setting: 0 |
| Settings 0: Static IP |  |
| 1: DynamicIP (DHCP) |  |
| [1] Setting 0: it needs to set IP address manually. |  |
| [1] Setting 1: IP address will be auto set by host controller. |  |
| 75-75 IP Address 1 of the Communication Card |  |
| 59-77 IP Address 2 of the Communication Card |  |
| 75-78 IP Address 3 of the Communication Card |  |
| 59-73 IP Address 4 of the Communication Card |  |

Factory Setting: 0
Settings 0~255
(1) Pr.09-76~09-79 needs to use with communication card.


Address Mask 1 of the Communication Card
Address Mask 2 of the Communication Card
Address Mask 3 of the Communication Card
Address Mask 4 of the Communication Card
Factory Setting: 0
Settings 0~255


Getway Address 1 of the Communication Card
Getway Address 2 of the Communication Card
Getway Address 3 of the Communication Card
Getway Address 4 of the Communication Card
Factory Setting: 0
Settings 0~255

Password for Communication Card (Low word)
Password for Communication Card (High word)
Factory Setting: 0
Settings 0~255
89-90 Reset Communication CardFactory Setting: 0
Settings 0: Disable
1: Reset, return to factory setting
Additional Setting for Communication Card
Factory Setting: 1Settings Bit 0: Enable IP Filter
Bit 1: Internet parameters enable(1bit)When IP address is set up, this bit need to be enabled to write down theparameters. This bit will change to disable when it finishes saving theupdate of internet parameters.
Bit 2: Login password enable(1bit)Enable login password (1bit). This bit will be changed to disable when itfinishes saving the update of internet parameters.

Status of Communication Card
Factory Setting: 0
Settings Bit 0: password enable
When the communication card is set with password, this bit is enabled. When the password is clear, this bit is disabled.

## 10 PID Control

$\wedge$ This parameter can be set during operation.

In this parameter group, ASR is the abbreviation for Adjust Speed Regulator and PG is the abbreviation for Pulse Generator.
1 $\boldsymbol{1}$ - $\boldsymbol{3}$ Encoder Type Selection
Factory Setting: 0
Settings 0: Disable
1: ABZ
2: ABZ (Delta encoder for Delta PM motor)
3: Resolver
4: ABZ/UVW
5. MI8 single phase pulse input

凹 For PG extension card EMC-PG01L and EMC-PG01O, set Pr.10-00=1. These extension cards are for IM motor only.
[1] For EMC-PG01U, when setting Pr.10-00=2 (Delta encoder) make sure SW1 is switched to D (Delta type). If the setting for Pr.10-00, 10-01 and 10-02 has changed, please turn off the drive's power and reboots to prevent PM motor stall. This mode is suggested for PM motor.
띠 For EMC-PG01R, when setting Pr.10-00=3 please also input 1024 ppr.
© For EMC-PG01U, when setting Pr.10-00=4 (Standard ABZ/UVW Encoder) make sure SW1 is switched to S (Standard Type). This mode is applicable for both IM and PM motor.
[1] When using MI8 single phase pulse input as frequency command, the Pr10-02 must set " 5 : Single-phase input". This only can be use with VF, VFPG, SVC, IM FOC Sensor-less, IM TQC Sensor-less control mode.
[a] When using MI8 single phase pulse as speed feedback, the drive must at VFPG control mode only.

## in-i : Encoder Pulse

Factory Setting: 600
Settings 1~20000
(1) A Pulse Generator (PG) or encoder is used as a sensor that provides a feedback signal of the motor speed. This parameter defines the number of pulses for each cycle of the PG control, i.e. the number of pulses for a cycle of A phase/B phase.
1 This setting is also the encoder resolution. With the higher resolution, the speed control will be more accurate.
[0] An incorrect input to Pr.10-00 may result drive over current, motor stall, PM motor magnetic pole origin detection error. If Pr.10-00 setting has changed, please trace the magnetic pole again, set Pr.05-00=4 (static test for PM motor magnetic pole and PG origin again).

## 19-3 Encoder Input Type Setting

Factory Setting: 0
Settings 0: Disable
1: Phase $A$ leads in a forward run command and phase $B$ leads in a reverse run command


2: Phase $B$ leads in a forward run command and phase $A$ leads in a reverse run command


3: Phase $A$ is a pulse input and phase $B$ is a direction input. ( $L$ =reverse direction, $\mathrm{H}=$ forward direction)


4: Phase $A$ is a pulse input and phase $B$ is a direction input. ( $L=$ forward direction, $\mathrm{H}=$ reverse direction)

A


B


5: Single-phase input

A


## 19-3 Output Setting for Frequency Division (denominator)

Factory Setting: 1
Settings 1~255
1 This parameter is used to set the denominator for frequency division (for PG card EMC-PG01L or EMC-PG01O). For example, when it is set to 2 with feedback 1024ppr, PG output will be 1024/2=512ppr.


Factory Setting: 100
Settings 1~65535
[a] Parameters 10-04 to 10-07 can be used with the multi-function input terminal (set to 48) to switch to Pr.10-04~10-05 or Pr.10-06~10-07 as shown as follows


## 19-98 Treatment for Encoder Feedback Fault

Factory Setting: 2
Settings 0 : Warn and keep operating
1: Warn and RAMP to stop
2: Warn and COAST to stop

## 18-89

Detection Time of Encoder Feedback Fault
Factory Setting: 1.0
Settings $0.0 \sim 10.0 \mathrm{sec}$
0 : No function
[10] When encoder loss, encoder signal error, pulse signal setting error or signal error, if time exceeds the detection time for encoder feedback fault (Pr.10-09), the encoder signal error will occur. Refer to the Pr.10-08 for encoder feedback fault treatment.

19-19 Encoder Stall Level
Factory Setting: 115
Settings 0~120\%
0 : No function
[a] This parameter determines the maximum encoder feedback signal allowed before a fault occurs. (Max. output frequency Pr.01-00 =100\%)

## 15-: : Detection Time of Encoder Stall

Factory Setting: 0.1
Settings $0.0 \sim 2.0 \mathrm{sec}$

Treatment for Encoder Stall
Factory Setting: 2
Settings 0 : Warn and keep operation
1: Warn and ramp to stop
2: Warn and coast to stop
When the motor frequency exceeds Pr.10-10 setting and detection time exceeds Pr.10-11, it will operate as Pr. 10-12 setting.

## 19-13 Encoder Slip Range

Factory Setting: 50
Settings 0~50\%
0: Disable

## 19-14 Detection Time of Encoder Slip

Factory Setting: 0.5
Settings $0.0 \sim 10.0 \mathrm{sec}$
Treatment for Encoder Stall and Slip Error
Factory Setting: 2
Settings 0 : Warn and keep operation
1: Warn and ramp to stop
2: Warn and coast to stop
凹】 When the value of (rotation speed - motor frequency) exceeds Pr.10-13 setting, detection time exceeds Pr.10-14; it will start to accumulate time. If detection time exceeds Pr.10-14, the encoder feedback signal error will occur. Refer to Pr.10-15 encoder stall and slip error treatment.

## 17-15 Pulse Input Type Setting (PG card: PG2)

Factory Setting: 0
Settings 0: Disable
1: Phase $A$ leads in a forward run command and phase $B$ leads in a reverse run command


2: Phase $B$ leads in a forward run command and phase $A$ leads in a reverse run command


3: Phase $A$ is a pulse input and phase $B$ is a direction input. (L=reverse direction, $\mathrm{H}=$ forward direction)


4: Phase $A$ is a pulse input and phase $B$ is a direction input. ( $L=$ forward direction, $\mathrm{H}=$ reverse direction)

A

(1) When this setting is different from Pr.10-02 setting and the source of the frequency command is pulse input (Pr.00-20 is set to 4 or 5), it may have 4 times frequency problem.

Example: Assume that Pr.10-01=1024, Pr. 10-02=1, Pr. 10-16=3, Pr.00-20=5, MI=37 and ON, it
needs 4096 pulses to rotate the motor a revolution.
[a] Assume that Pr.10-01=1024, Pr.10-02=1, Pr.10-16=1, Pr.00-20=5, MI=37 and ON, it needs 1024 pulses to rotate the motor a revolution.
[1] Position control diagram


## 1品- ! 7 Electrical Gear A <br> 18-98 Electrical Gear B

Factory Setting: 100
Settings 1~65535
[1] Rotation speed = pulse frequency/encoder pulse (Pr.10-01) * PG Electrical Gear A / PG Electrical Gear B.

## 19-19 Positioning for Encoder Position

Factory Setting: 0
Settings 0~65535 pulse
[】] This parameter determines the internal position in the position mode.
[1] It needs to be used with multi-function input terminal setting $=35$ (enable position control).
[0] When it is set to 0 , it is the Z-phase position of encoder.

## 19-3 Range for Encoder Position Attained

Factory Setting: 10
Settings 0~65535 pulse
This parameter determines the range for internal positioning position attained.
For example:
When the position is set by Pr.10-19 Positioning for Encoder Position and Pr.10-20 is set to 1000, it reaches the position if the position is within 990-1010 after finishing the positioning.

## 19-2 : Filter Time (PG2)

Factory Setting: 0.100
Settings $\quad 0.000 \sim 65.535 \mathrm{sec}$
When Pr.00-20 is set to 5 and multi-function input terminal is set to 37 (OFF), the pulse command will be regarded as frequency command. This parameter can be used to suppress the jump of speed command.

## 19-3 Speed Mode (PG2)

Factory Setting: 0
Settings 0: Electronic Frequency
1: Mechanical Frequency (base on pole pair)

## 19-23 Reserved

19-24 FOC\&TQC Function Control

Settings 0~65535

| Bit\# | Description |
| :--- | :--- |
| 0 | ASR control at sensorless torque <br> 0:use PI as ASR; 1:use P as ASR |
| $1 \sim 10$ | NA |
| 11 | Activate DC braking when executing zero torque command <br> $0:$ ON , 1:OFF |
| 12 | FOC Sensorless mode, cross zero means speed goes from negative to <br> positive or positive to negative (forward to reverse direction or reverse to <br> forward direction). 0: determine by stator frequency, 1: determine by speed <br> command |
| 13 | NA |
| 14 | NA |
| 15 | Direction control at open loop status <br> $0:$ Switch ON direction control 1: Switch OFF direction control |

[1] Except Bit=0 set to be used in closed loop, other Bit settings are for open loop.

## 19-95FOC Bandwidth of Speed Observer

Factory Setting:40.0
Settings $20.0 \sim 100.0 \mathrm{~Hz}$
[1] Setting speed observer to higher bandwidth could shorten the speed response time but will create greater noise interference during the speed observation.

## 19-26 FOC Minimum Stator Frequency

Factory Setting:2.0

## Settings $\quad 0.0 \sim 10.0 \% f N$

[1] This parameter is used to set the minimum level of stator frequency at operation status. This setting ensures the stability and accuracy of observer and avoid interferences from voltage, current and motor parameter.

19-27FOC Low-pass Filter Time Constant
Factory Setting:50
Settings 1~1000ms
[1] This parameter sets the low-pass filter time constant of a flux observer at start up. If the motor can not be activated during the high-speed operation, please lower the setting in this parameter.

Factory Setting:100
Settings 33~100\% Tr (Tr: rotor time constant)
This parameter sets the drive's excitation current rise time when activates at senslorless torque mode. When the drive's activation time is too long at torque mode, please adjust this parameter to a shorter time constant.

## 19-9 Top Limit of Frequency Deviation

Factory Setting: 20.00
Settings $0.00 \sim 100.00 \mathrm{~Hz}$
(1) Pr.10-29 is for setting the maximum of frequency deviation.
[1] When this parameter is set too large, resulting in abnormal PG feedback malfunction.
(1) If customer application require a large $\operatorname{Pr10-29}$ value, resulting in larger output slip, then it is tends to be PG Error (PGF3, PGF4) in such a case. To prevent PGF3 and PGF4 error, set Pr10-10 Encoder Stall Level and to 10-13 Encoder Slip Range to be 0 "No function" (means removing PGF3 and PGF4 detection). But this must only when the PG card connection and application are correct, or prompt PG protection function will be disable. Too large Pr10-29 setting is not a common set.

19-38 Resolver Pole Pair
Factory Setting: 1
Settings 1~50
To use Pr.10-30 function, user must set Pr.10-00=3(Resolver Encoder) first.

## 17-33 Reserved <br> 19-35 Reserved <br> 19-36 Reserved <br> 1是-38 Reserved

19-3:I/F Mode, current command
Factory Setting: 40
Settings $0 \sim 150 \%$ Irated (Rated current $\%$ of the drive)

19-3 PM Sensorless Obeserver Bandwith for High Speed Zone
Factory Setting: 5.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$

18-34 PM Sensorless Observer Low-pass Filter Gain
Factory Setting: 1.00
Settings $\quad 0.00 \sim 655.35 \mathrm{~Hz}$

19-37PM Sensorless Control Word
Factory Setting: 0000
Settings 0000~FFFFh

| Bit No. | Function |  |
| :---: | :--- | :--- |
| 0 | Reserved | Description |
| 1 | Reserved |  |
| 2 | Choose a control mode to <br> statrt. | $0:$ Start by IF mode <br> $1:$ Start by VF mode |
| 3 | Choose a mode to stop . | $0:$ Stop by IF mode <br> $1:$ Stop by VF mode |
| 4 | Reserved | Choose a control mode to stop |
| 5 | O When lower than Pr10-40, coast to stop <br> If lower than Pr10-40, decelerate to stop by VF mode. |  |
| 6 | Reserved |  |
| 7 | Reserved |  |

19-39 Frequency Point when switch from I/F mode to PM Sensorless mode
Factory Setting: 20.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$

17-4 Frequency Point when switch from PM Sensorless Observation mde to I/F mode Factory Setting: 20.00
Settings $\quad 0.00 \sim 600.00 \mathrm{~Hz}$
; $\mathrm{IN}_{1}$ - I/F mode, low pass-filter time
Factory Setting: 0.2
Settings $0.0 \sim 6.0 \mathrm{sec}$
: 9 - 42 Initial Angle Detection Time
Factory Setting: 5
Settings $0 \sim 20 \mathrm{~ms}$
(1) PM Sensorless Adjustment Procedure

1. When using high frequency standstill VFD parameter tuning, use VFD software to monitor adjustment procedure. To download VFD Sotware go to:
http://www.delta.com.tw/product/em/download/download_main.asp?act=3\&pid=1\&cid=1\&tpid=3
2. Testing PM High Frequency Standstill VFD (calculation of Rs, Ld, Lg)

Procedures:
A. Set control mode as VF mode ( $\mathrm{PrO0}-10=0, \mathrm{PrO0}-11=0$
B. Output Frequency of Motor 1 (Pr01-01)
C. Output Voltage of Motor 1 (Pr01-02)
D. Induction Motor and Permanent Magnet Motor Selection (Pr05-33=1)
E. Full-load current of Permanent Magnet Motor(Pr05-34
F. Set Moto Auto Tuning $\operatorname{Pr} 05-00=13$; High frequency and blocked rotor test for PM motor. Then run the drive.
3. Set control mode as PM sensorless Mode (Parameters 00-10=0, 00-11=6)
4. Set VFD Prameters

マ Pr05－35 Rated Power of Permanent Magnet Motor
－Pr05－36 Rated speed of Permanent Magnet Motor
マ Pr05－37 Pole number of Permanent Magnet Motor
च Pr05－38 Inertia of Permanent Magnet Motor
5．Set ASR Parameters
－Pr11－00 bit0＝1：Auto tuning for ASR and APR
च $\operatorname{Pr} 11-02$ ：ASR1／ASR2 Switch Frequency，it is recommended to set $\operatorname{Pr} 10-39$ higher than 10Hz．
$\square$ Pr11－03：ASR1 Low－speed Bandwidth and Pr11－03，ASR2 High－speed Bandwidth．Do not set Low－speed Bandwith too high to avoid dissipation of the estimator．
6．Set speed estimator and speed control＇s parameter．
マ Pr10－39 Frequency when switch from I／F Mode to PM sensorless mode．
－Pr10－32 PM Sensorless Obeserver Bandwith for High Speed Zone

## 7．Zero－load test

च Refer to switch point prodcedure of I／F and FOC as shown in the image below．


## 11 Advanced Parameters

This parameter can be set during operation.
In this parameter group, ASR is the abbreviation for Adjust Speed Regulator

## : 1 - 5 System Control

Factory Setting: 0
Settings 0 : Auto tuning for ASR and APR
1: Inertia estimate (only in FOCPG mode)
2: Zero servo
3: Dead time compensation closed
7: Selection to save or not save the freqeuncy
8: Maximum speed of point to point position control
Bit 0=0: Pr.11-06 to 11-11 will be valid and Pr.11-03~11-05 are invalid.
Bit 0=1: system will generate an ASR setting. At this moment, Pr.11-06~11-11 will be invalid and Pr.11-03~11-05 are valid.

Bit 1=0: no function.
Bit 1=1: Inertia estimate function is enabled. (Bit 1 setting would not activate the estimation process, please set Pr.05-00=12 to begin FOC/TQC Sensorless inertia estimating) Bit 2=0: no function.

Bit 2=1: when frequency command is less than Fmin (Pr.01-07), it will use zero servo function.


(1) Bit $7=0$ : frequency is saved before power turns off. When power turns on again, the display frequency will be the memorized frequency.
Bit 7=1: frequency is not saved before power turns off. When power turns ON again, the display frequency will be 0.00 Hz .

Bit 8=0: maximum speed for point-to-point position control is control by the setting of Pr.11-43.
Bit 8=1: maximum speed for point-to-point position control is control by the multi-step speed setting of the external terminal device. When multi-step speed of the external device is set to 0 , the maximum operation speed will bet the setting of Pr.11-43.

## ; : if Per Unit of System Inertia

Factory Setting: 400
Settings 1~65535 (256=1PU)
10 To get the system inertia from Pr.11-01, user needs to set Pr.11-00 to bit1=1 and execute continuous forward/reverse running.
Unit of induction motor system inertia is $0.001 \mathrm{~kg}-\mathrm{m}^{\wedge} 2$ :

| Power | Setting | Power | Setting |
| :---: | :---: | :---: | :---: |
| 1HP | 2.3 | 20HP | 95.3 |
| 2HP | 4.3 | 25HP | 142.8 |
| 3HP | 8.3 | 30HP | 176.5 |
| 5HP | 14.8 | 40HP | 202.5 |
| 7.5HP | 26.0 | 50 HP | 355.5 |
| 10HP | 35.8 | 60HP | 410.8 |
| 15HP | 74.3 | 75HP | 494.8 |


| Power | Setting |
| :---: | :---: |
| 100 HP | 1056.5 |
| 125 HP | 1275.3 |
| 150 HP | 1900.0 |
| 175 HP | 2150.0 |
| 215 HP | 2800.0 |
| 300 HP | 3550.0 |

The base value for induction motor system inertia is set by Pr.05-38 and the unit is in $0.001 \mathrm{~kg}-\mathrm{m}^{\wedge} 2$.

## : :- $\mathbf{I}^{2}$ ASR1/ASR2 Switch Frequency

Factory Setting: 7.00
Settings $5.00 \sim 600.00 \mathrm{~Hz}$

## : : - 3 ASR1 Low-speed Bandwidth

Factory Setting: 10
Settings $1 \sim 40 \mathrm{~Hz}(\mathrm{IM}) / 1 \sim 100 \mathrm{~Hz}$ (PM)

## : : - 1 - ASR2 High-speed Bandwidth

Factory Setting: 10
Settings $\quad 1 \sim 40 \mathrm{~Hz}(\mathrm{IM}) / 1 \sim 100 \mathrm{~Hz}$ (PM)
1:-95
Zero-speed Bandwidth
Factory Setting: 10
Settings $1 \sim 40 \mathrm{~Hz}$ (IM)/ 1~100Hz (PM)
[1] After estimating inertia and set Pr.11-00 to bit 0=1 (auto tuning), user can adjust parameters Pr.11-03, 11-04 and 11-05 separately by speed response. The larger number you set, the faster response you will get. Pr.11-02 is the switch frequency for low-speed/high-speed bandwidth.
: : - 5 E ASR (Auto Speed Regulation) control (P) 1
Factory Setting: 10
Settings $\quad 0 \sim 40 \mathrm{~Hz}$ (IM)/ 1~100Hz (PM)
; 1 ; ASR (Auto Speed Regulation) control (I) 1
Factory Setting: 0.100
Settings $0.000 \sim 10.000 \mathrm{sec}$
: 1-98 ASR (Auto Speed Regulation) control (PI) 2
Factory Setting: 10
Settings $\quad 0 \sim 40 \mathrm{~Hz}$ (IM)/ 0~100Hz (PM)
: : - 8 ASR (Auto Speed Regulation) control (I) 2
Factory Setting: 0.100
Settings $0.000 \sim 10.000 \mathrm{sec}$
: : 17 ASR(Auto Speed Regulation) Control (P) of Zero Speed
Factory Setting: 10
Settings $\quad 0 \sim 40 \mathrm{~Hz}(\mathrm{IM}) / \mathrm{0} 100 \mathrm{~Hz}$ (PM)
N ! : - ! ASR(Auto Speed Regulation) Control (I) of Zero Speed
Factory Setting: 0.100
Settings $0.000 \sim 10.000 \mathrm{sec}$
: : - $\mathbf{I}^{3}$ Gain for ASR Speed Feed Forward
Factory Setting: 0
Settings $0 \sim 100 \%$
This parameter is used to improve speed response.


Tq Bias

Factory Setting: 30
Settings 0~200\%
[1] After finishing estimating and set Pr.11-00 to bit 0=1 (auto tuning), using Pr. 11-13 to reduce overshoot. Please adjust PDFF gain value by actual situation.

1 This parameter will be invalid when Pr.05-24 is set to 1 .


N i : it Low-pass Filter Time of ASR Output
Factory Setting: 0.008
Settings $0.000 \sim 0.350 \mathrm{sec}$
It is used to set the filter time of ASR command.
i: 15
Notch Filter Depth
Factory Setting: 0
Settings 0~20db
: : - 6 Notch Filter Frequency
Factory Setting: 0.00
Settings $0.00 \sim 200.00 \mathrm{~Hz}$
1 This parameter is used to set resonance frequency of mechanical system. It can be used to suppress the resonance of mechanical system.
[1] The larger number you set Pr.11-15, the better suppression resonance function you will get.
The notch filter frequency is the resonance of mechanical frequency.
Forward Motor Torque Limit
Forward Regenerative Torque Limit
Reverse Motor Torque Limit
Reverse Regenerative Torque Limit
Factory Setting: 500
Settings 0~500\%
[1] The motor drive rated current is $100 \%$. The settings for Pr.11-17 to Pr.11-20 will compare with Pr.03-00=7, 8, 9, 10. The minimum of the comparison result will be torque limit. Please refer the chart as below.
(1) Calculation equation for motor rated torque:

$$
\text { Motor rated torque }=T(N . M)=\frac{P(W)}{\omega(\mathrm{rad} / \mathrm{s})} ; \mathrm{P}(\mathrm{~W}) \text { value= Pr.05-02; }
$$

$$
\omega(\mathrm{rad} / \mathrm{s}) \text { value }=\operatorname{Pr} .05-03 \circ \frac{\mathrm{RPM} \times 2 \pi}{60}=\mathrm{rad} / \mathrm{s}
$$

[1]. FOCPG and FOC sensor-less control mode
The drive rated current $=100 \%$. The setting value of parameters $\operatorname{Pr} 11-17 \sim \operatorname{Pr} 11-20$ will compare to Pr03-00=7, 8,9 and 10. The smallest value will become the torque limit value. Please refer to the torque limit diagram.
$\square$ TQCPG and TQC Sensor-less control mode
The drive rated current $=100 \%$. The setting value of parameters $\operatorname{Pr} 11-17 \sim \operatorname{Pr} 11-20$ will compare to Pr06-12. The smallest value will become the torque limit value.

VF, VFPG and SVC control mode
The Pr11-17~Pr11-20 are output current limit and its $100 \%=$ drive rated current. The smallest value between the Pr11-17~Pr11-20 and Pr06-12 will become output current limit. If the output current has reach this limit during acceleration or normal running, drive will enable "Over current Stall" function. Until the output current drops to limit value, drive can run normally.


[^3]Factory Setting: 90
Settings 0~200\%

## : $\mathbf{I}$ Gain Value of Flux Weakening Curve for Motor 2

Factory Setting: 90
Settings 0~200\%
[1] Pr.11-21 and 11-22 are used to adjust the output voltage of flux weakening curve.
[1] For the spindle application, the adjustment method is

1. It is used to adjust the output voltage when exceeding rated frequency.
2. Monitor the output voltage
3. Adjust Pr.11-21 (motor 1) or Pr.11-22 (motor 2) setting to make the output voltage reach motor rated voltage.
4. The larger number it is set, the larger output voltage you will get.


## : : - 3 Speed Response of Flux Weakening Area

Factory Setting: 65

| Settings | $0:$ Disable |
| :--- | :--- |
|  | $0 \sim 150 \%$ |

It is used to control the speed in the flux weakening area. The larger value is set in Pr.11-23, the faster acceleration/deceleration will generate. In general, it is not necessary to adjust this parameter.

## : : - 4 APR Gain

Factory Setting: 10.00
Settings $\quad 0.00 \sim 40.00$ (IM)/ 0~100.00Hz (PM)
■ Kip gain of internal position is determined by Pr.11-05.
: : - 5 Gain Value of APR Feed Forward
Factory Setting: 30
Settings 0~100
[1] For the position control, if it set a larger value in Pr.11-25, it can shorten the pulse differential and speed up the position response. But it may overshoot.
[】] When the multi-function input terminal is set to $37(\mathrm{ON})$, this parameter can be set as required. If this parameter is set to a non zero value and adjust Pr.10-21 (PG2 Filter Time) to reduce the position overshoot and pulse differential. If it is set to 0 , it won't have overshoot problem in position control but the pulse differential is decided by Pr.11-05 (KP gain).

## 1:-36 <br> APR Curve Time

Factory Setting: 3.00
Settings $0.00 \sim 655.35 \mathrm{sec}$
It is valid when the multi-function input terminal is set to $35(\mathrm{ON})$. The larger it is set, the longer the
position time will be．


## ：1－27Max．Torque Command

Factory Setting： 100

## Settings 0～500\％

［1］The upper limit of torque command is $100 \%$ ．
［1］Calculation equation for motor rated torque：

$$
\begin{aligned}
& \text { motor rated torque: } T(N . M)=\frac{P(\mathrm{~W})}{\omega(\mathrm{rad} / \mathrm{s})} ; \mathrm{P}(\mathrm{~W}) \text { value }=\operatorname{Pr} .05-02 ; \\
& \omega(\mathrm{rad} / \mathrm{s}) \text { value }=\operatorname{Pr} .05-03 \circ \frac{R P M \times 2 \pi}{60}=\mathrm{rad} / \mathrm{s}
\end{aligned}
$$

## ： $\boldsymbol{2} \boldsymbol{8}$ Source of Torque Offset

Factory Setting： 0
Settings 0：Disable
1：Analog input（Pr．03－00）
2：Torque offset setting（Pr．11－29）
3：Control by external terminal（by Pr．11－30 to Pr．11－32）
凹a This parameter is the source of torque offset．
［1］When it is set to 3，source of torque offset would determine Pr．11－30 to Pr．11－32 by
【】 When it is set to 3 ，the source of torque offset will regard Pr．11－30～11－32 by the multi－function input terminals（MI）setting（31， 32 or 33 ）．
N．O．switch status：ON＝contact closed，OFF＝contact open

| Pr．11－32 | Pr．11－31 | Pr．11－30 |  |
| :---: | :---: | :---: | :---: |
| MI＝33（High） | MI＝32（Mid） | MI＝31（Low） | Torque Offset |
| OFF | OFF | OFF | None |
| OFF | OFF | ON | $11-30$ |
| OFF | ON | OFF | $11-31$ |
| OFF | ON | ON | $11-30+11-31$ |
| ON | OFF | OFF | $11-32$ |
| ON | OFF | ON | $11-30+11-32$ |
| ON | ON | OFF | $11-31+11-32$ |
| ON | ON | ON | $11-30+11-31+11-32$ |

## : : - 3 Torque Offset Setting

Factory Setting: 0.0
Settings 0.0~100.0\%
[ad This parameter is torque offset. The motor rated torque is $100 \%$.
© Calculation equation for motor rated torque:

$$
\begin{aligned}
& \text { motor rated torque: } T(N . M)=\frac{P(\mathrm{~W})}{\omega(\mathrm{rad} / \mathrm{s})} ; \mathrm{P}(\mathrm{~W}) \text { value }=\mathrm{Pr} .05-02 \\
& \omega(\mathrm{rad} / \mathrm{s}) \text { value }=\operatorname{Pr} .05-03 \cdot \frac{R P M \times 2 \pi}{60}=\mathrm{rad} / \mathrm{s}
\end{aligned}
$$

## : : 3 High Torque Offset

Factory Setting: 30.0
Settings 0.0~100.0\%
; : 3 i Middle Torque Offset
Factory Setting: 20.0
Settings 0.0~100.0\%
: $\mathbf{i}$ - $\mathbf{3}$ Low Torque Offset
Factory Setting: 10.0
Settings $0.0 \sim 100.0 \%$
(1) When Pr.11-28 is set to 3 , the source of torque offset will regard Pr.11-30, Pr.11-31 and Pr.11-32 by the multi-function input terminals setting (31, 32 or 33 ). The motor rated torque is $100 \%$.
[a] Calculation equation for motor rated torque:

$$
\begin{aligned}
& \text { motor rated torque: } T(N . M)=\frac{P(\mathrm{~W})}{\omega(\mathrm{rad} / \mathrm{s})} ; \mathrm{P}(\mathrm{~W}) \text { value= Pr.05-02; } \\
& \omega(\mathrm{rad} / \mathrm{s}) \text { value }=\operatorname{Pr} .05-03 \cdot \frac{R P M \times 2 \pi}{60}=\mathrm{rad} / \mathrm{s}
\end{aligned}
$$

## : : 33 Source of Torque Command

Factory Setting: 0
Settings 0: Digital Keypad (Pr.11-34)
1: RS485 serial communication
2: Analog signal (Pr.03-00)
3: CANopen
4: Reserved
5: Communication card
[1] When Pr.11-33 is set to 0, torque command can be set in Pr.11-34.
[a] When Pr.11-33 is set to 1 or 2, Pr.11-34 would only display the torque command

## : :-34 Torque Command

Factory Setting: 0.0
Settings -100.0~100.0\%(Pr.11-27=100\%)
$\lfloor[1$ This parameter is for the torque command. When Pr.11-27 is set to $250 \%$ and Pr.11-34 is set to $100 \%$, actual torque command=250X100\%=250\% motor rated torque.The drive will save the setting to the record before power turns off.

## : : 35 Low-pass Filter Time of Torque Command

Factory Setting: 0.000
Settings $0.000 \sim 1.000 \mathrm{sec}$
[1] When the setting is too long, the control will be stable but the control response will be delay. When the setting is too short, the response will be quickly but the control maybe unstable. User can adjust the setting by the control and response situation.

## : : $\mathbf{3 6}$ Speed Limit Selection

## Factory Setting: 0

Settings 0: Set by Pr.11-37 (Forward speed limit) and Pr.11-38 (Reverse speed limit)
1: Set by Pr.11-37,11-38 and Pr.00-20 (Source of Master Frequency Command)
2: Set by Pr.00-20 (Source of Master Frequency Command).
[1] Speed limit function: in TQCPG, when the motor speed is accelerated to speed limit value (Pr.11-36, 11-37 and 11-38), it will switch to speed control mode to stop acceleration.
[a] $\operatorname{Pr} 11-36=1$ :
When the torque command is positive, the forward speed limit is Pr00-20 and reverse speed limit is $\operatorname{Pr} 11-38$.
When the torque command is negative, the forward speed limit is $\operatorname{Pr} 11-37$ and reverse speed limit is $\mathrm{PrO0}-20$.

凹】 Unwind application, Torque command direction is different to motor operating direction, this indicates that the motor is being load dragging. At this moment, the speed limit must be Pr11-37 or Pr11-38. When the torque command direction and speed limit have same direction, the speed limit will refer to the setting of Pr00-20. About the keypad display, please refer to the "LED function Descriptions " in User manual chapter10 "Digital Keypad".


Pr. 11-36=1
When it is reverse running, running direction is limited by Pr. 11-37
reverse running direction is limited by Pr.00-20.

: : 37 Forward Speed Limit (torque mode)
Factory Setting: 10
Settings 0~120\%
1:-38
Reverse Speed Limit (torque mode)
Factory Setting: 10
Settings 0~120\%
[1] These parameters are used in the torque mode to limit the running direction and opposite direction. (Pr.01-00 max. output frequency=100\%)

## : : 39 Zero Torque Command Mode

Factory Setting: 0
Settings 0: Torque mode
1: Speed mode
[a] The drive is running at Torque control mode, Pr11-39 defines the operation mode when torque command=0\%.
When Pr. 11-39 is set as 0 (the torque mode), if torque command is $0 \%$, the motor will produce excitation current but no torque current.

When Pr.11-39 is set as 1 (the speed mode), if torque command is $0 \%$ and speed limit is 0 Hz , the AC motor drive can still produce torque current through speed controller(at this moment, the torque limit is Pr06-12) and the control mode will changed from TQCPG to become FOCPG mode. The motor will have a holding torque.

## : : - 48 Command Source of Point-to-Point Position Control

Factory Settings:0
Settings 0: External terminal
1: Reserved
2: RS485
3: CAN
4: PLC
5: Communication card

## : :- H: Reserved

: : -
Factory Settings: 0000
Settings 0000~FFFFh

| Bit No. | Function | Description |
| :---: | :--- | :--- |
| 0 | At torque mode, selection between |  |
| speed control and current control. | 0:Speed control at torque mode, the largest current <br> limit is the torque command. <br> 1: Speed control at torque mode, P06-12 the largest <br> current limit is Pr06-12 |  |
| 1 | FWD/REV direction control | 0: FWD/REV cannot be controlled by 02-12 bit 0 \& 1 <br> 1: FWD/REV can be controlled by 02-12 bit 0\&1 |
| $2 \sim 15$ | Reserved |  |

: : - 3 Max. Frequency of Point- to-Point Position Control
Factory Settings:10.00
Settings $\quad 0.00 \sim 327.67 \mathrm{~Hz}$
: : - f Accel. Time of Point-to Point Position Control
Factory Settings:1.00
Settings $0.00 \sim 655.35 \mathrm{sec}$
: : - 45 Decel. Time of Point-to Point Position Control
Factory Settings:3.00
Settings $0.00 \sim 655.35 \mathrm{sec}$


## Chapter 13 Warning Codes


(1) Display error signal
(2) Abbreviate error code

The code is displayed as shown on KPC-CE01.
(3) Display error description

| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 1 | Warning ${ }^{\text {CENOD }}$ COMm. Error 1 | Modbus function code error |
| 2 | Warning CE02 Comm. Error 2 | Address of Modbus data is error |
| 3 | Warning CE03 Comm Crror 3 | Modbus data error |
| 4 |  | Modbus communication error |
| 5 | Warning CE10 Como Comm. Error 10 | Modbus transmission time-out |
| 6 |  | Keypad transmission time-out |
| 7 |  | Keypad COPY error 1 <br> Keypad simulation error, including communication delays, communication error (keypad recived error FF86) and parameter value error. |
| 8 | Warning SE2 HaND Save Error 2 | Keypad COPY error 2 <br> Keypad simulation done, parameter write error |
| 9 | Warning <br> oH1 <br> Over heat 1 warn | IGBT over-heating warning |


| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 10 | Warning $\mathrm{oH} 2$ <br> Over heat 2 warn | Capacity over-heating warning |
| 11 | Warning PID PID FBK Error | PID feedback error |
| 12 | Warning ANL Analog Anss | ACl signal error <br> When Pr03-19 is set to 1 and 2 . |
| 13 | Warning <br> uC <br> Under Current | Low current |
| 14 | Warning <br> AUE <br> Auto-tune error | Auto tuning error |
| 15 | Warning PGFB PG FBK Warn | PG feedback error |
| 16 | Warning <br> PGL <br> PG Loss Warn | PG feedback loss |
| 17 | Warning oSPD <br> Over Speed Warn | Over-speed warning |
| 18 | Warning DAvE Deviation Warn | Over speed deviation warning |
| 19 | Warning PHL Phand Phase Loss | Phase loss |
| 20 | Warning <br> ot1 <br> Over Torque 1 | Over torque 1 |
| 21 | Warning <br> ot2 <br> Over Torque 2 | Over torque 2 |


| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 22 | Warning <br> HAND <br> oH3 <br> Motor Over Heat | Motor over-heating |
| 24 | Warning <br> oSL <br> Over Slip Warn | Over slip |
| 25 | Warning tUn AunO Auto tuning | Auto tuning processing |
| 30 | Warning SE3 <br> Copy Model Err 3 | Keypad COPY error 3 <br> Keypad copy between different power range drive |
| 36 | Warning CGdn Guarding T-out | CAN guarding time-out 1 |
| 37 | Warning <br> CHbn <br> Heartbeat T-out | CAN heartbeat time-out 2 |
| 38 |  | CAN synchrony time-out |
| 39 | Warning CbFn Can Bus Off | CAN bus off |
| 40 | Warning CIdn CANO CAN/S Idx exceed | CAN index error |
| 41 | Warning <br> CAdn <br> CAN/S Addres set | CAN station address error |
| 42 | Warning CFrn CAN/S FRAM fail | CAN memory error |
| 43 | Warning CSdn <br> SDO T-out | CAN SDO transmission time-out |


| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 44 | Warning CSbn Buf Overflow | CAN SDO received register overflow |
| 45 | Warning <br> Cbtn <br> Boot up fault | CAN boot up error |
| 46 | Warning $\quad$ CPtn Error Protocol | CAN format error |
| 47 | Warning Plra RTANO RTC Adjust | Adjust RTC |
| 50 | Warning PLod ORND Oposite Defect | PLC download error |
| 51 | Warning <br> PLSv <br> Save mem defect | Save error of PLC download |
| 52 |  | Data error during PLC operation |
| 53 | Warning PLFn Function defect | Function code of PLC download error |
| 54 | Warning <br> PLor <br> Bufovo <br> Bufflow | PLC register overflow |
| 55 | Warning PLFF Funct Function defect | Function code of PLC operation error |
| 56 | Warning PLSn Check sum error | PLC checksum error |
| 57 | Warning <br> PLEd <br> No end command | PLC end command is missing |


| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 58 | Warning <br> PLCr <br> PLC MCR error | PLC MCR command error |
| 59 | Warning <br> PLdF <br> Download fail | PLC download fail |
| 60 | Warning <br> PLSF <br> Scane time fail | PLC scan time exceed |
| 61 | Warning <br> PCGd <br> CAN/M Guard err | CAN Master guarding error |
| 62 | Warning <br> PCbF <br> CAN/M bus off | CAN Master bus off |
| 63 | Warning <br> PCnL <br> CAN/M Node Lack | CAN Master node error |
| 64 | Warning PCCt HaNo CAN/M Cycle Time | CAN/M cycle time-out |
| 65 | Warning PCSF CAN/M SDO over | CAN/M SDOover |
| 66 | Warning PCSd CAN/M Sdo Tout | CAN/M SDO time-out |
| 67 | Warning <br> PCAd <br> CAN/M Addres set | CAN/M station address error |


| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 70 | Warning ECid ExCom ID failed | Duplicate MAC ID error Node address setting error |
| 71 | Warning ${ }^{\text {ERANO }}$ ECLV ExCom pwr loss | Low voltage of communication card |
| 72 | Warning ECtt ExCom Test Mode | Communication card in test mode |
| 73 | Warning ECbF ExCom Bus off | DeviceNet bus-off |
| 74 | Warning ECnP ExCom No power | DeviceNet no power |
| 75 | Warning ECFF ExCom Facty def | Factory default setting error |
| 76 |  | Serious internal error |
| 77 | Warning ECio ExCom IONet brk | IO connection break off |
| 78 |  | Profibus parameter data error |
| 79 | Warning ECPi ExCom Conf data | Profibus configuration data error |
| 80 | Warning ECEF ExCom Link fail | Ethernet Link fail |
| 81 | Warning ECto ExCom Inr T-out | Communication time-out for communication card and drive |


| ID No. | Display on LCM Keypad | Descriptions |
| :---: | :---: | :---: |
| 82 | Warning ECCS <br> ExCom Inr CRC | Check sum error for Communication card and drive |
| 83 | Warning ECrF ExCom Rtn def | Communication card returns to default setting |
| 84 | Warning ECOO ExCom MTCP over | Modbus TCP exceed maximum communication value |
| 85 | Warning ECo1 ExCom EIP over | EtherNet/IP exceed maximum communication value |
| 86 | Warning ECiP ExCom IP fail | IP fail |
| 87 | Warning EC3F ExCom Mail fail | Mail fail |
| 88 | WarningEnND <br> Exby <br> ExCom Busy | Communication card busy |
| 101 |  | Internal communication is off |

## Chapter 14 Fault Codes and Descriptions


(1) Display error signal
(2) Abbreviate error code

The code is displayed as shown on KPC-CE01.
(3) Display error description

* Refer to setting of Pr06-17~Pr06~22.

| ID* | Fault Name | Fault Descriptions | Corrective Actions |
| :---: | :---: | :---: | :---: |
| 1 |  | Over-current during acceleration (Output current exceeds triple rated current during acceleration.) | 1. Short-circuit at motor output: Check for possible poor insulation at the output. <br> 2. Acceleration Time too short: Increase the Acceleration Time. <br> 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model. |
| 2 |  | Over-current during deceleration (Output current exceeds triple rated current during deceleration.) | 1. Short-circuit at motor output: Check for possible poor insulation at the output. <br> 2. Deceleration Time too short: Increase the Deceleration Time. <br> 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model. |
| 3 |  | Over-current during steady state operation (Output current exceeds triple rated current during constant speed.) | 1. Short-circuit at motor output: Check for possible poor insulation at the output. <br> 2. Sudden increase in motor loading: Check for possible motor stall. <br> 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model. |
| 4 |  | Ground fault | When (one of) the output terminal(s) is grounded, short circuit current is more than $50 \%$ of AC motor drive rated current, the AC motor drive power module may be damaged. <br> NOTE: The short circuit protection is provided for AC motor drive protection, not for protecting the user. <br> 1. Check the wiring connections between the $A C$ motor drive and motor for possible short circuits, also to ground. <br> 2. Check whether the IGBT power module damaged. <br> 3. Check for possible poor insulation at the output. |
| 5 | Fault <br> Occ <br> Short Circuit | Short-circuit is detected between upper bridge and lower bridge of the IGBT module | Return to the factory |


| ID* | Fault Name | Fault Descriptions | Corrective Actions |
| :---: | :---: | :---: | :---: |
| 6 | Fault ocS <br> Oc at stop | Hardware failure in current detection | Return to the factory |
| 7 |  | DC BUS over-voltage during acceleration (230V: DC 450V; 460V: DC 900V) | 1. Check if the input voltage falls within the rated $A C$ motor drive input voltage range. <br> 2. Check for possible voltage transients. <br> 3. If DC BUS over-voltage due to regenerative voltage, please increase the acceleration time or add an optional brake resistor. |
| 8 | Fault <br> ovd <br> Ov at decel | DC BUS over-voltage during deceleration (230V: DC 450V; 460V: DC 900V) | 1. Check if the input voltage falls within the rated $A C$ motor drive input voltage range. <br> 2. Check for possible voltage transients. <br> 3. If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor. |
| 9 | Fault <br> ovn <br> Ov at normal SPD | DC BUS over-voltage at constant speed (230V: DC 450V; 460V: DC 900V) | 1. Check if the input voltage falls within the rated $A C$ motor drive input voltage range. <br> 2. Check for possible voltage transients. <br> 3. If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor. |
| 10 |  | Hardware failure in voltage detection | 1. Check if the input voltage falls within the rated $A C$ motor drive input voltage range. <br> 2. Check for possible voltage transients. |
| 11 | Fault LvA Lvand Lvaccel | DC BUS voltage is less than Pr.06-00 during acceleration | 1. Check if the input voltage is normal <br> 2. Check for possible sudden load |
| 12 | Fault <br> Lvd <br> Lvand | DC BUS voltage is less than Pr.06-00 during deceleration | 1. Check if the input voltage is normal <br> 2. Check for possible sudden load |
| 13 | HAND <br> Fault <br> Lvn <br> Lv at normal SPD | DC BUS voltage is less than Pr.06-00 in constant speed | 1. Check if the input voltage is normal <br> 2. Check for possible sudden load |
| 14 |  | DC BUS voltage is less than Pr.06-00 at stop | 1. Check if the input voltage is normal <br> 2. Check for possible sudden load |


| ID* | Fault Name | Fault Descriptions | Corrective Actions |
| :---: | :---: | :---: | :---: |
| 15 | Fault <br> OrP <br> Phase lacked | Phase Loss | Check Power Source Input if all 3 input phases are connected without loose contacts. <br> For models 40 hp and above, please check if the fuse for the $A C$ input circuit is blown. |
| 16 | Fault $\mathrm{oH} 1$ <br> IGBT over heat | IGBT overheating IGBT temperature exceeds protection level | 1. Ensure that the ambient temperature falls within the specified temperature range. <br> 2. Make sure that the ventilation holes are not obstructed. <br> 3. Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins. <br> 4. Check the fan and clean it. <br> 5. Provide enough spacing for adequate ventilation. |
| 17 |  | Heatsink overheating Capacitance temperature exceeds cause heatsink overheating. | 1. Ensure that the ambient temperature falls within the specified temperature range. <br> 2. Make sure heat sink is not obstructed. Check if the fan is operating <br> 3. Check if there is enough ventilation clearance for AC motor drive. |
| 18 | Fault <br> tH1o <br> Thermo 1 open | IGBT Hardware Error | Return to the factory |
| 19 | Fault <br> tH2o <br> Thermo 2 open | Capacitor Hardware Error | Return to the factory |
| 21 |  | Overload <br> The AC motor drive detects excessive drive output current. | 1. Check if the motor is overloaded. <br> 2. Take the next higher power AC motor drive model. |
| 22 | Fault <br> EoL1 <br> Thermal relay 1 | Electronics thermal relay 1 protection | 1. Check the setting of electronics thermal relay (Pr.06-14) <br> Take the next higher power AC motor drive model |
| 23 | Fault <br> EoL2 <br> Thermal relay 2 | Electronics thermal relay 2 protection | 1. Check the setting of electronics thermal relay (Pr.06-28) <br> 2. Take the next higher power AC motor drive model |



| ID* | Fault Name | Fault Descriptions | Corrective Actions |
| :---: | :---: | :---: | :---: |
| 36 | Fault <br> HdO cc HW error | CC (current clamp) | Reboots the power. If fault code is still displayed on the keypad please return to the factory |
| 37 | Fault <br> Hd1 <br> Oc HW error | OC hardware error | Reboots the power. If fault code is still displayed on the keypad please return to the factory |
| 38 | Fault <br> Hd2 Ov HW error | OV hardware error | Reboots the power. If fault code is still displayed on the keypad please return to the factory |
| 39 |  | Occ hardware error | Reboots the power. If fault code is still displayed on the keypad please return to the factory |
| 40 | Fault <br> AUE <br> Auto tuning err | Auto tuning error | 1. Check cabling between drive and motor <br> 2. Try again. |
| 41 | Fault <br> AFE <br> PID Fbk error | PID loss (ACI) | 1. Check the wiring of the PID feedback <br> 2. Check the PID parameters settings |
| 42 | Fault <br> PGF1 <br> PG Fbk error | PG feedback error | Check if encoder parameter setting is accurate when it is PG feedback control. |
| 43 |  <br> Fault <br> PGF2 <br> PG Fbk loss | PG feedback loss | Check the wiring of the PG feedback |
| 44 |  | PG feedback stall | 1. Check the wiring of the PG feedback <br> 2. Check if the setting of PI gain and deceleration is suitable <br> 3. Return to the factory |
| 45 |  | PG slip error | 1. Check the wiring of the PG feedback <br> 2. Check if the setting of PI gain and deceleration is suitable <br> 3. Return to the factory |


| ID* | Fault Name | Fault Descriptions | Corrective Actions |
| :---: | :---: | :---: | :---: |
| 46 | Fault PGr1 <br> PG Ref error | Pulse input error | 1. Check the pulse wiring <br> 2. Return to the factory |
| 47 | Fault <br> PGr2 <br> PG Refloss | Pulse input loss | 1. Check the pulse wiring <br> 2. Return to the factory |
| 48 | Fault <br> ACE <br> AClloss | ACl loss | 1. Check the ACI wiring <br> 2. Check if the ACl signal is less than 4 mA |
| 49 | Fault <br> EF <br> External fault | External Fault | 1. Input EF (N.O.) on external terminal is closed to GND. Output U, V, W will be turned off. <br> 2. Give RESET command after fault has been cleared. |
| 50 |  | Emergency stop | 1. When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output U, V, W and the motor coasts to stop. <br> 2. Press RESET after fault has been cleared. |
| 51 |   Fault <br>    <br> band   <br> Base block   | External Base Block | 1. When the external input terminal (B.B) is active, the $A C$ motor drive output will be turned off. <br> 2. Deactivate the external input terminal (B.B) to operate the AC motor drive again. |
| 52 | Fault <br> Pcod <br> Password error | Password is locked. | Keypad will be locked. Turn the power ON after power OFF to re-enter the correct password. See Pr.00-07 and 00-08. |
| 54 | Fault <br> CE1 <br> PC err command | Illegal function code | Check if the function code is correct (function code must be $03,06,10,63$ ) |
| 55 |  | Illegal data address ( 00 H to 254 H ) | Check if the communication address is correct |
| 56 | Fault <br> CE3 <br> PC err data | Illegal data value | Check if the data value exceeds max./min. value |


| ID* | Fault Name | Fault Descriptions | Corrective Actions |
| :---: | :---: | :---: | :---: |
| 67 | Fault <br> CE4 <br> PC slave fault | Data is written to read-only address | Check if the communication address is correct |
| 58 | Fault <br> CE10 PC time out | Modbus transmission time-out |  |
| 59 |  | Keypad transmission time-out |  |
| 60 | Fault <br> bF Braking fault | Brake resistor fault | If the fault code is still displayed on the keypad after pressing "RESET" key, please return to the factory. |
| 61 | Fault $y d c$ Y-delta connect | Y-connection/ $\Delta$-conn ection switch error | 1. Check the wiring of the $Y$-connection/ $\Delta$-connection <br> 2. Check the parameters settings |
| 62 |  | When Pr.07-13 is not set to 0 and momentary power off or power cut, it will display dEb during accel./decel. stop. | 1. Set Pr. $07-13$ to 0 <br> 2. Check if input power is stable |
| 63 |  | It will be displayed when slip exceeds Pr.05-26 setting and time exceeds Pr.05-27 setting. | 1. Check if motor parameter is correct (please decrease the load if overload <br> 2. Check the settings of Pr.05-26 and Pr.05-27 |
| 64 |  | Electric valve switch error when executing Soft Start. (This warning is for frame E and higher frame of AC drives) <br> Do not disconnect RST when drive is still operating. |  |
| 65 |  | Hardware error of PG Card Check if PG Card is insert to the right slot and parameter settings for encoder are accurate. |  |


| ID* | Fault Name | Fault Descriptions Corrective Actions |
| :---: | :---: | :---: |
| 68 | Fault <br> SdRv <br> SpdFbk Dir Rev | Rotaing direction is different from the commanding direction deteced by the sensorless. <br> Solution <br> Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. |
| 69 | $\begin{aligned} & \text { Fault }{ }^{\text {SdOr }} \\ & \text { SpdFbk over SPD } \end{aligned}$ | Overspeed rotation detected by the sensorless <br> Solution <br> Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. <br> Verify if the gains of the speed circuit is reasonable. |
| 70 | Fault <br> SdDe <br> SpdFbk deviate | Big difference between the rotating speed and the command deteced by the sensorless <br> Solution <br> Verify if the parameter setting of the motor drive is correct Increase the estimator's bandwidth and verify if parameters relating to the sensorless are correct. <br> Verify if the gains of the speed circuit is reasonable. |
| 73 |  | Emergency stop for external safety |
| 79 | Fault <br> Uoc <br> U phase oc | Phase U short circuit |
| 80 |  | Phase V short circuit |
| 81 |  | W phase short circuit |
| 82 | Fault <br> OPHL <br> U phase lacked | Output phase loss (Phase U) |
| 83 |  | Output phase loss (Phase V) |


| ID* | Fault Name | Fault Descriptions $\quad$ Corrective Actions |
| :---: | :---: | :---: |
| 84 | Fault | Output phase loss (Phase W) |
| 90 | Fault <br> Fstp <br> For ce Stop | Internal PLC forced to stop Verify the setting of Pr.00-32 |
| 101 | Fault <br> CGdE <br> Guarding T-out | CANopen guarding error |
| 102 | $\begin{aligned} & \text { Fault } \mathrm{CHbE} \\ & \text { Heartbeat T-out } \end{aligned}$ | CANopen heartbeat error |
| 103 | $\qquad$ | CANopen synchronous error |
| 104 | Fault <br> CbFE <br> Can bus off | CANopen bus off error |
| 105 | Fault <br> CIdE <br> Can bus Index Err | CANopen index error |
| 106 | Fault <br> CAdE <br> Can bus Add. Err | CANopen station address error |
| 107 | Fault <br> CFrE <br> Can bus off | CANopen memory error |
| 111 | Fault $\quad$ rant <br> int <br> InrCom Time Out | Internal communication time-out |

## Chapter 15 CANopen Overview

Newest version is available at http://www.delta.com.tw/industrialautomation/
15.1 CANopen Overview
15.2 Wiring for CANopen
15.3 CANopen Communication Interface Description
15.3.1 CANopen Control Mode Selection
15.3.2 DS402 Standard Control Mode
15.3.3 By using Delta Standard (Old definition, only support speed mode)
15.3.4 By using Delta Standard (New definition)
15.3.5 DI/DO AI AO are controlled via CANopen
15.4 CANopen Supporting Index
15.5 CANopen Fault Code
15.6 CANopen LED Function

## Built-in EMC-COP01 card is included in VFDXXXC23E/VFDXXXC43E models.

The built-in CANopen function is a kind of remote control. Master can control the AC motor drive by using CANopen protocol. CANopen is a CAN-based higher layer protocol. It provides standardized communication objects, including real-time data (Process Data Objects, PDO), configuration data (Service Data Objects, SDO), and special functions (Time Stamp, Sync message, and Emergency message). And it also has network management data, including Boot-up message, NMT message, and Error Control message. Refer to CiA website http://www.can-cia.org/ for details. The content of this instruction sheet may be revised without prior notice. Please consult our distributors or download the most updated version at http://www.delta.com.tw/industrialautomation

## Delta CANopen supporting functions:

Support CAN2.0A Protocol;
■ Support CANopen DS301 V4.02;
■ Support DSP-402 V2.0.

## Delta CANopen supporting services:

■ PDO (Process Data Objects): PDO1~ PDO4
■ SDO (Service Data Object):
Initiate SDO Download;
Initiate SDO Upload;
Abort SDO;
SDO message can be used to configure the slave node and access the Object Dictionary in every node.
■ SOP (Special Object Protocol):
Support default COB-ID in Predefined Master/Slave Connection Set in DS301 V4.02;
Support SYNC service;
Support Emergency service.
■ NMT (Network Management):
Support NMT module control;
Support NMT Error control;
Support Boot-up.

## Delta CANopen not supporting service:

Time Stamp service

### 15.1 CANopen Overview

## CANopen Protocol

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks, such as handling systems. Version 4.02 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).


## RJ-45 Pin Definition



| PIN | Signal | Description |
| :---: | :---: | :--- |
| 1 | CAN_H | CAN_H bus line (dominant high) |
| 2 | CAN_L | CAN_L bus line (dominant low) |
| 3 | CAN_GND | Ground $/ O V / N$ - |
| 6 | CAN_GND | Ground $/ O V / N$ - |

## CANopen Communication Protocol

It has services as follows:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Object)
- EMCY (Emergency Object)

NMT (Network Management Object)
The Network Management (NMT) follows a Master/Slave structure for executing NMT service. Only one NMT master is in a network, and other nodes are regarded as slaves. All CANopen nodes have a present NMT state, and NMT master can control the state of the slave nodes. The state diagram of a node is shown as follows:

(1) After power is applied, it is auto in initialization state
(2) Enter pre-operational state automatically
(3) (6) Start remote node

A: NMT
B: Node Guard
(4) (7) Enter pre-operational state

C: SDO
(5) (8) Stop remote node
(9) (10) (11) Reset node

D: Emergency
(12) (13) (14) Reset communication

E: PDO
(15) Enter reset application state automatically
(16) Enter reset communication state automatically

|  | Initializing | Pre-Operational | Operational | Stopped |
| :---: | :---: | :---: | :---: | :---: |
| PDO |  |  | 0 |  |
| SDO |  | 0 | 0 |  |
| SYNC |  | 0 | 0 |  |
| Time Stamp |  | $\circ$ | 0 |  |
| EMCY |  | 0 | 0 |  |
| Boot-up | $\circ$ |  |  |  |
| NMT |  | 0 | 0 | 0 |

## SDO (Service Data Objects)

SDO is used to access the Object Dictionary in every CANopen node by Client/Server model. One SDO has two COB-ID (request SDO and response SDO) to upload or download data between two nodes. No data limit for SDOs to transfer data. But it needs to transfer by segment when data exceeds 4 bytes with an end signal in the last segment.

The Object Dictionary (OD) is a group of objects in CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path of OD is the index and sub-index, each object has a unique index in OD, and has sub-index if necessary. The request and response frame structure of SDO communication is shown as follows:

## PDO (Process Data Object)

PDO communication can be described by the producer/consumer model. Each node of the network will listen to the messages of the transmission node and distinguish if the message has to be processed or not after receiving the message. PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and a RxPDO. PDOs are transmitted in a non-confirmed mode.

PDO Transmission type is defined in the PDO communication parameter index (1400h for the 1st RxPDO or 1800 h for the 1st TxPDO), and all transmission types are listed in the following table:

| Type Number | PDO |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Cyclic | Acyclic | Synchronous | Asynchronous | RTR only |  |
| 0 |  | $\circ$ | $\circ$ |  |  |  |
| $1-240$ | $\circ$ |  | $\circ$ |  |  |  |
| $241-251$ | Reserved |  |  |  |  |  |
| 252 |  |  | $\circ$ |  | $\circ$ |  |
| 253 |  |  |  | $\circ$ | $\circ$ |  |
| 254 |  |  |  | $\circ$ |  |  |
| 255 |  |  |  | $\circ$ |  |  |

Type number 1-240 indicates the number of SYNC message between two PDO transmissions.
Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.
Type number 253 indicates the data is updated immediately after receiving RTR.
Type number 254: Delta CANopen doesn't support this transmission format.
Type number 255 indicates the data is asynchronous transmission.
All PDO transmission data must be mapped to index via Object Dictionary.

## EMCY (Emergency Object)

When errors occurred inside the hardware, an emergency object will be triggered an emergency object will only be sent when an error is occurred. As long as there is nothing wrong with the hardware, there will be no emergency object to be served as a warning of an error message.

### 15.2 Wiring for CANopen

An external adapter card: EMC-COP01 is used for CANopen wiring to connect CANopen to VFD C2000. The link is enabled by using RJ45 cable. The two farthest ends must be terminated with $120 \Omega$ terminating resistors.


### 15.3 CANopen Communication Interface <br> Description

### 15.3.1 CANopen Control Mode Selection

There are two control modes for CANopen; Pr.09-40 set to 1 is the factory setting mode DS402 standard and Pr.09-40 set to 0 is Delta's standard setting mode.

Actually, there are two control modes according to Delta's standard, one is the old control mode (Pr09-30=0).
This control mode can only control the motor drive under frequency control. Another mode is a new standard (Pr09-30=1)
This new control mode allows the motor drive to be controlled under all sorts of mode.
Currently, C2000 support speed, torque, position and home mode.
The definition of relating control mode are:

| CANopen Control Mode Selection | Control Mode |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Speed |  | Torque |  | Position |  | Home |  |
|  | Index | Description | Index | Description | Index | Description | Index | Description |
| $\begin{gathered} \text { DS402 } \\ \text { standard } \\ \text { Pr. } 09-40=1 \end{gathered}$ | 6042-00 | Target rotating speed (RPM) | 6071-00 | Target Torque (\%) | 607A-00 | Target Position | ----- | ----- |
|  | ----- | ----- | 6072-00 | Max. Torque Limit(\%) | ----- | ----- | ----- | ----- |
| Delta Standard (Old definition) $\begin{aligned} & \text { P09-40=1, } \\ & \text { P09-30 }=0 \end{aligned}$ | 2020-02 | Target rotating speed (Hz) | ----- | ----- | ----- | --- | -- | -- |
| Delta Standard (New definition) | 2060-03 | Target rotating speed (Hz) | 2060-07 | Target Torque (\%) | 2060-05 | Target Position | ----- | -- |
| $\begin{aligned} & P 09-40=0, \\ & \text { P09-30 }=1 \end{aligned}$ | 2060-04 | Torque Limit (\%) | 2060-08 | Speed Limit (Hz) | ----- | ----- | ----- | ---- |


| CANopen Control Mode | Operation Control |  |
| :---: | :---: | :---: |
| Selection | Index | Description |
| DS402 standard <br> Pr. 09-40=1 | $6040-00$ | Operation Command |
| Delta Standard (OId definition) <br> P09-40=1, P09-30=0 | ----- |  |
| Delta Standard (New <br> definition) <br> P09-40=0, P09-30=1 | $2020-01$ | Operation Command |


| CANopen Control Mode Selection | Other |  |
| :---: | :---: | :---: |
|  | Index | Description |
| DS402 standard | 605A-00 | Quick stop processing mode |
| Pr. 09-40=1 | 605C-00 | Disable operation processing mode |
| Delta Standard (Old definition) P09-40=1, P09-30=0 | ----- | ----- |
| Delta Standard (New definition) | ----- | ----- |
| P09-40=0, P09-30=1 | ----- | ----- |

However, you can use some index regardless DS402 or Delta's standard.
For example:

1. Index which are defined as RO attributes.
2. Index correspond to parameters such as (2000 ~200B-XX)
3. Accelerating/Decelerating Index: 604F 6050

### 15.3.2 DS402 Standard Control Mode

### 15.3.2.1 Related set up of ac motor drive (by following DS402 standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (refer to chapter 15-2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr. 00.20 to 6 . (Choose source of frequency commend from CANopen setting.)
4. Source of torque setting is set by Pr.11-33. (Choose source of torque commend from CANopen setting.)
5. CANopen station setting: set Pr.09-36 (Choose source of position commend from CANopen setting.)
6. Set DS402 as control mode: Pr09-40=1
7. CANopen station setting: set Pr.09-36 (Range of setting is $1 \sim 127$. When Pr.09-36=0, CANopen slave function is disabled. ) (Note: If error arise (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
8. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))
9. Set multiple input functions to Quick Stop (it can also be enable or disable, default setting is disable). If it is necessary to enable the function, set MI terminal to 53 in one of the following parameter: Pr. 02.01 ~Pr. 02.08 or Pr. 02.26 ~ Pr.02.31. (Note: This function is available in DS402 only.)

### 15.3.2.1 The status of the motor drive (by following DS402 standard)

According to the DS402 definition, the motor drive is divided into 3 blocks and 9 status as described below.

## 3 blocks

Power Disable: That means without PWM output
Power Enable: That means with PWM output
Fault: One or more than one error has occurred.

## 9 status

Start: Power On
Not ready to switch on: The motor drive is initiating.
Switch On Disable: When the motor drive finishes the initiation, it will be at this mode.
Ready to switch on: Warming up before running.
Switch On: The motor derive has the PWM output now, but the reference commend is not effective.
Operate Enable: Able to control normally.
Quick Stop Active: When there is a Quick Stop request, you have to stop running the motor
drive.
Fault Reaction Active: The motor drive detects conditions which might trigger error(s).
Fault: One or more than errors has occurred to the motor drive.

Therefore, when the motor drive is turned on and finishes the initiation, it will remain at Ready to Switch on status. To control the operation of the motor drive, you need to change this status to Operate Enable status. The way to change it is to commend the control word's bit0 $\sim$ bit3 and bit7 of the Index 6040H and to pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described as below:

Index 6040

| $15 \sim 9$ | 8 | 7 | $6 \sim 4$ | 3 | 2 | 1 | 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Reserved | Halt | Fault Reset | Operation | Enable <br> operation | Quick Stop | Enable <br> Voltage | Switch On |

Index 6041

| $15 \sim 14$ | $13 \sim 12$ | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Reserved Operation | Internal <br> limit <br> active | Target <br> reached | Remote | Reserved | Warning | Switch on <br> disabled | Quick <br> stop | Voltage <br> enabled | Fault | Operation <br> enable | Switch on | Ready to <br> switch on |  |



Set command $6040=0 x E$, then set another command $6040=0 x F$. Then the motor drive can be switched to Operation Enable. The Index 605A decides the dashed line of Operation Enable when the control mode changes from Quick Stop Active. (When the setting value is 1~3, this dashed line is active. But when the setting value of 605A is not 1~3, once he motor derive is switched to Quick Stop Active, it will not be able to switch back to Operation Enable.)

| Index | Sub | Definition | Factory Setting | R/W | Size | Unit | $\begin{aligned} & \text { PDO } \\ & \text { Map } \end{aligned}$ | Mode | note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 605Ah | 0 | Quick stop option code | 2 | RW | S16 |  | No |  | 0 : disable drive function |
|  |  |  |  |  |  |  |  |  | 1 :slow down on slow down ramp |
|  |  |  |  |  |  |  |  |  | 2: slow down on quick stop ramp |
|  |  |  |  |  |  |  |  |  | 5 slow down on slow down ramp and stay in QUICK STOP |
|  |  |  |  |  |  |  |  |  | 6 slow down on quick stop ramp and stay in QUICK STOP |
|  |  |  |  |  |  |  |  |  | 7 slow down on the current limit and stay in Quick stop |

Besides, when the control section switches from Power Enable to Power Disable, use 605C to define parking method.

| Index | Sub | Definition | Factory Setting | R/W | Size | Unit | PDO <br> Map | Mode | note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 605Ch | 0 | Disable operation option code | 1 | RW | S16 |  | No | 0: Disable drive function <br> 1: Slow down with slow down ramp; <br> disable of the drive function |  |

## 15-3-2-3 Various mode control method (by following DS402 standard)

Control mode of C2000, supporting speed, torque, position and home control are described as below:

## Speed mode

1. Let Ac Motor Drive be at the speed control mode: Set Index6060 to 2.
2. Switch to Operation Enable mode: Set 6040=0xE, then set $6040=0 x F$.
3. To set target frequency: Set target frequency of 6042, since the operation unit of 6042 is rpm, there is a transformation:

$$
\begin{aligned}
& \mathrm{n}=\mathrm{f} \times \frac{120}{\mathrm{p}} \quad \mathrm{n} \text { : rotation speed (rpm) (rounds/minute) } \quad P \text { : motor's pole number (Pole) } \\
& \mathrm{f}: \text { rotation frequency }(\mathrm{Hz})
\end{aligned}
$$

For example:
Set $6042 \mathrm{H}=1500$ (rpm), if the motor drive's pole number is 4 (Pr05-04 or Pr05-16), then the motor drive's operation frequency is $1500(120 / 4)=50 \mathrm{~Hz}$.

Besides, the 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter clockwise
4. To set acceleration and deceleration: Use 604F(Acceleration) and 6050(Deceleration).
5. Trigger an ACK signal: In the speed control mode, the bit 6~4 of Index 6040 needs to be controlled. It is defined as below:

|  Index 6040   <br> Speed mode    <br> (Index 6060=2)    | Bit 6 | Bit 5 | Bit 4 | SUM |
| :---: | :---: | :---: | :---: | :---: |
|  | 1 | 0 | 1 | Locked at the current signal. |
|  | 1 | 1 | 1 | Run to reach targeting signal. |
|  | Other |  |  |  |



NOTE 01: To know the current rotation speed, read 6043. (unit: rpm)
NOTE 02: To know if the rotation speed can reach the targeting value; read bit 10 of 6041. (0: Not reached; 1: Reached)

## Torque mode

1. Let Ac Motor Drive be at the torque control mode: Set Index6060 $=4$.
2. Switch the current mode to Operation Enable, set $6040=0 x E$, then set $6040=0 x F$.
3. To set targeting torque: Set 6071 as targeting torque and 6072 as the largest output torque.

| Torque mode <br> (Index 6060=4) | Index 6040 |  |  | SUM |
| :---: | :---: | :---: | :---: | :---: |
|  | Bit 6 | Bit 5 | Bit 4 |  |



NOTE: The standard DS402 doesn't regulate the highest speed limit. Therefore if the motor drive defines the control mode of DS402, the highest speed will go with the setting of Pr11-36 to Pr11-38.
NOTE 01: To know the current torque, read 6077 (unit: $0.1 \%$ ).
NOTE02: To know if reaching the targeting torque, read bit 10 of 6041. (0: Not reached; 1: Reached)

## Position mode

1. Set the parameter of a trapezium curve to define position control (Pr11-43 Max. Frequency of Point- to-Point Position Control, Pr11-44 Accel. Time of Point-to Point Position Control and Pr11-45 Decel. Time of Point-to Point Position Control)
2. Let Ac Motor Drive be at the position control mode: Then set Index $6060=1$.
3. Switch the current mode to Operation Enable, set $6040=0 x E$ and then set $6040=0 x F$.
4. To set targeting position: set 607A as the targeting position.
5. Trigger an ACK signal: Set $6040=0 \times 0 F$ then set $6040=0 \times 1 F$. (Bit4 changes from 0 to 1 ).


NOTE 01: To know the current position, read 6064.
NOTE 02: To know if the position reaches the targeting position, read bit 10 of 6041. (0: reached, 1 : Not reached)
NOTE 03: To know if the position is over the limited area, read bit 11 of 6041 ( 0 : in the limit, 1 : over the limit)

## Home mode

1. Set Pr00-12 to choose a home method.
2. Set the left and right limits correspond to the position of MI terminal.
3. To switch Ac Motor Drive control mode to Home mode: Set Index $6060=6$.
4. To switch from current mode to Operation Enable: Set $6040=0 x E$, then set $6040=0 x F$.
5. To trigger an ACK signal: Set $6040=0 \times 0 F$, then set $6040=0 \times 1 F$ (Bit 4 changes from 0 to 1 and the motor drive will be back to home.)

Note 01: To know if the home mode is completed, read bit 12 of 6041 . ( 0 : reached, 1 : Not reached)

### 15.3.3 By using Delta Standard (Old definition, only support speed mode)

## 15-3.3.1 Various mode control method (by following DS402 standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (Refer to chapter 15.2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr. 00.20 to 6 . (Choose source of frequency commend from CANopen setting.)
4. Set Delta Standard (Old definition, only support speed mode) as control mode: Pr. 09-40 = 0 and $09-30=0$.

CANopen station setting: set Pr.09-36 (Range of setting is $1 \sim 127$. When Pr.09-36=0, CANopen slave function is disabled. ) (Note: If error arised (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
5. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))

## 15-3-3-2 By speed mode

1. Set the target frequency: Set 2020-02, the unit is Hz , with a number of 2 decimal places. For example 1000 is 10.00 .
2. Operation control: Set 2020-01 $=0002 \mathrm{H}$ for Running, and set $2020-01=0001 \mathrm{H}$ for Stopping.


$$
2020-01 \text { bit } 3 \sim 0=0010 b
$$

### 15.3.4 By using Delta Standard (New definition)

## 15-3-4-1 Related set up of ac motor drive (Delta New Standard)

If you want to use DS402 standard to control the motor drive, please follow the steps below:

1. Wiring for hardware (Refer to chapter 15.2 Wiring for CANopen)
2. Operation source setting: set Pr.00-21 to 3 for CANopen communication card control.
3. Frequency source setting: set Pr.00.20 to 6. (Choose source of frequency commend from CANopen setting.)
4. Source of torque setting is set by Pr.11-33. (Choose source of torque commend from CANopen setting.)
5. CANopen station setting: set Pr.09-36 (Choose source of position commend from CANopen setting.)
6. Set Delta Standard (Old definition, only support speed mode) as control mode: Pr. 09-40 = 0 and $09-30=0$.
7. CANopen station setting: set Pr.09-36 (Range of setting is 1~127. When Pr.09-36=0, CANopen slave function is disabled. ) (Note: If error arised (CAdE or CANopen memory error) as station setting is completed, press Pr.00-02=7 for reset.)
8. CANopen baud rate setting: set Pr.09.37 (CANBUS Baud Rate: 1M(0), 500K(1), 250K(2), 125K(3), 100K(4) and50K(5))

## 15-3-4-2 Various mode control method (Delta New Standard)

## Speed Mode

1. Let Ac Motor Drive be at the speed control mode: Set Index6060 $=2$.
2. Set the target frequency: set 2060-03, unit is Hz , with a number of 2 decimal places. For example 1000 is 10.00 Hz .
3. Operation control: set $2060-01=008 \mathrm{H}$ for Server on, and set $2060-01=0081 \mathrm{H}$ for Running.

$2060-01$ bit $4=0$

## Torque Mode

1. Let Ac Motor Drive be at torque control mode: set Index $6060=4$.
2. Set target torque: set 2060-07, unit is \%, a number of 1 decimal place. For example 100 is $10.0 \%$.
3. Operation control: Set $2060-01=0080 \mathrm{H}$ for Server on, then the motor drive will start to run to reach target torque.


Note01 To know what the current torque is, read 2061-07 (unit is $0.1 \%$ ).
Note02 To know if the torque can reach the setting value, read the bit 0 of 2061-01 (0: Not reached, 1: Reached).
Note 03: When doing torque output and if the motor drive's speed reaches the speed limit, the output torque will decrease to ensure the speed is under the limit.

## Position Mode

1. Set the parameter of a trapezium curve to define position control (Pr11-43 Max. Position Control Frequency), Pr11-44 Accel. Time of Position Control, Pr11-45 Decel. Time of Position Control)
2. Let Ac motor drive be at the position control mode, set Index $6060=1$.
3. Set 2060-01 $=0080 \mathrm{~h}$, then motor drive will have server on.
4. Set target position: set 2060-05 = target position.
5. Set 2060-01 $=0081 \mathrm{~h}$ to trigger the motor drive to run to the target position.
6. To move to another position, simply repeat step 3 to 5 .


NOTE01: To know the current position, read 2061-05.
NOTE02: To know if reaching the target position, read bit 0 of 2061 (0: Not reached, 1: Reached).

## Home Mode

1. Set Pr00-12 to choose how to return home.
2. Set the left and right limits correspond to the position of MI terminal.
3. To switch C2000 control mode to Home mode: Set Index $6060=6$.
4. Set 2060-01 $=0080 \mathrm{~h}$, then motor drive will have server on.
5. Set the ACK signal: set $2060-01=0081 \mathrm{~h}$, then the motor drive will start to go back home.

NOTE 01: To know if returning home is completed, read bit12 of 6041 ( 0 : Not reached, 1: Reached).

## 15-3-5 DI/DO AI AO are controlled via CANopen

To control the DO AO of the motor drive through CANopen, follow the steps below:

1. To set the $D O$ to be controlled, define this $D O$ to be controlled by CANopen. For example, set Pr02-14 to control RY2.
2. To set the DO to be controlled, define this $A O$ to be controlled by CANopen. For example, set Pr03-23 to control AFM2.
3. To control the mapping index of CANopen. If you want to control DO, then you will need to control Index2026-41. If you want to control AO, then you will need to control 2026-AX. If you want to set RY2 as ON, set the bit 1 of Index 2026-41 =1, then RY2 will output 1. If you want to control AFM2 output $=50.00 \%$, then you will need to set Index 2026-A2 $=5000$, then AFM2 will output $50 \%$.

## Mapping table of CANopen DI DO AI AO:

DI:

| Terminal | Related Parameters | R/W | Mapping Index |
| :---: | :--- | :--- | :--- |
| FWD | $==$ | RO | $2026-01$ bit 0 |
| REV | $==$ | RO | $2026-01$ bit 1 |
| MI 1 | $==$ | RO | $2026-01$ bit 2 |
| MI 2 | $==$ | RO | $2026-01$ bit 3 |
| MI 3 | $==$ | RO | $2026-01$ bit 4 |
| MI 4 | $==$ | RO | $2026-01$ bit 5 |
| MI 5 | $==$ | RO | $2026-01$ bit 6 |
| MI 6 | $==$ | RO | $2026-01$ bit 7 |
| MI 7 | $==$ | RO | $2026-01$ bit 8 |
| MI 8 | $==$ | RO | $2026-01$ bit 9 |
| MI 10 | $==$ | RO | $2026-01$ bit 10 |
| MI 11 | $==$ | RO | $2026-01$ bit 11 |
| MI 12 | $==$ | RO | $2026-01$ bit 12 |
| MI 13 | $==$ | RO | $2026-01$ bit 13 |
| MI 14 | $==$ | RO | $2026-01$ bit 14 |
| MI 15 | $==$ | RO | $2026-01$ bit 15 |

DO :

| Terminal | Related Parameters | R/W | Mapping Index |
| :---: | :---: | :---: | :---: |
| RY1 | P2-13 $=50$ | RW | $2026-41$ bit 0 |
| RY2 | P2-14 $=50$ | RW | $2026-41$ bit 1 |
|  | P2-15 $=50$ | RW | $2026-41$ bit 2 |
| MO1 | P2-16 $=50$ | RW | $2026-41$ bit 3 |
| MO2 | P2-17 $=50$ | RW | $2026-41$ bit 4 |
| MO3 | P2-18 $=50$ | RW | $2026-41$ bit 5 |
| MO4 | P2-19 $=50$ | RW | $2026-41$ bit 6 |


| MO5 | P2-20 $=50$ | RW | $2026-41$ bit 7 |
| :---: | :---: | :---: | :---: |
| MO6 | P2-21 $=50$ | RW | $2026-41$ bit 8 |
| MO7 | P2-22 $=50$ | RW | $2026-41$ bit 9 |
| MO8 | P2-23 $=50$ | RW | $2026-41$ bit 10 |

AI :

| Terminal | Related Parameters | R/W | Mapping Index |
| :---: | :---: | :---: | :---: |
| AVI | $==$ | RO | Value of 2026-61 |
| ACI | $==$ | RO | Value of 2026-62 |
| AUI | $==$ | RO | Value of 2026-63 |

AO :

| Terminal | Related Parameters | R/W | Mapping Index |
| :---: | :---: | :---: | :---: |
| AFM1 | $\mathrm{P} 3-20=20$ | RW | Value of 2026-A1 |
| AFM2 | $\mathrm{P} 3-23=20$ | RW | Value of 2026-A2 |

### 15.4 CANopen Supporting Index

C2000 Index:
Parameter index corresponds to each other as following:

## Index

2000H + Group

## sub-Index

member+1

For example:
Pr. 10.15 (Encoder Slip Error Treatment)
Group
member

$$
10(0 \bar{A} \mathrm{H}) \quad-\quad 15(0 \mathrm{FH})
$$

$$
\text { Index }=2000 \mathrm{H}+0 \mathrm{AH}=200 \mathrm{~A}
$$

Sub Index $=0 \mathrm{FH}+1 \mathrm{H}=10 \mathrm{H}$
C2000 Control Index:
Delta Standard Mode (Old definition)

| Index | Sub | Definition | Factory Setting | R/W | Size |  | Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2020H | 0 | Number | 3 | R | U8 |  |  |
|  | 1 | Control word | 0 | RW | U16 | Bit 1~0 | 00B:disable |
|  |  |  |  |  |  |  | 01B:stop |
|  |  |  |  |  |  |  | 10B:disable |
|  |  |  |  |  |  |  | 11B: JOG Enable |
|  |  |  |  |  |  | Bit3~2 | Reserved |
|  |  |  |  |  |  | Bit5~4 | 00B:disable |
|  |  |  |  |  |  |  | 01B: Direction forward |
|  |  |  |  |  |  |  | 10B: Reverse |
|  |  |  |  |  |  |  | 11B: Switch Direction |
|  |  |  |  |  |  | Bit7~6 | 00B: $1^{\text {st }}$ step Accel. /Decel. |
|  |  |  |  |  |  |  | 01B: $2^{\text {nd }}$ step Accel. /Decel. |
|  |  |  |  |  |  |  | 10B: $3^{\text {rd }}$ step Accel. /Decel. |
|  |  |  |  |  |  |  | 11B: $4^{\text {th }}$ step Accel. /Decel. |
|  |  |  |  |  |  | Bit11~8 | 0000B: Master speed |
|  |  |  |  |  |  |  | 0001B: $1^{\text {st }}$ step speed |
|  |  |  |  |  |  |  | 0010B: $2^{\text {nd }}$ step speed |
|  |  |  |  |  |  |  | 0011B: $3^{\text {rd }}$ step speed |
|  |  |  |  |  |  |  | 0100B: $4^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 0101B: $5^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 0110B: $6^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 0111B: $7^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1000B: $8^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1001B: $9^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1010B: $10^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1011B: $11^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1100B: $12^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1101B: $13^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1110B: $14^{\text {th }}$ step speed |
|  |  |  |  |  |  |  | 1111B: $15^{\text {th }}$ step speed |
|  |  |  |  |  |  | Bit12 | 1: Enable the function of Bit6-11 |
|  |  |  |  |  |  | Bit14~13 | 00B: no function |
|  |  |  |  |  |  |  | 01B: Operation command by the digital keypad |




| Index | Sub | Definition | Factory Setting | R/W | Size | Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1B | Display GFF in \% | 0 | R | U16 |  |
|  | 1 C | Display DCbus voltage ripples (Unit: Vdc) | 0 | R | U16 |  |
|  | 1D | Display PLC register D1043 data | 0 | R | U16 |  |
|  | 1E | Display Pole of Permanent Magnet Motor | 0 | R | U16 |  |
|  | 1F | User page displays the value in physical measure | 0 | R | U16 |  |
|  | 20 | Output Value of Pr.00-05 | 0 | R | U16 |  |
|  | 21 | Number of motor turns when drive operates | 0 | R | U16 |  |
|  | 22 | Operation position of motor | 0 | R | U16 |  |
|  | 23 | Fan speed of the drive | 0 | R | U16 |  |
|  | 24 | Control mode of the drive 0 : speed mode 1: torque mode | 0 | R | U16 |  |
|  | 25 | Carrier frequency of the drive | 0 | R | U16 |  |

CANopen Remote IO mapping

| Index | Sub | R/W |  |
| :---: | :---: | :---: | :--- |
| 2026 H | 01 h | R | Each bit corresponds to the different input terminals |
|  | 02 h | R | Each bit corresponds to the different input terminals |
|  | 03 h 40 h | R | Reserved |
|  | 41 h | RW | Each bit corresponds to the different output terminals |
|  | $42 \mathrm{~h} \sim 60 \mathrm{~h}$ | R | Reserved |
|  | 61 h | R | AVI (\%) |
|  | 62 h | R | ACI (\%) |
|  | 63 h | R | AUI (\%) |
|  | R | Reserved |  |
|  | 64h~A0h | RW | AFM1 (\%) |
|  | A1h | RW | AFM2 (\%) |

## Delta Standard Mode (New definition)

| Index | sub | R/W | Size | Descriptions |  |  | Speed Mode | Position Mode | Home Mode | Torque Mode |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | bit | Definition | Priority |  |  |  |  |
| 2060h | 00h | R | U8 |  |  |  |  |  |  |  |
|  | 01h | RW | U16 | 0 | Ack | 4 | $\begin{aligned} & \text { 0:fcmd }=0 \\ & \text { 1:fcmd = Fset(Fpid) } \end{aligned}$ | Pulse 1: Position control | Pulse 1: Return to home |  |
|  |  |  |  | 1 | Dir | 4 | 0 : FWD run command 1: REV run command |  |  |  |
|  |  |  |  | 2 |  |  |  |  |  |  |
|  |  |  |  | 3 | Halt |  | 0 : drive run till target speed is attained 1: drive stop by declaration setting |  |  |  |
|  |  |  |  | 4 | Hold |  | 0 : drive run till target speed is attained 1: frequency stop at current frequency |  |  |  |
|  |  |  |  | 5 | JOG |  | 0:JOG OFF <br> Pulse 1:JOG RUN |  |  |  |
|  |  |  |  | 6 | QStop |  | Quick Stop |  |  |  |


| Index | sub | R/W | Size | Descriptions |  |  | Speed Mode | Position Mode | Home Mode | Torque Mode |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | Definition |  |  |  |  |  |
|  |  |  |  | 7 | Power |  | 0 :Power OFF <br> 1:Power ON | 0 :Power OFF <br> 1:Power ON | $\begin{aligned} & \text { 0:Power OFF } \\ & \text { 1:Power ON } \end{aligned}$ | $\begin{aligned} & \text { 0:Power OFF } \\ & \text { 1:Power ON } \end{aligned}$ |
|  |  |  |  | 14~8 | $\begin{aligned} & \text { Cmd } \\ & \text { SW } \end{aligned}$ |  | Multi-step frequency switching | Multi-step position switching |  |  |
|  |  |  |  | 15 |  |  | Pulse 1: Fault code cleared | Pulse 1: Fault code cleared | Pulse 1: Fault code cleared | Pulse 1: Fault code cleared |
|  | 02h | RW | U16 |  |  |  |  |  |  |  |
|  | 03h | RW | U16 |  |  |  | Speed command (unsigned decimal) |  |  |  |
|  | 04h | RW | U16 |  |  |  |  |  |  |  |
|  | 05h | RW | S32 |  |  |  |  | Position command |  |  |
|  | 06h | RW |  |  |  |  |  |  |  |  |
|  | 07h | RW | U16 |  |  |  |  |  |  | Torque command (signed decimal) |
|  | 08h | RW | U16 |  |  |  |  |  |  | Speed limit (unsigned decimal) |
| 2061h | 1h | R | U16 | 0 | Arrive |  | Frequency attained | Position attained | Homing complete | Torque attained |
|  |  |  |  | 1 | Dir |  | 0 : Motor FWD run 1: Motor REV run | 0: Motor FWD run <br> 1: Motor REV run | 0: Motor FWD run <br> 1: Motor REV run | 0: Motor FWD run <br> 1: Motor REV run |
|  |  |  |  | 2 | Warn |  | Warning | Warning | Warning | Warning |
|  |  |  |  | 3 | Error |  | Error detected | Error detected | Error detected | Error detected |
|  |  |  |  | 4 |  |  |  |  |  |  |
|  |  |  |  | 5 | JOG |  | JOG | JOG | JOG | JOG |
|  |  |  |  | 6 | QStop |  | Quick stop | Quick stop | Quick stop | Quick stop |
|  |  |  |  | 7 | Power On |  | Switch ON | Switch ON | Switch ON | Switch ON |
|  |  |  |  | 15~8 |  |  |  |  |  |  |
|  | 02h | R |  |  |  |  |  |  |  |  |
|  | 03h | R | U16 |  |  |  | Actual output frequency | Actual output frequency | Actual output frequency | Actual output frequency |
|  | 04h | R |  |  |  |  |  |  |  |  |
|  | 05h | R | S32 |  |  |  | Actual position (absolute) | Actual position (absolute) | Actual position (absolute) | Actual position (absolute) |
|  | 06h | R |  |  |  |  |  |  |  |  |
|  | 07h | R | S16 |  |  |  | Actual torque | Actual torque | Actual torque | Actual torque |

## DS402 Standard

| Index | Sub | Definition | Factory <br> Setting | R/W | Size | Unit | $\begin{aligned} & \text { PDO } \\ & \text { Map } \end{aligned}$ | Mode | Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6007h | 0 | Abort connection option code | 2 | RW | S16 |  | Yes |  | 0: No action |
|  |  |  |  |  |  |  |  |  | 2: Disable Voltage, |
|  |  |  |  |  |  |  |  |  | 3: quick stop |
| 603Fh | 0 | Error code | 0 | R0 | U16 |  | Yes |  |  |
| 6040h | 0 | Control word | 0 | RW | U16 |  | Yes |  |  |
| 6041h | 0 | Status word | 0 | R0 | U16 |  | Yes |  |  |
| 6042h | 0 | vl target velocity | 0 | RW | S16 | rpm | Yes | vl |  |
| 6043h | 0 | vl velocity demand | 0 | RO | S16 | rpm | Yes | vl |  |
| 6044h | 0 | vl control effort | 0 | RO | S16 | rpm | Yes | vl |  |
| 604Fh | 0 | vl ramp function time | 10000 | RW | U32 | 1 ms | Yes | vl | Unit must be: 100 ms , and |
| 6050h | 0 | vl slow down time | 10000 | RW | U32 | 1 ms | Yes | vl | check if the setting is set to |
| 6051h | 0 | vl quick stop time | 1000 | RW | U32 | 1 ms | Yes | vl | 0. |
| 605Ah | 0 | Quick stop option code | 2 | RW | S16 |  | No |  | 0 : disable drive function |
|  |  |  |  |  |  |  |  |  | 1 :slow down on slow down ramp |
|  |  |  |  |  |  |  |  |  | 2: slow down on quick stop ramp |


| Index | Sub | Definition | Factory Setting | R/W | Size | Unit | PDO Map | Mode | Note |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  | 5 slow down on slow down ramp and stay in QUICK STOP <br> 6 slow down on quick stop ramp and stay in QUICK STOP |
| 605Ch | 0 | Disable operation option code | 1 | RW | S16 |  | No |  | 0 : Disable drive function 1: Slow down with slow down ramp; disable of the drive function |
| 6060h | 0 | Mode of operation | 2 | RW | S8 |  | Yes |  | 1: Profile Position Mode <br> 2: Velocity Mode <br> 4: Torque Profile Mode <br> 6: Homing Mode |
| 6061h | 0 | Mode of operation display | 2 | RO | S8 |  | Yes |  | Same as above |
| 6064h | 0 | pp Position actual value | 0 | RO | S32 |  | Yes | pp |  |
| 6071h | 0 | tq Target torque | 0 | RW | S16 | 0.1\% | Yes | tq | Valid unit: 1\% |
| 6072h | 0 | tq Max torque | 150 | RW | U16 | 0.1\% | No | tq | Valid unit: 1\% |
| 6075h | 0 | tq Motor rated current | 0 | RO | U32 | mA | No | tq |  |
| 6077h | 0 | tq torque actual value | 0 | RO | S16 | 0.1\% | Yes | tq |  |
| 6078h | 0 | tq current actual value | 0 | RO | S16 | 0.1\% | Yes | tq |  |
| 6079h | 0 | tq DC link circuit voltage | 0 | RO | U32 | mV | Yes | tq |  |
| 607Ah | 0 | pp Target position | 0 | RW | S32 | 1 | Yes | pp |  |

### 15.5 CANopen Fault Code

| Display | Fault code | Description | CANopen fault code | ```CANopen fault register (bit 0~7)``` |
| :---: | :---: | :---: | :---: | :---: |
| Fault <br> ocA <br> Oc at accel | 0001H | Over-current during acceleration | 2213 H | 1 |
| Faultocd <br> OAND <br> Oc at decel | 0002H | Over-current during deceleration | 2213 H | 1 |
| Fault $\quad$ HaND ocn Oc at normal SPD | 0003H | Over-current during steady status operation | 2214H | 1 |
| Fault $\quad$ GANO GFF Ground fault | 0004H | Ground fault. When (one of) the output terminal(s) is grounded, short circuit current is more than $50 \%$ of $A C$ motor drive rated current. <br> NOTE: The short circuit protection is provided for AC motor drive protection, not for protection of the user. | 2240H | 1 |
| Fault $\quad$ HaND Occ Short Circuit | 0005H | Short-circuit is detected between upper bridge and lower bridge of the IGBT module. | 2250H | 1 |
|  | 0006H | Over-current at stop. Hardware failure in current detection | 2314H | 1 |
| Fault $\quad$ HaNo ovA Ovat accel | 0007H | Over-current during acceleration. <br> Hardware failure in current detection | 3210 H | 2 |
| Fault $\quad$ HaND ovd Ovat decel | 0008H | Over-current during deceleration. Hardware failure in current detection. | 3210 H | 2 |
| Fault <br> ovn <br> Ov at normal SPD | 0009H | Over-current during steady speed. <br> Hardware failure in current detection. | 3210 H | 2 |
| $\square$ | 000AH | Over-voltage at stop. Hardware failure in current detection | 3210 H | 2 |


| Display | Fault code | Description | CANopen fault code | CANopen fault register (bit 0~7) |
| :---: | :---: | :---: | :---: | :---: |
| Fault <br> LvA <br> Lv at accel | 000BH | DC BUS voltage is less than Pr.06.00 during acceleration. | 3220 H | 2 |
| Fault <br> Lvd <br> Lv at decel | 000CH | DC BUS voltage is less than Pr.06.00 during deceleration. | 3220 H | 2 |
| Fault <br> Lvn <br> Lv at normal SPD | 000DH | DC BUS voltage is less than Pr.06.00 in constant speed. | 3220 H | 2 |
| Fault LvS <br> Lv at stop | 000EH | DC BUS voltage is less than Pr.06-00 at stop | 3220 H | 2 |
| Fault <br> OrP <br> Phase Lacked | 000FH | Phase Loss Protection | 3130 H | 2 |
| Fault <br> oH1 <br> IGBT over heat | 0010H | IGBT overheat <br> IGBT temperature exceeds protection level. $\begin{aligned} & 1 \sim 15 \mathrm{HP}: 90^{\circ} \mathrm{C} \\ & 20 \sim 100 \mathrm{HP}: 100^{\circ} \mathrm{C} \end{aligned}$ | 4310H | 3 |
| Fault $\mathrm{oH} 2$ <br> Hear Sink oH | 0011H | Heat sink overheat <br> Heat sink temperature exceeds 90oC | 4310H | 3 |
| Fault <br> tH1o <br> Thermo 1 open | 0012H | Temperature detection circuit error (IGBT) <br> IGBT NTC | FFOOH | 3 |
| Fault <br> tH2o <br> Thermo 2 open | 0013H | Temperature detection circuit error (capacity module) <br> CAP NTC | FF01H | 3 |
| Fault PWR Power RST OFF | 0014H | Power RST off | FF02H | 2 |


| Display | Fault code | Description | CANopen fault code | CANopen fault register (bit 0~7) |
| :---: | :---: | :---: | :---: | :---: |
| Fault $\quad$ HaND oL Inverterol | 0015H | Overload. The AC motor drive detects excessive drive output current. <br> NOTE: The AC motor drive can withstand up to $150 \%$ of the rated current for a maximum of 60 seconds. | 2310H | 1 |
| Fault $\quad$ HaND <br> EoL1 <br> Thermal relay 1 | 0016H | Electronics thermal relay 1 protection | 2310H | 1 |
| Fault <br> EoL2 <br> Thermal relay 2 | 0017H | Electronics thermal relay 2 protection | 2310H | 1 |
| Fault <br> ot1 <br> Over torque 1 | 001AH | These two fault codes will be displayed when output current exceeds the over-torque detection level (Pr. 06.07 or | 8311H | 3 |
| Fault <br> ot2 <br> Over torque 2 | 001BH | Pr.06.10) and exceeds over-torque detection (Pr.06.08 or Pr.06.11) and it is set 2 or 4 in Pr.06-06 or Pr.06-09. | 8311H | 3 |
| Fault <br> uC <br> Under torque 1 | 001CH | Low current | 8321H | 1 |
| Fault $\quad$ hano CF1 EEPROM write Err | 001EH | Internal EEPROM can not be programmed. | 5530H | 5 |
| Fault $\quad$ hano CF2 EEPROM read Err | 001FH | Internal EEPROM can not be read. | 5530H | 5 |
| Fault $\quad$ HaNo cd1 las sensor Err | 0021H | U-phase error | FF04H | 1 |
| Fault <br> cd2 <br> Ibs sensor Err | 0022H | V-phase error | FF05H | 1 |
|  | 0023H | W-phase error | FF06H | 1 |

$\left.\begin{array}{|c|c|l|l|l|}\hline \text { Display } & \text { Fault code } & & \begin{array}{c}\text { CANopen } \\ \text { fault }\end{array} \\ \text { fault code }\end{array} \begin{array}{c}\text { register } \\ \text { (bit 0 }\end{array}\right)$

| Display | Fault code | Description | CANopen fault code | CANopen fault register (bit 0~7) |
| :---: | :---: | :---: | :---: | :---: |
| Fault  <br>  EF <br> ExaNo  <br> External Fault  | 0031H | External Fault <br> When input EF (N.O.) on external terminal is closed to GND, AC motor drive stops output $\mathrm{U}, \mathrm{V}$, and W . | 9000H | 5 |
| Fault EF1 HaNo Emergency stop | 0032H | Emergency stop <br> When the multi-function input terminals MI1 to MI6 are set to emergency stop, the AC motor drive stops output $\mathrm{U}, \mathrm{V}, \mathrm{W}$ and the motor coasts to stop. | 9000H | 5 |
|  | 0033H | External Base Block <br> When the external input terminals MI1 to MI16 are set as bb and active, the AC motor drive output will be turned off | 9000H | 5 |
|  | 0034H | Password will be locked if three fault passwords are entered | FF26H | 5 |
| HAND <br> Fault <br> ccod <br> SW code Error | 0035H | Software error | 6100H | 5 |
| Fault <br> CE1 <br> Modbus CMD err | 0036H | Illegal function code | 7500H | 4 |
| HAN <br> Fault <br> cE2 <br> Modbus ADDR err | 0037H | Illegal data address ( 00 H to 254 H ) | 7500H | 4 |
| Fault $\quad$ haNo cE3 Modbus DATA err | 0038H | Illegal data value | 7500H | 4 |
| Fault CE4 Modbus slave FLT | 0039H | Data is written to read-only address | 7500H | 4 |
| Fault <br> cE10 <br> Modbus time out | 003AH | Modbus transmission timeout. | 7500H | 5 |


| Display | Fault code | Description | CANopen fault code | CANopen fault register (bit 0~7) |
| :---: | :---: | :---: | :---: | :---: |
| Fault <br> cP10 <br> Keypad time out | 003BH | Keypad transmission timeout. | 7500H | 4 |
| Fault $\quad$ bF Braking fault | 003CH | Brake resistor fault | 7110H | 4 |
| Fault $\quad$ yand Y-delta connect | 003DH | Motor Y- $\Delta$ switch error | 3330H | 2 |
| HAND <br> Fault <br> dEb <br> Dec. Energy back | 003EH | Energy regeneration when decelerating | FF27H | 2 |
| HAND <br> Fault oSL <br> Over slip Error | 003FH | Over slip error. Slip exceeds Pr.05.26 limit and slip duration exceeds Pr.05.27 setting. | FF28H | 7 |
| Fault <br> PGF5 <br> PG HW Error | 0041H | PG Card Error | FF29H | 5 |
| HAND <br> Fault <br> ocU <br> Unknow Over Apm | 0042H | over current caused by unknown reason | 2310 H | 1 |
| HAND <br> Fault <br> ovU <br> Unknow Over volt. | 0043H | over voltage caused by unknown reason | 3210 H | 2 |
| Fault S1 <br> S1-Emergy stop | 0049H | external safety emergency stop | FF2AH | 5 |
| HAND <br> Fault <br> OPHL <br> U phase lacked | 0052H | U phase output phase loss | 2331H | 2 |
| HAND <br> Fault <br> OPHL <br> U phase lacked | 0053H | $V$ phase output phase loss | 2332H | 2 |


| Display | Fault code | Description | CANopen fault code | CANopen fault register (bit 0~7) |
| :---: | :---: | :---: | :---: | :---: |
| Fault <br> OPHL <br> U phase lacked | 0054H | W phase output phase loss | 2333H | 2 |
| Fault $\quad$ HaND <br> aocc <br> Aphase short | 004FH | A phase short | FF2BH | 1 |
| Fault <br> bocc <br> B phase short | 0050H | B phase short | FF2CH | 1 |
|  | 0051H | C phase short | FF2DH | 1 |
| HAND <br> Fault <br> CGdE <br> Guarding T-out | 0065H | Guarding time-out 1 | 8130H | 4 |
| Fault <br> CHbE <br> Heartbeat T-out | 0066H | Heartbeat time-out | 8130H | 4 |
| Fault <br> CSyE <br> SYNC T-out | 0067H | CAN synchrony error | 8700H | 4 |
| Fault <br> CbFE <br> CAN/S bus off | 0068H | CAN bus off | 8140H | 4 |
|  | 0069H | Can index exceed | 8110H | 4 |
| Fault <br> CAdE <br> CAN/S add. set | 006AH | CAN address error | 0x8100 | 4 |
| Fault <br> CFdE <br> CAN/S FRAM fail | 006BH | CAN frame fail | 0x8100 | 4 |

### 15.6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.
RUN LED:

| LED status | Condition | CANopen State |
| :---: | :---: | :---: |
| OFF |  | Initial |
| Blinking | $\mathrm{ON} \underset{\mathrm{OFF}}{\mathrm{ONs}} \underset{\mathrm{~ms}}{200} \stackrel{200}{\mathrm{~ms}} \square \square \square \square$ | Pre-Operation |
| Single flash |  | Stopped |
| ON |  | Operation |

ERR LED:

| LED status | Condition/ State |
| :---: | :---: |
| OFF | No Error |
| Single <br> flash | One Message fail |
| Double <br> flash | Guarding fail or heartbeat fail |
| Triple flash | SYNC fail |
| ON | Bus off |

# Chapter 16 PLC Function 

16.1 PLC Overview
16.2 Precautions for Using PLC
16.3 Start-up
16-3-1 Connect to PC
16-3-2 I/O Device Reference Table
16-3-3 WPLSoft Installation
16-3-4 Program Input
16-3-5 Program Download
16-3-6 Program Monitor
16.4 PLC Ladder Diagram
16.5 PLC Devices
16-5-1Devices Functions
16-5-2 Special Auxiliary Relays (Special M)
16-5-3 Special Registers (Special D)
16-5-4 Communication address for PLC Devices
16.6 Commands
16-6-1 Basic Commands
16-6-2 Explanation for the Command
16-6-3 Description of the Application Commands
16-6-4 Explanation for the Application Commands
16.7 Error Code and Troubleshoot
16.8 CANopen Master Application
16.9 Descriptions of PLC Modes and Controls (Speed, Torque, Homing and Position)
16.10 Internal Communication for Master Control
16.11 Counting Function via MI8
16-12 Remote IO Control Application of MODBUS (using Modbus)

### 16.1 PLC Overview

### 16.1.1 Introduction

The built in PLC function in C2000 allows following commands: WPLSoft, basic commands and application commands; the operation methods are the same as Delta DVPPLC series. Other than that, CANopen master provides 8 stations for synchronous control and 126 asynchronous controls.

ص, Note
In C2000, CANopen master synchronous control complies with DS402 standard and supports homing mode, speed mode, torque mode and point to point control mode; CANopen slave supports two control modes, speed mode and torque mode.

### 16.1.2 Ladder Diagram Editor - WPLSoft

WPLSoft is a program editor of Delta DVP-PLC series and C2000 series for WINDOWS. Besides general PLC program planning and general WINDOWS editing functions, such as cut, paste, copy, multi-windows, WPLSoft also provides various Chinese/English comment editing and other special functions (e.g. register editing, settings, the data readout, the file saving, and contacts monitor and set, etc.).
Following is the system requirement for WPLSoft:

| Item | System Requirement |
| :--- | :--- |
| Operation System | Windows 95/98/2000/NT/ME/XP |
| CPU | Pentium 90 and above |
| Memory | 16MB and above (32MB and above is recommended) |
| Hard Disk | Capacity: 50 MB and above <br> CD-ROM (for installing WPLSoft) |
| Monitor | Resolution: $640 \times 480,16$ colors and above, <br> It is recommended to set display setting of Windows to 800×600. |
| Mouse | General mouse or the device compatible with Windows |
| Printer | Printer with Windows driver |
| RS-232 port | At least one of COM1 to COM8 can be connected to PLC |
| Applicable Models | All Delta DVP-PLC series and C2000 series |

## 16-2 Precautions for Using PLC Functions

1. Default setting of PLC communication protocol is $7, \mathrm{~N}, 2,9600$, station number 2. User can change PLC station using Pr.09-35 but station address must be different to the AC motor drive's station address (Pr.09-00).
2. C2000 series offers 2 communication ports for PLC program upload and download. Refer to the figure follows for port location. The communication protocol of Channel 1 is always 19200,8,N,2 。

3. Host controller can read/write data from/to both the AC motor drive and the internal PLC program by setting the drive and internal PLC program to two different station numbers. For example, if user wants to set AC motor drive as station 1 and PLC as station 2, please write following setting to the host controller:
When setting 01(Station) 03(Read) 0400(Address) 0001(1 data), the host controller can read the Pr.04-00 from the AC motor drive.
When setting 02(Station) 03(Read) 0400(Address) 0001(1 data), host controller will read X0 data from the internal PLC program.
4. The internal PLC program will stop operation when upload/download programs.
5. When using WPR command to write parameters, parameters can be changed for a maximum of $10^{9}$ times. It is crucial not to exceed this limit to prevent occurrence of serious error. Number of calculations based on the value is changed. If the values which to be written is same as present data, the number does not add up. If the value to be written is different, the number calculated will be "plus-one."
6. When Pr.00-04 is set to 28, D1043 value of PLC register will be displayed on the digital keypad:

Digital Keypad KPC-CC01
Display range: 0~65535


Digital Keypad KPC-CE01
Display range: 0~9999

## $[9990$

Display for values exceed 9999
[1000
7. When PLC is in PLC Run or PLC Stop mode, Pr.00-02 (settings 9 and 10) are disabled.
8. When Pr.00-02 is set to 6 , PLC function settings will return to factory settings.
9. When the Input Terminal X of PLC is programmed, the corresponding MI will be disabled (no function).
10. When AC motor drive operation status is controlled by PLC function, the setting of Pr.00-21 has no function and the drive is fully under the control of PLC function.
11. When PLC function is programmed with FREQ command, AC motor drive frequency is now under PLC function control. The setting of Pr.00-20 and Hand ON/OFF are disabled and has no control over AC motor drive frequency.
12. When PLC is programmed with TORQ command, AC motor drive torque is now under PLC function control. The setting of Pr.11-33 and Hand ON/OFF function are disabled and has no control over AC motor drive torque.
13. When PLC is programmed with POS command, AC motor drive position is now under PLC function control. The setting of Pr.11-40 and Hand ON/OFF function are disabled and has no control over AC motor drive position.
14. If the Stop function of digital keypad is enabled when AC motor drive frequency is under PLC function control, the AC motor drive will trigger FStP error and AC motor drive will stop operation.

### 16.3 Start-up

### 16.3.1 The Steps for PLC Execution

Please operate PLC functions by following the steps indicate below:

1. Press menu key on KPC-CC01 $\rightarrow$ select 3: PLC $\rightarrow$ ENTER.


## $\square$ NOTE

When using KPC-CE01 series digital keypad, switch the mode to PLC2 for program download/upload:
A. Press MODE key and select 'PLC'.
B. Press 'UP' key and look for 'PLC2' then press 'ENTER'.
C. If succeed, display 'END' for one to two seconds and return to 'PLC2' page.

The PLC warning that is displayed before program downloaded to C2000 can be ignored, please continue the operation.
OLF
Disable

Run PLC
Pire
PLC Stop
2. Connection: Connect RJ-45 of AC motor drive to the computer by using RS485.


C2000
3. Run the program.

PLC

- 1.Disable
2.PLC Run
3.PLC Stop
- PLC function, select function 2 (PLC Run).

1: Disable (PLCO)
2: PLC Run (PLC1)
3: PLC Stop (PLC2)
Optional accessories: Digital keypad KPC-CE01, display PLC function as shown in the ().
When external input terminals (MI1~MI8) are set to PLC Mode select bit0 (51) or PLC Mode select bit1 (52), it will force to switch to PLC mode regardless the terminal is ON or OFF. Meanwhile, switching via keypad is disabled. Please refer to the chart below:

| PLC Mode | PLC Mode select bit1(52) | PLC Mode select bit0 (51) |
| :---: | :---: | :---: |
| Disable (PLC 0) | OFF | OFF |
| PLC Run (PLC 1) | OFF | ON |
| PLC Stop (PLC 2) | ON | OFF |
| Previous state | ON | ON |

When KPC-CE01 execute PLC function:

1. When switching the page from PLC to PLC1, it will execute PLC. The motion of PLC (Execute/Stop) is controlled by WPL editor.
2. When switching the page from PLC to PLC2, it will stop PLC. Again the motion of PLC (Execute/Stop) is controlled by WPL editor.
3. The control of external terminals follows the same method.

## NOTE

When input/output terminals (FWD REV MI1~MI8 MI10~15, Relay1, Relay2 RY10~RY15, MO1~MO2 MO10~MO11,) are used in PLC program, they cannot be used in other places. Fro example, when PLC program (PLC1 or PLC2) is activated, such as when it controls Y0, the corresponding output terminals Relay (RA/RB/RC) will be used. At this moment, Pr. 03.00 setting will be invalid since the terminal has been used by PLC. Refer to Pr.02-52, 02-53, 03-30 to check which DI DO AO are occupied by PLC.

### 16.3.2 I/O Device Reference Table

Input device:

| Device | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X10 | X11 | X12 | X13 | X14 | X15 | X16 | X17 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathbf{1}$ | FWD | REV | MI1 | MI2 | MI3 | MI4 | MI5 | MI6 | MI7 | MI8 |  |  |  |  |  |  |
| $\mathbf{2}$ |  |  |  |  |  |  |  |  |  |  | MI10 | MI11 | MI12 | MI13 | MI14 | MI15 |
| $\mathbf{3}$ |  |  |  |  |  |  |  |  |  |  | MI10 | MI11 | MI12 | MI13 |  |  |

1: I/O extension card
2: I/O extension card EMC-D611A (D1022=4)
3: I/O extension card EMC-D42A (D1022=5)
Output device:

| Device | YO | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y10 | Y11 | Y12 | Y13 | Y14 | Y15 | Y16 | Y17 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | RY 1 | RY2 |  | MO1 | MO2 |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  | MO10 | MO11 |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  | RY10 | RY11 | RY12 | RY13 | RY14 | RY15 |  |  |  |  |  |

1: I/O extension card
2: I/O extension card EMC-D42A (D1022=5)
3: I/O extension card EMC-R6AA (D1022=6)

### 16.3.3 WPLSoft Installation

Download PLC program toC2000: Refer to D. 3 to D. 7 for program coding and download the editor (WPLSoft V2.09) at DELTA website http://www.delta.com.tw/industrialautomation/


### 16.3.4 Program Input



### 16.3.5 Program Download

Please download the program by following steps:

Step 1. Press cive button for compiler after inputting program in WPLSoft.

Step 2. After compiler is finished, choose the item "Write to PLC" in the communication items.
After finishing Step 2, the program will be downloaded from WPLSoft to the AC motor drive by the communication format.

### 16.3.6 Program Monitor

If you execute "start monitor" in the communication item during executing PLC, the ladder diagram will be shown as follows.


### 16.4 Ladder Diagram

### 16.4.1 Program Scan Chart of the PLC Ladder Diagram

Calculate the result by ladder diagram algorithm (it doesn't sent to the outer output point but the inner equipment will output immediately.)


Repeats the execution in cycle.

### 16.4.2 Ladder Diagram

Ladder diagram is a diagram language that applied on the automatic control and it is also a diagram that made up of the symbols of electric control circuit. PLC procedures are finished after ladder diagram editor edits the ladder diagram. It is easy to understand the control flow that indicated with diagram and also accept by technical staff of electric control circuit. Many basic symbols and motions of ladder diagram are the same as mechanical and electrical equipments of traditional automatic power panel, such as button, switch, relay, timer, counter and etc.

The kinds and amounts of PLC internal equipment will be different with brands. Although internal equipment has the name of traditional electric control circuit, such as relay, coil and contact. It doesn't have the real components in it. In PLC, it just has a basic unit of internal memory. If this bit is 1 , it means the coil is ON and if this bit is 0 , it means the coil is OFF. You should read the corresponding value of that bit when using contact (Normally Open, NO or contact a). Otherwise, you should read the opposite sate of corresponding value of that bit when using contact (Normally Closed, NC or contact b). Many relays will need many bits, such as 8 -bits makes up a byte. 2 bytes can make up a word. 2 words make up double word. When using many relays to do calculation, such as add/subtraction or shift, you could use byte, word or double word. Furthermore, the two equipments, timer and counter, in PLC not only have coil but also value of counting time and times.

In conclusion, each internal storage unit occupies fixed storage unit. When using these equipments, the corresponding content will be read by bit, byte or word.

Brief introduction to the internal devices of PLC:

| Internal Device | Function |
| :---: | :---: |
| Input Relay | Input relay is the basic storage unit of internal memory that corresponds to external input point (it is the terminal that used to connect to external input switch and receive external input signal). Input signal from external will decide it to display 0 or 1 . You couldn't change the state of input relay by program design or forced ON/OFF via WPLSoft. The contacts (contact $a, b$ ) can be used unlimitedly. If there is no input signal, the corresponding input relay could be empty and can't be used with other functions. <br> V Equipment indication method: $\mathrm{X} 0, \mathrm{X} 1 \ldots \mathrm{X} 7, \mathrm{X} 10, \mathrm{X} 11 \ldots$ The symbol of equipment is X and numbering in octal. |
| Output Relay | Output relay is the basic storage unit of internal memory that corresponds to external output point (it is used to connect to external load). It can be driven by input relay contact, the contact of other internal equipment and itself contact. It uses a normally open contact to connect to external load and other contacts can be used unlimitedly as input contacts. It doesn't have the corresponding output relay, if need, it can be used as internal relay. <br> - Equipment indication: Y0, Y1...Y7, Y10, Y11... The symbol of equipment is Y and numbering in octal. |
| Internal Relay | The internal relay doesn't connect directly to outside. It is an auxiliary relay in PLC. Its function is the same as the auxiliary relay in electric control circuit. Each auxiliary relay has the corresponding basic unit. It can be driven by the contact of input relay, output relay or other internal equipment. Its contacts can be used unlimitedly. Internal auxiliary relay can't output directly, it should output with output point. <br> - Equipment indication: M0, M1...M799. The symbol of equipment is M and numbering in decimal system. |
| Counter | Counter is used to count. It needs to set counter before using counter (i.e. the pulse of counter). There are coil, contacts and storage unit of counter in counter. When coil is from OFF to ON, that means input a pulse in counter and the counter should add 1. There are 16-bit, 32 -bit and high-speed counter for user to use. <br> Equipment indication: $\mathrm{C} 0, \mathrm{C} 1 \ldots \mathrm{C} 79$. The symbol of equipment is C and numbering in decimal system. |
| Timer | Timer is used to control time. There are coil, contact and timer storage. When coil is ON , its contact will act (contact $a$ is close, contact $b$ is open) when attaining desired time. The time value of timer is set by settings and each timer has its regular period. User sets the timer value and each timer has its timing period. Once the coil is OFF, the contact won't act (contact $a$ is open and contact $b$ is close) and the timer will be set to zero. <br> ■ Equipment indication: T0, T1...T159. The symbol of equipment is T and numbering in decimal system. The different number range corresponds with the different timing period. |

PLC needs to handle data and operation when controlling each order, timer value and counter value. The data register is used to store data or parameters. It stores 16 -bit binary number, i.e. a word, in each register. It uses two continuous number of data register to store double words.
■ Equipment indication: D0, D1,...,D399. The symbol of equipment is D and numbering in decimal system.

The structure of ladder diagram and information:

| Ladder Diagram Structure | Explanation | Command | Device |
| :---: | :---: | :---: | :---: |
| $\longmapsto \vdash$ | Normally open, contact a | LD | X, Y, M, T, C |
| $\square$ | Normally closed, contact b | LDI | X, Y, M, T, C |
| - $\longmapsto \longmapsto ~-~$ | Serial normally open | AND | X, Y, M, T, C |
|  | Parallel normally open | OR | X, Y, M, T, C |
| $\xrightarrow{+\square \longmapsto}$ | Parallel normally closed | ORI | X, Y, M, T, C |
|  | Rising-edge trigger switch | LDP | X, Y, M, T, C |
| $\|\downarrow\| \downarrow$ | Falling-edge trigger switch | LDF | X, Y, M, T, C |
| $\dashv \vdash\|\uparrow\|$ | Rising-edge trigger in serial | ANDP | X, Y, M, T, C |
| $\multimap \longmapsto \vdash \mid$ | Falling-edge trigger in serial | ANDF | X, Y, M, T, C |
|  | Rising-edge trigger in parallel | ORP | X, Y, M, T, C |
|  | Falling-edge trigger in parallel | ORF | X, Y, M, T, C |
|  | Block in serial | ANB | none |
| $\square$ | Block in parallel | ORB | none |


| Ladder Diagram <br> Structure | Explanation | Command | Device |
| :--- | :--- | :---: | :---: |
|  | Multiple output | MPS <br> MRD <br> MPP | none |
|  | Output command of coil <br> drive | OUT | Y, M |
|  | Basic command, <br> Application command | Basic command/ <br> Application <br> command |  |
|  | Inverse logic | INV | none |

### 16.4.3 The Edition of PLC Ladder Diagram

The program edited method is from left power line to right power line. (The right power line will be omitted during the edited of WPLSoft.) After editing a row, go to editing the next row. The maximum contacts in a row are 11 contacts. If you need more than 11 contacts, you could have the new row and start with continuous line to continue more input devices. The continuous number will be produced automatically and the same input point can be used repeatedly. The drawing is shown as follows.


The operation of ladder diagram is to scan from left upper corner to right lower corner. The output handling, including the operation frame of coil and application command, at the most right side in ladder diagram.

Take the following diagram for example; we analyze the process step by step. The number at the right corner is the explanation order.


The explanation of command order:

| 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 |

The detail explanation of basic structure of ladder diagram

1. LD (LDI) command: give the command LD or LDI in the start of a block.


The structures of command LDP and LDF are similar to the command LD. The difference is that command LDP and LDF will act in the rising-edge or falling-edge when contact is ON as shown in the following.

2. AND (ANI) command: single device connects to a device or a block in series.


The structures of ANDP and ANDF are the same but the action is in rising-edge or falling-edge.
3. OR (ORI) command: single device connects to a device or a block.



The structures of ORP and ORF are the same but the action is in rising-edge or falling-edge.
4. ANB command: a block connects to a device or a block in series.

5. ORB command: a block connects to a device or a block in parallel.


If there are several blocks when operate ANB or ORB, they should be combined to blocks or network from up to down or from left to right.
6. MPS, MRD, MPP commands: Divergent memory of multi-output. It can produce many various outputs.
7. The command MPS is the start of divergent point. The divergent point means the connection place between horizontal line and vertical line. We should determine to have contact memory command or not according to the contacts status in the same vertical line. Basically, each contact could have memory command but in some places of ladder diagram conversion will be omitted due to the PLC operation convenience and capacity limit. MPS command can be used for 8 continuous times and you can recognize this command by the symbol " $T$ ".
8. MRD command is used to read memory of divergent point. Because the logical status is the same in the same horizontal line, it needs to read the status of original contact to keep on analyzing other ladder diagram. You can recognize the command MRD by the symbol " $F$ ".
9. MPP command is used to read the start status of the top level and pop it out from stack. Because it is the last item of the horizontal line, it means the status of this horizontal line is ending.


### 16.4.4 The Example for Designing Basic Program

## Start, Stop and Latching

In the same occasions, it needs transient close button and transient open button to be start and stop switch. Therefore, if you want to keep the action, you should design latching circuit. There are several latching circuits in the following:

## Example 1: the latching circuit for priority of stop

When start normally open contact $\mathrm{X} 1=\mathrm{On}$, stop normally contact $\mathrm{X} 2=\mathrm{Off}$, and $\mathrm{Y} 1=\mathrm{On}$ are set at the same time, if $\mathrm{X} 2=\mathrm{On}$, the coil Y1 will stop acting. Therefore, it calls priority of stop.


## Example 2: the latching circuit for priority of start

When start normally open contact $\mathrm{X} 1=\mathrm{On}$, stop normally contact $\mathrm{X} 2=\mathrm{Off}$ and $\mathrm{Y} 1=\mathrm{On}$ (coil Y1 will be active and latching) are valid at the same time, if $\mathrm{X} 2=\mathrm{On}$, coil Y 1 will be active due to latched contact. Therefore, it calls priority of start.


## Example 3: the latching circuit of SET and RST commands

The figure at the right side is latching circuit that made up of RST and SET command. It is top priority of stop when RST command is set behind SET command. When executing PLC from up to down, The coil Y1 is ON and coil Y 1 will be OFF when X 1 and X 2 act at the same time, therefore it calls priority of stop.
It is top priority of start when SET command is set after RST command. When X1 and X 2 act at the same time, Y 1 is ON so it calls top priority of start.

Top priority of stop


Top priority of start


## The common control circuit

## Example 4: condition control

X1 and X3 can start/stop Y1 separately, X2 and X4 can start/stop Y2 separately and they are all self latched circuit. Y 1 is an element for Y 2 to do AND function due to the normally open contact connects to Y 2 in series. Therefore, Y 1 is the input of Y 2 and Y 2 is also the input of Y 1 .


## Example 5: Interlock control

The figure above is the circuit of interlock control. Y1 and Y2 will act according to the start contact X1 and X2. Y1 and Y2 will act not at the same time, once one of them acts and the other won't act. (This is called interlock.) Even if X 1 and X 2 are valid at the same time, Y 1 and Y 2 won't act at the same time due to up-to-down scan of ladder diagram. For this ladder diagram, Y 1 has higher priority than Y 2 .


## Example 6: Sequential Control



If add normally close contact Y 2 into Y 1 circuit to be an input for Y1 to do AND function. (as shown in the left side) Y 1 is an input of Y 2 and Y 2 can stop Y 1 after acting. In this way, Y 1 and Y 2 can execute in sequential.

## Example 7: Oscillating Circuit

The period of oscillating circuit is $\Delta T+\Delta T$

Y1


The figure above is a very simple ladder step diagram. When starting to scan Y 1 normally close contact, Y1 normally close contact is close due to the coil Y1 is OFF. Then it will scan Y1 and the coil Y1 will be ON and output 1 . In the next scan period to scan normally close contact $\mathrm{Y} 1, \mathrm{Y} 1$ normally close contact will be open due to Y 1 is ON. Finally, coil Y 1 will be OFF. The result of repeated scan, coil $Y$ will output the vibrating pulse with cycle time $\Delta T$ (On) $+\Delta T$ (Off).

The vibrating circuitry of cycle time $\Delta T(O n)+\Delta T$ (Off):


The figure above uses timer T0 to control coil Y1 to be ON. After Y1 is ON, timer T0 will be closed at the next scan period and output Y1. The oscillating circuit will be shown as above. ( $n$ is the setting of timer and it is decimal number. $T$ is the base of timer. (clock period))

## Example 8: Blinking Circuit



The figure above is common used oscillating circuit for indication light blinks or buzzer alarms. It uses two timers to control On/OFF time of Y1 coil. If figure, n 1 and n 2 are timer setting of T1 and T2. T is the base of timer (clock period)

Example 9: Triggered Circuit


In figure above, the rising-edge differential command of X 0 will make coil M 0 to have a single pulse of $\Delta T$ (a scan time). Y1 will be ON during this scan time. In the next scan time, coil M0 will be OFF, normally close M0 and normally close Y1 are all closed. However, coil Y1 will keep on being ON and it will make coil Y1 to be OFF once a rising-edge comes after input $\mathrm{X0}$ and coil MO is ON for a scan time. The timing chart is as shown above. This circuit usually executes alternate two actions with an input. From above timing: when input $X 0$ is a square wave of a period $T$, output coil Y 1 is square wave of a period 2 T .

## Example 10: Delay Circuit



When input X 0 is ON , output coil Y 1 will be ON at the same time due to the corresponding normally close contact OFF makes timer T10 to be OFF. Output coil Y1 will be OFF after delaying 100 seconds (K1000*0.1 seconds $=100$ seconds) once input X0 is OFF and T10 is ON. Please refer to timing chart above.

Example 11: Output delay circuit, in the following example, the circuit is made up of two timers.

No matter input X0 is ON or OFF, output Y4 will be delay.


## Example12: Extend Timer Circuit

In this circuit, the total delay time from input X 0 is close and output Y 1 is $\mathrm{ON}=(\mathrm{n} 1+\mathrm{n} 2)^{*} \mathrm{~T}$. where T is clock period. Timer: T11, T12; Timer cycle: T.


### 16.5 PLC Devices Function

$\left.$| Items | Specifications | Remarks |
| :--- | :--- | :--- |
| Control Method | Stored program, cyclic scan <br> system | Batch processing (when END <br> instruction is executed) | | I/O refresh instruction is |
| :--- |
| available | \right\rvert\, | I/O Processing Method | Basplication commands (1 ~ <br> dozens us) |
| :--- | :--- | :--- |
| Exs) |  | | Execution Speed |
| :--- |
| Program Language |
| Instruction, Ladder Logic, SFC |


|  | Device | Item |  | Range |  | Function |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | External Input Relay |  | X0~X17, 16 points, octal number system | Total is 32 points | Correspond to external input point |
|  | Y | External Output Relay |  | Y0~Y17, 16 points, octal number system |  | Correspond to external output point |
|  | M | Auxiliary | For general | M0~M799, 800 points | Total is 192 points | Contacts can switch to On/Off in program |
|  |  |  | For special | $\begin{aligned} & \text { M1000~M1079, } 80 \\ & \text { points } \end{aligned}$ |  |  |
|  | T | Timer | 100ms timer | T0~T159, 160 points | Total is 16 points | When the timer indicated by TMR command attains the setting, the T contact with the same number will be On. |
|  | C | Counter | 16-bit count up for general | C0~C79, 80 points | Total is 80 points | When the counter indicated by CNT command attains the setting, the C contact with the same number will be On. |
|  | T | Present value of timer |  | T0~T15, 160 points |  | When timer attains, the contact of timer will be On. |
|  | C | Present value of counter |  | C0~C79, 16-bit counter, 80 points |  | When timer attains, the contact of timer will be On. |
|  | D | Data register | For latched | D0~D399, 400 points | Total is 1300 points | It can be memory area for storing data. |
|  |  |  | For general | $\begin{aligned} & \text { D1000~D1099, } 100 \\ & \text { points } \end{aligned}$ |  |  |
|  |  |  | For special | $\begin{aligned} & \text { D2000~D2799, } 800 \\ & \text { points } \end{aligned}$ |  |  |
| $\begin{array}{\|l} \hline \stackrel{\rightharpoonup}{\mathrm{C}} \\ \text { त్ } \\ 0 \\ 0 \\ \hline 0 \\ \hline \end{array}$ | K | Decimal |  | K-32,768 ~ K32,767 (16-bit operation) |  |  |
|  | H | Hexadecimal |  | H0000 ~ HFFFF (16-bit operation) |  |  |
| Communication port (program read/write) |  |  |  | RS485 (slave) |  |  |
| Analog input/output |  |  |  | Built-in 2 analog inputs and 1 analog output |  |  |
| Function extension module (optional) |  |  |  | EMC-D42A; EMC-R6AA; EMCD611A |  |  |

### 16.5.1 Devices Functions

## The Function of Input/output Contacts

The function of input contact $X$ : input contact $X$ reads input signal and enter PLC by connecting with input equipment. It is unlimited usage times for contact $A$ or contact $B$ of each input contact $X$ in program. The On/Off of input contact $X$ can be changed with the On/Off of input equipment but can't be changed by using peripheral equipment (WPLSoft).

## The Function of Output Contact Y

The mission of output contact $Y$ is to drive the load that connects to output contact $Y$ by sending On/Off signal. There are two kinds of output contact: one is relay and the other is transistor. It is unlimited usage times for $A$ or $B$ contact of each output contact $Y$ in program. But there is number for output coil Y and it is recommended to use one time in program. Otherwise, the output result will be decided by the circuit of last output Y with PLC program scan method.


The output of YO will be decided by circuit 2 , i.e. decided by On/Off of X10.

## Value, Constant [K] / [H]

| Constant | K | Decimal | K-32,768 ~ K32,767 (16-bit operation) |
| :--- | :--- | :--- | :--- |
|  | H | Hexadecimal | H0000 ~ HFFFF (16-bit operation) |

There are five value types for DVP-PLC to use by the different control destination. The following is the explanation of value types.
Binary Number (BIN)
It uses binary system for the PLC internal operation or storage. The relative information of binary system is in the following.

| Bit | Bit is the basic unit of binary system, the status are 1 or 0. |
| :--- | :--- |
| Nibble | It is made up of continuous 4 bits, such as b3~b0. It can be used to represent <br> number 0~9 of decimal or 0~F of hexadecimal. |
| Byte | It is made up of continuous 2 nibbles, i.e. 8 bits, b7~b0. It can used to represent <br> $00 \sim$ FF of hexadecimal system. |
| Word | It is made up of continuous 2 bytes, i.e. 16-bit, b15~b0. It can used to represent <br> $0000 \sim$ FFFF of hexadecimal system. |
| Double Word | It is made up of continuous 2 words, i.e. 32-bit, b31~b0. It can used to represent <br> $00000000 \sim$ FFFFFFFF of hexadecimal system. |

The relations among bit, nibble, byte, word, and double word of binary number are shown as follows.

> Octal Number (OCT)
The numbers of external input and output terminal of DVP-PLC use octal number.
Example:
External input: $\mathrm{X0} \mathrm{\sim X7}, \mathrm{X} 10 \sim \mathrm{X17} \ldots$ (device number)
External output: Y0~Y7, Y10~Y17... (device number)
> Decimal Number, DEC
The suitable time for decimal number to be used in DVP-PLC system.
■ To be the setting value of timer T or counter C , such as TMR C0 K50. (K constant)
$\square$ To be the device number of $M, T, C$ and $D$. For example: M10, T30. (device number)
■ To be operand in application command, such as MOV K123 D0. (K constant)
> Binary Code Decimal (BCD)
It shows a decimal number by a unit number or four bits so continuous 16-bit can use to represent the four numbers of decimal number. BCD code is usually used to read the input value of DIP switch or output value to 7 -segment display to be display.
> Hexadecimal Number (HEX)
The suitable time for hexadecimal number to be used in DVP-PLC system.
$\square$ To be operand in application command. For example: MOV H1A2B D0. (constant H)
> Constant K :
In PLC, it is usually have K before constant to mean decimal number. For example, K100 means 100 in decimal number.
Exception: The value that is made up of K and bit equipment $\mathrm{X}, \mathrm{Y}, \mathrm{M}, \mathrm{S}$ will be bit, byte, word or double word. For example, K2Y10, K4M100. K1 means a 4-bit data and K2~K4 can be 8, 12 and 16-bit data separately.
> Constant H :
In PLC, it is usually have H before constant to mean hexadecimal number. For example, H 100 means 100 in hexadecimal number.

## The Function of Auxiliary Relay

There are output coil and $\mathrm{A}, \mathrm{B}$ contacts in auxiliary relay M and output relay Y . It is unlimited usage times in program. User can control loop by using auxiliary relay, but can't drive external load directly. There are two types divided by its characteristics.
1.Auxiliary relay for general : It will reset to Off when power loss during running. Its state will be Off when power on after power loss.
2.Auxiliary relay for special : Each special auxiliary relay has its special function.

Please don't use undefined auxiliary relay.

## The Function of Timer

The unit of timer is $1 \mathrm{~ms}, 10 \mathrm{~ms}$ and 100 ms . The count method is count up. The output coil will be On when the present value of timer equals to the settings. The setting is K in decimal number. Data register $D$ can be also used as settings.

- The real setting time of timer $=$ unit of timer * settings


## The Features and Functions of Counter

| Item | 16-bit counters | 32-bit counters |
| :--- | :--- | :--- |
| Type | General | General |
| Count direction speed | Count up | Count up/down |
| Settings | $0 \sim 32,767$ | $-2,147,483,648 \sim+2,147,483,647$ |
| Designate for <br> constant | Constant K or data register D | Constant K or data register D (2 for designated) |
| Present value <br> change | Counter will stop when attaining <br> settings | Counter will keep on counting when attaining <br> settings |
| Output contact | When count attains the settings <br> value, contact will be On and <br> latched. | When count up attains settings, contact will be <br> On and latched. <br> When count down attains settings, contact will <br> reset to Off. |
| Reset action | The present value will reset to 0 <br> reset to Off. | 32-bit |
| Present register command is executed and contact will |  |  |
| Contact action | After scanning, act together. | After scanning, act together. <br> Act immediately when count attains. It has no <br> relation with scan period. |

## Functions:

When pulse input signal of counter is from Off to On, the present value of counter equals to settings and output coil is On. Settings are decimal system and data register D can also be used as settings. 16-bit counters C0~C79:
$\checkmark \quad$ Setting range of 16 -bit counter is $\mathrm{K} 0 \sim \mathrm{~K} 32$, 767 . ( K 0 is the same as K 1 . output contact will be On immediately at the first count.
$\checkmark$ General counter will be clear when PLC is power loss. If counter is latched, it will remember the value before power loss and keep on counting when power on after power loss.
$\checkmark$ If using MOV command, WPLSoft to send a value, which is large than setting to C0, register, at the next time that X 1 is from Off to On, C 0 counter contact will be On and present value will be set to the same as settings.
$\square \quad$ The setting of counter can use constant $K$ or register $D$ (not includes special data register D1000~D1044) to be indirect setting.
$\checkmark$ If using constant $K$ to be setting, it can only be positive number but if setting is data register $D$, it can be positive/negative number. The next number that counter counts up from 32,767 is -32,768.

Example:


1. When $\mathrm{X} 0=\mathrm{On}, \mathrm{RST}$ command is executed, C 0 reset to 0 and output contact reset to Off.
2. When X1 is from Off to On, counter will count up (add 1).
3. When counter CO attains settings $\mathrm{K} 5, \mathrm{C} 0$ contact is On and $\mathrm{C} 0=$ setting $=\mathrm{K} 5 . \mathrm{C} 0$ won't accept X1 trigger signal and C0 remains K5.


### 16.5.2 Special Auxiliary Relays

| Special M | Function | Read(R)/ <br> Write(W) |
| :---: | :---: | :---: |
| M1000 | Normally open contact (a contact). This contact is On when running and it is On when the status is set to RUN. | Read only |
| M1001 | Normally closed contact (b contact). This contact is Off when running and it is Off when the status is set to RUN. | Read only |
| M1002 | On only for 1 scan after RUN. Initial pulse is contact a. It will get positive pulse in the RUN moment. Pulse width=scan period. | Read only |
| M1003 | Off only for 1 scan after RUN. Initial pulse is contact a. It will get negative pulse in the RUN moment. Pulse width=scan period. | Read only |
| M1004 | Reserved | - |
| M1005 | Fault indication of the AC motor drives | Read only |
| M1006 | Output frequency is 0, M1006 On | Read only |
| M1007 | Operation direction of AC motor drives (FWD: M1007 Off, REV: M1007On) | Read only |
| M1008 <br> M1010 | Reserved | - |
| M1011 | 10ms clock pulse, 5 ms On/5ms Off | Read only |
| M1012 | 100ms clock pulse, $50 \mathrm{~ms} \mathrm{On} / 50 \mathrm{~ms} \mathrm{Off}$ | Read only |
| M1013 | 1s clock pulse, $0.5 \mathrm{~s} \mathrm{On} / 0.5 \mathrm{~s}$ Off | Read only |
| M1014 | 1min clock pulse, 30s On / 30s Off | Read only |


| Special $\mathrm{M}$ | Function | Read(R)/ <br> Write(W) |
| :---: | :---: | :---: |
| M1015 | Frequency attained, M1015=On | Read only |
| M1016 | Parameter read/write error, M1016=On | Read only |
| M1017 | Succeed to write parameter, M1017 =On | Read only |
| M1018 | Reserved | - |
| M1019 | Reserved | - |
| M1020 | Zero flag | Read only |
| M1021 | Borrow flag | Read only |
| M1022 | Carry flag | Read only |
| M1023 | Divisor is 0 | Read only |
| M1024 | Reserved | - |
| M1025 | RUN(ON) / STOP(OFF) the AC motor drive | Read/Write |
| M1026 | The operation direction of the AC motor drive (FWD: OFF, REV: ON) | Read/Write |
| M1027 | AC motor drive reset | Read/Write |
| M1028 | Reserved | - |
| M1029 | Reserved | - |
| M1030 | Reserved | - |
| M1031 | The enforced integral value of PID is D1019 | Read/Write |
| M1032 | Reserved | - |
| M1033 | Reserved | - |
| M1034 | Enable CANopen real time control | Read/Write |
| M1035 | Enable internal communication control | Read/Write |
|  | Reserved | - |
| M1038 | Start counting MI8 | Read/Write |
| M1039 | Reset MI8 counting value | Read/Write |
| M1040 | Power On | Read/Write |
| M1041 | Reserved | - |
| M1042 | Quick stop | Read/Write |
| M1043 | Reserved | - |
| M1044 | Halt | Read/Write |
| M1045 <br> M1047 | Reserved | - |
| M1048 | New position | Read/Write |
| M1049 | Reserved | - |
| M1050 | Absolute position/Relatvie position(0: Relative/1:Absolute) | Read/Write |
| M1051 | Reserved | - |
| M1052 | Freuqency Lock | Read/Write |
| M1053 | Reserved | - |
| M1054 | Enforced to reset the absolute position |  |


| Special M | Function | Read(R)/ <br> Write(W) |
| :---: | :---: | :---: |
| M1055 | Home | Read/Write |
| M1056 | Power on ready | Read only |
| M1057 | Reserved | - |
| M1058 | On quick stopping | Read only |
| M1059 | CANopen master setting complete | Read only |
| M1060 | Initializing CANopen slave | Read only |
| M1061 | Initialize CANopen slave failed | Read only |
| M1062 | Reserved |  |
| M1063 | Target torque attained | Read only |
| M1064 | Target position attained | Read only |
| M1065 | Reserved | Read only |
| M1066 | Read/ Write CANopen data complete | Read only |
| M1067 | Read/ Write CANopen data suceed | Read only |
| M1068 | Calendare calculation error | - |
| M1069 | Reserved | - |
| M1070 | Homing complete | Read only |
| M1071 | Home error | Read only |
| M1072 <br> M1075 | Reserved | - |
| M1076 | Calendar time error or overtime updating | Read only |
| M1077 | 485 Reading \& Writing done | Read only |
| M1078 | 485 Reading \& Writing error | Read only |
| M1079 | 485 communication overtime | Read only |

### 16.5.3 Special Registers

| Special D | Function | Read(R)/ <br> Write(W) |
| :---: | :---: | :---: |
| D1000 | Reserved | - |
| D1001 | PLC firmware version | Read only |
| D1002 | Program capacity | Read only |
| D1003 | Checksum | Read only |
| $\begin{aligned} & \text { D1004 } \\ & \text { D1009 } \end{aligned}$ | Reserved | - |
| D1010 | Present scan time (Unit: 0.1 ms ) | Read only |
| D1011 | Minimum scan time (Unit: 0.1 ms ) | Read only |
| D1012 | Maximum scan time (Unit: 0.1 ms ) | Read only |
| $\begin{aligned} & \text { D1013 } \\ & \text { D1019 } \\ & \hline \end{aligned}$ | Reserved | - |
| D1020 | Output frequency (0.000~600.00Hz) | Read only |


| Special D | Function | Read(R)/ <br> Write(W) |
| :---: | :---: | :---: |
| D1021 | Output current (\#\#\#\#.\#A) | Read only |
| D1022 | The ID of the extension card: <br> 0 : no card <br> 1: Relay Card( 6 out ) <br> 2: I/O Card ( 4 in 2 out ) <br> 3~7: Reserved | Read only |
| D1023 | The ID of the extension card: <br> 0 : no card <br> 1: DeviceNet Slave <br> 2: Profibus-DP Slave <br> 3: CANopen Slave <br> 4: Modbus-TCP Slave <br> 5: EtherNet/IP Slave <br> 6~8: Reserved | Read only |
| $\begin{aligned} & \text { D1024 } \\ & \text { D1026 } \end{aligned}$ | Reserved | - |
| D1027 | Frequency command of the PID control | Read only |
| D1028 | The responsive value of AUI AVI (analog voltage input) (0.00~100.00\%) | Read only |
| D1029 | The responsive value of AUI ACI (analog current input) (0.0~100.00\%) | Read only |
| D1030 | The corresponding value for AUI (-100.0~100.00\%) | Read only |
| $\begin{aligned} & \text { D1031 } \\ & \text { D1035 } \end{aligned}$ | Reserved | - |
| D1036 | AC motor drive error code | Read only |
| D1037 | AC motor drive output frequency | Read only |
| D1038 | DC Bus voltage | Read only |
| D1039 | Output voltage | Read only |
| D1040 | Analog output value AFM1 (-100.00~100.00\%) | Read/Write |
| $\begin{aligned} & \text { D1041 } \\ & \text { D1042 } \end{aligned}$ | Reserved | - |
| D1043 | User defined (When Pr.00.04 is set to 28, the register data will be displayed as C xxx) | Read/Write |
| D1044 | Reserved | - |
| D1045 | Analog output value AFM2 (-100.00~100.00\%) | Read/Write |
| $\begin{aligned} & \text { D1046 } \\ & \text { D1049 } \end{aligned}$ | Reserved |  |
| D1050 | Actual mode <br> 0 : Velocity mode <br> 1: Position mode <br> 2: Torque mode <br> 3: Homing mode | Read only |
| $\begin{aligned} & \text { D1051 } \\ & \text { D1052 } \end{aligned}$ | Reserved | - |
| D1053 | Actual torque | Read only |
| D1054 | Present count value of MI8(L word) |  |
| D1055 | Present count value of MI8 (H word) |  |


| Special D | Function | Read(R)/ Write(W) |
| :---: | :---: | :---: |
| $\begin{aligned} & \text { D1056 } \\ & \text { D1059 } \end{aligned}$ | Reserved | Read only |
| D1060 | Mode setting <br> 0: Speed Mode <br> 1: Position Mode <br> 2: Torque Mode <br> 3: Homing Mode | Read/Write |
| $\begin{aligned} & \text { D1061 } \\ & \text { D1069 } \end{aligned}$ | Reserved | Read/Write |
| D1100 | Tartget frequency | Read only |
| D1101 | Target frequency (operating) | Read only |
| D1102 | Reference frequency | Read only |
| D1103 | Target position L | Read only |
| D1104 | Target position H | Read only |
| D1105 | Target torque | Read only |
| D1106 | - |  |
| D1107 | - | - |
| D1108 | - | - |
| D1109 | Random value | Read only |
| D1110 | Number of internal communication nodes | RW |
| D1111 | - | - |
| D1112 | - | - |
| D1113 | - | - |
| D1114 | - | - |
| D1115 | Synchronous time cycle of internal communication | Read only |
| D1116 | Internal communication node error | Read only |
| D1117 | Corresponding on-line bit of internal communication node | Read only |
| D1118 | - | - |
| D1119 | Random value | Read only |
| D1120 | Control command of internal communication node 0 | Read/Write |
| D1121 | Mode of internal communication node 0 | Read/Write |
| D1122 | Reference command L of internal communication node 0 | Read/Write |
| D1123 | Referenc command H of internal communication node 0 | Read/Write |
| D1124 | - | - |
| D1125 | - | - |
| D1126 | Status of internal communication node 0 | Read only |
| D1127 | Reference status L of internal communication node 0 | Read only |
| D1128 | Reference status H of internal communication node 0 | Read only |
| D1129 | - | - |
| D1130 | Control command of internal communication node 1 | Read/Write |
| D1131 | Mode of internal communication node 1 | Read/Write |
| D1132 | Reference command L of internal communication node 1 | Read/Write |
| D1133 | Referenc command H of internal communication node 1 | Read/Write |
| D1134 | - | - |
| D1135 | - | - |
| D1136 | Status of internal communication node 1 | Read only |
| D1137 | Reference status L of internal communication node 1 | Read only |
| D1138 | Reference status H of internal communication node 1 | Read only |
| D1139 | - | - |
| D1140 | Control command of internal communication node 2 | Read/Write |
| D1141 | Mode of internal communication node 2 | Read/Write |
| D1142 | Reference command L of internal communication node 2 | Read/Write |
| D1143 | Referenc command H of internal communication node 2 | Read/Write |


| Special D | Function | $\operatorname{Read}(\mathrm{R}) /$ Write(W) |
| :---: | :---: | :---: |
| D1144 | - | - |
| D1145 | - | - |
| D1146 | Status of internal communication node 2 | Read only |
| D1147 | Reference status L of internal communication node 2 | Read only |
| D1148 | Reference status H of internal communication node 2 | Read only |
| D1149 | - | - |
| D1150 | Control command of internal communication node 3 | Read/Write |
| D1151 | Mode of internal communication node 3 | Read/Write |
| D1152 | Reference command L of internal communication node 3 | Read/Write |
| D1153 | Referenc command H of internal communication node 3 | Read/Write |
| D1154 | - | - |
| D1155 | - | - |
| D1156 | Status of internal communication node 3 | Read only |
| D1157 | Reference status L of internal communication node 3 | Read only |
| D1158 | Reference status H of internal communication node 3 | Read only |
| D1159 | - | - |
| D1160 | Control command of internal communication node 4 | Read/Write |
| D1161 | Mode of internal communication node 4 | Read/Write |
| D1162 | Reference command L of internal communication node 4 | Read/Write |
| D1163 | Referenc command H of internal communication node 4 | Read/Write |
| D1164 | - | - |
| D1165 | - | - |
| D1166 | Status of internal communication node 4 | Read only |
| D1167 | Reference status L of internal communication node 4 | Read only |
| D1168 | Reference status H of internal communication node 4 | Read only |
| D1169 | - | - |
| D1170 | Control command of internal communication node 5 | Read/Write |
| D1171 | Mode of internal communication node 5 | Read/Write |
| D1172 | Reference command L of internal communication node 5 | Read/Write |
| D1173 | Referenc command H of internal communication node 5 | Read/Write |
| D1174 | - | - |
| D1175 | - | - |
| D1176 | Status of internal communication node 5 | Read only |
| D1177 | Reference status L of internal communication node 5 | Read only |
| D1178 | Reference status H of internal communication node 5 | Read only |
| D1179 | - | - |
| D1180 | Control command of internal communication node 6 | Read/Write |
| D1181 | Mode of internal communication node 6 | Read/Write |
| D1182 | Reference command L of internal communication node 6 | Read/Write |
| D1183 | Referenc command H of internal communication node 6 | Read/Write |
| D1184 | - | - |
| D1185 | - | - |
| D1186 | Status of internal communication node 6 | Read only |
| D1187 | Reference status L of internal communication node 6 | Read only |
| D1188 | Reference status H of internal communication node 6 | Read only |
| D1189 | - | - |
| D1190 | Control command of internal communication node 7 | Read/Write |
| D1191 | Mode of internal communication node 7 | Read/Write |
| D1192 | Reference command L of internal communication node 7 | Read/Write |
| D1193 | Referenc command H of internal communication node 7 | Read/Write |
| D1194 | - | - |
| D1195 | - | - |
| D1196 | Status of internal communication node 7 | Read only |
| D1197 | Reference status L of internal communication node 7 | Read only |


| Special D | Function | Read(R)/ <br> Write(W) |
| :--- | :--- | :--- |
| D1198 | Reference status H of internal communication node 7 | Read only |
| D1199 | - | Read only |

CANopen Master Special D (Special D can be written only when PLC is at STOP)

$$
\mathrm{n}=0 \sim 7
$$

| Special D | Function | PDO Map | Power Failure Memor y | Factory Setting | R/W |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D1070 | The station which completed CANopen initialization (bit0=Machine code0 | NO | NO | 0 | R |
| D1071 | The station which error occurs during CANopen initialization (bit0=Machine code0 .......) | NO | NO | 0 | R |
| D1072 | Reserved | - | - |  | - |
| D1073 | CANopen station cut off (bit0=Machine code0 .......) | NO | NO |  | R |
| D1074 | Error code of master error <br> 0 : no error <br> 1: slave setting error <br> 2: synchronous cycle setting error (the setting is too low) | NO | NO | 0 | R |
| D1075 | Reserved | - | - |  | - |
| D1076 | SDO fault (main index value) | NO | NO |  | R |
| D1077 | SDO fault (sub-index value) | NO | NO |  | R |
| D1078 | SDO fault (error code L) | NO | NO |  | R |
| D1079 | SDO fault (error code H) | NO | NO |  | R |
| D1080 | Reserved | - | - |  | - |
| $\begin{gathered} \text { D1081 } \\ \sim \\ \text { D1086 } \end{gathered}$ | Reserved | NO | NO |  | R |
| $\begin{aligned} & \text { D1087 } \\ & \text { D1089 } \end{aligned}$ | Reserved | - | - |  | - |
| D1090 | Synchronous cycle setting | NO | YES | 4 | RW |
| D1091 | The station for initialization during initializing process. | NO | YES | FFFFH | RW |
| D1092 | Delay time before initializing | NO | YES | 0 | RW |
| D1093 | Break off detection time | NO | YES | 1000 ms | RW |
| D1094 | Times of Break off detection | NO | YES | 3 | RW |
| $\begin{gathered} \text { D1095 } \\ \text { D1096 } \end{gathered}$ | Reserved | - | - |  | - |
| D1097 | Type of $P$ to $P$ send (PDO) Setting range: 1~240 | NO | YES | 1 | RW |
| D1098 | Type of $P$ to $P$ received (PDO) Setting range: 1~240 | NO | YES | 1 | RW |
| D1099 | Delay time of initialization complete Setting range: 1~60000 sec. | NO | YES | 15 sec | RW |


| Special D | Function | PDO <br> Map | Power <br> Failure <br> Memor <br> Factory | Setting |
| :---: | :--- | :---: | :---: | :---: | :---: | R/W

C2000 supports up to 8 CANopen protocol slaves; each slave occupies 100 of special D register and is numbered in $1 \sim 8$. There are in total of 8 stations.

| Slave No. | Slave No. 1 | $\begin{gathered} \text { D2000 } \\ \text { D2001 } \\ \sim \\ \text { D2099 } \end{gathered}$ | Station number <br> Factory code(L) <br> Mapping address $4(\mathrm{H})$ of receiving station |
| :---: | :---: | :---: | :---: |
|  | Slave No. 2 | D2100 | Station number |
|  |  | D2101 | Factory code(L) |
|  |  | ~ |  |
|  |  | D2199 | Mapping address 4(H) of receiving station $4$ |
|  | Slave No. 3 | D2200 | Station number |
|  |  | D2201 | Factory code(L) |
|  |  | ~ | ~ |
|  |  | D2299 | Mapping address $4(\mathrm{H})$ of receiving station |
|  |  |  |  |
|  |  | $\sqrt{3}$ |  |
|  | Slave No. 8 | D2700 | Station number |
|  |  | D2701 | Factory code(L) |
|  |  | ~ |  |
|  |  | D2799 | Mapping address 4(H)of receiving station |

Slave No. 0~7

- : PDOTX, A: PDORX, $\square$ : To upate by a CANFLS command

| Special D | Function | Pre-defined setting | R/W |
| :---: | :---: | :---: | :---: |
| D2000+100*n | Station number of slave No. n <br> Setting range: 0~127 <br> 0 : CANopen disable | 0 | RW |
| D2001+100*n | The category of slave No. $n$ <br> 192H: AC motor drive/ AC servo motor and drive <br> 191H: remote I/O module | 0 | R |
| D2002+100*n | Factory code (L) of slave No. n | 0 | R |
| D2003+100*n | Factory code (H) of slave No. n | 0 | R |
| D2004+100*n | Factory product code (L) of slave No. n | 0 | R |
| D2005+100*n | Factory product code (H) of slave No. n | 0 | R |

Basic definition

| Special D | Function | Pre-definedsetting | CAN <br> Index | PDO |  |  |  | R/W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 1 | 2 | 3 | 4 |  |
| D2006+100*n | Treatment for slave No. n communication disconnect | 0 | $6007 \mathrm{H}-0010 \mathrm{H}$ | - |  | - | - | RW |
| D2007+100*n | Error code of slave No. n | 0 | $603 \mathrm{FH}-0010 \mathrm{H}$ | $\bullet$ |  | - | - | R |
| D2008+100*n | Control word of slave No. n | 0 | $6040 \mathrm{H}-0010 \mathrm{H}$ |  |  |  |  | RW |
| D2009+100*n | Status word of slave No. n | 0 | $6041 \mathrm{H}-0010 \mathrm{H}$ |  |  |  |  | R |
| D2010+100*n | Control mode of slave No. n | 2 | $6060 \mathrm{H}-0008 \mathrm{H}$ |  |  |  |  | RW |
| D2011+100*n | Actual mode of slave No. n | 2 | $6061 \mathrm{H}-0008 \mathrm{H}$ |  |  |  |  | R |

Speed Control
Slave No. 0~7

| Special D | Function | Pre-defined Setting | CAN Index | PDO |  |  |  | R/W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 1 | 2 | 3 | 4 |  |
| D2012+100*n | Target speed of slave No. n | 0 | $6042 \mathrm{H}-0010 \mathrm{H}$ | - |  |  |  | RW |
| D2013+100*n | Actual speed of slave No. $n$ | 0 | $6043 \mathrm{H}-0010 \mathrm{H}$ | $\bullet$ |  |  |  | R |
| D2014+100*n | Speed deviation of slave No. n | 0 | $6044 \mathrm{H}-0010 \mathrm{H}$ |  |  |  |  | R |
| D2015+100*n | Accel. Time of slave No. n | 1000 | 604FH-0020H |  |  |  |  | R |
| D2016+100*n | Decel. Time of slave No. n | 1000 | 6050H-0020H |  |  |  |  | RW |

Torque control
Slave No. 0~7

| Special D | Function | Pre-defined Setting | CAN Index | PDO |  |  |  | R/W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 1 | 2 | 3 | 4 |  |
| D2017+100*n | Target torque of slave No. n | 0 | 6071H-0010H |  |  |  | - | RW |
| D2018+100*n | Actual torque of slave No. n | 0 | $6077 \mathrm{H}-0010 \mathrm{H}$ |  |  |  | $\bullet$ | R |
| D2019+100*n | Actual current of slave No. n | 0 | $6078 \mathrm{H}-0010 \mathrm{H}$ |  |  |  |  | R |

Position control
Slave No. 0~7

| Special D | Function | $\begin{aligned} & \text { Pre-defined } \\ & \text { Setting } \end{aligned}$ | CAN Index | PDO |  |  |  | R/W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 1 | 2 | 3 | 4 |  |
| D2020+100*n | Target position(L) of slave No. $n$ | 0 | 607AH-0020H |  | - |  |  | RW |
| D2021+100*n | Target position(H) of slave No. n | 0 |  |  |  |  |  | RW |
| D2022+100*n | Actual position(L) of slave No. $n$ | 0 | 6064H-0020H |  | - |  |  | R |
| D2023+100*n | Actual position(H) of slave No. n | 0 |  |  |  |  |  | R |
| D2024+100*n | Speed diagram(L) of slave No. n | 10000 | $6081 \mathrm{H}-0020 \mathrm{H}$ |  |  |  |  | RW |
| D2025+100*n | Speed diagram (H) of slave No. n | 0 |  |  |  |  |  | RW |

20XXH address corresponds to MI MO AI AO.
Slave No. n=0~7

| Special D | Function | Pre-defined Setting | CAN Index | PDO |  |  |  | R/W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | 1 | 2 | 3 | 4 |  |
| D2026+100*n | MI status of slave No. n | 0 | $2026 \mathrm{H}-0110 \mathrm{H}$ |  | - |  |  | RW |
| D2027+100*n | MO setting of slave No. n | 0 | $2026 \mathrm{H}-4110 \mathrm{H}$ |  | - |  |  | RW |
| D2028+100*n | Al1 status of slave No. n | 0 | 2026H-6110H |  | - |  |  | RW |
| D2029+100*n | Al2 status of slave No. $n$ | 0 | 2026H-6210H |  | - |  |  | RW |
| D2030+100*n | Al3 status of slave No. $n$ | 0 | 2026H-6310H |  | - |  |  | RW |
| D2031+100*n | AO1 status of slave No. n | 0 | 2026H-A110H |  | - |  |  | RW |
| D2032+100*n | AO2 status of slave No. n | 0 | 2026H-A210H |  | - |  |  | RW |
| D2033+100*n | AO3 status of slave No. n | 0 | 2026H-A310H |  | - |  |  | RW |

Setting of the PDO mapping length

| Special D | Function | Pre-defined <br> Setting | R/W |
| :--- | :--- | :--- | :--- |
| D2034+100*n | Transmission setting of slave No. n | 000 AH | RW |
| D2067+100*n | Receiving setting of slave No. $n$ | 0000 H | RW |

### 16.5.4 Communication Address for PLC Devices

| Device | Range | Type | Address (Hex) |
| :---: | :---: | :---: | :---: |
| X | 00~17 (Octal) | bit | 0400~040F |
| Y | 00~17 (Octal) | bit | 0500~050F |
| T | 00~159 | bit/word | 0600~069F |
| M | 000~799 | bit | 0800~0B1F |
| M | 1000~1079 | bit | 0BE8~0C37 |
| C | 0~79 | bit/word | 0E00~0E47 |
| D | 00~399 | word | 1000~118F |
| D | 1000~1099 | word | 13E8~144B |
| D | 2000~2799 | word | 17D0~1AEF |

Function Code

| Function Code | Description | Supported Devices |
| :---: | :---: | :---: |
| 01 | Read coil status | Y, M, T, C |
| 02 | Read input status | X,Y,M,T,C |
| 03 | Read one data | T,C,D |
| 05 | Force changing one coil status | Y,M,T,C |
| 06 | Write in one data | T,C,D |
| $0 F$ | Force changing multiple coil status | Y,M,T,C |
| 10 | Write in multiple data | T,C,D |

Only when PLC is at Stop status, PLC data can be read/write via communication device. When PLC is at Run status, the communication address should be the mapping address, e.g. for Pr.04-00 it maps to 0400 H .

## $\Rightarrow$ NOTE

When PLC function is activated, C2000 can Read/Write the PLC and drive's parameter by different addresses (pre-defined station number for the AC motor drive is 1 , for PLC station number is 2 )

### 16.6 Commands

### 16.6.1 Basic Commands

Commands

| Commands | Function | Operands |
| :---: | :--- | :---: |
| LD | Load contact A | X, Y, M, T, C |
| LDI | Load contact B | X, Y, M, T, C |
| AND | Series connection with A contact | X, Y, M, T, C |
| ANI | Series connection with B contact | X, Y, M, T, C |
| OR | Parallel connection with A contact | X, Y, M, T, C |
| ORI | Parallel connection with B contact | X, Y, M, T, C |
| ANB | Series connects the circuit block | -- |
| ORB | Parallel connects the circuit block | -- |
| MPS | Save the operation result | -- |
| MRD | Read the operation result (the pointer is not moving) | -- |
| MPP | Read the result | -- |

## Output Command

| Commands | Function | Operands |
| :---: | :--- | :---: |
| OUT | Drive coil | Y, M |
| SET | Action latched (ON) | Y, M |
| RST | Clear the contacts or the registers | Y, M, T, C, D |

## Timer and Counter

| Commands | Function | Operands |
| :---: | :--- | :---: |
| TMR | 16-bit timer | T-K or T-D |
| CNT | 16-bit counter | C-K or C-D (16 bit $)$ |

## Main Control Command

| Commands | Function | Operands |
| :---: | :--- | :---: |
| MC | Connect the common series connection contacts | N0~N7 |
| MCR | Disconnect the common series connection contacts | N0~N7 |

Rising-edge/falling-edge Detection Commands of Contact

| Commands | Function | Operands |
| :---: | :--- | :---: |
| LDP | Rising-edge detection operation starts | X, Y, M, T, C |
| LDF | Falling-edge detection operation starts | $X, Y, M, T, C$ |
| ANDP | Rising-edge detection series connection | $X, Y, M, T, C$ |
| ANDF | Falling-edge detection series connection | X, Y, M, T, C |
| ORP | Rising-edge detection parallel connection | X, Y, M, T, C |
| ORF | Falling-edge detection parallel connection | X, Y, M, T, C |

## Rising-edge/falling-edge Output Commands

| Commands Function | Operands |  |
| :---: | :---: | :---: |
| PLS | Rising-edge output | Y, M |
| PLF | Falling-edge output | Y, M |
| End Command |  |  |
| Commands | Function | Operands |
| END $\quad$ Program end | -- |  |

Other Command

| Commands | Function | Operands |
| :---: | :--- | :---: |
| NOP | No function | -- |
| INV | Inverse operation result | -- |
| P | Indicator | P |

### 16.6.2 Explanation for the Command

| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| LD | Load A contact |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

L The LD command is used on the A contact that has its start from the left BUS or the A contact that is the start of a contact circuit. Function of the command is to

Explanation save present contents, and at the same time, save the acquired contact status into the accumulative register.

Example Ladder diagram $\quad$| Command code | Operation |  |
| :--- | :--- | :--- |
| LD | X0 | Load contact A of X0 |

| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| LDI | Load B contact |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

The LDI command is used on the B contact that has its start from the left BUS or the $B$ contact that is the start of a contact circuit. Function of the command is to

Explanation save present contents, and at the same time, save the acquired contact status into the accumulative register.


| Command code: |  | Operation: |
| :--- | :--- | :--- |
| LDI | X0 | Load contact B of X0 |
| AND | X1 | Connect to contact A of <br> X1 in series |
| OUT | Y1 | Drive Y1 coil |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AND | Series connection- A contact |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

The AND command is used in the series connection of A contact. The function of the

## Explanation

 command is to readout the status of present specific series connection contacts first, and then to perform the "AND" calculation with the logic calculation result before the contacts, thereafter, saving the result into the accumulative register.| Example | Ladder diagram: | Command code: | Operation: |
| :--- | :--- | :--- | :--- | :--- |
|  | LDI | X1 | Load contact B of |
| X1 |  |  |  |


| Mnemonic | Function |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ANI | Series connection- B contact |  |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |  |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |  |

The ANI command is used in the series connection of B contact. The function of the command is to readout the status of present specific series connection contacts first, and then to perform the "AND" calculation with the logic calculation result before the contacts, thereafter, saving the result into the accumulative register.

Ladder diagram:

## Example



Command code: Operation:

| LD | X1 | Load contact A of <br> X1 |
| :--- | :--- | :--- |
| ANI | X0 | Connect to contact <br> B of X0 in series |
| OUT | Y1 | Drive Y1 coil |

## Function

Parallel connection- A contact

| X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

The OR command is used in the parallel connection of A contact. The function of the

## Explanation

 command is to readout the status of present specific series connection contacts, and then to perform the "OR" calculations with the logic calculation result before the contacts, thereafter, saving the result into the accumulative register.Ladder diagram:


Command code: Operation:

| LD | X0 | Load contact A of <br> X0 |
| :--- | :--- | :--- |
| OR | X1 | Connect to contact <br> A of X1 in parallel |
| OUT | Y1 | Drive Y1 coil |


| Mnemonic | Function |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ORI | Parallel connection- B contact |  |  |  |  |  |  |
| Operand | X0~X17 | $\mathrm{Y} 0 \sim \mathrm{Y} 17$ | $\mathrm{M} 0 \sim \mathrm{M} 799$ | T0~159 | C0~C79 | D0~D399 |  |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |  |

The ORI command is used in the parallel connection of $B$ contact. The function of the

## Explanation

 command is to readout the status of present specific series connection contacts, and then to perform the "OR" calculations with the logic calculation result before the contacts, thereafter, saving the result into the accumulative register.

| Mnemonic | Function |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| ANB | Series connection (Multiple Circuits) |  |  |  |
| Operand | None |  |  |  |
| Explanation | To perform the "ANB" calculation between the previous reserved logic results and contents of the accumulative register. |  |  |  |
| Example | Ladder diagram: | Command code: Operation: |  |  |
|  | ANB X1 | LD |  | Load contact A of X0 |
|  |  | ORI |  | Connect to contact $B$ of X2 in parallel <br> Load contact B of X1 |
|  |  | OR | X3 | Connect to contact A of X3 in parallel |
|  |  | ANB |  | Connect circuit block in series |
|  |  | OUT | Y1 | Drive Y1 coil |


| Mnemonic | Function |
| :---: | :--- |
| ORB | Parallel connection (Multiple circuits) |
| Operand | None |

Explanation
ORB is to perform the "OR" calculation between the previous reserved logic results and contents of the accumulative register.


Command code: Operation:

| LD | X0 | Load contact $A$ of $\mathrm{X0}$ |
| :---: | :--- | :--- |
| ANI | X1 | Connect to contact B of <br> X1 in series |
| LDI | X2 | Load contact B of X2 |
| AND | X3 | Connect to contact A of |
| ORB in series |  |  |


| Mnemonic | Function |
| :---: | :---: |
| MPS | Store the current result of the internal PLC operations |
| Operand | None |
| Explanation | To save contents of the accumulative register into the operation result. (the result <br> operation pointer pluses 1 ) |


| Mnemonic | Function |
| :---: | :---: |
| MRD | Reads the current result of the internal PLC operations |
| Operand | None |
| Explanation | Reading content of the operation result to the accumulative register. (the pointer of <br> operation result doesn't move) |


| Mnemonic | Function |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| MPP | Reads the current result of the internal PLC operations |  |  |  |
| Operand | None |  |  |  |
| Explanation | Reading content of the operation result to the accumulative register. (the stack pointer will decrease 1) |  |  |  |
| Example | Ladder diagram: | Command code: Operation: |  |  |
|  |  | LD | X0 | Load contact A of X0 |
|  | $\mathrm{X0}$ | MPS |  | Save in stack |
|  |  | AND | X1 | Connect to contact A of X 1 in series |
|  | MRD - M0 | OUT | Y1 | Drive Y1 coil |
|  |  | MRD |  | Read from the stack (without moving pointer) |
|  | END | AND | X2 | Connect to contact A of X 2 in series |
|  |  | OUT | M0 | Drive M0 coil |
|  |  | MPP |  | Read from the stack |
|  |  | OUT | Y2 | Drive Y2 coil |
|  |  | END |  | End program |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| OUT | Output coil |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | - | $\checkmark$ | $\checkmark$ | - | - | - |
| Explanation | Output the logic calculation result before the OUT command to specific device. |  |  |  |  |  |
|  |  |  |  |  |  |  |


| Operation <br> result | OUT command |  |  |
| :---: | :---: | :---: | :---: |
|  | Coil | Contact |  |
|  |  | A contact <br> (normally open) | B contact (normally closed) |
| FALSE | Off | Non-continuity | Continuity |
| TRUE | On | Continuity | Non-continuity |



Command code: Operation:

| LD | X0 | Load contact B of X0 |
| :---: | :---: | :--- |
| AND | X1 | Connect to contact A of |
| O1 in series |  |  |
| OUT | Y1 | Drive Y1 coil |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SET | Latch (ON) |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | - | $\checkmark$ | $\checkmark$ | - | - | - |

When the SET command is driven, its specific device is set to be "ON," which will

Explanation keep "ON" whether the SET command is still driven. You can use the RST command to set the device to "OFF".


| Command code: |  |  |
| :---: | :---: | :--- |
| LD | Operation: |  |
| X0 | Load contact A of X0 |  |
| AN | Y0 | Connect to contact B of <br> Y0 in series |
| SET | Y1 | Y1 latch (ON) |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RST | Clear the contacts or the registers |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | - | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ |
| Explanation | When the RST command is driven, motion of its specific device is as follows: |  |  |  |  |  |
|  | Device | Status |  |  |  |  |
|  | Y, M | Coil and contact will be set to "OFF". |  |  |  |  |
|  | T, C | Present values of the timer or counter will be set to 0 , and the coil and contact will be set to "OFF." |  |  |  |  |
|  | D | The content value will be set to 0 . |  |  |  |  |
|  | When the RST command is not driven, motion of its specific device is unchanged. |  |  |  |  |  |


| Example | Ladder diagram |  |  | Command code: |  | Operation: |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | LD | X0 | Load contact A of X0 |
|  |  | RST | Y5 | RST | Y5 | Clear contact Y5 |


| Mnemonic | Function |  |
| :---: | :---: | :---: |
| TMR | 16-bit timer |  |
| Operand | T-K | T0~T159, K0~K32,767 |
|  | T-D | T0~T159, D0~D399 |

## Explanation

When TMR command is executed, the specific coil of timer is ON and timer will start to count. When the setting value of timer is attained (counting value $>=$ setting value), the contact will be as following

| NO(Normally Open) | contact | Open <br> collector |
| :---: | :---: | :---: |
| NC(Normally Closed) | contact | Close <br> collector |

When the RST command is not driven, motion of its specific device remains unchanged.

Example Ladder Diagram:


Command code: Operation:

| LD | X0 | Load contact A of X0 |
| :---: | :---: | :---: |
| TMR | T5 | Setting of T5 counter | K 1000 is K1000.


| Mnemonic | Function |  |
| :---: | :---: | :--- |
| CNT | Clear contact or register |  |
| Operand | C-K | C0~C79, K0~K32,767 |
|  | C-D | C0~C79, D0~D399 |

When the CNT command is executed from OFF $\rightarrow$ ON, which means that the counter coil is driven, and 1 should thus be added to the counter's value; when the counter achieved specific set value (value of counter $=$ the setting value), motion of the contact is as follows:

| NO(Normally Open) contact | Open <br> collector |
| :---: | :---: |
| NC(Normally Close) contact | Close <br> collector |

If there is counting pulse input after counting is attained, the contacts and the counting values will be unchanged. To re-count or to conduct the CLEAR motion, please use the RST command.


## Mnemonic <br> Explanation

## Function

## MC/MCR Master control Start/Reset

Operand N0~N7

1. $M C$ is the main-control start command. When the MC command is executed, the execution of commands between MC and MCR will not be interrupted. When MC command is OFF, the motion of the commands that between MC and MCR is described as follows:

| Command | Description <br> The counting value is set back to zero, the coil and <br> the contact are both turned OFF |
| :--- | :--- |
| Accumulative timer | The coil is OFF, and the timer value and the <br> contact stay at their present condition |
| Subroutine timer | The counting value is back to zero. Both coil and <br> contact are turned OFF. |
| The coil is OFF, and the counting value and the |  |
| contact stay at their present condition |  |$|$| Counter | All turned OFF |
| :--- | :--- |
| Coils driven up by the OUT <br> command | Devices driven up by the SET <br> and RST commands |
| Stay at present condition |  |
| Application commands | All of them are not acted, but the nest loop <br> FOR-NEXT command will still be executed for <br> times defined by users even though the MC-MCR <br> commands is OFF. |

2. MCR is the main-control ending command that is placed at the end of the main-control program and there should not be any contact commands prior to the MCR command.
3. Commands of the MC-MCR main-control program support the nest program structure, with 8 layers as its greatest. Please use the commands in order from N0~ N7, and refer to the following:


Command code: Operation:

| LD | X0 | Load A contact of X0 |
| :---: | :---: | :--- |
| MC | N0 | Enable N0 common <br> series connection <br> contact |
| LD | X1 | Load A contact of X1 <br> OUT |
| Y0 | Drive Y0 coil |  |
| LD | X2 | Load A contact of X2 |
| MC | N1 | Enable N1 common <br> series connection <br> contact |
| LD | X3 | Load A contact of X3 |
| OUT | Y1 | Drive Y1 coil |


| MCR | N1 | Disable N1 common <br> series connection <br> contact |
| :---: | :--- | :--- |
| MCR | N0 | Disable N0 common <br> series connection <br> contact |
| LD | X10 | Load A contact of X10 |
| MC | N0 | Enable N0 common <br> series connection <br> contact |
| LD | X11 | Load A contact of X0 <br> Enable N0 common |
| OUT | Y10 | Eneries connection <br> sentact <br> cont A contact of X1 |
| MCR | N0 | Load ADrive Y0 coil |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| LDP | Rising-edge detection operation |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

## Explanation

Usage of the LDP command is the same as the LD command, but the motion is different. It is used to reserve present contents and at the same time, saving the
detection status of the acquired contact rising-edge into the accumulative register.

Example Ladder diagram:


Command code: Operation:

| LDP | X0 | Start X0 rising-edge <br> detection |
| :---: | :---: | :--- |
| AND | X1 | Series connection A <br> contact of X 1 |
| OUT | Y 1 | Drive Y1 coil |

Please refer to the specification of each model series for the applicable range of operands.

If rising-edge status is ON when PLC power is off, then the rising-edge status will be TRUE when PLC power is on.

| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| LDF | Falling-edge detection operation |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

Usage of the LDF command is the same as the LD command, but the motion is different. It is used to reserve present contents and at the same time, saving the detection status of the acquired contact falling-edge into the accumulative register.

Ladder diagram:


Command code: Operation:

| LDF | X0 | Start X0 falling-edge <br> detection |
| :---: | :---: | :--- |
| AND | X1 | Series connection A <br> contact of X1 |
| OUT | Y1 | Drive Y1 coil |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ANDP | Rising-edge series connection |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

Explanation
ANDP command is used in the series connection of the contacts' rising-edge detection.

Ladder diagram:


Command code:

| LD | X0 | Load A contact of X0 |
| :---: | :--- | :--- |
| ANDP | X1 | X1 rising-edge <br> detection in series <br> connection |
| OUT | Y1 | Drive Y1 coil |


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ANDF | Falling-edge series connection |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

Explanation ANDF command is used in the series connection of the contacts' falling-edge detection.


| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ORP | Rising-edge parallel connection |  |  |  |  |  |
| Operand | $\mathrm{X} 0 \sim \mathrm{X} 17$ | $\mathrm{Y} 0 \sim \mathrm{Y} 17$ | $\mathrm{M} 0 \sim \mathrm{M} 799$ | $\mathrm{~T} 0 \sim 159$ | $\mathrm{C} 0 \sim \mathrm{C} 79$ | D0~D399 |
|  | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | $\checkmark$ | - |

The ORP commands are used in the parallel connection of the contact's
Explanation rising-edge detection.



| Mnemonic | Function |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PLF | Falling-edge output |  |  |  |  |  |
| Operand | X0~X17 | Y0~Y17 | M0~M799 | T0~159 | C0~C79 | D0~D399 |
|  | - | $\checkmark$ | $\checkmark$ | - | - | - |



When $\mathrm{XO}=\mathrm{ON} \rightarrow$ OFF (falling-edge trigger), PLF command will be executed and M0 will send the pulse of one time which the length is the time for scan one time.
Ladder diagram:
Command code: Operation:


Timing Diagram:


| LD | X0 | Load contact A of X0 |
| :--- | :--- | :--- |
| PLF | M0 | M0 falling-edge output |
| LD | M0 | Load contact A of M0 |
| SET | YO | YO latched (ON) |


| Mnemonic | Function |  |
| :---: | :--- | :--- |
| END | Program End |  |
| Operand | None |  |

It needs to add the END command at the end of ladder diagram program or
Explanation command program. PLC will scan from address o to END command, after the execution it will return to address 0 and scan again.


| Mnemonic |  | Function |
| :---: | :--- | :--- | :--- |
| INV | Inverse operation result |  |
| Operand |  | None |
| Explanation | The operation result (before executing INV command) will be saved inversely into |  |
| cumulative register. |  |  |


| Mnemonic | Function |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| P | Indicator |  |  |  |  |
| Operand | P0~P255 |  |  |  |  |
| Explanation | Indicator P allows API 00 CJ command and API 01 CALL command to skip from 0. Though it is not necessary to start from number 0 , same number can not be used twice or serious error would occur. |  |  |  |  |
| Example | Ladder diagram: |  | Comm <br> LD <br> CJ | code: <br> X0 <br> P10 | Operation: <br> Load contact A of X0 <br> Skip command CJ to P10 |
|  |  |  | P10 |  | Indicator P10 |
|  |  |  | LD | X1 | Load contact A of X1 |
|  |  |  | OUT | Y1 | Drive Y1 coil |

### 16.6.3 Description of the Application Commands

|  | API | Mnemonic Codes |  | P <br> Command | Function | STEPS |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 16-bit | 32-bit |  |  | 16bit | 32bit |
| Loop control | 01 | CALL | - | $\checkmark$ | CALL subroutine | 3 | - |
|  | 02 | SRET | - | - | The end of subroutine | 1 | - |
|  | 06 | FEND | - | - | The end of main program | 1 | - |
| Transmission Comparison | 10 | CMP | DCMP | $\checkmark$ | Compare | 7 | 13 |
|  | 11 | ZCP | DZCP | $\checkmark$ | Zone compare | 9 | 17 |
|  | 12 | MOV | DMOV | $\checkmark$ | Data Move | 5 | 9 |
|  | 15 | BMOV | DCMP | $\checkmark$ | Block move | 7 | - |
| Four Fundamental Operations of Arithmetic | 20 | ADD | - | $\checkmark$ | Perform the addition of BIN data | 7 | 13 |
|  | 21 | SUB | DADD | $\checkmark$ | Perform the subtraction of BIN data | 7 | 13 |
|  | 22 | MUL | DSUB | $\checkmark$ | Perform the multiplication of BIN data | 7 | 13 |
|  | 23 | DIV | DMUL | $\checkmark$ | Perform the division of BIN data | 7 | 13 |
|  | 24 | INC | DDIV | $\checkmark$ | Perform the addition of 1 | 3 | 5 |
|  | 25 | DEC | DINC | $\checkmark$ | Perform the subtraction of 1 | 3 | 5 |
| Rotation and Displacement | 30 | ROR | DDEC | $\checkmark$ | Rotate to the right | 5 | - |
|  | 31 | ROL | DROR | $\checkmark$ | Rotate to the left | 5 | - |
| Data <br> Processing | 40 | ZRST | - | $\checkmark$ | Zero Reset | 5 | - |
|  | 49 | FLT | DFLT | $\checkmark$ | Floating Point | 5 | 9 |
| Communication | 150 | MODRW | - | $\checkmark$ | MODBUS R/W | 7 | - |
| Floating Point | 110 | - | DECMP | $\checkmark$ | Floating Point Compare | - | 13 |


|  | API | Mnemonic Codes |  | P <br> Command | Function | STEPS |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 16-bit | 32-bit |  |  | 16bit | 32bit |
| Operation | 111 | - | DEZCP | $\checkmark$ | Floating Point Zone Compare | - | 17 |
|  | 116 | - | DRAD | $\checkmark$ | Degree $\rightarrow$ Radian | - | 9 |
|  | 117 | - | DDEG | $\checkmark$ | Radian $\rightarrow$ Degree | - | 9 |
|  | 120 | - | DEADD | $\checkmark$ | Floating Point Addition | - | 13 |
|  | 121 | - | DESUB | $\checkmark$ | Floating Point Subtraction | - | 13 |
|  | 122 | - | DEMUL | $\checkmark$ | Floating Point Multiplication | - | 13 |
| Floating Point Operation | 123 | - | DEDIV | $\checkmark$ | Floating Point Division | - | 13 |
|  | 124 | - | DEXP | $\checkmark$ | Float Exponent Operation | - | 9 |
|  | 125 | - | DLN | $\checkmark$ | Float Natural Logarithm Operation | - | 9 |
|  | 127 | - | DESQR | $\checkmark$ | Floating Point Square Root | - | 9 |
|  | 129 | - | DINT | $\checkmark$ | Float to Integer | - | 9 |
|  | 130 | - | DSIN | $\checkmark$ | Sine | - | 9 |
|  | 131 | - | DCOS | $\checkmark$ | Cosine | - | 9 |
|  | 132 | - | DTAN | $\checkmark$ | Tangent | - | 9 |
|  | 133 | - | DASIN | $\checkmark$ | Arc Sine | - | 9 |
|  | 134 | - | DACOS | $\checkmark$ | Arc Cosine | - | 9 |
|  | 135 | - | DATAN | $\checkmark$ | Art Tangent | - | 9 |
|  | 136 | - | DSINH | $\checkmark$ | Hyperbolic Sine | - | 9 |
|  | 137 | - | DCOSH | $\checkmark$ | Hyperbolic Cosine | - | 9 |
|  | 138 | - | DTANH | $\checkmark$ | Hyperbolic Tangent | - | 9 |
| Calendar | 160 | TCMP | - | $\checkmark$ | Comaprison of calendar data | 11 | - |
|  | 161 | TZCP | - | $\checkmark$ | Comparison of calendar data area | 9 | - |
|  | 162 | TADD | - | $\checkmark$ | Calendar data addition | 7 | - |
|  | 163 | TSUB | - | $\checkmark$ | Calendar data substraction | 7 | - |
|  | 166 | TRD | - | $\checkmark$ | Read calendar data | 3 | - |
| Gray code | 170 | GRY | DGRY | $\checkmark$ | BIN $\rightarrow$ GRY code |  |  |
|  | 171 | GBIN | DGBIN | $\checkmark$ | GRY code $\rightarrow$ BIN |  |  |
| Contact type logic operation | 215 | LD\& | DLD\& | - | Contact Logical Operation LD\# | 5 | 9 |
|  | 216 | LD\| | DLD | - | Contact type logic operation LD \# | 5 | 9 |
|  | 217 | LD^ | DLD^ | - | Contact Logical Operation LD\# | 5 | 9 |
|  | 218 | AND\& | DAND\& | - | Contact Logical Operation AND\# | 5 | 9 |
|  | 219 | ANDI | DANDI | - | Contact Logical Operation AND\# | 5 | 9 |

Chapter 16 PLC Function \| C2000 Series

|  | API | Mnemonic Codes |  | P <br> Command | Function | STEPS |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 16-bit | 32-bit |  |  | 16bit | 32bit |
|  | 220 | AND^ | DAND^ | - | Contact Logical Operation AND\# | 5 | 9 |
|  | 221 | OR\& | DOR\& | - | Contact Logical Operation OR \# | 5 | 9 |
|  | 222 | OR\| | DOR\| | - | Contact Logical Operation OR \# | 5 | 9 |
|  | 223 | OR^ | DOR^ | - | Contact Logical Operation OR \# | 5 | 9 |
| Contact Type <br> Comparison | 224 | LD= | DLD = | - | Load Compare LD\% | 5 | 9 |
|  | 225 | LD > | DLD > | - | Load Compare LD※ | 5 | 9 |
|  | 226 | LD $<$ | DLD $<$ | - | Load Compare LD※ | 5 | 9 |
|  | 228 | LD $<>$ | DLD $<>$ | - | Load Compare LD※ | 5 | 9 |
|  | 229 | LD $<=$ | DLD $<=$ | - | Load Compare LD\% | 5 | 9 |
|  | 230 | LD $>=$ | DLD $>=$ | - | Load Compare LD\% | 5 | 9 |
|  | 232 | AND $=$ | DAND $=$ | - | AND Compare\% | 5 | 9 |
|  | 233 | AND > | DAND> | - | AND Compare\% | 5 | 9 |
|  | 234 | AND $<$ | DAND $<$ | - | AND Compare※ | 5 | 9 |
|  | 236 | AND $<>$ | DAND $<>$ | - | AND Compare※ | 5 | 9 |
|  | 237 | AND $<=$ | DAND $<=$ | - | AND Compare※ | 5 | 9 |
|  | 238 | AND $>=$ | DAND $>=$ | - | AND Compare※ | 5 | 9 |
|  | 240 | $\mathrm{OR}=$ | DOR= | - | OR compare ※ | 5 | 9 |
|  | 241 | OR > | DOR> | - | OR compare ※ | 5 | 9 |
|  | 242 | OR< | DOR< | - | OR compare $\ldots$ | 5 | 9 |
|  | 244 | OR $<>$ | DOR < > | - | OR compare ※ | 5 | 9 |
|  | 245 | $\mathrm{OR}<=$ | DOR $<=$ | - | OR compare ※ | 5 | 9 |
|  | 246 | OR $>=$ | DOR $>=$ | - | OR compare ※ | 5 | 9 |
| Comparison of floating-point | 275 | - | FLD $=$ | - | Comparison of floating-point LD※ | - | 9 |
|  | 276 | - | FLD > | - |  | - | 9 |
|  | 277 | - | FLD $<$ | - |  | - | 9 |
|  | 278 | - | FLD $<>$ | - |  | - | 9 |
|  | 279 | - | FLD $<=$ | - |  | - | 9 |
|  | 280 | - | FLD $>=$ | - |  | - | 9 |
|  | 281 | - | FAND = | - | Comparison of floating-point AND※ | - | 9 |
|  | 282 | - | FAND> | - |  | - | 9 |
|  | 283 | - | FAND $<$ | - |  | - | 9 |
|  | 284 | - | FAND $<>$ | - |  | - | 9 |
|  | 285 | - | FAND $<=$ | - |  | - | 9 |
|  | 286 | - | FAND $>=$ | - |  | - | 9 |
|  | 287 | - | FOR= | - | Comparison of floating-point OR※ | - | 9 |
|  | 288 | - | FOR> | - |  | - | 9 |
|  | 289 | - | FOR< | - |  | - | 9 |


|  | API | Mnemonic Codes |  | P <br> Command | Function | STEPS |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 16-bit | 32-bit |  |  | 16bit | 32bit |
|  | 290 | - | FOR<> | - |  | - | 9 |
|  | 291 | - | FOR $<=$ | - |  | - | 9 |
|  | 292 | - | FOR $>=$ | - |  | - | 9 |
| Special command for AC motor drive | 139 | RPR | - | $\checkmark$ | Read the parameters | 5 | - |
|  | 140 | WPR | - | $\checkmark$ | Write the parameters | 5 | - |
|  | 141 | FPID | - | $\checkmark$ | Drive PID control | 9 | - |
|  | 142 | FREQ | - | $\checkmark$ | Control the drive frequency | 7 | - |
|  | 261 | CANRX | - | $\checkmark$ | Read CANopen Slave data | 9 | - |
|  | 263 | TORQ | - | $\checkmark$ | Set target torque | 5 | - |
|  | 264 | CANTX | - | $\checkmark$ | Write CANopen Slave data | 9 | - |
|  | 265 | CANFLS | - | $\checkmark$ | Update the mapping special D of CANopen | 3 | - |

### 16.6.4 Explanation for the Application Commands

| API | $\square$ CALL |  | S | Call Subroutine |
| :---: | :---: | :---: | :---: | :--- |
| 01 |  |  |  |  |



1. $\mathbf{S}$ : The pointer of call subroutine.
2. Edit the subroutine designated by the pointer after FEND instruction.
3. If only CALL instruction is in use, it can call subroutines of the same pointer number with no limit of times.
4. Subroutine can be nested for 5 levels including the initial CALL instruction. (If entering the sixth level, the subroutine won't be executed.)

| API |  | FEND | - | The end of the main program (First End) |
| :---: | :---: | :---: | :---: | :--- |
| 06 |  |  |  |  |


| Bit Devices |  |  | Word Devices |  |  |  |  |  | 16-bit command (1 STEP) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| X | Y | M | K | H | KnX K $\mathrm{K} Y\|\mathrm{KnM}\|$ | T | C | D | FEND |  | - | - |
| Operands: |  |  |  |  |  |  |  |  | 32-bit c | and |  |  |
| No operand |  |  |  |  |  |  |  |  | - | - | - | - |
| No contact to drive the instruction is required. |  |  |  |  |  |  |  |  | Flag sig | Non |  |  |

1. This instruction denotes the end of the main program. It has the same function as that of END instruction when being executed by PLC.
2. CALL must be written after FEND instruction and add SRET instruction in the end of its subroutine. Interruption program has to be written after FEND instruction and IRET must be added in the end of the service program.
3. If several FEND instructions are in use, place the subroutine and interruption service programs between the final FEND and END instruction.
4. After CALL instruction is executed, executing FEND before SRET will result in errors in the program.

CALL
Command

When $\mathrm{X} 1=\mathrm{ON}$, operation


| API |  | CMP |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- |
| 10 | $\mathbf{D}$ |  | $\mathbf{P}$ | S1) (S2) D | Compare |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | \%-bit command ( 7 STEPS) |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * | CMP |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * |  |  |
| D |  | * | * |  |  |  |  |  |  |  |  | $\frac{32 \mathrm{bits} \text { command (13 STEPS) }}{-}$ |  |
| Operand <br> Operand D occupies 3 consecutive devices. |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | Flag signal: None |  |

## Explanation

Example

1. $\mathbf{S}_{1}$ : value comparsion $1, \mathbf{S}_{2}$ : value comparison $2, \mathbf{D}$ : result comparison
2. The contents in $\mathbf{S}_{1}$ and $\mathbf{S}_{\mathbf{2}}$ are compared and result is stored in $\mathbf{D}$.
3. The two comparison values are compared algebraically and the two values are signed binary values. When b15 = 1 in 16-bit instruction, the comparison will regard the value as negative binary values.
4. Designate device YO , and operand D automatically occupies $\mathrm{Y} 0, \mathrm{Y} 1$, and Y 2 .
5. When $\mathrm{X} 10=\mathrm{On}, \mathrm{CMP}$ instruction will be executed and one of $\mathrm{Y} 0, \mathrm{Y}$, and Y 2 will be On. When X10 = Off, CMP instruction will not be executed and Y0, Y 1 , and Y 2 remain their status before $\mathrm{X} 10=$ Off.
6. If the user need to obtain a comparison result with $\geq \leq$, and $\neq$, make a series parallel connection between $\mathrm{Y} 0 \sim \mathrm{Y} 2$.

7. To clear the comparison result, use RST or ZRST instruction.


| API |  | ZCP |  | S1 S2 S S | D | Zone Compare |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 11 | $\mathbf{D}$ |  | $\mathbf{P}$ |  |  |  |  |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | 16-bit command (9 STEPS) |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * | ZCP ZCPP |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * |  |  |
| S |  |  |  | * | * | * | * | * | * | * | * | 32-bit command (17 STEPS) |  |
| D |  | * | * |  |  |  |  |  |  |  |  | - - - | - |
| Operands: <br> $\mathbf{S}_{1}$ : Lower bound of zone comparison $\quad \mathbf{S}_{2}$ : Upper bound of zone comparison <br> S : Comparison value <br> D: Comparison result |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |

## Explanation

Example

1. $\mathbf{S}_{1}$ : Lower bound of zone comparison $\mathbf{S}_{2}$ : Upper bound of zone comparison

S : Comparison value
D: Comparison result
2. $\mathbf{S}$ is compared with its $\mathbf{S}_{1} \mathbf{S}_{2}$ and the result is stored in $\mathbf{D}$.
3. When $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{2}$, the instruction performs comparison by using $\mathbf{S}_{1}$ as the lower/upper bound.
4. The two comparison values are compared algebraically and the two values are signed binary values. When b15 = 1 in 16-bit instruction or b31 = 1 in 32-bit instruction, the comparison will regard the value as negative binary values.

1. Designate device M0, and operand D automatically occupies M0, M1 and M2.
2. When $X 0=O n, Z C P$ instruction will be executed and one of $M 0, M 1$, and M2 will be On. When X10 = Off, ZCP instruction will not be executed and M 0 , M1, and M2 remain their status before $\mathrm{X0}=$ Off.
3. If the user need to obtain a comparison result with $\geq \leq$, and $\neq$, make a series parallel connection between $\mathrm{Y} 0 \sim \mathrm{Y} 2$.

4. To clear the comparison result, use RST or ZRST instruction.


| API |  | MOV |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- |
| 12 | $\mathbf{D}$ |  | $\mathbf{P}$ | S D | Moving the data |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | MOV |  | MOVP |  |
| S |  |  |  | * | * | * | * | * | * | * | * | 32-bit |  |  |  |
| D |  |  |  |  |  |  | * | * | * | * | * | 32-b | d | (9 STEPS) |  |
| Operand: None |  |  |  |  |  |  |  |  |  |  |  | Flag signal: None |  |  |  |

Explanation

1. $\mathrm{S}:$ Source of data
D: Destination of data
2. When this instruction is executed, the content of $S$ will be moved directly to $D$. When this instruction is not executed, the content of $D$ remains unchanged.
3. When $\mathrm{XO}=\mathrm{Off}$, the content in D 10 will remain unchanged. If $\mathrm{XO}=\mathrm{On}$, the value K10 will be moved to D10 data register.
4. When $\mathrm{X} 1=\mathrm{Off}$, the content in D 10 will remain unchanged. If $\mathrm{X} 1=\mathrm{On}$, the present value T0 will be moved to D10 data register.


| API | BMOV |  | P | S D | D |
| :---: | :--- | :--- | :--- | :--- | :--- | Block Move


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | 16-bit command ( 7 STEPS) |  |  |
| S |  |  |  |  |  | * | * | * | * | * | * | BMOV | BMOVP |  |
| D |  |  |  |  |  |  | * | * | * | * | * | 32-bit command |  |  |
| n |  |  |  | * | * |  |  |  |  |  |  | 32-bit comma | - | - |
| Operand: <br> Range of $n=1 \sim 512$ |  |  |  |  |  |  |  |  |  |  |  | Flag signal: None |  |  |

2. The contents in $n$ registers starting from the device designated by $S$ will be moved to $n$ registers starting from the device designated by $D$. If $n$ exceeds the actual number of available source devices, only the devices that fall within the valid range will be used.

Example When X10 = On, the contents in registers D0 ~ D3 will be moved to the 4 registers D20
1 ~D23.


## Example

2

Assume the bit devices $\mathrm{KnX}, \mathrm{KnY}, \mathrm{KnM}$ and KnS are designated for moving, the number of digits of $S$ and $D$ has to be the same, i.e. their $n$ has to be the same.


| M4 | $\rightarrow$ | Y4 |
| :---: | :---: | :---: |
| M5 | $\rightarrow$ | Y5 |
| M6 | $\rightarrow$ | Y6 |
| M7 | $\rightarrow$ | Y7 |


| M 8 |  |  |
| :---: | :---: | :---: |
| M 9 |  |  |
| Y 10 |  |  |
| Y 11 |  |  |
| M 10 |  |  |
|  | $\rightarrow$ | Y 12 |
| M 11 |  |  | Y 13 H

## Example

To avoid coincidence of the device numbers to be moved designated by the two operands and cause confusion, please be aware of the arrangement on the
3 designated device numbers.

When $S>\mathrm{D}$, the BMOV command is processed in the order as $(1) \rightarrow(2) \rightarrow$ (3)


When $S<D$, the BMOV command is processed in the order as $(3) \rightarrow(2) \rightarrow$ (1)


| API |  | ADD |  | S1 S2 | D |
| :---: | :--- | :--- | :--- | :--- | :--- | BIN Addition


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | $\frac{16 \text {-bit command (7 STEPS) }}{\triangle D D}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * | 32-bit command (13 STEPS) |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * | - | $\frac{-}{-}$ |  |
| D |  |  |  |  |  |  | * | * | * | * | * |  |  |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  | Flag signal:M1020 <br> M1021 <br> M1022 | Zero flag Borrow flag Carry flag |  |

Explanation

1. $S_{1}$ : Summand $S_{2}$ : Addend $D$ : Sum
2. This instruction adds $\mathbf{S}_{1}$ and $\mathbf{S}_{\mathbf{2}}$ in BIN format and store the result in D.
3. The highest bit is symbolic bit $0(+)$ and $1(-)$, which is suitable for algebraic addition, e.g. $3+(-9)=-6$.
4. Flag changes in binary addition

16-bit command:
A. If the operation result $=0$, zero flag M1020 $=$ On.
в. If the operation result $<-32,768$, borrow flag M1021 $=$ On.
c. If the operation result >32,767, carry flag M1022 $=$ On.

Example 16-bit command:
When $\mathrm{X} 0=\mathrm{On}$, the content in D0 will plus the content in D 10 and the sum will be stored in D20.


Remarks Flags and the positive/negative sign of the values:


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | $\frac{16-\mathrm{bit}}{\text { SUB }}$ command (7 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * | 32-bit command (13 STEPS) |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * |  |  |  |  |
| D |  |  |  |  |  |  | * | * | * | * | * | Flag signal: M1020 Zero flag M1021 Borrow flag M1022 Carry flag |  |  |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Explanation

1. $S_{1}$ : Minuend
$\mathrm{S}_{2}$ : Subtrahend
D: Remainder
2. This instruction subtracts $\mathbf{S}_{1}$ and $\mathbf{S}_{\mathbf{2}}$ in BIN format and stores the result in $\mathbf{D}$.
3. The highest bit is symbolic bit $0(+)$ and $1(-)$, which is suitable for algebraic subtraction.
4. Flag changes in binary subtraction

In 16-bit instruction:
If the operation result $=0$, zero flag M1020 $=$ On.
If the operation result $<-32,768$, borrow flag M1021 $=$ On.
If the operation result $>32,767$, carry flag M1022 $=$ On.
Example In 16-bit BIN subtraction:
When $\mathrm{X0} 0=\mathrm{On}$, the content in D 0 will minus the content in D10 and the remainder will be stored in D20.


| API |  | MUL |  | S1 | S2 | D |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- |
| 22 | $\mathbf{D}$ |  | $\mathbf{P}$ |  | BIN Multiplication |  |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | M-bit command (7 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * | 32-bit command (13 STEPS) |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * |  |  |  |  |
| D |  |  |  |  |  |  | * | * | * | * | * | Flag signal: None |  |  |  |
| Operands: <br> In 16-bit instruction, D occupies 2 consecutive devices. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Explanation

1. $S_{1}$ : Multiplicand $S_{2}$ : Multiplication
D: Product
2. This instruction multiplies $\mathbf{S}_{1}$ by $\mathbf{S}_{2}$ in BIN format and stores the result in D. Be careful with the positive/negative signs of $\mathbf{S}_{1}, \mathbf{S}_{2}$ and $D$ when doing 16-bit and 32-bit operations. 16-bit command:


When D serves as a bit device, it can designate K1 ~ K4 and construct a 16-bit result, occupying consecutive 2 groups of 16-bit data.

The 16 -bit D0 is multiplied by the 16 -bit D10 and brings forth a 32 -bit product. The higher 16-bit are stored in D21 and the lower 16-bit are stored in D20. On/Off of the most left bit indicates the positive/negative status of the result value.


| API |  | DIV |  |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- |
| 23 | D |  | $\mathbf{P}$ | S2 | D | BIN Division |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | $\frac{16 \text {-bit command }(7 \text { STEPS })}{\text { DIV }}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * |  |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * | 32-bit | and | TEPS) |  |
| D |  |  |  |  |  |  | * | * | * | * | * | - |  |  |  |
| Operands: <br> In 16-bit instruction, $\mathbf{D}$ occupies 2 consecutive devices. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none` |  |  |  |
1. $\mathbf{S}_{1}$ : Dividend
$\mathrm{S}_{2}$ : Divisor
D: Quotient and remainder
2. This instruction divides $\mathbf{S}_{\mathbf{1}}$ and $\mathbf{S}_{\mathbf{2}}$ in BIN format and stores the result in D. Be careful with the positive/negative signs of $\mathbf{S}_{\mathbf{1}}, \mathbf{S}_{\mathbf{2}}$ and $D$ when doing 16 -bit and 32-bit operations.

16-bit instruction:


If $D$ is the bit device, it allocates K1~K14 to 16-bit and occupies 2 continuous sets of quotient and remainder.

Example When $\mathrm{X0}=\mathrm{On}$, D0 will be divided by D10; the quotient will be stored in D20 and remainder in D21. On/Off of the highest bit indicates the positive/negative value of the result.

| DIV | D0 | D10 | D20 |
| :--- | :--- | :--- | :--- | :--- |
|  | DIV D0 D10 K4Y0 |  |  |



| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | $\frac{16-\text { bit command (3 STEPS) }}{\text { INC }}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |
| D |  |  |  |  |  |  | * | * | * | * | * | 32-bit command (5TEPS) |  |
| Operands: none |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |

Explanation

1. D: Destination device
2. If the instruction is not a pulse execution one, the content in the designated device $D$ will plus " 1 " in every scan period whenever the instruction is executed.
3. This instruction adopts pulse execution instructions (INCP).
4. In 16-bit operation, 32,767 pluses 1 and obtains -32,768. In 32-bit operation, 2,147,483,647 pluses 1 and obtains -2,147,483,648.

Example When X0 goes from Off to On, the content in DO pluses 1 automatically.


| API |  | DEC |  |  | D |
| :---: | :---: | :---: | :---: | :---: | :--- |
| 25 | $\mathbf{D}$ |  | $\mathbf{P}$ | Decrement: BIN minus 1 |  |



Explanation D: Destination

1. If the command is not a pulse execution type, the content in the designated device D will minus " 1 " in every scan period whenever the instruction is executed.
2. This instruction adopts pulse execution instructions (DECP).
3. In 16-bit operation, $-32,768$ minuses 1 and obtains 32,767 . In 32-bit operation, $-2,147,483,648$ minuses 1 and obtains 2,147,483,647.

Example
When X0 goes from Off to On, the content in D0 minuses 1 automatically.


| API | ROR |  | (D) $n$ | Rotate to the Right |
| :---: | :---: | :---: | :---: | :---: |
| 30 |  | P |  |  |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16 bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | ROR |  | ROR |  |
| D |  |  |  |  |  |  | * | * | * | * | * | 32-bit command |  |  |  |
| n |  |  |  | * | * |  |  |  |  |  |  |  |  |  |  |
| Operands: <br> D: if in KnY and KnM , only K 4 (16-bit) is valid n : $\mathrm{n}=\mathrm{K} 1 \sim \mathrm{~K} 16$ (16-bit) |  |  |  |  |  |  |  |  |  |  |  | Flag signal: M1022 Carry flag |  |  |  |

Explanation 1. D: Device to be rotated $\mathbf{n}$ : Number of bits to be rotated in 1 rotation
2. This instruction rotates the device content designated by $\mathbf{D}$ to the right for n bits.
3. This instruction adopts pulse execution instructions (RORP).

Example When X0 goes from Off to On, the 16-bit (4 bits as a group) in D10 will rotate to the right, as shown in the figure below. The bit marked with $※$ will be sent to carry flag M1022.


| API | $\square$ |  |  | ROL | $\mathbf{P}$ |
| :---: | :--- | :--- | :--- | :--- | :--- |$\quad$ ( $\quad$ Rotate to the Left


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | ROL | ROLP |  |
| D |  |  |  |  |  |  | * | * | * | * | * |  |  |  |
| n |  |  |  | * | * |  |  |  |  |  |  | 32-bit command |  |  |
|  | $\begin{aligned} & \text { seranc } \\ & \text { if in } \mathrm{K} \\ & \mathrm{n}=\mathrm{K} 1 . \end{aligned}$ | $\begin{aligned} & \text { ds: } \\ & \text { ~nY } \\ & \text { ~K } \end{aligned}$ | $\begin{aligned} & \text { and } \\ & 6(1 \end{aligned}$ | $\mathrm{qM}$ | on | y K4 | (16-b | it) is |  |  |  | Flag signal: M1022 | Carry flag |  |

## Explanation

1. D: Device to be rotated; $\mathbf{n}$ : Number of bits to be rotated in 1 rotation
2. This instruction rotates the device content designated by $\mathbf{D}$ to the left for n bits.
3. This instruction adopts pulse execution instructions (ROLP).

Example When X0 goes from Off to On, the 16-bit (4 bits as a group) in D10 will rotate to the left, as shown in the figure below. The bit marked with $※$ will be sent to carry flag M1022.



Explanation
$D_{1}$ : Start device of the range to be reset
$D_{2}$ : End device of the range to be reset When $D_{1}>D_{2}$, only operands designated by $D_{2}$ will be reset.

## Example

1. When $\mathrm{X0} 0=\mathrm{On}$, auxiliary relays M300~M399 will be reset to Off.
2. When $\mathrm{X} 1=\mathrm{On}, 16$ counters $\mathrm{C} 0 \sim \mathrm{C} 127$ will all be reset (writing in 0 ; contact and coil being reset to Off).
3. When $\mathrm{X} 10=$ On, timers $\mathrm{T} 0 \sim \mathrm{~T} 127$ will all be reset (writing in 0 ; contact and coil being reset to Off).
4. When $\mathrm{X} 3=\mathrm{On}$, data registers $\mathrm{D} 0 \sim \mathrm{D} 100$ will be reset to 0 .


Remarks 1. Devices, e.g. bit devices $Y, M, S$ and Word Devices $T, C, D$, can use RST instruction.
2. API 16 FMOV instruction is also to send K0 to Word Devices T, C, D or bit registers $\mathrm{KnY}, \mathrm{KnM}, \mathrm{KnS}$ for reset.


| API | FLT |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- |
| 49 | D | $\mathbf{P}$ | D | Floating Point |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | 16-bit command (5 STEPS) |  |
| S |  | * | * |  |  |  |  |  | * | * | * | - | - |
| D |  | * | * |  |  |  |  |  | * | * | * |  |  |

Operands:
No of $D_{1}$ operand. $\leqq$ No. of $D_{2}$ operand $D_{1}$ and $D_{2}$ must select same device type

32-bit command
DFLT
Flag signal: none

Please refer to the specification of each model series for applicable range of the device.
Explanation - S: source device. D: Device for storing the conversion result

- Change the intergral number of BIN to a number with two decimal places.

Example 1. When X11 = On, change the corresponding integral number to the floating point notation and put them into D20 and D21.



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |
| D1 |  |  |  | * | * |  |  |  | * | * | * |
| D2 |  |  |  |  |  |  |  |  | * | * | * |

No of $D_{1}$ operand. $\leqq$ No. of $D_{2}$ operand $D_{1}$ and $D_{2}$ must select same device type

Please refer to the specification of each model series for applicable range of the device.

■ S1: Addres of the connecting device. S2: Communication function code. S3: Address to read data. S: Register to read and write data.

■ Before using this command, set COM1 to be controlled by PLC(Set Pr09-31 = -12). Then set the corresponding comunication speed and format(Set Pr09-01 and Pr09-04). S2: Communication function code. This command only supports the function codes in the table below.

| Function | Description |
| :---: | :--- |
| 02 | Input read |
| 03 | Read Word |
| 06 | Write a single Word. |
| $0 F$ | Write multiple coil |
| 10 | Write a single word |

■ Once the command is executed, M1077, M1078 and M1079 will become zero.

- Here is an example of when C2000 wants to control another motor drive and a PLC with station number 20.

To control a slave motor drive

| No. | Example | MODRW COMMAND |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | S1 | S2 | S3 | S4 | n |
|  |  | Station <br> \# | Fucntion Code | Address | Register | Leng |
| 1 | Read Pr01-00 ~ Pr01-03, four data and save the read data in D0 to D3. | K10 | H3 | H100 | D0 | K4 |
| 2 | Read motor drive's address from H2100~H2104, total 3 data and save the read data in D5 ~ D7. | K10 | H3 | H2100 | D5 | K3 |
| 3 | Write into Pr05-00 ~ Pr01-03, total 3 data, the value to write into are D10 ~ D2 | K10 | H10 | H500 | D10 | K3 |
| 4 | Write into motor drive's address H2000~H2104, total 2 data, the value to write into are D15~D16. | K10 | H10 | H2000 | D15 | K2 |


|  | To co | rol the slave PLC |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | MODR | RW COM | MAND |  |
|  | No. | Example | S1 | S2 | S3 | S4 | n |
|  |  |  | Station \# | Function code | Address | Registe r | Length |
|  | 1 | Read X0~X3 of slave PLC, total 4 data and save the data read in bit 0~3 of D0.. | K20 | H2 | H400 | D0 | K4 |
|  | 2 | Read Y0~Y3 of slave PLC, total 4 data and save the data read in bit 0~3 of D1. | K20 | H2 | H500 | D1 | K4 |
|  | 3 | Read M0~M3 of slave PLC, total 4 data and save the data read in bit 0~3 of D2.. | K20 | H2 | H800 | D2 | K4 |
|  | 4 | Read T0~T3 of slave PLC, total 4 data and save the data read in bit 0~3 of D3.. | K20 | H2 | H600 | D3 | K4 |
|  | 5 | Read C0~C3 of slave PLC, total 4 data and save the data read in bit 0~3 of D4.. | K20 | H2 | HE00 | D4 | K4 |
|  | 6 | Read T0~T3 of slave PLC, total 4 data and save the data read in D10~D13... | K20 | H3 | H600 | D10 | K4 |
|  | 7 | Read C0~C3 of slave PLC, total 4 data and save the data read in D20~D23. | K20 | H3 | HE00 | D20 | K4 |
|  | 8 | Read D0~D3 of slave PLC, total 4 data and save the data read in D30~D33. | K20 | H3 | H1000 | D30 | K4 |
|  | 9 | Write into Y0~Y3 of of slave PLC, total 4 data. The values to write in are bit0~3 of D1. | K20 | HF | H500 | D1 | K4 |
|  | 10 | Write into M0~M3 of of slave PLC, total 4 data. The values to write in are bit0~3 of D2. | K20 | HF | H800 | D2 | K4 |
|  | 11 | Write into TO~T3 of of slave PLC, total 4 data. The values to write in are bit0~3 of D3 | K20 | HF | H600 | D3 | K4 |
|  | 12 | Write into CO~C3 of of slave PLC, total 4 data. The values to write in are bit0~3 of D4 | K20 | HF | HE00 | D4 | K4 |
|  | 13 | Write into TO~T3 of of slave PLC, total 4 data. The values to write in are D10~D13. | K20 | H10 | H600 | D10 | K4 |
|  | 14 | Write into C0~C3 of of slave PLC, total 4 data. The values to write in are D20~D23. | K20 | H10 | HE00 | D20 | K4 |
|  | 15 | Write into D0~D3 of of slave PLC, total 4 data. The values to write in are D30~D33. | K20 | H10 | H1000 | D30 | K4 |
|  |  |  |  |  |  |  |  |

- As the PLC starts to run, $\mathrm{MO}=\mathrm{ON}$ will be triggered, and a MODRW command will be executed.
- If the command is correct and once a reply is sent from the slave, a ROL command will be executed, and then M 1 will be ON again.
- Once a reply is sent from the salve, M50=1 will be triggered after PLC's scanning cycle is delayed by 10 times, then a MODRW command will be executed.
- If the command is correct and once a reply is sent from the slave, a ROL command will be executed, and then M2 will be ON again. Since M2 is repeated, so it changes K4M0 to K1, then only $\mathrm{M} 0=1$, this command will repeat itself.. If more commands need to be added, simply add blue color command and change repeat M to repeat $\mathrm{Mn}+1$


| API | D DECMP |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| 110 |  | P | (S ${ }^{\text {d }}$ ( ${ }^{\text {d }}$ | Floating Point Compare |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S1 |  |  |  | * | * |  |  |  |  |  | * |  |  |  |
| S2 |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * | $\frac{32 \text {-bIt command }}{\text { DECMP }}$ | DECMPP |  |
| Operands: <br> D Operands occupy three continuous points. Please refer to the specification of each model series for applicable range of the device. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |  |

Explanation - $\mathbf{S}_{1}$ : Binary floating point number comparison value 1. $\mathbf{S}_{2}$ : Binary floating point number comparison value 2. D: Comparison result,.three continuous points are occupied.

- Comparison of the binary floating point number comparison value and binary floating point number comparison value 2. Comparison result $(>,=,<)$ is shown at $D$.
- If the source operands of $\mathbf{S}_{\mathbf{1}}$ or $\mathbf{S}_{\mathbf{2}}$ are assigned constants K or H , a command will change those constants to binary floating point numbers to make comparison.

Example - When assgined device is M10, then M10~M12 are automatically occupied.

- When $\mathrm{X} 0=\mathrm{On}$, DCMP execute a command, One of M10 ~M12 will be On. But when X0 = Off, DECMP doen't execute any command, M10 ~ M12 remains the same status as before $\mathrm{X0}=\mathrm{Off}$.

■ If you need to have results such as $\geqq, \leqq$ or $\neq$, make M10~ M12 parallel connection.

■ Use the RST or ZRST command to clean the results.


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | 16-bit command (5 STEPS) |  |
| S1 |  |  |  | * | * |  |  |  |  |  | * | - - - |  |
| S2 |  |  |  | * | * |  |  |  |  |  | * |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |
| D |  |  |  | * | * |  |  |  |  |  | * | DEZCP |  |
| Operands: <br> DOperands occupy three continuous points Please refer to the specification of each model series for applicable range of the device. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |

Explanation ■ $\mathbf{S}_{1}$ : The lower limit of a binary floating poiont number of a zone comparison. $\mathbf{S}_{\mathbf{2}}$ : The upper limit of a binary floating point number of a zone comparison. D: Comparison result,.three continuous points are occupied.

- $\mathbf{S}_{1}$ : Binary floating point number comparison value. Compare $\mathbf{S}$ to the $\mathbf{S}_{1}$ binary floating point number lower limit and to the $\mathbf{S}_{\mathbf{2}}$ binary floating point number upper limit. Show the comparison result at D.
- If the source operands of $\mathbf{S}_{1}$ or $\mathbf{S}_{2}$ are assigned constants K or H , a command will change those constants to binary floating point numbers to make comparison.
- When the binary floaring point number lower limit $\mathbf{S}_{1}$ is bigger than the binary floating point number upper limit $\mathbf{S}_{2}$. Then a command uses the binary floating point number lower limit $\mathbf{S}_{1}$ as upper/lower limit to make comparison.

■ When assgined device is M0, then M10~M12 are automatically occupied.
■ When $\mathrm{X0} 0=\mathrm{On}$, DCMP execute a command, One of M10 ~M12 will be On. But when X0 = Off, DECMP doen't execute any command, M10 ~ M12 remains the same status as before $\mathrm{X} 0=\mathrm{Off}$.

■ Use the RST or ZRST command to clean the results

| X0 |  | DEZCP |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | D0 | D10 | D20 | M0 |
|  | $\stackrel{\text { MO }}{\dashv}$ |  | When (D1D0) > (D21D20) , M0 = On |  |  |  |  |
|  | $\stackrel{\text { M1 }}{\text { - }}$ | When (D1D0) $\leq($ D21D20 $) \leq($ D11D10 $), \mathrm{M} 1=$ On |  |  |  |  |
|  | $\begin{gathered} \text { M2 } \\ \hline \end{gathered}$ | When (D21, D20) > (D11D10), M2= On |  |  |  |  |



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * |  |  |  |  |
| Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag s | --- | DRADP |  |

Explanation $\quad \mathbf{S}$ : source of the data (degree). $\mathbf{D}:$ result of the changes (radian).

- Use the following formula to change degree to radian.
- Radian $=$ Degree $\times(\pi / 180)$

Example When $\mathrm{X0}=\mathrm{On}$, assign the degree of binary floating point number (D11, D10). Once the dregree is chaned to radian, save it in the (D11, D10), the value is a binary floating poiont number.


(D) | D 11 | D 10 |
| :--- | :--- |
| RAD | $=($ Degree $\mathrm{x} \pi / 180)$ |

| API |  | DEG |  | (S © | Radian $\rightarrow$ Degree |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 117 | D | $\mathbf{P}$ |  |  |  |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| s |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * |  |  |  |
| Operan |  |  |  |  |  |  |  |  |  |  |  | DDEG ------------ DDEGP |  |  |

Explanation ■ S: source of the data (Radian). D: result of the changes (Degree).

- Use the following formula to change radian to degree.
- Degree $=$ Radian $\times(180 / \pi)$

Example When $\mathrm{XO}=\mathrm{On}$, assign the degree of binary floating point number (D1, D0). Once the dregree is chaned to radian, save it in the (D11, D10), the value is a binary



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | - | - | - | - |
| S1 |  |  |  | * | * |  |  |  |  |  | * |  |  |  |  |
| S2 |  |  |  | * | * |  |  |  |  |  | * | 32-bit | and |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * | DEAD |  | DEAD |  |

Operands:
Please refer to the specifications of each model for the Flag signal: none range of operands.
Explanation $\quad \mathbf{S}_{\mathbf{1}}$ : augend, $\mathbf{S}_{\mathbf{2}}$ : addend, $\mathbf{D}$ : sum

- $\quad \mathbf{S}_{1} \mathbf{S} 1+\mathbf{S} 2=\mathbf{D}$. The floating point value in $\mathbf{S} 1$ and $\mathbf{S} 2$ are added and the result is stored in $\mathbf{D}$. All calculation are done using binary floating poiont number.
- If the source operand $\mathbf{S} \mathbf{1}$ or $\mathbf{S 2}$ is specified as constant K or H , the constant will automatically be converted to binary floating point value for the addition operation.
$\mathbf{S 1}$ and $\mathbf{S 2}$ can designate the same register. In this case, if the instruction is specified as "continuous execution instruction" (generally DEADDP instruction) and the drive contact is ON,the register will be added once in every scan.

Example

- When $\mathrm{X} 0=\mathrm{On}$, the sum of binary floating point number (D1, D0) + binary floating point number (D3, D2) will be saved in (D11, D10).

| X0 | DEADD | D0 | D2 | D10 |
| :--- | :--- | :--- | :--- | :--- |

- When $\mathrm{X} 2=\mathrm{On}$, the sum of binary floating point number


| API |  | ESUB |  | $\mathbf{S}_{1} \mathbf{S}_{2}$ D | Floating Point Subtraction |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 121 | D | ESUB | P |  | Floating Point Subraction |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | - | - | - | - |
| S1 |  |  |  | * | * |  |  |  |  |  | * |  |  |  |  |
| S2 |  |  |  | * | * |  |  |  |  |  | * | 32-bit | and |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * | DESU |  | DESU |  |

Operands:
Please refer to the specifications of each model for the Flag signal: none range of operands.
Explanation
S1: Minuend S2: Subtrahend D: Subtraction result
$\mathbf{S 1}-\mathbf{S 2}=\mathbf{D}$. The floating point value in $\mathbf{S 2}$ is subtracted from the floating point value in $\mathbf{S 1}$ and the result is stored in $\mathbf{D}$. The subtraction is conducted in binary floating point format.

- If $\mathbf{S}_{1}$ or $\mathbf{S}_{2}$ is designated as constant K or H , the instruction will convert the constant into a binary floating point value before the operation.
- $\quad S_{1}$ and $S_{2}$ can designate the same register. In this case, if the instruction is specified as "continuous execution instruction" (generally DESUBP instruction) and the drive contact is ON, the register will be subtracted once in every scan.


## Example

- When $\mathrm{XO}=\mathrm{ON}$, binary floating point value (D1, D0) minuses binary floating point value (D3, D2) and the result is stored in (D11, D10).

| X0 | DESUB | D0 | D2 | D10 |
| :---: | :---: | :---: | :---: | :---: |

■ When X2 = ON, K1234 (automatically converted into binary floating point value) minuses binary floating point (D1, D0) and the result is stored in (D11, D10).

| X 2 | DESUB | K1234 | D0 | D10 |
| :--- | :--- | :--- | :--- | :--- |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S1 |  |  |  | * | * |  |  |  |  |  | * |  |  |  |
| S2 |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * | DEMUL | DEMULP |  |

Operands:
Please refer to the specifications of each model for the Flag signal: none range of operands.

S1: Multiplicand S2: Multiplier D: Multiplication result

- $\quad \mathbf{S 1} \times \mathbf{S 2}=\mathbf{D}$. The floating point value in $\mathbf{S} 1$ is multiplied with the floating point value in $\mathbf{S 2}$ and the result is $\mathbf{D}$. The multiplication is conducted in binary floating point format
- If $\mathbf{S} \mathbf{1}$ or $\mathbf{S} \mathbf{2}$ is designated as constant K or H , the instruction will convert the constant into a binary floating point value before the operation

■ S1 and $\mathbf{S 2}$ can designate the same register. In this case, if the instruction is specified as "continuous execution instruction" (generally DEMULP instruction) and the drive contact is ON , the register will be multiplied once in every scan

- When $\mathrm{X} 1=\mathrm{ON}$, binary floating point (D1, D0) multiplies binary floating point (D11, D10) and the result is stored in (D21, D20).

| X1 | DEMUL | D0 | D10 | D20 |
| :--- | :--- | :--- | :--- | :--- |

■ When $\mathrm{X} 2=\mathrm{ON}, \mathrm{K} 1234$ (automatically converted into binary floating point value) multiplies binary floating point (D1, D0) and the result is stored in (D11, D10).

| X2 | DEMUL | K1234 | D0 | D10 |
| :--- | :--- | :--- | :--- | :--- |


| API |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 123 | D | EDIV | $\mathbf{P}$ | $\boldsymbol{S}_{1}$ ( |  |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16 -bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | - | - | - | - |
| S1 |  |  |  | * | * |  |  |  |  |  | * |  |  |  |  |
| S2 |  |  |  | * | * |  |  |  |  |  | * | 32-bit | nd |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * | DEDI |  | DEDIV |  |

Operands:
Please refer to the specifications of each model for the Flag signal: none range of operands.
Explanation
S1: Dividend S2: Divisor D: Quotient and Remainder
 $\mathbf{S} 2$ and the result is stored in $\mathbf{D}$. The division is conducted in binary floating point

- If $\mathbf{S}_{1}$ or $\mathbf{S}_{2}$ is designated as constant K or H , the instruction will convert the constant into a binary floating point value before the operation.
- If $\mathbf{S 2}=0$, operation error will occur, the instruction will not be executed

Example When $\mathrm{X} 1=\mathrm{ON}$, binary floating point value of (D1, D0) is divided by binary floating point (D11, D10) and the quotient and remainder is stored in (D21, D20).

| X1 | DEDIV | D0 | D10 | D20 |
| :---: | :---: | :---: | :---: | :---: |

When X2 = ON, binary floating point value of (D1, D0) is divided by K1234 (automatically convertedto binary floating point value) and the result is stored in (D11, D10).

| X2 |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| DEDIV | D0 | K1234 | D10 |


| API | EXP |  | © | (S |
| :--- | :--- | :--- | :--- | :--- | Float Exponent Operation


Explanation
S: Exponent D: Operation result

- The base is $\mathrm{e}=2.71828$ and exponent is $\mathbf{S}$
- $[\mathbf{D}+1, \mathbf{D}]=\operatorname{EXP}^{[ } \mathbf{s}+\mathbf{1}, \mathbf{s}$ ]
- Both positive and negative values are valid for $\mathbf{S}$. Register $\mathbf{D}$ has to be 32-bit format. Operation is conducted in floating point value, so the value in $\mathbf{S}$ needs to be converted into floating value before exponent operation.

■ The content in $\mathbf{D}=e^{\mathrm{S}} ; \mathrm{e}=2.71828$ and $\mathbf{S}$ is the specified exponent.

Example ■ When M0 = ON, convert (D1, D0) to binary floating value and save the result in (D11, D10).

- Wehen M1 = ON, perform exponent operation with (D11, D10) as the exponent. The value is saved in register (D21, D20) in binary floating format.

| API |  | LN |  | S |
| :--- | :--- | :--- | :--- | :--- |
| 125 | $\mathbf{D}$ | $\mathbf{P}$ |  | Float Natural Logarithm Operation |



S: Source device D: Operation result
■ The base is $\mathrm{e}=2.71828$ and exponent is $\mathbf{S}$

- $[\mathbf{D}+\mathbf{1}, \mathbf{D}]=\operatorname{EXP}^{[ } \mathbf{S}+\mathbf{1}, \mathbf{s}$ ]
- Only a positive number is valid for $\mathbf{S}$. Register $\mathbf{D}$ has to be 32-bit format. Operation is conducted in floating point value, so the value in $\mathbf{S}$ needs to be converted into floating value before exponent operation.
- The content in $\mathbf{D}=e^{s} ; e=2.71828$ and $\mathbf{S}$ is the specified data source
- $\mathrm{eD}=\mathbf{S}$. The content of $\mathbf{D}=\mathrm{LN} \mathbf{S}$, where the value in $\mathbf{S}$ is specified by users.

Example ■ When M0 = ON, convert (D1, D0) to binary floating value and save the result in (D11, D10).

- When M1= ON, perform natural logarithm operation with (D11, D10) as the antilogarithm. The value is saved in register (D21, D20) in binary floating format.


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  | * | * |  |  |  |  |  | * |  |  |  |
| Operands: <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |  |

## Explanation <br> S: Source device D: Operation result

- This instruction performs a square root operation on the floating point value in $\mathbf{S}$ and stores the result in $\mathbf{D}$. All data will be operated in binary floating point format and the result will also be stored in floating point format.
- If the source device $\mathbf{S}$ is specified as constant K or H , the integer value will automatically be converted to binary floating value.

Example - When $\mathrm{XO}=\mathrm{ON}$, the square root of binary floating point ( $\mathrm{D} 1, \mathrm{D} 0$ ) is stored in (D11, D10) after the operation of square root.



- When $\mathrm{X} 2=\mathrm{ON}$, the square root of K1234 (automatically converted to binary floating value) is stored in (D11, D10).


| API |  |  | INT |  | S |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 129 | $\mathbf{D}$ |  | $\mathbf{P}$ | D | Float to Integer |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  |  |  |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
|  | ran | fer ope |  |  | ific | ations |  | each |  |  |  | Flag signal: none |  |  |

Explanation ■ S: Source device D: Operation result

- The binary floating point value in the register $\mathbf{S}$ is converted to BIN integer and stored inregister $\mathbf{D}$. The decimal of the operation result will be left out.
- This instruction is the opposite of the API 49 (FLT) instruction.

Example - When $\mathrm{X} 0=\mathrm{ON}$, the binary floating point value of (D1, D0) will be converted to BIN integer andthe result is stored in D10. The decimal of the result will be left out.

- When $\mathrm{X} 1=\mathrm{ON}$, the binary floating point value of (D21, D20) will be converted to BIN integerand the result is stored in (D31, D30). The decimal of the result will be left out.


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
| Operands: <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |  | Explanation $\quad \mathbf{S}$ : Source device $\left(0^{\circ} \leqq \mathbf{S}<360^{\circ}\right)$ D: Operation result

- The value in $\mathbf{S}$ can be set as radian.
- Radian mode. RAD $=$ degree $\times \pi / 180$.
- SIN instruction performs sine operation on $\mathbf{S}$ and stores the result in $\mathbf{D}$.

See the figure below for the relation between the radian and the operation result:


Example

- When XO = ON, DSIN instruction conducts sine operation on binary
floating value in (D1, D0) and stores the SIN value in (D11, D10) in binary floating format.



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
| Operands: <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none | DCOSP |  |

Explanation
S: Source device $\left(0^{\circ} \leqq \mathbf{S}<360^{\circ}\right)$
D: Operation result

- The value in $\mathbf{S}$ can be set as radian or degree by flag M1018.
- M1018 = OFF, radian mode. RAD $=$ degree $\times \pi / 180$.

■ M1018 $=$ ON, degree mode. Degree range: $0^{\circ} \leqq$ degree $<360^{\circ}$.

- If result to $0, \mathrm{M} 1020=\mathrm{On}$.
- COS instruction performs cos operation on $\mathbf{S}$ and stores the result in $\mathbf{D}$

See the figure below for the relation between the radian and the operation result:


Example ■ When $\mathrm{XO}=\mathrm{ON}, \mathrm{DCOS}$ instruction conducts cosine operation on binary floating value in (D1, D0) and stores the COS value in (D11, D10) in binary floating format.



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
| Operands: <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |  | Explanation - S: Source device $\left(0^{\circ} \leqq \mathbf{S}<360^{\circ}\right)$ D: Operation result

- The value in $\mathbf{S}$ can be set as radian or degree by flag M1018.
- M1018 $=$ OFF, radian mode. RAD $=$ degree $\times \pi / 180$.

■ M1018 $=$ ON, degree mode. Degree range: $0^{\circ} \leqq$ degree $<360^{\circ}$.

- When the operation result $=0, \mathrm{M} 1020=$ On.

■ TAN instruction performs tangent operation on $\mathbf{S}$ and stores the result in $\mathbf{D}$.
See the figure below for the relation between the radian and the operation result


Example When $\mathrm{X} 0=\mathrm{ON}$, DTAN instruction performs tangent operation on the radian value in (D1, D0) and stores the TAN value in (D11, D10) in binary floating format


| API |  |  | ASIN |  | © |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 133 | $\mathbf{D}$ |  | $\mathbf{P}$ |  | Arc Sine |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
|  | aran | s: <br> fer <br> op |  |  |  | ation | s of | each |  |  |  | Flag signal: none | DASINP |  |

Explanation
S: Source device (binary floating value)
D: Operation result

- ASIN value $=\sin ^{-1}$

See the figure below for the relation between input $\mathbf{S}$ and the result:


Example
When X0 = ON, DASIN instruction performs arc sine operation on the binary floating value in (D1, D0) and stores the ASIN value in (D11, D10) in binary floating format..


\section*{| API |  |  |  |
| :--- | :--- | :--- | :--- |
| 134 | ACOS | P $\quad$ D | Arc Cosine |}


Explanation
S: Source device (binary floating value)
D: Operation result

- $\quad$ ACOS value $=\cos ^{-1}$

See the figure below for the relation between the input $\mathbf{S}$ and the result:


Example
When X0 = ON, DACOS instruction performs arc cosine operation on the binary floating value in (D1,D0) and stores the ACOS value in (D11, D10) in binary floating format.

(D) $\square$ ACOS value binary floating point


Explanation
S: Source device (binary floating value) D: Operation result

- ATAN value $=\tan ^{-1}$

See the figure below for the relation between the input and the result:


Example When $\mathrm{X} 0=\mathrm{ON}$, DATAN instruction performs arc tangent operation on the binary floating value in(D1, D0) and stores the ATAN value in (D11, D10) in binary floating format.


| API |  |  | SINH |  | S © |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 136 | $\mathbf{D}$ |  | $\mathbf{P}$ |  | Hyperbolic Sine |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
| Operands: <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none | DSINHP |  |

Explanation
S: Specified source (binary floating point) D: Area where calculated result is stored

- Sinh value $=\left(e^{s}-e^{-s}\right) / 2$

Example When $\mathrm{XO}=\mathrm{On}$, specify binary floating point (D1, D0). Calculate SINH value and save the result in (D11, D10). The result stored in (D11, D10) is all in binary floating point format.




Explanation $\quad$ S: Specified source (binary floating point) D: Area where calculated result is stored

- cosh value $=\left(e^{s}+e^{-s}\right) / 2$

Example When $\mathrm{XO}=$ On, specify binary floating point (D1, D0). Calculate COSH value and save
the result in (D11, D10). The

- result stored in (D11, D10) is all in binary floating point format.


| API |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 138 | $\mathbf{D}$ | TANH | $\mathbf{P}$ | $\mathbf{S}$ D | Hyperbolic Tangent |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| S |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| D |  |  |  |  |  |  |  |  |  |  | * |  |  |  |
| Operands: <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none | DTANHP |  |

Explanation - S: Specified source (binary floating point) D: Area where calculated result is stored

- Tanh value $=\left(e^{s}-e^{-s}\right) /\left(e^{s}+e^{-s}\right)$

Example When $\mathrm{X} 0=$ On, specify binary floating point (D1, D0). Calculate $A S I N$ value and save the result in (D11, D10). The

- The result stored in (D11, D10) is all in binary floating point format.

| X0 |  | DTANH | D0 |
| :--- | :--- | :--- | :--- |
| H | D10 |  |  |

(S) D 1 D 0 binary floating point

(D) | D 11 | D 10 |
| :--- | :--- |

TANH value
binary floating point



S1: Hour of comparison time, setting range is K0~K23
S2: Minute of comparison time, setting range is K0~K59 S3:
Second of comparison time, setting range is K0~K59
S: Current time of calendar (occupies 3 continuous devices)
D: Comparison result (occupies 3 continuous devices)
The range of operand S1, S2, S3: S1=0~23, S2 =S3=K0~59

- S1, S2, S3 is compared to the current value of the head address $\mathbf{S}$ and save the comparsion result in $\mathbf{D}$.
- S1 is the hour of current time and the content is K0~K23. S2 is the minute of current time and the content is K0~K59. S3 is the second of current time and the content is K0~K59
- The current time of real time clock specified by $\mathbf{S}$ is read by using TRD command previously and then compared by using TCMP command. If the content of $\mathbf{S}$ exceeds the range, it will result in "operation error". At this time, the command won't be executed and M1067=On, M1068=On, records error code 0E1A (HEX) in D1067.

Example When $\mathrm{X} 10=$ On, the command is executed and the current time of real time clock in (D20~D22) is compared to the set value 12:20:45 and the result is shown at $\mathrm{M} 10 \sim \mathrm{M} 12$. When X10 goes from $\mathrm{On} \rightarrow$ Off, the command is not executed but the On/Off state before M10~M12 is kept. Connect M10~M12 in series or in parallel and then the result of $\geqq, \leqq, \neq$ are given.

| $\stackrel{\text { X10 }}{+10}$ | TCMP | K12 | K20 | K45 | D20 | M10 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | M10 | ON when12: 20: $45>$ |  | D20 (hr) |  |  |
|  |  |  |  | D21(min) |  |  |
|  |  |  |  | D22(sec) |  |  |
|  | $\stackrel{\text { M11 }}{\sim}$ | ON when 12: 20: $45=$ |  | D20 (hr) |  |  |
|  |  |  |  | D21(min) |  |  |
|  | -1ト |  |  | D22 (sec) |  |  |
|  | M12 |  |  | D20 (hr) |  |  |
|  |  | n12: 2 | $45<$ | D21(min) |  |  |
|  |  |  |  | D22(sec) |  |  |


| API | TZCP |  | $S_{1} S_{2}$ S | Comparison of calendar data area |
| :---: | :---: | :---: | :---: | :---: |
| 161 |  | P |  |  |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |
| S1 |  |  |  | * | * | * | * | * | * | * | * |
| S2 |  |  |  | * | * | * | * | * | * | * | * |
| S |  |  |  |  |  |  |  |  | * | * | * |
| D |  | * | * |  |  |  |  |  |  |  |  |

Operands:

## 16-bit command (5 STEPS) <br> TZCP

32-bit command

Flag signal: none

Please refer to the specifications of each model for the range of operands.
Explanation
-
D: Comparison result (occupies 3 continuous devices)

- $\quad \mathbf{S}$ is compared to the time period of $\mathbf{S 1} \sim \mathbf{S} 2$ and the comparsion result is stored in
D.
- S1, S1 +1, S1 +2: respectively represent "Hours", "Minutes", "Seconds" of the lower limit time data.
- $\mathbf{~} 2, \mathbf{S} 2+1, \mathbf{S} 2+2$ : respectively represent "Hours", "Minutes", "Seconds" of the upper limit time data。

■ S , S +1, S +2: respectively represent "Hours", "Minutes", "Seconds" of the current time of perpetual calender.

- The current time of real time clock specified by $\mathbf{S}$ is read by using TRD command previously and then compared by using TZCP command. If the content of S, S1, S2 exceeds the range, it will result in "operation error". At this time, the command won't be executed and M1068=On.
- If $S<S 1$, and if $S<S 2$, $\mathbf{D}$ is On. If $S>S_{1}$ and if $S>S 2, D+2$ is On. Besides these two situations, $\mathbf{D}+1$ is On.

Example - When X10 = On, the TZCP command is executed and one of M10~M12 will be On. When X10= Off, the TZCP command is not executed but the state of M10~M12 before X10=Off is kept.




[^4]Operand S1, S2, D occupies 3 continuous devices

- $\quad \mathbf{S 1}+\mathbf{S 2}=\mathbf{D}$. The time data in the register specified by $\mathbf{S 1}$ is added to the time data in the register specified by $\mathbf{S 2}$ and the addition result is stored in the register specified by $\mathbf{D}$
- If the time data in $\mathbf{S 1}$, $\mathbf{S} \mathbf{2}$ exceeds the range, it will result in "operation error". At this time, the command won't be executed and M1067=On, M1068=On, records error code 0E1A (HEX) in D1067.
- If the addition result is in a value greater than 24 hours, the Carry flag M1022=On. The value of the result shows in $\mathbf{D}$ is the time remaining above 24 hours.

■ If the addition result is equal to 0 (zero, 0 hour, 0 minute, 0 second), the Zero flag M1020= On.

## Example

- When $\mathrm{X} 10=\mathrm{On}$, the command is executed. Add the time data specified by D0~D2 and D10~D12 and store the result in the register specified by D20~D22.


8:10:20
6:40:6
14: 50: 26

| AP |  | TSUB |  | P | (S1) D |  |  |  |  |  |  | Ca |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |  |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C |  |  |
| S1 |  |  |  |  |  |  |  |  | * | * |  |  |
| S2 |  |  |  |  |  |  |  |  | * | * |  |  |
| D |  |  |  |  |  |  |  |  | * | * |  |  |

Please refer to the specifications of each model for the range of operands.
$\frac{16-\text { bit command (5 STEPS) }}{\text { TSUB }}$
32-bit command

- Flag signal: M1020 (Zero flag) M1022 (Carry flag) M1068 (calendar error)

Explanation

- S1: Time Minuend S2: Time Subtrahend D: Subtraction result Operand S1, S2, D occupies 3 continuous devices.
■ 將 $\mathbf{S 1} \mathbf{- S 2}=\mathbf{D}$. The time data in the register specified by $\mathbf{S} 2$ is subtracted from the time data in the register specified by $\mathbf{S 1}$ and the result is stored in the register specified by $\mathbf{D}$

■ If the time data in S1, S2 exceeds the range, it will result in "operation error". At this time, the command won't be executed and M1067=On, M1068=On, records error code 0E1A (HEX) in D1067.

- If the subtraction result is a negative value (less than 0), the Barrow Flag M1021= On. The value of the result shows in $\mathbf{D}$ is the time remaining above 24 (twenty-four) hour.
- If the subtraction result is equal to 0 (zero, 0 hour, 0 minute, 0 second), the Zero flag M1020= On.
- When $\mathrm{X} 10=\mathrm{On}$, the command is executed. The time data specified by D10~D12 is subtracted from the time data specified by D0~D2 and the result is stored in the register specified by D20~D22.

| X10 |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| TSUB | D0 | D10 | D20 |



$$
\text { 20: 20:5 14: 30: } 8 \quad \text { 5: 49:57 }
$$



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |
| D |  |  |  |  |  |  |  |  | * | * | * |

Operands:
Please refer to the specifications of each model for the range of operands.

16-bit command (5 STEPS)
TSUB
32-bit command

- Flag signal:

■ D: The device stores the current time of calendar (occupies 7 continuous devices)

- A perpetual calender clock is built in the EH/SA series PLC and this clock provide year (A.D.), week, month, date, hours, minutes and seconds total 7 data devices stored in D1063~D1069. The function of TRD command is for program designer to read the current time of perpetual calender directly and store the reading data in the 7 data registers specified by $\mathbf{D}$.
- D1063 reads only the last two digits of an year.
- When $\mathrm{X} 0=$ On, read the current time of perpetual calender to the specified register D0~D6.

■ The content of D1064: 1 is indicated Monday, 2 is indicated Tuesday,..., 7 is indicated Sunday.

| X0 |  |
| :---: | :---: |
| $1 ト$ | TRD |


| special D | Item | content | $\rightarrow$ | normal D | Item |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D1063 | Year | 00~99 |  | D0 | Year |
| D1064 | week | 1~7 | $\rightarrow$ | D1 | week |
| D1065 | month | 1~12 | $\rightarrow$ | D2 | month |
| D1066 | day | 1~31 | $\rightarrow$ | D3 | day |
| D1067 | hour | 0~23 | $\rightarrow$ | D4 | hour |
| D1068 | minute | 0~59 | $\rightarrow$ | D5 | minute |
| D1069 | second | 0~59 | $\rightarrow$ | D6 | second |


| API |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| 170 | GRY | $\mathbf{P}$ | $\mathbf{S}$ (D) | BIN $\rightarrow$ GRAY Code |


Explanation
S: Source device D: Destination to store Gray code result

The BIN value in the specified device by $S$ is converted to the GRAY CODE equivalent and the converted result is stored in the area specified by $\mathbf{D}$.

- The range of $\boldsymbol{S}$ that can be converted to the GRAY CODE is shown as follows:

16-bit command: 0~32,767
32-bit command: 0~2,147,483,647

If the BIN value is outside the range shown above, it is determined as "Operation Error". At this time, the command won't be executed
Example $\quad$ When $\mathrm{X} 0=O n$, constant K 6513 is converted to the GRAY CODE and stored in the D0.


DO

| API | $-\operatorname{GBIN}$ | $\mathbf{P}$ | S $\mathbb{D}$ | GRAY Code $\rightarrow$ BIN |
| :--- | :--- | :--- | :--- | :--- |
| 171 |  |  |  |  |



■ S: Source GRAY CODE D: Destination which stores converted BIN result

- The GRAY CODE value in the specified device by $\mathbf{S}$ is converted to the BIN value equivalent and the converted result is stored in the area specified by $\mathbf{D}$.
- This command can be used to read the value from an absolute position type encoder (it is generally a gray code encoder) which is connected to PLC inputs. Convert the value to the BIN value and store it in the specified register.
- The range of $\mathbf{S}$ that can be converted to the GRAY CODE is shown as follows:

16-bit command : 0~32,767
32-bit command : 0~2,147,483,647
If the GRAY CODE value is outside the range shown above, it is determined as "Operation Error".

- When X20=On, the GRAY CODE value in the absolute position type encoder connected to X0~X17 inputs is converted to BIN value and stored in D10.




1. $\mathbf{S}_{1}$ : Data source device $1 \quad \mathbf{S}_{2}$ : Data source device 2
2. This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. If the result is not " 0 ", the continuity of the instruction is enabled. If the result is " 0 ", the continuity of the instruction is disabled.
3. LD\# (\#: \& , |, ^) instruction is used for direct connection with BUS.

| API No. | $\begin{gathered} 16 \text {-bit } \\ \text { instruction } \end{gathered}$ | $\begin{gathered} 32 \text {-bit } \\ \text { instruction } \end{gathered}$ | Continuity condition |  |  |  | No-continuity condition |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 215 | LD\& | DLD\& | $\mathrm{S}_{1}$ | \& | $\mathrm{S}_{2}$ | $\neq 0$ | $\mathrm{S}_{1}$ | \& | $\mathrm{S}_{2}$ | $=0$ |
| 216 | LD\| | DLD | $\mathrm{S}_{1}$ | \| | $\mathrm{S}_{2}$ |  | $\mathrm{S}_{1}$ | \| | $\mathrm{S}_{2}$ | $=0$ |
| 217 | LD^ | DLD^ |  | $\wedge$ | $\mathrm{S}_{2}$ |  | $\mathrm{S}_{1}$ | $\wedge$ | $\mathrm{S}_{2}$ |  |

4. \&: Logical "AND" operation
5. I: Logical "OR" operation
6. $\wedge$ : Logical "XOR" operation
7. When the result of logical AND operation of CO and $\mathrm{C} 10 \neq 0, \mathrm{Y} 10=\mathrm{On}$.
8. When the result of logical OR operation of D200 and D300 $=0$ and $\mathrm{X} 1=\mathrm{On}$, Y11 = On will be retained.


| API |  |  |  |  |
| :---: | :---: | :---: | :---: | :--- |
| $218 \sim$ <br> 220 | D | AND\# | (S1) S2 | Contact Logical Operation AND\# |



Explanation

1. $\mathbf{S}_{1}$ : Data source device $1 \quad \mathbf{S}_{2}$ : Data source device 2
2. This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. If the result is not " 0 ", the continuity of the instruction is enabled. If the result is " 0 ", the continuity of the instruction is disabled.
3. AND\# (\#: \& , |, ^) is an operation instruction used on series contacts.

| API No. | 16 -bit <br> instruction | 32 -bit <br> instruction | Continuity condition |  |  | No-continuity <br> condition |  |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 218 | AND\& | DAND\& | $\mathbf{S}_{1}$ | $\&$ | $\mathbf{S}_{2}$ | $\neq 0$ | $\mathbf{S}_{1}$ | $\&$ | $\mathbf{S}_{2}$ | $=0$ |
| 219 | AND $\mid$ | DAND | $\mathbf{S}_{1}$ | $\mid$ | $\mathbf{S}_{2}$ | $\neq 0$ | $\mathbf{S}_{1}$ | \| | $\mathbf{S}_{2}$ | $=0$ |
| 220 | AND^ $^{\wedge}$ | DAND^ $^{\wedge}$ | $\mathbf{S}_{1}$ | $\wedge$ | $\mathbf{S}_{2}$ | $\neq 0$ | $\mathbf{S}_{1}$ | $\wedge$ | $\mathbf{S}_{2}$ | $=0$ |

4. \&: Logical "AND" operation
5. |: Logical "OR" operation
6. ^: Logical "XOR" operation

## Example

1. When $\mathrm{X} 0=\mathrm{On}$ and the result of logical AND operation of C 0 and $\mathrm{C} 10 \neq 0, \mathrm{Y} 10=$ On.
2. When $\mathrm{X} 1=\mathrm{Off}$ and the result of logical OR operation of D 10 and $\mathrm{DO} \neq 0$ and $\mathrm{X} 1=$ On, Y11 = On will be retained.
3. When $\mathrm{X} 2=$ On and the result of logical XOR operation of 32-bit register D200 (D201) and 32-bit register D100 (D101) $\neq 0$ or M3 $=$ On, M50 $=$ On.



4. $\mathbf{S}_{1}$ : Data source device $1 \quad \mathbf{S}_{2}$ : Data source device 2
5. This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. If the result is not " 0 ", the continuity of the instruction is enabled. If the result is " 0 ", the continuity of the instruction is disabled.
6. OR\# (\#: \& , |, ${ }^{\wedge}$ ) is an operation instruction used on parallel contacts.

| API No. | 16 bit <br> instruction | 32 bit <br> instruction | Continuity condition | No-continuity <br> condition |  |  |  |  |  |  |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 221 | OR\& | DOR\& | $\mathbf{S}_{1}$ | $\&$ | $\mathbf{S}_{2}$ | $\neq 0$ | $\mathbf{S}_{1}$ | $\&$ | $\mathbf{S}_{2}$ | $=0$ |
| 222 | OR $\mid$ | DOR $\mid$ | $\mathbf{S}_{1}$ | $\mid$ | $\mathbf{S}_{2}$ | $\neq 0$ | $\mathbf{S}_{1}$ | \| | $\mathbf{S}_{2}$ | $=0$ |
| 223 | OR^ $^{\wedge}$ | DOR^ $^{\wedge}$ | $\mathbf{S}_{1}$ | $\wedge$ | $\mathbf{S}_{2}$ | $\neq 0$ | $\mathbf{S}_{1}$ | $\wedge$ | $\mathbf{S}_{2}$ | $=0$ |

4. \&: Logical "AND" operation
5. I: Logical "OR" operation
6. $\wedge$ : Logical "XOR" operation

When $\mathrm{X} 1=\mathrm{On}$ and the result of logical AND operation of C 0 and $\mathrm{C} 10 \neq 0, \mathrm{Y} 10=\mathrm{On}$.
2. M60 will be On, if $X 2$ and $M 30$ are On with one of the following two conditions: 1 . The OR operation result of 32-bit register D10 (D11) and 32-bit register D20(D21) does not equal to 0.2. The XOR operation result of 32-bit counter C235 and 32bits register D200 (D201) does not equal 0.



|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX KnY KnM |  |  | T | C | D | LD* |  | ZRSTP |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * | * | * | * | * | * | * |  |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * | * | * | * | * | * | * | $\frac{32 \text { bits command (9 STEPS) }}{\text { DLD }}$ |  |  |  |
| Operands: $※:=,>,<,<>, \leqq, \geqq$ <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Flag sig | -- |  |  |

1. $S_{1}$ : Data source device $1 \quad S_{2}$ : Data source device 2
2. This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. Take API224 (LD=) for example, if the result is " $=$ ", the continuity of the instruction is enabled. If the result is " $\neq$ ", the continuity of the instruction is disabled.
3. LD $\because(※:=,>,<,<>, \leq, \geq)$ instruction is used for direct connection with BUS.

| API No. | 16 -bit <br> instruction | 32 -bit <br> instruction | Continuity <br> condition | No-continuity <br> condition |
| :---: | :--- | :--- | :---: | :---: |
| 224 | $\mathrm{LD}=$ | $\mathrm{DLD}=$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ |
| 225 | $\mathrm{LD}>$ | $\mathrm{DLD}>$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ |
| 226 | $\mathrm{LD}<$ | $\mathrm{DLD}<$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ |
| 228 | $\mathrm{LD}<>$ | $\mathrm{DLD}<>$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ |
| 229 | $\mathrm{LD}<=$ | $\mathrm{DLD}<=$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ |
| 230 | $\mathrm{LD}>=$ | $\mathrm{DLD}>=$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ |

Example

1. When the content in $\mathrm{C} 10=\mathrm{K} 200, \mathrm{Y} 10=\mathrm{On}$.
2. When the content in $\mathrm{D} 200>\mathrm{K}-30$ and $\mathrm{X} 1=\mathrm{On}, \mathrm{Y} 11=\mathrm{On}$ will be retained.




Explanation

1. $S_{1}$ : Data source device $1 \quad S_{2}$ : Data source device 2
2. This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. Take API232 (AND=) for example, if the result is " $=$ ", the continuity of the instruction is enabled. If the result is " $\neq$ ", the continuity of the instruction is disabled.
3. $\mathrm{AND} \circledast(\ldots:=,>,<,<>, \leq, \geq)$ is a comparison instruction is used on series contacts

| API No. | $16-$ bit <br> instruction | $32-$ bit <br> instruction | Continuity <br> condition | No-continuity <br> condition |
| :---: | :--- | :--- | :---: | :---: |
| 232 | AND $=$ | DAND $=$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ |
| 233 | AND $>$ | DAND $>$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ |
| 234 | AND $<$ | DAND $<$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ |
| 236 | AND $<>$ | DAND $<>$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ |
| 237 | AND $<=$ | DAND $<=$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ |
| 238 | AND $>=$ | DAND $>=$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ |

Example

1. When $\mathrm{X} 0=\mathrm{On}$ and the content in $\mathrm{C} 10=\mathrm{K} 200, \mathrm{Y} 10=\mathrm{On}$.
2. When $\mathrm{X} 1=$ Off and the content in $\mathrm{D} 0 \neq \mathrm{K}-10, \mathrm{Y} 11=$ On will be retained.
3. When $\mathrm{X} 2=$ On and the content in 32-bit register $\mathrm{DO}(\mathrm{D} 11)<678,493$ or $\mathrm{M} 3=$ On, M50 = On.




Explanation

1. $\mathbf{S}_{1}$ : Data source device $1 \quad \mathbf{S}_{2}$ : Data source device 2
2. This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. Take API240 (OR=) for example, if the result is " $=$ ", the continuity of the instruction is enabled. If the result is " $\neq$ ", the continuity of the instruction is disabled.
3. OR $※(※:=,>,<,<>, \leq, \geq$ ) is an comparison instruction used on parallel contacts.

| API No. | 16 -bit <br> instruction | 32 -bit <br> instruction | Continuity <br> condition | No-continuity <br> condition |
| :---: | :--- | :--- | :---: | :---: |
| 232 | AND $=$ | DAND $=$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ |
| 233 | AND $>$ | DAND $>$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ |
| 234 | AND $<$ | DAND $<$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ |
| 236 | AND $<>$ | DAND $<>$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ |
| 237 | AND $<=$ | DAND $<=$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ |
| 238 | AND $>=$ | DAND $>=$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ |

Example

1. When $\mathrm{X} 1=\mathrm{On}$ and the present value of $\mathrm{C} 10=\mathrm{K} 200, \mathrm{Y} 0=\mathrm{On}$.
2. When $\mathrm{X} 1=\mathrm{Off}$ and the content in $\mathrm{D} 0 \neq \mathrm{K}-10, \mathrm{Y} 11=\mathrm{On}$ will be retained.
3. M50 will be On when $\mathrm{X} 2=O n$ and the content of 32 -bit register D0(D11) <678,493 or M3= On.


| API | FLD※ | (S1) S2 |  |
| :---: | :---: | :---: | :---: |
| $\begin{gathered} 275 \sim \\ 280 \end{gathered}$ |  |  | Floating Point Contact Type <br> Comparison LD※ |



Explanation S1: Source device 1 S2: Source device 2

- This instruction compares the content in $\mathbf{S}_{1}$ and $\mathbf{S}_{2}$. Take "FLD=" for example, if the result is " $=$ ", the continuity of the instruction is enabled. If the result is " $\neq$ ", the continuity of the instruction is disabled.
- The user can specify the floating point value directly into operands S1 and S2 (e.g. F1.2) or store the floating point value in D registers for further operation.
- FLD※ instruction is used for direct connection with left hand bus bar.

| API No. | 32-bit instruction | Continuity condition | Discontinuity <br> condition |
| :---: | :--- | :--- | :--- |
| 275 | FLD $=$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ |
| 276 | FLD $>$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ |
| 277 | FLD $<$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ |
| 278 | FLD $<>$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ |
| 279 | FLD $<=$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ |
| 280 | FLD $>=$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ |

Example

- When the content in $\mathrm{D} 100(\mathrm{D} 101) \leq \mathrm{F} 1.2$ and X 1 is $\mathrm{ON}, \mathrm{Y} 21=\mathrm{ON}$ and latched.





## Explanation

## S1: Source device 1 S2: Source device 2

- This instruction compares the content in S1 and $\mathbf{S} 2$. Take "FAND =" for example, if the result is " $=$ ", the continuity of the instruction is enabled. If the result is " $\neq$ ", the continuity of the instruction is disabled.
- The user can specify the floating point value directly into operands S1 and S2 (e.g. F1.2) or store the floating point value in D registers for further operation.
- FAND※ instruction is used for serial connection with contacts

| API No. | 32-bit instruction | Continuity condition | Discontinuity <br> condition |
| :---: | :--- | :---: | :---: |
| 281 | FAND $=$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ |
| 282 | FAND $>$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ |
| 283 | FAND $<$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ |
| 284 | FAND $<>$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ |
| 285 | FAND $<=$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ |
| 286 | FAND $>=$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ |

Example

- When X 1 is OFF and the content in D100(D101) is not equal to $\mathrm{F} 1.2, \mathrm{Y} 21=\mathrm{ON}$ and latched.

| FAND<> | F1.2 | D0 | SET | Y21 |
| :---: | :---: | :---: | :---: | :---: |


| API | FOR※ | (S1) S2 |  |
| :---: | :---: | :---: | :---: |
| $\begin{gathered} 287 \sim \\ 292 \end{gathered}$ |  |  | Floating Point Contact Type Comparison OR※ |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | - | - | - | - |
| S1 |  |  |  |  |  |  |  |  | * | * | * |  |  |  |  |
| S2 |  |  |  |  |  |  |  |  | * | * | * | 32-bit command (9 STEPS) |  |  |  |
| Operand: \#: \& \|, ^ <br> Please refer to the specifications of each model for the range of operands. |  |  |  |  |  |  |  |  |  |  |  | Fla | -- | - |  |

Explanation
S1: Source device 1 S2: Source device 2

- This instruction compares the content in $\mathbf{S 1}$ and $\mathbf{S 2}$. Take "FOR =" for example, if the result is " $=$ ", the continuity of the instruction is enabled. If the result is " $\neq$ ", the continuity of the instruction is disabled
- The user can specify the floating point value directly into operands S1 and S2 (e.g. F1.2) or store the floating point value in D registers for further operation
- FOR※ instruction is used for parallel connection with contacts.

| API No. | 32-bit instruction | Continuity condition | Discontinuity <br> condition |
| :---: | :--- | :---: | :---: |
| 287 | FOR $=$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ |
| 288 | FOR $>$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ |
| 289 | FOR $<$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ |
| 290 | FOR $<>$ | $\mathbf{S}_{\mathbf{1}} \neq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}=\mathbf{S}_{\mathbf{2}}$ |
| 291 | FOR $<=$ | $\mathbf{S}_{\mathbf{1}} \leqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}>\mathbf{S}_{\mathbf{2}}$ |
| 292 | FOR $>=$ | $\mathbf{S}_{\mathbf{1}} \geqq \mathbf{S}_{\mathbf{2}}$ | $\mathbf{S}_{\mathbf{1}}<\mathbf{S}_{\mathbf{2}}$ |

Example

- When both X2 and M30 are On and the content in D100(D101) $\geq$ F1.234, M60 $=$ ON..



### 16.6.5 Description to drive's special commands

| API | RPR |  | (S1) (S2) | Read the AC motor drive's parameters |
| :--- | :--- | :--- | :--- | :--- |
| 139 |  | $\mathbf{P}$ |  |  |



| API | - |  |  | SPR |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 140 |  | $\mathbf{P}$ | S2 | Write the AC motor drive's parameters |  |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (5 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | WPR |  |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * |  |  |  |  |  | * |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * |  |  |  |  |  | * | 32-bit command | - |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  | Flag signal: none |  |  |

Explanation $\mathbf{S}_{1}$ : The data for writing. $\mathbf{S}_{2}$ : The parameters address for the write data.

## Example

1. It will read the data in parameter H 2100 of the C 2000 and write into $\mathrm{D} 0 ; \mathrm{H} 2101$ is read and write into D1.
2. When M0 $=\mathrm{ON}$ data in D 10 will be written into Pr. H 2001 of C 2000 .
3. When $\mathrm{M} 1=\mathrm{ON}$, data in H 2 will be written into $\operatorname{Pr}$. H 2001 of C 2000 , which is to activate the AC motor drive.
4. When $\mathrm{M} 2=\mathrm{ON}$, data in H 1 will be written into H 2000 of C 2000 , which is to stop the $A C$ motor drive.
5. When data writing successfully, M1017 will be on.


| API | FPID |  | (S1) S2 S3 (54 | PID control for the AC motor drive |
| :---: | :---: | :---: | :---: | :---: |
| 141 |  | P |  |  |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | F-bit command (9 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * |  |  |  |  |  | * |  |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * |  |  |  |  |  | * | 32-bit | and |  |  |
| $\mathrm{S}_{3}$ |  |  |  | * | * |  |  |  |  |  | * | - | - |  |  |
| $\mathrm{S}_{4}$ |  |  |  | * | * |  |  |  |  |  | * | Flag signal: None |  |  |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Explanation 1. $\mathbf{S}_{1}$ : PID Feedback Selection(0-6 acc.to Pr.08-00), $\mathbf{S}_{2}$ : Proportional Gain P, $\mathbf{S}_{3}$ : Integral Time I, S4: Derivative control D
2. This command FPID can control the PID parameters of the AC motor drive directly, including Pr.08.00 PID feedback, Pr.08.01 Proportional gain (P), Pr. 08.02 Integral time (I) and Pr. 08.03 Derivative control (D)

1. Assume that when $\mathrm{M} 0=\mathrm{ON}, \mathbf{S}_{1}$ is set to 0 (PID function is disabled), $\mathbf{S}_{2}=0, \mathbf{S}_{3}=1$ (unit: 0.01 seconds) and $\mathbf{S}_{4}=1$ (unit: 0.01 seconds).
2. Assume that when $\mathrm{M} 1=\mathrm{ON}, \mathbf{S}_{\mathbf{1}}$ is set to 0 (PID function is disabled), $\mathbf{S}_{\mathbf{2}}=1$ (unit: 0.01 ), $\mathbf{S}_{3}=0$ and $\mathbf{S}_{4}=0$.
3. Assume that when $\mathrm{M} 2=\mathrm{ON}, \mathbf{S}_{1}$ is set to 1 (frequency is inputted by digital keypad), $\mathbf{S}_{\mathbf{2}}=1$ (unit: 0.01), $\mathbf{S}_{3}=0$ and $\mathbf{S}_{4}=0$.
4. D1027: frequency command after PID calculation.


| API | FREQ |  | (S1) S2 S3 | Operation control of the AC motor drive |
| :--- | :--- | :--- | :--- | :--- |
| 142 | S |  |  |  |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (7 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | FREQ | EQP |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * |  |  |  |  |  | * | 32-bit command |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * |  |  |  |  |  | * | $\frac{32-b i t ~ c o m m a n d ~}{-}$ | - | - |
| $\mathrm{S}_{3}$ |  |  |  | * | * |  |  |  |  |  | * | Flag signal: M1028 |  |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1. $\mathbf{S}_{1}$ : frequency command, $\mathbf{S}_{2}$ : acceleration time, (Pr01-12) $\mathbf{S}_{3}$ : deceleration time (Pr01-13).
2. This command FREQ can control frequency command, acceleration time and deceleration time of the AC motor drive. Special register control is shown as following:

M1025: controls RUN (On)/STOP (Off) of the drive. (Run is valid when Servo On (M1040 On).)
M1026: Operation directions FWD (On)/REV (Off) of the drive.
M1040: controls Servo On (On)/ Servo Off (Off).
M1042: enable quick stop(ON)/ disable quick stop(Off)
M1044: enable Stop (On)/ disable stop(Off)
M1052: frequency locked (On)/ disable frequency locked(Off)
3. S2, S3:Acceleration and deceleration time setting. Its decimal point must according to the Pr01-45 Time Unit for Acceleration/Deceleration and S Curve.

For example:
When Pr01-45=0 "Unit=0.01 sec"
The S2 of below Ladder diagram is set as 50 and it means acceleration is 0.5 second.

The S 3 of below Ladder diagram is set as 60 and it means deceleration is 0.6 second.
4. WhenM11=Off, the drive frequency command will become 0 Hz .

1. M1025: controls RUN (On)/STOP (Off) of the drive. M1026: operation direction FWD (On)/REV (Off) of the drive. M1015: frequency attained.
2. When $\mathrm{M} 10=\mathrm{ON}$, setting frequency command of the $A C$ motor drive to $\mathrm{K} 300(3.00 \mathrm{~Hz})$ and acceleration/deceleration time is 0 .
3. When M11=ON, setting frequency command of the AC motor drive to $\mathrm{K} 3000(30.00 \mathrm{~Hz})$, acceleration time is 50 and deceleration time is 60.


| API |  |  |  | TORQ |
| :--- | :--- | :--- | :--- | :--- |
| 263 | $\mathbf{P}$ | S1 S2 | Torque Control of AC Motor Drive |  |



## Explanation

1. $\mathbf{S}_{1}$ : torque command (display in signed decimal with one decimal place)
$\mathbf{S}_{2}$ : speed limit
2. This command can control torque command and speed limi. Special register control is shown as following:
M1040: controls Servo On(On)/ Servo Off(Off). Torque output and speed limit are defined by the setting of TORQ command when TORQ command is set when Servo is ON.
3. M1040: control Servo On(On)/ Servo Off(Off). M1063: target torque attained. D1060: control mode setting. D1053: actual torque.
4. When $\mathrm{M} 0=\mathrm{Off}$, setting torque command of the AC motor drive to $\mathrm{K}+300(+30.0 \%)$ and speed limit to $3000(30 \mathrm{~Hz})$.
5. When $\mathrm{M} 0=O$, setting torque command of AC motor drive to $\mathrm{K}-300(-30.0 \%)$ and speed limit to $3000(30 \mathrm{~Hz})$ 。
6. When $\mathrm{M} 10=\mathrm{On}, \mathrm{AC}$ motor drive begins to execute torque command.
7. When target torque is attained, M1063 will switch ON and flag signal will be blinking.




## Explanation - $\mathbf{S}_{1}$ : target position (signed decimal)

- This DPOS command can control the motor position of AC motor drive. Special register control is shown as following:

M1040: controls Servo On(On)/ Servo Off(Off). M1055: searching origin point. M1048: operate to the new position point. In the condition D1060 $=1$ (control mode is set to position mode), M1040=1 (Servo ON), and DPOS command is given; when M1048 is set from OFF to ON the AC motor drive will operate till the new position point.

1. M1040: controls Servo On(On)/ Servo Off(Off). M1064: target position attained. D1060: control mode setting. D1051(L) and D1052(H): actual position point.
2. When $\mathrm{X} 0=O n$, setting M1040 to ON (Servo On).
3. When $\mathrm{X} 1=O n$, setting DPOS position command to +300000 . It will delay for 1 second then set M1048 to ON (operate to the new position). Please observe if the D1051 value changes. When position is attained, M1064 will set to ON and Y0 will output an ON signal.


| API | CANRX |  | S1 S2 S3 (S) | Read CANopen slave data |
| :--- | :--- | :--- | :--- | :--- |
| 261 |  |  |  |  |



Explanation 1. $\mathbf{S}_{1}$ : Slave station number, $\mathbf{S}_{2}$ : main index, $\mathbf{S}_{3}$ : sub-index + bit length, $\mathbf{D}$ : save address
2. Command CANRX can read the corresponding slave. Index. When executing this command, it will send SDO message to the slave. At this time, M1066 and M1067 are 0 but when reading is complete M1066 will set to 1 . If the slave replied an accurate response, the value will be written to the designated register and M1067 is now set to 1 . However, if the slave replied an inaccurate response, this error message will be recorded in D1076~D1079.

Example M1002: touch once to activate PLC and change K4M400=K1. After the change, different message will be displayed when M1066 is set to 1 .


| API |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| 264 |  |  |  |  |
| $\mathbf{P}$ | SANTX |  | S2 3 S4 | Write CANopen slave data |


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | 16-bit command (7 | $\frac{S T E P S)}{\text { FRFOP }}$ |  |
| $\mathrm{S}_{1}$ |  |  |  | * | * |  |  |  |  |  |  |  |  |  |
| $\mathrm{S}_{2}$ |  |  |  | * | * |  |  |  | * | * | * | 32 -bit command |  |  |
| S3 |  |  |  | * | * |  |  |  |  |  |  | - - | - | - |
| $\mathrm{S}_{4}$ |  |  |  | * | * |  |  |  |  |  |  | Flag signal: M1028 |  |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Explanation 1. $\mathbf{S}_{\mathbf{1}}$ : slave station number, $\mathbf{S}_{\mathbf{2}}$ : the address to write, $\mathbf{S}_{3}$ : main index, $\mathbf{S}_{4}$ : sub-index+ bit length.
2. Command CANTX can read the corresponding index of the slave. When executing this command, it will send SDO message to the slave. At this time, M1066 and M1067 are 0 but when reading is complete M1066 will set to 1 . If the slave replied an accurate response, the value will be written to the designated register and M 1067 is now set to 1 . However, if the slave replied an inaccurate response, this error message will be recorded in D1076~D1079.

| API | CANFLS |  | D | Update the mapping special D of CANopen |
| :--- | :--- | :--- | :--- | :--- |
| $\mathbf{2 6 5}$ |  |  |  |  |


| Bit Devices |  |  |  | Word Devices |  |  |  |  |  |  |  | 16-bit command (7 STEPS) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |  |  |  |
| D |  |  |  | * | * |  |  |  |  |  |  | 32-bit command |  |  |
| Operands: None |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  | Flag signal: M1028 |  |  |

1. $D$ : the special $D$ for update.
2. CANFLS can update the Special D command. When it executes in read only mode, it sends equivalent message as CANRX to the slave and saves the slave response to this particular Special D. When it executes in read/write mode, it sends equivalent message as CANTX to the slave and saves this special D value to the corresponding slave.
3. M1066 and M1067 are both 0 . When reading is complete, M1066 will be 1 and this value will write to the designated register if the slave replies an accurate response. When slave replies a fault response then M 1067 will be 0 and this error message will be recorded to D1076~D1079.


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D |
| S1 |  |  |  | * | * |  |  |  |  |  | * |
| S2 |  |  |  | * | * |  |  |  |  |  | * |
| S3 |  |  |  | * | * |  |  |  |  |  | * |
| D |  |  |  | * | * |  |  |  |  |  | * |

Operands: None

| 16-bit command (7 STEPS) |  |  |  |
| :---: | :---: | :---: | :---: |
| ICOMR | continuous processing | ICOMRP | pulse processing |
| 32-bit command |  |  |  |
| - | - | - | - |

Flag signal: M1077 M1078 M1079


|  | Bit Devices |  |  | Word Devices |  |  |  |  |  |  |  | 16－bit command（7STEPS） |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | X | Y | M | K | H | KnX | KnY | KnM | T | C | D | ICOMR | ICOMRP |  |
| S1 |  |  |  | ＊ | ＊ |  |  |  |  |  | ＊ |  |  |  |
| S2 |  |  |  | ＊ | ＊ |  |  |  |  |  | ＊ | 32－bit command |  |  |
| S3 |  |  |  | ＊ | ＊ |  |  |  |  |  | ＊ | DICOMR | DICOMRP |  |
| D |  |  |  | ＊ | ＊ |  |  |  |  |  | ＊ |  |  |  |
| Operands：None |  |  |  |  |  |  |  |  |  |  |  | Flag signal：M1077 | M1078 | M1079 |

Explanation S1：Slave station number S2 Device chosen（0：AC motor drive．，1：Internal PLC）
（S3）：Reading address
D：Saving device
■ 此指令 ICOMW 可以寫値到從站的變頻器和所內置 PLC 的暫存器値 The ICOMW command can write the register of the AC motor drive and that of internal PLC from slave station．

## Example



### 16.7 Error and Troubleshoot

| Fault | ID | Fault Descript | Corrective Action |
| :---: | :---: | :---: | :---: |
| PLiC | 48 | Internal communication signal off | Check if shielded wire is properly inserted to communication port COM1. |
| PLod | 50 | Data write error | Check if there is error in the program and download the program again. |
| PLSv | 51 | Data write error when executing | Re-apply the power and download the program again. |
| PLdA | 52 | Program upload error | Upload again. If error occurs continuously, please return to the factory. |
| PLFn | 53 | Command error when download program | Check if there is error in the program and download the program again. |
| PLor | 54 | Program capacity exceeds memory capacity | Re-apply the power and download the program again. |
| PLFF | 55 | Command error when executing | Check if there is error in the program and download the program again. |
| PLSn | 56 | Check sum error | Check if there is error in the program and download the program again. |
| PLEd | 57 | There is no "END" command in the program | Check if there is error in the program and download the program again. |
| PLCr | 58 | The command MC is continuous used more than 9 times | Check if there is error in the program and download the program again. |
| PLdF | 59 | Download program error | Check if there is error in the program and download the program again. |
| PLSF | 60 | PLC scan time over-time | Check if the program code is inaccurately written and download the program again. |

### 16.8 CANopen Master Application

Simple control of multiple-axes for certain application can be done by C2000 if the device supports CANopen protocol. One of the C2000 could acts as Master to perform simple synchronous control, e.g. position, speed, zero return, and torque control. The setup can be done in 7 steps:

## Step 1: Activate CANopen Master

1. Set Pr.09-45 to 1. (To activate Master function, turn off the power after setting and reboot. The digital keypadKPC-CC01 status will display "CAN Master".)
2. Set Pr. 00-02 to 6 for PLC reset. (Note: This action will erase the program and PLC register and will be set to factory setting.)
3. Turn off the power and reboot.
4. Set PLC control to"PLC Stop mode" by digital keypad KPC-CC01. (If the digital keypad is KPC-CE01 series, set PLC control to"PLC 2". If the drive just came out of the factory, since PLC program is not yet installed, the digital keypad will show PLFF warning code.)

## Step 2: Configuration of the Special D in Master

Each slave occupies 100 of Special D space and is numbered 1 to 8 . There are in total of 8 stations. Please refer to 4-3 Special Register in this chapter for Special D register definition.

1. When communication cable 485 is connected, set PLC status to "stop" by WPL soft. (If PLC had already switched to "PLC Stop" mode then PLC status should be "stop" already.)
2. To control the slave address and corresponding station. For example, control 2 stations of the slave (max. 8 stations synchronous control), if the station number is 21 and 22 , set D2000 and D2100 to 20 and 21 and then set D2200, D2300, D2400, D2500, D2600 and D2700 to 0 . The setting can be done via PLC software editor WPL, follow the steps shown:
■ Open WPL Editor > communication> Edit Register Memory(T C D)


- When the "Register" window appears, click "Transmit".


■ When transmission window appear, select "read" and input the range D2000~D2799 then press enter. The value in D2000~D2799 will be read. If communication failed, check the communication format (pre-defined PLC station is 2, 9600, 7N2, ASCII).
■ Insert the slave station for control. Set D2000 and D2100 to 20 and 21 then set D2200, D2300, D2400, D2500, D2600 and D2700 to 0.

■ Click"Transmit" again. When transmission window appears, input the range D2000~D2799 and enter. The value in D2000~D2799 will be write (If communication error occur and display failed, it means PLC is not in "stop" status. The value can only be write in "stop" status, pleas switch PLC to "stop".)
■ Another method is by setting D1091. Set the corresponding bit of the excluding slave to 0 (slave station range from No.1~8). For example, if the user wants to exclude slave No. 2, 6 and 7, please set D1091 = 003B by following steps: WPL Editor > communication> Edit Register Memory(T C D)
3. Setup the communication setting. If following conditions apply to you then no additional setting needs to be done:
$\square$ If the only control in this application is the speed mode of AC motor drive. (For other control such as position and torque control, D2000~D2799 should be set. Please refer to synchronous control on position, torque and zero return for more set up detail.

To perform synchronous control on position for the slave, please enable the corresponding function PDO 3. ( P to P function is not yet supported by C2000.)

- To activate PDO 3 TX (Master sending command to Slave), please set up bit $8 \sim 11$ of the PLC address D2034+n*100. This special D register is defined as below:

|  | PDO4 |  | PDO3 |  | PDO2 |  | PDO1 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Torque |  | Position |  | Remote I/O |  | Speed |  |
| Bit | 15 | $14 \sim 12$ | 11 | $10 \sim 8$ | 7 | $6 \sim 4$ | 3 |  |
| Definition | En | Number | En | Number | En | Number | En |  |
| Number |  |  |  |  |  |  |  |  |

The pre-defined setting of PDO 3 TX has corresponded to CANopen control word "Index 6040"and CANopen target position" Index 607A". If position control is the only control in this application then simply set Special $D$ register value to $0 \times 0 \mathrm{~A} 00$.

■ To activate PDO 3 RX (Slave response with the status to Master), please set up bit 8~11 of the PLC address D2067+n*100. This special D register is defined as below:

|  | PDO4 | PDO3 |  | PDO2 |  | PDO1 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Torque |  | Position |  | Remote I/O |  | Speed |  |
| Bit | 15 | $14 \sim 12$ | 11 | $10 \sim 8$ | 7 | $6 \sim 4$ | 3 | $2 \sim 0$ |
| Definition | En | Number | En | Number | En | Number | En | Number |

The pre-defined setting of PDO 3 TX has corresponded to CANopen control word "Index 6041"and CANopen actual position" Index 6064". If position control is the only control in this application then simply set Special D register value to $0 \times 0 \mathrm{~A} 00$.

In same theory, to perform torque control, please enable the mapping function PDO4.

The speed for 1 corresponding cycle is 8 ms . (When shorten the cycle time to $<8 \mathrm{~ms}$, make sure the time is enough for the data to be transmitted.

User should calculate the corresponding PDO quantity before setting the cycle. The PDO quantity should not be greater than the $N$. The quantity can be calculated by the following formula.
$\mathrm{N}=(1$ cycle (ms) * rate (kbs) )/250
Example: 1 cycle is 2 ms , speed= 1000 k , max PDO value is $2^{*} 1000 / 250=8$. If user wants to set the cycle time to 2 ms , turns off 4 of the C type AC motor drive slave stations must be turned off (since the pre-defined setting is 8 slaves, half of the slave station would be 4). The slave station can be turned off by setting the D2000+n*100 of the unused slaves to 0 .

## Number of control station $\leq 8$.

Controlling 8 slave stations at once can only be done by asynchronous control where to Read/Write the slave is done by CANRX and CANTX command. This is similar to the Read/Write action of Modbus protocol.

## The slave complies with DS402 standard.

Does not control Slave IO terminal.
If above conditions do not apply, please set up the slave corresponding addresses manually by open WPL editor > communication> Edit Register Memory (T C D).

## Step 3: Set up Master station number and communication speed.

$\square \quad$ Set up the station number for the Master (the default setting of Pr.09-46=100). Do not to set the same station number as the Slave.
$\square \quad$ Set up CANopen communication parameter Pr.09-37. It does not matter if the drive is defined as a Master or a Slave, communication speed is set by Pr.09-37 in both case.

## Step 4: Coding

Real-time corresponding action: the data can be Read/Write directly to the corresponding special "D" register.

Non Real-time corresponding action:
Read: Reading is made by CANRX command. When reading process is complete, $\mathrm{M} 1066=1$. If reading succeeded, $\mathrm{M} 1067=1$; if reading failed, $\mathrm{M} 1067=0$.

Write: Writing is made by CANTX command. When writing process is complete, M1066 =1. If writing succeeded, M1067=1; if reading failed, M1067 =0.

Update: Updating the data is made by CANFLS command. (If special D register is defined as RW type, Master will write the value into the slave. If special $D$ register is defined as RO type, then the data in the Slave will be read and write into the Master.) When updating process is complete, M1066 will be 1. If updating succeeded, M1067=1; if updating failed, M1067=0.

## $\square$ NOTE

When executing CANRX, CANTX and CANFLS commands, the device will wait till M1066 is completed before the next CANRX, CANT or CANFLS begins. When the commands completed, download the program to the drive. (Note: The factory setting of PLC communication protocol is ASCII 7N2 9600 and station number is 2. Please change WPL Editor setting at Setting> Communication Setting)

Step 5: Setting the Slave station number, communication speed, operation source and command source

CANopen communication is supported by Delta C2000 series and EC series AC motor drive.
The corresponding slave and CANopen speed are shown as below:

|  | Corresponding Parameter of Drive |  | Value | Definition |
| :---: | :---: | :---: | :---: | :---: |
|  | C2000 | E-C |  |  |
| Slave address | 09-36 | 09-20 | 0 | Disable CANopen Hardware Interface |
|  |  |  | 1~127 | CANopen communication address |
| CANopen speed | 09-37 | 09-21 | 0 | 1M |
|  |  |  | 1 | 500K |
|  |  |  | 2 | 250K |
|  |  |  | 3 | 125K |
|  |  |  | 4 | 100K |
|  |  |  | 5 | 50K |
| Source of operation command | 00-21 |  | 3 |  |
|  |  | 02-01 | 5 |  |
| Source of frequency command | 00-20 |  | 6 |  |
|  | - | 02-00 | 5 |  |
| Torque command | 11-34 | , | 3 |  |

The only servo motor and drive that supports CANopen communication interface is A2 series.
The corresponding slave station number and communication speed are shown as below:

|  | Corresponding <br> Parameter of Drive | Value |  |
| :--- | :---: | :---: | :--- |
|  | A2 |  |  |

## Step 6: Hardware connection

The terminating resistor must be installed at the two farthest ends as shown in the figure below:


## Step 7: Activate PLC Control Function

Download the program after coding is complete and switch PLC mode to Run status. Then reboots the power for Slave and Master. Please refer to CANMaster Test 1 vs. 2 driver.dvp.

## Example:

C2000 AC motor drive (1 master vs. 2 slave control)
Step 1: Activate CANopen Master
■ Set Pr.09-45 to 1. (To activate Master function, turn off the power after setting and reboot. The digital keypadKPC-CC01 status will display "CAN Master".)
■ Set Pr.00-02 to 6 for PLC reset. (Note: This action will erase the program and PLC register and will be set to factory setting.)
$\square$ Turn off the power and reboot.
■ Set PLC control to"PLC Stop mode" by digital keypad KPC-CC01. (If the digital keypad is KPC-CE01 series, set PLC control to"PLC 2". If the drive just came out of the factory, since PLC program is not yet installed, the digital keypad will show PLFF warning code.)
Step 2: Configuration of the Special D in Master
■ Open WPL editor
■ Set PLC mode to PLC Stop (PLC2) via the keypad
■ WPL editor read D1070~D1099 and D2000~D2799
■ Set D2000=10 and D2100=11
$\square$ Set D2100, 2200, 2300 $2400 \quad 2500 \quad 2600 \quad 2700=0$
■ Download D2000~D2799 setting
Step 3: Set up Master station number and communication speed
$\square$ Set up the station number for the Master (the default setting of Pr.09-46=100). Do not to set the same station number as the Slave.

Set up CANopen communication speed to 1 M (parameter Pr.09-37= 0). It does not matter if the drive is defined as a Master or a Slave, communication speed is set by Pr.09-37 in both case.

Step 4: Coding
Real-time corresponding action: the data can be Read/Write directly to the corresponding special "D" register.

Non Real-time corresponding action:
Read: Reading is made by CANRX command. When reading process is complete, M1066=1. If reading succeeded, M1067 =1; if reading failed, M1067=0.

Write: Writing is made by CANTX command. When writing process is complete, M1066 $=1$. If writing succeeded, M1067=1; if reading failed, M1067 $=0$.
Update: Updating the data is made by CANFLS command. (If special D register is defined as RW type, Master will write the value into the slave. If special $D$ register is defined as RO type, then the data in the Slave will be read and write into the Master.) When updating process is complete, M1066 will be 1. If updating succeeded, M1067=1; if updating failed, M1067=0.

## $\square$, NOTE

When executing CANRX, CANTX and CANFLS commands, the device will wait till M1066 is completed before the next CANRX, CANT or CANFLS begins. When the commands completed, download the program to the drive. (Note: The factory setting of PLC communication protocol is ASCII 7N2 9600 and station number is 2 . Please change WPL setting at setting> communication setting)

Step 5: Set Slave station number and communication speed.
Slave No.1: Pr.09-37 = 0(speed 1M), Pr.09-36=10 (station number 10)
Slave No.2: Pr. 09-37 = 0(speed 1M), Pr.09-36=10 (station number 11)
Step 6: Hardware connection
The terminating resistor must be installed at the two farthest ends as shown in the figure below:


Step 7: Activate PLC Control Function
Download the program after coding is complete and switch PLC mode to Run status. Then reboots the power for Slave and Master. Please refer to CAN Master Test 1 vs. 2 driver.dvp.

## 16-9Descriptions of PLC Control Modes <br> (Speed, Torque, Homing and Position Modes)

When the AC motor drive is in FOC vector control, it can perform torque mode, position mode and speed mode. However, auto-tuning of motor must be done first for these modes to function.

There are two types of motors, Induction Motor (IM) and Permanent Magnetic Motor (PM). After auto-tuning process, IM motor is ready for AC motor drive to control. For PM motor, user must complete PG offset angle process after auto-tuning. Please refer to Pr.12-58 and Pr.05-00 for more detail.
※ Set up Delta ECMA series PM motor by enter motor parameters, follow the motor parameters shown in Delta Servo Motor Catalogue. It is not required to execute auto-tuning for using Delta ECMA series PM motors.

Setting and Description for Other Control Modes:

## Speed Control:

The corresponding registers for Speed Mode are listed in the chart below:
Special M Control Settings

| Special M | Descriptions | R/W |
| :---: | :--- | :---: |
| M1025 | AC motor drive operation status: (0) Stop (1) Start up (must also set M1040 =1) | RW |
| M1026 | AC motor drive opeartion direction: (0) FWD (1) REV | RW |
| M1040 | Power ON | RW |
| M1042 | Quick stop | RW |
| M1044 | Halt | RW |
| M1052 | Frequency lock | RW |

Special M Status

| Special M |  | Descriptions |
| :---: | :--- | :---: |
| M1015 | Target frequency attained | R/W |
| M1056 | Power ON ready | RO |
| M1058 | Quick decelerating to stop | RO |

Special D Control Settings

| Special D | Descriptions | R/W |
| :---: | :--- | :---: |
| D1060 | Mode setting (speed mode =0) | RW |

Speical D Status

| Special D | Descriptions | R/W |
| :---: | :---: | :---: |
| D1037 | Output frequency of AC motor drive command $(0.00 \sim 600.00)$ | RO |


| Special D | Descriptions | R/W |
| :---: | :---: | :---: |
| D1050 | Actual mode (0:Speed, 1: Position, 2: Torque, 3: Homing) | RO |

Control command for Speed Mode:

| FREQ(P) | S1 | S2 | S3 |
| :---: | :---: | :---: | :---: |
|  | Target speed | 1st step accel. time | 1st step decel. time |

## Example of Speed Control Mode:

If the drive is in FOC control mode, please auto-tuning the motor before setting PLC control mode to speed control.

1. When setting $\mathrm{D} 1060=0, \mathrm{AC}$ motor drive is in speed mode (default setting).
2. Write FREQ command to PLC program to control AC motor drive's frequency and accel./decel. time.
3. When setting $\mathrm{M} 1040=1, \mathrm{AC}$ motor drive power turns ON but frequency remains 0 .
4. When setting M1025 = 1, AC motor drive begins to operate till the FREQ frequency is attained and will accel./decel. according to the setting of FREQ.
5. Use M1052 to lock present operation frequency.
6. Use M1044 to hault the drive and decelerate by the decleration setting.
7. Use M1042 to quick stopping the drive. The drive will declerate by it's maximum deceleration speed and it is the speed that would not trigger a fault alarm. However if loading is too large, a fault alarm may still occur.
8. Priority of the control command is: M1040(Power ON) $>$ M1042(Quick Stop) $>$ M1044(Halt) >M1052(LOCK)


## Torque Control:

The corresponding registers for Torque Mode are listed in the chart below:
Special M Control Setting

| Special M | Description | R/W |
| :---: | :---: | :---: |
| M1040 | Power ON | RW |

Special M Status

| Special M | Description | R/W |
| :---: | :--- | :---: |
| M1056 | Power ON ready | RO |
| M1063 | Target torque attained | RO |

Special D Conrol Setting

| Special D | Description | R/W |
| :---: | :--- | :---: |
| D1060 | Mode setting (Torque mode=2) | RW |

Special D Status

| Special D | Description | R/W |
| :---: | :--- | :---: |
| D1050 | Actual mode (0:Speed, 1: Position, 2: Torque, 3: Homing) | RO |
| D1053 | Actual torque | RO |

Control command for Torque Mode:

| TORQ(P) | S1 | S2 |
| :--- | :--- | :---: |
|  | Target torque (signed decimal) | Frequency limit |

## Example of Torque Control Mode:

Before setting PLC program to torque control mode, maker sure the torque parameter settings of the $A C$ motor drive are completed.

1. When setting $\mathrm{D} 1060=2, \mathrm{AC}$ motor drive is in torque mode.
2. Write TORQ command to PLC program for torque and speed limit control.
3. When setting $\mathrm{M} 1040=1, \mathrm{AC}$ motor drive power turns ON and operate till target torque or speed limit is attained. Actual torque value can be read in D1053.


## Homing/Position Control:

The corresponding registers for Homing/Position Mode are listed in the chart below:

Special M Control Setting

| Special M | Description | R/W |
| :---: | :--- | :---: |
| M1040 | Power ON | RW |
| M1048 | Run till the new position is attained. For M1048 to function, also need to set <br> control mode to position mode (D1060 $=1$ ) and set M1040 $=1$. | RW |
| M1055 | Home action begins. For 1055 to function, also need to set control mode to <br> position mode (D1060 $=3$ ) and set M1040=1. | RW |

## Special M Status

| Special M | Description | R/W |
| :---: | :--- | :---: |
| M1064 | Target position attained | RO |
| M1070 | Homing completed | RO |
| M1071 | Homing error | RO |

Special D Control Setting

| Special D | Description | R/W |
| :---: | :---: | :---: |
| D1060 | Mode selection (1: Position, 3: Homing) | RW |

Special D Status

| Special D | Description | R/W |
| :---: | :--- | :---: |
| D1050 | Actual mode (0:Speed, 1: Position, 2: Torque, 3: Homing) | RO |
| D1051 | Actual position (Low word) | RO |
| D1052 | Actual position (High word) |  |

※ Read both D1051 and D1052 for actual position. The display value is in signed decimal.
Control Command for Position Mode:

| DPOS(P) | S1 |  |
| :--- | :---: | :--- |
|  | Target position (signed decimal) |  |

## Example of Homing and Position Mode:

Before setting PLC program to homing mode or position mode, maker sure the motor parameter settings of the AC motor drive are completed.

1. Set Pr.00-40 to homing mode and set up corresponding limit sensor and origin point by MI ( $\mathrm{MI}=44$ is for reverse run limit, $\mathrm{MI}=45$ is for forward run limit and $\mathrm{MI}=46$ is for homing to origin point). C2000 series AC motor drive only supports $Z$ phase homing to origin point, please choose an Encoder with Z phase.
2. When setting $\mathrm{D} 1060=3, \mathrm{AC}$ motor drive is in homing mode.
3. When setting $\mathrm{M} 1040=1, \mathrm{AC}$ motor drive power turns ON .
4. When setting $M 1055=1, A C$ motor drive search for origin point.
5. When homing is complete, M1070 will be ON . Then set $\mathrm{D} 1060=1$ to switch control mode to position mode. (Ensure M1040 should not be turned OFF to avoid inaccurate origin point.)
6. Write DPOS command to PLC program for setting AC motor drive's target position. Use Pr.00-12 for the absolute or relative position selection.
7. Set M1048 to Pulse ON for one time and needs to be longer than 1 ms , then AC motor drive will begin to operate till the target position is attained (only when $\mathrm{M} 1040=1$ ). Present motor position can be read from D1051 and D1052.

Step $1 \sim 7$ can be categorized into three parts, please refer to the following example:
Part I: Set control mode to Homing Mode $(\mathrm{D} 1060=3)$ and turn $A C$ motor drive power ON by trigger X2.


Part II (Homing action): Begins homing mode by trigger X3. The drive will switch to position mode automatically when homing is complete.


Part III (Point to Point Position Control): Switch control mode to Position Mode (D1060=1) and motor will be running forward and reverse between the position setting(+300000~-300000).

※ If user's application does not require homing action, you may skip Part I and Part II and go to the next step. In this example, turn AC motor drive power ON by trigger X2 and set M1002 to position mode, then the PLC program will be in position mode when drive power turns ON.

## 16-10 Internal Communication for Master Control

The 'Internal Communication' function is designed and developed for the applications where CANopen communication is not applicable or accessable. It replaces CANopen by RS485 and provides real-time transmission as CANopen communication. This communication protocol is available for C2000 series and CT2000 series AC motor drives only and the way it functions is similar to Master/Slave control. A master drive could control a maximum of 8 slaves and the master/slave setting process is very simple.

## Slave Drives Settings:

1. Set Pr.09-31= $-1 \sim-8$, the drive is able to control 8 nodes.
2. Set Pr.00-21=1, set source of control to RS485.
3. Select for what RS485 should control: Pr.00-21=2 (Speed command) or Pr.11-33 = 1 (Torque command) or Pr.11-40=2 (Position command).
4. Once completed, the slave setting is done. It is not required to turn on PLC functions.

## Master Drives Settings:

1. Set Pr.09-31=-10 and set PLC to Enable.

Connection for Hardware:
Establish Master drive and Slave drives connections by using RS485 cable. The CT2000 series AC motor drive is designed with 2 types of RS485 ports, as shown in the figure following:
(Refer to Chapter 06 Control Terminal for more about wiring terminals)



## PLC Programming for Master Drive Control

1. In PLC program, D1110 is used for assigning the slave drive user wishes to control. The range setting for D1110 is 1~8 (if D1110 is set to 0 slave 8 is assigned).
2. Once the Slave drive is assigned, set M1035=1 for the Master to control the Slave.
3. Write control command to the corresponding Slave address then Master is able to control the Slave drive.

The corresponding registers for Internal Communication are listed in the chart below:

## Special M Control Setting

| Special M | Description | R/W |
| :---: | :---: | :---: |
| M1035 | Enable internal communication control | RW |

Special D Control Setting

| Special D | Description | R/W |
| :---: | :---: | :---: |
| D1110 | Number of internal communication nodes(1~8) | RW |


| Special D | Description |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Definition | bit | Priority | Speed Mode | Position Mode | Torque Mode | Homing Mode |  |
| D1120 + 10*N | Contorl Command for Internal Communication Node N | 0 | 4 | Command Enable | - | - | Return to Origin Point | RW |
|  |  | 1 | 4 | Reverse Command | Switch | - | - |  |
|  |  | 2 | 4 | - | - | - | - |  |
|  |  | 3 | 3 | Momentary Stop | Momentary Stop | - | - |  |
|  |  | 4 | 4 | Frequency Locked | - | - | Momentary Stop |  |
|  |  | 5 | 4 | JOG | - | - | - |  |
|  |  | 6 | 2 | Quick Stop | Quick Stop | Quick Stop | Quick Stop |  |
|  |  | 7 | 1 | Servo ON | Servo ON | Servo ON | Servo ON |  |
|  |  | 11~8 | 4 | Switch Multi-step Speed | Switch Multi-step Speed | - | - |  |
|  |  | 13~12 | 4 | Switch Deceleration Time | - | - | - |  |
|  |  | 14 | 4 | $\begin{gathered} \text { Enable Bit } \\ 13 \sim 8 \end{gathered}$ | $\begin{gathered} \text { Enable Bit } \\ 13 \sim 8 \end{gathered}$ | - | - |  |
|  |  | 15 | 4 | Clear Fault Code | Clear Fault Code | Clear Fault Code | Clear Fault Code |  |
| D1121 + 10*N | Contorl Mode for Internal Communication Node N |  |  | 0 | 1 | 2 | 3 | RW |
| D1122 + 10*N | Reference Command L of Internal Communication Node N |  |  | Speed Command (unsigned decimal) | Position Command (signed decimal) | Torque Command (signed decimal) | - | RW |
| D1123 + 10*N | Reference Command H of Internal Communication Node N |  |  | - |  | Speed Limit | - | RW |

※ $\mathrm{N}=0 \sim 7$
Special D Status

| Special D | Description | R/W |
| :---: | :--- | :---: |
| D1115 | Synchronous time cycle of internal communication $(\mathrm{ms})$ | RO |
| D1116 | Internal communication node error (bit0= Slave 1, bit1 = Slave 2, ..., bit7= Slave <br> 8) | RO |
| D1117 | Corresponding on-line bit of internal communication node (bit0= Slave 1, bit1= | RO |


| Special D | Description | R/W |
| :---: | :---: | :---: |
|  | Slave 2, ..., bit7= Slave 8) |  |


| Special D | Description |  |  |  |  | R/W bit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Definition | bit | Definition | bit | Definition |  |
| D1126 + 10*N | 0 | Frequency Attained | Position Attained | Torque Attained | Homing Completed | RO |
|  | 1 | Forward Run | Forward Run | Forward Run | Forward Run |  |
|  |  | Reverse Run | Reverse Run | Reverse Run | Reverse Run |  |
|  | 2 | Warning | Warning | Warning | Warning |  |
|  | 3 | Error | Error | Error | Error |  |
|  | 5 | JOG |  |  |  |  |
|  | 6 | Quick Stop | Quick Stop | Quick Stop | Quick Stop |  |
|  | 7 | SERVO ON | SERVO ON | SERVO ON | SERVO ON |  |
| D1127 + 10*N |  | Actual Frequency | Actual Position (signed decimal) | Actual Torque (signed decimal) | - | RO |
| D1128 + 10*N |  | - |  | - | - |  |

Example: The PLC programming diagram below shows how to use 'Internal Communication' to control the frequency of Slave 1 and switches between 30.00 Hz and 60.00 Hz .

Diagram 1: Detects Slave drive on-line status and check if error occurs. Then set internal communication node 0 to the control command user wishes to control.

0

| M1000 |  |
| :---: | :---: |
|  | MOV D1117 K1M700 |
| operation Monitoring opening Point (a) | Internal node Node 0 online Line correspondence |
|  | MOV D1126 K4M250 |
|  | Internal node Node 0 arrive Status of 0 |
|  | MOV K4M200 D1120 |
|  | Node 0ack Internal node 0 |
|  | $\qquad$ (M1035) <br> Enable internal communication control |

Diagram 2: When Slave 1 on-line status is detected, it will delay for 3 seconds before control command is enabled.


Diagram 3: Commanding Slave 1 to forward run in 30.00 Hz for 1 second and reverse run in 60.00 Hz for 1 second and repeats frequency switching.


## 16-11 Counting Function via MI8

The Multi-function Input Terminal (MI8) can be used for single direction Pulse counting and provides a maximum speed of 100K. To initiate MI8 for counting, simply set M1038 to ON and the count value will be saved to D1054 and D1055 in 32bit signed decimal. When M1039 is ON, counting value will reset to 0 .

※ WhenPLC program M1038 and M1039 uses MI8 for counting function, the previous AC motor drive setting of MI8 is disabled and have no function.

## 16-12 Remote IO Control Application of MODBUS (using Modbus)

C2000 internal PLC supports reading and writing of 485, and it is realized by MODRW command. But before programming, it is necessary to define the serial as PLC 485, which sets P09-31 $=-12$. After setting, standard Function defined by 485 can be used to read or write command to other nodes. Communication speed definition can be set in 09-01. Communication protocol can be set in P09-04, and current PLC node definition can be set in P09-35. So far, the Functions supported by C2000 are:
Reading Coil (H1), Reading Input (0x02), Reading Register (0x03), Writing single Register (0x06), Writing multiple Coil ( $0 \times 0 \mathrm{~F}$ ) and writing multiple Register ( $0 \times 10$ ). Explantion as below:

| MODRW Command |  |  |  |  | Meaning | Slave is Delta PLC | Slave is Delta Motor Drive |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| S1 | S2 | S3 | S4 | S5 |  |  |  |
| Node | Comm. | Addr. | Cor. D register | Length |  |  |  |
| K3 | H01 | H500 | D0 | K18 | Read Coil <br> (Bit) | Read slave 3 PLC 18 bits from Y0~ Y21, and save to master bit 0~ bit 15 of D0 and bit $0 \sim$ bit 3 of D1 | Does not support this Function |
| K3 | H02 | H400 | D10 | K10 | Read Input <br> (Bit) | Read slave 3 PLC 10 bits from X0 ~ X11, and save to master bit 0~ bit 9 of D10 | Does not support this Function |
| K3 | H03 | H600 | D20 | K3 | Read Register (word) | Read slave 3 PLC 3 words of T0~T2, and save to master D20 ~ D22 | Read slave 3 motor drive 3 words from 06-00~06-02, and save to master D20~D22 |
| K3 | H06 | H610 | D30 | XX | Read single <br> Register (word) | Write slave 3 PLC to T16 from ) master D30 | Write slave 3 motor drive to 06-16 from master D30 |
| K3 | H0F | H509 | D40 | K10 | Read multiple <br> Coil <br> (Bit) | Write slave 3 PLC to $\mathrm{Y} 11 \sim \mathrm{Y} 12$ frommaster bit 0~bit 9 of D40 | Does not support this Function |
| K3 | H10 | H602 | D50 | K4 | Read multiple <br> Register (word) | Write slave 3 PLC to T2~T5 from master D50~D53 | Write slave 3 motor drive to 06-02 ~ 06-05 from master D50~D53 |

※ XX means Disregard
When executing MODRW, the status will be shown in M1077 (485 reading and writing complete), M1078(485 reading and writing error), and M1079 (485 reading and writing time out). The definition of M1077 will be cleared as 0 when commanding MODRW. When feedback is complete, error, or time out, M1099 will be set as On.

## Example program : Each function testing

The first command will be transfer timing when turning on.


When feedback is finished without error, switch to next command


When occurring Time out or feedback error, M1077 will be ON, and after 30 times scan cycle, commanding again


After finishing all commands, repeat again


## Example :

To control RTU-485.

Step 1 : Set communication protocol, assuming communication protocol is $115200,8, N, 2, R T U$ C2000 : PLC default node is $2(9-35)$
$9-31=-12(C O M 1$ controlled by PLC) , 9-01=115.2 (communication speed is 115200)
$9-04=13$ ( protocol is $8, \mathrm{~N}, 2$, RTU)

$$
\text { RTU485 : node = } 8 \text { (example) }
$$



| PA3 | PA2 | PA1 | PA0 | DR2 | DR1 | DR0 | A/R |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | 0 | 0 | 0 | $\mathbf{1}$ | $\mathbf{1}$ | $\mathbf{1}$ | $\mathbf{0}$ |



Communication station \#:
ID0~ ID7 are defined as $2^{0}, 2^{1}, 2^{2} \ldots 2^{6}, 2^{7}$

Communication protocol

| PA3 | PA2 | PA1 | PAO | A/R | Communication ${ }^{\cdot}$ Protocol |
| :---: | :---: | :---: | :---: | :---: | :---: |
| OFF | OFF | OFF | OFF | ON | $7, E, 1 \cdot A S C I I$ |
| OFF | OFF | OFF | ON | ON | $7,0,1 \cdot A S C I I$ |
| OFF | OFF | ON | OFF | ON | $7, E, 2 \cdot A S C I I$ |
| OFF | OFF | ON | ON | ON | $7, \mathrm{O}, 2 \cdot A S C I I$ |
| OFF | ON | OFF | OFF | ON | $7, N, 2 \cdot A S C I I$ |
| OFF | ON | OFF | ON | ON | $8, E, 1 \cdot A S C I I$ |
| OFF | ON | ON | OFF | ON | $8, O, 1 \cdot A S C I I$ |
| OFF | ON | ON | ON | ON | $8, N, 1 \cdot A S C I I$ |
| ON | OFF | OFF | OFF | ON | $8, N, 2 \cdot A S C I I$ |
| OFF | ON | OFF | ON | OFF | $8, E, 1 \cdot R T U$ |
| OFF | ON | ON | OFF | OFF | $8, O, 1 \cdot R T U$ |
| OFF | ON | ON | ON | OFF | $8, N, 1 \cdot R T U$ |
| ON | OFF | OFF | OFF | OFF | $8, N, 2 \cdot R T U$ |


| DR2 | DR1 | DR0 | Communicaton Speed |
| :---: | :---: | :---: | :---: |
| OFF | OFF | OFF | $1,200 \mathrm{bps}$ |
| OFF | OFF | ON | $2,400 \mathrm{bps}$ |
| OFF | ON | OFF | $4,800 \mathrm{bps}$ |
| OFF | ON | ON | $9,600 \mathrm{bps}$ |
| ON | OFF | OFF | $19,200 \mathrm{bps}$ |
| ON | OFF | ON | $38,400 \mathrm{bps}$ |
| ON | ON | OFF | $57,600 \mathrm{bps}$ |
| ON | ON | ON | $115,200 \mathrm{bps}$ |

Step 2: Setting controlled equipments. We can connect DVP16-SP(8 IN 8 OUT), DVP-04AD ( 4 channels AD) , DVP02DA(2 channels DA) and DVP-08ST(8 switches) to RTU 485 sequentially. With RTU485 definition, correspond terminals as below:

DVP-04AD (4 channels AD), DVP02DA(2 channels DA) 和 DVP-08ST(8 switches)

| Module | Terminals | 485 Address |
| :--- | :--- | :--- |
| DVP16-SP | $\mathrm{X0} \sim \mathrm{X7}$ | $0400 \mathrm{H} \sim 0407 \mathrm{H}$ |
|  | $\mathrm{Y} 0 \sim \mathrm{Y7}$ | $0500 \mathrm{H} \sim 0507 \mathrm{H}$ |
| DVP-04AD | ADO $\sim$ AD3 | $1600 \mathrm{H} \sim 1603 \mathrm{H}$ |
| DVP02DA | DA0 $\sim$ DA1 | $1640 \mathrm{H} \sim 1641 \mathrm{H}$ |
| DVP-08ST | Switch $0 \sim 7$ | $0408 \mathrm{H} \sim 040 \mathrm{FH}$ |
|  |  |  |

Step 3 : Physical cinfiguration


## Step 4 : Programming PLC

0


48


56



Control Out $Y$


## Step 5 : Real action:

I/O testing : Toggling Switch, the corresponding reaction of M115 ~ M108 can be observed. In addition, the signals of output can be also observed (every one second add 1) (Binary display)


AD DA testing : D200 and D201 is around 2 times of D300, and keep increasing; D202 and D203 is around 2 times of D301, and keep decreasing.


Monitor ADO ~ AD3 (0~8000)


Control Out $Y$

$\stackrel{\text { M1013 }}{ } \stackrel{1314}{ } \quad$| $\operatorname{NNCP}$ |
| :--- |

1s clock $p$
ulse, 0.5s
Control DA Value ( $0 \sim 4000$ )

# Chapter 17 How to Select the Right AC Motor Drive 

17-1 Capacity formula
17-2 General Precautions
17-3 How to choose a suitable motor
The choice of the right AC motor drive for the application is very important and has great influence on its lifetime. If the capacity of AC motor drive is too large, it cannot offer complete protection to the motor and motor maybe damaged. If the capacity of AC motor drive is too small, it cannot offer the required performance and the AC motor drive maybe damaged due to overloading.

But by simply selecting the AC motor drive of the same capacity as the motor, user application requirements cannot be met completely. Therefore, a designer should consider all the conditions, including load type, load speed, load characteristic, operation method, rated output, rated speed, power and the change of load capacity. The following table lists the factors you need to consider, depending on your requirements.

| Item |  | Related Specification |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Speed and torque characteristics | Time ratings | Overload capacity | Starting torque |
| Load type | Friction load and weight load <br> Liquid (viscous) load Inertia load Load with power transmission | $\bigcirc$ |  |  | $\bigcirc$ |
| Load speed and torque characteristics | Constant torque Constant output Decreasing torque Decreasing output | $\bigcirc$ | $\bigcirc$ |  |  |
| Load characteristics | Constant load Shock load Repetitive load High starting torque Low starting torque | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| Continuous operation, Short-time operation Long-time operation at medium/low speeds |  |  | $\bigcirc$ | $\bigcirc$ |  |
| Maximum output current (instantaneous) Constant output current (continuous) |  | $\bigcirc$ |  |  |  |
| Maximum frequency, Base frequency |  | $\bigcirc$ |  |  |  |
| Power supply transformer capacity or percentage impedance Voltage fluctuations and unbalance Number of phases, single phase protection Frequency |  |  |  | $\bigcirc$ | $\bigcirc$ |
| Mechanical friction, losses in wiring |  |  |  | - | $\bigcirc$ |
| Duty cycle modification |  |  | $\bigcirc$ |  |  |

## 17-1 Capacity Formulas

## 1. When one AC motor drive operates one motor

The starting capacity should be less than $1.5 x$ rated capacity of AC motor drive The starting capacity=

$$
\frac{k \times N}{973 \times \eta \times \cos \varphi}\left(T_{L}+\frac{G D^{2}}{375} \times \frac{N}{t_{A}}\right) \leq 1.5 \times \text { the _capacity _of _AC_motor_drive }(k V A)
$$

## 2. When one AC motor drive operates more than one motor

2.1 The starting capacity should be less than the rated capacity of AC motor drive

- Acceleration time $\leqq 60$ seconds

The starting capacity=

$$
\frac{k \times N}{\eta \times \cos \varphi}\left[n_{T}+n_{s}\left(k_{s}-1\right)\right]=P_{C 1}\left[1+\frac{n_{s}}{n_{T}}\left(k_{s-1}\right)\right] \leq 1.5 \times \text { the_capacity_of } A C_{-} \text {motor_drive }(k V A)
$$

- Acceleration time $\geqq 60$ seconds

The starting capacity=

$$
\frac{k \times N}{\eta \times \cos \varphi}\left[n_{T}+n_{s}\left(k_{s-1}\right)\right]=P_{C 1}\left[1+\frac{n_{s}}{n_{T}}\left(k_{s}-1\right)\right] \leq t h e_{-} \text {capacity_of _AC_motor_drive }(k V A)
$$

2.2 The current should be less than the rated current of AC motor drive(A)

- Acceleration time $\leqq 60$ seconds

$$
n_{T}+I_{M}\left[1+\frac{n_{s}}{n_{T}}\left(k_{-}-1\right)\right] \leq 1.5 \times \text { the_rated_current_of_AC_motor_drive }(A)
$$

- Acceleration time $\geqq 60$ seconds

$$
n_{T}+I_{M}\left[1+\frac{n_{s}}{n_{T}}(k s-1)\right] \leq t h e_{-} r a t e d_{-} \text {current_of _AC_motor_drive }(A)
$$

2.3 When it is running continuously

- The requirement of load capacity should be less than the capacity of AC motor drive(kVA) The requirement of load capacity=

$$
\frac{k \times P_{M}}{\eta \times \cos \varphi} \leq t h e_{-} \text {capacity_of _AC_motor_drive }(k V A)
$$

■ The motor capacity should be less than the capacity of AC motor drive

$$
k \times \sqrt{3} \times V_{M} \times I_{M} \times 10^{-3} \leq \text { the_capacity_of _AC_motor_drive }(k V A)
$$

- The current should be less than the rated current of AC motor drive(A)

$$
k \times I_{M} \leq t h e \_r a t e d \_c u r r e n t \_o f ~ \_A C \_m o t o r \_d r i v e(A)
$$

## Symbol explanation

$P_{M} \quad$ : Motor shaft output for load (kW)
$\eta \quad$ : Motor efficiency (normally, approx. 0.85)
$\cos \varphi$ : Motor power factor (normally, approx. 0.75)
$V_{M} \quad$ : Motor rated voltage(V)
Im : Motor rated current(A), for commercial power
$k$ : Correction factor calculated from current distortion factor (1.05-1.1, depending on PWM method)
$P_{C 1} \quad$ : Continuous motor capacity (kVA)
ks : Starting current/rated current of motor
$n_{T} \quad$ : Number of motors in parallel
$n_{s} \quad$ : Number of simultaneously started motors
$G D^{2} \quad$ : Total inertia $\left(G D^{2}\right)$ calculated back to motor shaft $\left(\mathrm{kg} \mathrm{m}^{2}\right)$
$T_{L} \quad$ : Load torque
$t_{A}$ : Motor acceleration time
N : Motor speed

## 17-2 General Precaution

## Selection Note

1. When the AC Motor Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, excess peak currents may occur in the power input circuit and the converter section may be damaged. To avoid this, use an AC input reactor (optional) before AC Motor Drive mains input to reduce the current and improve the input power efficiency.
2. When a special motor is used or more than one motor is driven in parallel with a single AC Motor Drive, select the AC Motor Drive current $\geq 1.25 x$ (Sum of the motor rated currents).
3. The starting and accel./decel. characteristics of a motor are limited by the rated current and the overload protection of the AC Motor Drive. Compared to running the motor D.O.L. (Direct On-Line), a lower starting torque output with AC Motor Drive can be expected. If higher starting torque is required (such as for elevators, mixers, tooling machines, etc.) use an AC Motor Drive of higher capacity or increase the capacities for both the motor and the AC Motor Drive.
4. When an error occurs on the drive, a protective circuit will be activated and the AC Motor Drive output is turned off. Then the motor will coast to stop. For an emergency stop, an external mechanical brake is needed to quickly stop the motor.

## Parameter Settings Note

1. The AC Motor Drive can be driven at an output frequency up to 400 Hz (less for some models) with the digital keypad. Setting errors may create a dangerous situation. For safety, the use of the upper limit frequency function is strongly recommended.
2. High DC brake operating voltages and long operation time (at low frequencies) may cause overheating of the motor. In that case, forced external motor cooling is recommended.
3. Motor accel./decel. time is determined by motor rated torque, load torque, and load inertia.
4. If the stall prevention function is activated, the accel./decel. time is automatically extended to a length that the AC Motor Drive can handle. If the motor needs to decelerate within a certain time with high load inertia that can't be handled by the AC Motor Drive in the required time, either use an external brake resistor and/or brake unit, depending on the model, (to shorten deceleration time only) or increase the capacity for both the motor and the AC Motor Drive.

## 17-3 How to Choose a Suitable Motor

## Standard motor

When using the AC Motor Drive to operate a standard 3-phase induction motor, take the following precautions:

1. The energy loss is greater than for an inverter duty motor.
2. Avoid running motor at low speed for a long time. Under this condition, the motor temperature may rise above the motor rating due to limited airflow produced by the motor's fan. Consider external forced motor cooling.
3. When the standard motor operates at low speed for long time, the output load must be decreased.
4. The load tolerance of a standard motor is as follows:

5. If $100 \%$ continuous torque is required at low speed, it may be necessary to use a special inverter duty motor.
6. Motor dynamic balance and rotor endurance should be considered once the operating speed exceeds the rated speed $(60 \mathrm{~Hz})$ of a standard motor.
7. Motor torque characteristics vary when an AC Motor Drive instead of commercial power supply drives the motor. Check the load torque characteristics of the machine to be connected.
8. Because of the high carrier frequency PWM control of the VFD series, pay attention to the following motor vibration problems:

■ Resonant mechanical vibration: anti-vibration (damping) rubbers should be used to mount equipment that runs at varying speed.
■ Motor imbalance: special care is required for operation at 50 or 60 Hz and higher frequency.
■ To avoid resonances, use the Skip frequencies.
9. The motor fan will be very noisy when the motor speed exceeds 50 or 60 Hz .

## Special motors:

1. Pole-changing (Dahlander) motor:

The rated current is differs from that of a standard motor. Please check before operation and select the capacity of the AC motor drive carefully. When changing the pole number the motor needs to be stopped first. If over current occurs during operation or regenerative voltage is too high, please let the motor free run to stop (coast).
2. Submersible motor:

The rated current is higher than that of a standard motor. Please check before operation and choose the capacity of the AC motor drive carefully. With long motor cable between AC motor drive and motor, available motor torque is reduced.
3. Explosion-proof (Ex) motor:

Needs to be installed in a safe place and the wiring should comply with the (Ex) requirements.
Delta AC Motor Drives are not suitable for (Ex) areas with special precautions.
4. Gear reduction motor:

The lubricating method of reduction gearbox and speed range for continuous operation will be different and depending on brand. The lubricating function for operating long time at low speed and for high-speed operation needs to be considered carefully.
5. Synchronous motor:

The rated current and starting current are higher than for standard motors. Please check before operation and choose the capacity of the AC motor drive carefully. When the AC motor drive operates more than one motor, please pay attention to starting and changing the motor.

## Power Transmission Mechanism

Pay attention to reduced lubrication when operating gear reduction motors, gearboxes, belts and chains, etc. over longer periods at low speeds. At high speeds of $50 / 60 \mathrm{~Hz}$ and above, lifetime reducing noises and vibrations may occur.

## Motor torque

The torque characteristics of a motor operated by an AC motor drive and commercial mains power are different.

Below you'll find the torque-speed characteristics of a standard motor (4-pole, 15kW):


# Chapter 18 Suggestions and Error Corrections for Standard AC Motor Drives 

18-1 Maintenance and Inspections<br>18-2 Greasy Dirt Problem<br>18-3 Fiber Dust Problem<br>18-4 Erosion Problem<br>18-5 Industrial Dust Problem<br>18-6 Wiring and Installation Problem<br>18-7 Multi-function Input/Output Terminals Problem

The AC motor drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The following faults are displayed as shown on the AC motor drive digital keypad display. The six most recent faults can be read from the digital keypad or communication.

The AC motor drive is made up by numerous components, such as electronic components, including IC, resistor, capacity, transistor, and cooling fan, relay, etc. These components can't be used permanently. They have limited-life even under normal operation. Preventive maintenance is required to operate this AC motor drive in its optimal condition, and to ensure a long life.

Check your AC motor drive regularly to ensure there are no abnormalities during operation and follows the precautions:


CAUTION
W Wait 5 seconds after a fault has been cleared before performing reset via keypad of input terminal.
$\square$ When the power is off after 5 minutes for $\leqq 22 \mathrm{~kW}$ models and 10 minutes for $\geqq$ 30kW models, please confirm that the capacitors have fully discharged by measuring the voltage between + and -. The voltage between + and - should be less than 25VDC.
$\square$ Only qualified personnel can install, wire and maintain drives. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed.

『 Never reassemble internal components or wiring.
$\square$ Make sure that installation environment comply with regulations without abnormal noise, vibration and smell.

## 18-1 Maintenance and Inspections

Before the check-up, always turn off the AC input power and remove the cover. Wait at least 10 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged by measuring the voltage between DC+ and DC-. The voltage between DC+ and DC-should be less than 25VDC.

## Ambient environment

| Check Items | Methods and Criterion |  | Maintenance <br> Period |  |
| :--- | :--- | :---: | :---: | :---: |
|  | Daily |  | Half <br> Year | One <br> Year |
| Check the ambient temperature, humidity, <br> vibration and see if there are any dust, gas, <br> oil or water drops | Visual inspection and <br> measurement with equipment <br> with standard specification | $\bigcirc$ |  |  |
| If there are any dangerous objects | Visual inspection | $\bigcirc$ |  |  |

## Voltage

| Check Items | Maintenance |  |  |  |
| :--- | :--- | :---: | :---: | :---: |
|  | Methods and Criterion |  | Period |  |
|  |  | Daily | Half <br> Year | One <br> Year |
| Check if the voltage of main circuit and <br> control circuit is correct | Measure with multimeter with <br> standard specification | $\bigcirc$ |  |  |

Digital Keypad Display

| Check Items | Maintenance |  |  |  |  |
| :--- | :--- | :---: | :---: | :---: | :---: |
|  |  | Methods and Criterion |  | Period |  |  |
|  |  | Daily | Half <br> Year | One <br> Year |  |
| Is the display clear for reading | Visual inspection | $\bigcirc$ |  |  |  |
| Any missing characters | Visual inspection | $\bigcirc$ |  |  |  |

Mechanical parts

| Check Items | Methods and Criterion | Maintenance <br> Period |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Daily | Half Year | One Year |
| If there is any abnormal sound or vibration | Visual and aural inspection |  | $\bigcirc$ |  |
| If there are any loose screws | Tighten the screws |  | $\bigcirc$ |  |
| If any part is deformed or damaged | Visual inspection |  | $\bigcirc$ |  |
| If there is any color change by overheating | Visual inspection |  | $\bigcirc$ |  |
| If there is any dust or dirt | Visual inspection |  | $\bigcirc$ |  |

## Main circuit

| Check Items | Methods and Criterion |  | Maintenance <br> Period |  |
| :--- | :--- | :---: | :---: | :---: |
|  |  | Daily | Half <br> Year | One <br> Year |
| If there are any loose or missing screws | Tighten or replace the screw | $\bigcirc$ |  |  |
| If machine or insulator is deformed, cracked, <br> damaged or with color change due to <br> overheating or ageing | Visual inspection <br> NOTE: Please ignore the <br> color change of copper <br> plate |  |  |  |
| If there is any dust or dirt | Visual inspection |  |  |  |

Terminals and wiring of main circuit

| Check Items | Methods and Criterion | Maintenance <br> Period |  |  |
| :--- | :--- | :--- | :---: | :---: |
|  |  | Daily | Half <br> Year | One <br> Year |
| If the terminal or the plate is color change or <br> deformation due to overheat | Visual inspection |  | $\bigcirc$ |  |
| If the insulator of wiring is damaged or color <br> change | Visual inspection |  | $\bigcirc$ |  |
| If there is any damage | Visual inspection |  |  |  |

## DC capacity of main circuit

| Check Items | Methods and Criterion | Maintenance <br> Period |  |  |
| :--- | :--- | :--- | :--- | :--- |
|  |  | Daily | Half <br> Year | One <br> Year |
| If there is any leak of liquid, color change, <br> crack or deformation | Visual inspection | $\bigcirc$ |  |  |
| If the safety valve is not removed? If valve is <br> inflated? | Visual inspection | $\bigcirc$ |  |  |
| Measure static capacity when required |  | $O$ |  |  |

## Resistor of main circuit

| Check Items | Maintenance <br> Period |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| If there is any peculiar smell or insulator <br> cracks due to overheat |  | One <br> Year |  |  |
| If there is any disconnection | Daily | Malterion <br> Year | $\bigcirc$ |  |
| If connection is damaged? | Visual inspection | $\bigcirc$ |  |  |

Transformer and reactor of main circuit

| Check Items | Maintenance |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
|  |  | Period |  |  |
|  |  | Daily | Half <br> Year | One <br> Year |
| If there is any abnormal vibration or peculiar <br> smell | Visual, aural inspection and <br> smell | $O$ |  |  |

Magnetic contactor and relay of main circuit

| Check Items | Methods and Criterion | Maintenance <br> Period |  |  |
| :--- | :--- | :---: | :---: | :---: |
|  |  | Daily | Half <br> Year | One <br> Year |
| If there are any loose screws |  | Visual and aural inspection |  |  |
| If the contact works correctly | Visual inspection | $\bigcirc$ |  |  |

Printed circuit board and connector of main circuit

| Check Items | Methods and Criterion | Maintenance <br> Period |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Daily | Half Year | One Year |
| If there are any loose screws and connectors | Tighten the screws and press the connectors firmly in place. |  | $\bigcirc$ |  |
| If there is any peculiar smell and color change | Visual and smell inspection |  | $\bigcirc$ |  |
| If there is any crack, damage, deformation or corrosion | Visual inspection |  | $\bigcirc$ |  |
| If there is any liquid is leaked or deformation in capacity | Visual inspection |  | $\bigcirc$ |  |

## Cooling fan of cooling system

| Check Items | Methods and Criterion | Maintenance Period |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Daily | Half Year | One Year |
| If there is any abnormal sound or vibration | Visual, aural inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly |  | $\bigcirc$ |  |
| If there is any loose screw | Tighten the screw |  | $\bigcirc$ |  |
| If there is any color change due to overheat | Change fan |  | $\bigcirc$ |  |

Ventilation channel of cooling system

| Check Items | Methods and Criterion | Maintenance Period |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Daily | Half Year | One Year |
| If there is any obstruction in the heat sink, air intake or air outlet | Visual inspection |  | $\bigcirc$ |  |

## $\square$ NOTE

Please use the neutral cloth for clean and use dust cleaner to remove dust when necessary.

## 18-2 Greasy Dirt Problem

Serious greasy dirt problems generally occur in processing industries such as machine tools, punching machines and so on. Please be aware of the possible damages that greasy oil may cause to your drive:

1. Electronic components that silt up with greasy oil may cause the drive to burn out or even explode.
2. Most greasy dirt contains corrosive substances that may damage the drive.

## Solution:

Install the AC motor drive in a standard cabinet to keep it away from dirt. Clean and remove greasy dirt regularly to prevent damage of the drive.


## 18-3 Fiber Dust Problem

Serious fiber dust problems generally occur in the textile industry. Please be aware of the possible damages that fiber may cause to your drives:

1. Fiber that accumulates or adheres to the fans will lead to poor ventilation and cause overheating problems.
2. Plant environments in the textile industry have higher degrees of humidity that may cause the drive to burn out, become damaged or explode due to wet fiber dust adhering to the devices.

## Solution:

Install the AC motor drive in a standard cabinet to keep it away from fiber dust. Clean and remove fiber dust regularly to prevent damage to the drive.


## 18-4 Erosion Problem

Erosion problems may occur if any fluids flow into the drives. Please be aware of the damages that erosion may cause to your drive.

1. Erosion of internal components may cause the drive to malfunction and possibility to explode.

## Solution:

Install the AC motor drive in a standard cabinet to keep it away from fluids. Clean the drive regularly to prevent erosion.


## 18-5 Industrial Dust Problem

Serious industrial dust pollution frequently occurs in stone processing plants, flour mills, cement plants, and so on. Please be aware of the possible damage that industrial dust may cause to your drives:

1. Dust accumulating on electronic components may cause overheating problem and shorten the service life of the drive.
2. Conductive dust may damage the circuit board and may even cause the drive to explode.

Solution:
Install the AC motor drive in a standard cabinet and cover the drive with a dust cover. Clean the cabinet and ventilation hole regularly for good ventilation.


## 18-6 Wiring and Installation Problem

When wiring the drive, the most common problem is wrong wire installation or poor wiring. Please be aware of the possible damages that poor wiring may cause to your drives:

1. Screws are not fully fastened. Occurrence of sparks as impedance increases.
2. If a customer has opened the drive and modified the internal circuit board, the internal components may have been damaged.

## Solution:

Ensure all screws are fastened when installing the AC motor drive. If the AC motor drive functions abnormally, send it back to the repair station. DO NOT try to reassemble the internal components or wire.


## 18-7 Multi-function Input/Output Terminals Problem

Multi-function input/output terminal errors are generally caused by over usage of terminals and not following specifications. Please be aware of the possible damages that errors on multi-function input/output terminals may cause to your drives:

1. Input/output circuit may burns out when the terminal usage exceeds its limit.

## Solution:

Refer to the user manual for multi-function input output terminals usage and follow the specified voltage and current. DO NOT exceed the specification limits.


## AC Motor Drives

## EMC Standard Installation Guide EMC Compliance Practice

## Preface

When an AC motor drive is installed in a noisy environment, radiated and/or conducted noise via signal and power cables can interfere with the correct functioning, cause errors or even damage to the drive. To prevent this, some AC motor drives have an enhanced noise resistance but the results are limited and it is not economical. Therefore, an effective method would be finding the cause of the noise and use the right solution to achieve "no emission, no transmission and no reception of noise". All three solutions should be applied.

## Finding the Noise

- Ascertain whether the error is caused by noise.
- Find the source of the noise and its transmission path.
- Confirm the signal and the source of noise


## Solutions

- Grounding
- Shielding
- Filtering


## Table of Contents

Preface ..... i
Table of Contents ..... ii
Chapter 1 Introduction ..... 1
1.1 What is EMC ..... 1
1.2 EMC for AC Motor Drive ..... 1
Chapter 2 How to prevent EMI ..... 2
2.1 Types of EMI: common-mode and differential mode noise ..... 2
2.2 How does EMI transmit? (Noise transmission) ..... 2
Chapter 3 Solution to EMI: Grounding ..... 4
3.1 Protective Grounding \& Functional Grounding ..... 4
3.2 Ground Loops ..... 5
3.3 Earthing Systems ..... 5
Chapter 4 Solution to EMI: Shielding ..... 9
4.1 What is Shielding? ..... 9
4.2 How to Reduce EMI by Shielding? ..... 10
Chapter 5 Solution to EMI: Filter ..... 12
5.1 Filter ..... 12
5.2 Harmonic Interference ..... 14

## Chapter 1 Introduction

### 1.1 What is EMC?

Electromagnetic Compatibility (EMC) is the ability of an electrical device to function properly in electromagnetic environments. It does not emit electromagnetic noise to surrounding equipment and is immune to interference from surrounding equipment. The goal is to achieve high immunity and low emission; these two properties define the quality of EMC. In general, electrical devices react to high and low frequency phenomena. High frequency phenomena are electrostatic discharge (ESD); pulse interference; radiated electromagnetic field; and conducted high frequency electrical surge. Low frequency phenomena refer to mains power harmonics and imbalance.
The standard emission and immunity levels for compliance depend on the installation location of the drive. A Power Drive System (PDS) is installed in an industrial or domestic environment. A PDS in a domestic environment must have lower emission levels and is allowed to have lower immunity levels. A PDS in an industrial environment is allowed to have higher emission levels but must have more severe immunity levels.

### 1.2 EMC for AC Motor Drive

When an AC motor drive is put into operation, harmonic signal will occur at the AC drive's power input and output side. It creates a certain level of electromagnetic interference to the surrounding electrical devices and the mains power network. An AC motor dive is usually applied in industrial environments with a strong electromagnetic interference. Under such conditions, an AC drive could disturb or be disturbed.

Delta's AC motor drives are designed for EMC and comply with EMC standard EN61800-3 2004. Installing the AC motor drive accurately will decrease EMI influences and ensure long term stability of the electricity system. It is strongly suggested to follow Delta's user manual for wiring and grounding. If any difficulties or problems arise, please follow the instructions and measures as indicated in this EMC Standard Installation Guide.

## Chapter 2 How to prevent EMI

### 2.1 Types of EMI: Common-mode and differential-mode noise

The electromagnetic noise of an AC motor drive can be distinguished into common-mode and differentialmode noise. Differential-mode noise is caused by the stray capacitance between the conducting wires and common-mode noise is caused by the common-mode coupling current path created by the stray capacitance between the conducting wires and ground.
Basically, differential-mode noise has a greater impact to the AC motor drive and common-mode noise has a greater impact to high-sensitivity electronic devices. An excessive amount of differential-mode noise may trigger the circuit protection system of the AC motor drive. Common-mode noise affects peripheral electronic devices via the common ground connection.

EMC problems can be more serious when the following conditions apply:

- When a large horsepower AC motor drive is connected to a large horsepower motor.
- The AC motor drive's operation voltage increases.
- Fast switching of the IGBTs.
- When a long cable is used to connect the motor to the AC motor drive.


### 2.2 How does EMI transmit? (Noise transmission path)

Noise disturbs peripheral high-sensitivity electrical devices/systems via conduction and radiation, their transmission paths are shown hereafter:

1. Noise current in the unshielded power cable is conducted to ground via stray capacitances into a common-mode voltage. Whether or not other modules are capable to resist this common-mode noise depends on their Common-Mode Rejection Ratio (CMRR), as shown in the following figure.

2. Common-mode noise in the power cable is transmitted through the stray capacitance and coupled into the adjacent signal cable, as shown in Figure 2. Several methods can be applied to reduce the effect of this common-mode noise; for example, shield the power cable and/or the signal cables, separate the power and signal cables, take the input and output side of the signal cable and twist them together to balance out the stray capacitance, let power cables and signal cables cross at $90^{\circ}$, etc.


Ground
3. Common-mode noise is coupled via the power cable to other power systems then the cable of such a power system is coupled to the transmission system, as shown in Figure 3.

4. The common-mode noise of an unshielded power cable is transmitted to the ground via the stray capacitance. Since both shielded wire and unshielded wire are connected to a common ground, other systems can be interfered with by the common-mode noise that is transmitted from the ground back to the system via the shield. See Figure 4.

5. When excessive pulse modulated currents pass through an un-grounded AC drive cable, it acts as an antenna and creates radiated interference.

## Chapter 3 Solution to EMI: Grounding

The leakage current of an electronic equipment is conducted to ground via the grounding wire and the ground electrode. According to Ohm's law, potential differences may arise when the electrode's ground and the ground's ground resistance are different.

According to Ohm's law, the earth resistance for electrode and the ground are different, in this case potential differences may arise.

### 3.1 Protective Grounding \& Functional Grounding

Please carefully read the following instruction if two types of grounding are applied at the same time. Protective grounding is applied outside buildings and must have low resistance. On the other hand, functional grounding can be applied inside buildings and must have low impedance.
The goal of EMC is to avoid any interference effects. Grounding for EMC can be distinguished by frequency. For frequencies lower than 10 kHz , a single-point ground system should be used and for frequencies higher than 10 kHz , a multiple point ground system should be used.

- Single Point Grounding: all signal grounds of all IT equipment are connected in series to form a single reference point. This point can be grounded directly to earth; to the designated grounding point or to the safety point that is already grounded.
- Multiple Point Grounding: all signals of all IT equipment are grounded independently.
- Hybrid Grounding: this type of grounding behaves differently for low and high frequencies. When two pieces of IT equipment ( $A$ and $B$ ) are connected via a shielded cable, one end is connected directly to ground while the other end is connected to ground via a capacitor. This type of grounding system fulfils the criteria for high and low frequency grounding.
- Floating grounding: the signals of all IT equipment are isolated from each other and are not grounded.

DC current flows evenly throughout the conductor section. But AC current flows towards the conductor's surface as frequency increases; this is called the "skin effect". It causes the effective cross-section area to be reduced with increasing frequency. Therefore it is suggested to increase the effective ground crosssection area for high frequencies by replacing pigtail grounding by braided conductors or strip conductors. Refer to the following figure.


This is why a thick short ground wire must be implemented for connecting to the common grounding path or the ground busbar. Especially when a controller (e.g. PLC) is connected to an AC motor drive, it must be grounded by a short and thick conducting wire. It is suggested to use a flat braided conductor (ex: metal mesh) with a lower impedance at high frequencies.
If the grounding wire is too long, its inductance may interfere structure of the building or the control cabinet and form mutual inductance and stray capacitance. As shown in the following figure, a long grounding wire could become a vertical antenna and turn into a source of noise.


### 3.2 Ground Loops

A ground loop occurs when the pieces of equipment are connected to more than one grounding path. In this case, the ground current may return to the grounding electrode via more than one path. There are three methods to prevent ground loops

1. Use a common power circuit
2. Single point grounding
3. Isolate signals, e.g. by photocouplers


In order to avoid "Common Mode Noise", please use parallel wires or twisted pair wiring. Follow this rule and also avoid long wires, it is suggested to place the two wires as close to each other as possible.

### 3.3 Earthing Systems

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

- The first letter indicates the type of earthing for the power supply equipment (generator or transformer).
T: One or more points of the power supply equipment are connected directly to the same earthing point.
I: Either no point is connected to earth (isolated) or it is connected to earth via a high impedance.
- The second letter indicates the connection between earth and the power supply equipment.

T: Connected directly to earth (This earthing point is separate from other earthing points in the power supply system.)
$\mathbf{N}$ : Connected to earth via the conductor that is provided by the power supply system

- The third and forth letter indicate the location of the earth conductor.

S: Neutral and earth conductors are separate
C: Neutral and earth are combined into a single conductor

## TN system

TN: The neutral point of the low voltage transformer or generator is earthed, usually the star point in a three-phase system. The body of the electrical device is connected to earth via this earth connection at the transformer.
protective earth $(P E)$ : The conductor that connects the exposed metallic parts of the consumer. neutral $(N)$ : The conductor that connects to the start point in a 3-phase system or that carries the return current in a single phase system.


## TN-S system

TN-S: PE and N are two separate conductors that are combined together only near the power source (transformer or generator). It is the same as a three-phase 5 -wire system.


## TN-C system

TN-C: PE and N are two separate conductors in an electrical installation similar to a three-phase 5wire system, but near the power side, PE and $N$ are combined into a PEN conductor similar to a three-phase 4 wire system.


## TN-C-S system

TN-C-S: A combined earth and neutral system (PEN conductor) is used in certain systems but eventually split up into two separate conductors PE and N. A typical application of combined PEN conductor is from the substation to the building but within the building PEN is separated into the PE and N conductors. Direct connection of PE and $N$ conductors to many earthing points at different locations in the field will reduce the risk of broken neutrals. Therefore this application is also known as protective multiple earthing (PME) in the UK or as multiple earthed neutral (MEN ) in Australia


## TT system

TT: The neutral point ( N ) of the low voltage transformer and the equipment frames (PE) are connected to a separate earthing point. The Neutral $(\mathrm{N})$ of the transformer and electrical equipment are connected.


## IT system

IT: The neutral point of the transformer and electrical equipment are not earthed, only the equipment frames PE are earthed.
In the IT network, the power distribution system Neutral is either not connected to earth or is earthed via a high impedance. In such a system, an insulated monitoring device is used for impedance monitoring. A built-in filter should be disconnected by the RFI-jumper and an external filter should not be installed when the AC motor drive or the AC servo motor drive is connected to an IT system.


## Criteria for earthing system and EMC

|  | TN-S | TN-C | TT | IT |
| :---: | :---: | :---: | :---: | :---: |
| Safety of Personnel | Good <br> Continuity of the PE conductor must be ensured throughout the installation | Good <br> Continuity of the PE conductor must be ensured throughout the installation | Good $R C D$ is mandatory | Good <br> Continuity of the PE conductor must be ensured throughout the installation |
| Safety of property | Poor <br> High fault current (around 1kA) | Poor <br> High fault current (around 1kA) | Good <br> Medium fault current (< a few dozen amperes) | Good <br> Low current at the first fault (< a few dozen $m A$ ) but high current at the second fault |
| Availability of energy | Good | Good | Good | Excellent |
| EMC behavior | Excellent <br> Few equipotential <br> Problems: <br> - Need to handle the high leaking currents problem of the device <br> - High fault current (transient disturbances) | Poor <br> (prohibited) <br> - Neutral and PE are <br> the same <br> - Circulation of <br> disturbance <br> currents in exposed <br> conductive parts <br> (high magnetic-field <br> radiation) <br> - High fault currents <br> (transient <br> disturbances) | Good <br> - Over-voltage risk <br> - Equipotential <br> Problems: <br> - Need to handle the high leaking currents problem of the device <br> - RCD (Residualcurrent device) | Poor <br> (should be avoided) <br> - Over-voltage risk <br> - Common-mode filters and surge arrestors must handle the phase to phase voltage. <br> - RCDs subject to nuisance tripping when commonmode capacitors are present <br> - Equivalent to TN system for second fault |

## Chapter 4 Solution to EMI: Shielding

### 4.1 What is Shielding?

Electrostatic shielding is used to isolate equipment so that it will not create electromagnetic field interference or be influenced by an external electromagnetic field. A conductive material is used for electrostatic shielding to achieve this isolation.

A Faraday cage can be made from a mesh of metal or a conductive material.
One characteristic of metal is that it is highly conductive and not electrostatic,, which offers shielding and prevents interference by external electrical fields. Metal with its high conductivity protects the internal devices from high voltages-no voltage will enter the cage even when the cage is experiencing a high current. In addition, electromagnetic fields can also pass through the Faraday cage without causing any disturbance.

Electromagnetic shielding is applied to some electrical devices and measurement equipment for the purpose of blocking interference. Examples of shielding include:

- earth high-voltage indoor equipment using a metal frame or a high-density metal mesh
- shielding a power transformer is achieved by wrapping a metal sheet between the primary and secondary windings or by adding an enamel wire to the winding wire which is then earthed.
- a shielding coating, which is made of metal mesh or conductive fibres to provide effective protection for the workers who work in a high-voltage environment.

In the picture below, the radio appears to be not fully covered by metal but if the conductivity of the metal is high, radio waves are completely blocked and the radio will not receive any signal.


Mobile phone connections are also established through the transmission of radio waves. This is why the mobile phone reception is often cut off when we walk into an elevator. The metal walls of the elevator create the same shielding effect just as if we had entered a metal cage. Another example is a microwave oven. The microwave door may seem transparent in visible light, but the density of the metal mesh in the microwave door blocks the electromagnetic waves. A higher density of the metal mesh offers better shielding.

## Electromagnetic fields



### 4.2 How to reduce EMI by Shielding?

Iron and other metals are high conductivity materials that provide effective shielding at extremely low frequencies. But conductivity will decrease as:

1. High frequency signals are applied to the conductor.
2. Equipment is located in a strong magnetic field
3. The shielding frame is forced into a specific form by machines.

It is difficult to select a suitable high-conductivity material for shielding without the help from a shielding material supplier or a related EMI institution.

## Metallic Shielding Effectiveness

Shielding Effectiveness (SE) is used to assess the applicability of the shielding shell. The formula is:
$S E d B=A+R+B$ (Measures in $d B$ )
where $A=$ Absorption loss (dB)
$\mathrm{R}=$ Reflection loss (dB)
$\mathrm{B}=$ Correction factor (dB) (for multiple reflections in thin shields)

The absorption loss refers to the amount of energy loss as the electromagnetic wave travels through the shield. The formula is:
$A d B=1.314(f \circ \mu) 1 / 2 t$

$$
\text { where } \begin{aligned}
& \mathrm{f}=\text { frequency }(\mathrm{MHz}) \\
& \mu=\text { permeability relative to copper } \\
& \sigma=\text { conductivity relative to copper } \\
& \mathrm{t}=\text { thickness of the shield in centimetres }
\end{aligned}
$$

The reflection loss depends on the source of the electromagnetic wave and the distance from that source. For a rod or straight wire antenna, the wave impedance increases as it moves closer to the source and decreases as it moves away from the source until it reaches the plane wave impedance (377) and shows no change. If the wave source is a small wire loop, the magnetic field is dominant and the wave impedance decreases as it moves closer to the source and increases as it moves away from the source; but it levels out at 377 when the distance exceeds one-sixth of the wavelength.

## Electrical Cabinet Design

In a high frequency electric field, shielding can be achieved by painting a thin layer of conductive metal on the enclosure or on the internal lining material. However, the coating must be thorough and all parts should be properly covered without any seams or gaps (just like a Faraday cage). That is only the ideal. Making a seamless shielding shell is practically impossible since the cage is composed of metal parts. In some conditions, it is necessary to drill holes in the shielding enclosure for installation of accessories (like optional cards and other devices).

1. If the metallic components are properly welded using sophisticated welding technology to form an electrical cabinet, deformation during usage is unlikely to occur. But if the electrical cabinet is assembled with screws, the protective insulating layer under the screw must be properly removed before assembly to achieve the greatest conductivity and best shielding.
2. Drilling holes for the installation of wires in the electrical cabinet lowers the shielding effectiveness and increases the chance of electric waves leaking through the openings and emitting interference. We recommend that the drilled holes are as narrow as possible. When the wiring holes are not used, properly cover the holes with metal plates or metal covers. The paint or the coating of the metal plate and metal cover should be thoroughly removed to ensure a metal-to-metal contact or a conductive gasket should be installed.
3. Install industrial conductive gaskets to completely seal the electrical cabinet and the cabinet door without gaps. If conductive gaskets are too costly, please screw the cabinet door to the electrical cabinet with a short distance between the screws.
4. Reserve a grounding terminal on the electrical cabinet door. This grounding terminal shall not be painted. If the paint already exists, please remove the paint before grounding.

## Electrical wires and cables

Shielded Twisted Pair (STP) is a type of cable where two insulated copper wires are twisted together with a metal mesh surrounding the twisted pair that forms the electromagnetic shielding and can also be used for grounding.
The individual electrical wires and complete cable are surrounded by (synthetic) rubber, that provides insulation and also protects against damage.
There are two types of electrical cables: high voltage and low voltage. The high voltage cable differs from the low voltage cable in that it has an additional insulation layer called the dielectric insulator within the plastic sleeve. The dielectric insulator is the most important component in insulation. The low voltage cable is usually only filled with a soft polymer material for keeping the internal copper wire in place.

The shield has two functions.

1. To shield the electrical wire and cable.
A. Electric currents increase as power flows through the power cable and generate an electrical field. Such interference can be suppressed inside the cable by shielding the power cables or the electrical wires.
B. To form a protective earthing. When the cable core is damaged, the leakage current will flow via the shield to ground
2. To protect the cable. A power cable used for the computer control purpose generates only relatively low amount of current inside the cable. Such power cable will not become the source of interferences but has great possibility to be interfered by the surrounding electrical devices.


# Chapter 5 Solution to EMI: Filter 

### 5.1 Filter

Electromagnetic interference is transmitted in two ways, by radiation and by conduction. The most effective and economical method of reducing radiated interference is to use shielding and of reducing conducted interference is to use an electromagnetic filter.
Noise interference can be divided into two categories: high frequency ( $150 \mathrm{kHz} \sim 300 \mathrm{MHz}$ ) and low frequency $(100 \mathrm{~Hz} \sim 3000 \mathrm{~Hz})$. High-frequency noise fades more over distance and has a shorter wavelength, while low-frequency noise fades less over distance and has a longer wave-length.. Both types of interference are transmitted through power cables and power leads, affecting the power supply side.
High-frequency interference at the power side can be eliminated or attenuated by mounting a filter. The filter consists of coils and capacitors. Some drives do not have a built-in filter, in which case the installation of an external option filter is required. The drawing below shows a standard filter diagram:

## 1: Differential Mode Section <br> 2: Common Mode Section



A filter is composed of a Differential Mode section (to eliminate noise below 150 kHz ) and a Common Mode section (to eliminate noise above 150 kHz ). For high-frequency noise , the inductor acts as a high impedance to form an open circuit and the capacitor acts as a low impedance to form a short circuit. Proper design and dimensioning of inductors and capacitors give a resonant circuit to absorb harmonic currents. Capacitor Cy is earthed to lead the harmonic currents to the ground.

## External Filter

The filter and the AC drive should be installed in the control cabinet or on the mounting plate that is earthed to ground. The motor cable must be shielded and as short as possible. Please use the filters recommended by Delta to ensure compliance with EMC standards.


## AC Motor Drives with Built-in Filter

1. Since interferences are suppressed by installing an earthed capacitor in the filter, the amount of current to ground (leakage current) could result in electric shocks to personnel or the power system. Please be aware of this problem.
2. Since the leakage current to ground can be high, it is crucial to implement protective earthing to prevent electrical shocks.

## Filter Installation (With and Without)


<15m@60Hz with EMI Filter>

<15m@60Hz without EMI Filter>

## Zero Phase Reactor (Choke)

Interferences can also be suppressed by installing a zero phase reactor at the power supply side and/or the AC Motor Drive's output, depending on where the interference is. Since currents are large at the power input and the AC Motor Drive's output, please carefully select the magnetic core with suitable current handling capability. An ideal magnetic material for large currents is compound magnetic powder. It has a higher current handling capability and higher impedance compared to pure metallic magnetic cores. It is therefore suitable to implement in a high frequency environment. The impedance can also be enhanced by increasing the turn ratio.

## Zero Phase Reactor Installation

There are two installation methods, depending on the size of the zero phase reactor and the motor cable length.

1. Wind the motor cable through the middle of a zero-phase reactor 4 times. Place the reactor and the AC Motor Drive as close to each other as possible.

2. Place all wires through the middle of four zero-phase reactors without winding.


## Analog Input Signals

If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor and a ferrite core as indicated in the following diagram.
Wind the wires around the core in same direction for 3 times or more.


### 5.2 Harmonic Interference

The AC motor drive's input current is non-linear, the input rectifier generates harmonics. Harmonics must be limited to within a certain range to avoid impact the mains power and to avoid current distortion to ensure surrounding devices are not influenced. An AC Motor Drive with built-in DC reactor suppresses harmonic currents (Total Harmonic Current Distortion THID) effectively and therefore reduces the harmonic voltage peaks (Total Harmonic Voltage Distortion).
Harmonic Current at the Power Supply Side


## Suppression of Harmonic Currents

When a large portion of lower order harmonic currents ( $5^{\text {th }}, 7^{\text {th }}, 11^{\text {th }}$,etc) occur at the power input, surrounding devices will be disturbed and the power factor will be low as a result of reactive power. Installing a reactor at the AC Motor Drive's input effectively suppresses lower order harmonic currents.


## AC Reactor

Installed in series with the power supply and is effective in reducing low order current harmonics.
Features of an AC reactor include:

1. Reduces the harmonic currents to the AC Motor Drive and increases the impedance of the power supply.
2. Absorbs interferences generated by surrounding devices (such as surge voltages, currents, and mains surge voltages) and reduce their effect on the AC Motor Drive.
3. Increases the power factor.

## DC Reactor

A DC-Reactor is installed between the rectifier and the DC-bus capacitor to suppress harmonic currents and to achieve a higher power factor.

## Current Wave Diagrams



With Reactor



[^0]:    The content of this manual may be revised without prior notice. Please consult our distributors or download the most updated version at http://www.delta.com.tw/industrialautomation

[^1]:    c: \ SiLabs

[^2]:    55-4 7 Current detection level of output phase loss
    Factory Setting:1.00
    Settings 0.00~655.35\%

[^3]:    : $\boldsymbol{f}$ ! Gain Value of Flux Weakening Curve for Motor 1

[^4]:    Explanation

    - S1: Time augend S2: Time addend D: Addition result

